

Post Graduate Bylaw (Credit Hours System) 2024



قرار وزاري
رقم (٩٩) بتاريخ ٢٠٢٣/٨/٨
بشأن إصدار اللائحة الداخلية مرحلة الدراسات العليا
بنظام الساعات المعتمدة لكلية الهندسة بشبرا جامعة بنها

وزير التعليم العالي والبحث العلمي ورئيس المجلس الأعلى للجامعات:

- بعد الاطلاع على القانون رقم (٤٩) لسنة ١٩٧٢ في شأن تنظيم الجامعات والقوانين المعدلة له.
- وعلى قرار رئيس الجمهورية رقم (٨٠٩) لسنة ١٩٧٥ بإصدار اللائحة التنفيذية لقانون تنظيم الجامعات والقرارات المعدلة له.
- وعلى القرار الوزاري رقم (٣٨١) بتاريخ ٢٠١٦/٢/٧ بإصدار اللائحة الداخلية لمرحلة مرحلة الدراسات العليا بنظام الساعات المعتمدة لكلية الهندسة بشبرا جامعة بنها، والقرارات المعدلة له.
- وعلى موافقة مجلس جامعة بنها بجلساته بتاريخ ٢٠٢٢/٤/٢٧، ٢٠٢٢/٥/٣١، ٢٠٢٣/٨/٨.
- وعلى موافقة لجنة قطاع الدراسات الهندسية بجلساتها بتاريخ ٢٠٢٢/٦/٤، ٢٠٢٢/٩/١، ٢٠٢٢/١٠/٢٢، ٢٠٢٣/١٢/١٧، ٢٠٢٣/٣/٤، ٢٠٢٣/٥/٢٧، ٢٠٢٣/٨/٦.
- وعلى موافقة المجلس الأعلى للجامعات بجلسته بتاريخ ٢٠٢٣/٨/٢٦.

قرر

(المادة الأولى)

الموافقة على إصدار اللائحة الداخلية لمرحلة مرحلة الدراسات العليا بنظام الساعات المعتمدة، المرفقة والخاصة بكلية الهندسة بشبرا جامعة بنها، ويلغي كل نص يخالف أحكامها.

(المادة الثانية)

على جميع الجهات المختصة تنفيذ هذا القرار.

وزير التعليم العالي والبحث العلمي
ورئيس المجلس الأعلى للجامعات

(أ.د. محمد أيمن عاشور)



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INTRODUCTION

In 28th June 2012, the first bylaw of postgraduate studies in the faculty was approved by the credit hour system, in which the necessary rules for preparing the regulations at that time were taken into account. The faculty also set implementation mechanisms as well as the basic rules regulating the study in the faculty and then they were modified in 7th February 2016. The regulation approved in 2016 was characterized by its inclusion of a master's degree Engineering (courses only without a thesis), although this degree remains not attractive enough because it does not allow those who hold it to register for a Ph.D. In view of the tremendous development in engineering sciences, many study programs have become comprising more than one major or division, whether engineering divisions together or engineering divisions with other non-engineering, and this necessitated the inclusion of rules regulating enrollment and study requirements in inter-programmes. With the adoption of the reference framework for the preparation of study programs for graduate studies in the faculties of engineering from the Engineering Studies Sector Committee on 5/18/2020, the Faculty of Engineering in Shubra, Benha University was keen to prepare a list of graduate studies programs in the faculty in line with the rules and controls contained in this framework. This regulation has been prepared to ensure consistency with international study systems, in order to facilitate mutual recognition and the transfer of students between Egyptian and non-Egyptian universities. The research trends of postgraduate studies have also been updated in line with local, regional and global development. This regulation guarantees the unification of the names of postgraduate programs (diploma / masters / doctorate), as well as containing the rules and materials regulating enrollment and study in the various programs. The current regulation aims to provide objective solutions to the following problems:

- a) Confusing the diploma study eligible for admission to postgraduate studies (in case of not obtaining a cumulative average point that allows registration directly) with the degree of the advanced engineering diploma.
- b) Master's courses are not considered as an independent academic degree in the event that the master's thesis has not been completed.
- c) Completion of a master's degree within a long period of time in contravention of the main objective of the study, which is to add modern scientific and research experience.

- d) Absence of guiding systems for the newly developed methods for obtaining a doctorate of philosophy, such as the cumulative method, by preparing and publishing a number of research papers in highly rated journals, and then preparing a combined thesis at the end of the research.

In order to provide radical solutions to these problems, educational programs have been designed in line with the standard national academic standards issued by the Egyptian Quality Assurance and Accreditation Authority, which are flexible to accommodate diversity and excellence, and can express the capabilities and capabilities of the college with its professors to ensure a minimum level of compatibility between the regulations and programs of engineering colleges in different universities. And also developing the evaluation mechanism for the different degrees to comply with modern global trends, as well as providing a revealing modeling of the steps to do research in master's and doctoral degrees to provide mechanisms for continuous measurement in order to determine the extent of research progress or not. The following is a brief presentation of the college's vision and mission, its strategic objectives, and the date of its establishment.

Faculty Vision

The faculty of Engineering at Shoubra, Benha University, aspires to be a leading college at the national, regional and international levels in the fields of engineering education, scientific research, innovation and entrepreneurship to achieve the sustainable development goals.

Faculty Mission

The Faculty of Engineering at Shoubra is committed to prepare a graduate with competencies and problem-solving skills that qualify each engineer to compete in local and regional labor markets, the graduate will be able to innovate and become an entrepreneur, the faculty is also committed to the development of engineering sciences and producing internationally distinguished scientific research, within the framework of human values and social responsibility.

The Faculty Objectives

Engineering profession is a profession at which engineering science is applied, as well as the knowledge gained through study, experience and practice in order to develop and innovate methods

and techniques, machinery and equipment for optimal use of materials and natural resources for the benefit of human society. So, the faculty operates through its departments that cover most of the scientific disciplines needed by the labor market to achieve the following objectives:

- (1) Providing a distinguished educational service, according to advanced learning strategies, and within the framework of commitment to the ethics and rules of the profession, in order to develop students' individual and collective work potential, which supports their capabilities for innovation and entrepreneurship.
- (2) Preparing students for a successful professional future by providing them with the analytical, experimental and computer tools and means necessary to identify and formulate engineering problems and develop plans for a solution according to high technical specifications, considering the ethical aspects and societal responsibility.
- (3) Providing students with the basics of engineering sciences necessary to keep pace with the continuous development in the various engineering fields to become qualified to design, develop, maintain and manage many systems in those fields.
- (4) Providing an effective source of qualified engineering expertise in line with the needs of the labor market and the accompanying development through training and providing advice to governmental and industrial bodies in the local and international community.
- (5) Upgrading the system of graduate studies and scientific research so that the faculty offers new solutions to improve the standard of life and contribute to advancing economic development and developing the surrounding environment.
- (6) Providing students with the necessary skills to communicate and work with others as a team in order to assume responsibility and learn for life, which enables them to join freelance work or pursue postgraduate studies in the engineering field.

History of Faculty Establishment and its Scientific Departments

- In 1961, the Engineering Division was established at the Higher Technical Institute in Cairo, which is one of the higher institutes affiliated to the Ministry of Higher Education and Scientific Research at that time. It grants a bachelor's degree and the duration of study in the Engineering Division is five years.

- In 1975, the Engineering Division of the Higher Technical Institute in Cairo was merged into the Faculty of Technology in Mataria (one of the faculties of Helwan University) when Helwan University was established in the same year.
- In 1976, Republican Decree No. 367 of 1976 was issued on the seventh of April to join the Higher Technical Institute in Cairo to Ain Shams University under the name of the Faculty of Engineering in Shoubra.
- On the thirtieth of October of the same year, Presidential Decree No. 1069 of 1976 was issued to join the Faculty of Engineering in Shoubra to Zagazig University/Benha Branch.
- In 2005, Presidential Decree No. 84 of 2005 was issued to establish Benha University, and the Faculty of Engineering in Shubra became one of its faculties.
- In 2021, the name of the Department of Surveying Engineering has been changed to the Department of Geomatics Engineering since the activation of the Bachelor's Regulation that approved in 2021.

CHAPTER (1)

GENERAL RULES AND PROVISIONS

CHAPTER (1) GENERAL RULES AND PROVISIONS

Article (1): Scientific Departments at the Faculty

The Faculty of Engineering in Shoubra, Benha University, consists of the following scientific departments:

- 1) Department of Mechanical Engineering
- 2) Department of Electrical Engineering
- 3) Department of Civil Engineering
- 4) Department of Geomatics Engineering
- 5) Department of Architecture Engineering
- 6) Department of Basic Sciences

Article (2): Scientific Degrees

The Council of Benha University, based on the proposal of the Council of the Faculty of Engineering in Shubra, grants the following academic degrees to postgraduate students:

- 1) Advanced Engineering Diploma
- 2) Master of Science (M. Sc.) degree in Engineering.
- 3) Doctor of Philosophy (Ph.D.) degree in Engineering.

Article (3): Definition of Academic Degrees and General Specifications for Graduation and the method of preparing them

- a) **Advanced Engineering Diploma:** This study aims to raise the scientific competence and applied skills of students of engineers in specialized engineering fields by providing advanced courses of an applied nature and integrating the graduate of faculty Engineering/Equivalents into research work teams to prepare applied research projects. The graduate of the Advanced Engineering Diploma Program should be able to:
 - 1) Apply the acquired specialized knowledge acquired in professional practice.
 - 2) Define professional and design problems and propose solutions for them.
 - 3) Master of professional skills and the use of appropriate technological means, including computer-aided analysis, up-to-date software packages and design tools, in professional practice.
 - 4) Communicate and lead the team to work through systematic professional work.
 - 5) Make appropriate decisions in light of the available information.
 - 6) Utilize the available resources efficiently.
 - 7) Display awareness of the effective role in community development and environmental conservation.
 - 8) Behave in a manner that reflects the commitment to integrity and credibility, accepting accountability and taking responsibility.

- 9) Realize the need to the self-development and engage in continuous learning.

b) Master of Science (M. Sc.) in Engineering

This study aims to build the research capabilities and innovative scientific thinking of students, by studying advanced courses in the field of specialization using modern learning techniques and methods and conducting original scientific research in the form of a scientific thesis. The graduate of the Master of Engineering Science program should be able to:

- 1) Apply the basics and methodologies of scientific research and the use of its various tools.
- 2) Use the analytical approach in various engineering fields.
- 3) Blend the specialized knowledge with the most relevant knowledge to create new solutions to contemporary problems.
- 4) Demonstrate awareness of current problems and modern visions in engineering fields.
- 5) Identify professional problems and find appropriate solutions to them.
- 6) Demonstrate excellence in an appropriate set of specialized professional skills and use appropriate technological means to serve the professional practice.
- 7) Communicate effectively and demonstrate the ability to lead a team.
- 8) Make a decision in various professional contexts.
- 9) Maximize the utilization of available resources to achieve and maintain the greatest benefit.
- 10) Demonstrate awareness of the effective role in community development and environment preservation under the influence of local and global changes.
- 11) Behave in a manner that reflects commitment to integrity and credibility and in accordance with the rules and ethics of the profession.
- 12) Engage in long-life learning and self-development academically and professionally.

c) Doctor of Philosophy (Ph. D.) in Engineering

This study aims to develop thought and the ability to innovate and develop, and add new ones in the field of specialization in engineering sciences by following the rules of scientific research and specialized precise techniques and maximizing the research capabilities acquired during the previous postgraduate studies (advanced diploma stage and Master's degree) and conduct advanced and integrated applied scientific research. The graduate of the Doctor of Philosophy in Engineering Sciences program should be able to:

- 1) Master the basics and methodologies of scientific research.
- 2) Work continuously to gain knowledge in different engineering fields.
- 3) Apply the analytical and critical approach in the engineering fields.
- 4) Integrate the specialized knowledge with the most relevant knowledge to innovate solutions to contemporary engineering problems.
- 5) Demonstrate a deep awareness of current problems and modern theories in engineering.
- 6) Identify professional problems and find innovative solutions to them.
- 7) Master a wide range of professional skills in various engineering fields.

- 8) Lead towards developing new techniques and tools for professional practice.
- 9) Use appropriate technological means to serve professional practice.
- 10) Communicate effectively and lead a team in various professional contexts.
- 11) Make appropriate decisions using the available data.
- 12) Employ and develop the available resources effectively and work to find new resources.
- 13) Express awareness of the role in the development of society and the preservation of the environment.
- 14) Behave in a manner that reflects commitment to integrity and credibility and in accordance with the rules and ethics of the profession.
- 15) Demonstrate commitment to self-development and transfer of knowledge and experience to others.

Graduates of different programs enjoy a set of general and specific specifications that have been determined by the various scientific departments of the college. Committees have been formed to define a set of specifications for graduates of different programs, which have been identified according to the actual needs of the labor market and the needs of society in general, provided that these specifications ensure that graduates show general professional competencies that meet the expectations of society and are based on lifelong learning and professional development for engineering graduates. All relevant community parties interested in the program, such as faculty members in the programs, labor market organizations, and other community parties, participated in the preparation of these specifications, through questionnaires prepared from the programs. The councils of the scientific departments presented the final specifications of the graduate after analyzing the results of the questionnaires, the approvals of the councils of the scientific departments, the College Council for questionnaires, and the recommendations of the faculty members, service beneficiaries, and graduates regarding the specifications of the graduates of the programs.

Article (4): System of Study

- 1) The credit-hour study system is applied in graduate studies, where one credit hour is equivalent to a number of contact hours, equivalent to one hour of lecture per week, two hours of exercises per week, three practical hours in laboratories/workshops per week, or three hours of field training per week, and the contact hour is divided into 50 minutes teaching and 10 minutes break.
- 2) The number of weekly contact hours does not exceed 25 hours, so that the total weekly load of the student is within 50 hours, in case that the student is fully devoted to study.
- 3) The number of courses that a student is allowed to study varies between three and five courses, depending on time dedicated for study.
- 4) Hybrid teaching method can be approved for some academic courses.
- 5) The study of the credit hour system in postgraduate programs aims to achieve a number of main objectives as follows:

- a) Giving the postgraduate student the opportunity to choose the program or course needed for study, which increases the graduate's connection with the university and supports cooperation between the university and the various institutions.
- b) Giving the postgraduate student the opportunity to study supplementary subjects in other disciplines that support his original major to help him in his practical work, allowing the diversity of study programs within the same major.
- c) Meeting the increasing professional knowledge requirements from industrial and service bodies in applied fields, thus allowing more job opportunities for graduates in unique fields by creating interdisciplinary programs.
- d) Developing and building the student's personality in assuming responsibility, self-reliance, research and continuous learning.
- e) Allowing the interaction between students of different specializations due to the diversity of students registered for new diplomas.
- f) Choosing the appropriate academic load for each student, as the student chooses a number of courses commensurate with his competence and chooses to study one course before another unless there is a link between them.
- g) Providing the possibility of introducing new courses and other specializations without the need for a major change in study plans.
- h) Providing the possibility of continuous improvement and development of the study plans as the curriculum in various programs conforms to the international universities' standard.
- i) Encourage postgraduate students to develop research plans approved by the college and university councils that consistent with the national development plans "Egypt vision 2030".
- j) Activating the role of industry in preparing and developing academic courses that aim to support and develop the profession, as well as marketing applied scientific research locally and internationally, in a way that supports the publishing mechanisms for research and scientific theses.

Article (5): Program Management

The management and follow-up of the teaching process and research plans of all programs are managed by:

- 1) Dean,
- 2) Vice Dean for Graduate Studies and Research,
- 3) Relevant Scientific Department Council
- 4) Graduate Studies and Research Affairs

Article (6): Dates of Registration and Study

- 1) The academic year includes two main semesters:

- The first semester (Fall semester) starts from the second half of September and lasts for 14-15 weeks, not including the final exams period.
- The second semester (Spring semester) starts from the second half of February and lasts for 14-15 weeks, not including the final exams period.
- 2) The summer semester (offered at the request of the Graduate Studies Committee and approved by the College Council) lasts for 7-8 weeks, not including the period of final exams, in which the teaching hours are doubled.
- 3) The admission for registration, for new students, and course registration, for enrolled students, is opened twice a year at the beginning of each main semester for 2 weeks from the beginning of the study. Registration for summer courses (if available) is opened during the first week of the summer semester.

Article (7): General conditions of Registration

- 1) The student must have obtained a Bachelor of Science (B.Sc.) in Engineering from one of the engineering colleges in Egyptian universities, or B.Sc. equivalent from the Supreme Council of Universities in the field of specialization.
- 2) The student must offer all the documents required by the Department of Graduate Studies and Research at the college.
- 3) The student must fulfill all the requirements and conditions determined by the relevant department council.
- 4) The student must submit the required document clarify his military status.
- 5) Approval letter for full-time study (for employees except TA staff members) for at least two days weekly.
- 6) The student must pay the prescribed tuition fees at the beginning of each semester. This condition does not apply to the TA staff members and scholarship students at the college.
- 7) Registration is not allowed for students applying to register for graduate studies in the college after ten years from the last certificate / degree in the field of specialization

Article (8): Documents Required for Registration

- 1) Bachelor of Science (B.Sc.) degree in engineering, in the field of specialization, as determined by the relevant department council, from one of the engineering colleges in Egyptian universities, or its equivalent from the Supreme Council of Egyptian Universities in case of registration for a Master of Science (M.Sc.) degree in Engineering.
- 2) Master of Science (M.Sc.) degree in engineering, in the field of specialization, as determined by the relevant department council, from one of the engineering colleges in Egyptian universities, or its equivalent from the Supreme Council of Egyptian Universities in the case of applying for a Doctor of Philosophy (Ph.D.) in engineering sciences.
- 3) The employer's approval letter to study and devote at least two days per week (except TA staff members).

- 4) The appropriate document that clarify the student's military status.
- 5) The invoice of prescribed tuition fees.

Article (9): Registration of Courses

Students who have been enrolled to study, can register courses in postgraduate programs according to the following regulations:

- 1) Obtaining the approval of the relevant department council after completing the required documents from the Department of Postgraduate Studies and submitting them to the college council.
- 2) The relevant department council, upon registration, may determine the number of accepted students according to the infrastructure and HR available to the department and the college.
- 3) The relevant department council assigns to each student when registering for any academic degree an academic advisor among the faculty members of the department, to provide advice, guidance and follow-up the student progress until the completion of the Advanced Engineering Diploma courses. In the case of registering for an M.Sc. degree, the academic advisor is replaced by the principal supervisor. In the case of registering for a Ph.D. degree, the academic advisor continues with the student until the completion of the basic doctoral courses.
- 4) The part-time student may register for courses of 9 to 12 credit hours at the beginning of one of the two main semesters (First/Second). However, a full-time student can register for courses of more than 12 credit hours with maximum 15 credit hours.
- 5) The student may register for courses up to 6 credit hours in the summer semester (if available).
- 6) The courses available for registration in any semester depend on the number of students applying for registration and the number of specialized faculty members and according to the relevant department council decision.

Article (10): The Academic Advisor

The department council assigns a faculty member to be an academic advisor for the student after completing the enrollment procedure, in order to provide advice, guidance and academic follow-up.

- 1) The role of the academic advisor continues with the student until the end of the advanced engineering diploma courses, and the principal supervisor replaces him in case the student registers to study a master's degree in engineering.
- 2) The role of the academic advisor continues with the student until he successfully passes the basic doctoral courses. then the principal supervisor replaces the academic advisor to help student to select the specialized doctoral courses that serve the proposed research direction of the doctoral thesis.

Article (11): Procedures of Courses Registration

- 1) The relevant department council determines a committee to conduct the admission test for students applying to join the department's postgraduate studies after paying the tuition fees.
- 2) The department council appoints an academic advisor for each student who has passed the admission test for postgraduate studies.
- 3) The student who is qualified to join graduate studies at the M.Sc. stage, after reviewing the academic advisor, registers the basic engineering diploma courses with a minimum of 12 credit hours from the 500 level. These courses are recorded in the "course registration form" and signed by the student as well as his academic advisor.
- 4) The student who passes the basic engineering diploma courses with an average of 3 points or more registers the advanced engineering diploma courses with a minimum of 12 credit hours from the 600 level. These courses are recorded in the "course registration form" and signed by the student as well as his academic advisor.
- 5) The qualified student is allowed to register for a Ph.D. degree in Engineering, after reviewing the academic advisor, to choose the basic doctoral courses from the 600 level. These courses are recorded in the "course registration form" and signed by the student as well as his academic advisor.
- 6) The student who passes the basic doctoral courses with an average of 3 points or more, after reviewing the principal supervisor and the specialized department, chooses the specialized doctoral courses from the 700 level with a minimum of 9 credit hours. These courses are recorded in the course registration form and signed by the student and the principal supervisor.
- 7) All courses registration forms, whether for basic and advanced engineering diplomas or basic and specialized doctoral courses, are presented to the relevant department council for approval and sent to the vice dean for Graduate Studies and Research to finalize the registration procedures after paying the prescribed tuition fees.

Article (12): Deletion and addition of courses

- 1) After reviewing the academic advisor, the student can add or drop some courses, and failure to complete the necessary procedures to delete any course leads to it being considered a failed course.
- 2) The student can, upon the recommendation of the academic advisor, change courses by other courses within three weeks of starting the study in the Fall or Spring semester, or within two weeks of starting the study in the summer semester (if available). In these cases, the dropped courses are not appeared in the student's academic record.
- 3) The student can, upon the recommendation of the academic advisor, add courses that do not exceed the maximum number of credit hours for the study stage, within three weeks of the start of studies in the Fall or Spring semesters, or within two weeks of the start of studies in the summer semester (if available).

Article (13): Withdrawal and Re-registration of Courses

- 1) The student is allowed to drop courses without consequences until the end of the third week from the start of study in the two main semesters or the end of the second week from the start of study in the summer semester (if available).
- 2) The student is allowed to withdraw from academic courses at most by the end of the **fifth week** from the start of the study in the two main semesters or by the end of the **third week** of the start of the study in the summer semester (if available). In this case, the student is given a grade, withdrawn (W) in the academic record.
- 3) The student cannot withdraw from any course after the end of the fifth week from the start of the study in the two main semesters or after the end of the third week from the start of the study in the summer semester (if available). The student is given an absent grade (Abs) in the event of his absence from the final exam without an acceptable or compulsive excuse, and this course is considered within the cumulative average as the student who failed.
- 4) The student is not allowed to take the final exam unless he has attended at least 75% of the course's teaching hours. If his absence exceeds 25% of the total teaching hours, the student is denied to take the final exam based on a report submitted by the professor of that course and after the approval of the relevant department council, the Graduate Studies Committee and the College Council on the deprivation. In this course, the student is given a Forced Withdrawn grade (FW).
- 5) When re-studying a course that the student had previously withdrawn from, the full grade that he obtained upon repeating shall be considered.
- 6) The student is allowed to re-register the courses which he has previously failed for one time only, or in which he did not obtain the required minimum points. The student must attend the course activities and exams. The student achieves the grade of the last chance with a maximum of (B⁺) when calculating the cumulative average.

Article (14): Absence from the exam (with or without excuse)

- 1) If the student is unable to enter the final exam of a course for compelling reasons accepted by the department council and approved by the Graduate Studies Committee and the College Council, the student will receive an incomplete grade (I), provided that he has attended the prescribed percentage of the course's teaching hours. A grade (I) exam must be held for such student no more than the end of the second week of the following semester.
- 2) If the student does not enter the final exam for a course without an excuse accepted by the department council, the student gets an absent grade (Abs), and this course is calculated within the cumulative average, like the student who failed.
- 3) The student is not allowed to enter the final exam of the course if his absence exceeds the allowed percentage of the teaching hours and he is notified of being denied entry to the final exam of that course and the grade in his academic record will be forced withdrawal (FW).
- 4) The courses in which the student obtains a grade (I, W, FW) whose hours are not considered in the calculation of the accumulative grade point average.

Article (15): Study Duration

The study periods for each degree are determined by the number of semesters allowed, and Table (1.1) shows the minimum and maximum study period for each degree, as well as the period allowed after the end of the maximum limit.

Table 1. 1 Duration of study at different degrees*

Scientific Degree	Study Duration		Extention Duration (Max. No. of semesters)
	Min. Limit	Max. Limit	
Basic Engineering Diploma	1	2	1
Advanced Engineering Diploma	2	4	1
Master of science (M. Sc.) (Basic and Advanced Diplomas are Included)	4	6	2
Doctor of philosophy (Ph. D.) in Engineering	6	10	2

*The specified period is calculated from the date of the student's registration for the academic degree. And the suspension semesters are not counted within the specified permitted periods.

Article (16): Suspension of Student's Enrollment/Registration

- 1) The student may suspend his registration while studying the Master of Science (M.Sc.) in engineering with a maximum of two main semesters.
- 2) The student may stop his registration to study the Master of Science (M.Sc.) in engineering after completing the basic engineering diploma and obtaining a certificate for the courses he studied, or after completing the advanced engineering diploma and obtaining its certificate.
- 3) The student may stop his registration to study the Doctor of Philosophy (Ph.D.) in Engineering Sciences after completing any of the two sets of basic or specialized doctoral courses, with a maximum of four main semesters, and obtains a certificate for the courses he studied.

Article (17): Cancellation of Record and Registration

The student's registration will be canceled in the following cases:

- 1) If the student submits a request of his desire to cancel his enrollment and after the approval of the Department Council, the College Council, and the Vice President of the University for Postgraduate Studies and Research.
- 2) If he does not pass the minimum required credit hours and the required grade by the date specified for the degree in which he is registered in accordance with the time frames for study specified in Article (15) Table (1-1).
- 3) If it is stated in the report of the doctoral academic research evaluation committee, at any of its stages, whether the first stage or the second stage, that the research is useless and does not contain any scientific addition, or that the student is not serious and does not achieve the

desired completion rates, the student's registration will be canceled and a certificate will be granted for the courses that he studied.

- 4) If the student violates moral and academic values, such as cases of cheating and academic integrity violations that require cancellation of registration.
- 5) If the supervisor/s of the student's master's or doctoral thesis submit two successive reports over the course of two academic semesters that the student is not serious about the research, the student's registration will be canceled and a certificate will be granted for the courses he studied.
- 6) If a validity report is received from the members of the judging and discussion committee for a master's or doctoral thesis, stating that the thesis is not valid for obtaining the degree, the student's registration will be canceled and he will be granted a certificate for the courses he studied.
- 7) In the event that the supervisors disagree about the seriousness and feasibility of the student's continuation of research and/or his suitability, a committee proposed by the Department Council will be consulted and with the approval of the Graduate Studies Committee and the College Council, and the committee's report will be approved by all the relevant councils.
- 8) If the student does not apply within a year from the date of registration for the academic degree in the English language certificate (TOFEL) with the average required for the academic degree in accordance with what is stated in Article (33) of these regulations.
- 9) A student who has completed his registration procedures in the College's Graduate Studies Department and does not apply to register for courses in the first available semester and within the dates specified for registration, his enrollment will be canceled unless he presents to the College Council an acceptable excuse.
- 10) If three years have passed from the date of registration of the student (applicant for a master's/doctoral degree) and the research topic has not been registered and the supervision committee has not been determined.
- 11) Enrollment will be canceled if the student's supervision committee submits three periodic reports showing the student's lack of progress in the research topic and the student's lack of seriousness and response to the supervision committee's directives.
- 12) The enrollment of a student applying to study for a doctorate will be canceled if he fails the doctoral qualifying examination twice, and the Scientific Department Council can submit a proposal to give the student an opportunity to take the examination for the third time, after a recommendation from the Graduate Studies Committee and the approval of the College Council.
- 13) The student's registration will be canceled if validity reports are received from the judging and discussion committee stating that the thesis submitted for discussion is not valid, at most twice.

- 14) The College Council may approve the continuation of the student's enrollment before the end of the last year of the permitted legal period for a period of two semesters, provided that the student's achievement percentage in the research subject is not less than 75%.

Article (18): Re-enrollment and Re-registration

- 1) A student who obtained an advanced engineering diploma may apply to resume studies to obtain M.Sc. degree in engineering within a maximum period of 12 months from obtaining its certificate. In this case, the result of the courses that he has passed shall be taken into consideration, provided that the required GPA for M.Sc. registration is achieved.
- 2) A student who registered for a Ph.D. degree and suspended his registration after passing the basic or specialized courses, may submit a request for re-enrollment within a maximum period of (12) months from the date of suspension. Extra courses may be added as a requirement to complete his studies according to the decision of the department council.
- 3) In case of accepting the re-enrollment of a student for whom a thesis title and a supervisory board committee were previously nominated, the department council re-identifies the thesis title as well as the supervisory board committee.

Article (19): Tuition Fees

- 1) Tuition fees for new students are deducted upon the start of registration.
- 2) Tuition fees for enrolled students are deducted at the beginning of each semester.
- 3) Late students who didn't pay the tuition fees within the specified dates are allowed to pay the fees with 10% more as a penalty within ten days at most from the specified dates, after which the registration will be canceled automatically.
- 4) The fees include the cost of the registered credit hours in the semester according to the program hour rate determined by the College Council. Moreover, the fees include costs and contributions decided by the university in accordance to its financial regulations.
- 5) The fees for admission test (in case of M.Sc. & Ph.D.) according to college council decision.

Article (20): Course Grades and Students Performance Evaluation

All graduate studies programs in the college are committed to the percentages corresponding to the grades according to the percentages stipulated in Table (1.2).

Table 1. 2. Course Grades and Corresponding Points and Percentages

Percentage Obtained by student	Grades	Points
Greater or equal 97%	A ⁺	4.00
From 93% to less than 97%	A	4.00
From 89% to less than 93%	A ⁻	3.70
From 84% to less than 89%	B ⁺	3.30
From 80% to less than 84%	B	3.00

Percentage Obtained by student	Grades	Points
From 76% to less than 80%	B ⁻	2.70
From 73% to less than 76%	C ⁺	2.30
From 70% to less than 73%	C	2.00
From 67% to less than 70%	C ⁻	1.70
From 64% to less than 67%	D ⁺	1.30
From 60% to less than 64%	D	1.00
Less than 60%	F	0.00

The administration of the various programs is keen on diversifying the methods of evaluating students in a way that measures the student's abilities to understand, assimilate, self-learning, and the ability to innovate and create. Students are notified of exam dates at the beginning of the semester and of the course description, where the faculty member determines the methods of evaluating the student according to the program regulations, the course description, and the general policy for teaching in the program, which includes several systems:

- Short exams (Quizzes) at the time of lectures and exercises for the course.
- Assignments to measure the student's understanding of the applications of the scientific subject (Assignments).
- Research studies and presentations.
- Mini-projects for courses where appropriate.
- Written exams in the middle of the semester and at the end of the semester.

Each faculty member announces the general framework of the course to the students at the beginning of the semester, explaining the evaluation activities and the weight of each activity from the total score of the course. Continuous evaluation methods are applied to measure the targeted outputs. The methods of continuous evaluation already applied are as follows:

Final Exam 40%

Year Work 60% (contains a mid-semester exam + assignments + mini-projects)

Article (21): Calculation of the Grade Point Average (GPA) and Transfer to International Systems

- The points of each course are calculated as the number of credit hours multiplied by the number of points corresponding to the grade obtained by the student in the course.
- The total points obtained by the student in any semester are calculated as the sum of the points of all the courses he studied in that semester.
- The cumulative average points in any semester are calculated by dividing the total points obtained in all semester divided by the total credit hours studied by the student.

- 4) The transfer takes place between the different education systems (the Egyptian system / the American system / the European system) according to the following equation:

$$18 \text{ Cr. Hrs} \approx 30 \text{ ECTS} \approx 25 \text{ Contact Hrs}$$

Article (22) Coding System of Courses

- 1) The courses are coded by the department code as shown in Table (1.3).
- 2) The course code consists of two parts, the first part is the department code in letters and the second part consists of three-digit number; the first digit represents the level of courses (5 – 7). The second digit represents the course specialization (0 – 9). The third digit expresses a series of courses in the specialization at the same level (0 – 9).
- 3) In case of courses that are not taught in scientific departments, they are given a three-letter code for the inter-program.
- 4) The thesis code consists of two parts, the first part is the department code in letters and the second part consists of three-digit number; the first digit represents the level of thesis (8 - 9). The second digit represents the thesis specialization (1– 9, A, B). The third digit remains constant at (1).

Table 1.3. Scientific Department Codes

S. N.	DEPARTMENT	CODE	SPECIALTIES	2 ND DIGIT CODE
1	Mechanical Engineering	MEC	Mechanical Power Engineering	1,2,3,4
			Mechanical Design and Production Engineering	5,6,7,8
			Mechatronics Engineering	a,b,c
2	Electrical Engineering	ELE	Electrical Power and Machines	1,2,3
			Communication and Electronics Engineering	4
			Computer System Engineering	5
3	Civil Engineering	CIV	Construction Engineering	1,2,3
			Hydraulics and Water Resources Engineering	4
			Public Works Engineering	5,6
4	Geomatics Engineering	GED	Geomatics Engineering	1,2,3
5	Architectural Engineering	ARC	Architectural Engineering	1,2,3,4
6	Basic Science	BAS	Engineering Mathematics	1

S.N.	DEPARTMENT	CODE	SPECIALTIES	2 ND DIGIT CODE
			Engineering Physics	2
7	General Courses	GEN	---	0

Article (23): Enrollment and Registration

1) Basic Engineering Diploma:

- Students, who have a B.Sc. in Engineering from Egyptian institutes or universities, or the equivalent of the Supreme Council of Universities in all disciplines, enroll in it.
- An admission test is organized for enrollment, and if passed, the student will be registered with the Basic Engineering Diploma.
- If the student does not pass the admission test, the department council can determine qualification courses that do not exceed (24) credit hours at the level (400) that the applicant studies. If he succeeded in the qualification courses with GPA of no less than 3.0, enrollment can be accomplished.

2) Advanced Engineering Diploma

- Students who successfully finished the basic engineering diploma with a cumulative GPA of no less than 3.0 and the points of any course studied in the basic engineering are not less than 2.7.

3) Master of Science (M.Sc.) in Engineering

- Students who have completed the basic engineering diploma and advanced engineering diploma courses with a cumulative GPA of no less than 3.0 are enrolled in it. Moreover, the points of any course studied in the basic diploma and advanced diploma are not less than 2.7. Figure (1.1) shows the steps for obtaining the Advanced engineering diploma and Master of Science in Engineering.

4) Doctor of Philosophy (Ph.D.) in Engineering

- The students who obtained the M.Sc. in Engineering from Egyptian universities or an equivalent degree from the Supreme Council of Universities in the field of specialization are eligible to enroll in this program.
- The students who successfully passed the admission test are eligible to enroll in this program.
- In case of the student does not pass the admission test, the department council may assign him a qualifying courses with a maximum of (24) credit hours of the Level (500/600) in the main field he wishes to study and its sub-fields, based on internal regulations of the college.

- The students who passed successfully the qualifying courses are eligible to enroll in the Ph.D. program, beginning with the basic courses stage for the doctorate. Figure (1.2) shows the steps for obtaining a Ph.D. degree in engineering.

Article (24): Special Requirements for Course Grades in Different Degrees

1) Basic Engineering Diploma (12 Credit Hours as a minimum)

- In case of the student does not pass the admission test, he must pass the qualifying courses with an average point average of not less than (3.0) in order to be enrolled in the basic engineering diploma stage.
- To obtain a courses' certificate that the student has studied, the points of any course shall not be counted unless an average of (2.3) or more points is obtained.
- If the student wishes to continue studying the advanced engineering diploma, the average points of any course should not be less than (2.7) points.

2) Advanced Engineering Diploma (24 credit hours as a minimum)

- To obtain the advanced engineering diploma in the specialization branch, the student must successfully complete all courses (not less than 24 credit hours). Points are not counted for any course studied unless the student obtains an average of no less than (2.3) points.

3) Master of Science (M.Sc.) in Engineering (36 credit hours as a minimum)

- In case of the student wishes to continue study the Master of Science in Engineering, it is required that the cumulative average points be not less than (3.0) in the courses studied in the basic and advanced diplomas, and the average points of any course studied should not be less than (2.7) points.

4) Doctor of Philosophy (Ph.D.) in Engineering (54 credit hours as a minimum)

- In case of the student did not pass the admission test, the department council determines qualification courses at the Level (500/600) and with a maximum of 24 credit hours that the student must study and pass with a cumulative average of not less than (3.0).
- The student's success in basic and advanced doctoral courses at the Level (600/700) is required with a cumulative average of no less than (3.0) and the average point of any of the basic and advanced doctoral courses studied is not less than (2.7) points.

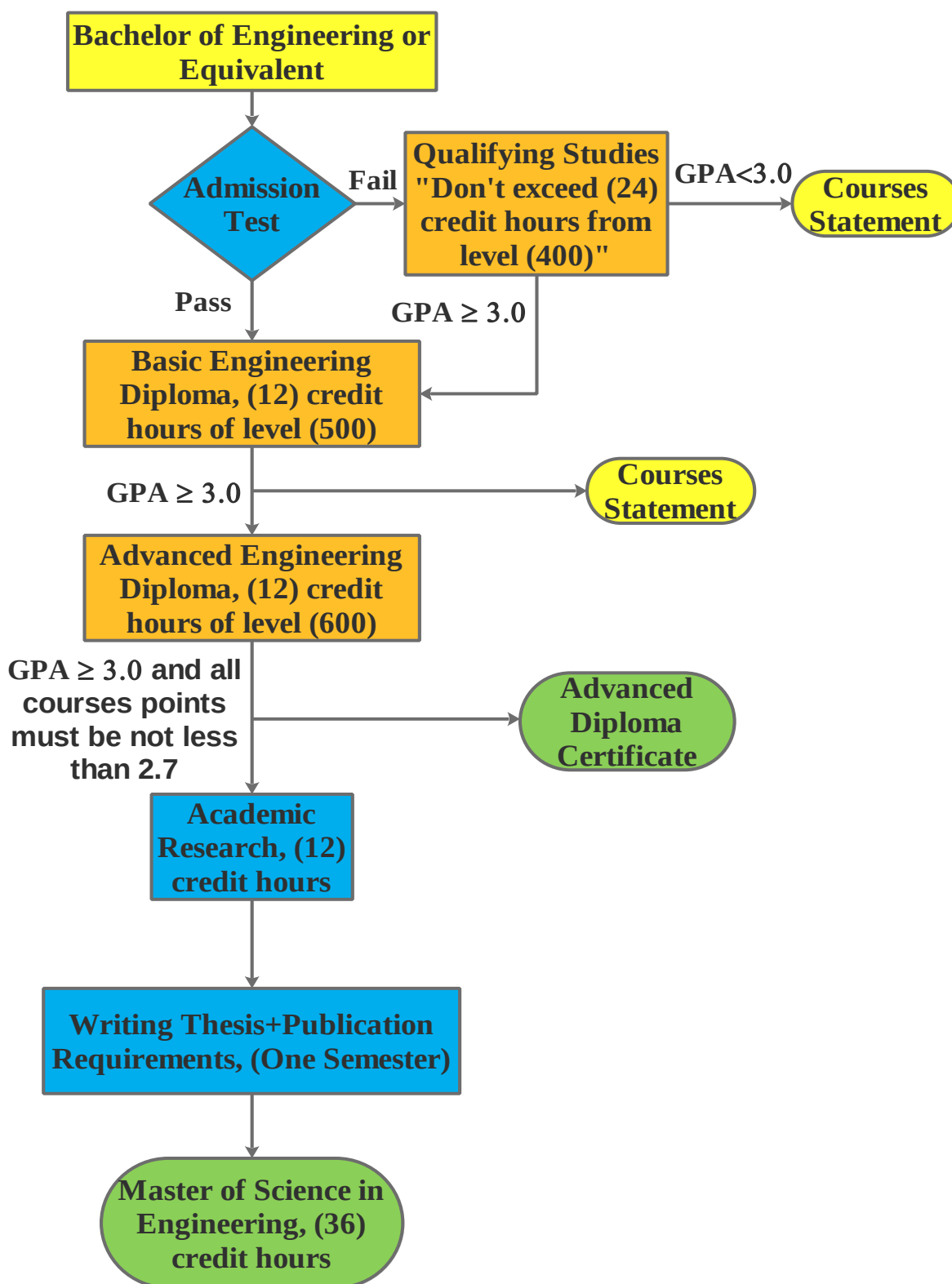


Fig. 1. 1. Flowchart for Acquiring Master of Science (M. Sc.) in Engineering

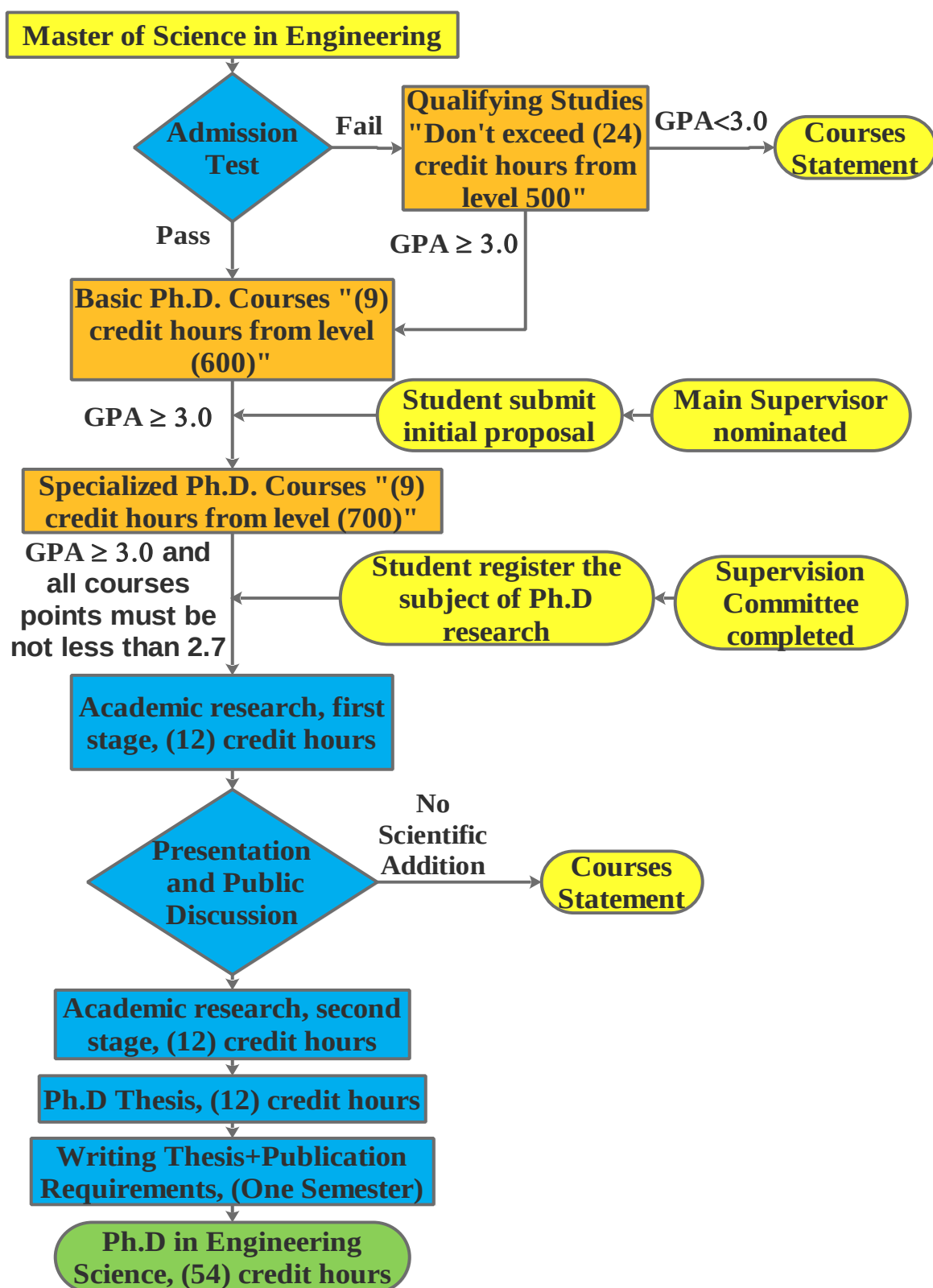


Fig. 1. 2. Flowchart for Acquiring Philosophy Doctorate (Ph. D) in Engineering

Article (25) The Hours That Can Be Registered Each Semester

A student is allowed to register a maximum number of courses (15) credit hours, provided that the number of courses does not exceed (5) courses in one semester.

1) Basic Engineering Diploma (12 credit hours as a minimum)

- In case that the student does not pass the admission exam, qualifying courses are determined with a maximum of (24) credit hours at the Level (400) and will be over two semesters if they exceed (15) credit hours (Maximum of Five Courses).
- Basic Engineering Diploma courses with a minimum of 12 credit hours at the Level (500).

2) Advanced Engineering Diploma (24 credit hours as a minimum)

- Advanced Engineering Diploma courses with a minimum of 12 hours at the Level (600/500).

3) Doctor of Philosophy in Engineering (54 credit hours as a minimum)

- In the event that the student does not pass the admission exam, the department council determines the qualifying courses of the Level (500) with a maximum of (24) credit hours that the applicant studies and that will be over two semesters if they exceed (15) credit hours.
- After the student passes the admission exam, he joins the doctoral program in Engineering Sciences and studies (9) credit hours of the basic courses of the Ph. D. at the Level (600).
- The student studies courses equivalent to (9) credit hours at the level (700) specialized courses for the Ph. D.

Article (26) Improvement of Courses' Points

The student is allowed to repeat study of courses in which he had previously passed with a grade lower than the required one only time, and for a maximum of three courses in basic diploma, two courses in advanced diploma, two basic doctoral courses, and two specialized doctoral courses for the purpose of improving the cumulative average or achieving the requirements for obtaining Diploma, Master and Ph. D. Course repetition will be via study and examination where the last grade is calculated with a maximum cumulative average (B+) while calculating the average, provided that both grades are mentioned in the academic record. The student also has the right to choose an alternative course for the course in which he did not achieve the required level unless The course is compulsory.

Article (27) Failing in Courses

The student is considered to have failed a course if he obtains a grade lower than the grades mentioned in Article (27) of the regulations at all stages of graduate studies. In this case, he must do the following:

- a) Restudying the same course and passing it if it is a compulsory course, and the grade obtained and the credit hours of the course are calculated in case of success.

- b) If a student fails an elective course, he may replace it with another elective course in accordance with the program, his studies, and his success in it. The grade he obtained and the number of credit hours for the course are calculated in case of success.
- c) The course in which the student receives a grade of less than (C+) in the grade point average is not considered and is not counted among the credit hours scheduled for the semester unless he repeats it and succeeds in it, in which case only the latter is counted.
- d) If the student fails the same course more than once, his enrollment in graduate studies will be cancelled, and the student will receive a statement of the grades for the courses he has completed.

Article (28) Periodic Report

- a) The supervision committee submits a periodic report to the student every six months (semi-annually) starting from the date of registering the thesis plan and it is signed by the supervision committee. In the event of a difference in the opinions of the members of the supervision committee, the relevant scientific department studies the student's case and takes the appropriate decision.
- b) Regularity in writing periodic reports is a condition for continuing supervision of the student's thesis and is considered a basic condition for presenting the thesis validity report to the relevant department council when submitting a proposal to form a judging and discussion committee.
- c) Failure to submit two consecutive periodic reports implicitly means that the supervisor/co-supervisor (who did not approve the report or who did not edit it) apologizes for supervision and the department council has the right to decide the extent to which new research supervisory tasks will be assigned to him.
- d) The dissertation registration shall be canceled after the Supervisory Committee collectively submits three consecutive unsatisfactory reports, taking into account taking appropriate measures towards warning the student after each periodic report.
- e) The student will be notified by the College's Graduate Studies Department of the opinion of the Supervision Committee regarding his progress in the thesis (continuing registration, warning the student, or canceling the registration of the thesis). The student is given a copy of the report and signs with it, and the student has the right to file any grievance or present a position different from Mr. Professor Dr., Vice Dean of the College for Postgraduate Studies and Research, to discuss the grievance with the relevant scientific department and present it to the College's Postgraduate Studies and Research Committee.
- f) The College Council, upon the recommendation of the Graduate Studies and Research Committee, has the right to amend the supervision committee based on the approval of the Department Council in the event that the supervisor does not commit to fulfilling supervision requirements through periodic reports related to monitoring the student's performance.
- g) In the case of international students enrolled on scholarships, the cultural attaché shall notify the student of a copy of the periodic reports.

Article (29) Minor Amendments

The faculty Council can make and approve some minor amendments, such as adding courses to the basket of elective courses, amending the course content by no more than 50% while preserving the name of the course, amending the course evaluation percentages, amending the number of contact hours in a way that does not affect the calculation of the approved hours for the course.

Article (30): Conditions for Passing Courses

The minimum limit for passing any course according to the grade in which the student is registered is given in Table 1. 4.

Table 1.4 Minimum Limits for Passing any Course as per Academic Degree

DEGREE	GRADE	POINTS	PERCENTAGE
Advanced Engineering diploma	C+	2.30	73%
Master of Science (M. Sc.) in Engineering	B⁻	2.70	76%
Doctor of Philosophy (Ph. D.) in Engineering	B⁻	2.70	76%

“In order to pass a course, the student must obtain grades of no less than 40% of the total grade of the written exam in the final exam”.

Article (31) Scientific Credit Transfer

- 1) The faculty Council, based on the proposal of the department council and the approval of the Graduate Studies Committee, may exempt the student from courses (from level 500 / 600 / 700 for students registered for master's and doctoral degrees, as well as courses from level 500 for the basic engineering diploma) after fulfilling the following conditions:
 - The exempted courses to be in the same specialization and among the courses required to obtain the degree, and the student has previously studied successfully in the college or in another college recognized by the Supreme Council of Universities during the three years prior to his current enrollment.
 - He must have obtained in each course he is to be exempted from, at least (2.7) points for master's and doctoral programs, or (2.3) points at least for the advanced Engineering Diploma programs.
 - The hours of these courses should not exceed (9) credit hours for M.Sc. degree and (6) credit hours for Ph.D. degree.
 - He should not have been awarded another academic degree (a diploma or a master's degree) with an exemption from the fees for those hours.

- 2) The conditions of previous exemption apply to students who have previously been registered in other universities, recognized by the Supreme Council of Universities, and who have not been awarded other degrees under the courses to be equivalent.

Article (32) Academic Integrity

- To form the judging and discussion committee, the student must submit a report regarding the Plagiarism percentage of thesis obtained from the University Central Library.
- It is required that the Plagiarism rate for researches extracted from scientific thesis does not exceed 25%.
- It is required that the Plagiarism rate in the thesis, whether master's or doctorate, does not exceed 25%.

Article (33): Registration of M. Sc. and Ph. D. Research Topics

1) Master of Science (M. Sc.) in Engineering

- After completing the basic and advanced engineering diploma courses with the required grades for a master's degree, the student, in consultation with the main supervisor, determines the topic of the thesis.
- The student presents a general lecture in the department on the thesis topic and an overview of the most important previous research in the field of research.
- The supervisor submits a request to the department council to register the thesis under an initial title with the research plan. The title is considered final upon requesting the formation of the judging and discussion committee.

2) Doctor of Philosophy (Ph.D.) in Engineering

- By passing the basic courses of the Ph.D. at the required GPA, the department council will nominate a principal supervisor according to the proposed research specialization.
- The first stage of academic research (12 hours) in a period of 3 to 6 months is based on collecting information about the study background, reviewing the literature on the subject of the study, collecting data and ending with a general presentation (a seminar), which is governed by the comprehensive examination committee, which consists of five professors members including the main supervisor, and they are chosen from the department so that their specializations vary around the general field of the student, provided that at least one of them is from outside the university. The oldest professors on the committee will be the chairman, and the result of this presentation is one of the following alternatives:
 - a) The research is feasible and a scientific addition at the doctoral level, and in this case, the second stage of academic research will be carried out.
 - b) The research is feasible and scientific addition at the doctoral level, but with a reformulation of the objectives or modifications in the analysis methodology. In this

case, the presentation is repeated within a period ranging from (3) months to a maximum of (6) months.

- c) The research is useless and has no scientific addition at the doctoral level. In this case, registration is suspended, and the student is given a certificate for the courses that have been studied.

Article (34): Supervising Academic Thesis

The supervision of master's and doctoral theses is for professors and associate professors. Specialists of professors and associate professors from outside the college may participate in supervision. Lecturers within the college are allowed to participate in supervision. The number of the outside supervisors must be less than the number of the inside supervisors. The main supervisor is determined by the department council which may be the oldest faculty member in the committee or one of the most specialized in the thesis subject. The supervisory staff does not exceed three in the case of a master's and five in the case of a doctorate.

1) Master of Science (M. Sc.) Degree

- After the completion of the basic engineering diploma for the student enrolled in a Master of Science degree, the framework of the exact specialization is determined, and the main supervisor of the student is also determined.
- The student, in consultation with the main supervisor, determines the courses of the advanced engineering diploma that must be studied for the M.Sc. program.
- After registering the thesis subject, the supervisory committee for the M.Sc. in engineering sciences can be completed according to the specializations required in the research.

2) Doctor of Philosophy (Ph. D.) degree

- The department council assigns the student a main supervisor according to the proposed research specialization, after passing the basic courses for the doctoral program at the required GPA.
- By succeeding in the basic and specialized courses, the student registers the subject of the doctoral research with the completion of the supervision committee according to the required specializations after a period of no less than (6) months and not more than (12) months from the date of submitting the research proposal.

Article (35): Examination and Judgment Committee on Scientific Thesis

- a) After the student successfully completes the study requirements and presents a general scientific symposium (seminar) on the results of the thesis, the supervisory committee may propose a final title based on the results reached by the researcher and its final conclusion without affecting the discussion time, provided that the department council approves. Scientific research and submitting evidence of the reasons for the requested change and approval of not quoting. Accordingly, the student prepares the thesis in English (with a summary in Arabic). Then the Supervisory Committee submits both the thesis and a report on the validity of the

thesis bearing the signatures of all members of the Supervisory Committee on the thesis to the department in preparation for presentation to the Department Council.

- b) In order to convene a judging committee for the Master of Science degree, the student must publish at least one research paper in the Master's thesis, and provide evidence of its publication or acceptance for publication in a specialized, peer-reviewed international journal indexed in the SCOPUS database.
- c) In order to convene a judging committee for the degree of Doctor of Philosophy, the student must publish two scientific papers, at least one of them, in a specialized, peer-reviewed international scientific journal indexed in the database (SCOPUS), and submit proof of its publication or acceptance for publication, and all scientific papers must be extracted from the doctoral thesis.
- d) It can be replaced by submitting patents for scientific publication (for only one of the two research papers) required to obtain a doctoral degree.
- e) The College Council shall form, based on the proposal of the Department Council/the relevant program administration, a scientific committee to examine the thesis and judge it from three faculty members from among professors or assistant professors at Egyptian or foreign universities or from specialists at their academic level, and the most senior professor shall be the rapporteur of the committee. The number of members of the governing body may be greater than that in the case of interdisciplinary studies due to the multi-specialization involved.
- f) The formation of the committee to examine and judge the thesis must include a member from outside the university and a member from within the university, in addition to a representative of the supervision committee from professors and assistant professors (a maximum of two members with one vote), provided that the most senior professor is the committee's rapporteur. One of the members of the committee judging doctoral theses of philosophy may be from outside Egypt.
- g) The committee chosen by the department council to judge the thesis is required to have the research in the field of their research specialization, and to have scientific production in this field.
- h) The formation of the judging committee depends on the letter from Professor Dr. Vice President of the University for Postgraduate Studies and Research based on the approval of the College Council.
- i) The thesis is referred to the examination and judging committee, and each member of the judging and discussion committee submits a report on the validity of the thesis on the forms prepared by the Department of Graduate Studies and Research for this purpose, where each member submits in the validity report one of the following recommendations:
 - I. "The thesis is valid for discussion in its current form."
 - II. "The thesis is valid for discussion and requires non-essential amendments."
 - III. "The thesis is valid for discussion and needs to make fundamental amendments."
 - IV. "The thesis is invalid and does not qualify for public discussion."

After receiving the validity reports that include one of the recommendations (1), (2), and (3), in agreement with the main supervisor, through the Dean of the College for Postgraduate Studies, a date will be set to publicly discuss the thesis within two weeks from the date of receipt of the validity reports, provided that the discussion and judgment do not take place. On the thesis (M. Sc. /PhD) only after fifteen days have passed from the date of the approval of the Vice

President of the University to form the judging committee and without exceeding a period of three months from the same date, which is the period of validity of the thesis judging committee, provided that the discussion takes place before the end of the period authorized for the student. In case that the thesis is not valid and does not qualify for public discussion, the student's registration will be canceled and he will be given a statement of the courses he successfully passed during his studies.

- j) The thesis (Master's or Doctorate) will not be discussed or judged except after the conditions for convening the judging committee have been met and the discussion must take place publicly during the period authorized for the student with the approval of Mr. Prof./Vice President of the University.
- k) The discussion will be announced sufficiently in advance (not less than ten days), and the judging committee will meet at the college headquarters and review the detailed individual reports on examining the thesis. The student will be discussed if the individual reports agree with the discussion, or the student will be given a period to amend what is stipulated in the discussion. The individual report of one or more members of the judging panel as a condition for qualifying for discussion. In the event that a member of the judging and discussion committee is unable to attend and his individual report is available, the discussion may take place in the presence of the majority of the committee members, and the final evaluation of the thesis by the judging committee will be as follows:
 - ✗ Accepted without modifications.
 - ✗ Accepted with non-essential amendments under the supervision of the internal examiner, and a maximum period of three months is given to complete the amendments.
 - ✗ It is accepted with substantial modifications under the supervision of the examination committee. A maximum period of twelve months is given to complete the modifications. If the period exceeds that, the presentation and discussion must be repeated before the examination committee.
 - ✗ It is not accepted.
- l) The individual reports and the group report are referred to the College Council and then to the university to consider awarding the degree.

Article (36) Conditions for Convening the Judging and Discussion Committee and Awarding Degree

- Students studying Master of Science in Engineering and Doctor of Philosophy degrees are required to submit evidence of passing the international TOEFL exam in English with a score of at least 450 for the Master's and at least 500 for the Ph.D. (or the equivalent of this exam from the internationally recognized English language exams), This is before registration or within a year from the date of registration, otherwise the registration will be canceled.
- To hold a judging committee on a master's thesis of engineering sciences, the student must publish at least one scientific paper in a refereed journal indexed in Scopus or a specialized

scientific conference and submit an evidence of its publication or acceptance for publication, extracted from the master's thesis.

- To hold a judging committee of the degree of Doctor of Philosophy, the student must publish two refereed scientific papers, at least one of them, in a specialized scientific journal, refereed and indexed in Scopus, and submit an evidence of publication or acceptance for publication. All scientific papers are extracted from the doctoral thesis.
- Fulfilling the university's requirements for forming committees to examine and judge academic theses.
- It can be replaced by submitting international or local patents for the scientific publication required to obtain an M. Sc and/or Ph. D degrees.

Article (37) Agreements of Understanding with Foreign Universities

Joint certificates or academic degrees may be granted with other universities under the dual degree system or joint degree program in accordance with the regulations set by the university council.

Article (38) Transitional Provisions

This regulation applies to students enrolled in postgraduate studies from the date of issue of the ministerial decision approving this bylaw. As for students enrolled before this date, the internal regulations shall apply to them. or settling their conditions and transferring them to the new regulation and equivalency of the courses they have passed with the required average based on the proposal of the Department Council and the approval of the Faculty Council.

CHAPTER (2)

GENERAL COURSES

AND THEIR CONTENTS

TABLE 2. 1 General Courses *

S. N	Course Code	Course Name	Pre-requisite	Credit Hours	Grades				Test Time
					Course Work	Oral / Practical	Written Exam	Total	
1	GEN501	Scientific Writing and Presentation Skills	–	2	60	–	40	100	2
2	GEN502	Statistics and Random Processes	–	2	60	–	40	100	2
3	GEN503	Projects Management	–	2	60	–	40	100	2
4	GEN504	Statistical Analysis and Experimental design	–	2	60	–	40	100	2
5	GEN505	Engineering Mathematics and Numerical Analysis	–	2	60	–	40	100	2
6	GEN506	Computer Applications	–	2	60	–	40	100	2
7	GEN507	Physics	–	2	60	–	40	100	2

* The student registers minimum of (4) credit hours (two courses) and maximum of (6) credit hours (three courses) with the assistance of the student's academic advisor.

Course Description

Course Title	Scientific Writing and Presentation Skills				Course Code	GEN 501
Contact Hours	Lecture	Tutorial		Oral / Practical	Credit Hours	2
	2	--		--		
Grades	Final Exam	Course Work	Practical	Oral	Total Marks	100
	40	60	0	0		
<u>Contents:</u> The Writing Process, Objectives in Scientific Writing, Audience Recognition and Involvement, Criteria for Writing Reports, Summaries, Letters and Proposals, Research Paper Writing, Oral Communication, Performing Scientific studies. Formal report writing. Patents. Email messages. The Summary writing. Reviewing and editing techniques, Thesis writing, Presentations.						
<u>References:</u> Course professor select the appropriate up-to-date reference(s)						

Course Title	Statistics and Random Processes				Course Code	GEN 502
Contact Hours	Lecture	Tutorial		Oral / Practical	Credit Hours	2
	2	--		--		
Grades	Final Exam	Course Work	Practical	Oral	Total Marks	100
	40	60	0	0		
Contents: Statistical data and notations, Statistical tables and measures, Measures of central tendency and dispersion, Regression analysis, Confidence intervals, Test of hypothesis – Reliability theory, Probability theory, Discrete and continuous random variable, Distributions, binomial, normal, gamma, Poisson, Bernoulli, Moment generating function, Correlation coefficients of two random variables.						
References: Course professor select the appropriate up-to-date reference(s)						

Course Title	Projects Management				Course Code	GEN 503
Contact Hours	Lecture	Tutorial		Oral / Practical	Credit Hours	2
	2	--		--		
Grades	Final Exam	Course Work	Practical	Oral	Total Marks	100
	40	60	0	0		
<u>Contents:</u> Project Management Systems, Plans and Programming methods, Follow up and reports, Total Quality Management.						
<u>References:</u> Course professor select the appropriate up-to-date reference(s)						

Course Title	Statistical Analysis and Experimental design					Course Code	GEN 504
Contact Hours	Lecture	Tutorial		Oral / Practical		Credit Hours	2
	2	--		--			
Grades	Final Exam	Course Work	Practical		Oral	Total Marks	100
	40	60	0		0		
Contents: Statistical terminology used in experimental design, Experimental design, random distribution, experimental error, control of experimental error, properties of a good experiment, Types of statistical design, Statistical analysis, presentation of statistical tables, comparison of mean factors, Means tables							
References: Course professor select the appropriate up-to-date reference(s)							

Course Title	Engineering mathematics and Numerical Analysis				Course Code	GEN 505
Contact Hours	Lecture	Tutorial		Oral / Practical	Credit Hours	2
	2	--		--		
Grades	Final Exam	Course Work	Practical	Oral	Total Marks	100

	40	60	0	0		
Contents: Ordinary and partial differential equations and its applications, System of linear ordinary differential equations, Series solution, Numerical methods for solving ordinary differential equations, Laplace transformations, Special functions, Initial boundary value problems, Wave Equation in spherical/cylindrical coordinates, Fourier series, Fourier integrals, Series and instantaneous integrals Arithmetic errors, Solving Equations with a Single Variable, interpolation using Polynomials and Differences, Lagrange method, Less-average method for squares of errors, Numerical Differentiation and Integration, Numerical Solutions of Partial Differential Equations, Nonlinear Equations Systems, Numerical Methods for Solving Governing Equations in Computational Fluid Dynamics.						
References: Course professor select the appropriate up-to-date reference(s)						

Course Title	Computer Applications				Course Code	GEN 506
Contact Hours	Lecture	Tutorial	Oral / Practical		Credit Hours	2
	2	--	--			
Grades	Final Exam	Course Work	Practical	Oral	Total Marks	100
	40	60	0	0		
Contents: Web GIS development, Web Protocols, HTML Language, CSS Language, JavaScript Language, Smartphone GIS Software development.						
References: Course professor select the appropriate up-to-date reference(s)						

Course Title	Physics				Course Code	GEN 507
Contact Hours	Lecture	Tutorial	Oral / Practical		Credit Hours	2
	2	--	--			
Grades	Final Exam	Course Work	Practical	Oral	Total Marks	100
	40	60	0	0		
Contents: Definition and preliminary laws of light, Polarization, Interference, Laser principles, Laser types, Waves and their characteristics and uses, Wave interference, Wave reflection, Wave absorption, Electromagnetic waves, Wave movement in the vacuum and other media, Calculation of distances using waves, Use of waves in the formation of aerial images and satellite images, and calculation of the effect of the medium on the images.						
References: Course professor select the appropriate up-to-date reference(s)						

CHAPTER (3)

MECHANICAL ENGINEERING DEPARTMENT

Mechanical Engineering Department presents three major programs

- 1) Mechanical Power Engineering Program
- 2) Mechanical Design and Production Program
- 3) Mechatronics and Robotics Engineering Program

(1) Mechanical Power Engineering Program

1) Postgraduate Advanced Diploma in Mechanical Power Engineering

Registration takes place in one of the following research specialities:

1. Fluid Mechanics and Turbo -machinery
2. Combustion and Internal Combustion Engines
3. Heat Transfer and Its Applications
4. Energy Systems

The Graduate of the Advanced Diploma in Mechanical Power Engineering should be able to:

1. Apply the acquired specialized knowledge in his structural engineering practice.
2. Identify professional and design problems and propose solutions for them.
3. Master of professional skills and the use of appropriate technological means including computer aided analysis, modern specialized programs, and design tools in his professional practice.
4. Communicate and lead teams through systemic professional work.
5. Make decisions in the light of available information.
6. Utilize available resources efficiently.
7. Display awareness of his role in community development and environmental conservation.
8. Act in a way that reflects his commitment to integrity and credibility and accept accountability and taking responsibility for his action.
9. Realize of the need to develop himself and engage in continuous education.

Table 3. 1. 1 Compulsory Courses for the Basic Diploma in Mechanical Power Engineering

S. N	Course Code	Course Name	Credit Hours	Grades				Exam Time
				Course Work	Oral / Practical	Written Exam	Total	
1	GEN 504	Statistical Analysis and Experimental design	2	60	-	40	100	2
2	GEN 505	Engineering Mathematics & Numerical Analysis	2	60	-	40	100	2

Table 3. 1. 2 Elective Courses for the Basic Diploma in Mechanical Power Engineering

S. N.	Course Code	Course Name	Credit Hours	Grades				Exam Time
				Course Work	Oral / Practical	Written Exam	Total	
1	MEC 510	Applied Fluid Mechanics	3	60	-	40	100	3
2	MEC 516	Turbomachinery	3	60	-	40	100	3
3	MEC 522	Internal Combustion Engines	3	60	-	40	100	3
4	MEC 530	Applied Heat and Mass Transfer	3	60	-	40	100	3
5	MEC 533	Solar Heating and Cooling Systems	3	60	-	40	100	3
6	MEC 540	Renewable Energy	3	60	-	40	100	3
7	MEC 545	Advanced Mechanical measurements	3	60	-	40	100	3
8	MEC 542	Power Stations and their Economics	3	60	-	40	100	3
9	MEC 549	Measurements and Instrumentation in Power Stations	3	60	-	40	100	3

*With the help of the academic advisor, the student chooses (9) credit hours with a minimum of elective courses for the Basic Diploma in one of the disciplines mentioned in Table (3.1.2) and according to what is determined by the Scientific Department Council.

Table 3. 1. 3 Elective Courses for Advanced Diploma in Mechanical Power Engineering

S. N.	Course Code	Course Name	Credit Hours	Grades				Exam Time
				Course Work	Oral / Practical	Written Exam	Total	
1) Fluid Mechanics and Turbomachinery								
1	MEC 610	Pumps and Compressors Stations	3	60	-	40	100	3
2	MEC 611	Gas Dynamics	3	60	-	40	100	3
3	MEC 612	Advanced Fluid Mechanics	3	60	-	40	100	3
4	MEC 613	Turbulent Flow	3	60	-	40	100	3
5	MEC 614	Pumps Design	3	60	-	40	100	3
6	MEC 615	Computational Fluid Dynamics	3	60	-	40	100	3
7	MEC 617	Fluid Distribution and Pipelines Systems	3	60	-	40	100	3
8	MEC 618	Computer Applications in Fluid Mechanics and Turbomachinery	3	60	-	40	100	3
2) Combustion and Internal Combustion Engines								
1	MEC 620	Advanced Thermodynamics	3	60	-	40	100	3
2	MEC 621	Applied combustion	3	60	-	40	100	3
3	MEC 623	Gas turbines	3	60	-	40	100	3
4	MEC 624	Combustion systems	3	60	-	40	100	3
5	MEC 625	Advanced Combustion	3	60	-	40	100	3
6	MEC 626	Reciprocating combustion engines	3	60	-	40	100	3
7	MEC 627	Computational Methods in Combustion	3	60	-	40	100	3
8	MEC 628	Computer Applications in Combustion and Internal Combustion Engines	3	60	-	40	100	3
9	MEC 629	Control in Combustion and Internal Combustion Engines Systems	3	60	-	40	100	3
3) Heat Transfer and Its Applications								
1	MEC 630	Advanced Heat and Mass Transfer	3	60	-	40	100	3
2	MEC 631	Advanced Air Conditioning	3	60	-	40	100	3
3	MEC 632	Control in Refrigeration and Air Conditioning Systems	3	60	-	40	100	3
4	MEC 633	Advanced Refrigeration and Cold Stores	3	60	-	40	100	3

S. N.	Course Code	Course Name	Credit Hours	Grades				Exam Time
				Course Work	Oral / Practical	Written Exam	Total	
◦	MEC 634	Fires, Explosions, and Fire Fighting systems	3	60	-	40	100	3
6	MEC 635	Thermal Loads and Advanced Psychrometry	3	60	-	40	100	3
7	MEC 636	Computer applications in Refrigeration and Air Conditioning	3	60	-	40	100	3
4) Energy Systems								
1	MEC 641	Solar energy	3	60	-	40	100	3
2	MEC 642	Water Desalination	3	60	-	40	100	3
3	MEC 643	Wind Energy	3	60	-	40	100	3
4	MEC 644	Tidal and sea wave energy	3	60	-	40	100	3
6	MEC 645	Gas Turbine Power plant	3	60	-	40	100	3
8	MEC 646	Solar Chimney Power Plants	3	60	-	40	100	3

*With the help of the academic advisor, the student chooses (12) credit hours as a minimum from the elective courses for the Advanced Diploma in one of the disciplines mentioned in Table (3.1.3) and according to what is determined by the Scientific Department Council.

Compatibility of the graduate's specifications with the courses of the engineering diploma in the mechanical power engineering program

S.N.	Code	Course Title	Graduate Competencies								
			1	2	3	4	5	6	7	8	9
Complursory Courses of the Basic Diploma in Mechanical Power Engineering											
1	GEN 504	Statistical Analysis and Experimental design	√	√				√		√	√
2	GEN 505	Engineering Mathematics & Numerical Analysis		√	√						√
Elective Courses of the Basic Diploma in Mechanical Power Engineering											
1	MEC 510	Applied Fluid Mechanics	√					√			
2	MEC 516	Turbomachinery	√								
3	MEC 522	Internal Combustion Engines	√					√			
4	MEC 530	Applied Heat and Mass Transfer	√								
5	MEC 533	Solar Heating and Cooling Systems	√						√		√
6	MEC 540	Renewable Energy	√			√			√	√	
7	MEC 542	Power Stations and their Economics	√			√	√				
8	MEC 545	Advanced Mechanical measurements	√	√				√			
9	MEC 549	Measurements and Instrumentation in Power Stations	√	√							√
Elective Courses of Advanced Diploma in Mechanical Power Engineering											
1	MEC 610	Pumps and Compressors Stations	√			√	√				
2	MEC 611	Gas Dynamics	√								√
3	MEC 612	Advanced Fluid Mechanics	√								
4	MEC 613	Turbulent Flow	√	√		√					
5	MEC 614	Pumps Design	√		√						√
6	MEC 615	Computational Fluid Dynamics	√		√						
7	MEC 617	Fluid Distribution and Pipelines Systems	√		√						

8	MEC 618	Computer Applications in Fluid Mechanics and Turbomachinery	√			√	√				
Combustion and Internal Combustion Engines											
1	MEC 620	Advanced Thermodynamics	√		√						√
2	MEC 621	Applied combustion	√	√		√					
3	MEC 623	Gas turbines	√								
4	MEC 624	Combustion systems	√								
5	MEC 625	Advanced Combustion	√		√						
6	MEC 626	Reciprocating combustion engines	√					√			
7	MEC 627	Computational Methods in Combustion	√		√						√
8	MEC 628	Computer Applications in Combustion and Internal Combustion Engines	√								
9	MEC 629	Control in Combustion and Internal Combustion Engines Systems	√		√			√			
Heat Transfer and Its Applications											
1	MEC 630	Advanced Heat and Mass Transfer	√								√
2	MEC 631	Advanced Air Conditioning	√			√	√				√
3	MEC 632	Control in Refrigeration and Air Conditioning Systems	√								
4	MEC 633	Advanced Refrigeration and Cold Stores	√				√				
5	MEC 634	Fires, Explosions, and Fire Fighting systems	√				√		√		
6	MEC 635	Thermal Loads and Advanced Psychrometry	√	√		√	√				√
7	MEC 636	Computer applications in Refrigeration and Air Conditioning	√		√				√		
Energy Systems											

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1	MEC 641	Solar energy	√	√		√	√	√	√	√	√
2	MEC 642	Water Desalination	√		√		√	√	√	√	√
3	MEC 643	Wind Energy	√			√	√	√	√	√	√
4	MEC 644	Tidal and sea wave energy	√			√	√	√		√	√
5	MEC 645	Gas Turbine Power plant	√	√	√				√		√
6	MEC 646	Solar Chimney Power Plants	√	√		√	√	√	√	√	√

5) Master of Science (M. Sc.) in Mechanical Power Engineering

Registration takes place in the following research fields:

1. Fluid Mechanics and Turbomachinery
2. Combustion and Internal Combustion Engines
3. Heat Transfer and Its Applications
4. Energy Systems

The Graduate of M. Sc. Program of Mechanical Power Engineering should be able to:

1. Master the application of the fundamentals and methodologies of scientific research and using its different tools.
2. Apply the analytic approach and use it in mechanical power engineering.
3. Apply specialized knowledge and combine it with relevant knowledge related to mechanical power engineering technology.
4. Show awareness of current problems and modern visions in mechanical power engineering.
5. Specify professional problems and find the appropriate solutions for them.
6. Show distinction in a proper range of specialized professional skills and use of appropriate technological means to serve his professional practice.
7. Communicate effectively and demonstrate the ability to lead a work team.
8. Make decisions in various professional contexts.
9. Maximize the utilization of the available resources to bring the greatest benefit and maintain.
10. Show awareness of the role in community development and preservation of the environment under the impact of local and global variables.
11. Act in a way that reflects the commitment to integrity, credibility and in accordance with the professional code of ethics.
12. Develop academically and professionally and carry out continuous education.

Table 3. 1. 4 M. Sc. Thesis in Mechanical Power Engineering

S.N	Course Code	Course Name	Prerequisites	Credit Hours
1	MEC 811	M.Sc. Thesis-1	All courses of the Advanced Diploma (Credit Hours) with a GPA of at least (3.0) and a minimum of (2.7) points in each course.	12
2	MEC 821	M.Sc. Thesis-2		
3	MEC 831	M.Sc. Thesis-3		
4	MEC 841	M.Sc. Thesis-4		

Compatibility of the specifications of the Master of Science graduate with the mechanical power engineering courses

Code	Course Title	Graduate Competencies											
		1	2	3	4	5	6	7	8	9	10	11	12
MEC 811	M.Sc. Thesis-1	√	√	√	√	√	√	√	√	√	√	√	√
MEC 821	M.Sc. Thesis-2	√	√	√	√	√	√	√	√	√	√	√	√
MEC 831	M.Sc. Thesis-3	√	√	√	√	√	√	√	√	√	√	√	√
MEC 841	M.Sc. Thesis-4	√	√	√	√	√	√	√	√	√	√	√	√

6) Doctor of Philosophy (Ph. D.) in Mechanical Power Engineering

Registration takes place in the following research fields:

1. Fluid Mechanics and Turbomachinery
2. Combustion and Internal Combustion Engines
3. Heat Transfer and Its Applications
4. Energy Systems

The Graduate of the Ph. D. Program of Mechanical Power Engineering should be able to:

1. Master the fundamentals and methodologies of scientific research.
2. Continue work towards adding to the knowledge in the Mechanical Power Engineering field.
3. Apply the analytic and critical approach in the Mechanical Power Engineering field and related fields.
4. Integrate specialized knowledge with the related knowledge to develop and conclude the bilateral ties between them.
5. Show deep awareness of current problems and modern theories in the Mechanical Power Engineering field.
6. Identify professional problems in the Mechanical Power Engineering field and find innovative solutions for them.
7. Master a wide range of professional skills in the Mechanical Power Engineering field.
8. Lead the way towards the development of new methods and tools for professional practice.
9. Utilize the suitable technological means to serve professional practice.
10. Communicate effectively and lead a work team in various professional contexts.
11. Make decisions using available data.
12. Effectively employ and develop available resources and work towards finding new resources.
13. Display awareness of the role in community development and environmental conservation.
14. Act in a way that reflects the commitment to integrity, credibility and in accordance with the rules of the profession.
15. Show commitment to self-development and transfer his knowledge and experiences to others.

Table 3. 1. 5 Basic Courses for the Ph.D. in Mechanical Power Engineering

S. N.	Course Code	Course Name	Credit Hours	Grades				Exam Time
				Course Work	Oral / Practical	Written Exam	Total	
1) Fluid Mechanics and Turbomachinery								
1	MEC 610	Pumps and Compressors Stations	3	60	-	40	100	3
2	MEC 611	Gas Dynamics	3	60	-	40	100	3
3	MEC 612	Advanced Fluid Mechanics	3	60	-	40	100	3
4	MEC 613	Turbulent Flow	3	60	-	40	100	3
5	MEC 614	Pumps Design	3	60	-	40	100	3
6	MEC 615	Computational Fluid Dynamics	3	60	-	40	100	3
7	MEC 616	Steam turbines	3	60	-	40	100	3
8	MEC 617	Fluid Distribution and Pipelines Systems	3	60	-	40	100	3
9	MEC 618	Computer Applications in Fluid Mechanics and Turbomachinery	3	60	-	40	100	3
10	MEC 619	Computational Methods for Optimization	3	60	-	40	100	3
2) Combustion and Internal Combustion Engines								
1	MEC 620	Advanced Thermodynamics	3	60	-	40	100	3
2	MEC 621	Applied combustion	3	60	-	40	100	3
3	MEC 622	Control of combustion systems and internal combustion machines	3	60	-	40	100	3
4	MEC 623	Gas turbines	3	60	-	40	100	3
5	MEC 624	Combustion systems	3	60	-	40	100	3
6	MEC 625	Advanced Combustion	3	60	-	40	100	3
7	MEC 626	Reciprocating combustion engines	3	60	-	40	100	3
8	MEC 627	Computational Methods in Combustion	3	60	-	40	100	3
9	MEC 628	Computer Applications in Combustion and Internal Combustion Engines	3	60	-	40	100	3
3) Heat Transfer and Its Applications								

S. N.	Course Code	Course Name	Credit Hours	Grades				Exam Time
				Course Work	Oral / Practical	Written Exam	Total	
1	MEC 630	Advanced Heat and Mass Transfer	3	60	-	40	100	3
2	MEC 631	Advanced Air Conditioning	3	60	-	40	100	3
3	MEC 632	Control in Refrigeration and Air Conditioning Systems	3	60	-	40	100	3
4	MEC 633	Advanced Refrigeration and Cold Stores	3	60	-	40	100	3
5	MEC 634	Fires, Explosions, and Fire Fighting systems	3	60	-	40	100	3
6	MEC 635	Thermal Loads and Advanced Psychrometry	3	60	-	40	100	3
7	MEC 636	Computer applications in Refrigeration and Air Conditioning	3	60	-	40	100	3
4) Energy Systems								
1	MEC 640	Hydro, electric Power Plants	3	60	-	40	100	3
2	MEC 641	Solar energy	3	60	-	40	100	3
3	MEC 642	Water Desalination	3	60	-	40	100	3
4	MEC 643	Wind Energy	3	60	-	40	100	3
5	MEC 644	Tidal and sea wave energy	3	60	-	40	100	3
6	MEC 645	Gas Turbine Power plant	3	60	-	40	100	3
7	MEC 646	Solar Chimney Power Plants	3	60	-	40	100	3
8	MEC 647	Nuclear Power plant	3	60	-	40	100	3
9	MEC 648	Computer Applications in Power Stations	3	60	-	40	100	3
10	MEC 649	Steam Generator	3	60	-	40	100	3

*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from the basic courses of the Doctor of Philosophy in one of the disciplines mentioned in Table (3.1.5) and according to what is determined by the Scientific Department Council.

Table 3.1.6 Specialized Courses for the Ph.D. in Mechanical Power Engineering

S. N	Course Code	Course Name	Credit Hours	Grades				Exam Time
				Course Work	Oral / Practical	Written Exam	Total	
1) Fluid Mechanics and Turbomachinery								
1	MEC 710	Selected topics in Fluid Dynamics	3	60	-	40	100	3
2	MEC 711	Selected Topics in Turbomachinery	3	60	-	40	100	3
3	MEC 712	Selected Topics in Pipelines and Pumps	3	60	-	40	100	3
4	MEC 713	Computational Methods and Artificial Intelligence in Mechanical Engineering	3	60	-	40	100	3
2) Combustion and Internal Combustion Engines								
1	MEC 720	Selected topics in Thermodynamics	3	60	-	40	100	3
2	MEC 721	Selected Topics in Combustion	3	60	-	40	100	3
3	MEC 722	Selected Topics in Internal Combustion Engines	3	60	-	40	100	3
4	MEC 723	Selected Topics in Air Pollution	3	60	-	40	100	3
3) Heat Transfer and Its Applications								
1	MEC 730	Selected Topics in Heat Transfer	3	60	-	40	100	3
2	MEC 731	Numerical Methods of Heat Transfer	3	60	-	40	100	3
3	MEC 732	Two-Phase Flow	3	60	-	40	100	3
4	MEC 733	Selected Topics in Refrigeration	3	60	-	40	100	3
5	MEC 734	Selected Topics in Air Conditioning	3	60	-	40	100	3
4) Energy Systems								
1	MEC 740	Selected Topics in Renewable Energies	3	60	-	40	100	3
2	MEC 741	Wind Turbine Farms	3	60	-	40	100	3
3	MEC 742	Marine Floating Solar Power Plant	3	60	-	40	100	3
4	MEC 743	Selected Topics in Power Stations	3	60	-	40	100	3
5	MEC 744	Selected Topics in Non-conventional Power Plants	3	60	-	40	100	3

S. N	Course Code	Course Name	Credit Hours	Grades				Exam Time
				Course Work	Oral / Practical	Written Exam	Total	
6	MEC 745	Selected Topics in Water Desalination Plants	3	60	-	40	100	3
7	MEC 746	Selected Topics in Water Treatment Plants	3	60	-	40	100	3

*The student chooses (9) credit hours as a minimum from the specialized courses for the Doctor of Philosophy in one of the disciplines mentioned in Table (3.1.6), upon the recommendation of the main supervisor and according to what is determined by the scientific department council.

Table 3. 1.7 Ph.D. Thesis in Mechanical Power Engineering

S. N.	Course Code	Course Name	Perquisites	Credit Hours
1	MEC 911	Ph.D. Thesis-1	1. Ph.D. Basic courses (9 credit) with a GPA of 3.0 at least and with a minimum of 2.7 points in each course. 2. Passing the first and second stage of the academic researches.	12
2	MEC 921	Ph.D. Thesis-2		
3	MEC 931	Ph.D. Thesis-3		
4	MEC 941	Ph.D. Thesis-4		

Compatibility of the graduate's specifications with the courses of the engineering Ph. D. in the mechanical power engineering program

S.N.	Code	Course Title	Graduate Competencies														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Basic Courses for the Ph.D. in Mechanical Power Engineering																	
Fluid Mechanics and Turbomachinery																	
1	MEC 610	Pumps and Compressors Stations		√		√		√	√			√		√			√
2	MEC 611	Gas Dynamics		√							√				√		√
3	MEC 612	Advanced Fluid Mechanics		√		√				√			√				
4	MEC 613	Turbulent Flow	√	√	√									√		√	
5	MEC 614	Pumps Design		√		√		√	√				√		√		√
6	MEC 615	Computational Fluid Dynamics		√			√			√		√				√	
7	MEC 616	Steam turbines		√				√	√					√			
8	MEC 617	Fluid Distribution and Pipelines Systems		√	√			√	√	√	√		√		√		√
9	MEC 618	Computer Applications in Fluid Mechanics and Turbomachinery		√	√	√	√	√	√		√			√		√	
10	MEC 619	Computational Methods for Optimization	√	√	√		√				√		√				√
Combustion and Internal Combustion Engines																	
1	MEC 620	Advanced Thermodynamics		√						√		√			√		
2	MEC 621	Applied combustion		√	√	√	√										
3	MEC 622	Control of combustion systems and internal combustion machines		√				√	√				√			√	
4	MEC 623	Gas turbines		√							√				√		√
5	MEC 624	Combustion systems		√			√	√	√			√			√		√
6	MEC 625	Advanced Combustion		√		√				√						√	
7	MEC 626	Reciprocating combustion engines		√				√	√			√			√		
8	MEC 627	Computational Methods in Combustion		√	√								√				

9	MEC 628	Computer Applications in Combustion and Internal Combustion Engines			√		√		√			√			√		√
Heat Transfer and Its Applications																	
1	MEC 630	Advanced Heat and Mass Transfer		√		√	√						√		√		√
2	MEC 631	Advanced Air Conditioning		√		√		√	√				√			√	
3	MEC 632	Control in Refrigeration and Air Conditioning Systems		√				√	√		√						
4	MEC 633	Advanced Refrigeration and Cold Stores		√		√								√		√	
5	MEC 634	Fires, Explosions, and Fire Fighting systems		√			√		√	√			√		√		
6	MEC 635	Thermal Loads and Advanced Psychrometry		√	√	√			√	√		√		√			√
7	MEC 636	Computer applications in Refrigeration and Air Conditioning		√	√		√		√			√			√		√
Energy Systems																	
1	MEC 640	Hydro, electric Power Plants		√		√	√	√	√		√				√	√	
2	MEC 641	Solar energy	√	√		√						√					√
3	MEC 642	Water Desalination				√			√			√		√			√
4	MEC 643	Wind Energy		√		√		√								√	
5	MEC 644	Tidal and sea wave energy					√		√		√			√			√
6	MEC 645	Gas Turbine Power plant	√	√		√		√		√			√		√		
7	MEC 646	Solar Chimney Power Plants	√			√			√			√				√	
8	MEC 647	Nuclear Power plant	√	√	√		√			√			√		√		√
9	MEC 648	Computer Applications in Power Stations	√	√				√			√			√			
10	MEC 649	Steam Generator		√					√				√			√	
Specialized Courses for the Ph.D. in Mechanical Power Engineering																	
Fluid Mechanics and Turbomachinery																	
1	MEC 710	Selected topics in Fluid Dynamics		√						√			√		√		
2	MEC 711	Selected Topics in Turbomachinery		√	√	√		√	√		√			√			√

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3	MEC 712	Selected Topics in Pipelines and Pumps		√				√	√	√			√		√	√	
4	MEC 713	Computational Methods and Artificial Intelligence in Mechanical Engineering	√	√	√		√				√			√			√
Combustion and Internal Combustion Engines																	
1	MEC 720	Selected topics in Thermodynamics		√		√	√		√		√		√			√	
2	MEC 721	Selected Topics in Combustion		√		√		√		√				√	√		
3	MEC 722	Selected Topics in Internal Combustion Engines		√		√	√		√		√						√
4	MEC 723	Selected Topics in Air Pollution		√		√			√		√		√		√		√
Heat Transfer and Its Applications																	
1	MEC 730	Selected Topics in Heat Transfer	√	√				√		√		√				√	
2	MEC 731	Numerical Methods of Heat Transfer		√							√				√		√
3	MEC 732	Two-Phase Flow		√	√							√					
4	MEC 733	Selected Topics in Refrigeration	√	√	√	√			√	√			√		√	√	
5	MEC 734	Selected Topics in Air Conditioning		√	√		√		√	√				√			√
Energy Systems																	
1	MEC 740	Selected Topics in Renewable Energies		√			√	√				√			√		√
2	MEC 741	Wind Turbine Farms	√	√		√	√		√		√		√			√	
3	MEC 742	Marine Floating Solar Power Plant	√		√			√		√				√			√
4	MEC 743	Selected Topics in Power Stations				√			√		√		√		√		
5	MEC 744	Selected Topics in Non-conventional Power Plants		√		√		√				√					
6	MEC 745	Selected Topics in Water Desalination Plants				√			√				√		√		√
7	MEC 746	Selected Topics in Water Treatment Plants		√	√		√	√			√					√	
Ph.D. Thesis in Mechanical Power Engineering																	
1	MEC 911	Ph.D. Thesis-1	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

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2	MEC 921	Ph.D. Thesis-2	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
3	MEC 931	Ph.D. Thesis-3	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
4	MEC 941	Ph.D. Thesis-4	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Course Description

Course Title	Applied Fluid Mechanics				Course Code	MEC 510
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Complete sets of governing equations of fluid flow – Integral and differential control volume analysis methods, laminar and turbulent boundary layer, drag and lift, flow in nozzles, pipe networks, pumps.

Reference/Source

- 1) Frank White, Fluid Mechanics, 9th Edition, McGraw-Hill, NY, 2021.
- 2) Andrew L. Gerhart, John I. Hochstein, Philip M. Gerhart; Fundamentals of Fluid Mechanics, 9th Edition, Wiley, December 2021.
- 3) F. Durst, Fluid Mechanics: An Introduction to the Theory of Fluid Flows, Springer; 2nd Ed., 2021.
- 4) Yunus Cengel and John Cimbala, Fluid Mechanics: Fundamentals and Applications, 4th Ed., McGraw-Hill, NY, 2018.

Course Title	Turbomachinery				Course Code	MEC 516
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Basic concepts and basic laws of turbo-machines – Theory of Similarity in turbo-machines – 1-D flow – 2-D flow through group of blades-cascade – Axial compressors, Centrifugal compressors – Axial gas turbines – Centrifugal gas turbines – 3-D flow through blade-cascades of turbo-machines-Solution methods for 3-D flow in turbo-machines.

Reference/Source

- 1) Marco Gambini and Michela Vellini, Turbomachinery: Fundamentals, Selection and Preliminary Design, Springer Tracts in Mechanical Engineering book series, 2021.
- 2) V. Dakshina Murty, “Turbomachinery: Concepts, Applications, and Design”, CRC Press, 2018.

Course Title	Internal Combustion Engines				Course Code	MEC 522
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Requirements of mixture of air-to-fuel ratio- Spark or Self Ignition Engines – Compression Ignition Engines – Two and four-stroke Engines – Engines Performance – Super-charging – Fuel combustion in engines.

Reference/Source

- 1) Federico Millo, Lucio Postrioti, Internal Combustion Engines Improving Performance, Fuel Economy and Emissions, Energies, 2020.
- 2) John B. Heywood, Internal Combustion Engine Fundamentals, 2nd Edition, McGraw-Hill Education, 2018.
- 3) Richard Stone, Introduction to Internal Combustion Engines, Sae Intl, 2017.

Course Title	Applied Heat and Mass Transfer				Course Code	MEC 530
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Modes of heat transfer - conduction heat – forced and free convection heat transfer - thermal radiation - thermal radiation of objects and gases - heat transfer in boiling and condensation – Mass transfer- heat exchangers.

Reference/Source

- 1) Yunus A. Cengel, Afshin Ghajar, “Heat Transfer: A Practical Approach”, 5th Edition, New York McGraw-Hill, 2021.
- 2) Theodore L Bergman; Adrienne S Lavine; Frank P Incropera; David P DeWitt, “Fundamentals of Heat and Mass Transfer”, 8th Edition, John Wiley & Sons, 2017.

Course Title	Solar Heating and Cooling Systems				Course Code	MEC 533
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Introduction, solar energy and the advantages and disadvantages of its use, explaining what solar radiation is, its structure and how to use it effectively, solar collectors, cooling and solar heating, the solar house, the basic components of a solar-powered cooling system, binary solutions, absorption cooling, cooling with vapor compression cycles, air cooling using drying and humidification processes, evacuated solar collectors, various solar systems used to heat water for domestic and commercial uses in terms of their mode of operation, equipment and practical installation schemes, various heating, air conditioning and cooling systems that work with solar energy with all its practical schemes and attached equipment.

Reference/Source

- 1) Ioan Sarbu and Calin Sebarchievici, Solar Heating and Cooling Systems: Fundamentals, Experiments and Applications, Academic Press; 1st Edition, 2016.

Course Title	Renewable Energy				Course Code	MEC 540
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Fundamentals and objectives of the different renewable energy technologies - Various applications of renewable energy: electricity generation, heating, cooling, drying, desalination, etc. – Biomass Resources - conversion of Biomass to Biofuel - Biomass products - Geothermal resources - Geothermal power production - The simplest geothermal cycle is the direct steam cycle - single-flash plant - double-flash geothermal power plant - Binary cycle plants - combined flash/binary plant - The latest in science and technological methods in renewable energy systems, Economic aspects of renewable energy: economic feasibility, financing, and incentive policies for adopting and implementing renewable energy projects.

Reference/Source

- 1) M. Kanoglu, Y. Cengel, J. Cimbal, Fundamentals and Applications of Renewable Energy, 1st Edition, McGraw Hill, 2019.
- 2) J. Libal, R. Kopecek, Bifacial Photovoltaics: Technology, Applications and Economics (Energy Engineering), The Institution of Engineering and Technology, 2018.
- 3) David W. Eaton, Passive Seismic Monitoring of Induced Seismicity: Fundamental Principles and Application to Energy Technologies 1st Edition, Kindle Edition, Cambridge University Press, 2018.

Course Title	Power Stations and their Economics				Course Code	MEC 542
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Classification of power plant - Energy resources - Power generation and consumption- Electricity generation – Steam power stations- Gas turbine power stations- Diesel engine power stations- Combined cycle power stations - Cogeneration- Nuclear power stations- Energy storage- Power stations and the environmental pollution. Total costs, fixed costs, variable costs, load curves, economic selection methods, Probabilistic analysis of capacity, energy prices, linear programming, project planning using probability method, evaluation and review and the critical path method.

Reference/Source

- 1) Farshid Zabihian, 2021, Power Plant Engineering, CRC Press.
- 2) Zark Bedalov, 2020, Practical Power Plant Engineering: A Guide for Early Career Engineers, 1st Edition, Wiley-IEEE Press.
- 3) Thomas R. Sadler, 2020, Energy Economics: Science, Policy, and Economic Applications, Lexington Books.
- 4) Subhes C. Bhattacharyya, 2019, Energy Economics: Concepts, Issues, Markets and Governance 2nd Edition, Springer.

Course Title	Advanced Mechanical measurements				Course Code	MEC 545
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

The concept of calibration and dynamic response, general components of measuring devices, behavior and

response of measuring devices, error analysis, Advanced methods and devices for measuring temperature, pressure, speed, flow rate, rate of heat transfer, control principles, control of pressure, temperature, and fluid flow rate. Error and the uncertainty coefficient in practical measurements, methods of statistical, electrical circuits and signal coding devices, computer's Interface & data processing.

Reference/Source

- 1) William Bolton, Instrumentation and Control Systems, Newnes, Elsevier Science, 2021.
- 2) Richard S. Figliola and Clemson University, "Theory and Design for Mechanical Measurements", 7th Edition, John Wiley & Sons, Inc., 2019.

Course Title	Measurements and Instrumentations in Power Stations				Course Code	MEC 549
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Overview of power generation – Measurements in power plants – Analyzers in power plants – Plant P&ID Discussions – General and special instruments in steam power plant - Control loops in steam power plants – Final control element – Boiler control system – Turbo generator control system - Wind turbine monitoring and control

Reference/Source

- 1) William Bolton, Instrumentation and Control Systems, Newnes, Elsevier Science, 2021.
- 2) Richard S. Figliola and Clemson University, "Theory and Design for Mechanical Measurements", 7th Edition, John Wiley & Sons, Inc., 2019.

Course Title	Pumps and Compressors Stations				Course Code	MEC 610
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Theory and design of Centrifugal and Mixed Flow Pumps – Theory of design – Axial flow pumps – Cavitation – Performance and testing of pumps – pumps operation problems – pumping stations – Theory and design of centrifugal compressors – Theory and design of axial flow compressors – Compressor accessories. Considering with the latest in science and modern technological methods in the applications of mechanical power engineering in pipelines, pumps, and compressors.

Reference/Source

- 1) Armando Carravetta, Shahram D., Helena M.04 Nov 2017, Pumps as Turbines, Newnes, Springer International Publishing AG.
- 2) Thomas Van Hardeveld, 2019, Pump and compressor operation, Encyclopedia of Life Support Systems (EOLSS).
- 3) Marc Borremans, 2022, Pumps and Compressors (Wiley-ASME Press Series) 1st Edition

Course Title	Gas Dynamics				Course Code	MEC 611
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Basic concepts of compressible flow- Isentropic ideal flow- Flow in converging nozzles – Normal shock waves- Oblique shock waves- Fanno-line flow- Isothermal flow – Rayleigh line flow –Isothermal flow - Prandtl flow – Theory of expansion of waves – Method of characteristics-Computational and numerical methods for solving compressible flow equations.

Reference/Source

- 1) J.D. Anderson, Modern Compressible Flow with Historical Perspective, McGraw-Hill, 4th Edition, 2020.
- 2) Robert D. Zucker and Oscar Biblarz, Fundamentals of Gas Dynamics, Wiley; 3rd Ed., 2019.

Course Title	Advanced Fluid Mechanics				Course Code	MEC 612
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Basic equations of motion, Navier- Stokes equations and their solutions, Computational Fluid Dynamics, Typical examples and practical applications for viscous and frictionless or ideal flows, Differential analysis of Boundary Layer Theory, Governing equations of boundary layer flow. Laminar boundary layer on a flat plate without and with variable pressure gradient Introduction to compressible flows and Aerodynamics.

Reference/Source

- 1) Meinhard T. Schobeiri, Advanced Fluid Mechanics and Heat Transfer for Engineers and Scientists, Springer, 2022.
- 2) William Graebel, Advanced Fluid Mechanics, Academic Press; 1st Edition, 2007.

Course Title	Turbulent Flow				Course Code	MEC 613
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Boundary layer in compressible flow- turbulent boundary layer on a flat plate with zero pressure gradient- Introduction to computational methods for boundary layer flows. Introduction to Turbulence- Origin, nature, and characteristics of turbulence, Theories of viscous vorticity and mixing length scale- General equations governing conservation of mass, momentum, energy, and conservation of vorticity. Turbulence models: Two-equation model, Large-scale model, Different typical patterns of turbulent flows: Wakes, Free Jets. Spectral dynamics and statistical analysis of turbulence- Experimental methods for turbulent measurements.

Reference/Source

- 1) Paul Durbin, Advanced Approaches in Turbulence: Theory, Modeling, Simulation, and Data Analysis for Turbulent Flows, Elsevier; 1st Edition, 2021.
- 2) Tapan K. Sengupta, Swagata Bhaumik, DNS of Wall-Bounded Turbulent Flows: A First Principle Approach, Springer, 1st Ed. 2019.

Course Title	Pumps Design				Course Code	MEC 614
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Types – specific speed - pumps selection - performance curves - losses in pumps - Compatibility between the network of pipes and pump performance - connections of pumps, series and parallel - cavitation in pumps - pump blades. The basics of pump maintenance, the basics of pump operation centrifugal pumps, gear pumps, reciprocating pumps, worm pumps, deep pumps, submerged pumps, vacuum pumps, lifting water using compressed air, pump selection, repair the faults (mechanical - electrical) of pumps.

Reference/Source

- 1) Thomas Merkle, Damages on Pumps and Systems: The Handbook for the Operation of Centrifugal Pumps, Elsevier; 1st Edition, 2014.
- 2) Michael Volk, Pump Characteristics and Applications, CRC Press; 3rd Edition, 2013.

Course Title	Computational Fluid Dynamics				Course Code	MEC 615
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Navier-Stokes equations for incompressible flow and converting them into non-dimensional form, formulas of primary and derived variables, uniqueness of gradient networks and co-site networks, Poisson pressure equation and its numerical solution, applications in internal and external flow, advanced topics and recent developments, Training sessions on ANSYS, FLUENT, ...etc. Software packages.

Reference/Source

- 1) J. Tu, G.H. Yeoh, C. Liu, Computational Fluid Dynamics: A Practical Approach, Butterworth-Heinemann; 3rd Edition, 2018.
- 2) Darrell W. Pepper, Juan C. Heinrich, The Finite Element Method: Basic Concepts and Applications with MATLAB, MAPLE, and COMSOL, CRC Press; 3rd Edition, 2017.

Course Title	Steam Power Plant				Course Code	MEC 616
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100

	40	60	-	-		
Course Content Characteristics of steam power plant - Steam power plant equipment – Coal handling and fuel burning furnaces – steam boilers (types, performance, requirements of a good boiler) - Fuel and combustion – Steam prime movers - Boiler control – Steam turbine (classification, capacity, performance, specifications) – Steam turbine testing – Steam condensers (Types, design, modern surface condensers).						
Reference/Source 1) Farshid Zabihian, 2021, Power Plant Engineering, CRC Press. 2) Zark Bedalov, 2020, Practical Power Plant Engineering: A Guide for Early Career Engineers, 1 st Edition, Wiley-IEEE Press.						

Course Title	Fluid Distribution and Pipelines Systems				Course Code	MEC 617
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		
Course Content Fluid flow and basic equations, types of fluid and flow, viscous incompressible flow in pipelines, 1-D flow for compressible and incompressible fluids with applications, 2-D flow: Navier - Stokes equations and examples of fluid flow within closed channels and tubes, friction and pressure losses in tubes and closed channels, boundary layer, turbulent flow, pipelines network and piping systems, applications of flow in pipelines for liquids and gases, Energy transfer through pipelines, performance of pumps and pipelines, pump selection.						
Reference/Source 1) Prabhata K. Swamee, Ashok K. Sharma, Design of Water Supply Pipe Networks, John Wiley & Sons, 2018.						

Course Title	Computer Applications in Fluid Mechanics and Turbomachinery				Course Code	MEC 618
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		
Course Content Special Course: It deals with the latest in science and technological methods in using computers and modern programs for designing and simulating pipeline systems, pumps, compressors, and mechanical power engineering applications such as AutoCAD, Autodesk Revit, ANSYS, Solid works, MATLAB - MathWorks & Simulink and others.						
Reference/Source 1) Daniel John Stine, Residential Design Using Autodesk Revit, SDC Publications, 2021. 2) Darrell W. Pepper, Juan C. Heinrich, The Finite Element Method: Basic Concepts and Applications with MATLAB, MAPLE, and COMSOL, CRC Press; 3 rd Edition, 2017.						

Course Title	Computational Methods for Optimization				Course Code	MEC 619
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100

	40	60	-	-		
Course Content						
Selected and advanced topics dealing with the latest in science and modern technological methods in computational methods in optimal solutions (Optimization) in mechanical power engineering systems and applications.						
Reference/Source						
1) Mykel J. Kochenderfer, Tim A. Wheeler, Algorithms for Optimization, The MIT Press, 2019.						
2) Y. Jaluria, Design and Optimization of Thermal Systems, Third Edition: with MATLAB Applications, CRC Press; 3 rd edition (September 6, 2019).						

Course Title	Advanced Thermodynamics				Course Code	MEC 620
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		
Course Content						
Review of basics of thermodynamics- Thermodynamic relations - Energy and entropy – Exergy - Properties of Solutions and Mixtures – Phase Equilibrium for a Mixture - Thermodynamic Stability and Equilibrium – Thermodynamics of reacting systems- Reaction Direction and Chemical Equilibrium - Basics and Principles of Statistical Thermodynamics.						
Reference/Source						
1) Yunus Cengel and Michael Boles, Thermodynamics, An Engineering Approach, 9 th Edition, McGraw-Hill Education; 2019.						
2) Claus Borgnakke, Richard E. Sonntag, Fundamentals of Thermodynamics, 10 th Edition, John Wiley & Sons, Inc., 2019.						

Course Title	Applied Combustion				Course Code	MEC 621
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		
Course Content						
Types of flames – Mixing and spreading of flames – Heat release in flames- Heat transfer in furnaces – Measurements in flames – Burners and combustors – Combustion equipment.						
Reference/Source						
1) Allan T. Kirkpatrick, Internal Combustion Engines: Applied Thermo-sciences, Wiley; 4 th Edition, 2020.						
2) Colin R. Ferguson, Allan T. Kirkpatrick, Internal Combustion Engines: Applied Thermo-sciences, Wiley; 3 rd Edition, 2015.						
3) Eugene L. Keating, Applied Combustion, CRC Press; 2 nd Edition, 2007.						

Course Title	Control of combustion systems and internal combustion machines				Course Code	MEC 622
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100

	40	60	-	-		
Course Content						
..						
Reference/Source						
1) Allan T. Kirkpatrick, Internal Combustion Engines: Applied Thermo-sciences, Wiley; 4 th Edition, 2020.						
2) Colin R. Ferguson, Allan T. Kirkpatrick, Internal Combustion Engines: Applied Thermo-sciences, Wiley; 3 rd Edition, 2015.						
3) Eugene L. Keating, Applied Combustion, CRC Press; 2 nd Edition, 2007.						

Course Title	Gas Turbines				Course Code	MEC 623
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		
Course Content						
Applications and usages-Range of output power-Description of gas turbines- Gas turbine cycles – Specific output, thermal efficiency and effects of main parameters - Methods of performance enhancing – Fuel and combustion – Power control – Testing –Maintenance-Combined cycles.						
Reference/Source						
1) Marco Gambini and Michela Vellini, Turbomachinery: Fundamentals, Selection and Preliminary Design, Springer Tracts in Mechanical Engineering book series, 2021.						
2) V. Dakshina Murty, “Turbomachinery: Concepts, Applications, and Design”, CRC Press, 2018.						

Course Title	Combustion Systems				Course Code	MEC 624
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		
Course Content						
The first law and the second law of thermodynamics, analysis of real thermodynamic processes according to the second law, thermodynamic relations, fuels, combustion, flame, mixing and heat transfer in furnaces, flame measurements, combustion in boilers and combustion chambers of gas turbines.						
Reference/Source						
1) S M Ashrafur Rahman, Islam Rizwanul Fattah MD, Sustainable Combustion Systems and Their Impact, Mdpi AG, 2021.						
2) John R. Puskar, Fuel and Combustion Systems Safety: What you don't know can kill you! Wiley, 1 st Edition, 2014.						

Course Title	Advanced Combustion				Course Code	MEC 625
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100

	40	60	-	-		
Course Content						
Combustion Reactions- Fuels: types, specifications, and properties- Flames: types, theories, and stability- Heat release and transfer from flames- Fuel Atomization: mechanisms and tools-Combustion chambers for solid, liquid and gaseous fuels- Measurements in flames and combustion systems.						
Reference/Source						
1) Akhilendra Pratap Singh, Nikhil Sharma, Ramesh Agarwal, Avinash Kumar Agarwal, Advanced Combustion Techniques and Engine Technologies for the Automotive Sector, Springer; 1 st Ed., 2019.						
2) U.S. Environmental Protection Agency, Advanced Combustion Systems for Stationary Gas Turbine Engines, Vol. I: Review and Preliminary Evaluation, Scholar's Choice, 2015.						

Course Title	Reciprocating Combustion Engines				Course Code	MEC 626
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		
Course Content						
Properties of working medium- Simulation of Cycles- Mathematical models- Mechanisms of air, fuel, and exhaust- Combustion and Pollutants- Heat and mass losses- Friction-Performance of ordinary and supercharging engines.						
Reference/Source						
1) Mdpi, Advances in Direct Injection Reciprocating Internal Combustion Engines, Mdpi AG, 2020.						
2) Rakesh Kumar Maurya, Reciprocating Engine Combustion Diagnostics: In-Cylinder Pressure Measurement and Analysis, Springer; 1 st Ed. 2019.						

Course Title	Computational Methods in Combustion				Course Code	MEC 627
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		
Course Content						
Review of chemical thermodynamics- Kinetics of combustion- Equations Governing multi-components reaction systems- Simple models for combustion- Mathematical models for reactive flow- Finite differences- Diffusion and Pre-mixed Flame Models- Computational methods for two-phase reactive flow- Practical applications for combustors simulation.						
Reference/Source						
1) Jr. Baukal, Vladimir Gershtein, Xianming Jimmy Li, Computational Fluid Dynamics in Industrial Combustion, CRC Press; 1 st Edition, 2019.						

Course Title	Computer Applications in Combustion and Internal Combustion Engines				Course Code	MEC 628
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3

	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: It deals with the latest in science and technological methods in using computers and modern programs for designing and simulating combustion systems and internal combustion engines and mechanical power engineering applications.

Reference/Source

- 1) Jr. Baukal, Vladimir Gershtein, Xianming Jimmy Li, Computational Fluid Dynamics in Industrial Combustion, CRC Press; 1st Edition, 2019.
- 2) Yu Shi, Hai-Wen Ge, Rolf D. Reitz, Computational Optimization of Internal Combustion Engines, Springer; 2011th Edition.

Course Title	Advanced Heat and Mass Transfer				Course Code	MEC 630
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Governing equations; (Heat transfer by conduction – Heat transfer by convection – Heat transfer by radiation) – Thermal Conduction: definitions, conduction general equation, steady state conduction, transient conduction, - 3-d conduction- Mathematical and algebraic methods - fins - Thermal convection: definitions, thermal boundary layer, governing equations- Flow through passages- Heat Transfer in fires and flames- Thermal Radiation: Governing equations, design of boiler furnaces- Boiling and Condensation- heat exchangers, Examples- Mass Transfer: Mass transfer in nonstationary media – Evaporation in column – Conservation of species for a stationary medium – -Governing equations- Transport phenomena - Catalytic surface reactions – Transient diffusion - Advanced topics; Use of computers and computational fluid dynamics in thermal applications.

Reference/Source

- 1) Yunus A. Cengel, Afshin Ghajar, “Heat Transfer: A Practical Approach”, 5th Edition, New York McGraw-Hill, 2021.
- 2) Theodore L Bergman; Adrienne S Lavine; Frank P Incropera; David P DeWitt, “Fundamentals of Heat and Mass Transfer”, 8th Edition, John Wiley & Sons, 2017.

Course Title	Advanced Air Conditioning				Course Code	MEC 631
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Air conditioning and central air conditioning include psychometric circuits, residential, industrial, design conditions, comfort conditions and explanation of the refrigeration cycle, estimation of thermal loads, air conditioning systems and their comparison, industrial ventilation systems, air conditioning equipment, automatic control of air conditioning systems, selection of air conditioning system and air duct design, pipes design and pipe sizing, energy efficiency in air conditioning field. Concepts and types of ventilation, Mechanical ventilation

systems, Ventilation and Air Quality, Balanced ventilation with heat recovery, Control system for Mechanical ventilation, Fans, Drive design, Maintenance and troubleshooting, MV applications.

Reference/Source

- 1) Maddali Ramgopal, Sachindra Kumar Rout, Sunil Kr Sarangi, Advances in Air Conditioning and Refrigeration, Springer; 1st Ed. 2020.
- 2) Andrew D. Althouse, Carl H. Turnquist, Alfred F. Bracciano, Daniel C. Bracciano, Gloria M. Bracciano, Modern Refrigeration and Air Conditioning, Goodheart-Willcox; Twenty first Edition, Revised, Textbook, 2019.

Course Title	Control in Refrigeration and Air Conditioning Systems				Course Code	MEC 632
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Terms and definitions of automatic control systems, the various systems to control air conditioning and ventilation systems, automatic control devices used in refrigeration and air conditioning applications. temperature and pressure regulators - float control - refrigerant flow rate control - automatic control for compressors and other equipment –design of proportional integral differential controllers in refrigeration and air conditioning systems. It deals with the latest in science and modern technological methods in the applications of control in refrigeration and air conditioning systems.

Reference/Source

- 1) Chris Johanson, Auto Heating and Air Conditioning, Goodheart-Willcox; 5th Edition, Revised, Textbook, 2019.
- 2) Ye Yao and Yuebin Yu, Modeling and Control in Air-conditioning Systems, Springer; 1st Ed. 2017.

Course Title	Advanced Refrigeration and Cold Stores				Course Code	MEC 633
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Main components of vapor-compression refrigeration systems: types, operation, and performance - Matching of system components- Refrigeration compressors (reciprocating – rotary) – Condensers - Evaporators - Expansion valves - Absorption refrigeration - Thermo-electric refrigeration - steam jet refrigeration - Gas liquification - Optimum design of refrigeration system- Energy utilization in refrigeration - Types of refrigerants and comparison among - Cold Stores design.

Reference/Source

- 1) Maddali Ramgopal, Sachindra Kumar Rout, Sunil Kr Sarangi, Advances in Air Conditioning and Refrigeration, Springer; 1st Ed. 2020.
- 2) Andrew D. Althouse, Carl H. Turnquist, Alfred F. Bracciano, Daniel C. Bracciano, Gloria M. Bracciano, Modern Refrigeration and Air Conditioning, Goodheart-Willcox; Twenty first Edition, Revised, Textbook,

2019.

Course Title	Fires, Explosions, and Fire Fighting Systems				Course Code	MEC 634
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Basics and characteristics of fires- Fire protection strategies – Fire dynamics – Fire protection tools and devices- Explosions of closed and semi-closed containers- Blast Waves – Explosions Safety Methods – Various firefighting methods– Firefighting systems design.

Reference/Source

- 1) Robert C. Comer, Explosion Vented Equipment System Protection Guide, Wiley; 1st Edition, 2020.
- 2) Robert C. TillJ. Walter Coon, Fire Protection: Detection, Notification, and Suppression, 2nd Edition, Jul 2018.

Course Title	Thermal Loads and Advanced Psychrometry				Course Code	MEC 635
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Properties of air – dry and wet bulb temperature - dew point - specific volume - the partial pressure of water vapor - humidity – psychrometry chart – human comfort zone - psychrometric processes and air conditioning processes - processes of air-water direct contact- enthalpy difference- air washers- cooling towers – water spray dehumidification- cooling coils – dehumidification by absorption materials – effect of pressure on the properties of the humid air on loads – sources of thermal loads for cooling and heating – solar heat gain - the heat transfer through the buildings – ventilation.

Reference/Source

- 1) Maddali Ramgopal, Sachindra Kumar Rout, Sunil Kr Sarangi, Advances in Air Conditioning and Refrigeration, Springer; 1st Ed. 2020.
- 2) Andrew D. Althouse, Carl H. Turnquist, Alfred F. Bracciano, Daniel C. Bracciano, Gloria M. Bracciano, Modern Refrigeration and Air Conditioning, Goodheart-Willcox; Twenty first Edition, Revised, Textbook, 2019.

Course Title	Computer applications in Refrigeration and Air Conditioning				Course Code	MEC 636
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: It deals with the latest in science and technological methods in using computers and modern

programs in designing and simulating refrigeration and air conditioning systems and mechanical power engineering applications

Reference/Source

- 1) Daniel John Stine, Residential Design Using Autodesk Revit, SDC Publications, 2021.
- 2) Darrell W. Pepper, Juan C. Heinrich, The Finite Element Method: Basic Concepts and Applications with MATLAB, MAPLE, and COMSOL, CRC Press; 3rd Edition, 2017.

Course Title	Hydro-Electric Power Plants				Course Code	MEC 640
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Introduction, basic laws of flow in hydraulic machinery, Components of hydro-electric power plant - pumps, hydraulic turbines, types and components of hydraulic power stations, water sources and types of dams, pipelines connected in series and parallel, water hammer in pipelines and methods of prevention it.

Reference/Source

- 1) Geraldo Magela Pereira, 2022, Design of Hydroelectric Power Plants – Step by Step, CRC Press.
- 2) Jafar Mehdi Hassan, Salman Hussien Omran, Laith Jaafer Habeeb, Alamaslamani Ammar Fadhil Shnawa, Adrian Ciocănea, 2021, Hydraulic Power Plants: A Textbook for Engineering Students, Benthambook.

Course Title	Solar Energy				Course Code	MEC 641
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Introduction- Solar angles Engineering-Extraterrestrial and on-ground solar radiation: its nature, characteristics, and quantity- Measurement methods for solar radiation- Transmission of solar radiation through transparent and partially transparent media- Radiation characteristics of different types of surfaces- Shading calculations- Collection of solar energy-Flat plate collectors- Concentrators- Storage. Classification of applications according to temperature levels- Heating of Fluids and buildings- Cooling and Air-conditioning- Passive and non-passive systems- Drying of products - Water desalination- Water pumping – Power generation using solar energy- Economics of solar systems.

Reference/Source

- 1) Michael Boxwell; “The Solar Electricity Handbook”, 2021 Edition, Greenstream Publishing, January 2021.
- 2) G. Stapleton, Susan Neill, Grid-connected Solar Electric Systems (Earthscan Expert), 1st Edition, Routledge, 2021.

Course Title	Water Desalination				Course Code	MEC 642
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		

Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		
<u>Course Content</u> Introduction - sea water chemistry - different methods of sea water desalination - dynamic systems – SEE, MEE, MSF, membrane types and characteristics- RO- Electro dialysis systems - introduction to economics of desalination plants, demand analysis and calculate the requested peak - costs of construction and operation of desalination plants - economic test of desalination plants - economics of operating stations - wasted energy recovery systems - calculate the costs of production, consumption and billing - calculate the costs of testing and maintenance of desalination plants. Desalination plants using Reverse Osmosis.						
<u>Reference/Source</u> 1) Advances in Water Desalination Technologies, Yoram Cohen (University of California, Los Angeles, USA), 2021.						

Course Title	Wind Energy				Course Code	MEC 643
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		
<u>Course Content</u> Introduction - types of wind turbines – theory of the momentum and mass conservation - Betz limit for the power factor of the turbine of horizontal axis – lift and drag turbines - use buildings to increase the power extraction - the properties of winds near the surface of the earth - power generated.						
<u>Reference/Source</u> 1) Tony Burton, Nick Jenkins, David Sharpe and Ervin Bossanyi, “Wind Energy Handbook”, 3 rd Edition, John Wiley & Sons, 2021. 2) Colin Anderson, “Wind Turbine Theory and Practice”, 1st Edition, Cambridge University Press, February 2020.						

Course Title	Tidal and Sea Wave Energy				Course Code	MEC 644
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		
<u>Course Content</u> Importance of non-conventional energy sources - Wave Energy Technology – Wave energy resource – Characterization of ocean waves – Measurements of Ocean waves – Hydrodynamics design of wave energy converter – Experimental testing and evaluation of wave energy converter - Fundamentals of Tidal Energy - Prefeasibility Analysis of Tidal Energy Systems - Optimum Sizing & Modeling of Tidal Energy Systems - Control Systems of Tidal Power Plant - Advances in Tidal Energy Systems - The Economics of Wave and Tidal Energy.						
<u>Reference/Source</u> 1) Arthur Pecher and Jens Peter Kofoed “Handbook of Ocean Wave Energy”, Volume 7, Springer Open, 2017.						

Course Title	Gas Turbine Power Plant	Course Code	MEC 645

Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Classification of Gas Turbine Power Plant – Elements of gas turbine power plant – Auxiliary systems - Control of gas turbine – Combined cycle power plants – Cogeneration - Operation and maintenance of performance – Applications of gas turbine.

Reference/Source

- 1) Farshid Zabihian, 2021, Power Plant Engineering, CRC Press.
- 2) Zark Bedalov, 2020, Practical Power Plant Engineering: A Guide for Early Career Engineers, 1st Edition, Wiley-IEEE Press.

Course Title	Solar Chimney Power Plants				Course Code	MEC 646
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Introduction to solar chimney power plant system, thermodynamic analysis of solar chimney power generation system, air gravity (HAG) effect of solar chimney power plant, fluid flow and heat transfer in solar chimney power plant, design and simulation method for turbines in solar chimney power plant, energy storage in solar chimney system.

Reference/Source

- 1) Tingzhen Ming, 2016, Solar Chimney Power Plant Generating Technology, Academic Press.
- 2) Haythem Nasraoui, Moubarek Bsisa, Zied Driss, 2020, Solar Chimney Power Plants: Numerical Investigations and Experimental Validation, Bentham Science Publishers.

Course Title	Nuclear Power Plant				Course Code	MEC 647
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Basic concepts of nuclear energy, Atomic and nuclear physics, Nuclear structure, Nuclear reactions, Interaction of radiation with matter, Nuclear reactor fuels, Power reactors and nuclear steam supply systems, Neutron diffusion and moderation, Nuclear reactor theory, Heat removal from nuclear reactors, Radiation protection and shielding, Reactor licensing, safety and environment.

Reference/Source

- 1) Raymond Murray, Keith E. Holbert, 2019, Nuclear Energy: An Introduction to the Concepts, Systems, and Applications of Nuclear Processes, 8th Edition, Butterworth-Heinemann.
- 2) Raymond L. Murray, 2000, Nuclear Energy, FIFTH EDITION, North Carolina State University, Raleigh, North Carolina, UAS.

Course Title	Computer Applications in Power Stations				Course Code	MEC 648
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3

	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: It deals with the latest in science and technological methods in using computers and modern programs in designing and simulating power stations and mechanical power engineering applications such as AutoCAD programs, Autodesk Revit, ANSYS, Solid works, and others.

Reference/Source

- 1) Daniel John Stine, Residential Design Using Autodesk Revit, SDC Publications, 2021.
- 2) Darrell W. Pepper, Juan C. Heinrich, The Finite Element Method: Basic Concepts and Applications with MATLAB, MAPLE, and COMSOL, CRC Press; 3rd Edition, 2017.

Course Title	Steam Generator				Course Code	MEC 649
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Types of boilers – Industrial boilers - Comparison of hot gas tube boilers and water tube boilers, dynamic performance of hot gas tube boilers, dynamic performance of water tube boilers, Boiler control, Drum-less boiler, High pressure boilers, Water treatment and disposal, Fluidized bed combustion, Boiler cleaning and maintenance, simulation of dynamic performance of steam boilers.

Reference/Source

- 1) Donatello A. 2008, Steam Generator, Springer, Berlin.
- 2) R.K. Hegde, 2015, Power Plant Engineering, Pearson Education India.

Course Title	Selected Topics in Fluid Dynamics				Course Code	MEC 710
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics that deal with the latest in science and modern technological methods in the applications of mechanical power engineering in the field of fluid dynamics, and it is an advanced course determined by the supervisor of the research, which is required by the research point, especially what is new in the field of fluid dynamics and is studied during one semester.

Reference/Source

- 1) Meinhard T. Schobeiri, Advanced Fluid Mechanics and Heat Transfer for Engineers and Scientists, Springer, 2022.
- 2) William Graebel, Advanced Fluid Mechanics, Academic Press; 1st Edition, 2007.

Course Title	Selected Topics in Turbomachinery				Course Code	MEC 711
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3

	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics that deal with the latest in science and modern technological methods in the applications of mechanical power engineering in the field of turbomachinery, and it is an advanced course determined by the supervisor of the research, which is required by the research point, especially what is new in the field of turbomachinery and is studied during one semester.

Reference/Source

- 1) Marco Gambini and Michela Vellini, Turbomachinery: Fundamentals, Selection and Preliminary Design, Springer Tracts in Mechanical Engineering book series, 2021.
- 2) V. Dakshina Murty, "Turbomachinery: Concepts, Applications, and Design", CRC Press, 2018.

Course Title	Selected Topics in Pipelines and Pumps				Course Code	MEC 712
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics that deal with the latest in science and modern technological methods in the applications of mechanical power engineering in the field of pipelines and pumps, and it is an advanced course determined by the supervisor of the research, which is required by the research point, especially what is new in the field of pipelines and pumps and is studied during one semester

Reference/Source

- 1) Prabhata K. Swamee, Ashok K. Sharma, Design of Water Supply Pipe Networks, John Wiley & Sons, 2018.
- 2) Thomas Merkle, Damages on Pumps and Systems: The Handbook for the Operation of Centrifugal Pumps, Isevier; 1st Edition, 2014.
- 3) Michael Volk, Pump Characteristics and Applications, CRC Press; 3rd Edition, 2013.

Course Title	Computational Methods and Artificial Intelligence in Mechanical Engineering				Course Code	MEC 713
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics that deal with the latest in science and modern technological methods in the field of computational methods and artificial intelligence in mechanical engineering and is studied during one semester.

Reference/Source

1. Kaushik Kumar , Divya Zindani , J. Paulo Davim, 2021, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press
2. Ashwani Kumar , Yatika Gori, Nitesh Dutt, Yogesh Kumar Singla, Ambrish Maurya , 2021, Advanced

Computational Methods in Mechanical and Materials Engineering, CRC press.

Course Title	Selected Topics in Thermodynamics				Course Code	MEC 720
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics that deal with the latest in science and modern technological methods in the applications of mechanical power engineering in the field of thermodynamics, and it is an advanced course determined by the supervisor of the research, which is required by the research point, especially what is new in the field of thermodynamics and is studied during one semester.

Reference/Source

- 1) Yunus Cengel and Michael Boles, Thermodynamics, An Engineering Approach, 9th Edition, McGraw-Hill Education; 2019.
- 2) Claus Borgnakke, Richard E. Sonntag, Fundamentals of Thermodynamics, 10th Edition, John Wiley & Sons, Inc., 2019.

Course Title	Selected Topics in Combustion				Course Code	MEC 721
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics that deal with the latest in science and modern technological methods in the applications of mechanical power engineering in the field of combustion, and it is an advanced course determined by the supervisor of the research, which is required by the research point, especially what is new in the field of combustion and is studied during one semester.

Reference/Source

- 1) Akhilendra Pratap Singh, Nikhil Sharma, Ramesh Agarwal, Avinash Kumar Agarwal, Advanced Combustion Techniques and Engine Technologies for the Automotive Sector, Springer; 1st Ed., 2019.
- 2) U.S. Environmental Protection Agency, Advanced Combustion Systems for Stationary Gas Turbine Engines, Vol. I: Review and Preliminary Evaluation, Scholar's Choice, 2015.

Course Title	Selected Topics in Internal Combustion Engines				Course Code	MEC 722
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics that deal with the latest in science and modern technological methods in the applications of mechanical power engineering in the field of internal combustion engines, and it is

an advanced course determined by the supervisor of the research, which is required by the research point.

Reference/Source

- 1) Federico Millo, Lucio Postrioti, Internal Combustion Engines Improving Performance, Fuel Economy and Emissions, Energies, 2020.
- 2) John B. Heywood, Internal Combustion Engine Fundamentals, 2nd Edition, McGraw-Hill Education, 2018.
- 3) Richard Stone, Introduction to Internal Combustion Engines, Sae Intl, 2017.

Course Title	Selected Topics in Air Pollution				Course Code	MEC 723
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Introduction- Main air pollutants and its effect- Standard specifications of clean air- Main sources of air pollution- Methods of control of pollutants emissions- Methods of pollutants detection, measuring and tracing.

Reference/Source

- 1) S. C. Bhatia, 2021, Textbook of Air Pollution and Its Control, Atlantic.
- 2) Karl B. Schnelle, Jr., Russell F. Dunn, Mary Ellen Ternes, 2017, Air Pollution Control Technology Handbook, CRC Press.

Course Title	Selected Topics in Heat Transfer				Course Code	MEC 730
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics that deal with the latest in science and modern technological methods in the applications of mechanical power engineering in the field of heat transfer, and it is an advanced course determined by the supervisor of the research, which is required by the research point, especially what is new in the field of heat transfer and is studied during one semester.

Reference/Source

- 1) Yunus A. Cengel, Afshin Ghajar, "Heat Transfer: A Practical Approach", 5th Edition, New York McGraw-Hill, 2021.
- 2) Theodore L Bergman; Adrienne S Lavine; Frank P Incropera; David P DeWitt, "Fundamentals of Heat and Mass Transfer", 8h Edition, John Wiley & Sons, 2017.

Course Title	Numerical Methods of Heat Transfer				Course Code	MEC 731
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Introduction-Governing equations- Thermal conduction in multi-dimensions-Convection and diffusion-Different numerical solution methods-General applications.

Reference/Source

- 1) Numerical Methods for Scientists and Engineers, R. W. Hamming, ISBN-13: 978-0486652412.
- 2) E. Kreyszig, 1999, Advanced Engineering Mathematics, John Wiley and Sons, New York.
- 3) ANSYS Fluent in ANSYS Workbench User's Guide, ANSYS, Inc.

Course Title	Two-Phase Flow				Course Code	MEC 732
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Introduction- Two and multiphase flows- Theory of Homogenous two-phase flow- Theory of Separated two phase flows- Distribution of velocity and concentration- The 1-D wave theory – The interference phenomenon and behavior of thin layers. especially what is new in the field of internal combustion engines and is studied during one semester.

Reference/Source

- 1) Cl Kleinstreuer, 2003, Two-Phase Flow Theory and Applications, CRC Press.
- 2) Mamoru Ishii, Takashi Hibiki, 2011, Thermo-Fluid Dynamics of Two-Phase Flow, Springer.

Course Title	Selected Topics in Refrigeration				Course Code	MEC 733
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics is determined by the supervisor of the research, which is required by the research point, especially what is new in the field of refrigeration and is studied during one semester.

Reference/Source

- 1) Maddali Ramgopal, Sachindra Kumar Rout, Sunil Kr Sarangi, Advances in Air Conditioning and Refrigeration, Springer; 1st Ed. 2020.
- 2) Andrew D. Althouse, Carl H. Turnquist, Alfred F. Bracciano, Daniel C. Bracciano, Gloria M. Bracciano, Modern Refrigeration and Air Conditioning, Goodheart-Willcox; Twenty first Edition, Revised, Textbook, 2019.

Course Title	Selected Topics in Air Conditioning				Course Code	MEC 734
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: It is an advanced course determined by the supervisor of the research, which is required by the research point, especially what is new in the field of air conditioning and is studied during one semester.

Reference/Source

- 1) Maddali Ramgopal, Sachindra Kumar Rout, Sunil Kr Sarangi, Advances in Air Conditioning and Refrigeration, Springer; 1st Ed. 2020.

- 2) Andrew D. Althouse, Carl H. Turnquist, Alfred F. Bracciano, Daniel C. Bracciano, Gloria M. Bracciano, Modern Refrigeration and Air Conditioning, Goodheart-Willcox; Twenty first Edition, Revised, Textbook, 2019.

Course Title	Selected Topics in Renewable Energies				Course Code	MEC 740
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics that deal with the latest in science and modern technological methods in the applications of mechanical power engineering in the field of renewable energy, and it is an advanced course determined by the supervisor of the research, which is required by the research point, especially what is new in the field of renewable energy and is studied during one semester.

Reference/Source

- 1) Sara Oliveira-Pinto and Jasper Stokkermans, 2020, Advanced Measurement

Course Title	Wind Turbine Farms				Course Code	MEC 741
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Introduction to wind energy characteristics, basic components of wind energy transformation systems, types of wind turbines, types of wind turbine generator configurations, topologies of wind turbine generator transducer. Design and simulation method for wind turbine farms. deals with the latest in science and modern technological methods in the field of wind turbine farms.

Reference/Source

- 1) Colin Anderson, "Wind Turbine Theory and Practice", 1st Edition, Cambridge University Press, February 2020.
2) A. R. Jha, , 2017, Wind Turbine Technology, CRC Press.

Course Title	Marine Floating Solar Power Plant				Course Code	MEC 742
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

An introduction to the marine floating solar farms power plant system, the design and simulation method for marine floating solar farms power plant system, energy storage in the marine floating solar farms power plant system, dealing with the latest in science and modern technological methods in the field of marine floating solar farms power plant systems.

Reference/Source

- 1) Sara O. , Jasper St. 2020, Maritime Engineering, <https://doi.org/10.1680/jmaen.2020.10>

Course Title	Selected Topics in Power Stations				Course Code	MEC 743
Teaching	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3

Hrs.	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics that deal with the latest in science and modern technological methods in the applications of mechanical power engineering in the field of power stations, and it is an advanced course determined by the supervisor of the research, which is required by the research point, especially what is new in the field of power stations and is studied during one semester.

Reference/Source: According to the selected topics

Course Title	Selected Topics in Non-conventional Power Plants				Course Code	MEC 744
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics that deal with non-conventional power plants and is studied during one semester.

Reference/Source: According to the selected topics

Course Title	Selected Topics in Water Desalination Plants				Course Code	MEC 745
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics that deal with desalination plants and is studied during one semester.

Reference/Source: According to the selected topics

Course Title	Selected Topics in Water Treatment Plants				Course Code	MEC 746
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class activity	Lab.	Oral	Total	100
	40	60	-	-		

Course Content

Special Course: Selected and advanced topics that deal with water treatment plants and is studied during one semester.

Reference/Source: According to the selected topics

(2) Mechanical Design and Production Engineering Program

1) Advanced Diploma in Mechanical Design and Production Engineering

Registration takes place in the following research fields:

1. Materials Engineering
2. Industrial Engineering
3. Mechanical Design
4. Manufacturing Engineering

The Graduate of the advanced diploma in in Mechanical Design and Production Engineering must be able to:

1. Apply the specialized knowledge gained in his professional practice.
2. Identify professional and design problems and propose solutions.
3. Mastering professional skills and using appropriate technological means, including computer-aided analysis, modern specialized programs and design tools, in his professional practice.
4. Communicate and lead the team to work through systematic professional work.
5. Take the appropriate decisions in light of the available information.
6. Utilize the available resources efficiently.
7. Demonstrate awareness of its role in community development and environmental preservation.
8. Act in a manner that reflects his commitment to integrity and credibility and accepts accountability and responsibility for his actions.
9. Develop himself and engage in continuous learning

Table 3. 2. 1 Complussory Courses for Basic Diploma in Mechanical Design and Production Engineering

S.N	Course Code	Course Name	Credit hours	Grades				Exam duration
				Semester Work	Oral/practical	Written exam	Total	
1	GEN 504	Statistical Analysis and Experimental design	2	60	-	40	100	2
2	GEN 505	Engineering Mathematics & Numerical Analysis	2	60	-	40	100	2

Table 3. 2. 2 Elective Courses for Basic Diploma in Mechanical Design and Production Engineering

S.N	Course Code	Course Name	Credit hours	Grades				Exam duration
				Semester Work	Oral/practical	Written exam	Total	
1	MEC 551	Measurements & Instrumentation	3	60	-	40	100	3
2	MEC 552	Physical Metallurgy	3	60	-	40	100	3
3	MEC 553	Materials Processing	3	60	-	40	100	3
4	MEC 561	Supply Chain Management	3	60	-	40	100	3
5	MEC 562	Total Quality Management	3	60	-	40	100	3
6	MEC 571	Advanced Computer-Aided Design (CAD)	3	60	-	40	100	3
7	MEC 572	Advanced Mechanics of Materials	3	60	-	40	100	3
8	MEC 581	Theory of Metal Forming	3	60	-	40	100	3
9	MEC 582	Theory of Metal Cutting	3	60	-	40	100	3

*With the help of the academic advisor, the student chooses (9) credit hours with a minimum of elective courses for the Basic Diploma “one of the disciplines mentioned in Table 3. 2. 2” and according to what is determined by the Scientific Department Council.

Table 3. 2. 3 Elective Courses for Advanced Diploma in Mechanical Design and Production Engineering

S. N	Course Code	Course Name	Credit Hours	Grades				Exam Time
				Course Work	Oral / Practical	Written Exam	Total	
1) Materials Engineering								
1	MEC 651	Phase Transformations & H.T. of Metals	3	60	-	40	100	3
2	MEC 652	Solidification of Metals	3	60	-	40	100	3
3	MEC 653	Materials Characterization	3	60	-	40	100	3
4	MEC 654	Modelling and Sim. in Mater. Eng.	3	60	-	40	100	3
5	MEC 655	Polymer Sci. & Eng.	3	60	-	40	100	3
6	MEC 656	Composite Materials	3	60	-	40	100	3
2) Industrial Engineering								
1	MEC 661	Work Study and Productivity Analysis	3	60	-	40	100	3
2	MEC 662	Optimization Techniques	3	60	-	40	100	3
3	MEC 663	Facility Management	3	60	-	40	100	3
4	MEC 664	Modelling and Simulation in IE	3	60	-	40	100	3
5	MEC 665	Production Management	3	60	-	40	100	3
6	MEC 562	Total Quality Management	3	60	-	40	100	3
3) Mechanical Design								
1	MEC 671	Acoustics & Advanced Vibrations	3	60	-	40	100	3
2	MEC 672	Engineering Tribology	3	60	-	40	100	3
3	MEC 673	Modeling and Simulation of Dynamic Systems	3	60	-	40	100	3
4	MEC 674	Materials Selection & Design	3	60	-	40	100	3
5	MEC 675	Fracture Mechanics & Fatigue	3	60	-	40	100	3
6	MEC 676	FEA in Solid Mechanics	3	60	-	40	100	3
4) Manufacturing Engineering								
1	MEC 681	Additive Manufacturing	3	60	-	40	100	3

2	MEC 682	Manufacturing of Polymers & Composites	3	60	-	40	100	3
3	MEC 683	Advanced Manuf. Processes	3	60	-	40	100	3
4	MEC 684	Manufacturing Systems	3	60	-	40	100	3
5	MEC 685	Modeling & Simulation of Manufacturing Processes	3	60	-	40	100	3
6	MEC 686	Advanced CNC Programming	3	60	-	40	100	3
7	MEC 687	Casting Engineering	3	60	-	40	100	3
8	MEC 688	Welding Engineering	3	60	-	40	100	3

*With the help of the academic advisor, the student chooses (12) credit hours as a minimum from the elective courses for the Advanced Diploma in one of the disciplines mentioned in Table (3.2.3) and according to what is determined by the Scientific Department Council.

Compatibility of the graduate's specifications with the courses of the engineering diploma in the mechanical Design and Production engineering program

S.N	Code	Course Title	Graduate Competencies								
			1	2	3	4	5	6	7	8	9
Complusory Courses for Basic Diploma in Mechanical Design and Production Engineering											
1	GEN 504	Statistical Analysis and Experimental design	√		√	√					√
2	GEN 505	Engineering Mathematics & Numerical Analysis	√		√	√					
Elective Courses for Basic Diploma in Mechanical Design and Production Engineering											
1	MEC 551	Measurements & Instrumentation	√	√							√
2	MEC 552	Physical Metallurgy	√			√				√	
3	MEC 553	Materials Processing	√				√		√		
4	MEC 561	Supply Chain Management	√						√		√
5	MEC 562	Total Quality Management	√			√	√			√	
6	MEC 571	Advanced Computer-Aided Design (CAD)			√					√	√
7	MEC 572	Advanced Mechanics of Materials	√	√					√		
8	MEC 581	Theory of Metal Forming	√	√					√		
9	MEC 582	Theory of Metal Cutting	√						√	√	
Courses for Advanced Diploma in Mechanical Design and Production Engineering											
Materials Engineering											
1	MEC 651	Phase Transformations & H.T. of Metals	√	√			√				
2	MEC 652	Solidification of Metals	√	√		√					
3	MEC 653	Materials Characterization		√				√	√		
4	MEC 654	Modelling and Sim. in Mater. Eng.	√		√			√			
5	MEC 655	Polymer Sci. & Eng.	√		√			√			

6	MEC 656	Composite Materials	√				√	√			
Industrial Engineering											
1	MEC 661	Work Study and Productivity Analysis	√				√	√			
2	MEC 662	Optimization Techniques			√		√		√		
3	MEC 663	Facility Management	√				√	√			
4	MEC 664	Modelling and Simulation in IE		√	√						√
•	MEC 665	Production Management	√				√	√			
6	MEC 562	Total Quality Management	√	√			√				
Mechanical Design											
1	MEC 671	Acoustics & Advanced Vibrations		√				√			√
2	MEC 672	Engineering Tribology	√					√			
3	MEC 673	Modeling and Simulation of Dynamic Systems			√			√			√
4	MEC 674	Materials Selection & Design		√			√	√			
•	MEC 675	Fracture Mechanics & Fatigue		√			√	√			
6	MEC 676	FEA in Solid Mechanics		√			√				√
Manufacturing Engineering											
1	MEC 681	Additive Manufacturing		v				√			√
2	MEC 682	Manufacturing of Polymers & Composites		v				√			√
3	MEC 683	Advanced Manuf. Processes		v	√						√
4	MEC 684	Manufacturing Systems		√			√	√			
•	MEC 685	Modeling & Simulation of Manufacturing Processes			√				√		√
6	MEC 686	Advanced CNC Programming			√	√					√

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7	MEC 687	Casting Engineering	√	√				√			
8	MEC 688	Welding Engineering									

2) Master of Science (M.Sc.) in Mechanical Design & Production Engineering

Registration takes place in the following research fields:

1. Materials Engineering
2. Industrial Engineering
3. Mechanical Design
4. Manufacturing Engineering

The Graduate of Master of Science Program of Industrial Engineering must be able to:

- 1) Mastering the application of the foundations and methodologies of scientific research and the use of its various tools.
- 2) Applying the analytical approach and using it in mechanical design and production engineering.
- 3) Applying specialized knowledge and integrating it with knowledge related to mechanical design engineering technology and production.
- 4) Demonstrate awareness of current problems and modern visions in mechanical design engineering and production.
- 5) Identifying professional problems and finding appropriate solutions.
- 6) Demonstrate excellence in an appropriate set of specialized professional skills and the use of appropriate technological means to serve his professional practice.
- 7) Effective communication and demonstrating the ability to lead the work team.
- 8) Making decisions in various professional contexts.
- 9) Maximize the use of available resources to achieve the greatest benefit and preserve it.
- 10) Demonstrate awareness of its role in the development of society and the preservation of the environment under the influence of local and global changes.
- 11) Act in a manner that reflects commitment to integrity, credibility and in accordance with the rules and ethics of the profession.
- 12) Develop himself academically and professionally and carry out continuing education.

Table 3. 2. 4 Master of Science Thesis in Mechanical Design and Production Engineering

S. N.	Course Code	Course Name	Perquisites	Credit Hours
1	MEC 851	MSc Thesis-5	All courses of the Advanced P.G. Diploma (12 Credit Hours) with a GPA of at least 3.0 and a minimum of 2.7 points in each course.	12
2	MEC 861	MSc Thesis-6		
3	MEC 871	MSc Thesis-7		
4	MEC 881	MSc Thesis-8		

Compatibility of the specifications of the Master of Science graduate with the mechanical design and production engineering courses

Code	Course Title	Graduate Competencies											
		1	2	3	4	5	6	7	8	9	10	11	12
MEC 851	M.Sc. Thesis-5	√	√	√	√	√	√	√	√	√	√	√	√
MEC 861	M.Sc. Thesis-6	√	√	√	√	√	√	√	√	√	√	√	√
MEC 871	M.Sc. Thesis-7	√	√	√	√	√	√	√	√	√	√	√	√
MEC 881	M.Sc. Thesis-8	√	√	√	√	√	√	√	√	√	√	√	√

3) Philosophy Doctorate (Ph. D.) in Mechanical Design & Production Engineering

Registration takes place in the following research fields:

1. Materials Engineering
2. Industrial Engineering
3. Mechanical Design
4. Manufacturing Engineering

The Graduate of the Ph.D. program of Mechanical Design & Production Engineering program should be able to:

- 1) Demonstrate an in-depth understanding of the core and advanced topics in design and manufacturing engineering.
- 2) Demonstrate the capability to conduct research in the related cutting-edge fields by identifying and formulating the relevant problems and introducing solutions by integrating the interdisciplinary principles of mathematics, sciences, design, and manufacturing engineering.
- 3) Demonstrate the ability to learn independently and work creatively as an individual and as part of a research team.
- 4) Demonstrate high communications skills, which can be implemented by writing a thesis as well as manuscripts for peer-reviewed journals and being able to articulate research in conferences and workshops.
- 5) Demonstrate commitment to the principles of ethics, responsibilities, and norms of design and manufacturing engineering practices.
- 6) Show success in finding employment in the desired sector whether in academia, national research centers, or industry.

Table 3. 2. 5 Basic Ph.D. Courses in Mechanical Design and Production Engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Exam Time
				Course Work	Oral / Practical	Written Exam	Total	
1) Materials Engineering								
1	MEC 651	Phase Transformations & H.T. of Metals	3	60	-	٤٠	١٠٠	3
2	MEC 652	Solidification of Metals	3	60	-	٤٠	١٠٠	3
3	MEC 653	Materials Characterization	3	60	-	٤٠	١٠٠	3
4	MEC 654	Modelling and Sim. in Mater. Eng.	3	60	-	٤٠	١٠٠	3
5	MEC 655	Polymer Sci. & Eng.	3	60	-	٤٠	١٠٠	3
6	MEC 656	Composite Materials	3	60	-	٤٠	١٠٠	3
7	MEC 657	Adv. Comp. Programming Techniques	3	60	-	٤٠	١٠٠	3
8	MEC 658	Measurement Uncertainty and Probability	3	60	-	٤٠	١٠٠	3
2) Industrial Engineering								
1	MEC 66١	Work Study and Productivity Analysis	3	60	-	٤٠	١٠٠	3
2	MEC 66٢	Optimization Techniques	3	60	-	٤٠	١٠٠	3
3	MEC 663	Facilities Management	3	60	-	٤٠	١٠٠	3
4	MEC 664	Modelling and Simulation in IE	3	60	-	٤٠	١٠٠	3
5	MEC 665	Production Management	3	60	-	٤٠	١٠٠	3
3) Mechanical Design								
1	MEC 671	Acoustics & Advanced Vibrations	3	60	-	٤٠	١٠٠	3
2	MEC 672	Engineering Tribology	3	60	-	٤٠	١٠٠	3
3	MEC 673	Modeling and Simulation of Dynamic Systems	3	60	-	٤٠	١٠٠	3
4	MEC 674	Materials Selection & Design	3	60	-	٤٠	١٠٠	3
5	MEC 675	Fracture Mechanics & Fatigue	3	60	-	٤٠	١٠٠	3
6	MEC 676	FEA in Solid Mechanics	3	60	-	٤٠	١٠٠	3
4) Manufacturing Engineering								
1	MEC 681	Additive Manufacturing	3	60	-	٤٠	١٠٠	3
2	MEC 682	Manufacturing of Polymers & Composites	3	60	-	٤٠	١٠٠	3
3	MEC 683	Advanced Manuf. Processes	3	60	-	٤٠	١٠٠	3
4	MEC 684	Manufacturing Systems	3	60	-	٤٠	١٠٠	3
5	MEC 685	Modeling & Simulation of Manufacturing Processes	3	60	-	٤٠	١٠٠	3
6	MEC 686	Advanced CNC Programming	3	60	-	٤٠	١٠٠	3
7	MEC 687	Casting Engineering	3	60	-	٤٠	١٠٠	3
8	MEC 688	Welding Engineering	3	60	-	٤٠	١٠٠	3

*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from the basic courses of the Doctor of Philosophy in Engineering in one of the disciplines mentioned in Table (3.2.5) and according to what is determined by the Scientific Department Council.

Table 3. 2. 6 Specialized Ph.D. courses in Mechanical Design and Production Engineering

S. N.	Course Code	Course Name	Credit Hours	Grades				Exam Time
				Course Work	Oral / Practical	Written Exam	Total	
1) Materials Engineering								
1	MEC 750	Nanoscience & Nanotechnology	3	60	-	40	100	3
2	MEC 751	Welding Metallurgy	3	60	-	40	100	3
3	MEC 752	Corrosion Science and Engineering	3	60	-	40	100	3
4	MEC 753	Advanced Materials Characterization	3	60	-	40	100	3
2) Industrial Engineering								
1	MEC 760	Mechanics of Composite Material	3	60	-	40	100	3
2	MEC 761	Residual Stresses	3	60	-	40	100	3
3	MEC 762	Contact Mechanics	3	60	-	40	100	3
4	MEC 763	Computational Eng. Design	3	60	-	40	100	3
5	MEC 764	Optical Imaging and Metrology	3	60	-	40	100	3
3) Mechanical Design								
1	MEC 770	Lean Manufacturing Systems	3	60	-	40	100	3
2	MEC 771	Risk and Reliability in Engineering	3	60	-	40	100	3
3	MEC 772	Stochastic Production Systems	3	60	-	40	100	3
4	MEC 773	Metaheuristics and Applications	3	60	-	40	100	3
5	MEC 774	Reverse Engineering	3	60	-	40	100	3
4) Manufacturing Engineering								
1	MEC 780	Artificial Intelligence	3	60	-	40	100	3
2	MEC 781	Machine Learning	3	60	-	40	100	3
3	MEC 782	Virtual Manufacturing	3	60	-	40	100	3
4	MEC 783	Intelligent Energy Field Manuf.	3	60	-	40	100	3

*The student chooses (9) credit hours as a minimum from the specialized courses for the Doctor of Philosophy in Engineering in one of the disciplines mentioned in Table (3.2.6), upon the recommendation of the main supervisor and according to what is determined by the scientific department council.

Table 3. 2. 7 Ph.D. Thesis in Mechanical Design and Production Engineering

S.N	Course Code	Course Name	Perquisites	Credit Hours
1	MEC 951	Ph.D. Thesis-5	1.Ph.D. Basic courses (9 credit) with a GPA of 3.0 at least and with a minimum of 2.7 points in each course. 2.Passing the first and second stage of the academic researches.	12
2	MEC 961	Ph.D. Thesis-6		
3	MEC 971	Ph.D. Thesis-7		
4	MEC 981	Ph.D. Thesis-8		

Compatibility of the graduate's specifications with the courses of the engineering Ph. D in the mechanical Design & Production engineering program

S.N.	Code	Course Title	Graduate Competencies					
			1	2	3	4	5	6
Basic Ph.D. Courses in Mechanical Design and Production Engineering								
Materials Engineering								
1	MEC 651	Phase Transformations & H.T. of Metals		√			√	√
2	MEC 652	Solidification of Metals	√			√		
3	MEC 653	Materials Characterization	√	√			√	√
4	MEC 654	Modelling and Sim. in Mater. Eng.			√	√	√	
5	MEC 655	Polymer Sci. & Eng.	√	√	√			√
6	MEC 656	Composite Materials	√	√			√	
7	MEC 657	Adv. Comp. Programming Techniques	√		√	√		
8	MEC 658	Measurement Uncertainty and Probability		√			√	√
Industrial Engineering								
1	MEC 66١	Work Study and Productivity Analysis	√				√	√
2	MEC 66٢	Optimization Techniques			√		√	
3	MEC 663	Facility Management	√				√	√
4	MEC 664	Modelling and Simulation in IE		√	√			
5	MEC 665	Production Management	√				√	√
Mechanical Design								
1	MEC 671	Acoustics & Advanced Vibrations		v				√

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2	MEC 672	Engineering Tribology		v				√
3	MEC 673	Modeling and Simulation of Dynamic Systems		v	√			
4	MEC 674	Materials Selection & Design		√			√	√
5	MEC 675	Fracture Mechanics & Fatigue			√			
6	MEC 676	FEA in Solid Mechanics			√	√		
Manufacturing Engineering								
1	MEC 681	Additive Manufacturing		√			√	√
2	MEC 682	Manufacturing of Polymers & Composites	√			√		
3	MEC 683	Advanced Manuf. Processes	√	√	√	√	√	√
4	MEC 684	Manufacturing Systems	√		√		√	
5	MEC 685	Modeling & Simulation of Manufacturing Processes	√	√	√			√
6	MEC 686	Advanced CNC Programming	√	√			√	
7	MEC 687	Casting Engineering			√	√		
8	MEC 688	Welding Engineering	√	√			√	√
Specialized Ph.D. courses in Mechanical Design and Production Engineering								
Materials Engineering								
1	MEC 750	Nanoscience & Nanotechnology			√	√	√	
2	MEC 751	Welding Metallurgy	√	√	√			√
3	MEC 752	Corrosion Science and Engineering	√	√			√	
4	MEC 753	Advanced Materials Characterization	√		√	√		
Industrial Engineering								

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1	MEC 760	Mechanics of Composite Material	√				√	√
2	MEC 761	Residual Stresses			√	√		
3	MEC 762	Contact Mechanics	√				√	√
4	MEC 763	Computational Eng. Design		√		√		
5	MEC 764	Optical Imaging and Metrology	√				√	√
Mechanical Design								
1	MEC 770	Lean Manufacturing Systems	√			√	√	
2	MEC 771	Risk and Reliability in Engineering				√		√
3	MEC 772	Stochastic Production Systems	√					√
4	MEC 773	Metaheuristics and Applications			√		√	
5	MEC 774	Reverse Engineering					√	√
Manufacturing Engineering								
1	MEC 780	Artificial Intelligence			√		√	
2	MEC 781	Machine Learning	√				√	√
3	MEC 782	Virtual Manufacturing		√	√			
4	MEC 783	Intelligent Energy Field Manuf.	√				√	√
Ph.D. Thesis in Mechanical Design and Production Engineering								
1	MEC 951	Ph.D. Thesis	√	√	√	√	√	√
2	MEC 961	Ph.D. Thesis	√	√	√	√	√	√
3	MEC 971	Ph.D. Thesis	√	√	√	√	√	√
4	MEC 981	Ph.D. Thesis	√	√	√	√	√	√

**Course Description**

Course Title	Measurements & Instrumentation				Course Code	MEC 551
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Elements of a measurement system. Classification of sensors, sensor characteristics, sensor types. Statistical analysis of data, curve fitting, and uncertainty analysis. Physical principles. Interfacing concepts - amplification, filtering, impedance buffering, etc. Computer-aided data acquisition, manipulation, transmission, and recording. Project to formulate and develop a measurement system using LabVIEW.

Reference/Sources

- 1) Myer Kutz., 2016. Handbook of Measurement in Science and Engineering.
- 2) Walt Boyes., 2009. Instrumentation Reference Book.
- 3) Robert B. Northrop., 2014. Introduction to Instrumentation and Measurements

Course Title	Physical Metallurgy				Course Code	MEC 552
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Introduction - Fundamentals of the physical metallurgy - Concepts of alloy design and microstructural engineering - Heating metals - Dislocation climb - Recovery - annealing - Alloying and deformation - Case Studies

Reference/Sources

- 1) Sidney H. Avner, 2012. Introduction to Physical Metallurgy.
- 2) George Dieter., 2014. Mechanical metallurgy.
Rafael Colás, George E. Totten., 2015. Encyclopedia of Iron, Steel, and Their Alloys

Course Title	Material Processing				Course Code	MEC 553
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Introduction - Fundamentals of material processing - Materials properties and characterization - Heat conduction - heat transfer processes - Solidification Analysis - Case Studies

Reference/Sources

- 1) Lorraine Francis, 2015. Materials Processing.
- 2) Sunpreet Singh, Chander Prakash, Seeram Ramakrishna, Grzegorz Krolczyk., 2021. Advances in Materials Processing.
- 3) James Evans, Lutgard De Jonghe., 2016. The Production and Processing of Inorganic Materials



Course Title	Supply Chain Management				Course Code	MEC 561
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		
<u>Course Content:</u> Introduction - Fundamentals of supply chain management - Supply chain in the global environment – Logistic management – Material planning – Product cost analysis - Key performance indicators - Case Studies.						
<u>Reference/Sources</u> 1) Sunil Chopra, Peter Meindl, 2000. Supply Chain Management: Strategy, Planning, and Operation. 2) S PAUL A. MYERSON., 2012 Lean Supply Chain and Logistics Management. 3) William L. Berry, Thomas E. Vollmann, David Clay Whybark, F. Robert Jacobs., 2018. Manufacturing Planning and Control for Supply Chain						

Course Title	Total Quality Management				Course Code	MEC 562
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		
<u>Course Content:</u> Introduction - Fundamentals of total quality management - Continuous improvement approaches – Kaizen approach – Kaizen tools - Lean six sigma approach – Lean six sigma tools - Key performance indicators - Case Studies						
<u>Reference/Sources</u> 1) D.R. Kiran, 2016. Total Quality Management: Key Concepts and Case Studies. 2) David L. Goetsch., 2000 Quality Management: Introduction to Total Quality Management. 3) Tapan K. Bose., 2011. Total Quality of Management.						
Course Title	Advanced Computer-Aided Design (CAD)				Course Code	MEC 571
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		
<u>Course Content:</u> Introduction - Fundamentals of computer-aided design - Advanced skills in drafting layout - CAD editing techniques - Virtual 3-D models - Case Studies.						
<u>Reference/Sources</u> 1) Jayanta Sarkar, 2015. Computer Aided Design A Conceptual Approach. 2) Randy H. Shih., 2019 Tools for Design Using AutoCAD 2020 and Autodesk Inventor 2020. 3) Shameer S A., 2019. AutoCAD 2020 For Beginners						

Course Title	Advanced Mechanics of Materials				Course Code	MEC 572
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

**Course Content:**

Introduction - Fundamentals of Solid Mechanics and Materials - Fundamentals for the analysis of materials and structures - Analysis of stresses, strains, deformation, and strength - Specific topics in stress and strain tensors, elasticity, plasticity, elementary solutions - Case Studies

Reference/Sources

- 1) Parviz Ghavami, 2016. Mechanics of Materials
- 2) Arthur P. Boresi, Richard J. Schmidt., 2002 Advanced Mechanics of Materials.
- 3) Anthony E. Armenakis., 2006. Advanced Mechanics of Materials and Applied Elasticity

Course Title	Theory of Metal Forming				Course Code	MEC 581
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Formability of metals and alloys. Resistance to deformation, the effect of basic parameters. Deformation work and force. Summary of mathematical theory of plasticity. Partial theories. Conditions of the appearance of plastic deformation. Analysis of the deformation process. Analytical and analytical-experimental methods for solving metal-forming processes. Theory of failure Von Mises and Tricia. Upsetting between parallel planes, Forward extrusion, stress, and strain analysis. Backward extrusion, Die forging, solution. Bending of thin bars and wide bands. Deep drawing, stress, and strain. Method of resistance to deformation. Theory of small elastic-plastic deformations. State of stress in free and closed shear and precise shearing.

Reference/Sources

- 1) J.G. Lenard, 2002. Metal Forming Science and Practice.
- 2) Heinz Tschaetsch., 2008 Metal Forming Practice Hardcover.
- 3) Peter I. Kattan., 2006. Advances in Damage Mechanics: Metals and Metal Matrix Composites with an Introduction to Fabric Tensors.

Course Title	Theory of Metal Cutting				Course Code	MEC 582
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Basic functional principles of machine tools, tool geometry and tool angles, Mechanism of chip formation in machining, Orthogonal cutting and oblique cutting, Causes of oblique cutting and chip flow deviation, Cutting forces and their represent them in Merchant's circle diagram, Estimation of cutting forces, Relevance of cutting temperature, estimation and its control, Concept of machinability and its improvement, the Failure mechanism of cutting tools and assessment of tool life, Cutting tool materials, properties, and their application, ISO standards for cutting tools Cutting Fluids, Chatter, Surface Roughness, Machining Cost, Optimization of The Machining Variables, Machinability.

Reference/Sources

- 1) David A. Stephenson, John S. Agapiou, 2019. Metal Cutting Theory and Practice
- 2) B. L. Juneja 2003 Fundamentals of Metal Cutting and Machine Tools
- 3) Milton C. Shaw, 2000. Metal Cutting Principles



Course Title	Phase Transformations & Heat Treatment of Metals				Course Code	MEC 651
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Thermodynamics and Kinetics, Interfaces: Structure of interfaces, free energy, Equilibrium shapes of crystals. Nucleation and Growth: Effect of interfaces, Solid-Solid Phase Transformations: Precipitation, Cellular precipitation, Eutectoid transformations, Massive transformations, Martensitic transformations, Spindale decomposition, Order-disorder transformation. Heat Treatment: Hardness and hardenability, Formation and evolution of microstructures, Practical aspects of heat treatment, Quenching, Some standard heat treatments.

Reference/Sources

- 1) Bankim Chandra Ray, Rajesh Kumar Prusty, Deepak Nayak, Published, 2020, Phase Transformations and Heat Treatments of Steels, CRC Press.
- 2) Hugh J. McQueen, Stefano Spigarelli, Michael E. Kassner, Enrico Evangelista, 2017, Hot Deformation and Processing of Aluminum Alloys.
- 3) Vladimir Panjkovic, 2017, Friction and the Hot Rolling of Steel.

Course Title	Solidification of Metals				Course Code	MEC 652
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Crystals and Melts, Thermodynamics of Crystal-Melt Phase Change, Thermal Concepts in Solidification, Solidification of Pure Materials, Macro segregation, Plane-Front Solidification, Composition Control, Solid-Liquid Interfaces: Capillarity, Stability, Nucleation, Microstructure Evolution: Dendritic Growth, Micro segregation, Interface Structure, and Growth Kinetics, Polyphase Solidification, Rapid Solidification Processing.

Reference/Sources

- 1) Zbigniew H. Stachurski Gang Wang Xiaohua Tan 2021; An Introduction to Metallic Glasses and Amorphous Metals.
- 2) Bo Song Shifeng Wen Selective, 2021; Laser Melting for Metal and Metal Matrix Composites

Course Title	Materials Characterization				Course Code	MEC 653
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Fundamental theory, basic operation, and application of important materials characterization techniques, including Light Microscopy (LM), Scanning Electron Microscopy (SEM), and X-ray characterization. Light Microscopy: construction of the instrument, imaging (contrast and resolution mechanism), illumination modes, polarized light, interference microscopy and interference layer of samples, elementary stereology for quantitative metallography.

Reference/Sources

- 1) Tawfik Abdo Saleh, 2021; Polymer Hybrid Materials and Nanocomposites



2) Mukesh Kumar Singh Annika Singh, 2021; Characterization of Polymers and Fibres,

Course Title	Modelling and Simulation in Materials Engineering				Course Code	MEC 654
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Introduction to modeling and simulation using the finite element analysis (FEA) approach. Strong and weak formulations of thermo-mechanical problems; FEA applied to heat flow; FEA applied to mechanics of linear elastic materials; Isoperimetric elements and Gauss quadrature; Introduction to FEA using MATLAB.

Reference/Sources

- 1) Lin Zhang, 2019, Model Engineering for Simulation
- 2) Chenshuo Liu, 2021, Machining and Tribology
- 3) Anthony Chukwujekwu Okafor, 2020, High Speed Machining

Course Title	Polymer Science & Engineering				Course Code	MEC 655
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Concepts and definitions: monomers and monomeric units, degree of polymerization, homopolymers, copolymers, nomenclature and classification, chain structure, microstructure, conformation and flexibility, average molecular weights and polydispersity, thermoplastics, thermosets, elastomers, fibers, plastics; Polymerization methods: step-growth, radical, living radical, anionic, cationic, catalytic, ring-opening metathesis, polyhomologation; Methods of molecular weight determination: membrane and vapor pressure osmometry, light scattering, size exclusion chromatography, viscometry; Properties: thermal, mechanical, flow; Fundamentals of polymer processing: extrusion, injection, film blowing.

Reference/Sources

- 1) Ali Dhinojwala, 2021, Macromolecular Engineering
- 2) CLARA D., 2000, Applied Polymer Science
- 3) Haryanto, 2021, Smart Polymer Nanocomposites

Course Title	Composite Materials				Course Code	MEC 656
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Introduction to ceramic, metal, and polymer-matrix composites. Reinforcements such as particles (including nanoparticles), whiskers, and fibers, their processing, and properties. Fabrication of particulate, whisker, and fiber composites in the liquid state, solid-state, and by reaction-based methods. The role of the reinforcement-matrix interface on mechanical properties at ambient and elevated temperatures. Composite materials: anisotropic elasticity, micromechanics for determining mechanical properties of composite materials, classical laminated plate theory, failure and strength analysis of composite materials.

Reference/Sources

- 1) Silu Huang, 2021, Composite Materials



- 2) A. Sambruno, 2021, Advanced Machining and Finishing
- 3) Hom Nath Dhakal, 2020, Sustainable Composites for Lightweight Applications

Course Title	Advanced Comp. Programming Techniques				Course Code	MEC 657
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Introduction of software packages including but not limited to advanced MATLAB. Partial Differential Equation Toolbox, statistics and machine learning toolbox, Symbolic math toolbox, Data Acquisition Toolbox, Curve Fitting Toolbox, Database Toolbox. Case Studies.

Reference/Sources

- 1) Rex A. Barzee, December 28th, 2011. Advanced Programming Techniques.
- 2) Grok code, 2010, The Top 9 1/2 Books in a Hacker's Bookshelf.
- 3) "Electrical Engineering and Computer Science; 6.001 Structure and Interpretation of Computer Programs". Open Courseware. MIT. Retrieved 2020-06-21.

Course Title	Measurement Uncertainty and Probability				Course Code	MEC 658
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

The general theory of uncertainty involves the combination (convolution) of non-Gaussian, student, Gaussian distributions; Use of rectangular distributions to represent systematic uncertainties; and measurable and no measurable uncertainties that require estimation.

Reference/Sources

- 1) Measurement Uncertainty and Probability, Cambridge University Press, , <https://doi.org/10.1017/CBO9781139135085>.
- 2) Hans Crauel, 2019, Random Probability Measures on Polish Spaces, CRC Press.
- 3) C. Richard Cassady, Joel A. Nachlas, 2019, Probability Models in Operations Research, CRC Press.

Course Title	Work Study and Productivity Analysis				Course Code	MEC 661
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Fundamentals of work study, Standard method, Standard time, Productivity analysis, Productivity improvement, Advanced topics in work study, Lean approach, Lean tools, Case Studies.

Reference/Sources

- 1) Toyoki Kozai, 2021, Plant Factory Basics, Applications and Advances
- 2) Moshood Olawale Fadeyi, 2021, Methods in Sustainability Science
- 3) Kenneth J, 2021, Aging and Creativity



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Course Title	Optimization Techniques				Course Code	MEC 662
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Advanced concepts in linear and integer programming. Solution techniques for stochastic and dynamic programming and formulation and solution of decision models in manufacturing, service, supply chain, healthcare, and electrical systems.

Reference/Sources

- 1) S. N. Kumar, 2021, Multi-Objective Combinatorial Optimization Problems and Solution Methods
- 2) Jayesh S Vasudeva, 2021, Applications of Computational Intelligence in Multi-Disciplinary Research

Course Title	Facilities Management				Course Code	MEC 663
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Introduction - Fundamentals of facility management – Location selection – Equipment selection Risk management - Advanced topics in facility management - Case Studies.

Reference/Sources

- 1) Robert Rynk, 2021, The Composting Handbook,
- 2) Marco Casini, 2021, Construction 4.0,
- 3) James Sinopoli, 2010, Smart Building Systems for Architects,

Course Title	Modelling and Simulation in Industrial Engineering				Course Code	MEC 664
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Elementary queueing models, simulation and modeling, simulation model design, a survey of simulation languages with one language covered in detail, input data analysis and distribution fitting, model verification and validation, output analysis and transient/steady-state response, terminating/nonterminating systems, model experimentation and optimization, random number/random variate generation, and variance reduction techniques.

Reference/Sources

- 1) Peng Zhang, 2010 Advanced Industrial Control Technology
- 2) Chieri Kubota, 2018 Plant Factory Using Artificial Light,
- 3) Manjuri Hazarika, 2018 Manufacturing Engineering Education,

Course Title	Production Management				Course Code	MEC 665
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Introduction to the theory of machine shop systems. Complexity results for various systems such as job,



flow, and open shops. Applications of linear programming, integer programming, network analysis. Enumerative methods for machine sequencing. Introduction to stochastic scheduling.

Reference/Sources

- 1) Zifei Wang, 2021 Applications of Artificial Intelligence in Process Systems Engineering,
- 2) Dimitris Mourtzis, 2021 Design and Operation of Production Networks for Mass Personalization in the Era of Cloud Technology,
- 3) D. R. Kiran, 2019 Production Planning and Control,

Course Title	Acoustics & Advanced Vibrations				Course Code	MEC 671
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Concepts of acoustics, including characterization and quantification of sound sources, exposure to noise, noise control, mitigation, and psychoacoustics, lumped parameter models, continuous and multi-degree of freedom systems, design of vibration control devices, vibration isolators and vibration absorbers, frequency response characteristics for both acoustics and vibration applications, spectral analysis and its application to predictive maintenance using machine condition monitoring.

Reference/Sources

- 1) Howard K, 2007, National Association of Broadcasters Engineering Handbook (Tenth Edition),
- 2) P. A. Lewin, 2012, Ultrasonic Transducers,
- 3) Wolfgang Ahnert, 2008 Handbook for Sound Engineers (Fourth Edition),

Course Title	Engineering Tribology				Course Code	MEC 672
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Fundamentals of surface contact: surface topography, asperity contact, interfacial phenomena. Friction theories and wear mechanisms. Temperatures in sliding contacts. Hydrodynamic, hydrostatic, electro-hydrodynamic, and boundary lubrication.

Reference/Sources

- 1) G. W. Poll, 2005, Tribology and Interface Engineering Series,
- 2) K. Bimla Mardi, 2021, Machining and Tribology,
- 3) Sanjay Mavinkere, 2021, Tribology of Polymer Composites,

Course Title	Modeling and Simulation of Dynamic Systems				Course Code	MEC 673
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Modeling and Simulation, Bond Graph Modelling of Dynamic Systems, Basic System Models, System Models of Combined Systems, Dynamic Response, and System Transfer Function, Block diagram/Signal flow diagram/State Space formulation and Frequency response. Simulation and Simulation application, Parameter Estimation, System Identification, and Optimization. This course develops competence in the modeling of dynamic systems and in the use of dynamic system simulation software (Matlab/Simulink) for conducting system analysis and control design.

**Reference/Sources**

- 1) J. Vörös, 1987, Simulation of Control Systems,
- 2) Jones, 1990, Information Control Problems in Manufacturing Technology,

Course Title	Materials Selection and Design				Course Code	MEC 674
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Materials selection is an essential component of mechanical design, optimum materials under multiple constraints resulting from functional, reliability, safety, cost, and environmental issues, materials-limited design and materials selection.

Reference/Sources

- 1) Ali Jahan, 2016, Multi-criteria Decision Analysis for Supporting the Selection of Engineering Materials in Product Design,
- 2) Ian Hutchings, 2017, Tribology (Second Edition),
- 3) Myer Ezrin, 2013 Plastics Failure Guide (Second Edition),

Course Title	Fracture Mechanics & Fatigue				Course Code	MEC 675
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Basic aspects of Engineering Fracture Mechanics, Modes of loading, Classification, Energy release rate, Resistance, Griffith Theory of fracture, Extension of Griffith Theory by Irwin and Orowan, R-Curve, Pop-in phenomena, Crack branching, Influence of the T-stress and higher-order terms, Role of photoelasticity on the development of stress equations in fracture mechanics, Various methods for evaluating Stress Intensity Factors, Modeling plastic zone at the crack-tip, Irwin and Dugdale models, Fracture toughness testing, Feddersen TMs residual strength diagram, Paris law, J-integral, HRR eld, Mixed-mode fracture, Crack arrest methodologies.

Reference/Sources

- 1) Hobbacher, 2011 Fracture and Fatigue of Welded Joints and Structures.
- 2) JWO PAN, 2005 Fatigue Testing and Analysis.
- 3) Kam, 1994 Handbook of Fatigue Crack Propagation in Metallic Structures.

Course Title	FEA in Solid Mechanics				Course Code	MEC 676
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

The practical and theoretical basis for the finite element method, Derivation of general stiffness and load terms for trusses, beams, membranes, plates, shells, axisymmetric and solid structures, System relations, boundary conditions, and linear constraints. Calculations of derived quantities such as strains, stresses, and reaction forces. Super element and subdomain techniques. Applications using MATLAB or FEA package.

Reference/Sources

- 1) Choi, 2014 Advances in Ceramic Matrix Composites,
- 2) Zeng, 2003 Computational Fluid and Solid Mechanics,



Course Title	Additive Manufacturing				Course Code	MEC 681
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Basic principles and development of additive manufacturing generalized process chain, Vat photo polymerization, powder bed fusion, extrusion-based processes, material jetting, sheet lamination and directed energy deposition processes, direct-write technologies, low-cost systems, process selection guidelines, post-processing and software issues, direct digital manufacturing, design for additive manufacturing, rapid tooling, applications.

Reference/Sources

- 1) Radim, 2021, Cyclic Plasticity of Metals
- 2) Rohit Agrawal, 2021, Green Production Engineering and Management
- 3) Michael Gelinsky, 2021, Tissue Engineering Using Ceramics and Polymers

Course Title	Manufacturing of Polymers and Composites				Course Code	MEC 682
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

The course deals with the basic nature of different welding polymers and polymer composites and their manufacturing processes, The structure and mechanical properties of plastics, thermoplastics, and thermosets, the various processing techniques of polymers such as Extrusion, Injection molding, Thermoforming, Compression molding, and Transfer molding, The fundamental concept and classification of composite materials, properties of composites and the primary as well as secondary processing methods of polymeric matrix composites are explained. The various issues, challenges, and opportunities in primary and secondary processing of polymers and polymer composites are also explained.

Reference/Sources

- 1) Heidari, 2021, Residual Stresses in Composite Materials
- 2) Saba Farooq, 2021, Smart Polymer Nanocomposites
- 3) Denis Cormier, 2020, Durability of Composite Systems

Course Title	Advanced Manufacturing Processes				Course Code	MEC 683
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Advanced Machining Processes, Nontraditional machining, Electro-chemical machining, Electro-discharge machining -Laser machining, Water jet machining, Abrasive water jet., Ultrasonic machining, plasma cut. Fabrication of Microelectronic Devices, Fabrication of Microelectromechanical Devices and Systems and Nanoscale Manufacturing, Automation of Manufacturing Processes, Computer-Aided Manufacturing, Non-Conventional Machining

Reference/Sources

- 1) Pieter Schmal, 2020, Smart Manufacturing
- 2) Khennane, 2013, Advanced Fibre-Reinforced Polymer (FRP) Composites for Structural Applications
- 3) Raghu Raja, 2020, Modern Manufacturing Processes



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Course Title	Manufacturing Systems				Course Code	MEC 684
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		
Course Content: Basic manufacturing concepts, Fundamentals of manufacturing automation, Automated flow lines, Automated assembly systems, Numerical control, Computer numerical control, Industrial robots: technology and applications. Group technology, Computer-aided process planning, Flexible manufacturing systems, Material handling, and storage systems, Computer integrated manufacturing: CAD/CAM and CIM.						
Reference/Sources 1) Aydin Nassehi, 2021, Design and Operation of Production Networks for Mass Personalization in the Era of Cloud Technology 2) Wen-Ren Jong, 2019, Advanced Injection Molding Technologies						

Course Title	Modeling and Simulation of Manufacturing Processes				Course Code	MEC 685
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		
Course Content: Basic concepts in modeling and simulation of manufacturing processes- conventional and unconventional manufacturing processes; Different approaches of modeling – Analytic and numerical techniques. Empirical and semi-empirical – Design of Experiments (DOE), Analysis of variance (ANOVA), Regression analysis; Numerical methods – Finite Difference and Finite Element Methods. Fuzzy Logic, Artificial Neural Networks, Genetic Algorithms. Case studies covering different manufacturing processes.						
Reference/Sources 1) Loucas Papadakis, 2021, Additive Manufacturing 2) C. H. Park, 2015, Advances in Composites Manufacturing and Process Design 3) Warnecke, 1978, Information-Control Problems in Manufacturing Technology						

Course Title	Advanced CNC Programming				Course Code	MEC 686
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		
Course Content: This course provides students with the advanced programming of CNC turning/milling machine concepts with CNC simulation software that replicates an actual CNC machine control. Students will be exposed to the CNC turning components and features, advanced programming features such as cycles, subprograms, parametric and CNC turning/milling machine operations.						
Reference/Sources 1) T. Vishnu Vardhan, 2020, Modern Manufacturing Processes 2) Anthony Chukwujekwu, 2020, High Speed Machining 3) E. Uhlmann, 2006, Intelligent Production Machines and Systems						

Course Title	Casting Technology				Course Code	MEC 687
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

**Course Content:**

Advanced Metal Casting Technology Casting Processes, classification, characteristics of sand-casting processes, metal mold casting processes and casting processes using another mold/core material, Pattern materials, types of patterns, Mold and core making materials, and their characteristics. The technology of Selected Casting Processes, clay bonded, oil bonded, synthetic resin bonded, inorganic material bonded mold, and core making processes. Sand additives and mold coatings. Metal mold casting processes; centrifugal and continuous casting processes. Solidification, Gating, and Rising, Nucleation and grain growth, Solidification of pure metals, short and long freezing range alloys. Rate of solidification, macrostructure, and microstructure. Solidification contraction; gating and risering design calculations. Fluidity and its measurement. Mold-metal interface reactions. Cast Metals and Alloys, Family of cast irons, Melting and casting technology; Inoculation. The technology of steel and non-ferrous cast metals. Gases in metals. Melting furnaces and refractories.

Reference/Sources

- 1) Şenol Bayraktar, 2021, Advanced Welding and Deforming
- 2) Geoffry Scamans, 2018, Fundamentals of Aluminum Metallurgy
- 3) Mark E. Schlesinger, 2021, Extractive Metallurgy of Copper (Sixth Edition)

Course Title	Welding Engineering				Course Code	MEC 688
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Classification of welding processes, some common concerns, types of fusion welds and types of joints, Design considerations, Heat effects, Weldability and join ability. Welding terms and definitions, welding positions, elements of and construction of welding symbols Gas flame and Arc processes: Welding power sources (features) Oxyfuel gas welding- processes, uses, advantages, and limitations Consumable electrode Arc welding: Shielded Metal Arc Welding, Flux-cored Arc Welding, Gas Metal Arc Welding, Stud welding Non-consumable electrode welding processes: Gas tungsten arc welding, gas tungsten arc spot welding, plasma arc welding Resistance and solid-state welding processes: Weldment Inspection and Testing

Reference/Sources

- 1) J. Zhou, 2020, Welding and Joining of Aerospace Materials (Second Edition)
- 2) Yongxian Huang, 2021, Joining Processes for Dissimilar and Advanced Materials
- 3) John Hicks, 2000, A Guide to Designing Welds

Course Title	Nanoscience & Nanotechnology				Course Code	MEC 750
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Nanophysics fundamentals, physics nanostructures, thermodynamics of nanostructures, monocrystalline structures, Quantum nanostructures, Nano-optics, nanoplasmonics. Introduction to nano-Engineering; nanoscale fabrication: nanolithography and self-assembly; characterization tools; nanomaterials and nanostructures: nanotubes, nanowires, nanoparticles, and nanocomposites; nanoscale and molecular electronics; nanotechnology in magnetic systems; nanotechnology in integrative systems; nanoscale optoelectronics; Nano biotechnology: biomimetic systems, Nano motors, Nano fluidics, and Nano medicine.

Reference/Sources



- 1) Muhammad Rafique, 2020, Nanotechnology and Photocatalysis for Environmental Applications
- 2) Michael Keidar, 2018, Plasma Engineering (Second Edition)
- 3) Marcio Loos, 2015, Carbon Nanotube Reinforced Composites

Course Title	Welding Metallurgy				Course Code	MEC 751
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Introduction to welding metallurgy, phase diagrams; Phase transformation, TTT and CCT diagrams; Metal strengthening approaches; Heat treatment processes for weldments; Analysis of heat flow and temperature distribution in welding; Concept of solidification in welding, constitutional super cooling; Introduction to heat affected zones (HAZ), Properties of HAZ; Residual stresses in welding, Preheat, and post-weld heat treatment; Types of welding distortion and its control; Cracks in welds; Weldability issues in materials; Welding defects, Design considerations in welding.

Reference/Sources

- 1) J. F. Dos Santos, 2010, Friction Stir Welding
- 2) L. Liu, 2010, Welding and Joining of Magnesium Alloys
- 3) Robert W. Messler, 2004, Joining of Materials and Structures

Course Title	Corrosion Science and Engineering				Course Code	MEC 752
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Corrosion principles: electrochemical, environmental, and materials aspects; Forms of corrosion: uniform attack, galvanic corrosion, crevice corrosion, pitting, intergranular; Corrosion, selective leaching, erosion-corrosion, stress corrosion, and fretting corrosion fatigue; Hydrogen damage Materials used for corrosion applications: ferrous alloys, steels, and cast irons, nonferrous alloys Ceramics, plastics, thermoplastics, and thermoses; Corrosion testing techniques; Corrosion control: materials selection, design, environment control, cathodic and anodic protection, coatings, high-temperature corrosion; Practical Case studies.

Reference/Sources

- 1) S. Lyon, 2012, Nuclear Corrosion Science and Engineering
- 2) Taiwo W. Quadri, 2021, Environmentally Sustainable Corrosion Inhibitors
- 3) Chandrabhan Verma, 2021, Handbook of Science & Engineering of Green Corrosion Inhibitors

Course Title	Advanced Materials Characterization				Course Code	MEC 753
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Scanning Electron Microscopy: construction of the instrument, electron optics, interactions between electron beam and specimen (secondary electrons, backscattered electrons, X-rays), microanalyses, imaging



(detectors, contrast mechanisms), diffraction, low-vacuum SEM, field emission SEM; X-ray characterization: X-ray sources and optics, interactions with matter, diffraction from perfect and imperfect crystals, phase identification and quantification, small-angle scattering, total scattering, imaging, tomography and holography, non-destructive testing.

Reference/Sources

- 1) Irfan Hussain Lone, 2021, Advanced Green Materials
- 2) Marcelo de Assumpção, 2017, Nano characterization Techniques
- 3) Zahava Barkay, 2017, Microscopy Methods in Nanomaterials Characterization

Course Title	Mechanics of Composite Materials				Course Code	MEC 760
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

The course focuses primarily on the elastic properties of a wide range of composites (laminated materials, particulate/fiber-reinforced composites, multidirectional laminates) and covers several engineering methods for the computation of the effective properties of these materials based on the properties and spatial arrangement (volume fraction, shape, orientation, ...) of their underlying constituents.

Reference/Sources

- 1) M. Ivey, 2017, Handbook of Advances in Braided Composite Materials
- 2) T. P. Philippidis, 2019, Fatigue Life Prediction of Composites and Composite Structures (Second Edition)
- 3) Andreas J. Brunner, 2020, Polymer Composites in the Aerospace Industry (Second Edition)

Course Title	Residual Stresses				Course Code	MEC 761
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Basic principles of residual stress, Destructive methods of residual stress measurement, Non-destructive methods of stress measurement, Origins of residual stress: Plastic deformation; Thermal origins; Phase transformation; Welding and other localized heat treatments; Composites and multiphase materials, mitigation and stress relief, Effect of residual stress on failure: Plastic collapse; Fracture; Fatigue and thermal fatigue; Transformation fatigue of smart structures; Creep cavitation cracking; Stress corrosion.

Reference/Sources

- 1) Mahmood M. Shokrieh, 2021, Residual Stresses in Composite Materials (Second Edition)
- 2) Yi Zhang, 2020, Multiscale Modeling of Additively Manufactured Metals
- 3) Erik R. Denlinger, 2017, Thermo-Mechanical Modeling of Additive Manufacturing

Course Title	Contact Mechanics				Course Code	MEC 762
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Equations of elasticity, Hertzian contact, Non-Hertzian elastic contact, Contact of rough surfaces, Normal contact of inelastic solids, Wear mechanisms, Tangential loading and sliding contact, rolling contact and rolling friction, Thermoelastic contact.

Reference/Sources



- 1) Bahman Azarhoushang, 2021, Tribology and Fundamentals of Abrasive Machining Processes
- 2) Ioan D. Marinescu, 2013, Tribology of Abrasive Machining Processes (Second Edition)
- 3) S. Iwnicki, 2009, Wheel–Rail Interface Handbook

Course Title	Computational Engineering Design				Course Code	MEC 763
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

In this course, the student will learn how to design using FEA simulation software such as Ansys or Abaqus. Applications in the fields such as advanced composite structures, thermal stresses, residual stresses are covered.

Reference/Sources

- 1) A. H. Choi, 2014, Advances in Ceramic Matrix Composites
- 2) R. Björnemo, 1993, Control and Dynamic Systems
- 3) Zhuming Bi, 2018, Finite Element Analysis Applications

Course Title	Optical Imaging and Metrology				Course Code	MEC 764
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Optical imaging methods for precise close-range measurement. Photogrammetric techniques with an emphasis on bundle adjustment. Photogrammetric datum definition, network design, and quality measures. Principles of laser range finding and laser scanning. Imaging distortions, sensor modeling, and system self-calibration for a variety of imaging sensors including digital cameras, panoramic cameras, 3D laser scanners, and 3D range cameras. Automated point cloud processing methods; registration, modeling, and segmentation. Selected case studies.

Reference/Sources

- 1) Ioana Nistea, 2015, Embedded Mechatronic Systems
- 2) David Flack, 2014, Fundamental Principles of Engineering Nano metrology (Second Edition)
- 3) Li-Piin Sung, 2006, Tribology and Interface Engineering Series

Course Title	Lean Manufacturing Systems				Course Code	MEC 770
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Covers the fundamentals of lean thinking and how to apply this knowledge to practical problems. Lean thinking is imperative for organizations aspiring to stay competitive in global markets. It calls for process changes to eliminate waste, shorten product delivery time, improve product quality, and curtail costs while improving customer satisfaction. Offers students an opportunity to learn concepts, a kit of process improvement tools, implementation methods, and best practices for lean workforce development. Makes extensive use of active learning exercises and simulations.

Reference/Sources

- 1) Prabir Jana, 2021, Lean Tools in Apparel Manufacturing
- 2) Patrik Thollander, 2020, Introduction to Industrial Energy Efficiency



Course Title	Risk and Reliability in Engineering				Course Code	MEC 771
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Reliability Engineering and Life Data Analysis, Statistical theory background and applications, The most commonly used distributions for product life and their applications, Product life data types, presented and defined, Parameter estimation methods and theory, Confidence bounds determination, Fundamentals of system reliability, Reliability block diagrams (RBDs), System reliability determination and optimization, Utilizing reliability block diagrams for multiple failure mode analysis, System maintainability and availability, Repair and downtime distributions and metrics, Renewal theory, Maintainability and availability definitions, and calculation, System-level availability determination, prediction and optimization, Key concept and basic definitions of risk, uncertainty, and vulnerability, Basic analysis techniques and main tools and methods for risk analysis, Decision-making process, economic aspects, cost/benefit analysis, risk acceptance criteria.

Reference/Sources

- 1) Gilberto Francisco, 2021, Reliability Analysis and Asset Management of Engineering Systems
- 2) Daniel A, 2021, Environmental Systems Science
- 3) Hugh Jack, 2021, Engineering Design, Planning, and Management (Second Edition)

Course Title	Stochastic Production Systems				Course Code	MEC 772
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Modeling techniques to evaluate performance and address issues in the design, control, and operation of systems. Markov models of single-stage make-to-order and make-to-stock systems. Approximations for non-Markovian systems. Impact of variability on flow lines. Open and closed queuing networks.

Reference/Sources

- 1) Cezary Z. Janikow, 1992, Artificial Intelligence V
- 2) Qiuwei Wu, 2021, Optimal Operation of Integrated Multi-Energy Systems Under Uncertainty
- 3) Zhaolong Yang, 2021, Applications of Artificial Intelligence in Process Systems Engineering

Course Title	Metaheuristics and Applications				Course Code	MEC 773
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Focuses on solving large combinatorial optimization problems. Metaheuristic search aims to find a very good solution that satisfies the problem constraints. Describes multiple metaheuristic search methods such as simulated annealing (SA), TABU search (TS), genetic algorithms (GA), particle swarm optimization (PSO), and multi-objective methods. Uses algorithms to find values of discrete and/or continuous variables that optimize a system's performance. Discusses the application of metaheuristics to a variety of different problems, including hub location-allocation, parallel machine scheduling, traveling salesman problem (TSP),



curve fitting, clustering, n-queen, min one, etc. Incorporates practical experiments to demonstrate the advantages and disadvantages of metaheuristic search methods for different applications.

Reference/Sources

- 1) Abhishek Banerjee, 2021, Cognitive Big Data Intelligence with a Metaheuristic Approach
- 2) Ana Carolina Borges, 2021, Multi-Objective Combinatorial Optimization Problems and Solution Methods
- 3) Manoj K. Jha, 2013, Metaheuristic Applications in Structures and Infrastructures

Course Title	Reverse Engineering				Course Code	MEC 774
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Reverse engineering in mechanical design, reverse engineering techniques, digitizing or collecting Data from Physical Part, contact and non-contact 3D scanning techniques, coordinates measuring machines (CMM), steps of finding the geometric models, equations for uniform and free shapes surfaces, recognition of other designs characteristics, manipulation of the collected data to obtain a CAD model, data transfer of geometric shapes to CAD/CAM software, STL files, rapid prototyping techniques.

Reference/Sources

- 1) Neil Walkinshaw, 2013, Advances in Computers
- 2) S. M. Milusheva, 2006, Intelligent Production Machines and Systems
- 3) Tamas Varady, 2002, Handbook of Computer Aided Geometric Design

Course Title	Artificial Intelligence				Course Code	MEC 780
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

This is an introductory course on Artificial Intelligence. The topics may include: methodology and fundamentals; intelligent agents; search algorithms; game playing; supervised and unsupervised learning; decision tree learning; neural networks; nearest neighbor methods; dimensionality reduction; clustering; kernel machines; support vector machines; uncertainty and probability theory; probabilistic reasoning in AI; Bayesian networks; statistical learning; fuzzy logic. Several assignments will be given to enable the student to gain practical experience in using these techniques.

Reference/Sources

- 1) Altahir A. Altahir, 2021, Applications of Computational Intelligence in Multi-Disciplinary Research
- 2) Aydin Nassehi, 2021, Design and Operation of Production Networks for Mass Personalization in the Era of Cloud Technology

Course Title	Machine Learning				Course Code	MEC 781
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

An introduction to machine learning. Topics include supervised learning (generative/discriminative learning,



parametric/non-parametric learning, neural networks, support vector machines); unsupervised learning (clustering, dimensionality reduction, kernel methods); learning theory (bias/variance tradeoffs, practical advice); reinforcement learning and adaptive control. The course will also discuss recent applications of machine learning, such as robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing.

Reference/Sources

- 1) Miloš Kotlar, 2021, Advances in Computers
- 2) Andrew F. Siegel, 2021, Practical Business Statistics (Eighth Edition)
- 3) Patrick Schneider, 2021, Anomaly Detection and Complex Event Processing over IoT Data Streams

Course Title	Virtual Manufacturing				Course Code	MEC 782
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Introduction to digital transformation, Drivers for digital transformation, the building blocks of Industry 4.0, Emerging technologies and trends in the manufacturing industry (including additive manufacturing, industrial internet of things, artificial intelligence, data, augmented reality, virtual reality, and collaborative robots) and their role in production, design and future supply chains.

Reference/Sources

- 1) B. K. Choi, 2000, Current Advances in Mechanical Design and Production VII
- 2) Gian F. Frontini, 2003, Manufacturing in Real-Time
- 3) Reginald D. Boswell, 1991, Control and Dynamic Systems

Course Title	Intelligent Energy Field Manufacturing				Course Code	MEC 783
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs.	3
	2	2	-	-		
Grades	Final Exam	Class Activities	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Basics of Intelligent EFM. Introduction to the Interdisciplinary Engineering Methodologies. Energy Flow and Interdisciplinary Process Innovations. Information Flow and Intelligent Manufacturing.

Reference/Sources

- 1) Hui Liu, 2020, Robot Systems for Rail Transit Applications
- 2) Zita Vale, 2021, Artificial Intelligence to Solve Pervasive Internet of Things Issues
- 3) Anit K. Giri, 2018, Robotic Systems and Autonomous Platforms



(3) Mechatronics and Robotics Engineering Program

1) Postgraduate Advanced Diploma in Mechatronics and Robotics

Registration takes place in the following research fields:

- Mechatronics and Industrial Process Control
- Robotics and Autonomous Vehicles
- Embedded Systems and Machine Learning

The Graduate of the Advanced Diploma in Mechatronics and Robotics should be able to:

- Apply the specialized knowledge acquired in his/her professional practice.
- Identify professional and design problems and propose solutions to them.
- Mastering professional skills and using appropriate technological means, including computer-aided analysis, modern specialized programs, and design tools, in his/her professional practice.
- Communicate and lead the team to work through systematic professional work.
- Take appropriate decisions in light of the available information.
- The ability to make efficient use of the available resources.
- Demonstrate awareness of his/her role in community development and environmental preservation.
- Act in a manner that reflects his commitment to integrity and credibility, accepting accountability and taking responsibility for his actions.
- Recognizes the need to develop him/her self and engage in continuous learning.

Table 3. 3. 1 compulsory Courses of Basic Diploma in Mechatronics and Robotics Engineering

S. N.	Course Code	Course Name	Prerequisites	Credit Hours	Grades				Exam Time
					Course Work	Oral / Practical	Written Exam	Total	
1	GEN504	Statistical Analysis and Experimental design	-	2	60	-	40	100	2
2	GEN505	Engineering Mathematics & Numerical Analysis	-	2	60	-	40	100	2



Table 3. 3. 2 Elective Courses for the Basic Diploma in Mechatronics and Robotics Engineering*

S. N	Course Code	Course Name	Prerequisites	Credit Hours	Grades				Exam Time
					Course Work	Oral / Practical	Written Exam	Total	
1	MEC5a1	Advanced automatic control	-	3	60	-	40	100	3
2	MEC5a2	Sensors, transducers, and measurement circuits	-	3	60	-	40	100	3
3	MEC5a3	Mechatronics System Design	-	3	60	-	40	100	3
4	MEC5a4	Hydraulic and Pneumatic control	-	3	60	-	40	100	3
5	MEC5a5	Modeling, simulation, and system Identification	-	3	60	-	40	100	3
6	MEC5a6	Industrial automation and microcontrollers	-	3	60	-	40	100	3

*With the help of the academic advisor, the student chooses (9) credit hours with a minimum of elective courses for the Basic Diploma in Computer Systems Engineering and according to what is determined by the Scientific Department Council.

Compatibility of the graduate's specifications with the Obligatory courses of the basic engineering diploma in the Mechatronics and Robotics engineering program

S.N	Code	Course Title	Graduate Competencies								
			1	2	3	4	5	6	7	8	9
Compulsory Courses of Basic Diploma in Mechatronics and Robotics Engineering											
1	GEN504	Statistical Analysis and Experimental design			√		√			√	
2	GEN505	Engineering Mathematics & Numerical Analysis	√		√						
Elective courses for the Basic Diploma in Mechatronics and Robotics Engineering											
1	MEC5a1	Advanced automatic control	√	√	√		√		√	√	√
2	MEC5a2	Sensors, transducers, and measurement circuits	√		√			√			√
3	MEC5a3	Mechatronics System Design	√	√	√	√	√	√	√	√	√
4	MEC5a4	Hydraulic and Pneumatic control	√		√	√	√	√	√		√
5	MEC5a5	Modeling, simulation, and system Identification	√	√				√			√
6	MEC5a6	Industrial automation and microcontrollers	√		√	√	√	√	√		√



TABLE 3. 3. 3 Courses for Advanced Diploma in Mechatronics and Robotics Engineering

S. N	Course Code	Course Name	Prerequisites	Credit Hours	Grades				Umi9m
					Course Work	Oral / Practical	Written Exam	Total	
a) Mechatronics and Industrial Process Control									
1	MEC6a1	Optimal & Robust Control	-	3	60	-	40	100	3
2	MEC6a2	Advanced intelligent control of mechatronics systems	-	3	60	-	40	100	3
3	MEC6a3	Nonlinear and Adaptive Control	-	3	60	-	40	100	3
4	MEC6a4	Signal processing of mechatronic systems	-	3	60	-	40	100	3
5	MEC6a5	Enhanced Electro-hydraulic, Pneumatic Servo systems	-	3	60	-	40	100	3
6	MEC6a6	Motion control of Enhanced Servo-Systems	-	3	60	-	40	100	3
7	MEC6a7	Motion Control of advanced robots and programming	-	3	60	-	40	100	3
8	MEC6a8	Object-oriented programming	-	3	60	-	40	100	3
9	MEC6c1	Embedded systems	-	3	60	-	40	100	3
b) Robotics and Autonomous Systems									
1	MEC6a4	Signal processing of mechatronic systems	-	3	60	-	40	100	3
2	MEC6a5	Enhanced Electro-hydraulic, Pneumatic Servo Systems	-	3	60	-	40	100	3
3	MEC6b1	Robotics engineering	-	3	60	-	40	100	3
4	MEC6b2	Autonomous robotics systems	-	3	60	-	40	100	3
5	MEC6b3	Computer vision for robotics	-	3	60	-	40	100	3
6	MEC6c1	Embedded Systems	-	3	60	-	40	100	3
c) Embedded Systems and Machine Learning									
1	MEC6a4	Signal processing of mechatronic systems	-	3	60	-	40	100	3
2	MEC6a5	Enhanced Electro-hydraulic, Pneumatic Servo Systems	-	3	60	-	40	100	3
3	MEC6c1	Embedded Systems	-	3	60	-	40	100	3
4	MEC6c2	Machine Learning Algorithms	-	3	60	-	40	100	3
5	MEC6c3	Real Time Programming of Embedded systems	-	3	60	-	40	100	3
6	MEC6c4	Advanced Artificial Intelligence	-	3	60	-	40	100	3



*With the help of the academic advisor, the student chooses (12) credit hours as a minimum from the elective courses for the Advanced Diploma in Computer Systems Engineering and according to what is determined by the Scientific Department Council.

Compatibility of the graduate's specifications with the elective courses of the advanced engineering diploma in the Mechatronics and Robotics engineering program

S.N	Code	Course Title	Graduate Competencies								
			1	2	3	4	5	6	7	8	9
a) Mechatronics and Industrial Process Control											
1	MEC6a1	Optimal & Robust Control	√		√		√			√	√
2	MEC6a2	Advanced intelligent control of mechatronics systems	√		√		√		√		√
3	MEC6a3	Nonlinear and Adaptive Control	√		√						√
4	MEC6a4	Signal processing of mechatronic systems	√		√		√	√			
5	MEC6a5	Enhanced Electro-hydraulic, -pneumatic servo systems	√	√		√		√	√	√	
6	MEC6a6	Motion control of Enhanced Servo-Systems	√	√		√	√	√	√		
7	MEC6a7	Motion Control of advanced robots and programming				√		√	√		
8	MEC6a8	Object-oriented programming		√		√	√				
9	MEC6c1	Embedded systems						√		√	√
b) Robotics and Autonomous Systems											
1	MEC6a4	Signal processing of mechatronic systems	√		√		√			√	√
2	MEC6a5	Enhanced Electro-hydraulic, -pneumatic servo systems	√		√		√		√		√
3	MEC6b1	Robotics engineering	√		√						√
4	MEC6b2	Autonomous robotics systems			√			√	√		√
5	MEC6b3	Computer vision for robotics		√	√		√	√	√		√
6	MEC6c1	Embedded Systems	√		√			√	√		
c) Embedded Systems and Machine Learning											
1	MEC6a4	Signal processing of mechatronic systems	√		√		√			√	√
2	MEC6a5	Enhanced Electro-hydraulic, -pneumatic servo systems	√		√						√
3	MEC6c1	Embedded Systems	√		√		√		√		√
4	MEC6c2	Machine Learning Algorithms		√	√				√		√
5	MEC6c3	Real Time Programming of Embedded systems	√		√				√	√	
6	MEC6c4	Advanced Artificial Intelligence	√		√	√		√	√	√	√

2) Master of Science (M. Sc.) in Mechatronics and Robotics Engineering

Registration takes place in the following research fields:

- a) Mechatronics and Industrial Process Control
- b) Robotics and Autonomous systems
- c) Embedded Systems and Machine Learning

The Graduate of the M.Sc. Program of Mechatronics and Robotics Engineering should be able to:

- 1) Master the application of the fundamentals and methodologies of scientific research and using its different tools in mechatronics and robotics engineering.
- 2) Apply the analytic approach and use it in mechatronics and robotics engineering.
- 3) Apply specialized knowledge and combine it with relevant knowledge related to mechatronics engineering technology.
- 4) Specify professional problems in mechatronics and robotics engineering and find the appropriate solutions for them.
- 5) Show distinction in an acceptable range of specialized professional skills and appropriate technological means to serve his professional practice.
- 6) Communicate effectively and demonstrate the ability to lead a work team.
- 7) Maximize the utilization of the available resources to bring the most significant benefit and maintain.

Table 3. 3. 4 M. Sc. Thesis in Mechatronics and Robotics Engineering

S. N.	Course Code	Course Name	Perquisites	Credit Hours
1	MEC8a1	M.Sc. Thesis- a	Average GPA (3.0) and minimum (2.7) in all courses in basic and advanced diploma courses	12
1	MEC8b1	M.Sc. Thesis-b		
1	MEC8c1	M.Sc. Thesis-c		



Compatibility of the specifications of the Master of Science graduate with the Mechatronics and Robotics engineering courses

Code	Course Title	Graduate Competencies											
		1	2	3	4	5	6	7	8	9	10	11	12
MEC8a1	M.Sc. Thesis	√	√	√	√	√	√	√	√	√	√	√	√
MEC8b1	M.Sc. Thesis	√	√	√	√	√	√	√	√	√	√	√	√
MEC8c1	M.Sc. Thesis	√	√	√	√	√	√	√	√	√	√	√	√

3) Doctor of Philosophy (Ph. D.) in Mechatronics and Robotics Engineering

Registration takes place in the following research fields:

- a) Mechatronics and Industrial Process Control
- b) Robotics and Autonomous systems
- c) Embedded Systems and Machine Learning

The Graduate of the Ph. D. Program of Mechatronics and Robotics Engineering should be able to:

- 1) Mastering the basics and methodologies of scientific research and using its various tools with mechatronics and robotics engineering technology.
- 2) Demonstrate the ability to conduct research in relevant cutting-edge areas by identifying and formulating relevant problems and providing solutions by integrating interdisciplinary principles of mathematics and science in the field of robotics and mechatronics.
- 3) Demonstrate deep awareness of current problems and modern and advanced theories in the field of mechatronics and robotics.
- 4) Demonstrated ability to learn independently and to work creatively individually and as part of a research team.
- 5) Demonstrate commitment to ethics, responsibilities, rules and practices in the field of mechatronics and robotics engineering.
- 6) Demonstrate high communication skills, which can be implemented by dissertation writing as well as manuscripts for peer-reviewed journals and able to articulate research at conferences and workshops.



Table 3. 3. 5 Basic Courses for the Ph.D. degree in Mechatronics and Robotics*

S. N.	Course Code	Course Name	Prerequisites	Credit Hours	Grades				Umi9m
					Course Work	Oral / Practical	Written Exam	Total	
a) Mechatronics and Industrial Process Control									
1	MEC6a1	Optimal & Robust Control	-	3	60	-	40	100	3
2	MEC6a2	Advanced intelligent control of mechatronics systems	-	3	60	-	40	100	3
3	MEC6a3	Nonlinear and Adaptive Control	-	3	60	-	40	100	3
4	MEC6a4	Signal processing of mechatronic systems	-	3	60	-	40	100	3
5	MEC6a5	Enhanced Electro-hydraulic, -pneumatic servo systems	-	3	60	-	40	100	3
6	MEC6a6	Motion control of Enhanced Servo-Systems	-	3	60	-	40	100	3
7	MEC6a7	Motion Control of advanced robots and programming	-	3	60	-	40	100	3
8	MEC6a8	Object-oriented programming	-	3	60	-	40	100	3
9	MEC6c1	Embedded systems	-	3	60	-	40	100	3
b) Robotics and Autonomous Systems									
1	MEC6a2	Advanced intelligent control of mechatronics systems	-	3	60	-	40	100	3
2	MEC6a6	Motion Control and Enhanced Servo -systems	-	3	60	-	40	100	3
3	MEC6a7	Controlling and programing the movement of advanced robotics	-	3	60	-	40	100	3
4	MEC6b4	Bioinspired robotic systems	-	3	60	-	40	100	3
5	MEC6b5	Teleoperation and Haptic Systems	-	3	60	-	40	100	3
c) Embedded Systems and Machine Learning									
1	MEC6a2	Advanced Intelligent Control of Mechatronics Systems	-	3	60	-	40	100	3
2	MEC6a6	Motion control and Enhanced Servo-systems	-	3	60	-	40	100	3
3	MEC6a7	Controlling and Programing the movement of advanced robotics	-	3	60	-	40	100	3
4	MEC6c5	Deep Learning	-	3	60	-	40	100	3
5	MEC6c6	Metaheuristic Optimization Techniques	-	3	60	-	40	100	3



*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from the basic courses of the Doctor of Philosophy in Computer Systems Engineering and according to what is determined by the Scientific Department Council.

Compatibility of the graduate's specifications with the basic courses of the advanced Ph. D. degree in engineering in the Mechatronics and Robotics engineering program

S.N	Code	Course Title	Graduate Competencies					
			1	2	3	4	5	6
a) Mechatronics and Industrial Process Control								
1	MEC6a1	Optimal & Robust Control			√		√	√
2	MEC6a2	Advanced intelligent control of mechatronics systems	√		√	√	√	√
3	MEC6a3	Nonlinear and Adaptive Control	√		√	√	√	√
4	MEC6a4	Signal processing of mechatronic systems	√		√	√	√	√
5	MEC6a5	Enhanced Electro-hydraulic, Pneumatic servo systems	√	√			√	√
6	MEC6a6	Motion control and Enhanced Servo systems	√		√	√	√	√
7	MEC6a7	Motion Control of advanced robots and programming	√		√	√	√	√
8	MEC6a8	Object-oriented programming	√	√		√	√	√
9	MEC6c1	Embedded systems	√	√	√			
b) Robotics and Autonomous Systems								
1	MEC6a2	Advanced intelligent control of mechatronics systems	√		√	√	√	√
2	MEC6a6	Motion control and Enhanced Servo systems			√		√	√
3	MEC6a7	Controlling and programing the movement of advanced robotics	√		√	√	√	√
4	MEC6b4	Bioinspired robotic systems	√		√		√	√
5	MEC6b5	Teleoperation and Haptic Systems		√	√	√	√	√
c) Embedded System and Machine Learning								
1	MEC6a2	Advanced intelligent control of mechatronics systems	√	√	√	√	√	√
2	MEC6a6	Motion control and Enhanced Servo systems		√	√		√	√
3	MEC6a7	Controlling and programing the movement of advanced robotics	√	√	√	√	√	√
4	MEC6c5	Deep Learning	√	√		√	√	√
5	MEC6c6	Metaheuristic Optimization Techniques	√	√		√	√	√



Table 3. 3. 6 Specialized Courses for Ph.D. degree in Mechatronics and Robotics*

S. N.	Course Code	Course Name	prerequisites	Credit Hours	Grades				Exam Time
					Course Work	Oral / Practical	Written Exam	Total	
a) Mechatronics and Industrial Process Control									
1	MEC7a1	Nonlinear mechatronic systems	-	3	60	-	40	100	3
2	MEC7a2	Selected Topics in MEMS	-	3	60	-	40	100	3
3	MEC7a3	Selected topics in Advanced and intelligent control	-	3	60	-	40	100	3
4	MEC7a4	Selected topics in mechatronics systems	-	3	60	-	40	100	3
5	MEC7a5	Selected topics in industrial process control	-	3	60	-	40	100	3
b) Robotics and Autonomous systems									
1	MEC7a2	Selected Topics in MEMS	-	3	60	-	40	100	3
2	MEC7a3	Selected topics in Advanced and intelligent control	-	3	60	-	40	100	3
3	MEC7b1	Selected topics in Advanced Robotics	-	3	60	-	40	100	3
4	MEC7b2	Selected topics in autonomous systems	-	3	60	-	40	100	3
c) Embedded Systems and Machine Learning									
1	MEC7a2	Selected Topics in MEMSs	-	3	60	-	40	100	3
2	MEC7a3	Selected topics in Advanced and intelligent control	-	3	60	-	40	100	3
3	MEC7c1	Selected topics in embedded systems	-	3	60	-	40	100	3
4	MEC7c2	Selected Topics in Deep & Reinforcement Learning	-	3	60	-	40	100	3

*The student chooses (9) credit hours as a minimum from the specialized courses for the Doctor of Philosophy in Computer Systems Engineering, upon the recommendation of the main supervisor and according to what is determined by the scientific department council.



Compatibility of the graduate's specifications with the specialized courses of the engineering Ph.D. in Mechatronics and Robotics engineering program

S.N	Code	Course Title	Graduate Competencies					
			1	2	3	4	5	6
a) Mechatronics and Industrial Process Control								
1	MEC7a1	Nonlinear mechatronic systems	√	√	√	√	√	√
2	MEC7a2	Selected Topics in MEMS	√	√	√	√	√	√
3	MEC7a3	Selected topics in Advanced and intelligent control	√		√	√	√	√
4	MEC7a4	Selected topics in mechatronics systems	√	√	√	√	√	√
5	MEC7a5	Selected topics in industrial process control		√	√	√		
b) Robotics and Autonomous Systems								
1	MEC7a2	Selected Topics in MEMS	√	√	√	√	√	√
2	MEC7a3	Selected topics in Advanced and intelligent control	√	√	√	√	√	√
3	MEC7b1	Selected topics in Advanced Robotics	√	√	√	√	√	√
4	MEC7b2	Selected topics in autonomous systems	√	√	√	√	√	√
c) Embedded System and Machine Learning								
1	MEC7a2	Selected Topics in MEMS	√	√	√	√	√	√
2	MEC7a3	Selected topics in Advanced and intelligent control	√	√	√	√	√	√
3	MEC7c1	Selected topics in embedded systems	√	√	√	√	√	√
4	MEC7c2	Selected Topics in Deep & Reinforcement Learning	√	√	√	√	√	√

Table 3. 3.7 Ph.D. Thesis in Mechatronics and Robotics

S.N.	Course Code	Course Name	Perquisites	Credit Hours
1	MEC9a1	Ph.D. Thesis-A	1. Average GPA (3.0) and minimum (2.7) in all courses in basic and specialized Ph.D. courses 2. Pass the seminar of stage one of the academic research.	12
2	MEC9b1	Ph.D. Thesis-B		
3	MEC9c1	Ph.D. Thesis-C		



Compatibility of the graduate's specifications with the Ph.D. theses in Mechatronics and Robotics engineering program

S. N	Code	Course Title	Graduate Competencies					
			1	2	3	4	5	6
1	MEC9a1	Ph.D. Thesis-A	√	√	√	√	√	√
2	MEC9b1	Ph.D. Thesis-B	√	√	√	√	√	√
3	MEC9c1	Ph.D. Thesis-C	√	√	√	√	√	√



COURSE DESCRIPTION

Course Title	Advanced automatic control				Course Code	MEC 5a1
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Course work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Classification of automatic control systems, modeling of compound dynamic, systems Mathematical models of feedback control systems, Definition of State, State Variables, State Space and State Trajectories, State Space Representation of Physical System, Jordan Forms, Canonical Forms and Symmetrical Transformation, Determination of The Transition Matrix, Relation with The Classical Methods, Relation Between State Space Representation and Transfer Function, Controllability and Observability Matrices, Pole Placement Design and Stability of Nonlinear Control Systems Using State Space Trajectories, Harmonic Linearization, Stochastic Linearization, Stability of Nonlinear Systems. Analysis/Simulation of linear and nonlinear control systems, Design of Proportional-integral-derivative (PID) controllers, Design of P, PI controllers by Routh-Hurwitz, Ziegler-Nicolas's tuning, Robust control systems, Stability of fractional-order (FO) systems, Design of FO PID and phase-compensators. LQR (optimal state feedback) control, Robustness of LQR control, Kalman filter (optimal observers), LQG control (combining LQR state feedback and optimal observer), Application by using MATLAB.

Reference/Sources:

1. Jongrae Kim, Dynamic System Modelling and Analysis with MATLAB and Python, IEEE press, Wiley, 2022
2. V. M. H-Guzmán and R. S. Ortigoza, Automatic Control with Experiments, Springer Verlag, 2019
3. G. Franklin, D Powell and A. Emami, Feedback Control of Dynamical Systems, Addison-Wiley, 8th ed., Pearson, 2018
4. Katsuhiko Ogata, Modern Control Engineering, Pearson India; 5th edition, 2015
5. Zhou, Doyle and Glover, Robust and Optimal Control, Prentice Hall, 1996.

Course Title	Sensors, transducers, and measurement circuits				Course Code	MEC 5a2
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Course work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Fundamentals of transducers and measurement, Elements of electrical sensors and instrument, Variable, Inductance and Capacitive Resistance Transducers, Carbon Resistor Gauge, Bonded Wire Strain Gauges, Differential Inductive Pickups, Linear Variable Differential Transducers (LVDT), Piezoelectric Transducers, Electric Magnetic Energy, signal conditioning and measurement techniques for MEMS (Micro Electromechanical) sensors, fiber-optic sensors, Nano-sensors, magnetic field, microwave and radiation sensors, vision and imaging sensors, comparisons and selection. Solar radiation sensors, Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement, Position, force, torque, measurement techniques and instruments for various **measurements such as humidity, moisture**, density, conductivity, ORP (oxygen reduction potential), pH, polarography, viscosity, consistency, turbidity, opacity-Sensors, measurement techniques and instruments for emerging application. Data Acquisition systems

**Reference/Sources:**

1. Walter Lang, Sensors and Measurement Systems, 2nd ed., River Publishers, 2021
2. Yurish, S., Modern Sensors, Transducers and Sensor Networks, 1st ed.). IFSA Publishing, 2014.
3. David G. Alciatore, Introduction to Mechatronics and Measurement Systems McGraw-Hill Education, 2011
4. Ian Sinclair, Sensors and Transducers, 3rd ed, Newnes, 2014.
5. Patranabis, D., Sensors, and transducers. New Delhi, PHI Learning, 2003.

Course Title	Mechatronics System Design				Course Code	MEC5a3
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Course work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Phase of design process, Dynamic system used to design compound mechatronic systems, Modeling of mechatronic systems, Structure of mechatronic systems, Electrical systems controlled by integration with functional elements from multiple fields, sensors, actuators and interference with mechatronic systems, design of control systems - PID motion control, servo motors, electronics for mechatronic systems - design of sustainable mechatronic systems, signal processing and adaptation, microcontroller architecture - microcontroller structure, Internal memory organization: program and data, Input/output ports, Interruptions: Enabling and service, Special features of microcontrollers, Timers, Interrupt for Timers, Analog and digital Converters, Pulse Width Modulation, Practical Application to Advanced and Sustainable Mechatronics Systems, Design and Implement a Mechatronics Product Specific aspects of Mechatronics, Problem-solving procedure, and Multidisciplinary project.

Reference/Sources:

1. Klaus Janschek, Mechatronic Systems Design: Methods, Models, Concepts, Springer, 2012
2. Musa Jouaneh, Fundamentals of Mechatronics, Publisher. Cengage Learning. Publication date, 2012.
3. Devdas Shetty and Richard A. Kolk, Mechatronics System Design, 2nd Edition., 2010.
4. Robert H. Bishop, Mechatronic System Control, Logic, and Data Acquisition, 2nd ed. CRC Press, 2007.
5. Karl J. Astrom, Bjorn Wittenmark, Computer Controlled Systems: Theory and Design, Prentice Hall, 1997.

Course Title	Hydraulic and Pneumatic control				Course Code	MEC 5a4
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Introduction to Pneumatic and Hydraulic Control Systems (Review to The Basic Principles of Hydraulics and Pneumatics), Hydraulic Pumps and performance curves, Cylinders, Motors, Valves: Pressure Valves, Directional Control Valves and Flow Valves, cartridges, Accelerators, Pressure Switches), Pneumatic Compressors and performance, Principle of Pneumatic Switching, Pneumatic Logic, logic valves regulator valves and actuators Pneumatic Sequence Techniques (Breakdown of Cycles, Operating Modes, Simultaneous Cycles, Optional Cycles), Pneumatic cascade circuits, Industrial Applications.

Reference/Sources:

1. James Johnson, Introduction to Fluid Power, Cengage publisher, 2022.
2. James R. Daines, Martha J. Daines, Fluid Power: Hydraulics and Pneumatics, Goodheart Willcox Company 2009



3. K. Hiraniya Singh, Pneumatic and Hydraulic Systems, I K International Publishing House, 2017
4. Joji Parambath, Electro-pneumatics and Automation, JOJI Books, 2020.
5. Joji Parambath, Electro-hydraulic Systems and Relay Circuits (Advanced Level), 2020.
6. K. Shanimuga Sundaram, S. Chand, Hydraulic and Pneumatic Controls, 2014.

Course Title	Modeling, simulation, and System Identification				Course Code	MEC 5a5
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Course work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Mathematical and practical modeling methods, modeling of mechatronics systems (mechanical, electrical, electronic, hydraulic and pneumatics), Analogy between electrical, mechanical, and other systems. Simulation of compound mechatronic systems using computer programs and packages such as MATLAB, LabVIEW..., etc.

Algorithms of system identification: Linear regression, the least squares method and prediction error methods, Signals and Systems and Model Parameterization and Prediction. Identifiability; Convergence; Consistency; Bias, Asymptotic Distribution of Parameter Estimates, The Instrumental-Variable Method, Correlation analysis and spectral analysis. Wiener and Kalman Filters for System Identification, Auto Regressive Models for SISO- and MIMO-Systems, Stochastic Analysis of Control Systems Using Correlation and Spectral Methods. Black box and gray box modeling. Model validation and practical aspects.

Reference/Sources:

1. Ljung, Lennart; Glad, Torkel; Hansson, Anders, Modeling and identification of dynamic systems, 2nd ed, Lund, 2021.
2. Hemchandra Madhusudan Shertukde, Digital Control Applications :Illustrated with MATLAB, CRC Press, 2015.
3. Stephen A Billings. Nonlinear system identification: NARMAX methods in the time, frequency, and spatio-temporal domains. John Wiley & Sons, 2013
4. Oystein Haugen, Reinhard Gotzhein, System Analysis and Modeling, Springer-Verlag, 2012.
5. M. Gopal, Digital Control and State Variable Methods 4th ed., McGraw Hill Education, 2010.
6. Dean C. Karnopp, Donald L. Margolis, Ronald C. Rosenberg, System Dynamics: Modeling and Simulation of Mechatronic Systems, 2006.
7. Ljung, Lennart, System Identification: A Theory for the User. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 1998.
8. Juang, Jer-Nan, Applied System Identification, Prentice Hall PTR, Englewood Cliffs, New Jersey 07632, 1994.
9. Johansson, Rolf, System Modeling and Identification, Prentice Hall, Englewood Cliffs, NJ, 1993.

Course Title	Industrial automation and microcontrollers				Course Code	MEC 5a6
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Course work	Lab.	Oral	Total	100
	40	60	-	-		



Course Content:

Architecture of Industrial Automation system, Analog and digital signal processing, Designing and control different industrial processes using PLC. Connection varies type of inputs and outputs using different communication protocols. Industrial bus systems: Modbus & profibus. Designing Supervisory control and data acquisition (SCADA) systems to monitor different input and outputs for the whole process. Impart of HMI Systems for Industry. Measure industrial parameters. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Servo Motors and drives for motion control of industrial Automation. Sequence control, Control of Machine Tools, Hydraulic & Pneumatic Control Systems, Motor Drives, Adjustable Speed Drives. Basic construction and configuration of industrial robot. Architecture of microcontroller, common features of Microcontrollers. Blocks, Memory organization of Microcontroller 8051. Programing and Interfacing of microcontrollers to industrial equipment.

Reference/Sources:

1. Avinash Malekar, Learn everything about factory automation, 2021.
2. Bornet P., Barkin I., Wirtz J, Intelligent Automation, 2020.
3. Nathan Clark, PLC Programming Using RSLogix 5000, 2020
4. Frank Lamb, Advanced PLC Hardware & Programming, Automation Consulting, LLC, 2019.
5. K S Manoj, Industrial Automation with SCADA: Concepts, Communications and Security, Notion Press, 2019.
6. A.K. Gupta, S.K. Arora, Jean Riescher Westcott, Industrial Automation and Robotics: An Introduction, Mercury Learning and Information; Har/Cdr edition, 2016.
7. Mathur S., Panda J., Microprocessors and Microcontrollers, Prentice-Hall, 2016.
8. Clint Bodungen, Hacking Exposed Industrial Control Systems: ICS and SCADA Security Secrets & Solutions, 2016
9. Frank Lamb, Industrial Automation: Hands On, 1st Ed., McGraw Hill, 2013.
10. Rex Miller, Mark R. Miller, Industrial Electricity and Motor Controls, McGraw-Hill Education 2008.
11. Joseph Vithayathil, Power electronics: Principles and Applications, McGraw Hill Education, 2010.
12. Vedam Subrahmanyam, Electric Drives: Concepts & Applications, 2nd Edition, Tata McGraw-Hill Education, 2010.

Course Title	Optimal & Robust Control				Course Code	MEC 6a1
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Course work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Introduction to Optimum Control, Important Control Criteria: The Minimum Time Criterion, The Linear Regulator Problem, The Tracking Problem. Extrema, The Variational Methods (Euler Equation). Design of State Observers, Closed Loop Control with Observer, The Principle of Optimality and Hamilton, Jacob Equation Matrix, Recatti Equation, and its Solution, LQR (optimal state feedback) control, Robustness of LQR control, Kalman filter (optimal observers), LQG control (combining LQR state feedback and optimal observer), Design of Optimum Systems with Wiener Filter, and Kalman Filter, The Maximum pontryagin Principle. Introducing The Following Optimal Control Problems, Continuous Time Case, Stabilizing Control, Covariance Upper Bound Control, Linear Quadratic Regulator, L-Infinity Control, H-Infinity Control LQR (H2). Loop transfer recovery, adding integral action, H2 norms, and H2 optimal Control, H-infinity norm and the H-infinity function space, Linear Fractional Transformations (LFT) and LFT uncertainty representation, Robust stability, Riccati based H-infinity control synthesis, H-infinity loop shaping control design methodology.

**Reference/Sources:**

1. G. E. Dullerud and F. Paganini, A Course in Robust Control Theory: A Convex Approach, Springer Verlag, 2000
2. Mi-Ching Tsaim, Da-Wei Gu, Robust and Optimal Control, Springer, 2014
3. Luigi Fortuna and Mattia Frasca, Optimal and Robust Control, Taylor & Francis, 2012
4. D. Liberzon, Calculus of Variations and Optimal Control Theory: A Concise Introduction, Princeton University Press, 2012.
5. D. Liberzon, Calculus of Variations and Optimal Control Theory: A Concise Introduction, Princeton University Press, 2012.
6. G. E. Dullerud and F. Paganini, A Course in Robust Control Theory: A Convex Approach, Springer Verlag, 2000.
7. Zhou, Doyle and Glover, Robust and Optimal Control", Prentice Hall, 1996

Course Title	Advanced intelligent control of mechatronics systems				Course Code	MEC 6a2
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Course work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Artificial intelligence basics, fuzzy set theory, fuzzy rules and fuzzy reasoning, the fuzzy logic Control Engineering, Fuzzy inference systems, Regression and optimization, Least-Square methods, System identifications, Application of fuzzy logic control in mechatronic systems, comparison fuzzy logic controller with PID controller by using MATLAB software package.

Neural networks, The Learning Techniques in Neural Networks, Learning from Reinforcement, Applications of the Neural Controllers in the ACS, Comparison of the Neural Network Approach with the classical and State Space Design Methods.

Reference/Sources:

1. Patricia Melin, Oscar Castillo, Fuzzy Logic and Neural Networks for Hybrid for hybrid intelligent system design, Springer, 2023.
2. Khuman A. S., Carter J., Chen T., Chiclana F., Fuzzy Logic: Recent Applications and Developments, Springer, 2021.
3. Esfandiari K., Abdollahi F., Talebi H. A., Neural Network-Based Adaptive Control of Uncertain Nonlinear Systems, Springer, 2021.
4. De Silva, C.W., Intelligent control: fuzzy logic applications. CRC press, 2018.
5. Gupta, M. and Sinha, N. Intelligent control system. New York: IEEE press, 1996.

Course Title	Nonlinear and Adaptive Control				Course Code	MEC 6a3
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Adaptive control strategies, Properties of adaptive systems, Types of Adaptive Control Systems, Self-Adjusting System, Identifier-based and Non-identifier Based, Parametric Models, Parameter identification Methods, linear model –based Gradient Algorithms, Least-Square algorithms, Parameter Projection, Robust Parameter Identification, Robust adaptive laws, Model Reference



adaptive control (MRAC), Simple MRAC schemes, MRAC for SISO Plants, Stability analysis of adaptive controllers, adaptive pole placement control, Adaptive observers, adaptive control for discrete systems, Robust adaptive control schemes. real-time parameter estimation, Deterministic self-tuning regulators, introduction to the analysis and design of nonlinear control systems. Linearization of nonlinear systems. Phase-plane analysis, Lyapunov stability analysis. Design of stabilizing controllers. The Dual Control Concept with Applications, Analysis of Adaptive Systems as Nonlinear Systems.

Reference/Sources:

- Bellman, R., Adaptive Control Processes. Princeton, NJ: Princeton University Press, 2016.
- Stephen A Billings, Nonlinear system identification: NARMAX methods in the time, frequency, and spatio-temporal domains, John Wiley & Sons, 2013.
- Ioannou, P. and Sun, J., Robust Adaptive Control. New York: Dover Publications, 2013.
- Jean Levine, Analysis and Control of Nonlinear Systems, Springer-Verlag, 2009.
- Fidan, B. and Ioannou, P., Adaptive control tutorial. Philadelphia, PA: Society for Industrial and Applied Mathematics (SIAM), 2006.
- Jain, Lakhmi C., de Silva, Clarence W., Intelligent Adaptive Control: Industrial Applications, CRC Press, 1998.

Course Title	Signal processing of mechatronic systems				Course Code	MEC 6a4
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Analog signal processing; digital signal processing; the basic mathematical tools to analyze signals in time and frequency domains; Bode plot. Fundamentals of advanced discrete-time signal processing (Discrete signals, sampling, periodicity, classifications and discrete signals manipulation, Discrete Systems, Discrete convolution), Model discrete-time signals in various ways (pole-zero, all-pole, FIR, etc.), Frequency analysis: (Frequency Response, Discrete Time Fourier analysis, Discrete Fourier series, Discrete Time Fourier transform, Fast Fourier Transform (Time and Frequency Decimation), Z Transform, Z transform Properties, , passive and active filters are analyzed and designed for signal-conditioning; FIR and IIR filters are analyzed, design, and implemented on a computer, Digital Filters, Low-pass Filter Design, High-pass Filter Design, Bandpass Filters, Band-reject Filters, Refinements in LC Filter Design and The Use of Resistive Networks, Normalized Filter Design Tables, Digital Filters, Finite Impulse-response Filters, Infinite Impulse-response Filters, Multi-rate Digital Filters, Microwave Filters, realization, frequency response, Matlab Simulation, Design optimum filters (Wiener and Kalman), and you have a basic understanding of adaptive filtering (LMS, RLS algorithm), Wavelet transform and Feature Extraction techniques.

Reference/Sources:

- Andrey E. Gorodetskiy, Irina L. Tarasova, Smart Electromechanical Systems: Recognition, Identification, Modeling, Measurement Systems, Sensors, Springer, 2022.
- Processing Systems, 2nd Edition, 2013.
- Richard G. Lyons. Understanding Digital Signal Processing, Third Edition, Pearson Education, Inc, 2012.
- Seung-Ki Sul, Control of Electric Machine Drive Systems, IEEE Press and John Wiley, 2011.
- Hamdy, Nadder, Applied Signal Processing: Concepts, Circuits and System, Publisher: Taylor & Francis, 2009.
- Stanley Henry Mneney, An Introduction to Digital Signal Processing: A Focus on Implementation”,



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River Publishers, 2008

- Robert H. Bishop, Mechatronics system control, logic and data acquisition, 2nd Ed, "ch.22" Imprint CRC Press, 2007
- Marina Ruggieri, Michele Luglio, Marco Pratesi. Aracne Editrice, Digital Signal Processing Exercises and Applications", 2004.
- Bhattacharyya, S.S., Deprettere, E.F., Leupers, R., Takala, J. (Eds.), Handbook of Signal
- Digital Signal Processing: A Computer-Based Approach, S. K. Mitra, McGraw-Hill, Third edition, 2006.

Course Title	Enhanced Electro-hydraulic, Pneumatic servo systems				Course Code	MEC 6a5
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Classification of servo-hydraulic systems, fluid-Tronic: Electro-Pneumatic System, Electro-Hydraulic System, Solenoids, Coils, Motors. Design of sequential and cascade pneumatic and Hydraulic Circuits: Grafcet technique, Pertinent and State Diagram, Industrial Applications of electron-pneumatic and electro-hydraulic manipulators. Simulation Electrohydraulic &-Electro-pneumatic circuits by Fluidsim or Automation studio software package. dynamic characteristics, modeling of single-stage servo valves, modeling of two-stage servo valves, nonlinear state-space model of servo valves, identification of servo-hydraulic system, control of hydraulic servo system with force feedback, the influence of servo valve dynamics characteristics on closed-loop control, filtration in hydraulic system with servo and proportional valves. Hydraulic and Pneumatic Proportional Valves: Directional Proportional Valves, Pressure Proportional Valves, Flow Proportional Valves. Hydraulic and Pneumatic Servo System: Directional Servo Valves, Pressure Servo valves. Pneumatic Controller: Types, Dynamic Performance, Tuning.

Reference/Sources:

- Lavzon, Shanae, Electro-hydraulic Power: How Does an Electro-Hydraulic Servo Valve Work, 2021
- Joji Parambath, Electro-pneumatics and Automation, JOJI Books, 2020
- Joji Parambath, Electro-hydraulic Systems and Relay Circuits (Advanced Level), 2020
- Joji Parambath, Electro-hydraulic Servo Valves (Advanced Level), Kindle unlimited publisher, 2020
- Muhammad Babar Nazir, Electro-hydraulic Servo System: A Practical guideline for control and optimization, VDM Verlag Dr. Müller, 2010.
- Mohieddine Jelali, Andreas Kroll, Hydraulic Servosystems: Modelling, Identification and Control, Springer, 2003.

Course Title	Motion control and Enhnace Servo-systems				Course Code	MEC6a6
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Definition of motion control of servo systems, structure of servo systems, Elements of a motion control system, Characteristics and features of servo system applications, Types of motion control servo systems (Control type, controlled variable, actuation power), Parts of servo control systems, Sensors in motion Control: position, velocity, acceleration sensors, voltage and current sensors, force and torque sensors, Encoder and torque resolution, Control patterns, Mathematical modeling of one axis in a mechatronic servo



system, reduced order model of one axis in a mechatronic servo system, linear models. Relation between reference input time interval and velocity fluctuation & locus irregularity. Motion Actuators: analysis of the dynamics of induction, brushless DC and synchronous machines, Scalar VS Vector Control, Parameter sensitivity and identification, Stepper and switched Reluctance motors, Static and dynamic characteristics, Piezoelectric motors, Motion systems, Converter and Controller, Motion Control of Electrohydraulic Servo Systems, Robot servo systems, Motion control System Design: Stability, Hierarchical design techniques, Quantization error of a mechatronic servo system, Error analysis and elimination, Disturbance Rejection. Torque saturation of a mechatronic servo system: measurement method for the torque saturation property, contour control method with avoidance of torque saturation. Master-slave synchronous positioning control: control method, contour control with master-slave synchronous positioning.

Reference/Sources:

1. Yaobao Yin - High Speed Pneumatic Theory and Technology Volume I, Servo System-Springer Singapore, 2019.
2. MD Sabir Ahmed and MD Arifur Rahman, Speed Control of Sensorless Brushless DC Motor, , 2018.
3. Riazollah Firoozian, Servo Motors and Industrial Control Theory, Springer Verlag, 2014.
4. Amro Shafik, Magdy Abdelhameed, Ahmed Kassem, CMAC Based Motion Control of Electrohydraulic Servo Systems, LAP LAMBERT Academic, 2013.
5. Wilfried Voss, A Comprehensive Guide to Servo Motor Sizing, Copperhill Media Corporation; 2nd ed., 2007.
6. M. Nakamura, S. Goto & N Kyura, Mechatronic servo system control, Springer, 2004.

Course Title	Controlling and programing the movement of advanced robotics				Course Code	MEC6a7
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Introduction to Robot Programming, Coordinate systems of Robot, Robot controller, major components, functions-Wrist Mechanism, Interpolation, Interlock commands, Operating mode of the robot, Jogging-Types, Robot specifications, Motion commands, end effectors and sensors commands. VAL Language Robot Languages, Classifications, Structures, VAL language commands motion control, hand control, program control, pick and place applications, Robot operating system ROS, build robot environment Autonomous Navigation. Map creation with the G-Mapping package autonomously navigates a known map with ROS navigation, Manipulation, Motion planning, pick and place behaviors using industrial robots with ROS Move It.

Reference/Sources:

1. Newman, Wyatt S. A systematic approach to learning robot programming with ROS. Chapman and Hall/CRC, 2017.
2. Calinon, Sylvain. Robot programming by demonstration. EPFL Press, 2009.
3. Pattis, Richard E., Jim Roberts, and Mark Stehlik. Karel the robot a gentle introduction to the art of programming. John Wiley & Sons, Inc., 1995.

Course Title	Object-Oriented Programming				Course Code	MEC6a8
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100



	40	60	-	-		
Course Content: Programming Standards Paradigms, Object-Oriented Programming (OOP), Languages, C++ and Python Programming, Introduction to OOP, Basic principles of the OOP, interest of this kind of programming, Essential Python data structures, design patterns, and effective object-oriented techniques. The basic concepts like Object, Encapsulation, Polymorphism, Abstraction, genericity and Inheritance and advanced concepts like Composition, Delegation, Association, and Aggregation. SOLID Principles of Object-Oriented Design.						
Reference/Sources: 1. Mark Reed (Author) Python Programming and SQL, 2023. 2. Deitel and Deitel, C++ How to Program, Third Edition, Pearson Publication. 2020. 3. Herbert Schildt, C++ The Complete Reference, Fourth Edition, Tata McGraw Hill Publication, 2018 4. Robert Lafore, Object Oriented Programming in C++, 4 th ed., SAMS publications, 2012.						

Course Title	Robotics engineering				Course Code	EC6b1
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		
Course Content: Robot mechanisms, End-effector mechanisms, Actuators and drives, Sensors. Robot forward and inverse kinematics. Differential motion and Jacobian (Velocities and forces). Simulation software and analysis. Acceleration and Inertia, Robot dynamics. Trajectory generation and control of robot manipulators. Robot planning and control. Task-oriented control, Force compliance control. Introduction to Robot Programming, Coordinate systems of Robot, Robot controller- major components, functions-Wrist Mechanism-Interpolation-Interlock commands Operating mode of the robot, Jogging-Types, Robot specifications- Motion commands, end effectors and sensors commands, VAL Language Robot Languages-Classifications, Structures, VAL language commands, motion control, hand control, program control, pick and place applications, Robot operating system ROS, build robot environment, Autonomous Navigation, Map creation with the G-Mapping package, autonomously navigates a known map with ROS navigation, Manipulation., Motion planning, pick and place behaviors using industrial robots with ROS Move It.						
Reference/Sources: 1. Kurdila, Andrew J., and Pinhas Ben-Tzvi. Dynamics and control of robotic systems, 2019. 2. Newman, Wyatt S. A systematic approach to learning robot programming with ROS. Chapman and Hall/CRC, 2017. 3. Xu, Yangsheng, and Takeo Kanade, eds. Space robotics: dynamics and control. Vol. 188. Springer Science & Business Media, 2012. 4. Calinon, Sylvain. Robot programming by demonstration. EPFL Press, 2009. 5. Chiacchio, Pasquale, and Stefano Chiaverini, eds. Complex robotic systems. Berlin, Heidelberg: Springer Berlin Heidelberg, 1998. 6. Pattis, Richard E., Jim Roberts, and Mark Stehlik. Karel the robot a gentle introduction to the art of programming, John Wiley & Sons, Inc., 1995.						

Course Title	Autonomous Robotic systems				Course Code	MEC6b2
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100



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	40	60	-	-		
Course Content: Autonomous and Mobile robots, Locomotion concepts and mechanisms, non-holonomic concept and constraint. Wheeled mobile robots: Kinematic and dynamic models. Trajectory generation and control methods. Sensors, sensor models, and perception. Mapping and knowledge representations. Control architectures and Navigation: Planning, Subsumption, Potential field, Motor Schemas, Probabilistic, Learning from observations and Reinforcement learning. Relative and absolute localization. Navigation and localization techniques. SLAM (Simultaneous Localization and Mapping). Multi robotic system: navigation, cooperation, and autonomy.						
Reference/Sources: 1. Yanjun Huang et al., Recent Advancements in Connected Autonomous Vehicle Technologies, Springer Cham, 2023. 2. Newman, Wyatt S. A systematic approach to learning robot programming with ROS. Chapman and Hall/CRC, 2017. 3. Yang Shi, Chao Shen, Henglai Wei, Kunwu Zhang, Advanced Model Predictive Control for Autonomous Marine Vehicles, Springer Cham, 2023 4. Maksym Spiriyagin, Stefano Bruni, Christopher Bosomworth, Peter Wolfs, Colin Cole, Rail Vehicle Mechatronic, CRC Press 2022. 5. M. W. Spong, S. Hutchinson and M. Vidyasagar, "Robot Modelling and Control", 2nd ed., Wiley, 2020. 6. Calinon, Sylvain. Robot programming by demonstration. EPFL Press, 2009. 7. Konrad Reif, Automotive Mechatronics, Bosch Professional Automotive Information, Springer, 2015 8. Asama, Hajime, et al., Distributed autonomous robotic systems 2, Springer Science & Business Media, 2013. 9. Alami, Richard, Raja Chatila, and Hajime Asama, eds. Distributed Autonomous Robotic System 6. Springer Science & Business Media, 2008. 10. Anibal T. Almeida, Oussama Khatib, Autonomous Robotic Systems. Vol. 236. Springer, 1998.						

Course Title	Computer Vision of Robotics				Course Code	MEC6b3
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content: Image Formation, Image Geometry, Radiometry, Digitization Recognition Methodology: Motion-based segmentation. Area Extraction: Boundary analysis: Models database organization. Knowledge-Based Vision: Knowledge representation, Control strategies, Information Integration. Object Recognition: Model-based methods, Appearance-based methods, Invariants. Applications: Image-based rendering, constructing 3-D models from image sequences, light fields.						
Reference/Sources: 1. Eliot, L., & Eliot, M., Autonomous Vehicle Driverless Self-Driving Cars and Artificial Intelligence: Practical Advances in AI and Machine Learning (1st ed.). LBE Press Publishing, 2017. 2. Sankowski, Dominik, and Jacek Nowakowski, eds. Computer vision in robotics and industrial applications. Vol. 3. World Scientific, 2014. 3. Forsyth Ponce, Computer vision: A modern Approach, Pearson 2nd edition, 2011 4. Simon J. D. Prince, Computer Vision: Models, Learning and Interface, 2019 5. Corke, Peter I., and Oussama Khatib. Robotics, vision, and control: fundamental algorithms in MATLAB. Vol. 73, Berlin: Springer, 2011. 6. B. Jähne, Digital Image Processing, Springer, 2005. 7. Chiacchio, Pasquale, and Stefano Chiaverini, Complex robotic systems, Berlin, Heidelberg: Springer						



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Berlin Heidelberg, 1998.
8. Pattis, Richard E., Jim Roberts, and Mark Stehlik. Karel the robot a gentle introduction to the art of programming, John Wiley & Sons, Inc., 1995.

Course Title	Bioinspired Robotic Systems				Course Code	MEC6b4
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Autonomy and cooperation. Task definition, decomposition, and knowledge representation. Resource management and deadlocks. Collaborative Observation and Localization. Multi-Robot Navigation. Human-Robot Interaction. Biologically inspired solutions: Ant colony and social insect behavior, Swarm intelligence, and self-organization.

Reference/Sources:

1. Toshio Fukuda, Fei Chen, Qing Shi, Bio-Inspired Robotics, 2018.
2. Jun Ueda, Yuichi Kurita, Human Modelling for Bio-Inspired Robotics: Mechanical Engineering in Assistive Technologies, 2016.
3. Christopher H. M. Jenkins, Bio-Inspired Engineering, Momentum Press 2011.
4. Nagatomi J, Mechanobiology Handbook. Florida, CRC Press, Print, 2011.
5. Dario Floreano, Claudio Mattiussi, Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies, 2008.
6. J.J. Craig, Introduction to Robotics: Mechanics and Control, Prentice Hall; 3rd edition, 2003.

Course Title	Teleoperation and Haptic Systems				Course Code	MEC6b5
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab	Oral	Total	100
	40	60	-	-		

Course Content:

Technical specifications: teleoperation and haptics systems. Haptics: Human, Machine, and Computer haptics, and their interrelation. Haptic systems: sensors, actuators, and interfaces. Haptic device modeling and control. Event-based haptics, Haptic teleoperation. Bilateral teleoperation, Teleoperation, and haptic systems architecture control approach. Force control, impedance control, stiffness control, Feed-forward control, Adaptive motion/force control. Design for time-delayed teleoperation. Robustness issues. Collaborative control and collaborative virtual environment.

Reference/Sources:

1. Walter Lang, Sensors and
2. Troy McDaniel and Sethuraman Panchanathan, *Haptic Interfaces for Accessibility, Health, and Enhanced Quality of Life*, Springer, 2020.
3. Lynette Jones, *Haptics*, The MIT Press, 2018
4. Femke Elise van Beek, *Making Sense of Haptics: Fundamentals of Perception and Implications for Device Design*, 2017.
5. Haruhisa Kawasaki, *Robot Hands and Multi-fingered Haptic Interfaces: Fundamentals and Applications*, World Scientific Publishing Co Pte Ltd, 2015.
6. Claudio Pacchierotti, *Cutaneous Haptic Feedback in Robotic Teleoperation*, 2015.
7. Matjaž Mihelj, Janez Podobnik, *Haptics for Virtual Reality and Teleoperation*, 2012.



Course Title	Embedded systems				Course Code	MEC6c1
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Fundamentals of embedded systems, operating systems, Real Time operating system, Overview of Embedded Systems architecture and Real-Time Systems, Embedded System Components, Optimum selection of embedded system components for mechatronic systems. Design of Embedded Systems According to Real Time Hardware and Software Components, Communications, Linking, Interfacing and Processing Techniques for Embedded Systems, validation and verification tools, Quality and performance of embedded systems, Embedded Systems Applications in Mechatronics.

Reference/Sources:

1. Frank Vasquez, Chris Simmonds, Mastering Embedded Linux Programming, Packt Publishing; 3rd ed., 2021.
2. Jiacun Wang, Real-Time Embedded Systems, 2017.
3. Hassan Gomaa, Real-Time Software Design for Embedded Systems, 2016.
4. Xiacong Fan, Real-Time Embedded Systems: Design Principles and Engineering Practices, 2015.

Course Title	Machine Learning Algorithms				Course Code	MEC6c2
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

This course introduces many concepts, techniques, and algorithms in machine learning, beginning with topics such as classification and linear regression and ending up with more recent topics such as boosting, support vector machines, kernel methods, decision trees, random forests, hidden Markov models, and Bayesian networks. The course will give the student the basic ideas and intuition behind modern machine learning methods as well as a more formal and advanced understanding of how, why, and when they work. Applications covered in this course include solving problems on real data such as pattern recognition, verification, prediction, and classification.

References

- 1) C. M. Bishop, 2006. *Pattern Recognition and Machine Learning*. Springer.
- 2) Kevin P. Murphy, 2012. *Machine Learning: A Probabilistic Perspective*. MIT Press.
- 3) Ian Goodfellow, Yoshua Bengio and Aaron Courville, 2016. *Deep Learning*. MIT Press.

Numerous articles from the literature Provided by the course instructor.

Course Title	Real Time Programming of Embedded systems				Course Code	MEC6c3
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		



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Course Content:

Practical and theoretical aspects of developing embedded systems with real-time constraints. Topics include real-time operating systems, task management and synchronization, real-time scheduling algorithms, performance analysis and optimization, real-time communication, design for low power, interfacing to external devices, and device drivers.

Programming Examples, Discipline, Methods, and Process of Assembler Program Development, Machine Instruction Format and Instruction Timing, Interface Between OS, ISA and RTL Layers of The Virtual Machine Model, Interrupts, Privilege States and Exception Handling, Programming Examples with Algorithm Analysis, Applications on applied programs of embedded Systems in Mechatronics.

Reference/Sources:

1. Frank Vasquez, Chris Simmonds, Mastering Embedded Linux Programming, Packt Publishing; 3rd ed., 2021.
2. Jiacun Wang, Real-Time Embedded Systems, 2017.
3. Hassan Gomaa, Real-Time Software Design for Embedded Systems, 2016
4. Xiaocong Fan, Real-Time Embedded Systems: Design Principles and Engineering Practices, 2015.

Course Title	Advanced Artificial Intelligence				Course Code	MEC6c4
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

AI Definitions, AI Problems, AI Applications: Production Systems, Search Programs, Heuristic Techniques, Representation and Mapping. AI Applications, Knowledge Importance, Knowledge-Based Systems, Knowledge Representation Approaches: Predicate Logic and Natural Reduction, Procedural and Declaration Knowledge, Logic Programming, Expert Systems, Different Learning Methodologies, Connections Models, Genetic Algorithms, Artificial Neural Networks, Fuzzy Logic Evolutionary System. Knowledge Representation, Search Problems, Blind Search, Informed Search, Structured Knowledge, Associative Network, Object Oriented Representation, Rule-Based Systems, Knowledge Acquisition, General Learning Model, Learning by Induction.

Reference/Sources:

1. Denis Rothman, Artificial Intelligence by Example, 2nd Edition, Packt Publishing 2020.
2. Neil Wilkins, Artificial Intelligence, Bravex Publications, 2020.
3. Zhongzhi Shi, Advanced Artificial Intelligence, 2nd Edition, WSPC; 2019. Neil Wilkins, Artificial Intelligence: A Comprehensive Guide to AI, Machine Learning, Internet of Things, Robotics, Deep Learning, Predictive Analytics, Neural Networks, Reinforcement Learning, and Our Future, 2019
4. Stuart Russell and Peter Norvig, Artificial Intelligence – A Modern Approach, 3rd Edition, 2003.

Course Title	Deep Learning				Course Code	MEC6c5
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

The fundamentals of modern statistical machine learning. The fundamental aspects of machine learning such as data set, overfitting, ensemble learning, evaluation techniques, regularization, and more, regression, and classification (for example, K-Means clustering, Support Vector Machines, Decision Trees, Linear and



Logistic Regression, Neural Networks, among others). Neural network building blocks: linear and logistic regression, followed by shallow artificial neural networks and various deep networks algorithms and their derivations. Explores the usage of deep learning on various problems, including image classification, Students will be expected to perform theoretical derivations. The course will conclude with a final project and presentation on a machine learning problem of their choosing.

Reference/Sources:

1. Kelleher, J. D., Namee, M. B., & D'Arcy, A., Fundamentals of Machine Learning for Predictive Data Analytics, second edition: Algorithms, Worked Examples, and Case Studies, 2nd ed., The MIT Press, 2020.
2. Alpaydin, E., Introduction to Machine Learning, fourth edition (Adaptive Computation and Machine Learning series), 1st ed, The MIT Press, 2016.
3. Mitchell, Thom M., Machine Learning, McGraw-Hill Higher Education, 1997.

Course Title	Metaheuristic Optimization Techniques				Course Code	MEC6c6
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Technical specifications: teleoperation and haptics systems. Haptics: Human, Machine, and Computer haptics, and their interrelation. Haptic systems: sensors, actuators, and interfaces. Haptic device modeling and control. Event-based haptics, Haptic teleoperation. Bilateral teleoperation, Teleoperation, and haptic systems architecture control approach. Force control, impedance control, stiffness control, Feed-forward control, Adaptive motion/force control. Design for time-delayed teleoperation. Robustness issues. Collaborative control and collaborative virtual environment.

Reference/Sources:

1. Walter Lang, Sensors and
2. E.-G. Talbi, Metaheuristics: From design to implementation. Hoboken, New Jersey, USA: John Wiley & Sons, 2009.
3. X.-S. Yang, Nature-inspired optimization algorithms. London, UK: Elsevier, 2014.
4. T. F. Gonzalez, Handbook of approximation algorithms and metaheuristics. Boca Raton, FL, USA: CRC Press, 2007.

Course Title	Nonlinear Mechatronic Systems				Course Code	MEC7a1
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

Identified by the course instructor and approved by the department council.

Reference/Sources:

Course Title	Selected Topics in MEMS				Course Code	MEC7a2
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100



	40	60	-	-		
Course Content: An advanced course was determined by the thesis supervisor and selected based on the research point. The course presents the most recent research topics and in the field of Micro-Electromechanical Systems from the perspective of the sensors and actuators.						
Reference/Sources: 1. Qifa Zhou, Yi Zhang, MEMS Technology for Biomedical Imaging Applications, Mdp AG, 2019 2. Dan Zhang, Advanced Mechatronics and MEMS Devices, Springer, 2013. 3. Arno Lenk, Rüdiger G. Ballas, Roland Werthschützky, Günther Pfeifer, Electromechanical Systems in Microtechnology and Mechatronics, Springer, 2011.						

Course Title	Selected topics in Advanced and intelligent control				Course Code	MEC7a3
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		
Course Content: An advanced course was determined by the thesis supervisor and selected based on the research point. The course presents the most recent research topics and Advanced automatic control and intelligent control in mechatronic systems						
Reference/Sources: 1. Patricia Melin, Oscar Castillo, Fuzzy Logic and Neural Networks for Hybrid for hybrid intelligent system design, Springer, 2023. 2. Denis Rothman, Artificial Intelligence by Example, 2nd Edition, Packt Publishing, 2020. 3. K. J. Åström and B. Wittenmark, Adaptive Control, Courier Dover Publications, 2013. 4. K. S. Narendra and A. M. Annaswamy, Stable Adaptive Systems, Courier Dover Publications, 2012. 5. S. Sastry and M. Bodson, Adaptive Control: Stability, Convergence and Robustness, Courier Dover Publications, 2011.						

Course Title	Selected topics in mechatronics systems				Course Code	MEC7a4
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		
Course Content: An advanced course was determined by the thesis supervisor and selected based on the research point.						
Reference/Sources: 1. Klaus Janschek, Mechatronic Systems Design: Methods, Models, Concepts, Springer, 2012 2. Musa Jouaneh, Fundamentals of Mechatronics, Publisher. Cengage Learning. Publication date, 2012. 3. Devdas Shetty and Richard A. Kolk, Mechatronics System Design, 2nd Edition., 2010. 4. Robert H. Bishop, Mechatronic System Control, Logic, and Data Acquisition, 2nd ed. CRC Press, 2007. 5. Karl J. Åström, Björn Wittenmark, Computer Controlled Systems: Theory and Design, Prentice Hall, 1997.						



Course Title	Selected topics in industrial process control				Course Code	MEC7a5
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

The course presents the most recent research topics and industrial process control in mechatronic systems.

Reference/Sources:

1. Avinash Malekar, Learn everything about factory automation, 2021.
2. Bornet P., Barkin I., Wirtz J, Intelligent Automation, 2020.
3. Nathan Clark, PLC Programming Using RSLogix 5000, 2020
4. Frank Lamb, Advanced PLC Hardware & Programming, Automation Consulting, LLC, 2019.
5. K S Manoj, Industrial Automation with SCADA: Concepts, Communications and Security, Notion Press, 2019.
6. A.K. Gupta, S.K. Arora, Jean Riescher Westcott, Industrial Automation and Robotics: An Introduction, Mercury Learning and Information; Har/Cdr edition, 2016.
7. Mathur S., Panda J., Microprocessors and Microcontrollers, Prentice-Hall, 2016.
8. Clint Bodungen, Hacking Exposed Industrial Control Systems: ICS and SCADA Security Secrets & Solutions, 2016
9. Frank Lamb, Industrial Automation: Hands On, 1st ed., McGraw Hill, 2013.
10. Rex Miller, Mark R. Miller, Industrial Electricity and Motor Controls, McGraw-Hill Education 2008.

Course Title	Selected topics in Advanced Robotics				Course Code	MEC7b1
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content: An advanced course was determined by the thesis supervisor and selected based on the research point. The course presents the most recent research topics in Robot Vision and control from the perspective of images, image enhancement, Feature extraction, Image-based tracking, Imaging, camera models and calibration, Pose Estimation, Motion analysis, etc. visual serving, Stereovision, 3-D reconstruction.



Reference/Sources:

1. Bartneck C., Belpaeme T., Eyssel F., Kanda T., Keijsers M., Šabanović S., Human-Robot Interaction: An Introduction, Cambridge University Press; 1st ed., 2020.
2. Changliu Liu, Te Tang, Hsien-Chung Lin, Masayoshi Tomizuka, Designing Robot Behavior in Human-Robot Interactions, CRC Press; 1st edition, 2019.
3. Marko B. Popovic, Biomechatronics, Academic Press, 2019.
4. Segil, Jacob, Handbook of biomechatronics, Academic Press, 2018.
5. Graham M. Brooker, Introduction to Biomechatronics, 2012.
6. Sankowski, Dominik, and Jacek Nowakowski, eds. Computer vision in robotics and industrial applications. Vol. 3. World Scientific, 2014.
7. Corke, Peter I., and Oussama Khatib. Robotics, Vision, and control: fundamental algorithms in MATLAB. Vol. 73. Berlin: Springer, 2011.
8. Forsyth, David, and Jean Ponce. Computer vision: A modern approach. Prentice hall, 2011

Course Title	Selected topics in autonomous systems				Course Code	MEC7b2
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content: An advanced course was determined by the thesis supervisor and selected based on the research point. The course presents the most recent research topics and in the field of Autonomous Systems from the perspective of Learning from observations and Reinforcement learning. Relative and absolute localization. Navigation and localization techniques. SLAM (Simultaneous Localization and Mapping). Multi robotic system: navigation, cooperation, and autonomy

Reference/Sources:

1. Mittu, R., Sofge, D., Wagner, A., & Lawless, W. F. (2016). Robust Intelligence and Trust in Autonomous Systems, 1st ed., Springer, 2016.
2. Asama, Hajime, et al., eds. Distributed autonomous robotic systems 2. Springer Science & Business Media, 2013.
3. Siegwart, R., Nourbakhsh, I. R., & Scaramuzza, D., Introduction to Autonomous Mobile Robots, second edition (Intelligent Robotics and Autonomous Agents series). The MIT Press, 2011.
4. Alami, Richard, Raja Chatila, and Hajime Asama, eds. Distributed Autonomous Robotic System 6. Springer Science & Business Media, 2008.
5. Oussama Khatib, de Almeida, Anibal T. Autonomous Robotic Systems., Vol. 236. Springer, 1998.
6. Hirose, S., Groen, F. C. A., & Thorpe, C. E., Intelligent Autonomous Systems IAS-3, Ios Pr. Inc., 1993.

Course Title	Selected Topics in embedded systems				Course Code	MEC7c1
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

An advanced course was determined by the thesis supervisor and selected based on the research point. The



course presents the most recent research topics and in the field of embedded system in the from the Robotics, smart robotics.

Reference/Sources:

1. Frank Vasquez, Chris Simmonds, Mastering Embedded Linux Programming, Packt Publishing; 3rd ed., 2021.
2. Jiacun Wang, Real-Time Embedded Systems, 2017.
3. Hassan Gomaa, Real-Time Software Design for Embedded Systems, 2016.
4. Xiaocong Fan, Real-Time Embedded Systems: Design Principles and Engineering Practices, 2015.

Course Title	Selected Topics in Deep & Reinforcement Learning				Course Code	MEC7c2
Teaching Hrs.	Lectures	Tutorial	Lab.	Oral	Cr. Hrs	Prerequisite
	2	2	-	-	3	-
Grades	Final Exam	Semester work	Lab.	Oral	Total	100
	40	60	-	-		

Course Content:

An advanced course was determined by the thesis supervisor and selected based on the research point. The course presents the most recent research topics and in the field of Deep Learning from the Robotics, Autonomous Systems perspective.

Reference/Sources:

1. Richard S. Sutton and Andrew G. Barto, Reinforcement learning: An introduction, Second Edition, MIT Press, 2019.
2. Li, Yuxi., Deep reinforcement learning, arXiv preprint arXiv, 2018.
3. Wiering, Marco, and Martijn Van Otterlo., Reinforcement learning; Adaptation, learning, and optimization, 2012.



CHAPTER (4)

ELECTRICAL ENGINEERING DEPARTMENT

Electrical Engineering Department presents three main Programs

1. Electrical Power and Machines Engineering Program
2. Communication and Electronics Program
3. Computer Systems Engineering Program

1) Electrical Power and Machines Engineering Program

1. Advanced Diploma in Electrical Power and Machines Engineering

Registration takes place in the following research fields:

- 1) Electrical power systems
- 2) High voltage engineering
- 3) Electrical machines and power electronics

By the end of the program, the student should be able to:

1. Apply theories and specialized knowledge in electrical power systems to professional practice.
2. Employ renewable energy resources for protecting the environment and work towards its conservation and maintenance.
3. Discuss and analyze contemporary problems in electrical power systems and categorize them according to their priority in power systems.
4. Solve specialized problems in electrical power systems as power electronic converters and motor drives systems.
5. Apply professional skills in electrical power systems.
6. Use information technology to serve the development of professional practice in electrical power systems.
7. Assess himself/herself and identify his/her own personal learning needs and obtain information from different resources.

TABLE 4. 1. 1 Compulsory Courses of Basic Diploma in Electrical Power and Machines Engineering

S. N	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral/ Practical	Written Exam	Total	
1	GEN501	Scientific Writing and Presentation Skills	2	60	–	40	100	2
2	GEN505	Engineering Mathematics and Numerical Analysis	2	60	–	40	100	2



TABLE 4. 1. 2 Elective Courses of Basic Diploma in Electrical Power and Machines Engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1) Electrical Power Systems								
1	ELE 510	Transmission Systems of Electrical Power	3	60	–	40	100	2
2	ELE 511	Distribution Systems of Electrical Power	3	60	–	40	100	2
3	ELE 512	Analysis of Electrical Power Systems	3	60	–	40	100	2
4	ELE 513	Transient Analyses of Electrical Power Circuits	3	60	–	40	100	2
5	ELE 514	Protection of Electric Power Systems	3	60	–	40	100	2
6	ELE 515	Generation and Utilization of Electrical Power	3	60	–	40	100	2
7	ELE 516	Numerical Methods in Electrical Engineering	3	60	–	40	100	2
8	ELE 517	Linear Control Systems	3	60	–	40	100	2
9	ELE 518	Digital Control Systems	3	60	–	40	100	2
10	ELE 519	Nonlinear Control Systems	3	60	–	40	100	2
2) High Voltage Engineering								
1	ELE 520	Grounding Practices in Power System Networks	3	60	–	40	100	2
2	ELE 521	Substation and Switchgear	3	60	–	40	100	2
3	ELE 522	Dielectric Materials in Power System Networks	3	60	–	40	100	2
4	ELE 523	High-Voltage Applications in Industry	3	60	–	40	100	2
3) Electrical Machines and Power Electronics								
1	ELE 530	Electrical Machines (1)	3	60	–	40	100	2
2	ELE 531	Special Electrical Machines	3	60	–	40	100	2
3	ELE 532	Analysis of Power Electronic Circuits (1)	3	60	–	40	100	2
4	ELE 533	Renewable Energy Systems	3	60	–	40	100	2



*With the help of the academic advisor, the student chooses (9) credit hours with a minimum of elective courses for the Basic Diploma in Electrical Power and Machines Engineering in one of the disciplines mentioned in Table (4.1.2) and according to what is determined by the Scientific Department Council.

TABLE 4. 1. 3 Elective Courses of Advanced Diploma in Electrical Power and Machines Engineering*

S. N	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1) Electrical Power Systems								
1	ELE 610	Dynamic Modeling of Electrical Power Systems	3	60	–	40	100	2
2	ELE 611	Dynamics and Stability of Electrical Power Systems	3	60	–	40	100	2
3	ELE 612	Control of Electrical Power Systems	3	60	–	40	100	2
4	ELE 613	Economic Operation of Electrical Power Systems	3	60	–	40	100	2
5	ELE 614	Planning of Electrical Power Systems (1)	3	60	–	40	100	2
2) High Voltage Engineering								
1	ELE 620	High Voltage Insulators	3	60	–	40	100	2
2	ELE 621	Electrical Transients on Power Systems	3	60	–	40	100	2
3	ELE 622	High Voltage Circuit Breakers	3	60	–	40	100	2
4	ELE 623	High Voltage Testing Techniques	3	60	–	40	100	2
5	ELE 628	HVDC Transmission Lines	3	60	–	40	100	2
3) Electrical Machines and Power Electronics								
1	ELE 630	Electrical Machines (2)	3	60	–	40	100	2
2	ELE 631	Advanced Study in Electrical Machines (1)	3	60	–	40	100	2
3	ELE 632	Analysis of Power Electronic Circuits (2)	3	60	–	40	100	2
4	ELE 633	Advanced Studies in Power Electronic Circuits	3	60	–	40	100	2
5	ELE 634	Advanced Power Electronic Inverter Circuits	3	60	–	40	100	2
6	ELE 635	Power Electronics Applications in Electric Power Transmission	3	60	–	40	100	2

*With the help of the academic advisor, the student chooses (12) credit hours as a minimum from the elective courses for the Advanced Diploma in one of the disciplines mentioned in Table (4.1.3) and according to what is determined by the Scientific Department Council.



Matching matrix for courses versus graduate Competencies of Advanced Diploma in Electrical Power and Machines Engineering

S.N	Course Code	Course Name	Graduate Competencies of Advanced Diploma in Electrical Power and Machines Engineering							Total
			1	2	3	4	5	6	7	
1	GEN 501	Scientific Writing and Presentation Skills	√				√	√	√	٤
2	GEN 505	Engineering mathematics and Numerical Analysis	√		√	√	√			٤
Electrical Power Systems										
3	ELE 510	Transmission Systems of Electrical Power		√						١
4	ELE 511	Distribution Systems of Electrical Power			√					١
5	ELE 512	Analysis of Electrical Power Systems			√			√		٢
6	ELE 513	Transient Analyses of Electrical Power Circuits		√						١
7	ELE 514	Protection of Electric Power Systems	√		√					٢
8	ELE 515	Generation and Utilization of Electrical Power		√			√			٢
9	ELE 516	Numerical Methods in Electrical Engineering			√	√				٢
10	ELE 517	Linear Control Systems		√					√	٢
11	ELE 518	Digital Control Systems						√		١
12	ELE 519	Nonlinear Control Systems					√			١
Total										
High Voltage Engineering										
13	ELE 520	Grounding Practices in Power System Networks							√	١
14	ELE 521	Substation and Switchgear	√					√		٢
15	ELE 522	Dielectric Materials in Power System Networks	√							١
16	ELE 523	High-Voltage Applications in Industry					√		√	٢
Total										
Electrical Machines and Power Electronics										
18	ELE 530	Electrical Machines (1)				√				١
19	ELE 531	Special Electrical Machines				√				١
29	ELE 532	Analysis of Power Electronic Circuits (1)				√				١
21	ELE 533	Renewable Energy Systems		√				√	√	٣
Total			5	5	5	5	5	5	5	

2. Master of Science (M. Sc.) in Electrical Power and Machines Engineering

Registration takes place in the following research fields:

1. Electrical power systems
2. High voltage engineering
3. Electrical machines and power electronics

By the end of the program, the student should be able to:

- 1) Apply theories, principles and concepts to advanced engineering research topics.
- 2) Solve complex engineering problems in electrical power systems.
- 3) Manage concepts and practices in engineering research, design in the power systems.
- 4) Apply and integrate knowledge and understanding of other engineering disciplines to support study of the electrical power systems.
- 5) Show good reasoning and creativity in the solutions of theoretical and practical problems in electrical power systems.
- 6) Gather data, plan, write, and conduct a research project.
- 7) Demonstrate professional competence and critical awareness when selecting and applying appropriate methods for designing and analyzing electrical power system schemes.
- 8) Communicate effectively both orally and in writing to appropriate according to professional and academic standards.

TABLE 4. 1. 4 M. Sc. Thesis in Electrical Power and Machines Engineering

S. N.	Course Code	Course Name	Perquisites	Credit Hours
1	ELE811	M.Sc. Thesis-1	Average GPA 3.0 and minimum 2.7 in all courses in basic and advanced diploma courses	12
2	ELE821	M.Sc. Thesis-2		
3	ELE831	M.Sc. Thesis-3		



Matching matrix for courses versus graduate Competencies of Master of Science in Electrical Power and Machines Engineering

S.N	Course Code	Course Name	Graduate Competencies of M. Sc. Graduate								Total
			1	2	3	4	5	6	7	8	
Electrical Power Systems											
1	ELE 610	Dynamic Modeling of Electrical Power Systems	√	√						√	3
2	ELE 611	Dynamics and Stability of Electrical Power Systems	√	√						√	3
3	ELE 612	Control of Electrical Power Systems	√	√	√	√				√	5
4	ELE 613	Economic Operation of Electrical Power Systems			√	√	√	√	√		5
5	ELE 614	Planning of Electrical Power Systems (1)			√		√	√	√	√	5
Total			3	3	3	2	2	2	2	4	
High Voltage Engineering											
1	ELE 620	High Voltage Insulators	√	√	√	√					4
2	ELE 621	Electrical Transients on Power Systems	√	√	√	√					4
3	ELE 622	High Voltage Circuit Breakers		√	√	√				√	3
4	ELE 623	High Voltage Testing Techniques	√				√	√	√	√	5
5	ELE 628	HVDC Transmission Lines				√	√	√	√	√	5
Total			3	3	3	4	2	2	2	3	
Electrical Machines and Power Electronics											
1	ELE 630	Electrical Machines (2)	√	√		√	√		√		5
2	ELE 631	Advanced Study in Electrical Machines (1)	√	√	√	√	√				5
3	ELE 632	Analysis of Power Electronic Circuits (2)		√	√	√	√	√			5
4	ELE 633	Advanced Studies in Power Electronic Circuits			√	√	√	√			4
5	ELE 634	Advanced Power Electronic Inverter Circuits	√				√	√	√		4
6	ELE 635	Power Electronics Applications in Electric Power Transmission	√	√				√	√	√	5
Total			2	4	3	4	5	3	3	1	
1	ELE811	M.Sc. Thesis	√	√	√	√	√	√	√	√	8
2	ELE821	M.Sc. Thesis	√	√	√	√	√	√	√	√	8
3	ELE831	M.Sc. Thesis	√	√	√	√	√	√	√	√	8
Total			1	1	1	1	1	1	1	1	



3. Philosophy Doctorate (Ph. D) in Electrical Power and Machines Engineering

Registration takes place in the following research fields:

- 1- Electrical power systems
- 2- High voltage engineering
- 3- Electrical machines and power electronics

By the end of the program, the student should be able to:

1. Apply the concepts relevant to electrical power systems, and able to evaluate them critically and apply them effectively to new research topics.
2. Use appropriate knowledge of electrical power systems to investigate new and emerging technologies.
3. Apply appropriate engineering analysis methods for solving complex problems in electrical power systems and assess their limitations.
4. Compile and analyze research data and use appropriate engineering tools in tackling contemporary electrical power systems problems.
5. Process information that may be incomplete or uncertain, quantify the effect of this on the design and use theory or experimental research to mitigate deficiencies.
6. Develop knowledge and comprehensive understanding of development processes and methodologies in electrical power systems and the ability to apply and adapt them in unfamiliar situations.
7. Develop awareness that engineering activities in power systems should promote sustainable development.
8. Develop advanced level knowledge and understanding of a wide range of power systems engineering equipment and components.
9. Critically appraise current practice and its limitations and demonstrate some appreciation of likely new developments.
10. Present innovative design for products, systems, components, or processes to fulfill new needs.
11. Apply engineering technique subject to commercial and industrial constraints.
12. Self and long-life learning.

TABLE 4. 1. 5 Basic Ph. D. Courses in Electrical Power and Machines Engineering*

S. N	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1) Electrical Power Systems								
1	ELE 615	Power Quality	3	60	–	40	100	2
2	ELE 616	Fundamentals of Photovoltaic	3	60	–	40	100	2
3	ELE 617	Economic Operation of Electrical Power Plants	3	60	–	40	100	2
4	ELE 618	Planning of Electrical Power Systems (2)	3	60	–	40	100	2
5	ELE 619	Intelligent Control	3	60	–	40	100	2
2) High Voltage Engineering								
1	ELE 624	Numerical Analysis of Electromagnetic Fields	3	60	–	40	100	2
2	ELE 625	Precision Measurements	3	60	–	40	100	2
3	ELE 626	Design and Planning of High Voltage Laboratories	3	60	–	40	100	2
4	ELE 627	Insulators and Sudden Voltages	3	60	–	40	100	2
3) Electrical Machines and Power Electronics								
1	ELE 636	Advanced Study in Electrical Drive Systems (1)	3	60	–	40	100	2
2	ELE 637	Transient Performance of Electrical Machines	3	60	–	40	100	2
3	ELE 638	High Voltage DC Transmission (HVDC) System	3	60	–	40	100	2
4	ELE 639	Dynamic Control of Power Electronic Converters	3	60	–	40	100	2

*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from the basic courses of the Doctor of Philosophy in one of the disciplines mentioned in Table (4.1.5) and according to what is determined by the Scientific Department Council.



TABLE 4. 1. 6 Specialized Ph. D. Courses in Electrical Power and Machines Engineering*

S. N	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1) Electrical Power Systems								
1	ELE 710	Voltage Stability of Electrical Power Systems	3	60	–	40	100	2
2	ELE 711	Robust Control of Electrical Power Systems	3	60	–	40	100	2
3	ELE 712	Smart Grids	3	60	–	40	100	2
4	ELE 713	Artificial Intelligence	3	60	–	40	100	2
5	ELE 714	Flexible AC Transmission Systems	3	60	–	40	100	2
6	ELE 715	Solar Energy Systems	3	60	–	40	100	2
7	ELE 716	Wind Energy Systems	3	60	–	40	100	2
8	ELE 717	Energy Storage Technologies	3	60	–	40	100	2
9	ELE 718	Model Predictive Control Systems	3	60	–	40	100	2
10	ELE 719	Adaptive Control Systems	3	60	–	40	100	2
2) High Voltage Engineering								
1	ELE 720	Advanced Topics in High Voltage Engineering	3	60	–	40	100	2
2	ELE 721	Advanced Topics in Gas discharge	3	60	–	40	100	2
3	ELE 722	Advanced Topics in High Voltage Testing Techniques	3	60	–	40	100	2
4	ELE 723	Recent Trends in Outdoor High Voltage Insulators	3	60	–	40	100	2
5	ELE 724	Nanotechnology Applications in HV Engineering	3	60	–	40	100	2
6	ELE 725	Power Electronics Applications in High Voltage	3	60	–	40	100	2
3) Electrical Machines and Power Electronics								
1	ELE 730	Advanced Study in Electrical Drive Systems (2)	3	60	–	40	100	2
2	ELE 731	Selected Topics in Electrical Machines	3	60	–	40	100	2



3	ELE 732	Selected Topics in Electric Drive Systems	3	60	–	40	100	2
4	ELE 733	Advanced Study in Electrical Machines (2)	3	60	–	40	100	2
5	ELE 734	Microgrids	3	60	–	40	100	2
6	ELE 735	Resonant Power Converters	3	60	–	40	100	2
7	ELE 736	Electric Vehicles	3	60	–	40	100	2
8	ELE 737	Selected Topics in Power Electronics	3	60	–	40	100	2

*The student chooses (9) credit hours as a minimum from the specialized courses for the Doctor of Philosophy in one of the disciplines mentioned in Table (4.1.6), upon the recommendation of the main supervisor and according to what is determined by the scientific department council.

TABLE 4. 1. 7 Ph.D. Thesis in Electrical Power and Machines Engineering

S. N.	Course Code	Course Name	Perquisites	Credit Hours
1	ELE911	Ph. D. Thesis-1	1. Average GPA <u>3.0</u> and minimum <u>2.7</u> in all courses in basic and specialized Ph. D. courses given in Tables (4.1.5) and (4.1.6) 2. Pass the seminar of stage one of the academic researches.	12
2	ELE921	Ph. D. Thesis-2		
3	ELE931	Ph. D. Thesis-3		



Matching matrix for courses versus graduate Competencies of Doctor of Philosophy in Electrical Power and Machines Engineering

S.N	Code	Course Name	Graduate Competencies of Ph. D. graduate												Total
			1	2	3	4	5	6	7	8	9	10	11	12	
Electrical Power Systems															
1	ELE 615	Power Quality	√	√					√					√	4
2	ELE 616	Fundamentals of Photovoltaic	√	√									√		3
3	ELE 617	Economic Operation of Electrical Power Plants	√	√								√			3
4	ELE 618	Planning of Electrical Power Systems (2)		√	√				√		√				4
5	ELE 619	Intelligent Control		√	√					√		√			4
6	ELE 710	Voltage Stability of Electrical Power Systems			√	√	√						√		4
7	ELE 711	Robust Control of Electrical Power Systems			√	√	√								3
8	ELE 712	Smart Grids			√	√	√	√							4
9	ELE 713	Artificial Intelligence	√			√	√	√							4
10	ELE 714	Flexible AC Transmission Systems						√	√	√				√	4
11	ELE 715	Solar Energy Systems			√			√	√	√					4
12	ELE 716	Wind Energy Systems			√				√	√	√	√			5
13	ELE 717	Energy Storage Technologies				√				√	√	√			4
14	ELE 718	Model Predictive Control Systems	√									√	√	√	4
15	ELE 719	Adaptive Control Systems									√	√	√	√	4
Total			5	5	7	5	4	4	5	5	4	6	4	4	
High Voltage Engineering															
1	ELE 624	Numerical Analysis of Electromagnetic Fields	√	√							√			√	4
2	ELE 625	Precision Measurements	√	√	√				√				√		5
3	ELE 626	Design and Planning of High Voltage Laboratories		√	√	√						√			4
4	ELE 627	Insulators and Sudden Voltages		√	√	√					√				4
5	ELE 720	Advanced Topics in High Voltage Engineering			√	√	√	√							4
6	ELE 721	Advanced Topics in Gas discharge			√	√	√	√							4
7	ELE 722	Advanced Topics in High Voltage Testing Techniques				√	√	√		√					4
8	ELE 723	Recent Trends in Outdoor High Voltage Insulators	√			√	√		√	√					5
9	ELE 724	Nanotechnology Applications in HV Engineering							√	√		√	√	√	5
10	ELE 725	Power Electronics Applications in High Voltage	√							√	√	√	√	√	6
Total			4	4	5	6	4	3	3	4	3	3	3	3	
Electrical Machines and Power Electronics															
1	ELE 636	Advanced Study in Electrical Drive Systems (1)	√	√									√	√	4
2	ELE 637	Transient Performance of Electrical Machines	√	√									√		3
3	ELE 638	High Voltage DC Transmission (HVDC) System	√	√								√		√	4
4	ELE 639	Dynamic Control of Power Electronic Converters		√	√						√				3



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5	ELE 730	Advanced Study in Electrical Drive Systems (2)		√	√				√					3
6	ELE 731	Selected Topics in Electrical Machines			√	√	√							3
7	ELE 732	Selected Topics in Electric Drive Systems			√	√	√							3
8	ELE 733	Advanced Study in Electrical Machines (2)			√	√	√	√						4
9	ELE 734	Microgrids				√	√	√						3
10	ELE 735	Resonant Power Converters					√	√	√					3
11	ELE 736	Electric Vehicles					√	√	√	√	√			5
12	ELE 737	Selected Topics in Power Electronics						√		√	√	√	√	5
Total			3	5	5	4	4	4	3	3	3	3	3	
1	ELE911	Ph. D. Thesis	√	√	√	√	√	√	√	√	√	√	√	12
2	ELE921	Ph. D. Thesis	√	√	√	√	√	√	√	√	√	√	√	12
3	ELE931	Ph. D. Thesis	√	√	√	√	√	√	√	√	√	√	√	12
Total			1	1	1	1	1	1	1	1	1	1	1	



COURSES DESCRIPTION

Course Name	Transmission Systems of Electrical Power					Course Code	ELE 510
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

General considerations of transmission systems, Characteristic of overhead lines, Characteristics of underground cables, Power transformer, Reactors, Capacitors, Regulation and losses, Steady state performance by methods of network solutions, Relays and circuit breakers, Power-line carrier, Voltage and currents during abnormal conditions, Wave propagation on transmission lines, Line design by direct strokes, Insulation coordination, Grounding of power systems.

References

- 1) Bakshi, U.A. and Bakshi, M.V., 2020. *Transmission and distribution*. Technical Publications.
- 2) Bayliss, C.R., Bayliss, C. and Hardy, B., 2012. *Transmission and distribution electrical engineering*. Elsevier.
- 3) Grigsby, L.L., 2007. *Electric power generation, transmission, and distribution*. CRC press.

Course Name	Distribution Systems of Electrical Power				Course Code	ELE 511
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		

Courses Description

Concepts of electric distribution systems, Primary/Secondary network distribution systems, Power quality improvement of electric distribution systems in terms of (voltage variation, power factor, harmonics), Management and monitoring of distribution systems, Application of demand-side management approach to distribution systems, Smart grid concept, Application of smart grid concepts to distribution systems, Application of distributed generation in distribution systems, Earthing of electric distribution systems..

References

- 1) Bayliss, C.R., Bayliss, C. and Hardy, B., 2012. *Transmission and distribution electrical engineering*. Elsevier.
- 2) Grigsby, L.L., 2007. *Electric power generation, transmission, and distribution*. CRC press.

Course Name	Analysis of Electrical Power Systems					Course Code	ELE 512
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Formation of network matrices, load flow iterative methods, Gauss, Gauss-Seidel, Newton-Raphson Methods, Symmetrical faults, Symmetrical components, Unsymmetrical faults: Line to Ground, Line to Line, Double



Line to Ground, Swing equation, Equal-area criterion, Dynamic and transient Stability of single-machine connected to infinite-bus systems (SMIB)..

References

- 1) Glover, J.D., Sarma, M.S. and Overbye, T., 2012. *Power system analysis & design, SI version*. Cengage Learning.
- 2) Gonen, T., 2013. *Modern power system analysis*. CRC Press.

Course Name	Transient Analyses of Electrical Power Circuits					Course Code	ELE 513
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Classical approach to transient analysis, Transient response of basic circuits, Transient analysis using Laplace transform, Transient analysis using Fourier transform, Transient analysis using state variables, Transients in three-phase systems, Transient behavior of transmission line, Travelling waves, Static and Dynamic stability of power systems.

References

- 1) Sauer, P.W., Pai, M.A. and Chow, J.H., 2017. *Power system dynamics and stability: with synchrophasor measurement and power system toolbox*. John Wiley & Sons.
- 2) Machowski, J., Lubosny, Z., Bialek, J.W. and Bumby, J.R., 2020. *Power system dynamics: stability and control*. John Wiley & Sons

Course Name	Protection of Electrical Power Systems					Course Code	ELE 514
Teaching Hours	Lecture	Tutorial		Practical		Credit Hours	3
	2	2		-			
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Protective Relying Function, DC schematic and control circuits, Rely Input Sources, CT, VT and CVT Characteristics, Transformer Protection: Buchholz rely, Pressure Relays, Differential Protection, Differential Protection of 3-winding Transformers, Auto-transformer Protection, Restricted Ground Fault Protection, Generator Protection, Over Excitation protection, Loss of Excitation Protection, Transmission Line Protection, Directional relaying, Over-current Relaying, Distance Relaying, Bus Protection, Breaker Failure Protection, Shunt Capacitor/Reactor Protection, Automatic Reclosure..

References

- 1) Anderson, P.M., Henville, C., Rifaat, R., Johnson, B. and Meliopoulos, S., 2022. *Power system protection*. John Wiley & Sons.
- 2) Paithankar, Y.G. and Bhide, S.R., 2010. *Fundamentals of power system protection*. PHI Learning Pvt. Ltd.

Course Name	Generation and Utilization of Electrical Energy	Course Code	ELE 515



Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Conventional Power Generation, Hydropower Power, Thermal Power Generation, Nuclear Power Generation, Gas/Diesel Power Generation, Non-conventional Power Generation: Solar Energy, Wind Energy, Geothermal Energy Tidal energy, and Biomass/Bio-gas Power Generation, Conservation of Electrical Energy, Cost of Electrical Energy, Tariff, Power Factor Corrections, Electric Heating, Electric Welding, Illumination Terms and Laws, Photometry, Illumination Methods, Electric Derives, Electric Traction, AC and DC Traction, Traction Motors, Electric Braking, Electrolysis..

References

- 1) Wadhwa, C.L., 1989. *Generation, distribution and utilization of electrical energy*. New Age International.
- 2) Sivanagaraju, S., Reddy, M.B. and Srilatha, D., 2010. *Generation and Utilization of Electrical Energy*. Pearson Education India.

Course Name	Numerical Methods in Electrical Engineering					Course Code	ELE 516
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Solution of Linear Equations, Direct and Iterative Methods, Gauss, Gauss-Jordan, LU matrix, Jacobi and Gauss-Seidel, Single Nonlinear Equations: Lin's, Bairstow's and Laguerre, Bisection, Secant, and Tangents, Direct Iteration, Iterative Parameter Perturbation, Newton Iterative Method, Interpolation and Approximation of One-variable Functions, Piecewise Linear Interpolation, Lagrange, Newton-Gregory Polynomials, Chebyshev Polynomials, Numerical Integration and Differentiation of One/Two Variable Functions, Integration of Ordinary Differential Equations (ODEs), Euler and Modified Euler's Method, Heun, Runge-Kutta, Eigen Properties of Matrices and Solution of ODEs, Boundary-Value Problems, Finite Difference Method.

References

- 1) Chapra, S.C. and Canale, R.P., 2011. *Numerical methods for engineers* (Vol. 1221). New York: Mcgraw-hill.
- 2) Rosloniec, S., 2008. *Fundamental numerical methods for electrical engineering* (Vol. 18). Springer Science & Business Media.

Course Name	Linear Control Systems					Course Code	ELE 517
Teaching Hours	Lecture		Tutorial		Practical	Credit Hours	3
	2		2		-		
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Mathematical models of feedback control systems, State-space realization: Controllability, Stability,



Observability, Detectability, Analysis/Simulation of linear control systems, Simulation of non-linear systems, Design of Proportional-integral-derivative (PID) controllers, Design of P, PI controllers by Routh-Hurwitz, Nyquist, Robust control systems, Stability of fractional-order (FO) systems, Design of FO PID and phase-compensators.

References

- 1) Golnaraghi, F. and Kuo, B., 2017. *Automatic control systems*. McGraw-Hill Education.
- 2) Richard C. Dorf and Bishop, R.H., 2008. *Modern control systems*. Pearson Prentice Hall.

Course Name	Digital Control Systems					Course Code	ELE 518	
Teaching Hours	Lecture		Tutorial		Practical	Credit Hours	3	
	2		2		-			
Grades	Written Exam	Course Work		Practical		Oral	Total	100
	40	60		-		-		

Courses Description

Introduction to computer control, Discrete-time signals, Shannon's sampling theorem, z-transform, Convolution Sum and z-transfer functions, Stability Analysis by Bilinear Transformation, Schur-Cohn-Jury Criterion, State-space Representation of Discrete-time Systems, Pole Placement, Controllability and Observability, Observer Design, Polynomial Equations Approach to Design of Digital Control Systems, Diophantine Equation, Robust Digital controller design, Digital PID design, Tracking and Regulation with independent objectives, Internal model control, Pole placement with sensitivity function shaping, Digital controller design with persistent random disturbance, models of random disturbance, minimum/generalized minimum variance tracking and regulation.

References

- 1) Isermann, R., 2013. *Digital control systems*. Springer Science & Business Media.
- 2) Jacquot, R.G., 2019. *Modern digital control systems*. Routledge.

Course Name	Nonlinear Control Systems					Course Code	ELE 519
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Fundamentals of nonlinear systems, Definition of stability of nonlinear systems, Asymptotic Stability, Finite/Global Stability, Sector definition, Classification of nonlinearities, Analysis of nonlinear systems, Analytical Method, Describing Function method, linearization about operating point, Piecewise Linearization, Numerical methods, Phase-plane method, Lyapunov's method, Describing functions of ideal relay, Relay with hysteresis, Dead zones, Saturation, Stability of limit-cycles, Constructing Phase plane, Isoclines method, Delta method, Lenard's method, Bendixen's theorem for existence of limit cycles, Lyapunov's First and Second methods, System Identification, Off-line Parameters Estimation, On-line Parameter Estimation.

References

- 1) Vukic, Z., 2003. *Nonlinear control systems*. CRC Press.
- 2) Marquez, H.J., 2003. *Nonlinear control systems: analysis and design*. John Wiley.



Course Name	Grounding Practices in Power Networks					Course Code	ELE 520
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Introduction, Step and Touch Potential, Allowable limits of body current, Allowable step and touch voltages, transferred potential, Soil resistivity, Different Effects on resistivity, Soil Resistivity Measurements, transient performance of an Earthing System, Protective Surface Material, Ground Conductor, Design of a Substation Grounding System according IEEE standard.

References

- 1) Meliopoulos, A.S., 2017. Power system grounding and transients: an introduction. Routledge.
- 2) Tleis, N., 2007. Power systems modelling and fault analysis: theory and practice. Elsevier.
- 3) Lakervi, E. and Holmes, E.J., 1995. Electricity distribution network design (No. 212). IET.

Course Name	Substation and Switchgear					Course Code	ELE 521
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Introduction, HV buses arrangements, Current transformers and their applications, Voltage transformers and their applications, Circuit breakers, Disconnectors, Earthing switches, Load switches, Lightning arresters. Gas insulated substations

References

- 1) Ryan, H.M. ed., 2001. *High voltage engineering and testing* (No. 32). Iet.
- 2) Bakshi, U.A. and Bakshi, M.V., 2020. *Switchgear & Protection*. Technical Publications.
- 3) Ravindranath, B. and Chander, M., 1977. *Power system protection and switchgear*. New Age International.

Course Name	Dielectric Materials in Power System Networks					Course Code	ELE 522
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Gas/Vacuum as Insulator, Liquid Dielectrics, Solid Dielectrics, Composites, Applications of Insulating Materials.

References

- 1) Khalifa, M., 1990. High-voltage engineering.
- 2) Kuffel, J. and Kuffel, P., 2000. *High voltage engineering fundamentals*. Elsevier.
- 3) Looms, J.S., 1988. *Insulators for high voltages* (No. 7). IET.



Course Name	High voltage applications in Industry					Course Code	ELE 523
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Electrostatic precipitators, Electrostatic separation, Electrostatic painting and coating, Electrostatic spraying, Electrostatic imaging, Electrostatic printing, Electric transducers, Electrostatic transport of light materials, Sandpaper manufacture, Smoke particle detector, Electrostatic spinning, Electrostatic pumping, Electrostatic propulsion, Air cleaning from gaseous pollutants, Ozone Generation, Biomedical applications.

References

1. Mazen Abdel-Salam, et al, "High-Voltage Engineering: Theory and Practice", 2nd Edition, Marcel Dekker Cor., 2000.
2. M S Naidu and V Kamaraju, "High-Voltage Engineering", 5th Edition, McGraw Hill Education (India) Private Limited, ISBN-13: 978-1-25-906289-6, 2013

Course Name	Electrical Machines (1)					Course Code	ELE 530
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Types of induction motors, Performance characteristics of induction motors fed from nonsinusoidal supply, Control of induction motors, Dynamic performance of synchronous motors, Different types of connections of three-phase transformers, Transformation from three phase voltage source to two-phase voltage source, Harmonics in transformers.

References

- 1) Jokinen, T., Hrabovcova, V. and Pyrhonen, J., 2013. Design of rotating electrical machines. John Wiley & Sons.
- 2) Hindmarsh, J., 2014. Electrical machines & their applications (Vol. 1). Elsevier.
- 3) Upadhyay, K.G., 2011. Design of electrical machines. New Age International.
- 4) Gross, C.A., 2006. Electric machines. CRC press.

Course Name	Special Electrical Machines				Course Code	ELE 531
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		

Courses Description

Electromechanical energy conversion, Servo motors, single phase commutator series motor, reluctance motors, stepper motors, linear induction motors, permanent magnet machines, brushless DC motors.

References

- 1) Burman, S.P., 2013. Special Electrical Machines. SK Kataria & Sons.



- 2) Tipping, D., 1964. The Analysis of Some Special-Purpose Electrical Machines. The University of Manchester (United Kingdom).
- 3) Melkebeek, J.A., 2018. Electrical Machines and Drives (pp. 1612-1287). Springer.

Course Name	Analysis of Power Electronic Circuits (1)				Course Code	ELE 532
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		

Courses Description

Analysis of rectifier circuits with inductive load - Analysis of single-phase rectifier circuits with DC motor - Harmonics analysis of output voltage and supply current - Harmonics reduction using output and input filters - Analysis of square-wave voltage-source inverter (VSI) circuits - Analysis of VSI circuits using PWM technique.

References

- 1) Rashid, M.H. ed., 2017. Power electronics handbook. Butterworth-Heinemann.
- 2) Rashid, M.H., 2005. Spice for power electronics and electric power. CRC press.
- 3) Erickson, R.W. and Maksimovic, D., 2007. Fundamentals of power electronics. Springer Science & Business Media.

Course Name	Renewable Energy Systems				Course Code	ELE 533
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		

Courses Description

Types of energy sources (conventional and renewable), Solar photovoltaic (PV) cells, Electric Characteristics, Types of solar cells, Maximum power point tracking (MPPT), PV systems and PV converter systems. Standalone and grid connected of PV systems. Wind energy conversion system, types, wind turbines characteristics, power extracted, generator types (DFIG, PMSG, SEIG), Standalone and grid connected of wind systems, Wind turbines converters systems, Energy Storage Systems.

References

- 1) Dunn, P.D., 1986. Renewable energies: sources, conversion and application.
- 2) Tiwari, G.N. and Mishra, R.K., 2012. Advanced renewable energy sources. Royal Society of Chemistry.
- 3) Hossain, J. and Mahmud, A. eds., 2014. Renewable energy integration: challenges and solutions. Springer Science & Business Media.

Course Name	Dynamic Modeling of Electrical Power Systems					Course Code	ELE 610	
Teaching Hours	Lecture		Tutorial		Practical	Credit Hours	3	
	2		2		-			
Grades	Written Exam	Course Work		Practical		Oral	Total	100
	40	60		-		-		

Courses Description

Synchronous Machine Model in abc Reference Frame, Two-reaction Theory, Rankin's Transformation, Park's Transformations, Rotor-locked Frame of Reference, Dynamic Models of Lumped/Multi-mass Machine Rotor, Models of Transmission Lines, Models of Capacitors Banks, Models of Loads in Rotating Frame of Reference, Elimination of Stator Transients, Integral Manifolds, Reduced Order Models d1-q0, d1-q1, d1-q2 and d2-q2, Voltage controllers, Speed/Frequency controllers, IEEE Types of Excitation Systems, IEEE Types of Power system stabilizers (PSS), FACTS Devices, Models of SVC, TCSC, SSSC and UPFC, Reference Frames in Multimachine Systems, Models of Multimachine Systems, Small-Perturbed Models.



Course Name	Economic Operation of Electrical Power Systems					Course Code	ELE 613
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Advanced Studies in Economic Operation of Electrical Power Systems, Transmission Losses Formula, Coordination of incremental Production Costs and incremental Transmission Losses, Unit Commitment, Economic Operation for Hydro-Thermal Power Systems, Calculation Methods for Determining the Optimal Solution.

References

- 1) Kirschen, D.S. and Strbac, G., 2018. *Fundamentals of power system economics*. John Wiley & Sons
- 2) Stoft, S., 2002. *Power system economics: designing markets for electricity* (Vol. 468). Piscataway: IEEE press.

Course Name	Planning of Electrical Power Systems (1)					Course Code	ELE 614
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Economic Assessment, Fundamental economic Analysis, Electrical Loads and energy Forecasting, Factors for accurate forecasts, Approaches to load forecasting, Forecast methods and uncertainties. Introduction to Power Systems planning (Generation, Distribution and Transmission), Factors affecting power system planning, Objective of power system planning, Network Expansion Planning, a Basic approach, Mathematical simulation of system cost and network constraint equations, Optimization Techniques, Mathematical solution models in static and dynamic Expansion planning, Evaluation of Reliability of Transmission Systems.

References

- 1) Seifi, H. and Sepasian, M.S., 2011. *Electric power system planning: issues, algorithms and solutions* (pp. 69-70). Berlin: Springer.

Course Name	Power Quality					Course Code	ELE 615
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Definition of power quality, Ideal voltage waveform, Nonlinear Loads: rectifier, Power quality IEEE standards 519 and 1159, ANSI Standard C84, High-frequency EMI Curves, Voltage Distortion, Sag, Swell, Transient, Interruption, Notching, Flickers, Harmonics and Inter-harmonics, Harmonic current sources, Power harmonic filters: Line reactor, Shunt passive and multi-section filters, Active filters and Hybrid Harmonic Filters,



Harmonic Current Sources, Switch mode power supplies, Correction of power quality problems, Voltage Disturbance, Reliability, Dynamic Voltage Compensators, Uninterruptible Power Supplies (UPSs), Batteries, Flywheel, Fuel cells, Ultra-capacitors, Magnetic Energy Storage coils, Power quality Events, Standby systems, Power quality Measurements, Meters and analyzers.						
References						
1) Sankaran, C., 2017. <i>Power quality</i> . CRC press.						
2) Kusko, A., 2007. <i>Power quality in electrical systems</i> . McGraw-Hill Education.						
Course Name	Fundamentals of Photovoltaic				Course Code	ELE 616
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
Courses Description						
Sunlight energy, Energy conversion, Solar radiation measurement, Principles of solar cell operation, structure, electrical and optical characteristics, equivalent circuit, Crystalline silicon solar cells, Thin film technologies for PV, building integrated PV (BIPV), Energy production by a PV array, Energy balance in stand-alone PV systems, the estimated cost and payback times for the various technologies, the advantages and disadvantages of each type, feed-in tariffs and other incentives, Standards, Calibration and Testing of PV Modules and Solar cells, PV system monitoring, Safety considerations in PV system, Site Assessment, System Design and Sizing, Maximizing Cell Efficiency, Social and environment Impact of PV systems, Testing and Commissioning of PV systems.						
References						
1) Mertens, K., 2018. <i>Photovoltaics: fundamentals, technology, and practice</i> . John Wiley & Sons.						
2) Cook, G., 1991. <i>Photovoltaic fundamentals</i> . Solar Energy Research Institute.						
Course Name	Economic Operation of Electrical Power Plants				Course Code	ELE 617
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
Courses Description						
Unit Commitment, Economic Operation of Thermal Power Systems, Economic Operation of Hydro-thermal Power Systems, Calculation Methods of Determining of the Optimal Solution.						
References						
1) Kirschen, D.S. and Strbac, G., 2018. <i>Fundamentals of power system economics</i> . John Wiley & Sons.						
2) Stoft, S., 2002. <i>Power system economics: designing markets for electricity</i> (Vol. 468). Piscataway: IEEE press.						
Course Name	Electrical Power Systems Planning (2)				Course Code	ELE 618
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
Courses Description						



Load characteristics (Basic definition, The load and loss factors, Maximum diversified demand, Load growth, ...), Introduction to Planning of Electrical Power Systems (Sub-transmission lines and Distribution Substations), Problem definition, Factors affecting power system planning, Objective of power system planning, Mathematical simulation of objective function and constraint equations, Problem formulation, required data, Solution Algorithm Reliability, Numerical results. Generation planning (added capacity, investment cost, Fuel consumption by type, operation and maintenance costs, ...), Reliability criteria, Load management, Electricity consumption patterns and load management potential in the different load sector.

References

- 1) Seifi, H. and Sepasian, M.S., 2011. *Electric power system planning: issues, algorithms and solutions* (pp. 69-70). Berlin: Springer.

Course Name	Intelligent Control					Course Code	ELE 619
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Artificial intelligence basics, fuzzy set theory, fuzzy rules and fuzzy reasoning, Fuzzy inference systems, Regression and optimization, Least-Square methods, System identifications, Neural networks: Adaptive Networks, Supervised Learning Networks, Back Propagation learning Hybrid Learning algorithms, Recurrent networks, Radial basis networks, Learning from Reinforcement, Neuro-fuzzy systems, Modeling, ANFIS systems, Generalized ANFIS, Applications and Examples.

References

- 1) Gupta, M.M. ed., 1996. *Intelligent control system*. New York: IEEE press.
- 2) De Silva, C.W., 2018. *Intelligent control: fuzzy logic applications*. CRC press.

Course Name	High Voltage Insulators					Course Code	ELE 620
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Electric fields, Analytical calculations of space charge fields, Numerical calculations of space charge fields, Electric field control, gas charge, breakdown in gases, Effect of different factors on gas breakdown, Breakdown in uniform and non-uniform fields, Breakdown under impulse voltage, Breakdown in electronegative gases and its mixtures, insulating liquids, breakdown theories in liquid dielectrics, factors affecting breakdown in liquid, Tests on liquid dielectrics, solid dielectrics, Breakdown in solid dielectrics, solid insulators.

References

- 1) Looms, J.S., 1988. *Insulators for high voltages* (No. 7). IET.
- 2) Kuffel, J. and Kuffel, P., 2000. *High voltage engineering fundamentals*. Elsevier.
- 3) Wadhwa, C.L., 2006. *High voltage engineering*. New Age International.



Course Name	Electrical Transients on Power Systems					Course Code	ELE 621
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Basic considerations and the simple transient changes from breaking conditions, analysis of three phase transient circuits, traveling waves, switching overvoltages, Transient Recovery Voltage, lightning overvoltages, Numerical Simulation of Transient Overvoltages, Insulation Coordination.

References

- 1) Küchler, A., 2017. *High Voltage Engineering: Fundamentals-Technology-Applications*. Springer.
- 2) Kuffel, J. and Kuffel, P., 2000. *High voltage engineering fundamentals*. Elsevier.
- 3) Van der Sluis, L., 2001. *Transients in power systems*. John Wiley & Sons Ltd.

Course Name	High Voltage Circuit Breakers					Course Code	ELE 622
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Principles of arc quenching, Basic theory of electrical discharge, electrical arc, electrical arc of alternating current, Steps of current interruption, Main theories of current interruption, Transient recovery voltage, switching of small capacitive current, switching of small inductive current, current chopping, Control of impulse voltage, Types of HV circuit breakers, Operating mechanisms of circuit breaker, Standard specifications of HV circuit breakers.

References

- 1) Bakshi, U.A. and Bakshi, M.V., 2020. *Switchgear & Protection*. Technical Publications.
- 2) Garzon, R.D., 2002. *High voltage circuit breakers: design and applications*. CRC Press. Flurschein, C.H. and Flurschein, C.H. eds., 1982. *Power circuit breaker theory and design* (Vol. 17). Iet.

Course Name	High Voltage Testing Techniques					Course Code	ELE 623
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Non-Destructive test Techniques, Laboratory HV testing procedures, Statistical treatment of results, Design and testing of external HV insulation, HV circuit breakers test techniques, HV cables test techniques.

References

- 1) Hauschild, W. and Lemke, E., 2014. *High-voltage test and measuring techniques* (Vol. 1). Berlin/Heidelberg, Germany: Springer.
- 2) Kuffel, J. and Kuffel, P., 2000. *High voltage engineering fundamentals*. Elsevier.


 3) Ryan, H.M. ed., 2001. *High voltage engineering and testing* (No. 32). Iet.

Course Name	Numerical Analysis of Electromagnetic Fields					Course Code	ELE 624
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Revision of electromagnetic theories, Classification of electromagnetic problems, Analytical Analysis, Finite Difference Method, Finite Element Method, Charge simulation method, Monte Carlo Method.

References

- 1) Abdel-Salam, M., 2018. *High-voltage engineering: theory and practice, revised and expanded*. CRC Press.
- 2) Haddad, A., Haddad, M., Warne, D.F. and Warne, D. eds., 2004. *Advances in high voltage engineering* (Vol. 40). IET.
- 3) Khalifa, M., 1990. *High-voltage engineering*.

Course Name	Precision Measurements					Course Code	ELE 625
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Peak Voltage measurements by spark gaps, voltage dividers, High voltage capacitors for measuring circuits, voltage dividing systems and impulse voltage measurements, fast digital transient recorders for impulse measurements, Optical measurements and monitoring in HV environments, Partial discharge measurements, electrical detection, acoustic detection, Thermography and other camera techniques, chemical detection.

References

- 1) Khalifa, M., 1990. *High-voltage engineering*.
- 2) Hauschild, W. and Mosch, W., 1992. *Statistical techniques for high-voltage engineering* (No. 13). IET.
- 3) Haddad, A., Haddad, M., Warne, D.F. and Warne, D. eds., 2004. *Advances in high voltage engineering* (Vol. 40). IET.

Course Name	Design, Planning and Layout of High-Voltage Laboratories					Course Code	ELE 626
Teaching Hours	Lecture	Tutorial	Practical			Credit Hours	3
	2	2	-				
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Test Facilities Provided in High Voltage Laboratories, Activities and Studies in High Voltage and UHV Laboratories, Classification of High Voltage Laboratories, Size and Ratings of Large Size High Voltage Laboratories, Grounding of Impulse Testing Laboratories.



References

- 1) Haddad, A., Haddad, M., Warne, D.F. and Warne, D. eds., 2004. *Advances in high voltage engineering* (Vol. 40). IET.
- 2) Abdel-Salam, M., 2018. *High-voltage engineering: theory and practice, revised and expanded*. CRC Press.
- 3) Ryan, H.M. ed., 2001. *High voltage engineering and testing* (No. 32). Iet.

Course Name	Insulators and Sudden Voltages					Course Code	ELE ٦٢٧	
Teaching Hours	Lecture		Tutorial		Practice	Credit Hours	3	
	2		2		--			
Grades	Written Exam	Course Work		Practical		Oral	Total	100
	40	60		-		-		

Course Description:

Causes of Over voltage in Power System, Direct and Indirect lightning stroke, Switching over voltages, Temporary over voltages;, Overvoltage Protection, Protection Against Lightning, Lightning Arrester, Dielectric stress, Insulation characteristics, Randomness of the appearance of discharge, Types of insulation, Types of stress used in high-voltage testing, Insulation coordination.

References:

1. J. P. Holtzhausen and W. L. Vosloo, "High Voltage Engineering Practice and Theory", McGraw-Hill Educ., 2021, ISBN 978-0-620-3767-7.
2. Haddad and D. F. Warne, "Advances in High Voltage Engineering", Published by the Institution of Engineering and Technology, London, U. K., 2007.
3. E. Kuffel and W.S. Zaengl, "High Voltage Engineering; Fundamentals", published by Butterworth-Heinemann, 2000.
4. Hugh M. Ryan, "High Voltage Engineering and Testing", IET Power and Energy series, Published by The Institution of Engineering and Technology, London, U. K., 2009.

Course Name	HVDC Transmission Lines					Course Code	ELE ٦٢٨
Teaching Hours	Lecture		Tutorial	Practice		Credit Hours	3
	2		2	--			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Course Description:

Introduction, Examples on HVDC systems (Existing and under construction), Advantage and disadvantage of HVDC transmission, Types of HVDC linkers, Inverters and Bridges, Inverter circuit analysis, HVDC systems control and protection, Design of HVDC cables.

References:

1. Hugh M. Ryan, "High Voltage Engineering and Testing", 2nd Edition, The Institution of Engineering and Technology, London, United Kingdom, 2009.
2. Dragan Jovicic, "High Voltage Direct Current Transmission: Converters, Systems and DC Grids", John Wiley & Sons Ltd , ISBN:9781119566540, 2019.



Course Name	Electrical Machines (2)					Course Code	ELE 630
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Induction motors field-oriented control, Principles of induction motors field-oriented control, Direct field-oriented control, indirect field-oriented control, Induction motor rotor field-oriented Harmonics, Efficient motors, Starting of electrical machines.

References

1. Bakshi, U.A., 2020. Electrical Machines-II. Technical Publications.
2. Aissaoui, A.G., Tahour, A. and Colak, I. eds., 2018. Optimization and Control of Electrical Machines. BoD–Books on Demand.
3. Vas, P., 1999. Artificial-intelligence-based electrical machines and drives: application of fuzzy, neural, fuzzy-neural, and genetic-algorithm-based techniques (Vol. 45). Oxford university press.

Course Name	Advanced Study in Electrical Machines (1)					Course Code	ELE 631
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Introduction, General theory of electrical machines, Transient performance of electrical machines, Unbalanced operation of three-phase induction machines, Computer simulation of AC machines, Electrical machines insulation, Cooling and ventilation of electrical machines, Noise and vibration of electrical machines.

References

- 1) Toliyat, H.A., Nandi, S., Choi, S. and Meshgin-Kelk, H., 2012. Electric machines: modeling, condition monitoring, and fault diagnosis. CRC press.
- 2) Chiasson, J., 2005. Modeling and high-performance control of electric machines. John Wiley & Sons.
- 3) Kaboli, S. ed., 2016. Reliability in power electronics and electrical machines: industrial applications and performance models: industrial applications and performance models. IGI Global.

Course Name	Analysis of Power Electronic Circuits (2)					Course Code	ELE 632
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Analysis of four quadrants DC choppers, Switching-mode Regulators, Dynamic performance of different DC chopper circuits, Chopper circuit design, DC choppers in renewable energy systems.

References



- 1) Rashid, M.H. ed., 2017. Power electronics handbook. Butterworth-Heinemann.
- 2) Rashid, M.H., 2005. Spice for power electronics and electric power. CRC press.
- 3) Erickson, R.W. and Maksimovic, D., 2007. Fundamentals of power electronics. Springer Science & Business Media.
- 4) Zhong, Q.C. and Hornik, T., 2013. Control of power inverters in renewable energy and smart grid integration. John Wiley & Sons, Incorporated.

Course Name	Advanced Studies in Power Electronic Circuits					Course Code	ELE 633
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Methods of harmonics elimination - Power factor improvement techniques- High voltage DC transmission- Performance analysis of matrix converter.

References

- 1) Zhong, Q.C. and Hornik, T., 2013. Control of power inverters in renewable energy and smart grid integration. John Wiley & Sons, Incorporated.
- 2) Kazmierkowski, M.P., Krishnan, R. and Blaabjerg, F. eds., 2002. Control in power electronics (Vol. 17). San Diego: Academic press.
- 3) Acha, E. and Madrigal, M., 2001. Power System Harmonics: computer modelling and analysis. John Wiley.

Course Name	Advanced Power Electronic Inverter Circuits					Course Code	ELE 634
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Z-source inverters, quasi z-source inverter, Split-source single- and three-phase inverters, Multilevel inverters: diode-clamped, flying-capacitors, cascaded, applications of multilevel inverters in renewable energy systems, reactive power compensation, DC link capacitor voltage balancing, comparison of multilevel converters, Matrix inverters.

References

- 1) Zhong, Q.C. and Hornik, T., 2013. Control of power inverters in renewable energy and smart grid integration. John Wiley & Sons, Incorporated.
- 2) Luo, F.L. and Ye, H., 2017. Advanced DC/AC inverters: applications in renewable energy. Crc Press.
- 3) Saghaforia, A. ed., 2017. Recent Developments on Power Inverters. BoD-Books on Demand.

Course Name	Power Electronics Applications in Electric Power Transmission				Course Code	ELE 635
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written	Course	Practical	Oral	Total	100



	Exam	Work				
	40	60	-	-		
Courses Description Power transmission control, Modern power semiconductor device, Review of power converters used in electric power transmission. Static shunt compensators: Static VAR Compensator (SVC) and Static compensator (STATCOM), Static series compensators, Static voltage and phase angle regulators, Unified power flow controller (UPFC).						
References 1) Skvarenina, T.L. ed., 2018. The power electronics handbook. CRC press. 2) Mazda, F.F., 2016. Power electronics handbook: components, circuits and applications. Elsevier. 3) Ellis, J. and Korper, S., 2002. Control in Power Electronics: selected problems. Academic Press.						

Course Name	Advanced Study in Electrical Drive Systems (1)				Course Code	ELE 636
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Requirements of a good Electrical drive system, DC Motor Drive Systems, AC Motor Drive Systems.						
<u>References</u> 1) Boldea, I. and Nasar, S.A., 2016. Electric drives. CRC press. 2) Chomat, M. ed., 2015. New Applications of Electric Drives. 3) Chomat, M. ed., 2011. Electric machines and drives. BoD–Books on Demand.						
Course Name	Transient Performance of Electrical Machines				Course Code	ELE 637
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Introduction, Linear transformation of electrical machines equations, Transient performance of DC machines, Transient performance of induction machines, Transient performance of DC motor drive systems, Transient performance of induction motor drive systems.						
<u>References</u> 1) Ostovic, V., 2012. Dynamics of saturated electric machines. Springer Science & Business Media. 2) Boldea, I., 2009. Electric machines: steady state, transients, and design with MATLAB. CRC press. 3) Boldea, I. and Tutelea, L.N., 2021. Electric Machines: Transients, Control Principles, Finite Element Analysis, and Optimal Design with MATLAB®. CRC Press.						
Course Name	High Voltage DC Transmission (HVDC) System				Course Code	ELE 638
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100



	40	60	-	-		
<u>Courses Description</u> Comparison between ac and dc transmission systems, Types of dc transmission systems, Power electronics converters used in HVDC, line commutated converters (LCC) and voltage source converters (VSC), Harmonics and harmonics removing of HVDC converters, Control techniques and firing unit of HVDC converters, Transformers of HVDC converters, Active filters, Light HVDC Converters.						
<u>References</u> 1) Sood, V.K., 2006. HVDC and FACTS controllers: applications of static converters in power systems. Springer Science & Business Media. 2) Sharifabadi, K., Harnefors, L., Nee, H.P., Norrga, S. and Teodorescu, R., 2016. Design, control, and application of modular multilevel converters for HVDC transmission systems. John Wiley & Sons. 3) Kim, C.K., Sood, V.K., Jang, G.S., Lim, S.J. and Lee, S.J., 2009. HVDC transmission: power conversion applications in power systems. John Wiley & Sons.						
Course Name	Dynamic Control of Power Electronic Converters				Course Code	ELE 639
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Course Description:</u> Mathematical modeling of DC converters, power electronic converters, equilibrium point, modeling in state space, linear modeling of power converter, transfer function of converters, frequency response analysis, output feedback control, optimal response, simulation of power electronic converter with feedback.						
<u>References:</u> 1. S. Bacha, I. Munteanu, A. I. Bratcu Power Electronic Converters Modeling and Control, with Case Studies, Springer-Verlag London, 2014, ISSN 1439-2232, ISBN 978-1-4471-5477-8, ISBN (eBook) 978-1-4471-5478-5. 2. Weidong Xiao, Power Electronics Step-By-Step: Design, Modeling, Simulation, and Control, 2021, McGraw Hill, ISBN: 978-1-26-045698-1, MHID: 1-26-045698-6. 3. B. Mirafzal, Power Electronic in Energy Conversion Systems, McGraw Hill, 2022, ISBN: 978-1-26-046381-1, MHID: 1-26-046381-8						
Course Name	Voltage Stability of Electrical Power Systems				Course Code	ELE 710
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Power System Stability Classification, Voltage Stability and Voltage Collapse, Time Frames for Voltage Instability, Relationship between Voltage Stability and Rotor Angle Stability, P-V curves, V-Q curves, Reactive Power Compensation, Power system Loads, Static and Dynamic Characteristics of Load Components, Generator Reactive Power Capability, Voltage Stability of a large System, Dynamic Performance subject to Under-voltage Load Shedding.						
<u>References</u> 1) Van Cutsem, T. and Vournas, C., 2007. <i>Voltage stability of electric power systems</i> . Springer Science & Business Media. 2) Danish, M.S.S., 2015. <i>Voltage stability in electric power system: a practical introduction</i> . Logos Verlag Berlin GmbH.						



Course Name	Robust Control of Electrical Power Systems					Course Code	ELE 711
Teaching Hours	Lecture		Tutorial		Practical	Credit Hours	3
	2		2		-		
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Structured and unstructured uncertainties in power systems, Polytopic/affine representation of uncertain systems, Interval plant models, Vertex/Segment plants, Stability of interval polynomials, Kharitonov's theorem, Generalization of Kharitonov's theorem, Edge theorem, Tsypkin-Polyak function, Robustness analysis via Value-set approach, Value sets for nonlinear coefficient functions, Design of robust P, PI, and PID controllers, D-decomposition Method, Pole-placement via D-decomposition, Hermite-Biehler theorem and its generalization, H_∞ controller design, Non-fragile controllers.

References

- 1) Pal, B. and Chaudhuri, B., 2006. *Robust control in power systems*. Springer Science & Business Media.
- 2) Zhou, K. and Doyle, J.C., 1998. *Essentials of robust control* (Vol. 104). Upper Saddle River, NJ: Prentice hall.

Course Name	Smart Grids					Course Code	ELE 712
Teaching Hours	Lecture	Tutorial		Practical		Credit Hours	3
	2	2		-			
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

History of Smart grids, Benefits and Applications, Smart Grid Power and Communication Networks Architecture, Advanced Metering Infrastructure (AMI), Pricing and energy consumption scheduling, Electric Vehicles (EVs) and vehicle-to-grid systems, Integration of Renewable Energy Sources (RES), Microgrid architecture, Fault Detection and Self-healing Systems, Load control switches, Interoperability between power grids, International perspectives (Europe's Super Smart Grid).

References

- 1) Hadjsaïd, N. and Sabonnadière, J.C. eds., 2013. *Smart grids*. John Wiley & Sons.
- 2) Ali, A.S. ed., 2013. *Smart grids: opportunities, developments, and trends*. Springer Science & Business Media.

Course Name	Artificial Intelligence					Course Code	ELE 713	
Teaching Hours	Lecture		Tutorial		Practical	Credit Hours	3	
	2		2		-			
Grades	Written Exam	Course Work		Practical		Oral	Total	100
	40	60		-		-		

Courses Description

Design principles of autonomous agents, Agent architectures, Machine Learning, Neural Networks, Genetic Algorithms (GAs), Swarm Optimization, Multi-agent Collaboration, Recent Algorithms and Soft Computing.



Intelligent Electrical Power Systems and Equipment, Applications of Neural Networks in Power Systems, Power Management, Consumption, Security and Stability, Intelligent Integration of Renewable Energy Sources (RESs), Meta-heuristic Optimization Algorithms: Applications in Planning, Operation, Control, Economic Dispatch, Microgrids and Smart Grids.

References

- 1) Hunt, E.B., 2014. *Artificial intelligence*. Academic Press.
- 2) Boden, M.A. ed., 1996. *Artificial intelligence*. Elsevier.

Course Name	Flexible AC Transmission Systems					Course Code	ELE 714
Teaching Hours	Lecture	Tutorial		Practical		Credit Hours	3
	2	2		-			
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Limitations of transmission systems, Modeling of FACTS controllers, Thyristor-controlled reactor, Static VAR compensator (SVC), Thyristor-controlled series Compensators (TCSC), Voltage source converter, Pulse-width modulation, Conventional Power flow, power flow solution methods, Constrained Power Flow (CPF) Solution, Phase-shifting Transformer, Power Flow Including FACTS controllers, Three-phase power flow in phase frame of reference comprising SVC, TCSC and static compensators, Unified power flow controllers, Optimal Power flow, Newton's Method, Power Flow Tracing.

References

- 1) Song, Y.H. and Johns, A. eds., 1999. *Flexible ac transmission systems (FACTS)* (No. 30). IET.
- 2) Machowski, J., Bialek, J., Bumby, J.R. and Bumby, J., 1997. *Power system dynamics and stability*. John Wiley & Sons.

Course Name	Solar Energy					Course Code	ELE 715
Teaching Hours	Lecture	Tutorial		Practical		Credit Hours	3
	2	2		-			
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Intensity of Solar Radiation within the Outer Space, Calculation of the Solar Intensity on the Earth, Availability and Usability of Solar Energy, Measurement of the Solar Intensity, Direct and Diffuse Radiation, Reflection from the Ground, Solar Angles, Shades, the Equation of Time, Incidence Angle on Horizontal and Inclined Surfaces, Theory of the Flat Plate Collector, Transmission through Glass, Heat Loss Calculations, Collector Performance, Solar Energy Concentrators, Point and Line Concentrators, Cylindrical Trough, Parabolic Trough, Parabolic Dish, Central Receiver, Heliostat, Heliostat Optimum Placement, Sun Beam Tracking, Shadowing and Blocking, Concentration Ratios, Fresnel Lens, Thermal performance, Heat Transfer Coefficients, Receiver Efficiency

References

- 1) Kalogirou, S.A., 2013. *Solar energy engineering: processes and systems*. Academic press.
- 2) Kreider, J.F. and Kreith, F., 1981. *Solar energy handbook*.

Course Name	Wind Energy Systems				Course Code	ELE 716
Teaching	Lecture	Tutorial	Practical		Credit	3



Hours	2	2	-	Hours	
Grades	Written Exam	Course Work	Practical	Oral	Total
	40	60	-	-	100

Courses Description

Introduction to Wind Energy, Wind Speed Classification, Wind Data, Maps, and Wind Rose, Statistical Analysis of Wind Data, Types of Wind Turbines, Instrumentations Used for Operating Wind Data, Construction Details of a Wind Turbine, Wind Turbine Control Schemes, Estimation of Wind Power, Betz' Theorem, Blade Element Theory, Translating Wind Power Machines, Vertical-Axis Wind Turbines, Savonius and Darrieus, Airfoil Theory, Horizontal-Axis Wind Turbines, Wind Energy for Water Pumping, Basics of testing and maintaining major components of wind energy conversion system

References

- 1) Garcia-Sanz, M. and Houppis, C.H., 2012. *Wind energy systems: control engineering design*. CRC press.
- 2) Ali, M.H., 2012. *Wind energy systems: solutions for power quality and stabilization*. Crc Press.

Course Name	Energy Storage Technologies			Course Code	ELE 717
Teaching Hours	Lecture	Tutorial	Practical	Credit Hours	3
	2	2	-		
Grades	Written Exam	Course Work	Practical	Oral	Total
	40	60	-	-	100

Courses Description

Introduction of Energy Storage, Energy Storage Systems, Comparative Ratings and Properties, Electrochemical Energy Storage, Energy Storage by Means of Super-capacitors, Conventional Batteries and Flow Batteries, Superconducting Magnetic Energy Storage, Energy Storage Systems Based on Compressed Air, Hydropower and Pumped Storage Facilities, Flywheel Systems, Energy Storage Based on Hydrogen, System Arrangements and Applications (The Battery Management System (BMS)).

References

- 1) Zobaa, A.F. ed., 2013. *Energy Storage: Technologies and Applications*. BoD–Books on Demand.
- 2) Sterner, M. and Stadler, I. eds., 2019. *Handbook of energy storage: Demand, technologies, integration*. Springer.

Course Name	Model Predictive Control Systems			Course Code	ELE 718
Teaching Hours	Lecture	Tutorial	Practical	Credit Hours	3
	2	2	-		
Grades	Written Exam	Course Work	Practical	Oral	Total
	40	60	-	-	100

Courses Description

Introduction to model predictive control (MPC), Predictive control, Receding Horizon control, State Estimation, Discrete-time MPC with constraints, Formulation of constrained control problems, Quadratic programming, Predictive control with constraints on input variables, Discrete-time MPC using Laguerre Functions, Discrete MPC with prescribed degree of stability, Finite Prediction Horizon, Exponential Data weighting, Asymptotic stability with exponential weighting, Tuning parameters for closed loop performance, Exponentially weighted constrained control, Continuous-time Ortho-normal Basis Functions, Continuous-time MPC, Continuous-time MPC with prescribed degree of stability, Implementation of MPC using Matlab.

**References**

- 1) Soeterboek, R., 1992. *Predictive control: a unified approach*. Prentice-Hall, Inc.
- 2) Raković, S.V. and Levine, W.S. eds., 2018. *Handbook of model predictive control*. Springer.

Course Name	Adaptive Control Systems					Course Code	ELE 719
Teaching Hours	Lecture	Tutorial		Practical		Credit Hours	3
	2	2		-			
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Adaptive control strategies, Identifier-based and Non-identifier Based, Parametric Models, Parameter identification Methods, linear model –based Gradient Algorithms, Least-Square algorithms, Recursive LS Algorithms, Pure LS Algorithms, Modified LS Algorithms, Parameter Projection, Robust Parameter Identification, Robust adaptive laws, Model Reference adaptive control (MRAC), Simple MRAC schemes, MRAC for SISO Plants, Stability analysis of adaptive controllers, adaptive pole placement control, adaptive control for discrete systems, Robust adaptive control schemes.

References

- 1) Fidan, B. and Ioannou, P., 2006. *Adaptive control tutorial*. Philadelphia, PA: Society for Industrial and Applied Mathematics (SIAM).
- 2) Ioannou, P. and Sun, J., 2013. *Robust Adaptive Control*. New York: Dover Publications.
- 3) Bellman, R., 2016. *Adaptive Control Processes*. Princeton, NJ: Princeton University Press.

Course Name	Advanced Topics in High Voltage					Course Code	ELE 720
Teaching Hours	Lecture	Tutorial		Practical		Credit Hours	3
	2	2		-			
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Travelling Waves, Energy Contents of Travelling Waves, The Telegraph Equations, Reflection and Refraction of Travelling Waves, The Origin of Transient Recovery Voltages, The Lattice Diagram, Numerical Simulation of Electrical Transients, Recent Developments of HVDC Electromechanical and Static Circuit Breaker, Grounding of Wind Turbines

References

- 1) Ryan, H.M. ed., 2001. *High voltage engineering and testing* (No. 32). Iet.
- 2) Khalifa, M., 1990. *High-voltage engineering*.
- 3) Jovcic, D., 2019. *High voltage direct current transmission: converters, systems and DC grids*. John Wiley & Sons.

Course Name	Advanced Topics in Gas Discharge					Course Code	ELE 721
Teaching Hours	Lecture	Tutorial		Practical		Credit Hours	3
	2	2		-			
Grades	Written Exam	Course Work		Practical	Oral	Total	100



	40	60	-	-		
<u>Courses Description</u> Corona Discharges, Mechanism of Corona formation in HVAC and HVDC, Waveform of Corona Current in HVAC, Stable Corona formation, Partial discharge measuring technique, Physical background of partial discharges, Requirements on a partial discharge measuring system, Measuring systems for apparent charge, Calibration of a partial discharge measuring system, Examples of partial discharge measurements.						
<u>References</u> 1) Abdel-Salam, M., 2018. <i>High-voltage engineering: theory and practice, revised and expanded</i> . CRC Press. 2) Kuffel, J. and Kuffel, P., 2000. <i>High voltage engineering fundamentals</i> . Elsevier. 3) Jovcic, D., 2019. <i>High voltage direct current transmission: converters, systems and DC grids</i> . John Wiley & Sons.						
Course Name	Advanced Topics in HV Testing Techniques				Course Code	ELE 722
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Basic testing techniques, Recommendations and definitions, Test AC, DC and impulse voltages, Impulse current, Test conditions, Digital measuring technique and evaluation procedures, Requirements on the recording device, Requirements on the evaluation software, Application of digital recording systems, Traceable measurements in high voltage tests, Direct voltage, Alternating voltage, Impulse voltage, Linearity test, Uncertainty of measurement, Definitions related to accreditation, Definitions related to uncertainty.						
<u>References</u> 1) Hauschild, W. and Lemke, E., 2014. <i>High-voltage test and measuring techniques</i> (Vol. 1). Berlin/Heidelberg, Germany: Springer. 2) Kuffel, J. and Kuffel, P., 2000. <i>High voltage engineering fundamentals</i> . Elsevier. 3) Ryan, H.M. ed., 2001. <i>High voltage engineering and testing</i> (No. 32). Iet.						
Course Name	Recent Trends in Outdoor High Voltage Insulators				Course Code	ELE 723
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Porcelain, Toughened glass, Epoxy Resin, Polymer composites, Creepage distance, Puncture distance, Insulator class, Environmental Considerations, Pollution, Weather, Site Severity Assessment, Failure Mechanisms, Tests and Specifications, Insulator Selection and Specification, Inspection and Analysis Techniques, Pollution Mitigation Techniques, Recent Trends in Outdoor HV Insulators.						

**References**

- 1) Kind, D. and Kärner, H., 1985. *High-voltage insulation technology* (Vol. 621). Braunschweig, Wiesbaden: Vieweg.
- 2) Ushakov, V.Y., Ušakov, V.J., Ushakov, V.Y. and Ushakov, V.I., 2004. *Insulation of high-voltage equipment*. Springer Science & Business Media.
- 3) James, R.E. and Su, Q., 2008. *Condition assessment of high voltage insulation in power system equipment* (Vol. 53). IET.

Course Name	Nanotechnology Applications in HV Engineering					Course Code	ELE 724
Teaching Hours	Lecture		Tutorial		Practical	Credit Hours	3
	2		2		-		
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Nanomaterials and Nanotechnology, Types and Classification of Nanomaterials, improving liquid Dielectrics Properties using Nanoparticles, Improving different solid dielectrics properties using Nanoparticles, Improving the Properties of Nonlinear Resistance of Arresters using Nanoparticles, Recent Researches in Nanotechnology Applications in HV Engineering.

References

- 1) Mohamed, A.T. ed., 2020. *Design and investment of high voltage nanodielectrics*. IGI Global.
- 2) Zhou, W. and Wang, Z.L. eds., 2007. *Scanning microscopy for nanotechnology: techniques and applications*. Springer science & business media.
- 3) Karkare, M., 2013. *Nanotechnology: fundamentals and applications*. IK International Pvt Ltd.

Course Name	Power Electronics Applications in HV Engineering					Course Code	ELE 725
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Power Diode, Thyristors, Power Bipolar Transistors, Power MOSFET, Insulated Gate Bipolar Transistor (IGBT), Power Electronics for Renewable Energy Sources.

References

- 1) Ryan, H.M. ed., 2001. *High voltage engineering and testing* (No. 32). Iet.
- 2) Liu, Y., 2012. *Power electronic packaging: design, assembly process, reliability and modeling*. Springer Science & Business Media.

Course Name	Advanced Study in Electrical Drive Systems (2)					Course Code	ELE 730
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3	
	2	2	-				
Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	60	-	-			

**Courses Description**

Induction motors drives fed from AC voltage regulators, Induction motors drives fed from voltage source inverters, Induction motors drives fed from current source inverters, DC motor drives using DC choppers, Variable reluctance motor drives, Stepper motors drives

References

- 1) Boldea, I. and Nasar, S.A., 2016. Electric drives. CRC press.
- 2) Chomat, M. ed., 2015. New Applications of Electric Drives.
- 3) Chomat, M. ed., 2011. Electric machines and drives. BoD–Books on Demand.

Course Name	Selected Topics in Electrical Machines					Course Code	ELE 731
Teaching Hours	Lecture	Tutorial		Practical		Credit Hours	3
	2	2		-			
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Topics of this course will be determined according to the appropriate background of the graduate students and their research topic

References

- 1) The references based on the topics that will be selected by the professor.

Course Name	Selected Topics in Electric Drive Systems					Course Code	ELE 732	
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3	
	2		2	-				
Grades	Written Exam	Course Work		Practical		Oral	Total	100
	40	60		-		-		

Courses Description

Topics of this course will be determined according to the appropriate background of the graduate students and their research topic.

References

- 1) The references based on the topics that will be selected by the professor.

Course Name	Advanced Study in Electrical Machines (2)					Course Code	ELE 733
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Study the effect of unbalanced operation on the performance of electrical machines and transformers, study the effect of the quality of energy sources on the performance of electric motors and transformers and on the stability of synchronous generators, devise and identify defects of electrical machines and study their impact on performance, study the performance of modern systems used in the electromechanical conversion of wind energy and many more



One of the topics that keep pace with development in the field of electrical machines.

References

- 1) Toliyat, H.A., Nandi, S., Choi, S. and Meshgin-Kelk, H., 2012. Electric machines: modeling, condition monitoring, and fault diagnosis. CRC press.
- 2) Chiasson, J., 2005. Modeling and high-performance control of electric machines. John Wiley & Sons.
- 3) Kaboli, S. ed., 2016. Reliability in power electronics and electrical machines: industrial applications and performance models: industrial applications and performance models. IGI Global.

Course Name	Microgrids					Course Code	ELE 734	
Teaching Hours	Lecture	Tutorial		Practical		Credit Hours	3	
	2	2		-				
Grades	Written Exam	Course Work		Practical		Oral	Total	100
	40	60		-				

Courses Description

Electrical Sources of Microgrids: Microturbines (Gas turbines), Fuel Cells, Photovoltaic (PV), Wind Turbines, Energy Storage Systems (Batteries, Super Capacitors, and Flywheels), and Power Electronics Converters of Microgrids.

References

- 1) de Souza, A.C.Z. and Castilla, M. eds., 2019. Microgrids design and implementation. Springer International Publishing.
- 2) Bahrami, S. and Mohammadi, A., 2019. Smart microgrids. Springer Nature Switzerland AG: Springer International Publishing.
- 3) Sharkh, S.M., Abusara, M.A., Orfanoudakis, G.I. and Hussain, B., 2014. Power electronic converters for microgrids (p. 352). Wiley-IEEE Press.

Course Name	Resonant Power Converters					Course Code	ELE 735
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Loss-less switching characteristics: zero voltage switching (ZVS) and zero current switching (ZCS), Series resonant inverters, Parallel resonant inverters, Resonant DC/DC converters with variable frequency control: Basic topologies of resonant series and parallel resonant converters, Asymmetrical pulse-width modulated (PWM) resonant converters, AC/DC converters with soft-switching techniques, Applications of high frequency converters: telecom applications, battery chargers, resonant converters for renewable energy applications.

References

- 1) Kazimierczuk, M.K. and Czarkowski, D., 2012. Resonant power converters. John Wiley & Sons.
- 2) Ioinovici, A., 2013. Power Electronics and Energy Conversion Systems: Fundamentals and Hard-switching Converters. Volume 1. Wiley.
- 3) Lee, F.C. ed., 1989. High-frequency resonant, quasi-resonant, and multi-resonant converters. Blacksburg, VA: Virginia Power Electronics Center.



Course Name	Electric Vehicles					Course Code	ELE 736
Teaching Hours	Lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Environmental Impact and history of electric vehicles, Electric vehicles traction motor characteristics, tractive effort and transmission requirement, energy consumption, Energy storages: electrochemical batteries, ultra-capacitors. Electric propulsion systems: permanent magnet brushless DC motor drives, switched reluctance motor drives, Antilock braking system, Design of drive train parameters: design of electric motor drive power, capacity transmission design, energy storage design, simulations.

References

- 1) Soylu, S. ed., 2011. Electric vehicles: modelling and simulations. BoD–Books on Demand.
- 2) Soylu, S. ed., 2011. Electric vehicles: the benefits and barriers. BoD–Books on Demand.
- 3) Patel, N., Bhoi, A.K., Padmanaban, S. and Holm-Nielsen, J.B. eds., 2021. Electric Vehicles: Modern Technologies and Trends. Springer.

Course Name	Selected Topics in Power Electronics					Course Code	ELE 737
Teaching Hours	Lecture	Tutorial	Practical		Credit Hours	3	
	2	2	-				
Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	60	-	-			

Courses Description

Topics are determined according to the recent trends in the graduate students' research topic.

References

The references based on the topics that will be selected by the professor.



2) Communication and Electronics Engineering Program

1. Advanced Diploma in Communication and Electronics Engineering

By the end of the program, the student should be able to:

1. Apply theories and specialized knowledge in electronics and communication systems to professional practice.
2. Discuss and analyze contemporary problems in electronics and communication systems.
3. Solve specialized problems in electronics and communication systems.
4. Apply professional skills in electronics and communication systems.
5. Use information technology to serve the development of professional practice in electronics and communication systems.
6. Identify and categorize appropriate information sources and evaluate critically their reliability and relevance to a specific topic.
7. Demonstrate initiative, self-motivation and exercise personal responsibility for management of own learning.

TABLE 4. 2. 1 Compulsory Courses of Basic Diploma in Communication and Electronics Engineering

S. N	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1	GEN 501	Scientific Writing and Presentation Skills	2	60	--	40	100	2
2	GEN 502	Statistics and Random Processes	2	60	--	40	100	2



TABLE 4. 2. 2 Elective Courses of Basic Diploma in Communication and Electronics Engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1	ELE541	CAD for Electronics and Communication Engineering	3	60	–	40	100	2
2	ELE542	Applications of Artificial Intelligence and Machine Learning	3	60	–	40	100	2
3	ELE543	Signal Processing for Communication	3	60	–	40	100	2
4	ELE544	Digital Communications	3	60	–	40	100	2
5	ELE545	Microwaves Engineering	3	60	–	40	100	2
6	ELE546	VLSI Design	3	60	–	40	100	2
7	ELE547	Embedded Systems	3	60	–	40	100	2
8	ELE548	Digital Systems	3	60	–	40	100	2
9	ELE549	Internet-of-Things	3	60	–	40	100	2

*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from elective courses of the Basic Diploma in communication and electronics Engineering mentioned in Table (4.2.2)” and according to what is determined by the Scientific Department Council.

TABLE 4. 2. 3 Elective Courses of Advanced Diploma in Communication and Electronics Engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1	ELE641	Radar Systems	3	60	-	40	100	2
2	ELE645	Acoustic Engineering	3	60	-	40	100	2
3	ELE646	Electronic Devices	3	60	-	40	100	2
4	ELE648	Modeling and Control for Robotic Systems	3	60	-	40	100	2



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5	ELE649	Digital Signal Processing	3	60	-	40	100	2

*With the help of the academic advisor, the student chooses (12) credit hours as a minimum from the elective courses of the Advanced Diploma in communication and electronics Engineering mentioned in Table (4.2.3) and according to what is determined by the Scientific Department Council.

TABLE 4. 2. 4 Matrix linking the advanced diploma courses in the Communication and Electronics Engineering Program with the Competencies of the graduates of the program.

S.N	Course Code	Course Name	Advanced Diploma in Communication and Electronics Engineering Program - Graduate Competencies							Total
			1	2	3	4	5	6	7	
1	GEN 501	Scientific Writing and Presentation Skills		√			√	√		٣
2	GEN 502	Statistics and Random Processes	√	√	√					٣
3	ELE541	CAD for Electronics and Communication Engineering	√		√		√		√	٤
4	ELE542	Applications of Artificial Intelligence and Machine Learning	√			√	√		√	٤
5	ELE543	Signal Processing for Communication	√	√	√					٣
6	ELE544	Digital Communications	√	√	√	√				٤
7	ELE545	Microwaves Engineering	√		√	√				٣
8	ELE546	VLSI Design	√		√	√				٣
9	ELE547	Embedded Systems	√	√	√	√				٤
١٠	ELE548	Digital Systems	√	√	√	√				٤
١١	ELE549	Internet-of-Things		√	√	√	√		√	٥
١٢	ELE641	Radar Systems	√		√	√				٣
١٣	ELE645	Acoustic Engineering	√		√	√				٣
١٤	ELE646	Electronic Devices	√	√	√	√				٤
١٥	ELE648	Modeling and Control for Robotic Systems		√	√	√	√			٤
١٦	ELE649	Digital Signal Processing	√	√	√	√				٤
Total			١٣	١٠	١٤	١٢	٥	١	٣	

2) Master of Science in Electronics and Communication Engineering

By the end of the program, the student should be able to:

1. Apply theories, principles, and concepts to advanced engineering research topics.
2. Integrate mathematics, science, information technology, project management and engineering practice to design and innovate solutions for challenging situations.
3. Manage concepts and practices in engineering research, design in electronics and communication systems.
4. Apply and integrate knowledge and understanding of other engineering disciplines to support study of the electronics and communication systems.
5. Show good reasoning and creativity in the solutions of theoretical and practical problems in electronics and communication systems.
6. Gather data, plan, write, and conduct a research project.
7. Demonstrate professional competence and critical awareness when selecting and applying appropriate methods for designing and analyzing electronics and communication systems.
8. Communicate effectively both orally and in writing to appropriate according to professional and academic standards.

TABLE 4. 2. 5 Master of Science Thesis in Communication and Electronics Engineering

S. N.	Course Code	Course Name	Perquisites	Credit Hours
1	ELE841	M.Sc. Thesis-4	Average GPA 3.0 and minimum 2.7 in all courses in basic and advanced diploma courses	12

TABLE 4. 2. 6 Matrix linking the Master of Science courses in the Communication and Electronics Engineering Program with the Competencies of the graduates of the program

S.N.	Code	Course Name	Master of Science in Communication and Electronics Engineering Program - Graduate Competencies								Total
			1	2	3	4	5	6	7	8	
1	GEN 501	Scientific Writing and Presentation Skills					√	√	√	√	4
2	GEN 502	Statistics and Random Processes	√	√		√					3
3	ELE541	CAD for Electronics and Communication Engineering	√	√	√		√		√		5
4	ELE542	Applications of Artificial Intelligence and Machine Learning	√	√			√		√		4
5	ELE543	Signal Processing for Communication	√	√	√		√				4
6	ELE544	Digital Communications	√	√	√		√		√		5
7	ELE545	Microwaves Engineering	√	√	√						3
8	ELE546	VLSI Design	√	√	√				√		4
9	ELE547	Embedded Systems	√	√	√	√			√		5
١٠	ELE548	Digital Systems	√	√	√				√		4
١١	ELE549	Internet-of-Things		√	√	√	√	√			5
١٢	ELE641	Radar Systems	√	√	√				√		4
١٣	ELE645	Acoustic Engineering	√	√	√	√			√		5
١٤	ELE646	Electronic Devices	√	√	√						3
١٥	ELE648	Modeling and Control for Robotic Systems		√	√	√	√		√		5
١٦	ELE649	Digital Signal Processing	√	√	√						3
17	ELE841	M.Sc. Thesis	√	√	√	√	√	√	√	√	8
Total			14	16	14	6	8	3	11	2	



3) Philosophy Doctorate (Ph. D.) in Electronics and Communication Engineering

By the end of the program, the student should be able to:

1. Apply the concepts relevant to electronics and communication systems, and able to evaluate them critically and apply them effectively to new research topics-
2. Use appropriate knowledge of electronics and communication systems to investigate new and emerging technologies.
3. Apply appropriate engineering analysis methods for solving complex problems in electronics and communication systems and assess their limitations.
4. Compile and analyze research data and use appropriate engineering tools in tackling contemporary electronics and communication systems.
5. Process information that may be incomplete or uncertain, quantify the effect of this on the design and use theory or experimental research to mitigate deficiencies.
6. Develop knowledge and comprehensive understanding of development processes and methodologies in communication and electronic systems and the ability to apply and adapt them in unfamiliar situations.
7. Develop awareness that engineering activities in addition to electronics and communication systems should promote sustainable development.
8. Develop advanced level knowledge and understanding of a wide range of electronics and communication equipment and components.
9. Critically appraise current practice and its limitations and demonstrate some appreciation of likely new developments.
10. Present innovative design for products, systems, components, or processes to fulfill new needs.
11. Apply engineering technique subject to commercial and industrial constraints.
12. Self- and long-life learning

TABLE 4. 2. 7 Basic Ph. D. Courses in Communication and Electronics Engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1	ELE642	Communication Systems for Smart grids	3	60	–	40	100	2
2	ELE643	Advanced Computer Networks	3	60	–	40	100	2
3	ELE644	Antennas	3	60	–	40	100	2
4	ELE647	Analog Integrated Circuits Design	3	60	–	40	100	2



*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from the basic courses of the Doctor of Philosophy in Engineering mentioned in Table (4.2.7) and according to what is determined by the Scientific Department Council.

TABLE 4. 2. 8 Specialized Ph. D. courses in Communication and Electronics Engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1	ELE 741	Satellite Systems	3	60	—	40	100	2
2	ELE 742	Millimeter and Terahertz Communications	3	60	—	40	100	2
3	ELE 743	Optical Communication Engineering	3	60	—	40	100	2
4	ELE 744	Selected Topics in Communications	3	60	—	40	100	2
5	ELE 745	Estimation and Detection	3	60	—	40	100	2
6	ELE 746	Selected Topics in Electronics	3	60	—	40	100	2
7	ELE 747	Advanced Mathematics and Operational Research	3	60	—	40	100	2
8	ELE 748	Advanced Topics in Robotic Engineering	3	60	—	40	100	2
9	ELE 749	Biomedical Electronics	3	60	—	40	100	2

*The student chooses (9) credit hours as a minimum from the specialized courses for the Doctor of Philosophy in Engineering mentioned in Table (4.2.8), upon the recommendation of the main supervisor and according to what is determined by the scientific department council.

TABLE 4. 2. 9 Ph. D. Thesis in Communication and Electronics Engineering

Serial	Course Code	Course Name	Perquisites	Credit Hours
1	ELE941	Ph. D. Thesis-4	1. Average GPA 3.0 and minimum 2.7 in all courses in basic and specialized Ph.D. courses 2. Pass the seminar of stage one of the academic researches.	12



TABLE 4. 2. 10 Matrix linking the Doctor of Philosophy courses in the Communication and Electronics Engineering Program with the Competencies of the graduates of the program

S.N.	Code	Course Name	Competencies of Ph. D Graduate in Communication and Electronics Engineering												Total
			1	2	3	4	5	6	7	8	9	10	11	12	
1	ELE642	Communication Systems for Smart grids	√			√			√	√	√		√		6
2	ELE643	Advanced Computer Networks	√			√			√	√	√	√			6
3	ELE644	Antennas		√	√		√			√		√			5
4	ELE647	Analog Integrated Circuits Design		√		√	√		√			√			5
5	ELE 741	Satellite Systems		√	√				√	√		√	√		6
6	ELE 742	Millimeter and Terahertz Communications	√					√	√		√	√			5
7	ELE 743	Optical Communication Engineering		√		√				√		√			4
8	ELE 744	Selected Topics in Communications	√			√		√			√	√		√	6
9	ELE 745	Estimation and Detection		√	√	√	√								4
10	ELE 746	Selected Topics in Electronics	√			√		√			√	√		√	6
11	ELE 747	Advanced Mathematics and Operational Research	√		√	√	√							√	5
12	ELE 748	Advanced Topics in Robotic Engineering		√	√			√				√	√	√	6
13	ELE 749	Biomedical Electronics		√			√		√	√		√	√		6
14	ELE941	Ph. D. Thesis	√	√	√	√	√	√	√	√	√	√	√	√	12
Total			7	8	6	9	6	5	7	7	6	11	5	5	



COURSES DESCRIPTION

Course Name	Scientific Writing and Presentation Skills				Course Code	GEN501
Teaching hours	lecture	Tutorial		Practical	Credit Hours	2
	2	-		-		
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		

Courses Description

The Writing Process, Objectives in Scientific Writing, Audience Recognition and Involvement, Criteria for Writing Reports, Summaries, Letters and Proposals, Research Paper Writing, Oral Communication, Performing Scientific studies. Formal report writing. Patents. Email messages. The Summary writing. Reviewing and editing techniques, Thesis writing, Presentations.

References

Course professor select the appropriate up-to-date reference(s)

Course Name	Statistics and Random Processes				Course Code	GEN502
Teaching hours	lecture	Tutorial		Practical	Credit Hours	2
	2	-		-		
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		

Courses Description

Statistical data and notations, Statistical tables and measures, Measures of central tendency and dispersion, Regression analysis, Confidence intervals, Test of hypothesis – Reliability theory, Probability theory, Discrete and continuous random variable, Distributions, binomial, normal, gamma, Poisson, Bernoulli, Moment generating function, Correlation coefficients of two random variables.

References

Course professor select the appropriate up-to-date reference(s)

Course Name	CAD for Electronics and Communication Engineering				Course Code	ELE541
Teaching hours	lecture	Tutorial		Practical	Credit Hours	3
	2	2		-		
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		

Courses Description

Modeling, design and simulation concepts - Computer graphic design tools – Computer design applications in Communication and Electronics Engineering fields – using different CAD software packages e.g., Matlab/Simulink, LabVIEW, PSpice..etc.

References

1. Jain S, Kapshe S. Modeling and simulation using MATLAB-Simulink for ECE. Wiley India; 2016.
2. Stratoudakis T. Introduction to LabVIEW FPGA for RF, Radar, and Electronic Warfare Applications. Artech House; 2021 Jan 31.
3. Sulaymon Eshkabilov, Beginning MATLAB and Simulink: From Novice to Professional, A Press, 1st Edition, 2019



Course Name	Applications of Artificial Intelligence and Machine Learning					Course Code	ELE542
Teaching hours	lecture	Tutorial		Practical		Credit Hours	3
	2	2		-			
Course Grades	Final Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Introduction to AI and machine learning, Supervised learning, unsupervised learning, and reinforcement learning. Neural Networks, Deep Learning, Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization, Types of deep Neural Networks. Machine Learning and Deep learning applications in signal processing and communication

References

- 1) Stuart j. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach ", 4th Ed., Prentice Hall, Pearson, 2020.
- 2) Tom Taulli, Artificial intelligence Basics", 1st Ed., A press, 2019.
- 3) Neural Networks and Deep Learning", by Charu C. Aggarwal, 1st Ed., Springer, 2018.
- 4) Selected papers by the instructor

Course Name	Signal Processing for Communication					Course Code	ELE543
Teaching hours	lecture	Tutorial		Practical		Credit Hours	3
	2	2		-			
Course Grades	Final Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Signals and Systems definitions and classifications, Convolution, cross correlation and autocorrelation, Signal processing model of the wireless channel, Beamforming concepts (spatial filtering), wireless channel model and linear algebra: QR, SVD, eigenvalue decompositions, projections, Elementary beamformers/receivers: the matched filter, the Wiener filter, Estimation of angles and delays using ESPRIT, adaptive space-time filters and the LMS algorithm, the Constant-Modulus algorithm, Signal Analysis using Computer based program: Introduction to MATLAB and SIMULINK, signal manipulations, convolution, frequency analysis and Filters.

References

- 1- Luis Chaparro, Aydin Akan, "Signals and Systems using MATLAB", 3rd Ed., Academic Press, 2018
- 2- Oppenheim, Alan V., and A. S. Willsky, "Signals and Systems". Prentice Hall, 1982

Course Name	Digital Communications					Course Code	ELE544
Teaching hours	lecture		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Final Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Digital Modulation techniques, digital transmission through band-limited channels- multipath fading channels,



diversity reception, multiple access interference, MIMO and space-time coding, Error Detection and Correction, Media Access Control (TDMA – FDMA – CDMA –OFDMA).

References

- 1- Yong Soo Cho, Jaekwon Kim, Won Y. Yang, Chung G. Kang, “MIMO-OFDM Wireless Communications with MATLAB”, 1st Edition, Wiley-IEEE Press; 2010
- 2- Bernard Sklar, Fredric Harris, “Digital Communications: Fundamentals and Applications”, 3rd Edition, Pearson 2020

Course Name	Microwaves Engineering					Course Code	ELE545
Teaching hours	lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Final Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Matching networks, Filters, Microwave Devices (Microwave Tubes: klystron and magnetron), Microwave transistor amplifier design.

References

1. Michael Steer, “Microwave and RF Design, Volume 1: Radio Systems”, 3rd Ed., 2019
2. David Pozar, “Microwave Engineering”, 4th edition, Wiley 2011
3. Shymala Thamarai, “RF & Microwave Engineering: Beginner Guide”, 2022

Course Name	VLSI Design					Course Code	ELE546
Teaching hours	lecture		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Final Exam	Course Work	Practical		Oral	Total	100
	40	60	-		-		

Courses Description

Introduction on Chip design/manufacturing, CMOS processing technology and enhancements, depth analysis of CMOS inverter and layout, designing combinational and sequential circuit, data path and memory subsystem, system design using FPGA, Design of analog CMOS integrated circuits, frequency response, noise analysis, power efficient VLSI design, power optimization, power estimation.

References

1. Jan Rabaey, Anantha Chandrakasan, Borivoje Nikolic, “Digital Integrated Circuits”, Pearson; 2nd edition, 2002
2. Jong-Ryul Yang, Seong-Tae Han, “Advanced CMOS Integrated Circuit Design and Application”, mdp AG, 1st edition, 2022

Course Name	Embedded Systems				Course Code	ELE547
Teaching hours	lecture	Tutorial		Practical	Credit Hours	3
	2	2		-		
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100



	5	60	-	-		
Courses Description Fundamentals of embedded system hardware and firmware design. Issues such as embedded processor selection, hardware/firmware partitioning, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging. The architecture and instruction set of the microcontroller.						
References 1. Peter Marwedel, “Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things”, 4th Edition, Springer 2021						

Course Name	Digital Systems				Course Code	ELE548
Teaching hours	lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Digital Systems, Combinational Circuits, Arithmetic Blocks, Sequential Circuits, Synthesis of a Processor, Physical Implementation and manufacturing technologies, Scheduling and Resource Assignment, Pipeline, Input–Output Interfaces						
<u>References</u> 1. M. Morris Mano and Michael Ciletti, “Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog”, 6th Edition, 2018.						

Course Name	Internet-of-Things				Course Code	ELE549
Teaching hours	lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Overview of IoT and High-level Architecture, setting up IoT workflow - Programming IoT using Python, Matlab, etc. - Building IoT Applications using Arduino, Raspberry Pi, etc. - IoT Protocols: HTTP, CoAP, MQTT, AMQP, 6LoWPAN- Low-power IoT networks (LoRaWAN- NB-IoT, etc.) - IoT Cloud Infrastructure, Performance and Security in IoT – cloud computing – Modern applications in communications.						
<u>References</u> 1. Peter Marwedel, “ Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things”, 4 th Edition, Springer 2021						

Course Name	Radar Systems				Course Code	ELE641
Teaching hours	lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100



	40	60	-	-		
Courses Description Radar Equation, probability of false alarm and threshold detection, radar cross-section, system losses, propagation characteristics over land and sea, Pulsed and Continuous Wave (CW) Radar, Moving Target Indicator (MTI) and Pulse Doppler Radars, Detection of signals in noise, Matched Filter, Detection Criteria, Detector characteristics.						
References 1. G. Raju, "Radar Engineering and Fundamentals of Navigational Aids", Dreamtech Press 1 st edition, 2021						

Course Name	Communication Systems for Smart grids				Course Code	ELE642
Teaching hours	lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
Courses Description Introduction to smart grid architecture, applications and requirements of smart grid , Technical challenges and enhancements in smart grid applications, Smart metering systems based on power line communications, Frequency estimation and demand response for smart grid systems, Demand-side management and demand response for smart grid, Energy management system for renewable distributed generation and energy storage, Standards and communication systems in smart grid, Next generation mobile communication systems: fundamentals, challenges, and key technologies, 5G/B5G/6G communication networks and modulation schemes for next generation smart grid, cyber security objectives and requirements for smart grid.						
References 1- Alberto Sendin, Javier Matanz, Ramon Ferrús, “Smart Grid Telecommunications: Fundamentals and Technologies in the 5G Era”, Wiley-IEEE Press; 1st edition , 2021						

Course Name	Advanced Computer Networks				Course Code	ELE643
Teaching hours	lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Internet procedures and technologies, efficient, effective, and secure interconnection of both distributed applications and related structured data. Routing, flow and congestion control algorithms and procedures, quality of service for various distributed application.						
<u>References</u> 1. Behrouz A. Forouzan, “Data Communications and Networking”, 5th Ed., McGraw Hill, 2012. 2. Curt White, “Data Communications and Computer Networks: A Business User's Approach”, 8th Edition, 2015						



Post Graduate Bylaw (Credit Hours System) 2023

Course Name	Antennas					Course Code	ELE644
Teaching hours	lecture	Tutorial		Practical		Credit Hours	3
	2	2		-			
Course Grades	Final Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		
<u>Courses Description</u> Antenna arrays and smart antenna, aperture antennas (equivalence principle, slot antennas, horn antennas), broadband antennas (traveling-wave antennas, Log-Periodic Antennas), printed antennas (microstrip antennas, printed inverted F antennas), Artificial Impedance Surfaces for Antennas.							
<u>References</u> 1. Constantine A. Balanis, “Antenna Theory: Analysis and Design”, 4th Ed., Wiley, 2016							

Course Name	Acoustic Engineering					Course Code	ELE645
Teaching hours	lecture	Tutorial		Practical		Credit Hours	3
	2	2		-			
Course Grades	Final Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Parameters and definitions, Acoustic wave propagation in free space, SAW devices (delay lines, filters, resonators), modeling and simulation for SAW devices (impulse response model, equivalent circuit model, finite element model), Applying different simulation tools (e.g. MATHCAD / OCTAVE / MATLAB/ COMSOL), Recent applications for SAW devices in electronics and communications fields.

References

1. Allan D. Pierce, “Acoustics: An Introduction to Its Physical Principles and Applications”, 3rd ed, Springer, 2019

Course Name	Electronic Devices				Course Code	ELE646
Teaching hours	lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Fabrication of MOS devices on Silicon and on Silicon Over Insulator (SOI), MOS Capacitors and Transistors properties, Short and narrow channel effects, Applications.						
<u>References</u> 1. Weste NH, Harris D. “CMOS VLSI design: a circuits and systems perspective.” Pearson Education India; 2015. 2. Kononchuk, Oleg, and Bich-Yen Nguyen. “Silicon-on-insulator (soi) technology: Manufacture and applications”. Elsevier, 2014. 3. Thomas Floyed, “Electronics Fundamentals. Circuits, Devices, and Applications”, Pearson; 8 th edition, 2014						



Post Graduate Bylaw (Credit Hours System) 2023

Course Name	Analog Integrated circuits design				Course Code	ELE647
Teaching hours	lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Pre transistor era, Advanced analysis of MOS transistors, layout for Amplifiers, diode connected load, Differential Amplifiers, DC voltage / current sources, Frequency Response, Miller effect, Noise, Negative feedback, compensation.						
<u>References</u> 1- Behzad Razav, “Design of Analog CMOS Integrated Circuits (Irwin Electronics & Computer Engineering)”, McGraw Hill; 2nd edition, 2016 2- Tony Chan Carusone, David Johns, Kenneth Martin, “Analog Integrated Circuit Design“, Wiley; 2nd edition, 2011						

Course Name	Modeling and Control for Robotic Systems				Course Code	ELE648
Teaching hours	lecture		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Forward Kinematics, Inverse Kinematics, Velocity Kinematics, Control, Sensors, Actuators and Drive Systems, Mobile Robots, MATLAB Robotics Toolbox.						
<u>References</u> 1- M. W. Spong, S. Hutchinson and M. Vidyasagar, “Robot Modelling and Control”, 2nd ed., Wiley, 2020. 2- Kevin M. Lynch and Frank C. Park, “Modern Robotics Mechanics, Planning, And Control”, Cambridge University Press, 2017. 3- Spyros G. Tzafestas, “Introduction to Mobile Robot Control,” ELSEVIER, 2014.						

Course Name	Digital Signal Processing				Course Code	ELE649
Teaching hours	lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Fundamentals of advanced discrete-time signal processing (Discrete signals, sampling, periodicity, classifications and discrete signals manipulation, Discrete Systems, Discrete convolution), Model discrete-time signals in various ways (pole-zero, all-pole, FIR, etc.), Frequency analysis: (Frequency Response, Discrete Time Fourier analysis, Discrete Fourier series, Discrete Time Fourier transform, Fast Fourier Transform (Time and Frequency Decimation), Z Transform, Z transform Properties, Digital Filters, types, realization, frequency response, Matlab Simulation, Design optimum filters (Wiener and Kalman), and you have a basic understanding of adaptive filtering (LMS, RLS algorithm), Wavelet transform and Feature						



Extraction techniques.

References

1. Keonwook Kim, "Conceptual Digital Signal Processing with MATLAB (Signals and Communication Technology)", Springer; 1st ed. 2021
2. Anand Kumar, "Digital Signal Processing Paperback", Prentice Hall of India; 2nd Ed., 2015
3. Dimitris G. Manolakis, Vinay K. Ingle, "Applied Digital Signal Processing: Theory and Practice", Cambridge University Press, 1st Ed., 2011

Course Name	Satellite Systems				Course Code	ELE741
Teaching hours	lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		

Courses Description

Introduction to Satellites and their Applications, Satellite orbits and trajectories- Satellite launch and in-orbit operations, Satellite hardware, Communication techniques, Multiple access techniques (FDMA, TDMA, CDMA, and SDMA), Satellite link design fundamentals, Earth station, Networking concepts, Satellite applications: Communication satellites, Remote sensing satellites- Weather satellite- Navigation satellites...etc., Emerging trends.

References

1. Anil K. Maini, Varsha Agrawal, "SATELLITE TECHNOLOGY PRINCIPLES AND APPLICATIONS", Third Ed., 2014, Wiley
2. Wayne Tomasi, "Advanced Electronic Communications Systems", Pearson; 6th Ed., 2003
3. L.Frenzel, "Principles of electronic communication systems", McGraw Hill; 4th Ed., 2015

Course Name	Millimeter and Terahertz Communications					Course Code	ELE742
Teaching hours	lecture		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Final Exam	Course Work		Practical	Oral	Total	100
	40	60		-	-		

Courses Description

Millimeter wave bands characteristics, millimeter wave antennas, millimeter wave massive MIMO, millimeter wave massive MIMO channel modeling, beam steering and beamforming, multiple-access for mmWave massive MIMO, Precoding for mmWave massive MIMO, modulations for millimeter wave communications, Terahertz waves characteristics, Selected topics in Terahertz communication.

References

1. Peng Yang, Wen Wu, Ning Zhang, Xuemin Shen, "Millimeter-Wave Networks: Beamforming Design and Performance Analysis", Springer, 1st ed. 2021 Edition
2. Selected papers by the instructor.

Course Name	Optical Communication Engineering				Course Code	ELE743
Teaching hours	lecture	Tutorial		Practical	Credit Hours	3
	2	2		-		
Course Grades	Final	Course	Practical	Oral	Total	100



	Exam	Work				
	40	60	-	-		
<u>Courses Description</u> Optical Modulators: Introduction, Review of basic principles, Electro-optic modulators, Acoustic-optic modulators applications, Optical Amplifiers: Introduction, Semiconductors Optical Amplifiers, Erbium-doped fiber amplifiers, Fiber Raman amplifiers, Application Areas, Optical Planar guides, Wave Propagation in an Inhomogeneous Medium, Planar Optical Waveguide Solutions, Modes of a Step-Index Symmetric waveguide, Power Distribution and Confinement Factor.						
<u>References</u> 1. John Gowar, "Optical Communication Systems", Prentice-Hall International Series in Optoelectronics, 1993 2. Gerd Keiser, "Optical Fiber Communications" 4 th Ed., McGraw-Hill, 2010 3. S.C. GUPTA, TEXTBOOK ON OPTICAL FIBER COMMUNICATION AND ITS APPLICATIONS, 3 rd Ed. PHI Learning, 2021.						

Course Name	Selective Topics in Communications				Course Code	ELE744
Teaching hours	lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Recent Topics selected by the instructors.						
<u>References</u> Selected papers by the instructor						

Course Name	Estimation and Detection				Course Code	ELE745
Teaching hours	lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Basics of detection and estimation theory, as used in statistical signal processing, adaptive beamforming, radar, telecommunication, system identification, and elsewhere, Optimal estimation, minimum variance unbiased estimators, the Cramer-Rao bound, best linear unbiased estimators, maximum likelihood estimation, recursive least squares, Bayesian estimation techniques, and the Wiener filter, Detection theory, multiple hypothesis testing, the Neyman-Pearson Theorem, Bayes Risk, and testing with unknown signal and noise parameters						
<u>References</u> 1- Kung Yao, Flavio Lorenzelli, Chiao-En Chen , “Detection and Estimation for Communication and Radar Systems”, Cambridge University Press, 1st Edition, 2013						

Course Name	Selective Topics in Electronics			Course Code	ELE746
Teaching hours	lecture	Tutorial	Practical	Credit Hours	3
	2	2	-		



Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
Courses Description						
Recent Topics selected by the instructors.						
References:						
Selected papers by the instructor						

Course Name	Advanced Mathematics and Operational Research				Course Code	ELE747
Teaching hours	lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
Courses Description						
Introduction to mathematical and Operations Research, Linear and nonlinear optimization, Introduction to convexity, Convex optimization problems, Lagrangian duality, Applications in ELE, Interior point methods, Convex relaxations, Applications of advanced mathematics techniques in electronics and communications (including Ordinary Differential Equations, Laplace Transforms, Linear Algebra, Numeric Methods, Fourier analysis, Partial Differential Equations, Hypergeometric functions, etc.).						
References						
1. Renata Mansini, Włodzimierz Ogryczak, M. Grazia Speranza, "Linear and Mixed Integer Programming for Portfolio Optimization", Springer, 1st edition, 2015 2. Boyd, S. & Vandenberghe, L., "Convex optimization", Cambridge university press, 1 st edition, 2004						

Course Name	Advanced Topics in Robotic Engineering				Course Code	ELE748
Teaching hours	lecture	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
Courses Description						
Probabilistic State Estimation, Gaussian Filters (Kalman Filters – Extended Filters) and Nonparametric Filters (Particle Filters), Modelling robot motion and measurements, Mobile Robot Localization, Cell Decompositions, Roadmaps, Mobile Robot Mapping, Simultaneous Localization and Mapping (SLAM).						
References						
1. Mohinder S. Grewal (Author), Angus P. Andrews, "Kalman Filtering: Theory and Practice with MATLAB", Wiley-IEEE Press; 4th edition, 2014 2. Selected papers by the instructor						

Course Name	Biomedical Electronics			Course Code	ELE749
Teaching hours	lecture	Tutorial	Practical	Credit Hours	3
	2	2	-		



Course Grades	Final Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Courses Description</u> Safety and Isolation in Medical Devices, Methods of Deleting Noises, Heart Assistant Devices, Measurements of Physiological and Biosensors, Bio-Signal Processing, Scanning Methods.						
<u>References</u> 1. David Prutchi, Michael Norris m “Design and Development of Medical Electronic Instrumentation: A Practical Perspective of the Design, Construction, and Test of Medical Devices”, Wiley, 1st Edition, 2004						



3) Computer Systems Engineering Program

1. Advanced Diploma in Computer Systems Engineering

By the end of the program, the student should be able to:

1. Apply advanced mathematics and engineering knowledge in identifying, formulating, and solving computer engineering problems.
2. Apply analytic critical and systemic thinking to identify, diagnose and solve computer systems engineering problems with a wide range of complexity and variation.
3. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
4. Apply proper theoretical practical knowledge of software requirements engineering and software systems design. This includes feasibility analysis, negotiation, and good communication with stakeholders.
5. Conduct a research study and write a scientific essay about a research problem.
6. Self-learn new models, techniques, and technologies as they emerge.
7. Use appropriate specialized computer software, computational tools, and packages professionally.

TABLE 4. 3. 1 Compulsory Courses of Basic Diploma in Computer Systems Engineering

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1	GEN 501	Scientific Writing and Presentation Skills	2	60	–	40	100	2
2	GEN 502	Statistics and Random Processes	2	60	–	40	100	2



TABLE 4. 3. 2 Elective Courses of Basic Diploma in Computer Systems Engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1	ELE 551	High Performance Computer Architecture	3	60	–	40	100	2
2	ELE 552	Human computer interaction	3	60	–	40	100	2
3	ELE 553	Embedded Systems	3	60	–	40	100	2
4	ELE 554	Artificial Intelligence Theories	3	60	–	40	100	2
5	ELE 555	Advanced Software Engineering	3	60	–	40	100	2
6	ELE 556	Advanced Computer Networks	3	60	–	40	100	2
7	ELE 557	Advanced algorithms	3	60	–	40	100	2
8	ELE 558	Machine Learning algorithms	3	60	–	40	100	2
9	ELE 559	Selected topic in computer Engineering	3	60	–	40	100	2

*With the help of the academic advisor, the student chooses (9) credit hours with a maximum of three elective courses for the Basic Diploma in Computer Systems Engineering and according to what is determined by the Scientific Department Council.

TABLE 4. 3. 3 Elective Courses of Advanced Diploma in Computer Systems Engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1	ELE 650	Distributed and Parallel computer Systems	3	60	–	40	100	2
2	ELE 651	Advanced Cryptography and Network Security	3	60	–	40	100	2
3	ELE 652	Advanced Image Processing	3	60	–	40	100	2
4	ELE 653	Neural Networks and Deep Learning	3	60	–	40	100	2
5	ELE 654	Recent Trends in Computer Systems	3	60	–	40	100	2

*With the help of the academic advisor, the student chooses (9) credit hours as minimum and five elective courses at maximum for the Advanced Diploma in Computer Systems engineering and according to what is determined by the Scientific Department Council.


Advanced Diploma in Computer Systems Engineering Program's Courses Vs Program's Graduate Competencies

S. N.	Code	Course Name	Advanced Diploma in Computer Systems Engineering Graduate Competencies						
			1	2	3	4	5	6	7
Compulsory Courses of Basic Diploma in Computer Systems Engineering									
1	GEN 501	Scientific Writing and Presentation Skills	√	√	√	√	√	√	
2	GEN 502	Statistics and Random Processes	√	√		√		√	
Elective Courses of Basic Diploma in Computer Systems Engineering									
3	ELE 551	High Performance Computer Architecture	√	√			√	√	√
4	ELE 552	Human computer interaction	√	√	√	√	√	√	√
5	ELE 553	Embedded Systems	√	√			√	√	√
6	ELE 554	Artificial Intelligence Theories	√	√		√	√	√	√
7	ELE 555	Advanced Software Engineering	√	√		√	√	√	√
8	ELE 556	Advanced Computer Networks	√	√			√	√	√
9	ELE 557	Advanced algorithms	√	√		√	√	√	√
10	ELE 558	Machine Learning algorithms	√	√	√	√	√	√	√
11	ELE 559	Selected topic in computer Engineering	√	√	√	√	√	√	√
Elective Courses of Advanced Diploma in Computer Systems Engineering									
12	ELE 650	Distributed and Parallel computer Systems	√	√			√	√	√
13	ELE 651	Advanced Cryptography and Network Security	√	√	√	√	√	√	√
14	ELE 652	Advanced Image Processing	√	√	√	√	√	√	√
15	ELE 653	Neural Networks and Deep Learning	√	√	√	√	√	√	√
16	ELE 654	Recent Trends in Computer Systems	√	√	√	√	√	√	√

2. Master of Science (M. Sc.) in Computer Systems Engineering

By the end of the program, the student should be able to:

1. Apply advanced mathematics and engineering knowledge in identifying, formulating, and solving computer engineering problems.
2. Apply analytic critical and systemic thinking to identify, diagnose and solve computer systems engineering problems with a wide range of complexity and variation.
3. Define the basics and the ethics of scientific research
4. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
5. Apply proper theoretical practical knowledge of software requirements engineering and software systems design. This includes feasibility analysis, negotiation, and good communication with stakeholders.
6. Apply abstract reasoning to complex problems in computer engineering,
7. Perform research emphasizing creativity, independent learning and scientific methods in a chosen area of computer engineering.



8. Carry out literature review, develop research proposal, and conduct research in specific topics related to computer systems engineering

TABLE 4. 3. 4 Master of Science (M. Sc.) Thesis in Computer Systems Engineering

S. N	Course Code	Course Name	Perquisites	Credit Hours
1	ELE851	M.Sc. Thesis-5	Average GPA 3.0 and minimum 2.7 in all courses in basic and advanced diploma courses	12

Master of Science (M. Sc.) in Computer Systems Engineering Program's Courses Vs Program's Graduate Competencies

S.N	Code	Course Name	M. Sc. Graduate Competencies							
			1	2	3	4	5	6	7	8
Compulsory Courses of Basic Diploma in Computer Systems Engineering										
1	GEN501	Scientific Writing and Presentation Skills	√	√	√	√	√	√		√
2	GEN502	Statistics and Random Processes	√	√		√		√		√
Elective Courses of Basic Diploma in Computer Systems Engineering										
3	ELE 551	High Performance Computer Architecture	√	√	√		√	√	√	√
4	ELE 552	Human computer interaction	√	√	√	√	√	√	√	√
5	ELE 553	Embedded Systems	√	√	√		√	√	√	√
6	ELE 554	Artificial Intelligence Theories	√	√	√	√	√	√	√	√
7	ELE 555	Advanced Software Engineering	√	√	√	√	√	√	√	√
8	ELE 556	Advanced Computer Networks	√	√	√		√	√	√	√
9	ELE 557	Advanced algorithms	√	√	√	√	√	√	√	√
10	ELE 558	Machine Learning algorithms	√	√	√	√	√	√	√	√
11	ELE 559	Selected topic in computer Engineering	√	√	√	√	√	√	√	√
Elective Courses of Advanced Diploma in Computer Systems Engineering										
12	ELE 650	Distributed and Parallel computer Systems	√	√	√		√	√	√	√
13	ELE 651	Advanced Cryptography and Network Security	√	√	√	√	√	√	√	√
14	ELE 652	Advanced Image Processing	√	√	√	√	√	√	√	√
15	ELE 653	Neural Networks and Deep Learning	√	√	√	√	√	√	√	√
16	ELE 654	Recent Trends in Computer Systems	√	√	√	√	√	√	√	√
Master of Science (M. Sc.) Thesis in Computer Systems Engineering										
17	ELE851	M.Sc. Thesis	√	√	√	√	√	√	√	√

3. Philosophy Doctorate (Ph. D.) in Computer Systems Engineering

By the end of the program, the student should be able to:

1. Apply analytic critical and systemic thinking to identify, diagnose and solve computer systems engineering problems with a wide range of complexity and variation.
2. Define the basics and the ethics of scientific research.
3. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
4. Apply proper theoretical practical knowledge of software requirements engineering and software systems design. This includes feasibility analysis, negotiation, and good communication with stakeholders.
5. Analyze the current significant software technology; articulate its strengths and weaknesses, and improvements.
6. Able to participate in computer systems engineering academic society.
7. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.
8. Recognize his/her role in promoting the engineering field and contribute to the development of the profession and the community.
9. Conduct self-learning and continuous education practices

TABLE 4. 3. 5 Basic Ph. D. Courses in Computer Systems Engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1	ELE 655	Data Mining and Information Retrieval	3	60	–	40	100	2
2	ELE 656	Advanced database systems	3	60	–	40	100	2
3	ELE 657	Mobile Computing	3	60	–	40	100	2
4	ELE 658	Internet of Things and Cloud Computing	3	60	–	40	100	2
5	ELE 659	Interdisciplinary applications of computer Engineering	3	60	–	40	100	2

*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from the basic courses of the Doctor of Philosophy in Computer Systems Engineering and according to what is determined by the Scientific Department Council.



TABLE 4. 3. 6 Specialized Ph.D. courses in Computer Systems Engineering

S. N	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1	ELE 751	Concurrent and real time Computing	3	60	–	40	100	2
2	ELE 752	Advanced topics in machine learning	3	60	–	40	100	2
3	ELE 753	Principles of Distributed ledger – Blockchain	3	60	–	40	100	2
4	ELE 754	Computer Vision	3	60	–	40	100	2
5	ELE 755	Advanced topics in computer architecture	3	60	–	40	100	2
6	ELE 756	Advanced operating systems	3	60	–	40	100	2
7	ELE 757	Modeling of computer systems	3	60	–	40	100	2
8	ELE 758	Data Science (Big Data)	3	60	–	40	100	2
9	ELE 759	Directed studies	3	60	–	40	100	2

*The student chooses (9) credit hours as a minimum from the specialized courses for the Doctor of Philosophy in Computer Systems Engineering, upon the recommendation of the main supervisor and according to what is determined by the scientific department council.

TABLE 4. 3. 7 Ph. D. Thesis in Computer Systems Engineering

S. N	Course Code	Course Name	Perquisites	Credit Hours
1	ELE951	Ph. D. Thesis	1. Average GPA <u>3.0</u> and minimum <u>2.7</u> in all courses in basic and specialized Ph.D. courses. 2. Pass the seminar of stage one of the academic research.	12



Doctor of Philosophy (Ph. D.) in Computer Systems Engineering Program's Courses Vs Program's Graduate Competencies

S.N.	Code	Course Name	Competencies of Ph. D. graduate in Computer Systems Engineering								
			1	2	3	4	5	6	7	8	9
Basic Ph. D. Courses in Computer Systems Engineering											
1	ELE 655	Data Mining and Information Retrieval	√	√	√	√	√	√	√	√	√
2	ELE 656	Advanced database systems	√	√	√	√	√	√	√	√	√
3	ELE 657	Mobile computing	√	√	√	√	√	√	√	√	√
4	ELE 658	Internet of Things and Cloud Computing	√	√	√	√	√	√	√	√	√
5	ELE 659	Interdisciplinary applications of computer Engineering	√	√	√	√	√	√	√	√	√
Specialized Ph.D. courses in Computer Systems Engineering											
6	ELE 751	Concurrent and real time Computing	√	√	√	√	√	√	√	√	√
7	ELE 752	Advanced topics in machine learning	√	√	√	√	√	√	√	√	√
8	ELE 753	Principles of Distributed ledger – Block-chain	√	√	√	√	√	√	√	√	√
9	ELE 754	Computer Vision	√	√	√	√	√	√	√	√	√
10	ELE 755	Advanced topics in computer architecture	√	√	√	√	√	√	√	√	√
11	ELE 756	Advanced operating systems	√	√	√	√	√	√	√	√	√
12	ELE 757	Modeling of computer systems	√	√	√	√	√	√	√	√	√
13	ELE 758	Data Science (Big Data)	√	√	√	√	√	√	√	√	√
14	ELE 759	Directed studies	√	√	√	√	√	√	√	√	√
Ph. D. Thesis in Computer Systems Engineering											
15	ELE951	Ph. D. Thesis	√	√	√	√	√	√	√	√	√



COURSES DESCRIPTION

Course Name	High Performance Computer Architecture				Course Code	ELE 551
Teaching Hours	Practical	Tutorial	Lecture		Credit Hours	3
	-	2	2			
Grades	Oral	Practical	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

The aim of the course is to present how modern computer systems work and are built. The students should learn the advanced concepts and principle of computer architecture and organization, as well as methods developed in order to improve the performance of current microprocessors and parallel systems. The contents include Instruction set, memory management and hierarchy, input/output and buses, pipelining techniques, branch prediction, RISC architectures, VLIW architectures and specific compiling techniques, superscalar architectures, out of order execution, parallel architectures and multiprocessors.

References

- 1) Jean Loup Baer, December 7, 2009, *Microprocessor Architecture*, CAMBRIDGE UNIVERSITY PRESS
- 2) *HPCA Course*, Milos Prvulovic, Georgia Tech. accessible from: <https://www.udacity.com/course/high-performance-computer-architecture--ud007>
- 3) Numerous articles from the literature.

Course Name	Human Computer Interaction				Course Code	ELE 552
Teaching Hours	Practical	Tutorial	Lecture		Credit Hours	3
	-	2	2			
Grades	Oral	Practical	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

This Course introduces the principles of user interface development, focusing on three key areas: Design: human capabilities (including the human information processor model, perception, motor skills, color, attention, and errors) and using those capabilities to drive design techniques: task analysis, user-centered design, iterative design, usability guidelines, interaction styles, and graphic design principles. The course includes Implementation: Techniques for building user interfaces, and Evaluation Techniques.

References

- 1) Yvonne Rogers, Helen Sharp, and Jenny Preece, 2019, *Interaction Design: Beyond Human-Computer Interaction* (5th edition). Wiley Publishing.
- 2) Claude Ghaoui, December 31, 2005, *Encyclopedia of Human Computer Interaction*, Idea Group Reference
- 3) Numerous articles from the literature.

Course Name	Embedded Systems				Course Code	ELE 553	
Teaching Hours	Practical	Tutorial		Lecture	Credit Hours	3	
	-	2		2			
Grades	Oral	Practical	Course Work		Written Exam	Total	100
	-	-	60		40		

Courses Description



The course topics include formal models, algorithms, various simulation techniques, tools and case studies in the specific context of embedded systems, The focus will be on system-level design techniques, with the aim of critically accessing known models and methods in terms of their generality and applicability at different stages of an embedded system design process. It includes also execution time analysis, Resource sharing and communication, and time, simulation versus analytical models.

References

- 1) Peter Marwedel, 2021, *Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things*, 4th Edition, Springer.
- 2) Ivan Cibrario Bertolotti , Tingting Hu, December 22, 2015, *Embedded Software Development: The Open-Source Approach (Embedded Systems)*, 1st edition, CRC Press.
- 3) Numerous articles from the literature.

Course Name	Artificial Intelligence Theories				Course Code	ELE 554
Teaching Hours	Practical		Tutorial	Lecture	Credit Hours	3
	-		2	2		
Grades	Oral	Practical	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

This course covers AI theories and applications. The students gain the basic knowledge of most important systems over the last five decades. The course describes different techniques of introducing intelligence to machines - Information and knowledge tools that depends on AI concepts. The practical part of the course introduces a non-algorithmic PROLOG language in addition to other tools.

References

- 1) Kuntal Barua, Prof Prasun Chakrabarti, 2019, “*Fundamentals of Soft Computing: Theory, Concepts and Methods of Artificial Intelligence, Neurocomputing*”, 1st Edition, Bb publications.
- 2) Pearson, 2021, *Artificial Intelligence: A Modern Approach* (4th Edition).
- 3) Numerous articles from the literature.

Course Name	Advanced Software Engineering				Course Code	ELE 555
Teaching Hours	Practical		Tutorial	Lecture	Credit Hours	3
	-		2	2		
Grades	Oral	Practical	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

This course covers software testing, software installation, maintaining information systems, software quality assurance, and technical metrics for software, software sizing, software development methodologies, requirement engineering, and configuration management.

References

- 1) E. Gamma, R. Helm, R. Johnson, and J. Vlissides, 1995, *Design Patterns: Elements of Reusable Object-Oriented Software*, Addison-Wesley.
- 2) Eric Freeman , Elisabeth Robson, 01 Jan 2021, *Headfirst Design Patterns: Building Extensible and Maintainable Object-Oriented Software*, 2nd edition, O'Reilly Media, Inc, USA.
- 3) Numerous articles from the literature.



Course Name	Advanced Computer Networks				Course Code	ELE 556
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			
Grades	Oral	Practical	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

The course will focus on the design, implementation, analysis, and evaluation of large-scale networked systems. Topics include internetworking philosophies, unicast and multicast routing, congestion control, network quality of service, mobile networking, router architectures, network-aware applications, content dissemination systems, network security, and performance issues. Material for the course will be drawn from research papers, industry white papers, and Internet RFCs.

References

- 1) Behrouz A. Forouzan, 2012, *Data Communications and Networking*, 5th Ed., McGraw Hill.
- 2) Curt White, 2015, *Data Communications and Computer Networks: A Business User's Approach*, 8th Edition.

Course Name	Advanced Algorithms				Course Code	ELE 557
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			
Grades	Oral	Practical	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

This course introduces many advanced techniques for the design of efficient algorithms along with their applications in a wide range of domains. Topics covered in this course include amortization, randomization, fingerprinting, word-level parallelism, bit scaling, dynamic programming, network flow, linear programming, fixed-parameter algorithms, and approximation algorithms. Application domains covered in this course include string algorithms, network optimization, parallel algorithms, computational geometry, online algorithms, external memory, cache memory, streaming algorithms, and data structures.

References

- 1) Thomas Cormen, Charles Leiserson, Ronald Rivest and Clifford Stein, 2009, *Introduction to Algorithms*, (third edition), MIT Press.
- 2) S. Dasgupta, C.H. Papadimitriou, and U. V. Vazirani, 2006, *Algorithms*, Mcgraw-Hill.
- 3) J. Kleinberg and E. Tardos, 2006, *Algorithm Design*, Addison-Wesley.
- 4) Marcello La Rocca, 2021, *Advanced Algorithms and Data Structures*, Manning.
- 5) Numerous articles from the literature Provided by the course instructor.

Course Name	Machine Learning Algorithms				Course Code	ELE 558
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			
Grades	Oral	Practical	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

This course introduces many concepts, techniques, and algorithms in machine learning, beginning with topics such as classification and linear regression and ending up with more recent topics such as boosting, support



vector machines, kernel methods, decision trees, random forests, hidden Markov models, and Bayesian networks. The course will give the student the basic ideas and intuition behind modern machine learning methods as well as a more formal and advanced understanding of how, why, and when they work. Applications covered in this course include solving problems on real data such as pattern recognition, verification, prediction, and classification.

References

- 1) C. M. Bishop, 2006. *Pattern Recognition and Machine Learning*. Springer.
- 2) Kevin P. Murphy, 2012. *Machine Learning: A Probabilistic Perspective*. MIT Press.
- 3) Ian Goodfellow, Yoshua Bengio and Aaron Courville, 2016. *Deep Learning*. MIT Press.
- 4) Numerous articles from the literature Provided by the course instructor.

Course Name	Selected Topic in Computer Engineering				Course Code	ELE 559
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			
Grades	Oral	Practical	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

The aim of this course is to explore the advanced topics in the area of computer engineering.

References

- 1) Class materials will be provided by the course instructor.

Course Name	Distributed and Parallel Systems				Course Code	ELE 650
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			
Grades	Oral	Practical	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

This course introduces parallel and distributed architectures and systems, parallel and distributed programming paradigms, parallel algorithms, and scientific and other applications of parallel and distributed computing. Topics covered in this course include: multi-core, SMP, MMP, client-server, clusters, clouds, grids, peer-to-peer systems, GPU computing, scheduling, scalability, resource discovery and allocation, fault tolerance, security, parallel I/O, sockets, threads, message passing, MPI, RPC, distributed shared memory, data parallel languages, MapReduce, parallel debugging, and applications of parallel and distributed computing.

References

- 1) Peter Pacheco, January 4, 2011, *An Introduction to Parallel Programming*, Morgan Kaufmann; 1st edition.
- 2) George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, April 27, 2011, *Distributed Systems: Concepts and Design*, Pearson; 5th edition.
- 3) Andrew S. Tanenbaum and Maarten van Steen, February 26, 2016, *Distributed Systems: Principles and Paradigms*, CreateSpace Independent Publishing Platform, 2nd edition.



Course Name	Advanced Cryptography and Network Security				Course Code	ELE 651
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			
Grades	Oral	Practical	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

This is a course on Cryptography and Network Security, objectives are: Classical encryption techniques, Block ciphers and the Data Encryption Standard, Basics of finite fields, Advanced Encryption Standard, Contemporary Symmetric Ciphers, Confidentiality Using Symmetric Encryption, Basics of Number Theory, Key Management; Other Public Key Cryptosystems, Message Authentication, Hash Functions and Algorithms, Digital Signatures and Authentication Protocols, Network Security Practice, Applications, E-Mail, IP and Web Security, System Security, Intruders, Malicious Software, Firewalls.

References

- 1) William Stallings, 2017, *Cryptography and Network Security*, Pearson Education, 7th Edition.
- 2) Bernard Menezes, 2010, *Cryptography Network Security and Cyber Laws*, Cengage Learning.
- 3) Numerous articles from the literature provided by the course instructor.

Course Name	Advanced Image Processing				Course Code	ELE 652
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			
Grades	Oral	Lab	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

This course is intended to provide to the students the capability of analyzing images of different types (medical, fingerprint, satellite image, compressed images, encrypted/watermarked images, etc.) apply some transformations, extract needed information, locate objects of interest in an image and analyze the objects motions in a video. Students will deal with some concrete examples such as detecting a pathological region in a medical image, recognize a fingerprint, identify some objects of interest in satellite images, use of some techniques allowing the compression of an image, encrypt an image using cryptographic algorithms and use some techniques for image watermarking. Students will be familiar with different problems in the image processing field that facilitate their contribution in this area during their research projects.

References

- 1) Gonzalez, R.C., & Woods, R.E, 2018, *Digital Image Processing*, 4th ed. Pearson.
- 2) Numerous articles from the literature Provided by the course instructor.

Course Name	Neural Networks and Deep Learning				Course Code	ELE 653
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			
Grades	Oral	Lab	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

Recap on NN: Supervised vs unsupervised learning, generalization, over-fitting, Perceptron, including deep vs shallow models, stochastic gradient descent and backpropagation. Convolutional neural networks (CNN) and underlying mathematical principles. CNN architectures and applications in image analysis. Recurrent neural networks (RNN), long-short term memory (LSTM), gated recurrent units (GRU), transformers. Applications on



RNNs in speech analysis and machine translation. Mathematical principles of generative networks; variational autoencoders (VAE); generative adversarial networks (GAN). Applications of generative networks in image generation. Graph neural networks (GNN): spectral and spatial domain methods, message passing. Students will be familiar with different problems in the image processing field that facilitate their contribution in this area during their research projects.

References

- 1) M. Nielsen. , *Neural Networks and Deep Learning*, Open source textbook available free at: <http://neuralnetworksanddeeplearning.com/>
- 2) Numerous articles from the literature Provided by the course instructor.

Course Name	Recent Trends in Computer Systems				Course Code	ELE 654
Teaching Hours	Practical	Tutorial		Lecture	Credit Hours	3
	-	2		2		
Grades	Oral	Lab	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

The aim of this course is to explore the recent trends in the area of computer engineering.

References

Class materials will be provided by the course instructor.

Course Name	Data Mining and Information Retrieval				Course Code	ELE 655
Teaching Hours	Practical	Tutorial		Lecture	Credit Hours	3
	-	2		2		
Grades	Oral	Lab.	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

Data mining is concerned with the extraction of novel knowledge from large amounts of data. This course introduces and studies the concepts, issues, tasks and techniques of data mining. Topics include data preparation and feature selection, association rules, classification, clustering, evaluation and validation, scalability, spatial and sequence mining, and data mining applications.

References

- 1) Ian H. Witten, Eibe Frank, and Mark A. Hall, Christopher Pal, January 2017, *Data Mining: Practical Machine Learning Tools and Techniques* (Fourth Edition), Morgan Kaufmann.
- 2) Tefan Buttcher, Charles L. A. Clarke, and Gordon V. Cormack, 2010, *Information Retrieval : Implementing and Evaluating Search Engines*, S, MIT Press.
- 3) Numerous articles from the literature Provided by the course instructor.

Course Name	Advanced Database Systems				Course Code	ELE 656
Teaching Hours	Practical	Tutorial		Lecture	Credit Hours	3
	-	2		2		
Grades	Oral	Lab.	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

Current and emerging issues in advanced database systems are introduced. The state-of-the-art techniques for



various DB topics are studied. Topics include OODBMS, and ORDBMS. Deductive DB, and optimization techniques. Properties and specialized multidimensional indexing methods used to access spatial and temporal data. Querying unstructured and semi structured data.

References

- 1) Perkins, L., Redmond, E., Wilson, J., 2018, *Seven databases in seven weeks: a guide to modern databases and the NoSQL movement*. Second edition, Pragmatic Bookshelf.
- 2) Numerous articles from the literature Provided by the course instructor.

Course Name	Mobile Computing				Course Code	ELE 657
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			
Grades	Oral	Lab.	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

This course will cover various topics of mobile computing, networking, and systems, including but not limited to: applications of smartphones, cellular networks, embedded sensor systems, localization systems, energy efficiency of mobile devices, wearable and vehicular mobile systems, mobile security, virtual reality and augmented reality. We will discuss research papers from top conferences, brainstorm new ideas.

References

- 1) Talukder, Asoke K., Roopa R. Yavagal, and Asoke K. Talukder. *Mobile Computing*. Tata McGraw-Hill Education, 2005.
- 2) A.V. Senthil Kumar and Hakikur Rahman. *Mobile Computing Techniques in Emerging Markets: Systems, Applications and Services*. 2012.
- 3) Mutamed Khatib and Nael Salman *Mobile Computing - Technology and Applications*, 2018
- 4) Numerous articles from the literature Provided by the course instructor.

Course Name	Internet of Things and Cloud Computing				Course Code	ELE 658
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			
Grades	Oral	Lab.	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

This course will evaluate the recent achievements having fundamental importance in the field of cloud computing and IOT. The course will be divided into two phases. In the first phase, introductory discussions and recent research topics regarding cloud computing and IOT will be introduced to the students. Students will learn how to Independently Design, Code and Build IOT products, In the second phase, every student should give research paper presentations after going through a thorough literature review, actively contribute to the overall discussions and finally ends up a term paper.

References

- 1) Peter Marwedel, 2021, *Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things*, 4th Edition, Springer.
- 2) Thomas Erl, et al., 2013, *Cloud Computing: Concepts, Technology & Architecture*, Prentice-Hall.
- 3) Ian, and Dennis B. Gannon, 2017, *Cloud computing for science and engineering*, Foster. MIT Press.
- 4) Numerous articles from the literature Provided by the course instructor.

Course Name	Interdisciplinary Applications of Computer Engineering				Course Code	ELE 659
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			



Grades	Oral	Lab.	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

The aim of this course is to explore the Interdisciplinary applications of computer engineering.

References

- 1) Class materials will be provided by the course instructor.

Course Name	Concurrent and Real-time Computing				Course Code	ELE 751
Teaching Hours	Practical		Tutorial	Lecture	Credit Hours	3
	-		2	2		
Grades	Oral	Practical	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

Concurrent Programming: Model of abstraction based on encapsulated processes, Models and methods for synchronization and communication between concurrent processes. Reactive Programming: Event-driven program structures, Interrupts and signal-handling. Real Time Systems: Priorities and deadline requirements, Connections of external devices, embedded systems, Process scheduling and error handling, Design of a real time kernel.

References

- 1) M. Ben-Ari, November 2005 *Principles of Concurrent and Distributed Programming*, 2nd Edition, Addison-Wesley
- 2) M. Herlihy & N. Shavit, September 2020, *The Art of Multiprocessor Programming*, Morgan Kaufmann
- 3) Patterson, David A.; Hennessy, John L, 2013, *Computer Organization and Design: The Hardware/Software Interface*.
- 4) Morgan Kaufmann, 2014, *The Morgan Kaufmann Series in Computer Architecture and Design* (5 ed.).
- 5) Numerous articles from the literature Provided by the course instructor.

Course Name	Advanced Topics in Machine Learning				Course Code	ELE 752
Teaching Hours	Practical		Tutorial	Lecture	Credit Hours	3
	-		2	2		
Grades	Oral	Lab.	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

This course gives thorough grounding in the methods, theory, mathematics and algorithms needed to do research and applications in machine learning. The topics of the course are drawn from machine learning, classical statistics, data mining, Bayesian Description statistics, and from information theory.

References

- 1) William L. Hamilton, 2020, *Graph Representation Learning*. Synthesis Lectures on Artificial Intelligence and Machine Learning, Vol. 14.
- 2) Christopher M. Bishop, 2006, "Pattern Recognition and Machine Learning".
- 3) Marc Peter Deisenroth, 2020, A. Aldo Faisal, and Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press.
- 4) Numerous articles from the literature Provided by the course instructor.



Course Name	Principles of Distributed Ledger–Blockchain				Course Code	ELE 753
Teaching Hours	Practical	Tutorial		Lecture	Credit Hours	3
	-	2		2		
Grades	Oral	Lab.	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

Hash Functions, Digital Signature, Decentralization and permissionless/permissioned ledgers, Wallets and transactions, Authenticated data structures, Blocks and the blockchain, Proof of work and mining, Ethereum smart contracts, Smart contract security, Network layer propagation, Blockchain security and privacy, Building decentralized applications, Security and privacy of distributed ledgers, scaling decentralized ledger and alternatives, Network and Hardware aspects of decentralized ledgers.

References

- 1) Nakamoto, 2008, Bitcoin: A peer-to-peer electronic cash system.
- 2) Antonopoulos, A. M. ,2015, *Mastering Bitcoin*. O'Reilly Media, Inc. Online edition.
- 3) Asharaf, S. & Adarsh, S., 2017, *Decentralized Computing Using Blockchain Technologies and Smart Contracts: Emerging Research and Opportunities*.
- 4) Numerous articles from the literature Provided by the course instructor.

Course Name	Computer Vision				Course Code	ELE 754
Teaching Hours	Practical	Tutorial		Lecture	Credit Hours	3
	-	2		2		
Grades	Oral	Lab.	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

Presenting the theoretical fundamentals of hardware and software concepts underlying computer vision systems, Computer vision application, environment, and requirement, Image processing techniques, Mathematical and statistical methods for visual attribute recognition such as contour, size, texture, color, motion, tracking, and segmentation and other physical properties, Recent trends in the computer vision field.

References

- 1) J.F. Peters, 2017, *Foundations of Computer Vision. Computational Geometry, Visual Image Structures and Object Shape Detection*, Springer.
- 2) B. Jähne, 2005, *Digital Image Processing*, Springer.
- 3) Richard Szeliski, 2013, *Computer Vision: Algorithms and Applications*, 2nd ed.
- 4) Numerous articles from the literature Provided by the course instructor.

Course Name	Advanced Topics in Computer Architecture				Course Code	ELE 755
Teaching Hours	Practical	Tutorial		Lecture	Credit Hours	3
	-	2		2		
Grades	Oral	Lab.	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

This course helps students to be up to date with new research trends in computer architecture as Coarse-Grained Adaptable Architectures, Quantum Architectures, Ultra Energy Efficient Computing, Brain Architecture, new models of computation, and Parallel memories. In addition, such topics as programmability and reliability of multiprocessor and multicore systems are covered. Structured Shared-Memory Communication, simultaneous multithreading Dependable Systems, Clusters, Grids and interconnects will be



introduced.

References

- 1) David A Patterson and John L. Hennessy, 2011, *Computer Architecture: A Quantitative Approach* 5th Edition
- 2) Jim Ledin, 2020, *Modern Computer Architecture and Organization: Learn x86, ARM, and RISC-V architectures*
- 3) Class materials will be provided by the course instructor.

Course Name	Advanced Operating Systems				Course Code	ELE 756
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			
Grades	Oral	Lab.	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

Advanced Operating System Design Concepts, System Requirements, Distributed systems, Real-time Systems, Reliability and Performance, Security, Computer Networks, Study of Systems Highlighting these Concepts.

References

- 1) Andrew S. Tanenbaum, 2018, *Modern Operating Systems* 3rd Edition
- 2) Greg Tomsho, 2017, *Guide to Operating Systems*, Fifth Edition
- 3) Avi Silberschatz, Peter Baer Galvin, and Greg Gagne, 2018, *Operating System Concepts*, 10th Edition , John Wiley & Sons, Inc.
- 4) Class materials will be provided by the course instructor.

Course Name	Modeling of Computer Systems				Course Code	ELE 757
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			
Grades	Oral	Lab.	Course Work	Written Exam	Total	100
	-	-	60	40		

Courses Description

This course will cover the techniques for modeling and formally analyzing computing systems, with a focus on applications in software, hardware, and security. Students will learn the fundamentals of classical logic, induction and recursion, program semantics, rewriting, reactive systems, temporal logic, model checking, and abstraction. We will examine how these methods can be used to verify software, hardware, and security protocols. Students will learn how to use various tools, including theorem proving and model checking tools, and will work in groups to apply the tools to various domains. We will discuss the limitations of current techniques and systems and we will examine promising research directions including building more useful systems and developing more powerful techniques.

References

- 1) R. Jain, 2007, *The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling*, Wiley.
- 2) Howard J. Seltman, 2018, *Experimental Design and Analysis*, Available online at <https://www.stat.cmu.edu/~hseltman/309/Book/Book.pdf>

Course Name	Data Science (Big Data)				Course Code	ELE 758
Teaching Hours	Practical	Tutorial	Lecture	Credit Hours	3	
	-	2	2			
Grades	Oral	Lab.	Course Work	Written Exam	Total	100
	-	-	-	-		



	-	-	60	40		
<u>Courses Description</u> Statistics and Statistical Data Mining, Machine Learning, Data Programming (in Python), Big Data Analysis, Data Visualization, Data Science Research Topics.						
<u>References</u> 1) Wes McKinney, 2018, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython 2) Elizabeth Matsui and Roger D. Peng, 2013, The Art of Data Science: A Guide for Anyone who Works, 2 nd Edition 3) Tom White, 2019, Hadoop: The Definitive Guide. 4) Numerous articles from the literature Provided by the course instructor.						
Course Name	Directed Studies				Course Code	ELE 759
Teaching Hours	Practical		Tutorial	Lecture	Credit Hours	3
	-		2	2		
Grades	Oral	Lab.	Course Work	Written Exam	Total	100
	-	-	60	40		
<u>Courses Description</u> Topics Selected by the supervisor in the Research Field Directions.						
<u>References</u> Class materials will be provided by the course instructor.						



CHAPTER (5)

CIVIL ENGINEERING DEPARTMENT

Civil Engineering Department presents three main programs:

- 1) Structure Engineering Program.
- 2) Hydraulics and Water Resources Engineering Program.
- 3) Public Works Engineering Program.

1) Structure Engineering Program

1. Advanced Diploma in Structure Engineering

Registration is made in the following research specializations:

1. Structural Engineering.
2. Geotechnical Engineering.
3. Construction Engineering and Management Engineering.

The Graduate of the Advanced Engineering Diploma Program in Structural Engineering should be able to:

1. Show awareness of significant research methods and approaches.
2. Practice successful scientific writing skills.
3. Show awareness of the scientific study importance.
4. Apply engineering concepts in professional practice.
5. Find and gather available data.
6. Practice socio-cultural and professional ethics.
7. Define scientific problems and gather data, prioritize solutions.
8. Solve practical and theoretical problems.
9. Able to present fundamental assessments for projects in his field.
10. Show a high level of scientific performance.
11. Write successful technical reports.
12. Use IT and computer applications in his field.
13. Find comprehensive data and information sources.
14. Collaborate effectively, within teams.
15. Lead various professional teams in his field.

Table 5. 1. 1 Compulsory Courses for the Basic Diploma in Structural Engineering

S. N.	Course Code	Course Name	Pre-Requisite	Credit Hours	Grades				Test Time
					Course Work	Oral/Practical	Written Exam	Total	
1	GEN501	Technical Writing and presentation skills	–	2	60	–	40	100	2
2	GEN502	Statistics and Random Processes	–	2	60	–	40	100	2



Table 5. 1. 2 Elective Courses for Basic Diploma in Structural Engineering*

S. N.	Course Code	Course Name	Pre-Requirement	Credit Hours	Work Hours			Grades				Test Time
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1) Structural Engineering												
1	CIV511	Repair and Strengthening of Structures	–	3	2	2	--	40	20	40	100	2
2	CIV512	Bridges Construction Technology	–	3	2	2	--	40	20	40	100	2
3	CIV513	Matrix Structural Analysis	–	3	2	2	--	40	20	40	100	2
4	CIV514	Masonry Wall Bearing Structures	–	3	2	2	--	40	20	40	100	2
5	CIV515	Composite Structures	–	3	2	2	--	40	20	40	100	2
6	CIV516	Inspection and Testing of Materials in Structures	–	3	2	2	--	40	20	40	100	2
7	CIV517	Construction Materials	–	3	2	2	--	40	20	40	100	2
8	CIV518	Design of Structural Steel Members Using LRFD	–	3	2	2	--	40	20	40	100	2
9	CIV519	Steel Plated Structures	–	3	2	2	--	40	20	40	100	2
2) Geotechnical Engineering												
1	CIV521	Site Investigation	–	3	2	2	--	40	20	40	100	2
2	CIV522	Problematic Geo-materials	–	3	2	2	--	40	20	40	100	2
3	CIV523	Advanced Foundation Engineering	–	3	2	2	--	40	20	40	100	2
4	CIV524	Laboratory Characterization of Geo-materials	–	3	2	-	3	40	20	40	100	2
5	CIV525	Earth Retaining Structures	–	3	2	2	--	40	20	40	100	2
6	CIV526	Tunnel Engineering	–	3	2	2	--	40	20	40	100	2
7	CIV527	Advanced Laboratory Testing Techniques	–	3	2	-	3	40	20	40	100	2
3) Construction Engineering and Management Engineering												
1	CIV531	Construction Project Management	–	3	2	2	--	40	20	40	100	2
2	CIV532	Building Construction Systems	–	3	2	2	--	40	20	40	100	2
3	CIV533	Construction Safety and Environmental Management	–	3	2	2	--	40	20	40	100	2



4	CIV534	Feasibility Studies and Project Management	–	3	2	2	--	40	20	40	100	2
5	GEN503	Project Management	–	2	2	-	--	40	20	40	100	2

*With the help of the academic advisor, the student chooses (9) credit hours with a minimum of elective courses for the Basic Diploma in Structural Engineering in one of the disciplines mentioned in Table (5.1.2) and according to what is determined by the Scientific Department Council.

TABLE 5.1.3 Elective Courses for the Advanced Diploma in Structural Engineering*

S. N.	Course Code	Course Name	Pre-Requirement	Credit Hours	Work Hours			Grades				Test Time
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1) Structural Engineering												
1	CIV611	Advanced Topics in Design of Reinforced Concrete Structures	–	3	2	2	--	40	20	40	100	2
2	CIV612	Computational Methods of Nonlinear Analysis	–	3	2	2	--	40	20	40	100	2
3	CIV613	Finite Elements Analysis	–	3	2	2	--	40	20	40	100	2
4	CIV614	Microstructure of Engineering Materials	–	3	2	2	--	40	20	40	100	2
5	CIV615	Design for Cold Formed Steel Structures	–	3	2	2	--	40	20	40	100	2
2) Geotechnical Engineering												
1	CIV621	Ground Improvement Techniques	–	3	2	2	--	40	20	40	100	2
2	CIV622	Soil Hydraulics	–	3	2	2	--	40	20	40	100	2
3	CIV623	Advanced Site Investigation Techniques	–	3	2	-	3	40	20	40	100	2
4	CIV624	Soil Stabilization and Reinforcement	–	3	2	2	--	40	20	40	100	2
5	CIV625	Research Topics in Geotechnical Engineering	–	3	2	2	--	40	20	40	100	2
3) Construction Engineering and Management Engineering												
1	CIV631	Construction Equipment Systems	–	3	2	2	--	40	20	40	100	2
2	CIV632	Construction Estimating, Planning, and Control	–	3	2	2	--	40	20	40	100	2



3	CIV633	Entrepreneurship in Construction	–	3	2	2	--	40	20	40	100	2
4	CIV634	Innovative Project Delivery	–	3	2	2	--	40	20	40	100	2
5	CIV635	Design for Sustainability	–	2	2	-	--	40	20	40	100	2

*With the help of the academic advisor, the student chooses (12) credit hours as a minimum from the elective courses for the Advanced Diploma in Structural Engineering in one of the disciplines mentioned in Table (5.1.3) and according to what is determined by the Scientific Department Council.

2) Master of Science in Structural Engineering

Registration is made in the following research specialization:

1. Structural engineering.
2. Geotechnical engineering.
3. Construction engineering and management engineering.

The graduate of Master of Science in Structural Engineering should be able to:

1. Use and apply significant research method, tools and approaches in his scientific studies.
2. Find various data and information sources.
3. Collect, analyze, systemize and discuss data and information.
4. Create a scientifically structured study.
5. Show his comprehension of the various types of research methods applications.
6. Define, analyze and create debates in a scientifically structured study.
7. Show awareness of the impact of the scientific studies on community development.
8. Use modern tools and applications in gathering and managing data.
9. Produce adequate scientific solutions to problems in his field.
10. Assesses the human-made projects on the natural environment.
11. Practice the required fundamental rules and theories in his practice.
12. Manage time successfully.
13. Categorize literature in a hierarchically ordered.
14. Commit himself and his teams to professional ethics.

Table 5. 1. 4 Master of Science Thesis in Structural Engineering

S. N.	Course Code	Course Name	Perquisites	Credit Hours
1	CIV811	M.Sc. Thesis-1	Average GPA of 3.0 and minimum of 2.7 in all Basic and Advanced Engineering Diploma courses studied.	12
2	CIV821	M.Sc. Thesis-2		
3	CIV831	M.Sc. Thesis-3		



3. Philosophy Doctorate (Ph.D.) in Structural Engineering

Doctor of Philosophy degree is registered in the following research specialization:

1. Structural engineering.
2. Geotechnical engineering.
3. Construction engineering and management engineering.

By the end of the Ph.D. program the student should be able to:

1. Show awareness of research methods different application.
2. Master the use of research methods, tools and approaches.
3. Perform various scientific studies adding to the human knowledge.
4. Apply scientific conclusions practically.
5. Show awareness of the scientific studies' ethics.
6. Relate various discipline into multidisciplinary studies.
7. Take decisions in light of the available data.
8. Apply effectively, available resources in his profession.
9. Manage scientific and professional meetings.
10. Manage time effectively.
11. Find and use various kinds of literature, sources and plan applicable field studies.

Table 5. 1. 5 Core Courses for Philosophy Doctorate (Ph. D) in Structural Engineering*

S. N.	Course Code	Course Name	Pre-Requirement	Credit Hours	Work Hours			Grades				Test Time
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1) Structural Engineering												
1	CIV616	Structural Dynamics	–	3	2	2	--	40	20	40	100	2
2	CIV617	Quality in Construction	–	3	2	2	--	40	20	40	100	2
3	CIV618	Special Concrete Types	–	3	2	2	--	40	20	40	100	2
4	CIV619	Steel Structural Stability	–	3	2	2	--	40	20	40	100	2
2) Geotechnical Engineering												
1	CIV626	Geotechnical Engineering Modeling	–	3	2	2	--	40	20	40	100	2
2	CIV627	Advanced Geotechnical Engineering	–	3	2	2	--	40	20	40	100	2
3	CIV628	Soil-Structure Interaction	–	3	2	2	--	40	20	40	100	2
4	CIV629	Dynamic Geotechnical Engineering	–	3	2	2	--	40	20	40	100	2
3) Construction Engineering and Management Engineering												



1	CIV636	Resource Management of Construction Projects	–	3	2	2	--	40	20	40	100	2
2	CIV637	Logistics and Supply Chain	–	3	2	2	--	40	20	40	100	2
3	CIV638	Organizational Management	–	3	2	2	--	40	20	40	100	2
4	CIV639	Strategic Planning	–	2	2	-	--	40	20	40	100	2

*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from the basic courses of the Doctor of Philosophy in Structural Engineering in one of the disciplines mentioned in Table (5.1.5) and according to what is determined by the Scientific Department Council.

Table 5. 1. 6 Specialized Courses for Ph.D. in Structural Engineering*

S. N.	Course Code	Course Name	Pre-Requisite	Credit Hours	Work Hours			Grades				Test Time
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1) Structural Engineering												
1	CIV711	Introduction for Seismic Strengthening	–	3	2	2	–	40	20	40	100	2
2	CIV712	Options for Repair and Demolition of Buildings	–	3	2	2	–	40	20	40	100	2
3	CIV713	Elasticity Theory	–	3	2	2	–	40	20	40	100	2
4	CIV714	Theory of Plates and Shells	–	3	2	2	–	40	20	40	100	2
5	CIV715	Transport Properties in Concrete	–	3	2	2	–	40	20	40	100	2
6	CIV716	Smart Materials	–	3	2	2	–	40	20	40	100	2
7	CIV717	Materials Specifications	–	3	2	2	–	40	20	40	100	2
8	CIV718	Advanced Analysis and Design of Steel Frames	–	3	2	2	–	40	20	40	100	2
9	CIV719	Suspension and Guyed Steel Structures	–	3	2	2	–	40	20	40	100	2
2) Geotechnical Engineering												
1	CIV721	Rock Engineering	–	3	2	2	–	40	20	40	100	3
2	CIV722	Geo-Environmental Engineering	–	3	2	2	–	40	20	40	100	2
3	CIV723	Rehabilitation of Geo-structures	–	3	2	2	–	40	20	40	100	2
4	CIV724	Geotechnical Earthquake Engineering	–	3	2	2	–	40	20	40	100	2
5	CIV725	Advanced Topics in Geotechnical	–	3	2	2	–	40	20	40	100	2



		Engineering										
3) Construction Engineering and Management Engineering												
1	CIV731	Special Topics in Construction Engineering & Management	–	3	2	2	–	40	20	40	100	2
2	CIV732	Risk and Financial Management in Construction	–	3	2	2	–	40	20	40	100	2
3	CIV733	Contract Management	–	3	2	2	–	40	20	40	100	2
4	CIV734	Construction Productivity	–	3	2	2	–	40	20	40	100	2
5	CIV735	Research Topics in Construction Engineering and Management	–	3	2	2	–	40	20	40	100	2

*The student chooses (9) credit hours as a minimum from the specialized courses for the Doctor of Philosophy in Structural Engineering in one of the disciplines mentioned in Table (5.1.6), upon the recommendation of the main supervisor and according to what is determined by the scientific department council.

Table 5. 1. 7 Ph.D. Thesis in Structural Engineering

S. N.	Course Code	Course Name	Perquisites	Credit Hours
1	CIV911	Ph.D. Thesis-1	1. Average GPA 3.0 and minimum 2.7 in all courses in basic and specialized Ph.D. courses 2. Pass the seminar of stage one of the academic research.	12
2	CIV921	Ph.D. Thesis-2		
3	CIV931	Ph.D. Thesis-3		



COURSES DESCRIPTION

Course Name	Repair and Strengthening of Structures				Course Code	CIV511
Teaching Hours	Lectures	Tutorial		Lab	Credit Hours	3
	2	2		-		
Course Grades	Written Exam	Course Work	Lab.	Oral	Total	100
	40	40	-	20		

Scientific Content:

Definition of repair, maintenance, protection, rehabilitation and strengthening – Causes of deterioration of concrete structures – Evaluation of concrete structures – Repair and strengthening materials (types, selection, properties, uses, testing) – Bond between strengthening materials and substrate concrete (factors affecting bond, bond testing) – Different repair and strengthening techniques – Case studies for repair and strengthening of different concrete elements.

References:

- 1) Lecture notes and handouts prepared by the instructor.
- 2) Advanced repair methods of RC structures.
- 3) ACI Concrete-Repair-Guide.
- 4) Egyptian code of practice and design of RC structures.

Course Name	Bridges Construction Technology				Course Code	CIV512
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Lab.	Oral	Total	100
	40	40	-	20		

Scientific Content:

Introduction to methods of construction of bridges. Explanation to most famous methods of construction, Incremental Launching method, Balanced Cantilever method, Maintenance and repair, Fabrication and erection Equipment selection, methods of repair, maintenance, and loading tests.

References:

- 1) Durkee, J. "Steel Bridge Construction", *Bridge Engineering Handbook*. Ed. Wai-Fah Chen and Lian Duan, Boca Raton: CRC Press, 2000.
- 2) Prestressed Concrete Bridges (Structures and Buildings) 2nd Revised edition, Nigel Hewson, ICE Publishing; (2011), ISBN-13: 978-0727741134.
- 3) Standard Specifications for Road and Bridge Construction, Illinois Department of Transportation, Adopted January 1, 2012.

Course Name	Matrix Structural Analysis				Course Code	CIV513
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grade	Written Exam	Course Work	Lab.	Oral	Total	100
	40	40	-	20		

Scientific Content:

Matrix methods for analysis of structures – Direct stiffness method, Computation of element stiffness matrix of 2D and 3D trusses, beams, frames and grids – Load vectors – Assembly and equation solution techniques – Use of computer for solution – Applications.

References:



- 1) Lecture notes and handouts prepared by the instructor.
- 2) Dawe, D.J., (1984), "Matrix and Finite Element Displacement Analysis of Structures", Clarendon Press, Oxford, 1984.

Course Name	Masonry Wall Bearing Structures				Course Code	CIV514
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Wall-bearing structural system – Masonry materials – Masonry units and mortar - Physical and mechanical properties – Testing and acceptance criteria – Unreinforced masonry elements – Structural behaviour – Design codes – Design criteria for masonry load bearing walls – Stresses – Section design.

References:

- 1) Lecture notes and handouts prepared by the instructor.
- 2) Drysdale, A., Hamid, A., and Baker, L., "Masonry Structures – Behavior and Design", 2nd edition, 1999.
- 3) ECP-204-2005, "Egyptian Code of Practice for Design and Construction of Masonry Structures", Ministry of Housing and Urban Communities, Egypt, 2005.
- 4) Hendry, A. W. (1998), Structural Masonry, Mc Millan, UK, 2nd Edition.

Course Name	Composite Structures				Course Code	CIV515
Teaching Hours	Lectures	Tutorial		Practical	Credit Hours	3
	2	2		-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Composite materials used in construction – Constituent materials: types, physical and mechanical properties – Examples: fibrous concrete, Ferro-cement, fiber-reinforced polymer (FRP) composites, hybrid and composite structural members – Applications, construction method and structural behavior –Construction details and connections – Quality control methods.

References:

- 1) Lecture notes and handouts prepared by the instructor.
- 2) Jones, R.J. "Mechanics of Composite Materials", 1999.
- 3) Gibson, R.F. "Principles of Composite Material Mechanics", McGraw-Hill, 1994.
- 4) Christensen R.M. Mechanics of Composite Materials. Dover Publications; 2005.
- 5) Journal of Structural Engineering, American Society of Engineers (ASCE).
- 6) Journal of Composites for Construction, American Society of Civil Engineers (ASCE).

Course Name	Inspection and Testing of Materials in Structures				Course Code	CIV516
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Materials tests (steel, cement, aggregate, brick, paints ...etc.). Types of defects in buildings - Inspection procedures - Definition of defects - preparation of technical report of inspection - Methods of testing and assessment of existing structures.



References: References to be determined by the lecturer						
Course Name	Construction Materials			Course Code		CIV517
Teaching Hours	Lectures	Tutorial	Practical	Credit Hours		3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		
Scientific Content: Engineering properties of materials (strength, toughness, hardness, elasticity), introduction to common types of building materials, steel, cement, aggregates, concrete, admixtures, bricks, stones, timber, glass, polymers, adhesives, sealants.						
References: 1) "Civil Engineering materials", N. Jackson and R. K. Dhir, Fifth Edition, PALGRAVE publishing, ISBN 9780333636831. 2) Frederick S. Merritt; Jonathan T. Ricketts: Building Design and Construction Handbook, Sixth Edition, Chapter (McGraw-Hill Professional, 2001), Access Engineering.						
Course Name	Design of Structural Steel Members Using LRFD			Course Code		CIV518
Teaching Hours	Lectures	Tutorial	Practical	Credit Hours		3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		
Scientific Content: Fundamentals of design of structural steel members using the Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings. The course emphasizes a limit states view of the design process. An explanation of the common failure modes, or limit states, for which members must be designed and how the LRFD Specification addresses these limit states is the focus of the course.						
References: 1) Lecture notes and handouts prepared by the instructor. 2) Segui, W.T., "LRFD Steel Design", 4th Edition, 2008, Thompson, Brooks/Cole, USA. 3) Manual of Steel Construction, American Institute of Steel Construction (AISC), 2010						

Course Name	Steel Plated Structures				Course Code	CIV519
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Lab.	Oral	Total	100
	40	40	-	-20		
Scientific Content: Steel Plate Girders behavior and design – Steel Box Girders behavior and design - Orthotropic floors and decks behavior and design, Different applications, Theory and behavior, Members design, Connections design, Details of connections. - Storage structures: Tanks: Types of tanks, Analysis, design, and construction details; Silos: Types of silos, Analysis, design, and construction details.						
References:						



- 1) ESDEP WG 8 Plates and Shells.
- 2) Timoshenko, S. and Weinowsky-Kreiger, S., "Theory of Plates and Shells" Mc Graw-Hill, New York, International Student

Course Name	Site Investigation					Course Code	CIV521
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Field and laboratory testing, sampling of geomaterials, primarily soils and rocks, methods of drilling, probing, and in-situ measurement of soils for determining stratigraphy and engineering parameters for analysis, including soil borings, penetration tests, vane shear test, load tests, foundation recommendation and geotechnical report writing.

References:

- 1) Lecture Notes and Handouts; Power Point Presentations; Selected Papers; Videos by the Instructor.
- 2) Mayne, P.W., Christopher, B.R., and DeJong, J., 2000, *Geotechnical Site Characterization*, Federal Highway Administration Washington, DC.

Course Name	Problematic Geo-materials					Course Code	CIV522	
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3	
	2		2	-				
Course Grades	Written Exam	Course Work		Practical		Oral	Total	100
	40	40		-		20		

Scientific Content:

This course presents many of the fundamental concepts behind the mechanical behavior of unsaturated soils such as collapsible soils and expansive soils and rocks. It also includes the engineering problems and geotechnical solutions for weak problematic geomaterials such as; organic soils, compressible silts, soft clay, shale, cavernous limestone and soluble gypsum.

References:

- 1) Lecture Notes and Handouts; Power Point Presentations; Selected Papers; Videos by the Instructor.
- 2) *Geotechnical Site Characterization* (2000), by Paul W. Mayne, Barry R. Christopher, and Jason DeJong, Federal Highway Administration Washington, DC.

Course Name	Advanced Foundation Engineering					Course Code	CIV523
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Evaluation and design of foundations for civil engineering structures, including the settlement and bearing



capacity of shallow and deep foundations. Beams on elastic foundations. Raft foundation, driven piles, bored piles, and drilled shafts analyzed using elastic continuum theory, limit plasticity, and cavity expansion solutions, lateral and moment loading of piles, behavior of pile groups, and pile testing.

References:

- 1) Coduto, D. P., "Geotechnical Engineering Principles and Practice" Prentice-Hall. Inc., 2012, ISBN 0-13-576380.
- 2) Soil and Foundation Handbook, April 2011, State of Florida.
- 3) Pile Foundation Design, School of the Built Environment, Napier University

Course Name	Laboratory Characterization of Geo-materials					Course Code	CIV524
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		-	3			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	20		-		

Scientific Content:

Instruction in the procedures, methods of interpretation and apparatus limitations and influences for geotechnical laboratory index, strength, deformation, and permeability tests, analysis of test results, determination of basic physical and mechanical properties and soil deformation and strength parameters.

References:

- 1) Das, B.M., 2001, *Soil Mechanics Laboratory Manual*, 6th Edition, Engineering Press, Inc., CA.
- 2) American Society of Testing Materials (ASTM), 2005, *Annual Book of ASTM Standards, Section 4, Volumes 04.08 and 04.09; Soil and Rock, Building Stones* Philadelphia, PA.
- 3) Bardet, Jean-Pierre, 1997, *Experimental Soil Mechanics*, Prentice-Hall, Inc., NJ

Course Name	Earth Retaining Structures					Course Code	CIV525
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Instruction in techniques for assessing the stability of earth-retaining structures including unreinforced slopes, reinforced slopes, free-standing retaining structures, diaphragm walls, secant piles, and various reinforced retaining structures.

References:

- 1) Coduto, D. P., "Geotechnical Engineering Principles and Practice" Prentice-Hall. Inc., 2012, ISBN 0-13-576380
- 2) Soil and Foundation Handbook, April 2011, State of Florida.
- 3) Pile Foundation Design, School of the Built Environment, Napier University, Geotechnique, ICE, UK.

Course Name	Tunnel Engineering			Course Code	CIV526
Teaching Hours	Lectures	Tutorial	Practical	Credit Hours	3



	2	2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total
	40	40	-	20	
					100

Scientific Content:

Main concepts associated to design and construction of tunnels in soils and rocks. Urban tunnels, excavated in soil or weak rock masses, geotechnical aspects related to tunnel behavior, factors controlling this behavior, tunnel construction methods, improvement and reinforcement techniques, the available analysis methods and tunnel instrumentation and observation.

References:

- 1) Tunnel Engineering Handbook by John O. Bickel, Thomas R. Kuesel, Elwyn H. King ISBN: 0412992914
- 2) SUPPORT UNDERGROUND EXCAVATIONS Author: HOEK ISBN: 9054101873 Paperback: 300 pages Publisher: SWETS; 1 edition (January 1, 2000)
- 3) A Short Course in Soil-Structure Engineering of Deep Foundations, Excavations and Tunnels Author: Charles Ng ISBN: 0727732633 Hardcover: 408 pages Publisher: Thomas Telford, Ltd (September 2004)

Course Name	Advanced Laboratory Testing Techniques				Course Code	CIV527
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	-	3			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	20	-		

Scientific Content:

Advanced laboratory testing, dynamic laboratory tests, swelling pressure tests, collapsibility tests, lab vane shear test, soil chemistry tests, ground water analysis, x-ray diffraction, differential thermal analysis, electron microscope.

References:

- 1) Richard Jardin "Advanced Soil Mechanics Laboratory Testing" Spon Press; 1 edition (February 27, 2012) ISBN-10: 0415464838
- 2) ASTM (2006). *Annual Book of ASTM Standards – Sections 4.02, 4.08, 4.09 and 4.13.*
- 3) ASTM International, West Conshohocken, PA.

Course Name	Construction Project Management				Course Code	CIV531
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Construction project management and control using network-based tools, time-money analysis and other quantitative and qualitative techniques. Planning and scheduling, critical path, lead-lag, resource allocation, uncertainty, cash flow and payment scheduling, change orders, project acceleration, coordination and



communication, record keeping. Emphasis on computer-based techniques.

References:

- 1) Project Management Institute ,2021. *A Guide to the Project Management Body of Knowledge, PMBOK Guide.*: Seventh Edition and the Standard for Project Management, ISBN 1628257008
- 2) Dykstra, A. ,2018. *Construction Project Management: A Complete Introduction*, 2nd Edition, ISBN 0982703430.

Course Name	Building Construction Systems					Course Code	CIV532
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Construction engineering of conventional and industrialized building systems. Emphasis in areas of structural systems utilizing cast-in-place concrete, precast concrete, prestressed concrete, structural steel, cold-formed steel, masonry, timber, composite and mixed materials. Mechanisms for resisting and transmitting loads, detailing, fabrication, transportation, erection, stability, shoring, quality control and integration of service systems.

References:

- 1) Mehta,M. Scarborough,W. and Armpriest, D. ,2018. *Building Construction: Principles, Materials, and Systems*, Third Edition, ISBN 0134454170.
- 2) Allen, E. and Iano, J. ,2019. *Fundamentals of Building Construction: Materials and Methods*, Seventh Edition.

Course Name	Construction Safety and Environmental Management					Course Code	CIV533
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3	
	2	2	-				
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	40	-	20			

Scientific Content:

Fundamentals of safety management principles. Detailed review of OSHA regulations and standards critical to construction engineers and managers who expect to design and administer safety related systems in a construction project. Analysis and design of example minimum safety requirements for application in construction field operations. Review of OSHA Standards for the Construction Industry.

References:

- 1) Construction Industry Service Program, 2017. *The Construction Safety and Health Resource Guide*.
- 2) Griffith, A. and Howarth, T., 2014. *Construction Health and Safety Management*.

Course Name	Feasibility Studies and Project Management	Course Code	CIV534



Teaching Hours	Lectures		Tutorial		Practical		Credit Hours	3
	2		2		-			
Course Grades	Written Exam	Course Work		Practical		Oral	Total	100
	40	40		-		20		

Scientific Content:
Determining the type of project to be studied, its location and the type of environment - Determining the value of private property and fixed assets - Determining operation and maintenance costs and material and in-kind incentives - The project implementation timeline - Feasibility study reports.

References:
1) American Business Academy ,2019. *Feasibility Study and Project Management: A Practical Guide* - Arabic Edition 2019.
2) Kulwin, M. 2016. *Feasibility Studies in Construction Projects: Practice and Procedure*.

Course Name	Advanced Topics in Design of Reinforced Concrete Structures					Course Code	CIV611
Teaching Hours	Lectures		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		
<u>Scientific Content:</u> Advanced topics such as analysis and design of RC shear walls for high-rise buildings. (Cantilever, coupled shear walls, openings in shear walls). Design of precast units, fiber-reinforced concrete, high strength concrete. Analysis of axi-symmetric bodies, stresses and deformations (shell, spherical, conical structures). Non-linear Analysis of RC structures.							
<u>References:</u> 1) Lecture notes and handouts prepared by the instructor. 2) M.A. El-Reedy, Advanced Materials & Techniques for RC Structures, Second edition 2015. 3) Egyptian code for the use of FRP in construction fields, 2006. 4) T.T.C. Hsu, Unified theory of concrete structures, 2010.							

Course Name	Computational Methods of Nonlinear Analysis				Course Code	CIV612
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		
Scientific Content: Nonlinear behavior of reinforced concrete and steel structural elements – Stress-strain relationships – Equation solution –Numerical and computer representation of failure of normal and high strength concrete and steel – Applications using computer programs.						
References:						



- 1) Lecture notes and handouts prepared by the instructor.
- 2) Timoshenko, S. P., and Gere, J.M., "Theory of Elastic Stability", 2nd Edition, McGraw-Hill Inc., New York, N.Y., 1961.
- 3) Park, R. and Paulay, T., "Reinforced Concrete Structures", John Wiley and Sons, Inc., New York, N.Y., 1975, pp. 769-790.

Course Name	Finite Elements Analysis					Course Code	CIV613
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Basic principles and fundamentals of the finite element method – Numerical formulation for continuous systems – Formulations for one-dimensional element and plane stress/strain element – Load vector – Solution method and computer implementation – Stresses calculation – Accuracy.

References:

- 1) Lecture notes and handouts prepared by the instructor.
- 2) Zienkiewicz O.C. and Taylor R.L., (2000), "The Finite Element Method", 5th Edition, Butterworth Heinemann.
- 3) Friedel Hartmann and Casimir Katz, (2007), "Structural Analysis with Finite Elements", Springer.
- 4) Liu, G.R. and Quek, S.S., (2003), "The Finite Element Method: A practical Course", Butterworth Heinemann.

Course Name	Microstructure of Engineering Materials				Course Code	CIV614
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Types of crystal structures, microstructure and effect on macro-properties.

References:

- 1) Concrete microstructure, properties and materials, P. Kumar Mehta and Paulo J. M. Monteiro Third Edition McGraw-Hill 2006.
- 2) Ilson, J.M, "Construction Materials, Their nature and behavior", ISBN 0-419-25860.

Course Name	Design for Cold Formed Steel Structures				Course Code	CIV615
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

This course will cover the spectrum of cold-formed steel applications to include joists, purlins, girts, headers, trusses, shear walls and diaphragms, panels, and decks. Local buckling, overall buckling and web crippling of cold formed sections will be studied. Design criteria and example problems will be presented.

**References:**

- 1) Course notes prepared by instructor.
- 2) Solved examples prepared by instructor.
- 3) Wei-Wen Yu, Cold-Formed Steel Design, JOHN WILEY & SONS, INC, New York • Chichester • Weinheim • Brisbane • Singapore • Toronto, 2000.

Course Name	Structural Dynamics				Course Code	CIV616
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Types of dynamic loads – Dynamic equilibrium equations – Structural dynamic behavior – Free vibration – Damping – Solution methods – Response of single degree of freedom system to dynamic excitation: free vibration, harmonic loads, pulses and earthquakes - Response of multi-degree-of-freedom systems – Solution of Eigen value problem – Modal superposition method – Deterministic time domain integration method – Approximate methods – Random vibrations.

References:

- 1) Mario Paz and William Leigh, Structural Dynamics (Theory and Computation-Fifth Edition), ISBN: 1-4020-7667-3, Publisher: Kluwer Academic Press (Boston, Dordrecht, London)
- 2) Egyptian codes for loads on buildings (ECP 201- 2012)

Course Name	Quality in Construction					Course Code	CIV617
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Quality concerns in construction, organizing for quality and work and material specifications, quality control and inspection, statistical methods, sampling by Competencies and variables, total quality management (TQM), ISO concepts and regulations.

References:

- 1) “Managing Quality”, Barrie G. Dale, Ton van der Wiele, Jos van Iwaarden, 5th Edition, 2007, Wiley-Blackwell, ISBN: 978-1-4051-4279-3.
- 2) “Construction Quality Management: Principles and Practice”, Paul Watson, Tim Howarth, Routledge (2011) , ISBN-13: 978-0415569118 .
- 3) www.elsevier.com

Course Name	Special Concrete Types					Course Code	CIV618
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Concrete containing mineral or chemical admixtures. Light weight, heavy weight, high strength, underwater,



self-compacting, roller compacted, polymer, fiber, high performance, reactive powder.

References:

- 1) Lecture notes and handouts prepared by the instructor.
- 2) A.M. Neville, Properties of Concrete, Wiley; 4 edition (1996), ISBN-13: 978-0470235270.
- 3) P.K. Mehta, Concrete Structure, Properties, and Materials, Prentice Hall College Div; 2 Sub edition (1992), ISBN-13: 978-0131756212
- 4) ACI Material Journal, American Concrete Institute www.aci.org
- 5) ACI Manual of Concrete Practice.

Course Name	Steel Structural Stability					Course Code	CIV619
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Elastic buckling of axially loaded bars – Elastic stability of columns and simple frames – Buckling of beams subjected to out-of-plane loads – Buckling of thin plates – Design codes requirements for buckling resistance.

References:

- 1) Chai H Yoo, Sung Lee, Stability of Structures: Principles and Applications, Elsevier publisher, 2011
- 2) Zdenek P. Bazant, Luigi Cedolin, Stability of Structures: Elastic, Inelastic, Fracture and Damage Theories, world scientific publishing co., 2010.
- 3) Segui, W.T., “LRFD Steel Design”, 3rd Edition, 2003, Thompson, Brooks/Cole, USA.
- 4) Manual of Steel Construction, Allowable Stress Design, American Institute of Steel Construction (AISC), 3rd Edition. 2001
- 5) Mc.Cormac, J. C. and Nelson, J. K., Structural Steel Design: LRFD Method, 3rd Edition, 2003, Prentice Hall, NJ, USA
- 6) Kulak, G. L. and Gilmor, M. I., Limit State Design in Structural Steel, 6th Edition, 1998, Canadian Institute of Steel Construction, Alliston, Ontario, Canada.
- 7) American Institute of steel constructions, AISC.

Course Name	Ground Improvement Techniques					Course Code	CIV621
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Methods for improving sites for geotechnical engineering projects, preloading, dynamic compaction, blast densification, pounding, chemical, physical and electrical stabilization.

References:

- 1) Petros P., Lee W. and Donald A.” Ground Control and Improvement” Third Edition, John Wiley & Sons, New York, 605P, ISBN 0-471-55231-3.
- 2) Raj P.P ,2005, “Ground Improvement Techniques” Laxmi Publications LTD, New Delhi.



3) Jones, C.J., 1996, "Earth Reinforcement and Soil Structures" Third edition, Thomas.

Course Name	Soil Hydraulics					Course Code	CIV622
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Seepage and its effects on engineering behavior of soils and its consequences for design of geo-infrastructure, flow nets, construction dewatering, pumping tests, and lowering of water table.

References:

- 1) Lecture notes, handouts, power point presentations, selected papers and videos prepared by the instructor.
- 1) Powers, J. P., "Construction Dewatering and Groundwater Control", Wiley, 2007, ISBN 0471479438
- 2) Cashman, P. M., "Groundwater Lowering", Spon Press, 2001, ISBN 0419211101.

Course Name	Advanced Site Investigation Techniques					Course Code	CIV623
Teaching Hours	Lectures	Tutorial		Practical		Credit Hours	3
	2	-		3			
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		20	-		

Scientific Content:

Field shear strength tests, pressure-meter, dilatometer, piezometers, piezocone, collapsibility tests, swelling tests, geophysical methods including seismic, magnetic, electromagnetic, radar, and resistivity methods.

References:

- 1) Selected papers in "Advances in Site Investigation Practice," Proceedings of the International Conference Held in London on 30-31 March 1995
- 2) FHWA Site Investigation NHI-SI-Manual
- 3) Site Investigation (2002) by C. R. I. Clayton, M. C. Matthews and N. E. Simons.

Course Name	Soil Stabilization and Reinforcement					Course Code	CIV624
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Mechanical, physical, chemical, electrical, thermal stabilization of foundation soils, embankments for roads, railways, and runways, water structures and dams. Geosynthetic; development, fabrication, design, and applications of geotextiles, geogrids, geonets, and geomembranes.

References:



- 1) Jones, C.J., 1996, "Earth Reinforcement and Soil Structures" Third edition, Thomas Telford.
- 2) Colin, J.F., 1978, "The York method of reinforced earth construction", American Society of Civil Engineers, 1978.

Course Name	Research Topics in Geotechnical Engineering					Course Code	CIV625
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Updated theoretical and research topics that cover advanced and comprehensive knowledge relating to topics relevant to M.Sc. students research interests.

References:

- 1) Cashman, P. M., "Groundwater Lowering", Spon Press, 2001, ISBN 0419211101
- 2) Mansur, C. I. & Kaufman, R. I., "Dewatering", in "Foundation Engineering", Leonards G. A. (editor), McGraw Hill, 1962.
- 3) Journal of Geotechnical and geo -environmental Engineering, ASCE American society of civil engineering Geo-technique.

Course Name	Geotechnical Engineering Modeling					Course Code	CIV626
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Fundamental concepts in modeling behavior of soils, implementation of models into numerical solution codes. Evaluation of models used in practice. Geotechnical Analysis Using Mathematical Methods, Finite Difference Method, Finite Element Method, Geotechnical Analysis Using Boundary Element Method, Numerical Analysis of Case Studies in Geotechnical Engineering. Analysis and Design Packages, Package Selections, Commercial Computer Packages.

References:

- 1) Soil and Foundation Handbook, April 2014, State of Florida.
- 2) Pile Foundation Design, School of the Built Environment, Napier University
- 3) Lambe, W., and Whitman, R. V., "Soil mechanics", John Wiley & Sons, Inc., 2004 ISBN 77 14210

Course Name	Advanced Geotechnical Engineering				Course Code	CIV627
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100



	40	40	-	20		
Scientific Content: Soil mineralogy, physical and chemical behavior of soils, fundamental concepts related to the mechanical behavior of soils, including effective stress, strength, stiffness, permeability, time-dependent behavior.						
References: 1) Pile Foundation Design, School of the Built Environment, Napier University 2)						

Course Name	Soil Structure Interaction				Course Code	CIV628
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:
 Interaction between ground and structure, exchange of mutual stress between structure and foundation ground, interface of the major structural elements within a structure and the foundation material, methods of analysis and modeling, effect of ground movement, site response analysis, numerical seismic analysis and modeling for underground structures, soil-structure interaction under extreme loading conditions including performance during earthquakes, floods, landslides, large deformations due to tunneling, deep excavations, and subsidence due to dewatering and cavernous rocks.

References:
 1) David, M.W., "Geotechnical Modelling", Span Press, Taylor & Francis group, 2004, ISBN 0-415-34304-6.
 2) Jhon, W. B., "Soil structure interaction: numerical analysis and modelling", Taylor & Francis group, 1994, 727P, ISBN 0-419-19070-8.
 3) Jhon, W. B., "Numerical analysis and modelling in geomechanics", Taylor & Francis group, 2003, 371P.
 4) Dynamic Soil-Structure Interaction Journal: ELSEVIER
<http://www.elsevier.com/wps/find/bookdescription.advertisers/601276/description#description>

Course Name	Dynamic Geotechnical Engineering				Course Code	CIV629
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:
 Introduction to wave propagation theories; engineering behavior of soils under dynamic loading; dynamic soil properties; dynamic stiffness of foundations; response of foundations to dynamic loads; machine foundations; dynamic analysis of pile driving.

References:
 1) Richart, F. E., Woods, R. D. & Hall, J. R., "Vibrations of Soils and Foundations", Prentice Hall, 1970, ISBN 0139417168.
 2) Das, B. J. & Ramane, G. V., "Principles of Soil Dynamics", Cengage Learning, USA, 2011, ISBN 0-495-41134-5.



3) Arya S., O'Neill, M. & Pincus, G., " Design of Structures and Foundations for Vibrating Machines", Gulf Publishing, 1981, ISBN 0-87201-294-8.

Course Name	Construction Equipment Systems					Course Code	CIV631
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Analysis of heavy construction processes as systems in order to optimize the selection and employment of construction equipment. Considerations in system design, cost and productivity estimation, operational procedures, safety and maintenance. Computer applications utilizing analytical and simulation techniques.

References:

- 1) Gransberg, D.D., Jorge A. and Benavides,R.,2020. Construction Equipment Management for Engineers, Estimators, and Owners, ISBN 9780367488840
- 2)Schaufelberger, H.E. and Migliaccio,G.C. , 2019. *Construction Equipment Management*, Second Edition.

Course Name	Construction Estimating, Planning, and Control					Course Code	CIV632
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Overview of the construction industry; life cycle of construction projects, work breakdown structure, activity cost and time estimation, computerized planning and scheduling methods, resource leveling, time-cost tradeoff; computerized cost estimating, bidding and negotiation strategies; and cost/schedule control systems.

References:

- 1) Schaufelberger, J.E. and Holm, L. ,2017. *Management of Construction Projects: A Constructor's Perspective*, Second Edition.
- 2) Cooke, B. andWilliams, P. ,2013. *Construction Planning, Programming and Control*.

Course Name	Entrepreneurship in Construction				Course Code	CIV633
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Explains the role of the entrepreneur in the built environment using case studies to outline different steps in developing real estate, construction, architectural and related enterprises. Emphasizes strategic marketing and implementation of the plan in the development of these businesses. Addresses the progression of an idea,



from an opportunity to a sustainable business.

Course Name	Innovative Project Delivery				Course Code	CIV634
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Develops a strong strategic understanding of how best to deliver various types of projects in the built environment. Examines the compatibility of various project delivery methods, consisting of organizations, contracts, and award methods, with certain types of projects and owners. Six methods examined: traditional general contracting; construction management; multiple primes; design-build; turnkey; and build-operate-transfer.

References:

- 1) *Innovation Project Management: Methods, Case Studies*, 2019. Harold Kerzner.
- 2) Pakkala, P., 2002. *Innovative Project Delivery Methods for Infrastructure*.

Course Name	Design for Sustainability				Course Code	CIV635
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Presents thought processes and quantitative tools, including life-cycle assessment (LCA) and the LEED rating system, applicable to integrated design of buildings and horizontal infrastructure with the goal of minimizing the waste of materials, energy, and water.

References:

- 1) *Handbook of Green Building: Design and Construction*, 2006. Sam Kubba.
- 2) Yates, J.K. and Lacouture, D.C. 2015. *Sustainability in Engineering Design and Construction*.

Course Name	Resource Management of Construction Projects					Course Code	CIV636
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Management of materials; scheduling, handling, utilization, and costing. Management of labor; tabulation, productivity, ergonomics, utilization, and costing. Management of equipment; acquisition, production rates, utilization, matching, and costing. Techniques of managing the three resources as an integral part of construction management.

References:

- 1) Gransberg, D.D., Jorge A. and Benavides, R., 2020. *Construction Equipment Management for Engineers, Estimators, and Owners*, ISBN 9780367488840.
- 2) Stewart, G.L. and Brown, K.G., 2019, *Human Resource Management*, 4th Edition, ISBN: 978-1-119-49217-7.



Course Name	Logistics and Supply Chain					Course Code	CIV637
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Provides an introduction to supply chain management from both analytical and practical perspectives. Taking a unified approach, students develop a framework for making intelligent decisions within the supply chain. Covers key logistics functions, such as demand planning, procurement, inventory theory and control, reverse logistics, and flexible contracting.

References:

- 1) Mangan, J., Lalwani, C. and Calatayud, A., 2020. Global Logistics and Supply Chain Management, 4th Edition.
- 2) Successful Construction Supply Chain Management: Concepts, Stephen Pryke, 2020.
- 3) Christopher, M., 2013. Logistics and Supply Chain Management, Fourth Edition, Pearson, UK.

Course Name	Organizational Management					Course Code	CIV638
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Organizational culture, Ethics, Understanding Personal Values, Motivation and incentives, Organization structure, Performance evaluation, Coaching, Charismatic leadership, Warmth and competence, Leading change.

References:

- 1) Bratton, J., 2020. Organizational Leadership.
- 2) Schein, E.H., 2010, Organizational Culture and Leadership.

Course Name	Strategic Planning					Course Code	CIV639
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Strategic planning principle, Strategic planning process, Organization's mission, External environment, Internal environment, formulating plan, Competitiveness, Strategic Alignment, Executing plan.

References:



- 1) Gruneberg, S., 2018. *A Strategic Approach to the UK Construction Industry*.
- 2) Male, S., 2008. *Strategic Management in Construction* David Langford.

Course Name	Introduction for Seismic Strengthening					Course Code	CIV711
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3	
	2	2	-				
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	40	-	20			

Scientific Content:

Philosophy of Seismic strengthening of structures, Structural damage and collapse patterns due to earthquakes, soil liquefaction and landslides as a result of earthquakes, foundation collapse, designation of collapses forms, modern methods of seismic assessment of buildings and estimation of structural damage, methods of checking of structures, maintenance and restoration techniques, causes of seismic damage to facilities, materials used in the repair and strengthening of installations, Repair of reinforced concrete structures, repair of metal structures and brick-bearing buildings, techniques of restoration and strengthening of structures to resist earthquakes, case studies.

References:

- 1) Lecture notes and handouts prepared by the instructor.
- 2) Advanced repair methods of RC structures.
- 3) ACI Concrete-Repair-Guide.

Course Name	Options for Repair and Demolition of Buildings					Course Code	CIV712
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3	
	2	2	-				
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	40	-	20			

Scientific Content:

Methods of repair (structural repair, patch repair), Performance of repaired buildings. Long term repair solutions (cathodic protection, alkalinity restoration...etc.). Demolition arrangements and procedures.

References:

- 1) Handbook of analytical techniques in Concrete Science and Technology, V.S. Ramachandran, J.J. Beaudoin, 2001, Noyes publications / William Andrew Publishing, ISBN 0815514379
- 2) Lecture notes and handouts prepared by the instructor.

Course Name	Elasticity Theory			Course Code	CIV713
Teaching	Lectures	Tutorial	Practical	Credit	3



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Hours	2	2	-	Hours	
Course Grades	Written Exam	Course Work	Practical	Oral	Total
	40	40	-	20	

Scientific Content:

Basic relations – Stress and strain tensors – Constitutive equations for linear elasticity – Compatibility equations – Variation principles and energy methods – Plane stress/strain formulation – Isotropic and anisotropic materials – Nonlinear stress-strain relationships and yielding – Applications: bending and torsion of beams, retaining walls and dams.

References:

- 1) Lecture notes and handouts prepared by the instructor.
- 2) Boresi, A.P., Chong, K. and Lee, J.D. “Elasticity in Engineering Mechanics”, 3rd ed., ISBN 978 0470402559, Wiley, 2010.
- 3) Lurie, A.I. “Theory of Elasticity”, ISBN 978 3540245568, Springer, 2005.

Course Name	Theory of Plates and Shells				Course Code	CIV714
Teaching Hours	Lectures	Tutorial	Practical	Credit Hours	3	
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Classical plate bending theory; Equations of slope and curvature. Moments and equilibrium equations. Basic equations of equilibrium of axi-symmetrical shells. Curvature, slope and bending moment relations. Membrane theory for axi-symmetric shell structures. Analysis of shells by membrane and bending theories. Classical and numerical solutions. Anisotropic and sandwich plates and shells. Applications to design of plate and shell structures with different boundary conditions.

References:

- 1) Lecture notes and handouts prepared by the instructor.
- 2) Timoshenko, S.P. and Woinowsky-Krieger, S. “Theory of Plates and Shells”, 2nd ed., ISBN 0-07-085820-9, McGraw-Hill, 1970.
- 3) Reddy, J.N. “Theory and Analysis of Elastic Plates and Shells”, 2nd ed., ISBN 978-0849384158, CRC Press, 2006.

Course Name	Transport Properties in Concrete				Course Code	CIV715
Teaching Hours	Lectures	Tutorial	Practical	Credit Hours	3	
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100



	40	40	-	20		
Scientific Content: Definitions, methods of measurements, assessment in buildings.						
References: 1) P. A. Claisse, "Transport Properties of Concrete – Measurement and Applications", Woodhead Publications Series in Civil and Structural Engineering, (2014), ISBN-13: 978-1782423065. 2) Advanced concrete technology v1, 2003, John Newman and B, a Seng Choo (Eds), Butterworth-Heinemann, 2003, ISBN: 9780750651035 3) Advanced concrete technology v2, 2003, John Newman and B, a Seng Choo (Eds), Butterworth-Heinemann, 2003, ISBN: 0750651040						

Course Name	Smart Materials					Course Code	CIV716
Teaching Hours	Lectures	Tutorial		Practical		Credit Hours	3
	2	2		-			
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		
<u>Scientific Content:</u> Aerogels. Self-Healing Concrete. Nano concrete. Advanced Insulating Materials. Self-cleaning and anti-reflecting glazing. Transparent Wood-Aluminum-Concrete. Sensors.							
<u>References:</u> References to be determined by the lecturer.							

Course Name	Materials Specifications					Course Code	CIV717
Teaching Hours	Lectures	Tutorial		Practical		Credit Hours	3
	2	2		-			
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		
<u>Scientific Content:</u> Types of specifications. Types of project specifications. Examples and applications.							
<u>References:</u> 1) H. J. Rosen; M. Kalin; R. S. Weygant and J. R. Regener, “Construction Specification Writing”, John Wiley & Sons Inc., Sixth Edition, 2010.							

Course Name	Advanced Analysis and Design of Steel Frames			Course Code	CIV718
Teaching	Lectures	Tutorial	Practical	Credit	3



Hours	2	2	-	Hours	
Course Grades	Written Exam	Course Work	Practical	Oral	Total
	40	40	-	20	

Scientific Content:

Fundamental equations governing the elastic and elastic-plastic equilibrium of beam, sheer beam, column, joint-panel and brace elements for steel frames. Analysis of elastic buckling, elastic-plastic capacity and earthquake-excited behavior of steel frames. Hysteretic behavior of steel beam-column, composite beams. Development of structural design approaches. Reliability- based advanced analysis. Methods and procedures for establishing practical design formula.

References:

- 1) Lecture notes and handouts prepared by the instructor Essential Books (Textbooks).
- 2) Gou-Qiang Li, Jin-Jin Li, "Advanced Analysis and Design of Steel Frames", April 2007, ISBN: 978-0-470-03061-5.

Course Name	Suspension and Guyed Steel Structures			Course Code	CIV719
Teaching Hours	Lectures	Tutorial	Practical	Credit Hours	3
	2	2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total
	40	40	-	20	

Scientific Content:

Classification of Suspension and Guyed Structures, Construction Materials, Joint Details, Design Considerations, Static Analysis, Dynamic Analysis, Computer Programming for Suspension and Guyed Structures, Practical Applications.

References:

- 1) Lecture notes and handouts prepared by the instructor.
- 2) Chung C. Fu, Shuqing Wang, "Computational Analysis and Design of Bridge Structures", CRC Press, 2014, ISBN 9781466579842.

Course Name	Rock Engineering			Course Code	CIV721
Teaching Hours	Lectures	Tutorial	Practical	Credit Hours	3
	2	2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total
	40	40	-	20	

Scientific Content:

Rock characterization, scale effect, in-situ stresses, mechanisms of rock deformation and fracture, rock falls, rockslides, rock cavities, foundations on rocks.

References:

- 1) Duncan, C. W., "Foundations on rock", E & FN SPON.
- 2) Hudson, J.A., Harrison, J.P., "Engineering rock mechanics: an introduction to principles", 1997,



Elsevier, Oxford.

3) Journal of Geotechnical and geo -environmental Engineering, ASCE American society of civil engineering Geo-technique.

Course Name	Geo-Environmental Engineering					Course Code	CIV722
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

The course deals with landfill design and construction; site selection, geomaterial selection and characterization, chemical compatibility, placement procedures (including compaction), design strategies, seepage issues, instrumentation, and environmental monitoring.

References:

- 1) Qian, X., Koerner, R.M., Gray, D.H., "Geotechnical aspects of landfill design", 2001.
- 2) Bagchi, H., "Design of landfills and integrated solid waste management", 2004, John Wiley & Sons.
- 3) Journal of Geotechnical and geo-environmental Engineering, ASCE American society of civil engineering Geo-technique.

Course Name	Rehabilitation of Geo-Structures					Course Code	CIV723
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Underpinning, grout curtains, injection grouting, geopiers, stone columns, and micro piles.

References:

- 1) Bowles, J. E. "Foundation analysis and design", McGraw Hill, 1996, ISBN 0-07-912247-7.
- 2) Brown, R. W., "Practical foundation engineering hand book", Mc Periodicals Web sites,

Course Name	Geotechnical Earthquake Engineering					Course Code	CIV724
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3	
	2	2	-				
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	40	-	20			



<u>Scientific Content:</u>
Earthquake magnitude and intensity, seismic hazard evaluation using deterministic and probabilistic approaches, site response analyses and ground motion amplification liquefaction, and response of earth structures.
<u>References:</u>
1) Wolf, P. J., "Dynamic Soil-Structure Interaction", Prentice Hall, 1985, ISBN 0132215659
2) Kramer, S. L., "Geotechnical Earthquake Engineering", Prentice Hall, 1996, ISBN 0133749436

Course Name	Advanced Topics in Geotechnical Engineering				Course Code	CIV725
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

<u>Scientific Content:</u>
Advanced theoretical and practical and/or experimental studies that cover updated scientific knowledge and state-of-the-art in engineering practice relating to topics relevant to the Ph. D. students research interests.
<u>References:</u>
1) Cashman, P. M., "Groundwater Lowering", Spon Press, 2001, ISBN 0419211101
2) Mansur, C. I. & Kaufman, R. I., "Dewatering", in "Foundation Engineering", Leonards G. A. (editor), McGraw Hill, 1962.
3) Journal of Geotechnical and geo -environmental Engineering, ASCE American society of civil engineering Geo-technique.

Course Name	Special Topics in Construction Engineering & Management				Course Code	CIV731
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

<u>Scientific Content:</u>
New or special course on recent developments in some phase of construction engineering & management. Specific topics and prerequisites identified for each section and varied from term to term.
<u>References:</u>
1) Selected Topics by Instructor.
2) Proceedings of ACMM, 2021. <i>Advances in Construction Management</i> .
3) Brockmann, C., 2020. <i>Advanced Construction Project Management: The Complexity of Megaprojects</i> .

Course Name	Risk and Financial Management in Construction	Course Code	CIV732



Teaching Hours	Lectures		Tutorial		Practical		Credit Hours	3
	2		2		-			
Course Grades	Written Exam	Course Work		Practical		Oral	Total	100
	40	40		-		20		
<u>Scientific Content:</u> Fundamental concepts in financial and risk analysis in construction; accounting and financial metrics in construction; risk assessment and risk management in construction including the cost of risk, decision making strategies, the role of sureties, effects of risk in project delivery methods and contract types.								
<u>References:</u> 1) AGunn, A.B.,2017. <i>Risk and Financial Management in Construction</i> Simon. 2) Hillson, D. ,2016, <i>The Risk Management Handbook: A Practical Guide</i> .								

Course Name	Contract Management				Course Code	CIV733
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		
<u>Scientific Content:</u> Legal aspects of contract documents, drawings and specifications; owner-engineer-constructor relationship and responsibilities; bids and contract performance; labor laws; governmental administrative and regulatory agencies; torts; business organizations; ethics and professionalism; analysis of current topics and issues.						
<u>References:</u> 1) Greenhalgh, B. ,2016. <i>Introduction to Construction Contract</i> . 2) Powell, G., 2016. <i>Management Construction Contract Preparation and Management</i> .						

Course Name	Construction Productivity				Course Code	CIV734
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		
<u>Scientific Content:</u> Methods of collecting, assembling and analyzing construction productivity data in order to increase construction productivity. Applications of methods improvement techniques such as time-lapse photography, flow charts, process charts and time standards to improvement of construction productivity. Safety and human factors in construction and their relation to construction productivity.						
<u>References:</u> 1) Pheng, L.S., and Meng, C.Y., 2018. <i>Managing Productivity in Construction</i> . 2) Thomas, H. R. and Ellis, R. D., 2017. <i>Construction Site Management and Labor Productivity</i>						



Improvement. ISBN, print.: 9780784414651, doi:10.1061/9780784414651, ASCE.

Course Name	Research Topics in Construction Engineering and Management					Course Code	CIV735
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3	
	2	2	-				
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	40	-	20			

Scientific Content:

Research topics in construction engineering and management. Prerequisite courses and topics are determined by the academic advisor and approved by the department council.

References:

- 1) Selected Topics by Instructor.
- 2) Loon, L.Y., Subramaniyan, M., and Gunasekaran, K., 2021.
- 3) *Advances in Construction Management*.
- 4) Lu.W., Lai, C.C. and Tse, T., 2018. *BIM and Big Data for Construction Cost Management*.

2) Hydraulics and Water Resources Engineering.

1. Advanced diploma in Hydraulics and Water Resources Engineering.

The Graduate of the Advanced Engineering Diploma Program in Hydraulics and Water Resources should be able to:

1. Show awareness of significant research methods and approaches.
2. Practice successful scientific writing skills.
3. Show awareness of the scientific study importance.
4. Apply engineering concepts in professional practice.
5. Find and gather available data.
6. Practice socio-cultural and professional ethics.
7. Define scientific problems and gather data, prioritize solutions.
8. Solve practical and theoretical problems.
9. Able to present fundamental assessments for projects in his field.
10. Show a high level of scientific performance.
11. Write successful technical reports.
12. Use IT and computer applications in his field.



13. Find comprehensive data and information sources.
14. Collaborate effectively, within teams.
15. Lead various professional teams in his field.

Table 5. 2. 1 Compulsory Courses for the Basic Diploma in Hydraulics and Water Resources Engineering

S. N.	Course Code	Course Name	Pre-Requisite	Credit Hours	Work Hours			Grades				Test Time
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1	GEN501	Technical Writing and presentation skills	–	2	2	–	–	40	20	40	100	2
2	GEN502	Statistics and Random Processes	–	2	2	–	–	40	20	40	100	2

Table 5. 2. 2 Elective Courses for Basic Diploma in Hydraulics and Water Resources Engineering*

S. N.	Course Code	Course Name	Pre-Requisite	Credit Hours	Work Hours			Grades				Test Time (hr)
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1	CIV5٢1	Site Investigation	–	3	2	2	–	40	20	40	100	2
2	CIV5٢٢	Problematic Geo-Materials	–	3	2	2	–	40	20	40	100	2
3	CIV541	Hydraulics of Open Channels	–	3	2	2	–	40	20	40	100	2
4	CIV542	Wave Mechanics	–	3	2	2	–	40	20	40	100	2
5	CIV543	Principles in Soil Hydraulics	–	3	2	2	–	40	20	40	100	2



*With the help of the academic advisor, the student chooses (9) credit hours with a minimum of elective courses for the Basic Diploma in Hydraulics and Water Resources Engineering in one of the disciplines mentioned in Table (5.2.2) and according to what is determined by the Scientific Department Council.

Table 5. 2. 3 Elective Courses for the Advanced Engineering Diploma in Hydraulics and Water Resources Engineering*

S. N.	Course Code	Course Name	Pre-Requisite	Credit Hours	Work Hours			Grades				Test Time
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1	CIV623	Advanced Site Investigation Techniques	--	3	2	-	3	40	20	40	100	2
2	CIV641	Water Resources Management	--	3	2	2	--	40	20	40	100	2
3	CIV642	Coastal Engineering (I)	--	3	2	2	--	40	20	40	100	2
4	CIV643	Hydraulic Modeling	--	3	2	2	--	40	20	40	100	2
5	CIV644	Coastal Structures	--	3	2	2	--	40	20	40	100	2

*With the help of the academic advisor, the student chooses (12) credit hours as a minimum from the elective courses for the Advanced Diploma in Hydraulics and Water Resources Engineering in one of the disciplines mentioned in Table (5.2.3) and according to what is determined by the Scientific Department Council.

4. Master of Science in Hydraulics and Water Resources Engineering

The graduate of the Master of Science in Hydraulics and Water Resources Engineering Program should be able to:

1. Use and apply significant research method, tools and approaches in his scientific studies.
2. Find various data and information sources.
3. Collect, analyze, systemize and discuss data and information.
4. Create a scientifically structured study.
5. Show his comprehension of the various types of research methods applications.
6. Define, analyze and create debates in a scientifically structured study.
7. Show awareness of the impact of the scientific studies on community development.
8. Use modern tools and applications in gathering and managing data.
9. Produce adequate scientific solutions to problems in his field.

10. Assesses the human-made projects on the natural environment.
11. Practice the required fundamental rules and theories in his practice.
12. Manage time successfully.
13. Categorize literature in a hierarchically ordered.
14. Commit himself and his teams to professional ethics.

Table 5. 2. 4 M. Sc. Thesis in Hydraulics and Water Resources Engineering

S.N.	Course Code	Course Name	Perquisites	Credit Hours
1	CIV841	M.Sc. Thesis	Average GPA of 3.0 and minimum of 2.7 in all Advanced Engineering Diploma courses studied	12

5. Doctor of Philosophy (Ph.D.) in Hydraulics and Water Resources Engineering

By the end of the program the student should be able to:

1. Show awareness of research methods different application.
2. Master the use of research methods, tools and approaches.
3. Perform various scientific studies adding to the human knowledge.
4. Apply scientific conclusions practically.
5. Show awareness of the scientific studies' ethics.
6. Relate various discipline into multidisciplinary studies.
7. Take decisions in light of the available data.
8. Apply effectively, available resources in his profession.
9. Manage scientific and professional meetings.
10. Manage time effectively.
11. Find and use various kinds of literature, sources and plan applicable field studies.

Table 5. 2. 5 Basic Courses for Doctor of Philosophy in Hydraulics and Water Resources Engineering*

Serial	Course Code	Course Name	Pre-Requisite	Credit Hours	Work Hours			Grades				Test Time
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1	CIV621	Ground Improvement Techniques	–	3	2	2	–	40	20	40	100	2
2	CIV645	Advanced Fluid Mechanics	–	3	2	2	–	40	20	40	100	2
3	CIV646	Advanced Hydraulics	–	3	2	2	–	40	20	40	100	2
4	CIV647	Dam Engineering	–	3	2	2	–	40	20	40	100	2
5	CIV648	Computational Fluid Dynamics	–	3	2	2	–	40	20	40	100	2
6	CIV656	Special studies in Sanitary and Environmental Engineering	–	3	2	2	–	40	20	40	100	2

*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from the basic courses of the Doctor of Philosophy in Hydraulics and Water Resources Engineering in one of the disciplines mentioned in Table (5.2.5) and according to what is determined by the Scientific Department Council.

Table 5. 2. 6 Specialized Courses for Ph.D. in Hydraulics and Water Resources Engineering*

S. N.	Course Code	Course Name	Pre-Requisite	Credit Hours	Work Hours			Grades				Test Time
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1	CIV742	Ground water Hydrology	--	3	2	2	--	40	20	40	100	2
2	CIV743	Marine Dredging Engineering	--	3	2	2	--	40	20	40	100	2
3	CIV744	Water Quality in Streams and Estuaries	--	3	2	2	--	40	20	40	100	2
4	CIV745	Special Studies in Water Resources Engineering and Hydraulics	--	3	2	2	--	40	20	40	100	2
5	CIV 746	Economical Methods of Wastewater Treatment	--	3	2	2	--	40	20	40	100	2
6	CIV7 ^o 1	Coastal Engineering II	--	3	2	2	--	40	20	40	100	2



*The student chooses (9) credit hours as a minimum from the specialized courses for the Doctor of Philosophy in Hydraulics and Water Resources Engineering in one of the disciplines mentioned in Table (5.2.6), upon the recommendation of the main supervisor and according to what is determined by the scientific department council.

Table (5.2.7) Ph.D. Thesis in Hydraulics and Water Resources Engineering

S. N.	Course Code	Course Name	Perquisites	Credit Hours
1	CIV941	Ph.D. Thesis	1. Average GPA 3.0 and minimum 2.7 in all courses in basic and specialized Ph.D. courses. 2. Pass the seminar of stage one of the academic research.	12



Matrix Linking the advanced engineering diploma in the Hydraulics and Water Resources Engineering program with the graduate Competencies

Total	Advanced engineering diploma graduate Competencies in the Hydraulics and Water Resources Engineering program															Course Name	Course Code	No.
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1			
6			√	√	√	√				√				√		Technical Writing and presentation skills	GEN501	1
6			√	√				√	√		√	√				Statistics and Random Processes	GEN502	2
3						√						√	√			Hydraulics of Open Channels	CIV541	3
5			√			√	√				√		√			Wave Mechanics	CIV542	4
4			√						√		√	√				Principles in Soil Hydraulics	CIV543	5
10	√	√		√	√			√	√	√			√	√	√	Site Investigation	CIV521	6
9		√	√		√	√		√		√			√	√	√	Problematic Geo-Materials	CIV522	7
8	√	√						√	√	√		√		√	√	Water Resources Management	CIV641	8
5			√			√	√				√		√			Coastal Engineering (I)	CIV642	9
6			√	√			√				√	√			√	Hydraulic Modeling	CIV643	10
7			√	√		√	√				√	√	√			Coastal Structures	CIV644	11
9	√	√			√			√	√	√			√	√	√	Advanced Site Investigation Techniques	CIV623	12
78	3	4	8	5	4	6	4	5	5	5	6	6	7	5	5	Total		

Matrix Linking the Master of Science thesis in the Hydraulics and Water Resources Engineering Program with the graduate Competencies

Total	Master of science thesis graduate Competencies in the Hydraulics and Water Resources Engineering Program															Course Name	Course Code	No.
	14	13	12	11	10	9	8	7	6	5	4	3	2	1				
	√	√	√	√	√	√	√	√	√	√	√	√	√	√		M.Sc. Thesis	CIV841	1
14	1	1	1	1	1	1	1	1	1	1	1	1	1	1		Total		



Matrix Linking Doctor of Philosophy (Ph. D.) in the Hydraulics and Water Resources Engineering Program with the graduate Competencies

Total	Doctor of Philosophy (Ph. D.) graduate Competencies in the Hydraulics and Water Resources Engineering Program											Course Name	Course Code	No.
	11	10	9	8	7	6	5	4	3	2	1			
3		√		√		√						Advanced Fluid Mechanics	CIV645	1
6	√	√		√		√				√	√	Advanced Hydraulics	CIV646	2
6			√	√	√	√	√	√				Dam Engineering	CIV647	3
3		√	√		√							Computational Fluid Dynamics	CIV648	4
5	√				√				√	√	√	Special studies in Sanitary and Environmental Engineering	CIV656	5
6	√						√	√	√	√	√	Ground Improvement Techniques	CIV621	6
3			√	√		√						Coastal Engineering II	CIV701	7
4		√	√				√	√				Ground water Hydrology	CIV742	8
3			√	√		√						Marine Dredging Engineering	CIV743	9
5		√		√			√	√	√			Water Quality in Streams and Estuaries	CIV744	10
7	√				√		√	√	√	√	√	Special Studies in Water Resources Engineering and Hydraulics	CIV745	11
7	√				√		√	√	√	√	√	Economical Methods of Wastewater Treatment	CIV 746	12
58	5	5	5	6	5	5	6	6	5	5	5	Total		



COURSES DESCRIPTION

Course Name	Hydraulics of Open Channels				Course Code	CIV541
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Application of momentum and energy principles to advanced topics in uniform, nonuniform, gradually varied and rapidly varied flow problems. Backwater flow profile computation in steady flow. The method of characteristics applied to unsteady flows. Jeffreys-Vedernikov criteria.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Subramanya, K, 2009. *Flow in Open Channels*, Tata McGraw-Hill Education.
- 3) French R.H., 2015. *Open Channel Hydraulics*; McGraw Hill.
- 4) American Society of Civil Engineering Journal.

Course Name	Wave Mechanics					Course Code	CIV542
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Wave theory and applications to engineering problems; linear and non-linear theories of regular gravity wave; wave properties and transformation in shoaling water; spectral analysis of irregular waves; forecasting, hindcasting and theoretical spectra.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Bocotti, P., 2015. *Wave Mechanics and Wave Loads on Marine Structures*, Elsevier Publisher.
- 3) Davis A. D., 2015. *Wave Mechanics*, Lewis Publisher.
- 4) American Society of Civil Engineering Journal.

Course Name	Principles in Soil Hydraulics					Course Code	CIV543
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		

Scientific Content:

"Study of water cycle, Water in filtration in different type of soils, Water in filtration analysis and its effect to dams, bridges and different retaining structures, Formation of ground water aquifers

References:

- 1) Lecture notes, handouts, power point presentations, selected papers and videos prepared by the instructor.
- 2) Powers, J. P., "Construction Dewatering and Groundwater Control", Wiley, 2007, ISBN 0471479438



- 3) Cashman, P. M., "Groundwater Lowering", Spon Press, 2001, ISBN 0419211101.
- 4) Mansur, C. I. & Kaufman, R. I., "Dewatering", in "Foundation Engineering", Leonards G. A. (editor), McGraw Hill, 1962.
- 5) Journal of Geotechnical and geo-environmental Engineering, ASCE American society of civil engineering Geo-technique.

Course Name	Water Resources Management				Course Code	CIV641
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Planning and measurement concepts for control, conservation and use for water resources by emphasizing interdisciplinary approaches; alternatives to minimize flood damages; Egypt water rights, multipurpose projects, environmental impacts, policies for the future and systems approach to planning.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Chin, D.A., 2006. *Water Quality Engineering in Natural Stream*, University of Miami. Coral Gables Florida.
- 3) Wahaab, RA and Badawy, MI, 2004. *Water Quality Assessment of the River Nile System*.
- 4) World Bank Group, 2015. *Good Governance for Good Water Management*.
- 5) McGraw Hill, 2000. *Economics of water resources planning*.
- 6) *Ecosystems and Human Well-Being*, MEA
- 7) *Environment and Disaster Risk, Emerging Perspectives*, ISDR .
- 8) Journal of Geotechnical and Geo- Environmental Engineering, ASCE American Society of Civil Engineering.
- 9) Journal of Geotextiles and Geomembranes, www.journals.elsevier.com/geotextiles-and-geomembranes.
- 10) American Society of Civil Engineering Journal.
- 11) Davis A. D., 2015. *Wave Mechanics*, Lewis Publisher.
- 12) American Society of Civil Engineering Journal

Course Name	Coastal Engineering (I)					Course Code	CIV642
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical	Oral		Total	100
	40	40	-	20			

Scientific Content:

Small amplitude waves theory and applications to engineering problems. Analysis of wave data. Wave forces on coastal structures. Wave run-up on seawalls and breakwaters. Control of spills and offshore pipelines

References:

- 1) Course Notes Prepared by the Instructor.
- 2) *The Overseas Coastal Area Development Institute (OCDI) of Japan*, 2002.
- 3) *Technical Standards and Commentaries for Port and - Harbor Facilities in Japan*, Daikousha Printing Co., Ltd, pp. 600.



Course Name	Hydraulic Modeling				Course Code	CIV643
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Dimensional analysis; model laws; mathematical techniques; applications to fluid mechanics and coastal engineering models; fixed-bed; movable-bed, geometric and distorted models for flows with free surface; sediment transport; waves, tides and estuary models.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) American Society of Civil Engineering Journal.
- 3) Academic Press; 1st edition (July 5, 2007), "Advanced Fluid Mechanics"
- 4) William Graebel (2001) "Engineering Fluid Mechanics"

Course Name	Coastal Structures				Course Code	CIV644
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Effects of waves on coastal structures; design of seawall breakwaters, jetties, harbors, ship channels and pipelines, intentional and accidental discharge of pollutants; diffusion and spreading; oil spill containment and collection.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Mokhles, A.M., 2014. Introduction to Harbor and Coastal Engineering, Faculty of Engineering, Cairo university.

Course Name	Advanced Fluid Mechanics					Course Code	CIV645
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical	Oral		Total	100
	40	40	-	20			

Scientific Content:

General introduction to fluid mechanics: hydrostatics, kinematics and fluid dynamics, conservation of mass, energy, mass and momentum, acceleration and velocity, vortices and potential flow: flow function, flow network, source / intake, vortex and fluid flow around cylindrical objects, laminar motion: vector calculations, Navier's equation, Stoke's Euler equation, Bernoulli's equation.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) American Society of Civil Engineering Journal.
- 3) Academic Press; 1st edition (July 5, 2007), "Advanced Fluid Mechanics"
- 4) William Graebel (2001) "Engineering Fluid Mechanics."



Course Name	Advanced Hydraulics					Course Code	CIV646
Teaching Hours	Lectures		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		

Scientific Content:

A general review of water flow in open waterways, survival laws, specific energy and its applications, flow resistance equations, governing sectors, gradual change flow calculations in long and short waterways, fast changing flow: free, submersible and controlled water jump, waterfalls, variable flow with time: representation of the flood movement in rivers and lakes, the use of computer programs to assist in the design, methods of field measurements of open streams.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Spiral-Bound 2014. *Water-Based Systems Layout Advanced Hydraulics* ج
- 3) American Society of Civil Engineering Journal.
- 4) Doddamani, A., 2016. *Advance Hydraulics Technologies and Their Modern Applications*.

Course Name	Dam Engineering				Course Code	CIV647
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Types of dams, dam selection, site selection, design loads, factors of safety, seepage prevention, concrete dams, embankment dams; rock fill dams and earth dams.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Amin, M. and Ardebili, H., 2020. *Advances in Dam Engineering. Edited Book*.
- 3) Tosun, H., 2019. *Dam Engineering, Edited Book*.

Course Name	Computational Fluid Dynamics				Course Code	CIV648
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Basic numerical concepts for the solution of dispersion, propagation and equilibrium problems commonly encountered in real fluid flows using finite-difference and finite-element methods. Theoretical accuracy analysis techniques.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Ferziger, J.H. and Perić, M., 2002. *Computational Methods for Fluid Dynamics*, ISBN: 978-3-540-42074-3 (Print) 978-3-642-56026-2 (Online)



Course Name	Special studies in Sanitary and Environmental Engineering					Course Code	CIV656
Teaching Hours	Lectures		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		

Scientific Content:

Theoretical and experimental studies covering advanced and comprehensive knowledge in research topics of interest to post graduate students.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Egyptian Code of Practice for water and wastewater treatment plants design. 2000.
- 3) Metcalf and Eddy, 2018. *Wastewater Engineering Treatment and Reuse*, 3rd Edition, ISBN 0-07100824-1.

Course Name	Ground Water Hydrology				Course Code	CIV742	
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical	Oral		Total	100
	40	40	-	20			

Scientific Content:

Groundwater hydrology, theory of groundwater movement, steady state flow, potential flow, flow nets, mechanics of well flow, multiple-phase flow, saltwater intrusion, artificial recharge, legal aspects and models.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Ohio State University Agricultural Drainage - Bulletin 871, U.S.A, 1998.
- 3) The Hydrologic Center, Davis, California, 2001.
- 4) *Improving Egypt's Irrigation System in Old Lands*, EWUP Report 1984.

Course Name	Marine Dredging Engineering					Course Code	CIV743
Teaching Hours	Lectures		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		

Scientific Content:

Dredge pump selection; pump and system characteristics; cavitation; types of dredges; head loss on horizontal and vertical pipes for two and three-phase flow; design of disposal methods for dredged material; environmental effects of dredging.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Karassik, I.J., 1996. *Pump Handbook*, McGraw-Hill.
- 3) Wiley, 2004. *Pumps and Hydraulic*, Wiley Publishing.
- 4) American Society of Civil Engineering Journal.



Course Name	Water Quality in Streams and Estuaries				Course Code	CIV744
Teaching Hours	Lectures	Tutorial		Practical	Credit Hours	3
	2	2		-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Physical, chemical, radiological and biological properties of streams, reservoirs and estuaries, and the interrelationships of these properties; water quality standards, legal aspects of water pollution control; quality criteria for beneficial uses of water; evaluation of critical problems.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) CHIN, D.A., 2006, *Water Quality Engineering in Natural Stream*, University of Miami. Coral Gables Florida.
- 3) Wahaab RA, and Badawy M. I., 2004. *Water Quality Assessment of the River Nile System*.
- 4) American Society of Civil Engineering Journal.

Course Name	Special Studies in Water Resources Engineering and Hydraulics				Course Code	CIV745
Teaching Hours	Lectures	Tutorial		Practical	Credit Hours	3
	2	2		-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Field, physical and studies covering the advances and comprehensive information and knowledge covering the research topics related to the students.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Griffen, R.C., *Water Resource Economics: Theory, Institutions, and Applications*.
- 3) Dinar, A. and Zilberman, D., *Economics of Water Resources: The Contributions of Dan Yaron*.

Course Name	Economical Methods of Wastewater Treatment				Course Code	CIV746
Teaching Hours	Lectures	Tutorial		Practical	Credit Hours	3
	2	2		-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Natural treatment methods, stabilization ponds, aerated lagoons, wetlands, land treatment.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Egyptian Code of Practice for water and wastewater treatment plants design. 2000.
- 3) Metcalf and Eddy, 2018. *Wastewater Engineering Treatment and Reuse*, 3rd Edition, ISBN 0-07-100824-1.
- 4) McGhee, T.J., 2011. *Water Supply and Sewerage*, 6th Edition, ISBN 0-07-100873-3.



Course Name	Coastal Engineering II				Course Code	CIV751
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Non-linear wave theories and their application to engineering problems, wave forces on off-shore structures; floating, hydraulic and pneumatic breakwaters; off-shore pipelines; diffusion in coastal waters; oil spill containment and collection.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Sorensen, R.M., 2010. *Basic Coastal Engineering*. 3rd Edition.
- 3) The Overseas Coastal Area Development Institute (OCDI) of Japan, 2002. *Technical Standards and Commentaries for Port and Harbor Facilities in Japan*, Daikousha Printing Co., Ltd, pp. 600

3) Public Works Engineering Program

1. Advanced diploma in Public Works Engineering.

Registration is made in the following research specializations:

1. Sanitary and Environmental Engineering.
2. Transportation Engineering.

The Graduate of the Advanced Engineering Diploma Program in Public Works Engineering should be able to:

1. Show awareness of significant research methods and approaches.
2. Practice successful scientific writing skills.
3. Show awareness of the scientific study importance.
4. Apply engineering concepts in professional practice.
5. Find and gather available data.
6. Practice socio-cultural and professional ethics.
7. Define scientific problems and gather data, prioritize solutions.
8. Solve practical and theoretical problems.
9. Able to present fundamental assessments for projects in his field.
10. Show a high level of scientific performance.
11. Write successful technical reports.
12. Use IT and computer applications in his field.
13. Find comprehensive data and information sources.
14. Collaborate effectively, within teams.
15. Lead various professional teams in his field.

Table 5. 3. 1 Compulsory Courses for the Basic Diploma in Public Works Engineering

S. N.	Course Code	Course Name	Pre-Requisite	Credit Hours	Work Hours			Grades				Test Time
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1	GEN501	Technical Writing and presentation skills	–	2	2	–	–	40	20	40	100	2
2	GEN502	Statistics and Random Processes	–	2	2	–	–	40	20	40	100	2



Table 5. 3. 2 Elective Courses for Basic Diploma in Public Works Engineering*

S. N	Course Code	Course Name	Pre-Requirement	Credit Hours	Work Hours			Grades				Test Time
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1) Sanitary and Environmental Engineering												
1	GEN503	Project Management	–	2	2	-	–	40	20	40	100	2
2	CIV551	Wastewater Collection Systems	–	3	2	2	–	40	20	40	100	2
3	CIV552	Advanced Water Treatment	–	3	2	2	–	40	20	40	100	2
4	CIV553	Environmental Engineering and Pollution Control	–	3	2	2	–	40	20	40	100	2
5	CIV554	Wastewater Engineering in Rural Areas	–	3	2	2	–	40	20	40	100	2
2) Transportation Engineering												
1	CIV561	Public transportation network planning	–	3	2	2	–	40	20	40	100	2
2	CIV562	Advanced studies in Traffic Engineering	–	3	2	2	–	40	20	40	100	2
3	CIV563	Geometric design of highway engineering	–	3	2	2	–	40	20	40	100	2
4	CIV564	Economics of highways, airports and railways	–	3	2	2	–	40	20	40	100	2
5	CIV565	Advanced studies in construction and maintenance of railway lines	–	3	2	2	–	40	20	40	100	2
6	CIV566	Terminal stations and their operation methods	–	3	2	2	–	40	20	40	100	2
7	CIV567	Selected Studies in Transport and Traffic	–	3	2	2	–	40	20	40	100	2
8	CIV568	Selected studies in roads and airports	–	3	2	2	–	40	20	40	100	2
9	CIV569	Selected Studies in Railway Engineering	–	3	2	2	–	40	20	40	100	2

*With the help of the academic advisor, the student chooses (9) credit hours with a minimum of elective courses for the Basic Diploma in Public Works Engineering in one of the disciplines mentioned in Table (5.3.2) and according to what is determined by the Scientific Department Council.



Table 5.3.3 Elective Courses for the Advanced Engineering Diploma in Public Works Engineering*

Serial	Course Code	Course Name	Pre-Requirement	Credit Hours	Work Hours			Grades				Test Time
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1) Sanitary and Environmental Engineering												
1	CIV622	Soil Hydraulics	–	2	2	-	–	40	20	40	100	2
2	CIV651	Sanitary Chemistry	–	3	2	2	–	40	20	40	100	2
3	CIV652	Bacteriology of Water and Wastewater	–	3	2	2	–	40	20	40	100	2
4	CIV653	Environmental Assessment	–	3	2	2	–	40	20	40	100	2
5	CIV654	Advanced Studies in Wastewater Treatment	–	3	2	2	–	40	20	40	100	2
2) Transportation Engineering												
1	CIV661	Transportation and Traffic Planning (1)	–	3	2	2	–	40	20	40	100	2
2	CIV662	Traffic Flow Theories and Engineering	–	3	2	2	–	40	20	40	100	2
3	CIV663	Traffic Accidents and Roads Safety	–	3	2	2	–	40	20	40	100	2
4	CIV664	Selective topics in highway pavement materials	–	3	2	2	–	40	20	40	100	2
5	CIV665	Advanced study for construction and operation of railway lines and operation costs` assessment	–	3	2	2	–	40	20	40	100	2

*With the help of the academic advisor, the student chooses (12) credit hours as a minimum from the elective courses for the Advanced Diploma in Public Works Engineering one of the disciplines mentioned in Table (5.3.3) and according to what is determined by the Scientific Department Council.



2. Master of Science in Public Works Engineering

Registration is made in the following research specialization:

1. Sanitary and Environmental Engineering.
2. Transportation Engineering.

The graduate of the Master of Science in Public Works Engineering Program should be able to:

1. Use and apply significant research method, tools and approaches in his scientific studies.
2. Find various data and information sources.
3. Collect, analyze, systemize and discuss data and information.
4. Create a scientifically structured study.
5. Show his comprehension of the various types of research methods applications.
6. Define, analyze and create debates in a scientifically structured study.
7. Show awareness of the impact of the scientific studies on community development.
8. Use modern tools and applications in gathering and managing data.
9. Produce adequate scientific solutions to problems in his field.
10. Assesses the human-made projects on the natural environment.
11. Practice the required fundamental rules and theories in his practice.
12. Manage time successfully.
13. Categorize literature in a hierarchically ordered.
14. Commit himself and his teams to professional ethics.

Table 5 .3. 4 Master of Science (M. Sc.) Thesis in Public Works Engineering

S. N.	Course Code	Course Name	Perquisites	Credit Hours
1	CIV851	M.Sc. Thesis	Average GPA of 3.0 and minimum of 2.7 in all Basic and Advanced Engineering Diploma courses studied	12
2	CIV861	M.Sc. Thesis		

3. Doctor of Philosophy (Ph.D.) in Public Works Engineering

Doctor of Philosophy degree is registered in the following research specialization:

1. Sanitary and Environmental Engineering.
2. Transportation Engineering.

By the end of the program the student should be able to:

1. Show awareness of research methods different application.
2. Master the use of research methods, tools and approaches.
3. Perform various scientific studies adding to the human knowledge.
4. Apply scientific conclusions practically.
5. Show awareness of the scientific studies' ethics.
6. Relate various discipline into multidisciplinary studies.
7. Take decisions in light of the available data.
8. Apply effectively, available resources in his profession.
9. Manage scientific and professional meetings.



10. Manage time effectively.
11. Find and use various kinds of literature, sources and plan applicable field studies.

Table 5. 3. 5 Core Courses for Philosophy Doctorate (Ph. D) in Public Works Engineering*

S. N.	Course Code	Course Name	Pre-Requirement	Credit Hours	Work Hours			Grades				Test Time
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1) Sanitary and Environmental Engineering												
1	CIV641	Water Resources Management	–	2	2	-	–	40	20	40	100	2
2	CIV655	Solid Waste Management	–	3	2	2	–	40	20	40	100	2
3	CIV656	Special studies in Sanitary and Environmental Engineering	–	3	2	2	–	40	20	40	100	2
4	CIV657	Industrial Wastewater Treatment	–	3	2	2	–	40	20	40	100	2
5	CIV658	Sludge Treatment	–	3	2	2	–	40	20	40	100	2
2) Transportation Engineering												
1	CIV666	Urban Transportation Planning	–	3	2	2	–	40	20	40	100	2
2	CIV667	Advanced Railway Signaling	–	3	2	2	–	40	20	40	100	2
3	CIV668	Statistical Application to Traffic Operations	–	3	2	2	–	40	20	40	100	2
4	CIV669	Yards of railway stations, containers and special yards	–	3	2	2	–	40	20	40	100	2

*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from the basic courses of the Doctor of Philosophy in Public Works Engineering in one of the disciplines mentioned in Table (5.3.5) and according to what is determined by the Scientific Department Council.



Table 5.3.6 Specialized Courses for Doctor of Philosophy in Public Works Engineering*

S. N.	Course Code	Course Name	Pre-Requisite	Credit Hours	Work Hours			Grades				Test Time
					Lectures	Tutorial	Practical	Course Work	Oral/Practical	Written Exam	Total	
1) Sanitary and Environmental Engineering												
1	CIV742	Ground Water Hydrology	–	3	2	2	–	40	20	40	100	2
2	CIV746	Economical Methods of Wastewater Treatment	–	3	2	2	–	40	20	40	100	2
3	CIV752	Water and Soil Pollution	–	3	2	2	–	40	20	40	100	2
4	CIV753	Environmental Management and Legislation	–	3	2	2	–	40	20	40	100	2
5	CIV754	Specialized Topics in Sanitary and Environmental Engineering	–	3	2	2	–	40	20	40	100	2
6	CIV755	Anaerobic treatment of effluents and sludge treatment	–	3	2	2	–	40	20	40	100	2
2) Transportation Engineering												
1	CIV761	Advanced Transportation Systems	–	3	2	2	–	40	20	40	100	2
2	CIV762	Traffic Operations and Control	–	3	2	2	–	40	20	40	100	2
3	CIV763	Analysis of Aerial Photos	–	3	2	2	–	40	20	40	100	2
4	CIV764	Advanced studies in soil mechanics	–	3	2	2	–	40	20	40	100	2
5	CIV765	Integration and coordination between transportation modes and the role of terminals and operation methods	–	3	2	2	–	40	20	40	100	2
6	CIV766	Tunnels, their places of construction and their impact on the movement of transport on the streets and main roads	–	3	2	2	–	40	20	40	100	2
7	CIV767	Distinguished studies in transportation and traffic	–	3	2	2	–	40	20	40	100	2

*The student chooses (9) credit hours as a minimum from the specialized courses for the Doctor of Philosophy in Public Works Engineering in one of the disciplines mentioned in Table (5.3.6), upon the recommendation of the main supervisor and according to what is determined by the scientific department council.



Table 5. 3. 7 Ph. D. Thesis in Public Works Engineering

S. N.	Course Code	Course Name	Perquisites	Credit Hours
1	CIV951	Ph.D. Thesis	1. Average GPA 3.0 and minimum 2.7 in all courses in basic and specialized Ph.D. courses 2. Pass the seminar of stage one of the academic research.	12
2	CIV961	Ph.D. Thesis		



Matrix linking the advanced engineering diploma in the Public Works Engineering program with the graduate Competencies

Total	Advanced engineering diploma graduate Competencies in the Public Works Engineering program															Course Name	Course Code	No.
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1			
Sanitary and Environmental Engineering																		
6			√	√	√	√				√				√		Technical Writing and presentation skills	GEN501	1
6			√	√				√	√		√	√				Statistics and Random Processes	GEN502	2
10	√	√	√	√			√	√	√	√	√	√				Wastewater Collection Systems	CIV551	3
5						√			√				√	√	√	Advanced Water Treatment	CIV552	4
8	√	√	√				√	√		√	√	√				Environmental Engineering and Pollution Control	CIV553	5
6							√	√	√	√	√	√				Wastewater Engineering in Rural Areas	CIV554	6
13	√	√		√	√	√	√	√	√	√		√	√	√	√	Project Management	GEN503	7
5			√		√						√		√		√	Sanitary Chemistry	CIV651	8
6	√		√						√		√		√	√		Bacteriology of Water and Wastewater	CIV652	9
13	√	√	√	√	√	√	√	√	√	√			√	√	√	Environmental Assessment	CIV653	10
4					√			√					√		√	Advanced Studies in Wastewater Treatment	CIV654	11
6	√	√	√			√	√	√								Soil Hydraulics	CIV622	12
88	6	5	8	5	5	5	6	8	7	6	6	5	6	5	5	Total		
Transportation Engineering																		
6			√	√	√	√				√				√		Technical Writing and presentation skills	GEN501	1
6			√	√				√	√		√	√				Statistics and Random Processes	GEN502	2
10	√	√	√	√	√			√	√	√	√	√				Public transportation network planning	CIV561	3
6					√	√	√						√	√	√	Advanced studies in Traffic Engineering	CIV562	4
5					√	√	√						√		√	Geometric design of highway engineering	CIV563	5
8	√	√	√	√				√	√	√		√				Economics of highways, airports and railways	CIV564	6
6	√	√						√		√	√	√				Advanced studies in construction and maintenance of railway lines	CIV565	7
6			√	√			√		√		√	√				Terminal stations and their operation methods	CIV566	8



Post Graduate Bylaw (Credit Hours System) 2023

4					√	√							√		√	Selected Studies in Transport and Traffic	CIV567	9
6					√	√	√						√	√	√	Selected studies in roads and airports	CIV568	10
5					√	√							√	√	√	Selected Studies in Railway Engineering	CIV569	11
10	√	√	√	√	√			√	√	√	√	√				Transportation and Traffic Planning (1)	CIV661	12
4			√	√			√				√					Traffic Flow Theories and Engineering	CIV662	13
7	√	√	√	√						√	√	√				Traffic Accidents and Roads Safety	CIV663	14
5				√			√						√	√	√	Selective topics in highway pavement materials	CIV664	15
10			√	√	√	√	√	√	√				√	√	√	Advanced study for construction and operation of railway lines and operation costs' assessment	CIV665	16
104	5	5	9	10	9	7	7	6	6	6	7	7	7	6	7	Total		

Matrix Linking the Master of Science thesis in the Public Works Engineering Program with the graduate Competencies

Total	Master of science thesis graduate Competencies in the Public Works Engineering Program															Course Name	Course Code	No.
	14	13	12	11	10	9	8	7	6	5	4	3	2	1				
Sanitary and Environmental Engineering																		
	√	√	√	√	√	√	√	√	√	√	√	√	√	√	M. Sc. Thesis	CIV851	1	
14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Total			
Transportation Engineering																		
	√	√	√	√	√	√	√	√	√	√	√	√	√	√	M. Sc. Thesis	CIV861	1	
14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Total			



Matrix Linking Doctor of Philosophy (Ph.D.) in the Public Works Engineering program with the graduate Competencies

Total	Doctor of Philosophy (Ph. D.) graduate Competencies in the Public Works Engineering program											Course Name	Course Code	No.
	11	10	9	8	7	6	5	4	3	2	1			
Sanitary and Environmental Engineering														
7	√		√	√	√		√	√	√			Solid Waste Management	CIV655	1
4		√				√				√	√	Special studies in Sanitary and Environmental Engineering	CIV656	2
5				√			√	√	√	√		Industrial Wastewater Treatment	CIV657	3
5	√			√			√	√		√		Sludge Treatment	CIV658	4
7			√	√	√			√	√	√	√	Water Resources Management	CIV641	5
4		√		√	√	√						Economical Methods of Wastewater Treatment	CIV746	6
4	√		√			√	√					Water and Soil Pollution	CIV752	7
10		√	√	√	√	√	√	√	√	√	√	Environmental Management and Legislation	CIV753	8
4	√	√								√	√	Specialized Topics in Sanitary and Environmental Engineering	CIV754	9
6	√		√	√	√			√	√			Anaerobic treatment of effluents and sludge treatment	CIV755	10
4	√	√				√					√	Ground Water Hydrology	CIV742	11
60	6	5	5	7	5	5	5	6	5	6	5	Total		
Transportation Engineering														
7			√	√	√	√			√	√	√	Urban Transportation Planning	CIV666	1
5	√	√					√	√	√			Advanced Railway Signaling	CIV667	2
8	√			√	√		√	√	√	√	√	Statistical Application to Traffic Operations	CIV668	3
4		√		√				√			√	Yards of railway stations, containers and special yards	CIV669	4
4		√			√	√		√				Advanced Transportation Systems	CIV761	5
6	√		√		√	√	√		√			Traffic Operations and Control	CIV762	6



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5	√	√					√		√	√		Analysis of Aerial Photos	CIV763	7
6			√	√	√	√				√	√	Advanced studies in soil mechanics	CIV764	8
6	√		√	√		√	√	√				Integration and coordination between transportation modes and the role of terminals and operation methods	CIV765	9
8	√	√	√			√	√	√		√	√	Tunnels, their places of construction and their impact on the movement of transport on the streets and main roads	CIV766	10
6				√	√	√			√	√	√	Distinguished studies in transportation and traffic	CIV767	11
65	6	5	5	6	6	7	6	6	6	6	6	Total		



COURSES DESCRIPTION

Course Name	Wastewater Collection Systems				Course Code	CIV551
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Collection methods of domestic sewage, types of collection sewers, design of domestic sewers, primary studies of collection systems, pipelines construction, appurtenances of sewer systems, Wastewater pump stations and rising mains.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Egyptian Code of Practice for water networks and sewerage systems design. 2000.
- 3) Water and Wastewater Engineering Design Principles and Practice, Mackenzie L. Davis, McGraw-Hill international Edition. ISBN 978-007-128924-5. (2001).
- 4) McGhee, T.J., 2011. *Water Supply and Sewerage*, 6th Edition, ISBN 0-07-100873-3.

Course Name	Advanced Water Treatment				Course Code	CIV552
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Water resources, portability of water, drinking water standards, ground water, surface water collection works, low lift units, sedimentation processes, water filtration, water disinfection.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Egyptian Code of Practice for water and wastewater treatment plants design. 2000.
- 3) Farag, M.A., 2020. *Sanitary Engineering. Encyclopedia*, ISBN 977- 5758537-8.

Course Name	Environmental Engineering and Pollution Control				Course Code	CIV553
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Main Parameters of environment impacts on the projects, environmental impacts of the project on the human, animals, Plants, and Birds, environmental impacts of the project on the rest of Components of the environment, environmental impacts of the project during the construction, environmental impacts of the project after construction, governing Laws.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Mara, D. and Horan, N, 2010. *Water and Wastewater Microbiology*, ISBN: 978-0-12-470100-7, 2010.



3) Metcalf and Eddy, 2018. *Wastewater Engineering Treatment and Reuse*, 3rd Edition, ISBN 0-07-100824-1.

Course Name	Wastewater Engineering in Rural Areas				Course Code	CIV554
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Characteristics of wastewater in rural areas, wastewater treatment methods in rural areas, disposal and reuse, biogas.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Egyptian Code of Practice for water and wastewater treatment plants design. 2000.
- 3) Metcalf and Eddy, 2018. *Wastewater Engineering Treatment and Reuse*, 3rd Edition, ISBN 0-07-100824-1.

Course Name	Public transportation network planning				Course Code	CIV561
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Introduction to transportation planning- introduction to public transportation planning- public transport network- public transport routes planning. Schedules design for public transport routes. Calculation of benefits of public transport investment. Pricing policies.

References:

- 1) *Handbook of Transportation Engineering*, McGraw-Hill, (WWW.digitalengineering.com).
- 2) Ortuzar, J.D.D. and Willumsen, L.G. ,2011. *Modeling Transport*, Fourth Edition, John Wiley, Ltd, ISBN 978-0-4.

Course Name	Advanced studies in Traffic Engineering					Course Code	CIV562
Teaching Hours	Lectures		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		

Scientific Content:

Introduction, Traffic problems, Characteristics of drivers, pedestrian, vehicle and roads, Traffic flow characteristics, Traffic flow elements, Volume, Speed, Travel time and delay study, Capacity and level of service, weaving, Traffic control devices, Intersection control, Pedestrian control, Bicycles control, Traffic signals, Parking characteristics and planning, Accidents and road safety.

References:

- 1) Adolf D., 1990. *Traffic Flow Fundamentals*, Prentice Hall, Inc. Englewood Cliffs, New Jersey 07632.
- 2) Denos C. Gazis ,2002. *Traffic Theory*, Kluwer Academic Publishers, ISBN: 1-4020-7095-0.



Course Name	Geometric design of highway engineering				Course Code	CIV563
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Introduction for planning different highways/roads types in special land- studies and variables affecting highway alignment selection - Special engineering aspects using cadastral devices in setting-out and planning horizontal and vertical alignment and traverses. Using new technologies in road alignment.

References:

- 1) Nicholas J. Garber, Lester A. ,2018. *Traffic and Highway Engineering*, Fourth Edition, Hoel, University of Virginia, Library of Congress Control Number: 2008926026, ISBN-13: 978-0-495-08250-7.
- 2) *American Association of State Highway and Transportation Officials (AASHTO). A Policy on Geometric Design of Highways and Streets*. Washington, D.C.: AASHTO, 2015.
- 3) Dusan and Milan, *Transportation Engineering, (Theory, Practice, and Modeling)*, 2017
- 4) Meyer, Michael D-*Transportation planning handbook*-Wiley (2016)

Course Name	Economics of highways, airports and railways				Course Code	CIV564
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Advanced studies in highway construction cost – Sensitivity analysis for vehicles operation cost according to road characteristics - analysis and economic evaluation for re-execute or maintain highways/roads (income and outcome, overall cost, net value, income rates, ...). Pricing policies.

References:

- 1) Adler , 1987.*Economic Appraisal of Transport Projects Rev: A Manual with Case Studies (EDI Series in Economic Development)*, Publisher : John Hopkins University Press; 2nd Edition, ISBN-10 : 0801834295.
- 2) *Transport Economics*, 3rd Edition, Kenneth Button, University Professor, Schar School of Policy and Government, George Mason University, US. Publication, Date: 2010 ISBN: 978 1 84064 189 9.
- 3) David Levinson, Michael Iacono, and others, *Transportation Economics*, 2016.
- 4) Jonathan Cowie, *The Economics of Transport_ A Theoretical and Applied Perspective*

Course Name	Advanced studies in construction and maintenance of railway lines					Course Code	CIV565
Teaching Hours	Lectures		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		

Scientific Content:

Train axle loads and its effect on track components and calculation of stresses - Design of fasteners - Design of rails - Road bed or subgrade - Fills or Embankment - Types of instability - Stabilization methods - Ballast stresses - Design of Ties - Continuous welded rails - Welding methods - Alignment and speeds - Design of curves - Different cases of grades - Slab track requirements - Slab track design - Tamping machines - Mechanical track renewal - Railway



infrastructure monitoring - Ultrasonic rail inspection - Track maintenance management systems.

References:

- 1) Bernahard Lichtberger, 2011. "Track Compendium". Eurail Press.
- 2) Lester A. Hoel, Nicholas J. Garber, Adel W. Sadek. (2011). "Transportation Infrastructure Engineering". Cengage Learning.

Course Name	Terminal stations and their operation methods				Course Code	CIV566
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Function of transport terminals - Freight terminals - Terminal costs - Introduction to intermodal terminals - intermodal terminal equipment - Port sites - Port functions and traffic - Port evolution and development - Conceptual model of intermodal terminals – necessary equipment for operation of different transportation modes (rail – roads – air – marine – pipes – belts etc.) - Airport sites - Airport components.

References:

- 1) Lester A. Hoel, Nicholas J. Garber, Adel W. Sadek. (2011). "Transportation Infrastructure Engineering". Cengage Learning.
- 2) Southwest Jiaotong Principles of Railway Location and Design, 2018, Sirong Yi University Press. Published by Elsevier Inc.
- 3) Sirong Yi, Principles of railway location and design (2021)

Course Name	Selected Studies in Transport and Traffic				Course Code	CIV567
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Planning and processing road networks and allocating trips, mass transportation networks, the general framework of the transportation planning process, data sources and collection, demand models for transporting goods, applications to practical models, methods used in modeling and simulation, steps used in deducing simulation models, looking at numbers and random variables in Simulation methodology, realization and processing of the results of simulation models, computer simulation programs, traffic lights intersections and main road networks and free. Applications of geographic information systems in transportation and traffic, modern methods of traffic inventory - modern applications in traffic engineering - traffic laws and legislation in different countries - modern methods of speed regulation - modern methods of regulating parking - modern pedestrian counting technologies - associated traffic lights and street lighting.

References:

- 1) Ortuzar, J.D.D. and Willumsen, L.G., 2011. Modeling Transport, Fourth Edition, John Wiley, Ltd, ISBN 978-0-4
- 2) Adolf D., 1990. Traffic Flow Fundamentals, Prentice Hall, Inc. Englewood Cliggs, New Jersey 07632



Course Name	Selected studies in roads and airports				Course Code	CIV568
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Elements of engineering design for roads (visibility distance for skipping or standing, horizontal design, vertical design) - Cross-sectional elements and the characteristics of each - Design of surface and free intersections, different types of pavement - Principles of structural design foundations - Foundations and theories of paving layer design - Stress analysis views of paving - Calculation of equivalent axial loads - properties of materials used in paving layers - different paving construction methods - evaluation and tests of paving materials. Sources of bituminous materials - production methods - physical and chemical properties of bituminous materials - properties of aggregates used in asphalt mixtures - types of mixtures and methods of design - methods and means of constructing asphalt paving. The use of asphalt materials in road maintenance and restoration works. Principles of airport planning - Aircraft characteristics and their impact on airport planning and design - Principles of engineering design for helipads and connection methods - Signing and determining the direction of the airport relative to the wind rose - Major port locations - Waiting areas - Structural design materials for airports - Views of stress analysis, load calculation, and thickness of pavement layers.

References:

- 1) Nicholas J. Garber, Lester A., *Traffic and Highway Engineering*, Fourth Edition, Hoel, University of Virginia, Library of Congress Control Number: 2008926026, ISBN-13: 978-0-495-08250-7
- 2) American Association of State Highway and Transportation Officials (AASHTO). A Policy on Geometric Design of Highways and Streets. Washington, D.C.: AASHTO, 2015.
- 3) Athanassios Nikolades, *Highway Engineering*, 2015

Course Name	Selected Studies in Railway Engineering				Course Code	CIV569
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Operating systems - operating using route schedules - operating with a block system - operating with an automatic block system - rules and regulations for blocks - controlling the path of trains - statuses and types of signals - automatic linking - automatic control of train tracks - central control - operating trains at passenger stations - operating trains at goods stations. History of bridge construction - Construction of earth bridges - Water drainage systems - Formation of bridge foundations - Earthworks for supporting and bearing structures - Environmental considerations - Different types of soil and their properties - Formation of bridges and plots - Laboratory experiments to determine the validity of the soil - Field laboratories for continuous review to confirm the validity of the soil and ensure its quality - Specifications of the compaction.

References:

- 1) Martin Lindhal, *Track Geometry for High-Speed Railways*, 2001
- 2) Bernahard Lichtberger, 2011. "Track Compendium". Eurail Press.
- 3) Lester A. Hoel, Nicholas J. Garber, Adel W. Sadek. (2011). "Transportation Infrastructure Engineering". Cengage Learning.

Course Name	Sanitary Chemistry				Course Code	CIV651
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Water quality and methods of measurements, design of water quality measurement program, physiological and physical properties such as pH, hardness, nitrogen, phosphorus, phosphate, sulfate, chlorides, dissolved



oxygen, chlorine, iron and manganese, water pollution with pesticides, methods of removal of dissolved organic matter, methods of determination of BOD, COD, and TOC.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Metcalf and Eddy, 2018. *Wastewater Engineering Treatment and Reuse*, 3rd Edition, ISBN 0-07-100824-1.
- 3) Ellen H. Richards, 2018. *Laboratory Notes: Sanitary Chemistry and Water Analysis*.

Course Name	Bacteriology of Water and Wastewater				Course Code	CIV652
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Biological organisms, water borne diseases, Indicator organisms for water quality, water as a source of bacterial contamination. Tests for the coliform group, BOD of domestic sewage and industrial wastewater, Factors affecting growth in biological treatment systems.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Mara, D. and Horan, N, 2010. *Water and Wastewater Microbiology*, ISBN: 978-0-12-470100-7, 2010.
- 3) Metcalf and Eddy, 2018. *Wastewater Engineering Treatment and Reuse*, 3rd Edition, ISBN 0-07-100824-1.
- 4) Duncan M. and Nigel H., 2003, *Handbook of Water and Wastewater Microbiology*, School of Civil Engineering, University of Leeds, UK.

Course Name	Environmental Assessment				Course Code	CIV653
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Information on the recent advances and various approaches to EIA, developments in the improved evaluation of the social, economic and environmental impacts of development, detailed account of the evolution of environmental assessment related processes, procedures and best practices, limitations, highlight the links between EA and other planning and decision-making systems in support of sustainable development, a current perspective on the existing tools being used in EA to enable more integrated assessments.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Andrew C., John G., and Riki T., 1994, *Introduction to Environmental Impact Assessment: Principles and Procedures, Process, Practice, and Prospects*.
- 3) Arjun A. Rathi, 2021, *Environmental Impact Assessment: Concepts and Practice*.

Course Name	Advanced Studies in Wastewater Treatment			Course Code	CIV654
Teaching Hours	Lectures	Tutorial	Practical	Credit Hours	3



	2		2		-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100		
	40	40	-	20				
<u>Scientific Content:</u> Quantity and quality of wastewater, biological treatment, nitrification, identification, phosphorus removal, anaerobic treatment, oxidation ponds, aerated lagoons, land application, disinfecting, upgrading of existing wastewater treatment plants.								
<u>References:</u> 1) Course Notes Prepared by the Instructor. 2) Egyptian Code of Practice for water and wastewater treatment plants design. 2000. 3) Metcalf and Eddy, 2018. Wastewater Engineering Treatment and Reuse, 3 rd Edition, ISBN 0-07-100824-1.								

Course Name	Solid Waste Management				Course Code	CIV655
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		
<u>Scientific Content:</u> Solid wastes sources, collection, transportation and classification, Sanitary landfill, composting, recycling.						
<u>References:</u> 1) Course Notes Prepared by the Instructor. 2) Cheremisinoff, N.P., 2017. Glossary of Environmental and Waste Management Terms. ISBN 0-7506-7507-1. 3) George T. and Frank K., 2002. <i>Handbook of Solid Waste Management 2nd Edition</i> .						

Course Name	Special studies in Sanitary and Environmental Engineering					Course Code	CIV656
Teaching Hours	Lectures		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		
<u>Scientific Content:</u> Theoretical and experimental studies covering advanced and comprehensive knowledge in research topics of interest to post graduate students.							
<u>References:</u> 1) Course Notes Prepared by the Instructor. 2) Egyptian Code of Practice for water and wastewater treatment plants design. 2000. 3) Metcalf and Eddy,2018. <i>Wastewater Engineering Treatment and Reuse</i> , 3 rd Edition, ISBN 0-07100824-1. 4) Farag, M.A., 2020. <i>Sanitary Engineering. Encyclopedia</i> , ISBN 977- 5758537-8. 5) McGhee, T.J., 2011. <i>Water Supply and Sewerage</i> , 6 th Edition, ISBN 0-07-100873-3.							



Course Name	Industrial Wastewater Treatment				Course Code	CIV657
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Effect of industrial wastes on sewerage system and wastewater treatment plant, methods of industrial wastes produced from paper industry, textile, feed industry, pharmaceutical industry, steel industry, reuse of treated Industrial wastewater.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Athar H. and Sirajuddin A. 2018. Advanced Treatment Techniques for Industrial Wastewater, ISBN13: 9781522557548|ISBN10: 1522557547|EISBN13: 9781522557555|
- 3) Jern N.W., 2010. Industrial Wastewater Treatment, ISBN-10 1-86094-580-5
- 4) Joseph D. E. 2017. Industrial Wastewater Treatment, ISBN 9781315894409

Course Name	Sludge Treatment				Course Code	CIV658
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Characteristics and volume of sludge, sludge handling, sludge stabilization, thermal processing of sludge, ultimate disposal and utilization of sludge.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Egyptian Code of Wastewater Sludge Treatment.
- 3) Cleveron V. A., Marcos V. S., Fernando F., and Mariska R. 2007. *Sludge Treatment and Disposal*, IWA Publishing.

Course Name	Transportation and Traffic Planning (1)				Course Code	CIV661
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Systems of transportation planning, Relation to planning urban design, study of a site and the possibilities of reaching it through different traffic networks, relation of local traffic networks (in the framework of urban projects) with regional networks, system of calculation of traffic flow into developing areas.

References:

- 1) Handbook of Transportation Engineering, McGraw-Hill, (WWW.digitalengineering.com).
- 2) Ortuzar, J.D.D. and Willumsen, L.G., 2011. Modeling Transport, Fourth Edition, John Wiley, Ltd, ISBN 978-0-4.
- 3) Adolf D., 1990. Traffic Flow Fundamentals, Prentice Hall, Inc. Englewood Cliffs, New Jersey 07632.



4) Denos C. Gazis ,2002. Traffic Theory, Kluwer Academic Publishers, ISBN: 1-4020-7095-0.

Course Name	Traffic Flow Theories and Engineering					Course Code	CIV 662
Teaching Hours	Lectures		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		

Scientific Content:

Deterministic models, Capacity, Differential and integral equations, Shock wave theory, Traffic flow parameters measurements, Stochastic models, queuing theory, vehicle and pedestrian delays, Maximum probability theory for gap acceptance estimation, Optimum usage of traffic signals, buses unloading, Determination of critical zones, Cycle time calculation and green allocation, Actuated traffic signal systems.

References:

- 1) Ortuzar, J.D.D. and Willumsen, L.G., 2011. *Modeling Transport*, Fourth Edition, John Wiley, Ltd, ISBN 978-0-4.
- 2) Adolf D., 1990. *Traffic Flow Fundamentals*, Prentice Hall, Inc. Englewood Cliggs, New Jersey 07632

Course Name	Traffic Accidents and Roads Safety					Course Code	CIV663
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical	Oral		Total	100
	40	40	-	20			

Scientific Content:

Accidents incidents and conflicts, Types of accidents, Identification of high accidents locations, Human factors and behavior, vehicular and pedestrian safety requirement, Data collection procedures of accidents, Accidents statistics, Accidents rates and their usage, statistical analysis of before and after accidents data, Accidents prediction models, Site analysis, Geometric and physical conditions of the site, Evaluation of safety at site, Approaches to highway safety, New techniques of safety analysis, Traffic conflict techniques.

References:

References to be determined by the lecturer.

Course Name	Selective topics in highway pavement materials				Course Code	CIV664
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Soil classification and physical, chemical and engineering properties and its validation in highway and airport pavements - different methods for soil stabilization - slope stability for road banks under subjected operating loads - different types of compactions, engineering properties, lab. and field tests for materials used in road pavement.

References:

References to be determined by the lecturer.



Course Name	Advanced study for construction and operation of railway lines and operation costs` assessment					Course Code	CIV665
Teaching Hours	Lectures		Tutorial	Practical		Credit Hours	3
	2		2	-			
Course Grades	Written Exam	Course Work	Practical	Oral		Total	100
	40	40	-	20			

Scientific Content:

Economical design of tracks, track components and installation methods – optimal geometrical design – railway station planning and its operation – Crossings of railway lines with other transportation modes – Narrow gauge tracks – Sharp curved tracks – check and guide rails – railway line capacity and efficiency – economical loading of trains – timetables and trains` operation.

References:

- 1) Joern Pachl, Railway Operation and Control, 2004
- 2) Alex Landex et al., Railway Operation, 2006
- 3) Lowe, D. (2005). Intermodal freight transport (e-book.). Amsterdam; Boston: Elsevier Butterworth-Heinemann.
- 4) Bernahard Lichtberger, 2011. "Track Compendium". Eurail Press.
- 5) Lester A. Hoel, Nicholas J. Garber, Adel W. Sadek. (2011). "Transportation Infrastructure Engineering". Cengage Learning.

Course Name	Urban Transportation Planning					Course Code	CIV666
Teaching Hours	Lectures		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Written Exam	Course Work	Practical		Oral	Total	100
	40	40	-		20		

Scientific Content:

Introduction to transportation demand and supply, Balancing demand and supply, Calibration of trip generation models, Calibration of different gravity models, Direct demand models, Mode choice models, Optimization of transport networks, intercity transportation demand, Freight Transport.

References:

References to be determined by the lecturer.

Course Name	Advanced Railway Signaling				Course Code	CIV667
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Fixed and temporary signals- Main mechanical signals - Secondary mechanical signals - Shallow signals - Application for mechanical signals - Security of running trains on facing switches - Block room and block section - Operating of double track - Operating of single track - Electrical operating devices - Transmission media - Interlocking - Monitoring devices - Power supply - Colored electrical signals - Calculation of line capacity - Automatic train control - Central traffic control systems - Level crossing signals - Fixed block system - Moving block system - Cab signaling - Turn backs and Junctions.

References:

- 1) Joern Pachl, Railway Operation and Control, 2004.



2) Gregor Theeg, Railway Signaling & Interlocking book, 2009.

Course Name	Statistical Application to Traffic Operations					Course Code	CIV668
Teaching Hours	Lectures		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		

Scientific Content:

Introduction of traffic distribution, Sampling procedures and sample size, Fitting procedures, Speed distribution, Volume distribution, Time headway distribution, Statistical significance of traffic improvement measures.

References:

- 1) Bernhard Lichtberger, 2011. "Track Compendium". Eurail Press.
- 2) Lester A. Hoel, Nicholas J. Garber, Adel W. Sadek. (2011). "Transportation Infrastructure Engineering". Cengage Learning.
- 3) Southwest Jiaotong Principles of Railway Location and Design, 2018, Sirong Yi University Press. Published by Elsevier Inc.

Course Name	Yards of railway stations, containers and special yards				Course Code	CIV669
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Planning of passenger station yards - Planning of intermediate stations - Passenger terminal stations - Required structures for bulk goods - Loading and unloading tracks - Required structures for packaged goods - Required tracks for freight stations - Planning of freight station yard - Planning of locomotives yards - Container yards planning - Significance and consequences of terminal operators - Types of special service terminals.

References:

- 1) Southwest Jiaotong Principles of Railway Location and Design, 2018, Sirong Yi University Press. Published by Elsevier Inc.
- 2) Sirong Yi, Principles of railway location and design (2021).
- 3) VECTOR. (2015). Freight Analysis Network – Terminal Capacity Estimation. Vanderbilt Center for Transportation Research (VECTOR).

Course Name	Water and Soil Pollution				Course Code	CIV752
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Environmental resources, liquid wastes, types of pollutants and their impact on the environment, wastes consuming dissolved oxygen in water, industrial organic compounds, water pathogens, aquatic plants, inorganic chemical compounds, silt and sewage wastes. Agricultural drainage, industrial drainage, soil pollution with waste, soil pollution with wastewater, the effect of soil pollution on foundations.

References:

- 1) Course Notes Prepared by the Instructor.



- 2) Mara, D. and Horan, N, 2010. *Water and Wastewater Microbiology*, ISBN: 978-0-12-470100-7, 2010.
3) Metcalf and Eddy, 2018. *Wastewater Engineering Treatment and Reuse*, 3rd Edition, ISBN 0-07-100824-1.

Course Name	Environmental Management and Legislation					Course Code	CIV753
Teaching Hours	Lectures		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		

Scientific Content:

A definition of environmental management, multiple environmental management systems: managing the quality of each of: water, air, soil, solid waste and others, environmental legislation in Egypt: Law 48 for the Protection of Water Bodies, Law 93 for the Protection of Sewerage Networks and Stations, Law 4 of 94 for Environmental Protection.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Peter M. Haas and Paul M. Haas, 1990. *Towards Management of Environmental Problems in Egypt*. Cambridge University.
- 3) Ministry of State for Environmental Affairs, *Environmental Protection Law*. 2009.

Course Name	Specialized Topics in Sanitary and Environmental Engineering				Course Code	CIV754
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Drinking water, specifications, tests and their types, engineering systems for water supply: water transport networks and their attachments and methods of establishment, methods of desalination of sea water, hard water removal, sanitation, wastewater treatment properties, modern laws for their protection, regulations. The environmental impacts of drinking water projects, the environmental impacts of sanitation projects.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Egyptian Code of Practice for water and wastewater treatment plants design. 2000.
- 3) Metcalf and Eddy, 2018. *Wastewater Engineering Treatment and Reuse*, 3rd Edition, ISBN 0-07-100824-1.
- 4) Farag, M.A., 2020. *Sanitary Engineering. Encyclopedia*, ISBN 977- 5758537-8.
- 5) McGhee, T.J., 2011. *Water Supply and Sewerage*, 6th Edition, ISBN 0-07-100873-3.

Course Name	Anaerobic treatment of effluents and sludge treatment				Course Code	CIV755
Teaching Hours	Lectures		Tutorial	Practical	Credit Hours	3
	2		2	-		
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Scientific basis for anaerobic treatment, study of technologies for anaerobic wastes treatment, scientific idea and



hydraulic design for UASBs - Anaerobic Lagoons - Wetlands, low-cost treatment methods for liquid wastes in villages and small urban communities.

References:

- 1) Course Notes Prepared by the Instructor.
- 2) Egyptian Code of Practice for water and wastewater treatment plants design. 2000.
- 3) Metcalf and Eddy, 2018. *Wastewater Engineering Treatment and Reuse*, 3rd Edition, ISBN 0-07-100824-1.
- 4) Cleverston V. A., Marcos V. S., Fernando F., and Mariska R. 2007. *Sludge Treatment and Disposal*, IWA Publishing.

Course Name	Advanced Transportation Systems				Course Code	CIV761
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Transportation system components, Forecasting Transport demand, Interaction of transport systems and land use, Formation of transport networks, Direct transportation from origin to destination, Optimization of urban and regional transportation networks.

References:

- 1) Ennio Cascetta (auth.)-Transportation systems analysis_ models and applications-Springer US (2009)
- 2) Lester A. Hoel, Nicholas J. Garber, Adel W. Sadek. (2011). "Transportation Infrastructure Engineering". Cengage Learning.
- 3) Partha, Das, Principles of transportation Engineering, (2012).

Course Name	Traffic Operations and Control				Course Code	CIV762
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Urban congestions and causes, Traffic control measurements, Freeway surveillance and incident detection, Simulation of Traffic behavior, Highway occupancy vehicle systems, Integrated traffic management systems, Strategies for urban mobility.

References:

References to be determined by the lecturer.

Course Name	Analysis of Aerial Photos				Course Code	CIV763
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Aerial photos introduction - Identifying soil type using aerial photos - Analysis of aerial photos and uses to investigate best highway alignment location.

References:

References to be determined by the lecturer



Course Name	Advanced studies in soil mechanics				Course Code	CIV764
Teaching Hours	Lectures	Tutorial	Practical		Credit Hours	3
	2	2	-			
Course Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	40	-	20		

Scientific Content:

Soil classification and natural, chemical and engineering properties and its suitability to be used as highway materials - different ways for soil stabilization - slope stability for road banks under normal traffic operation.

References:

- 1) Dingqing Li, James Hyslip, Ted Sussmann, Steven Chrismer, Railway Geotechnics, 2016.

Course Name	Integration and coordination between transportation modes and the role of terminals and operation methods					Course Code	CIV765
Teaching Hours	Lectures	Tutorial		Practical		Credit Hours	3
	2	2		-			
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		

Scientific Content:

Terminals of freights – necessary equipment for operation of different transportation modes (rail – roads – air – marine – pipes – belts ... etc.) Passenger railway stations – different transportation modes (Rail – buses – taxi – aircrafts – ports ...etc.) .Terminals for special services (Oil – quarries – fresh products (agricultural – animals – marine – crops` silos).

References:

- 1) Lester A. Hoel, Nicholas J. Garber, Adel W. Sadek. (2011). "Transportation Infrastructure Engineering". Cengage Learning.
- 2) Sironi Yi, Principles of railway location and design (2021).
- 3) VECTOR. (2015). Freight Analysis Network – Terminal Capacity Estimation. Vanderbilt Center for Transportation Research (VECTOR). Retrieved from TRB. (2003).

Course Name	Tunnels, their places of construction and their impact on the movement of transport on the streets and main roads					Course Code	CIV766
Teaching Hours	Lectures		Tutorial		Practical	Credit Hours	3
	2		2		-		
Course Grades	Written Exam	Course Work		Practical	Oral	Total	100
	40	40		-	20		

Scientific Content:

Tunnel engineering projects - Functions and requirements of tunnels - An overview of the construction of the Cairo subway - Reasons and studies that begin in tunnel projects inside Cairo - Methods for the implementation of Al-Matrokoon tunnels Tunnel planning - Tunneling in soft soils - Punching by impregnation - Injections - Tunnel lining - Tunnels digging and backfilling - Securing tunnels - means of fire protection.

References:

- 1) Dimitrois Koltmbas, Tunnelling and Tunnel Mechanics, 2008
- 2) Pietro Lunardi, Design and Construction of Tunnels, 2008.

Course Name	Distinguished studies in transportation and traffic				Course Code	CIV767



Teaching Hours	Lectures		Tutorial		Practical		Credit Hours	3		
	2		2		-					
Course Grades	Written Exam		Course Work		Practical		Oral		Total	100
	40		40		-		20			

Scientific Content:

Representation of transport networks, balance of transport networks from the user's point of view, basics of the process of less time on the network, formation of the allocation process and its mathematical basis, review of operations research processes, balance of transport networks based on the difference in demand for transport, transport planning process at the unit level. Introduction to traffic distributions, advanced methods, calculating sample size, distribution of traffic flow at the urban and regional levels and comparing them, distribution of intermittent times, continuous and discontinuous distributions.

References:

References to be determined by the lecture



CHAPTER (6)

GEOMATICS ENGINEERING DEPARTMENT



1) Advanced Diploma in Geomatics Engineering

Registration takes place in the following research fields:

1. Geodesy.
2. Photogrammetry and Remote Sensing.
3. Geographic Information Systems.

The graduate of the advanced diploma program should be able to:

Graduate attribute

- 1 Understand concepts, principles, and theories of Geomatics Engineering.
- 2 Understand statistical analysis processes needed for recent Geomatics Engineering.
- 3 Relate management concepts and apply it to different Geomatics Engineering activities.
- 4 Integrate spatial information and data from different sources appropriately to the required task.
- 5 Have advanced knowledge of programming concepts and specialized software packages.
- 6 Present Geomatics Engineering materials and components.
- 7 Understand his/her role within a teamwork as a team member or a team leader.
- 8 Apply appropriate engineering analysis methods in dealing with Geomatics Engineering complex problems and assess their limitations.
- 9 Apply appropriate engineering analysis methods in Geomatics Engineering projects for achieving the required standard specifications.

Table 6. 1. 1 Compulsory Courses in Basic Engineering Diploma in Geomatics Engineering

S. N.	Course Code	Course Name	Pre-requisite	Credit Hours	Grades				Test Time
					Course Work	Oral / Practical	Written Exam	Total	
1	GEN 506	Computer Applications	—	2	60	—	40	100	2
2	GEN 507	Physics	—	2	60	—	40	100	2

Table 6. 1. 2 Elective Courses for Basic Engineering Diploma in Geomatics Engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
1	GEN 501	Scientific Writing and Presentation Skills	2	60	–	40	100	2
2	GEN 505	Engineering Mathematics and Numerical Analysis	2	60	–	40	100	2
3	GED 511	Data Base Principles	3	60	–	40	100	2
4	GED 512	Fundamentals of Object-Oriented Programming	3	60	–	40	100	2

* With the help of the academic advisor, the student chooses (8) credit hours as a minimum and two courses as a maximum from the courses of basic diploma in geomatics engineering in one of the specializations mentioned in Table (6.1.2) and as determined by the Scientific Department Council.

Table 6. 1. 3 Elective Courses for Advanced Engineering Diploma in Geomatics Engineering*

Table of Elective Courses for Advanced Engineering Diploma in Geomatics Engineering									
S. N	Course Code	Course Name	Pre-requisites	Credit Hours	Grades				Test Time
					Course Work	Oral / Practical	Written Exam	Total	
Geodesy									
1	ELE 554	Artificial Intelligence Theories	–	3	60	–	40	100	2
2	ELE 558	Machine Learning algorithms	–	3	60	–	40	100	2
3	GED 613	Cartography	–	3	60	–	40	100	2
4	GED 614	Satellite Geodesy (1)	–	3	60	–	40	100	2
5	GED 615	Physical Geodesy (1)	–	3	60	–	40	100	2
6	GED 621	Photogrammetry (1)	–	3	60	–	40	100	2



7	GED 631	Geographic Information Systems (1)	–	3	60	–	40	100	2
Photogrammetry and Remote Sensing									
1	ELE 554	Artificial Intelligence Theories	–	3	60	–	40	100	2
2	ELE 558	Machine Learning algorithms	–	3	60	–	40	100	2
3	GED 613	Cartography	–	3	60	–	40	100	2
4	GED 614	Satellite Geodesy (1)	–	3	60	–	40	100	2
5	GED 621	Photogrammetry (1)	–	3	60	–	40	100	2
6	GED 622	Remote Sensing (1)	–	3	60	–	40	100	2
7	GED 623	Digital Photogrammetry	–	3	60	–	40	100	2
8	GED 631	Geographic Information Systems (1)	–	3	60	–	40	100	2
Geographic Information Systems (GIS)									
1	ELE 554	Artificial Intelligence Theories	–	3	60	–	40	100	2
2	ELE 558	Machine Learning algorithms	–	3	60	–	40	100	2
3	GED 613	Cartography	–	3	60	–	40	100	2
4	GED 621	Photogrammetry (1)	–	3	60	–	40	100	2
5	GED 622	Remote Sensing (1)	–	3	60	–	40	100	2
6	GED 631	Geographic Information Systems (1)	–	3	60	–	40	100	2
7	GED 632	Planning and Land Use	–	3	60	–	40	100	2
8	GED 633	Geographic Information Science	–	3	60	–	40	100	2

* With the help of the academic advisor, the student chooses (12) credit hours as a minimum and five courses as a maximum from the courses of advanced diploma in geomatics engineering in one of the specializations mentioned in Table (6.1.3) and as determined by the Scientific Department Council.

2) Master of Science in Geomatics Engineering

Registration takes place in the following research fields:

1. Geodesy.
2. Photogrammetry and Remote Sensing.
3. Geographic Information Systems.

The graduate of the M.Sc. program should be able to:

Graduate attribute

- 1 Understand topics and requirements of activities related to the general context of Geomatics Engineering.
- 2 Display a critical awareness of the accuracies, limitations, and other Implications when using investigation methods in Geomatics engineering works.
- 3 Demonstrate relevant comprehensive scientific principles of different branches of Geomatics Engineering.
- 4 Show good reasoning and creativity in finding solutions of theoretical and practical problems of the specialization.
- 5 Apply appropriate engineering analysis methods for achieving the required standard specifications of the Geomatics Engineering works.

Table 6. 1. 4 Master of Science (M. Sc.) Thesis in Geomatics Engineering

S.N.	Course Code	Course Name	Perquisites	Credit Hours
1	GED811	M.Sc. Thesis	Average GPA 3.0 and minimum 2.7 in all courses in basic and advanced diploma courses	12
2	GED821	M.Sc. Thesis		
3	GED831	M.Sc. Thesis		

3) Doctor of Philosophy (Ph.D.) in Geomatics Engineering

Registration takes place in the following research fields:

1. Geodesy.
2. Photogrammetry and Remote Sensing.

The graduate of the PhD. Program should be able to:

Graduate attribute

- 1 Have the experience with the fundamentals and methodologies of scientific research.
- 2 Add to the knowledge in the branches of Geomatics Engineering.
- 3 Have the analytical and critical sense in the fields of Geomatics Engineering.

- 4 Manage the cross ties between the different branches of Geomatics Engineering.
- 5 Understand current problems and modern theories in Geomatics Engineering.
- 6 Find innovative solutions for the new problems of the career.
- 7 Lead a teamwork in various professional Geomatics Engineering works and projects.
- 8 Take optimum decisions utilizing the available data and information.
- 9 Illustrate concern in community development and environmental conservation.

Table 6. 1. 5 Basic Ph. D. Courses in Geomatics Engineering*

S. N	Course Code	Course Name	Pre-requisites	Credit Hours	Grades				Test Time
					Course Work	Oral / Practical	Written Exam	Total	
1	ELE 652	Advanced Image Processing	--	3	60	--	40	100	2
2	ELE 653	Neural Networks and Deep Learning	--	3	60	--	40	100	2
3	ELE 658	Internet of Things and Cloud Computing	--	3	60	--	40	100	2
4	ELE 758	Data Science (Big Data)	--	3	60	--	40	100	2
5	GED 634	Geographical Information Systems (2)	--	3	60	--	40	100	2
6	GED 624	Remote Sensing (2)	--	3	60	--	40	100	2
7	GED 625	Photogrammetry (2)	--	3	60	--	40	100	2
8	GED 616	Physical Geodesy (2)	--	3	60	--	40	100	2
9	GED 617	Satellite Geodesy (2)	--	3	60	--	40	100	2

*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from the basic courses for Doctor of Philosophy in geomatics engineering in one of the specializations mentioned in Table (6.1.5) and as determined by the Scientific Department Council.

Table (6.1.6) Specialized Ph.D. Courses in Geomatics Engineering

Serial	Course Code	Course Name	Pre-requisites	Credit Hours	Grades				Test Time
					Course Work	Oral / Practical	Written Exam	Total	
1	GED 721	Modern Systems for Remote Sensing	--	3	60	--	40	100	2
2	GED 722	Modern developments in digital photogrammetry	--	3	60	--	40	100	2
3	GED 711	Modern Applications in Geodesy	--	3	60	--	40	100	2
4	GED 712	Modern Applications of Global Navigation Systems	--	3	60	--	40	100	2

*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from the specialized courses for Doctor of Philosophy in geomatics engineering in one of the specializations mentioned in Table (6.1.6) on the recommendation of the main supervisor and as determined by the Scientific Department Council.

Table 6.1.7 Ph.D. Thesis in Geomatics Engineering

Serial	Course Code	Course Name	Prerequisites	Credit Hours
1	GED911	Ph.D. Thesis	1. Average GPA 3.0 and minimum 2.7 in all courses in basic and specialized Ph.D. courses 2. Pass the seminar of stage one of the academic research.	12
2	GED921	Ph.D. Thesis		



Matrix of Relation between Courses and Graduate Attribute

Table (6.1.8) Matrix of Relation between Compulsory Courses in Basic Engineering Diploma in Geomatics Engineering and Graduate Attribute

S.N.	Course Code	Course Name	Attribute of the advanced diploma program graduate									Number
			1	2	3	4	5	6	7	8	9	
1	GEN 506	Computer Applications		√		√	√			√	√	5
2	GEN 507	Physics	√									1

Table (6.1.9) Matrix of Relation between Elective Courses for Basic Engineering Diploma in Geomatics Engineering and Graduate Attribute

S.N.	Course Code	Course Name	Attribute of the advanced diploma program graduate									Number
			1	2	3	4	5	6	7	8	9	
1	GEN 501	Scientific Writing and Presentation Skills		√	√				√		√	4
2	GEN 505	Engineering Mathematics and Numerical Analysis	√	√						√	√	4
3	GED 511	Data Base Principles				√	√			√	√	4
4	GED 512	Fundamentals of Object-Oriented Programming				√	√			√	√	4

Table (6.1.10) Matrix of Relation between Elective Courses for Advanced Engineering Diploma in Geomatics Engineering and Graduate Attribute

S.N.	Course Code	Course Name	Attribute of the advanced diploma program graduate									Number	
			1	2	3	4	5	6	7	8	9		
Geodesy													
1	ELE 554	Artificial Intelligence Theories				√	√			√	√	4	
2	ELE 558	Machine Learning algorithms				√	√			√	√	4	
3	GED 613	Cartography	√	√				√	√			4	
4	GED 614	Satellite Geodesy 1	√					√	√			3	
5	GED 615	Physical Geodesy 1	√					√	√			3	
6	GED 621	Photogrammetry 1	√					√	√			3	
7	GED 631	Geographic Information Systems 1	√					√	√			3	
Photogrammetry and Remote Sensing													



1	ELE 554	Artificial Intelligence Theories	√			√	√			√	√	5
2	ELE 558	Machine Learning algorithms	√			√	√			√	√	5
3	GED 613	Cartography	√	√					√			3
4	GED 614	Satellite Geodesy 1	√					√	√			3
5	GED 621	Photogrammetry 1	√					√	√			3
6	GED 622	Remote Sensing 1	√					√	√			3
7	GED 623	Digital Photogrammetry						√	√			3
8	GED 631	Geographic Information Systems 1	√					√	√			3
Geographic Information Systems (GIS)												
1	ELE 554	Artificial Intelligence Theories				√	√			√	√	4
2	ELE 558	Machine Learning algorithms				√	√			√	√	4
3	GED 613	Cartography	√	√					√			3
4	GED 621	Photogrammetry 1	√					√	√			3
5	GED 622	Remote Sensing 1	√					√	√			3
6	GED 631	Geographic Information Systems 1	√					√	√			3
7	GED 632	Planning and Land Use	√					√	√			3
8	GED 633	Geographic Information Science	√					√	√			3

Table (6.1.11) Matrix of Relation between Master of Science Thesis in Geomatics Engineering and Graduate Attribute

S.N.	Course Code	Course Name	Attribute of the Master of Science graduate					Number
			1	2	3	4	5	
1	GED811	M.Sc. Thesis	√	√	√	√	√	5
2	GED821	M.Sc. Thesis	√	√	√	√	√	5
3	GED831	M.Sc. Thesis	√	√	√	√	√	5

Table (6.1.12) Matrix of Relation between Basic Ph.D. Courses in Geomatics Engineering and Graduate Attribute

S.N.	Course Code	Course Name	Attribute of the PhD graduate								Number
			1	2	3	4	5	6	7	8	
1	ELE 652	Advanced Image Processing		√	√					√	3
2	ELE 653	Neural Networks and Deep Learning	√	√	√				√	√	5
3	ELE 658	Internet of Things and Cloud Computing			√				√	√	3



4	ELE 758	Data Science (Big Data)							√	√	2
5	GED 634	Geographical Information Systems 2				√	√	√		√	4
6	GED 624	Remote Sensing 2				√	√	√		√	4
7	GED 625	Photogrammetry 2				√	√	√		√	4
8	GED 616	Physical Geodesy 2				√	√	√			3
9	GED 617	Satellite Geodesy 2				√	√	√			3

Table (6.1.13) Matrix of Relation between Specialized Ph.D. Courses in Geomatics Engineering and Graduate Attribute

S. N.	Course Code	Course Name	Attribute of the PhD graduate								Number
			1	2	3	4	5	6	7	8	
1	GED 721	Modern Systems for Remote Sensing	√	√	√	√	√	√	√	√	8
2	GED 722	Modern developments in digital photogrammetry	√	√	√	√	√	√	√	√	8
3	GED 711	Modern Applications in Geodesy	√	√	√	√	√	√	√	√	8
4	GED 712	Modern Applications of Global Navigation Systems	√	√	√	√	√	√	√	√	8

Table (6.1.14) Matrix of Relation between Ph.D. Thesis in Geomatics Engineering and Graduate Attribute

#	Course Code	Course Name	Attribute of the PhD graduate								Number
			1	2	3	4	5	6	7	8	
1	GED911	Ph.D. Thesis	√	√	√	√	√	√	√	√	8
2	GED921	Ph.D. Thesis	√	√	√	√	√	√	√	√	8

**COURSES DESCRIPTION**

Course Name		Data Base Principles				Course Code	GED 511
Teaching Hours		lecture	Tests	practical		Credit Hours	3
		2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	60	-	-			

Content of Course:

Modeling and Database, Languages, Data Attribute, Database Management, Design and Use of Database, and Database Programming.

References:

1. Ramez Elmasri and Shamkant B. Navathe (2006) : Fundamentals of Database Systems
2. Connolly, Thomas M.; Begg, Carolyn E. (2014). Database Systems – A Practical Approach to Design Implementation and Management (6th ed.). Pearson. ISBN 978-1292061184.
3. Connolly, Thomas M.; Begg, Carolyn E. (2014). Database Systems – A Practical Approach to Design Implementation and Management (6th ed.). Pearson. ISBN 978-1292061184.

Course Name		Fundamentals of Object-Oriented Programming			Course Code	GED 512
Teaching Hours	lecture	Tests	practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		

Content of Course:

Concepts of object-oriented programming, C++ programming fundamentals, Classes and objects, Java programming, Scripts, Object-oriented programming.

References:

1. R. Hirschfeld, P. Costanza, O. Nierstrasz, Context oriented Programming. Journal of Object Technology, 7(3), 125-151, 2008.
2. A. Savinov, Concept-oriented model: Extending objects with identity, hierarchies and semantics. Computer Science Journal of Moldova (CSJM), 19(3), 254-287, 2011.
3. A. Savinov, Concept-Oriented Programming: Classes and Inheritance Revisited. 7th International Conference on Software Paradigm Trends, 381-387, 2012.
4. Pecinovsky, Rudolf (2013). OOP – Learn Object Oriented Thinking & Programming. Bruckner Publishing. ISBN 978-80-904661-8-0.



Course Name		Cartography				Course Code	GED 613
Teaching Hours		lecture	Tests	practical		Credit Hours	3
		2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	60	-	-			

Content of Course:

Principles of Cartography, Methods of map production, Technology of GIS for map production, Theory and applications of artificial intelligence, On the quality of maps and color theory, Types of maps, Map distortion and scale factor, Index Factor, Different Types of map projection, Choice of suitable projection, Calculation of projected coordinates, projections used in Egypt ETM, UTM, and MTM.

References:

1. Arthur Howard Robinson, Elements of cartography, Wiley, 1995
2. Rameshwar Prasad Misra, A. Ramesh, "Fundamentals of Cartography", Concept Publishing Company, 1989
3. John Noble Wilford, The Mapmakers, Vintage Books U.S.A, 2000
4. Katharine Harmon, The Map as Art: Contemporary Artists Explore Cartography, Gayle Clemans Tributary Books, 2010
5. Mark Monmonier, ed. (2015). The History of Cartography. Vol. 6: Cartography in the Twentieth Century. Chicago and London: University of Chicago Press. ISBN 9780226534695.

Course Name		Satellite Geodesy 1			Course Code	GED 614	
Teaching Hours		lecture	Tests	practical		Credit Hours	3
		2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	60	-	-			

Content of the Course:

Geodetic satellites, Types, Orbits, Satellite Coordinate System, GPS, Signal structure, Observables, Errors, Satellite observation techniques.

References:

1. Meyer, T. H. (2018). Introduction to geometrical and physical geodesy: Foundations of geomatics. Esri Press.
2. Sansò, F., Reguzzoni, M., & Barzaghi, R. (2019). Geodetic heights (Vol. 141). Berlin: Springer.
3. Montillet, J. P., & Bos, M. S. (Eds.). (2019). Geodetic time series analysis in earth sciences. Springer.
4. Ogaja, Clement (2022). Introduction to GNSS Geodesy: Foundations of Precise Positioning Using Global Navigation Satellite Systems. Cham, Switzerland: Springer International Publishing AG. ISBN 978-3-030-91821-7
- Paternain, G. P., Salo, M., & Uhlmann, G. (2023). Geometric inverse problems (Vol. 204). Cambridge University Press.



Course Name	Physical Geodesy (1)				Course Code	GED 615
Teaching Hours	lecture	Tests	practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Content of The Course:</u> Mass of the earth, Gravity and its measurements, Absolute and relative gravimeters, Gravity Corrections and reductions, Effect of Gravity on Observations, Geodetic boundary value problem, Classical Geoid determination methods, Airborne Gravimetry.						
<u>References:</u> 1. Moritz, H. (2015). Classical physical geodesy. In Handbook of geomathematics (pp. 253-289). Springer, Berlin, Heidelberg. 2. Sjöberg, L. E., & Bagherbandi, M. (2017). Gravity inversion and integration. Basel, Switzerland: Springer International Publishing AG. 3. Delva, P., Denker, H., & Lion, G. (2019). Chronometric geodesy: methods and applications. Relativistic Geodesy: Foundations and Applications, 25-85. 4. Puetzfeld, D., & Lämmerzahl, C. (Eds.). (2019). Relativistic geodesy: Foundations and applications (Vol. 196). Springer.						

Course Name		Physical Geodesy 2			Course Code	GED 616
Teaching Hours	lecture	Tests	practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Content of Course:</u> Classical and satellite methods of Geoid determination, Spherical harmonics, and determination of Gravity field through satellite missions, Global geoid models, Geoid determination using heterogeneous data, Improving global satellite-only models.						
<u>References:</u> 1. Vermeer, M. (2020). Physical geodesy. Aalto-yliopisto 2. Freymueller, J. T. (2021). GPS, tectonic geodesy. In Encyclopedia of Solid Earth Geophysics (pp. 558-578). Cham: Springer International Publishing. 3. Gruber, T., Eicker, A., & Flechtner, F. (Eds.). (2021). Remote sensing by satellite gravimetry. MDPI. Guo, J. Y. (2022). The Earth’s Gravity Field and Some of Its Properties. In Physical Geodesy: A Theoretical Introduction (pp. 1-45). Cham: Springer Nature Switzerland.						



Course Name		Satellite Geodesy 2			Course Code	GED 617
Teaching Hours	lecture	Tests	practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Content of Course:</u> GNSS, Segments and sources of errors, Datums, Types of positioning and precisions, GNSS integration with other positioning sensors, GNSS Applications, Space and satellite missions SLR, VLBI, DORIS.						
<u>References:</u> 1. Heiskanen W& H Moritz (1967). Physical Geodesy, WH Freeman and Co., San Francisco (reprinted by TU Graz) 2. Dawod, G., Mohamed, W., 2009, Data management of different height systems within GPS/GIS integrated spatial technology, December 7-9, Kingdom of Bahrain. 3. Sosnica, Krzysztof (2014). Determination of Precise Satellite Orbits and Geodetic Parameters using Satellite Laser Ranging. Bern: Astronomical Institute, University of Bern, Switzerland. p. 5. ISBN 978-8393889808. 4. Ogaja, Clement (2022). Introduction to GNSS Geodesy: Foundations of Precise Positioning Using Global Navigation Satellite Systems. Cham, Switzerland: Springer International Publishing AG. ISBN 978-3-030-91821-7						

Course Name		Photogrammetry (1)				Course Code	GED 621
Teaching Hours	lecture	Tests	Practical		Credit Hours	3	
	2	2	-				
Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	60	-	-			
<u>Content of Course:</u> Photogrammetric systems and products, Essential photogrammetric operations, Photogrammetric mathematical models, Aerial and satellite triangulation, Rectification of aerial and satellite imagery, GPS photogrammetry, Fundamentals of digital photogrammetry, Engineering and environmental applications of photogrammetry.							
<u>References:</u> 1. Schenk T., Digital Photogrammetry, Laurelville, OH: TerraScience, 1999. 2. Wolf, P. and Dewitt, B., Elements of Photogrammetry, McGraw Hill, Inc., New York, 2000. 3. Mikail, E.M., Bethel, J.S. and McGlone, J.C., Introduction to Modern Photogrammetry, John Wiley & Sons, Inc., New York, 2001. 4. Gonzalez, Rafael (2018). Digital image processing. New York, NY: Pearson. ISBN 978-0-13-335672-4. OCLC 966609831.							



Course Name	Remote Sensing 1				Course Code	GED 622
Teaching Hours	lecture	Tests	practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
Content of the Course: Principles of remote sensing, Remote Sensing Satellite, Analysis and Corrections of Satellite Images, Use of Satellite Images, and Integration of Remote Sensing with GIS.						
References: 1. Remote Sensing of the Environment : Earth Resource Perspective - 2nd edition, John R Jensen. Prentice Hall, Inc., 2006. 2. Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, John Wiley & Sons, Remote sensing and image interpretation, 2008 3. James B. Cambell, Introduction to Remote Sensing, Fifth Edition, The Guilford Press, 2011. 4. Fuzhong., Weng (2017). Passive Microwave Remote Sensing of the Earth : For Meteorological Applications. John Wiley & Sons, Incorporated. ISBN 978-3-527-33629-6. OCLC 994737066. 5. Navalgund, Ranganath (2018). Comprehensive Remote Sensing, Volume 9: Applications for Societal Benefits. Current Science. 115 (5): 988. doi:10.18520/cs/v115/i5/988-988. ISSN 0011-3891. S2CID 155885488.						

Course Name	Digital Photogrammetry				Course Code	GED 623
Teaching Hours	lecture	Tests	practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Content of the Course:</u> Processing of digital Imagery, Extraction of features on digital images, Acquisition of distinct image points, Acquiring conjugate points by matching techniques, AAT for automatic generation of precise 3-D object points, Resampling of digital images, automatically generated DTMs and its shortcomings, Techniques of Digital orthorectification, Drawbacks of digital orthophotos.						
<u>References:</u> 1. Mikail, E.M., Bethel, J.S. and McGlone, J.C., Introduction to Modern Photogrammetry, John Wiley & Sons, Inc., New York, 2001. 2. Gonzalez, R. C., Woods, R .E. and Eddins S. L., Digital Image Processing Using MATLAB, Pearson Education, Inc., New Jersey, 2004 3. Gonzalez, Rafael (2018). Digital image processing. New York, NY: Pearson. ISBN 978-0-13-335672-4. OCLC 966609831. 4. Vipin Tyagi (2018). Understanding Digital Image Processing. Taylor and Francis CRC Press. ISBN 978-11-3856-6842. 5. Kovalevsky, Vladimir (2019). Modern algorithms for image processing : computer imagery by example using C#. [New York, New York]. ISBN 978-1-4842-4237-7. OCLC 1080084533.						



Course Name		Remote Sensing 2				Course Code	GED 624
Teaching Hours		lecture	Tests	practical		Credit Hours	3
		2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	60	-	-			

Content of the Course:

Microwave remote sensing (SAR, SIR, InSAR, IfSAR, ...), GPR, Bathymetry, Image classification and segmentation, Laser scanning and point cloud processing, LU/LC change detection, and other applications.

References:

1. Remote Sensing of the Environment : Earth Resource Perspective - 2nd edition, John R Jensen. Prentice Hall, Inc., 2006.
2. Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, John Wiley & Sons, Remote Sensing and Image Interpretation, 2008
3. James B. Cambell, Introduction to Remote Sensing, Fifth Edition, The Guilford Press, 2011.
4. Fuzhong., Weng (2017). Passive Microwave Remote Sensing of the Earth : For Meteorological Applications. John Wiley & Sons, Incorporated. ISBN 978-3-527-33629-6. OCLC 994737066.
5. Navalgund, Ranganath (2018). "Comprehensive Remote Sensing, Volume 9: Applications for Societal Benefits". Current Science. 115 (5): 988. doi:10.18520/cs/v115/i5/988-988. ISSN 0011-3891. S2CID 155885488.

Course Name		Photogrammetry 2				Course Code	GED 625
Teaching Hours		lecture	Tests	practical		Credit Hours	3
		2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	60	-	-			

Content of Course:

Techniques of extracting linear and area features, Methods of Feature-based matching, Dense matching, Generation of rigorous DEMs from stereo imagery, Generation of true orthophotos, integration between Lidar and photogrammetry, Drone Photogrammetry, integration between Lidar and drone photogrammetry. Modern advances in photogrammetry.

References:

1. John R Jensen, Introductory Digital Image Processing (3rd Edition), Prentice Hall, 2004.
2. Gonzalez, R. C., Woods, R. E. and Eddins S. L., Digital Image Processing Using MATLAB, Pearson Education, Inc., New Jersey, 2004
3. Gonzalez, Rafael (2018). Digital image processing. New York, NY: Pearson. ISBN 978-0-13-335672-4. OCLC 966609831.
4. Vipin Tyagi (2018). Understanding Digital Image Processing. Taylor and Francis CRC Press. ISBN 978-11-3856-6842.
5. Kovalevsky, Vladimir (2019). Modern algorithms for image processing : computer imagery by example using C#. [New York, New York]. ISBN 978-1-4842-4237-7. OCLC 1080084533.



Course Name		Geographical Information Systems 1				Course Code	GED 631
Teaching Hours		lecture	Tests	practical		Credit Hours	3
		2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	60	-	-			

Content of the Course:

Introduction, Definitions, Modeling, the building of Spatial and attribute data System, Data Collection and Analysis, GIS applications.

References:

1. Longley, Paul A.; Goodchilde, Michael F.; Maguire, David J.; Rhind, David W. (2015). Geographic Information Systems & Science (4th ed.). Wiley.
2. Zhang, Chuanrong; Zhao, Tian; Li, Weidong (2015). Geospatial Semantic Web. Springer International Publishing. ISBN 978-3-319-17801-1.
3. Chang, Kang-tsung (2016). Introduction to Geographic Information Systems (9th ed.). McGraw-Hill. p. 1. ISBN 978-1-259-92964-9.
4. Bolstad, Paul (2019). GIS Fundamentals: A First Text on Geographic Information Systems (6th ed.). XanEdu. ISBN 978-1-59399-552-2.
5. Bolstad, P. (2019). GIS Fundamentals: A first text on Geographic Information Systems, Sixth Edition. Ann Arbor: XanEdu, 764 pp.

Course Name		Planning and Land Use				Course Code	GED 632
Teaching Hours		lecture	Tests	practical		Credit Hours	3
		2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	60	-	-			

Content of the Course:

Theoretical and historical land use planning, Cultural evolution and planning reform in Egypt, Planning Division of partial areas, governmental requirements and regional support charts.

References:

1. John Randolph (2004), Environmental Land Use Planning and Management, Island Press, 2004
2. Tyler and Ward (2011), Planning and Community Development – A Guide for the 21st Century”; W.W. Norton & Company, 2011 – First Edition.
3. Long, Hualou; Qu, Yi (2018). "Land use transitions and land management: A mutual feedback perspective". Land Use Policy. 74: 111–120. doi:10.1016/j.landusepol.2017.03.021. ISSN 0264-8377. S2CID 51938021.
4. Raman, Rewati; Roy, Uttam Kumar (2019). "Taxonomy of urban mixed land use planning". Land Use Policy. 88: 104102.



Course Name		Geographic Information Science			Course Code	GED 633
Teaching Hours	lecture	Tests	practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Content of Course:</u> Database Structure, Verification and Validation Test, Database Contents, Feature Definition, Discrete and Continuous Functions, Documentation, Metadata.						
<u>References:</u> 1. Longley, Paul A.; Goodchilde, Michael F.; Maguire, David J.; Rhind, David W. (2015). Geographic Information Systems & Science (4 th ed.). Wiley. 2. Chang, Kang-tsung (2016). Introduction to Geographic Information Systems (9 th ed.). McGraw-Hill. p. 1. ISBN 978-1-259-92964-9. 3. Bolstad, P. (2019). GIS Fundamentals: A first text on Geographic Information Systems, Sixth Edition. Ann Arbor: XanEdu, 764 pp.						

Course Name		Geographical Information Systems 2			Course Code	GED 634
Teaching Hours	lecture	Tests	practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Content of the Course:</u> Structure of Geographic Information, Unified Modeling Language, Metadata standards. Use of GIS in data analysis.						
<u>References:</u> 1. National Information Standards Organization (NISO) (2004), Understanding Metadata, NISO Press, Bethesda, USA 2. Lambe, P. (2007), Organizing Knowledge: Taxonomies, Knowledge and Organizational effectiveness, Chandos Publishing, Oxford 3. Zhang, Chuanrong; Zhao, Tian; Li, Weidong (2015). Geospatial Semantic Web. Springer International Publishing. ISBN 978-3-319-17801-1.						

Course Name		Modern Systems for Remote Sensing			Course Code	GED 721
Teaching Hours	lecture	Tests	practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		
<u>Content of Course:</u> Modern Technologies of Remote Sensing, Modern Classifiers, Global Elevation Data, Environmental Application of Remote Sensing.						

**References:**

1. Remote Sensing of the Environment: Earth Resource Perspective - 2nd edition, John R Jensen. Prentice Hall, Inc., 2006.
2. Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, John Wiley & Sons, Remote sensing and image interpretation, 2008
3. James B. Cambell, Introduction to Remote Sensing, Fifth Edition, The Guilford Press, 2011.
4. Fuzhong, Weng (2017). Passive Microwave Remote Sensing of the Earth : For Meteorological Applications. John Wiley & Sons, Incorporated. ISBN 978-3-527-33629-6. OCLC 994737066.
5. Navalgund, Ranganath (2018). Comprehensive Remote Sensing, Volume 9: Applications for Societal Benefits. Current Science. 115 (5): 988. doi:10.18520/cs/v115/i5/988-988. ISSN 0011-3891. S2CID 155885488.

Course Name		Modern developments in digital photogrammetry			Course Code	GED 722	
Teaching Hours		lecture	Tests	practical		Credit Hours	3
		2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	60	-	-			

Content of Course:

Space Sensors, Modeling Digital Imagery from Space, Quality and Reliability of Raw data from Space, Map Production, Map Updating, Map Revision, Automation of Cartography, The future of Space Photogrammetry.

References:

1. Mikail, E.M., Bethel, J.S. and McGlone, J.C., Introduction to Modern Photogrammetry, John Wiley & Sons, Inc., New York, 2001.
 2. Gonzalez, R. C., Woods, R .E. and Eddins S. L., Digital Image Processing Using MATLAB, Pearson Education, Inc., New Jersey, 2004
 3. Gonzalez, Rafael (2018). Digital image processing. New York, NY: Pearson. ISBN 978-0-13-335672-4. OCLC 966609831.
 4. Vipin Tyagi (2018). Understanding Digital Image Processing. Taylor and Francis CRC Press. ISBN 978-11-3856-6842.
- Kovalevsky, Vladimir (2019). Modern algorithms for image processing : computer imagery by example using C#. [New York, New York]. ISBN 978-1-4842-4237-7. OCLC 1080084533.

Course Name		Modern Applications in Geodesy			Course Code	GED 711	
Teaching Hours		lecture	Tests	practical		Credit Hours	3
		2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100	
	40	60	-	-			

Content of Course:

Satellite Laser Ranging , Very Long Base Line Interferometry , Long line formulae

References:

1. Teunissen, P. J., & Montenbruck, O. (Eds.). (2017). Springer handbook of global navigation satellite



- systems (Vol. 10, pp. 978-3). Cham, Switzerland: Springer International Publishing.
2. Awange, J. (2018). GNSS environmental sensing. Springer International Publishers. DOI, 10, 978-3.
 3. Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone. (2020). Global Navigation Satellite Systems, Inertial Navigation, and Integration, 4th Edition. ISBN: 978-1-119-54783-9
 4. Ogaja, Clement (2022). Introduction to GNSS Geodesy: Foundations of Precise Positioning Using Global Navigation Satellite Systems. Cham, Switzerland: Springer International Publishing AG. ISBN 978-3-030-91821-7
 5. Van Sickle, J. (2023). GPS and GNSS for Land Surveyors, Fifth Edition (5th ed.). CRC Press. <https://doi.org/10.1201/9781003405238>

Course Name		Modern Applications of Global Navigation Systems			Course Code	GED 712
Teaching Hours	lecture	Tests	practical		Credit Hours	3
	2	2	-			
Grades	Written Exam	Course Work	Practical	Oral	Total	100
	40	60	-	-		

Content of Course:

Introduction to GNSS - GPS, Glonass, Galileo / GPS signal, Code and Carrier Observations, Wide and Narrow Lane/ Techniques of Ambiguity Resolutions, Ionosphere and Troposphere Modeling/ Augmentation system, Regional Navigation Satellite System

References:

1. Leick, A., Papoport, L., & Tatarnikov, D. (2015). GPS SATELLITE SURVEYING (4th edition). Hoboken, New Jersey: John Wiley & Sons, Inc.
2. Grewal, M. S., Andrews, A. P., & Bartone, C. G. (2020). Global navigation satellite systems, inertial navigation, and integration. John Wiley & Sons.
3. Zajdel, Radosław; Sośnica, Krzysztof; Bury, Grzegorz; Dach, Rolf; Prange, Lars (2020). "System-specific systematic errors in earth rotation parameters derived from GPS, GLONASS, and Galileo". GPS Solutions. 24 (3): 74. doi:10.1007/s10291-020-00989-w
4. Zajdel, Radosław; Sośnica, Krzysztof; Bury, Grzegorz (2021). "Geocenter coordinates derived from multi-GNSS: a look into the role of solar radiation pressure modeling". GPS Solutions. 25 (1): 1. doi:10.1007/s10291-020-01037-3.



CHAPTER (7)

ARCHITECTURAL ENGINEERING DEPARTMENT

1) Advanced Diploma in Architectural Engineering

Registration is in one of the following research specializations:

- 1- Architectural Design
- 2- Urban Design
- 3- Regional and Urban Planning
- 4- Maintenance, Restoration and Preservation

The graduate of the advanced diploma in architectural engineering should be able to:

1. Recognize awareness of significant research methods and approaches.
2. Practice successful scientific writing skills.
3. Show awareness of the scientific study importance.
4. Apply engineering concepts in professional practice.
5. Find and gather available data.
6. Providing practical practices that guarantee the ethics of the profession.
7. Define scientific problems and gather data, priorities solutions.
8. Solve practical and theoretical problems.
9. Able to present fundamental assessments for projects in his field.
10. Introducing a high level of scientific performance.
11. Write successful technical reports.
12. Use IT and computer applications in his field.
13. Find comprehensive data and information sources.
14. Collaborate effectively, within teams.
15. Lead various professional teams in his field.

Table 7.1.1 Compulsory Courses in Basic Diploma in architectural engineering

S. N.	Course Code	Course Name	Pre-requisites	Credit hours	Grades				Exam duration
					course work	Oral / practical	Written exam	Total	
1	GEN 501	Scientific writing and presentation skills	–	2	60	–	40	100	2
2	GEN 502	Statistics and Random Processes	–	2	60	–	40	100	2
3	ARC 503	Research Methods	–	2	60	–	40	100	2



Table 7. 1. 2 Elective Courses for Basic Diploma in architectural engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
Architectural Design								
1	ARC 511	Ethics of Professional Practice	3	40	20	40	100	2
2	ARC 512	Architectural Applied Research	3	40	20	40	100	2
3	ARC 513	Buildings Rehabilitation	3	40	20	40	100	2
4	ARC 514	Project Management	3	40	20	40	100	2
5	ARC 515	Environmental Design of Buildings	3	40	20	40	100	2
Urban Design								
1	ARC 521	Scientific Seminars on Selected Topics in Urban Design	3	60	40	–	100	Oral
2	ARC 522	Urbanization and Utility Networks	3	40	20	40	100	2
3	ARC 523	Urban Context of Historic Buildings	3	40	20	40	100	2
4	ARC 524	Urban Rehabilitation and Renovation	3	40	20	40	100	2
5	ARC 525	Urban Maintenance	3	40	20	40	100	2
6	ARC 526	Urbanization, Traffic and Public Transportation	3	60	–	40	100	۲
Regional and Urban Planning								
1	ARC 531	Research Seminars in Urban Planning	3	60	40	–	100	Oral
2	ARC 532	Geographic Information Systems	3	40	20	40	100	2
3	ARC 533	Planning Projects Management	3	40	20	40	100	2
4	ARC 534	Service Structures	3	40	20	40	100	2
5	ARC 535	Environmental Impact Assessment	3	60	–	40	100	2
6	ARC 536	Introduction to Regional Development and Planning	3	40	20	40	100	2
Maintenance, Restoration and Preservation								
1	ARC 541	Finishing Materials and Installation Technologies	3	40	20	40	100	3
2	ARC 542	Conservation of the urban fabric of the heritage areas	3	40	20	40	100	3
3	ARC 543	Building maintenance and restoration techniques	3	40	20	40	100	3
4	ARC 544	Policies regulating the heritage areas	3	40	20	40	100	3

* With the help of the academic advisor, the student chooses (6) credit hours as a minimum and two courses as a maximum from the courses of basic diploma in architectural engineering in one of the specializations mentioned in Table (7.1.2) and as determined by the Scientific Department Council.

Table 7. 1. 3 Elective Courses for Advance Diploma in architectural engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
Architectural Design								
1	ARC 611	Architectural Criticism	3	40	20	40	100	2
2	ARC 612	Architectural Design Philosophy	3	40	20	40	100	2
3	ARC 613	Human Science in Architecture	3	40	20	40	100	2
4	ARC 614	Desert and Rural Architecture	3	40	20	40	100	2
5	ARC 615	Sustainability and Architecture	3	40	20	40	100	2
Urban Design								
1	ARC 621	Scientific Seminars for Selected Researches in Urban Design	3	60	40	–	100	Oral
2	ARC 622	Urban Management	3	60	–	40	100	2
3	ARC 623	Introduction to Landscape	3	40	20	40	100	2
4	ARC 624	Sustainable Urban Design	3	40	20	40	100	2
5	ARC 625	Theories of Urban Design	3	40	20	40	100	2
Regional and Urban Planning								
1	ARC 631	Advanced Research Seminars in Urban Planning	3	60	40	–	100	Oral
2	ARC 632	Development of Informal Areas	3	40	20	40	100	2
3	ARC 633	Environmental Considerations for Urbanization	3	40	20	40	100	2
4	ARC 634	The Urban Landscaping	3	40	20	40	100	2
5	ARC 635	Urban Planning and Sustainability	3	40	20	40	100	2
Maintenance, Restoration and Preservation								
1	ARC 641	Traditional crafts materials and techniques	3	40	20	40	100	2
2	ARC 642	Fine Restoration Techniques	3	40	20	40	100	2
3	ARC 643	Documentation of historical buildings	3	40	20	40	100	2
4	ARC 644	Preparing Maintenance and Restoration Projects	3	40	20	40	100	2
5	ARC 645	Specification of maintenance and restoration work items for heritage buildings	3	40	20	40	100	2

*With the help of the academic advisor, the student chooses (12) credit hours as a minimum and five courses as a maximum from the courses of advanced diploma in architectural engineering in one of the specializations mentioned in Table (7.1.3) and as determined by the Scientific Department Council.



3) Master of Science in Architectural Engineering

Registration is in one of the following research specializations:

- 1- Architectural Design
- 2- Urban Design
- 3- Regional and Urban Planning
- 4- Maintenance, Restoration and Preservation

The graduate of the Master of Science in architectural engineering should be able to:

1. use and apply significant research method, tools and approaches in his scientific studies.
2. Find various data and information sources.
3. Collect, analyze, systemize and discuss data and information.
4. Presenting organized scientific studies.
5. Understand the different types of applications of research methods.
6. Define, analyze and create debates in a scientifically structured study.
7. Realizing the impact of scientific studies on community development.
8. Use modern tools and applications in gathering and managing data.
9. Produce adequate scientific solutions to problems in his field.
10. Assesses the human-made projects on the natural environment.
11. Practice the required fundamental rules and theories in his practice.
12. Manage time successfully.
13. The use of the hierarchy in the classification of reference papers.
14. Commitment to professional ethics.

Table 7.1.4 Master of Science in Architectural Engineering Thesis

S.N.	Course Code	Course Name	Perquisites	Credit Hours
1	ARC811	M.Sc. Thesis	Average GPA 3.0 and minimum 2.7 in all courses of the Basic and Advanced Diploma in architectural engineering that were studied	12
2	ARC821	M.Sc. Thesis		
3	ARC831	M.Sc. Thesis		
4	ARC841	M.Sc. Thesis		

4) Doctor of Philosophy in Architectural Engineering

Registration is in one of the following research specializations:

- 1- Architectural Design
- 2- Urban Design
- 3- Regional and Urban Planning
- 4- Maintenance, Restoration and Preservation

The graduate of the Doctor of Philosophy in architectural engineering should be able to:

1. Understand the different applied research methods.
2. Master the use of research methods, tools and approaches.
3. Perform various scientific studies adding to the human knowledge.
4. Apply scientific conclusions practically.
5. Awareness of the ethics of scientific research.
6. Relate various discipline into multidisciplinary studies.
7. Take decisions in light of the available data.
8. Apply effectively, available resources in his profession.
9. Manage scientific and professional meetings.
10. Manage time effectively.
11. Explore and use various kinds of literature, sources and plan applicable field studies.

Table 7. 1. 5 Basic courses for Doctor of Philosophy in architectural engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
Architectural Design								
1	ARC 616	Concepts Governing Theories and Practice in Architecture	3	40	20	40	100	2
2	ARC 617	Applied Studies in Architecture	3	40	20	40	100	2
3	ARC 618	Global Architecture and Future Projections	3	40	20	40	100	2
4	ARC 619	Built Environment and Energy Conservation	3	40	20	40	100	2
Urban Design								
1	ARC 626	Culture and Urbanism	3	40	20	40	100	2
2	ARC 627	Housing Development	3	40	20	40	100	2



3	ARC 628	Visual Studies	3	40	20	40	100	2
4	ARC 629	GIS and Urban Data Management	3	40	20	40	100	2
Regional and Urban Planning								
1	ARC 636	Urban Geoinformatics	3	40	20	40	100	2
2	ARC 637	Urban development Research	3	60	40	–	100	Oral
3	ARC 638	Planning of Urban Infrastructures	3	40	20	40	100	2
4	ARC 639	Facilities Planning	3	40	20	40	100	2
Maintenance, Restoration and Preservation								
1	ARC 646	Seminars in the field of specialization	3	60	40	–	100	Oral
2	ARC 647	Building maintenance and restoration technology	3	40	20	40	100	3
3	ARC 648	Management of Implementation of Maintenance and Restoration Projects	3	40	20	40	100	3
4	ARC 649	Field studies in the field of specialization	3	60	40	–	100	Oral

*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from the basic courses for Doctor of Philosophy in architectural engineering in one of the specializations mentioned in Table (7.1.5) and as determined by the Scientific Department Council.

Table 7. 1. 6 specialized courses for Doctor of Philosophy in Architectural Engineering*

S. N.	Course Code	Course Name	Credit Hours	Grades				Test Time
				Course Work	Oral / Practical	Written Exam	Total	
Architectural Design								
1	ARC 711	Philosophy Studies in Architectural Design	3	40	20	40	100	2
2	ARC 712	Advanced Applied Research Seminars in “Specialty”	3	60	40	–	100	Oral
3	ARC 713	Smart Architecture	3	40	20	40	100	2
4	ARC 714	Advanced Research in Culture and the Built Environment	3	40	20	40	100	2
٥	ARC 715	Selected Topics on Energy and Architectural Design	3	40	20	40	100	2
٦	ARC 716	Building Technology and Architectural Concepts	3	40	20	40	100	2
Urban Design								



1	ARC 721	Advanced Forum in Selected Scientific Studies in Urban Design	3	60	40	–	100	Oral
2	ARC 722	Philosophy Studies in Urban Design	3	60	–	40	100	2
3	ARC 723	Urban Modelling	3	40	20	40	100	2
4	ARC 724	Scientific Citation and Reference Writing Styles	3	40	20	40	100	2
٥	ARC 725	Criticism of Urban Design Projects	3	40	20	40	100	2
٦	ARC 726	Urbanism in Egypt	3	40	20	40	100	2
٧	ARC 727	Urban Place making	3	40	20	40	100	2
٨	ARC 728	Smart Urbanism	3	40	20	40	100	2
٩	ARC 729	Environmental Psychology	3	40	20	40	100	2
Regional and Urban Planning								
1	ARC 731	Advanced Forum/Applied Research in Urban Planning	3	60	40	--	100	Oral
2	ARC 732	Policies and regional development theories	3	40	20	40	100	2
3	ARC 733	Computer Aided Planning	3	40	20	40	100	2
4	ARC 734	Studies and sustainable planning research	3	40	20	40	100	2
٥	ARC 735	Writing Planning Reports	3	40	20	40	100	2
٦	ARC 736	Sustainability in Desert Settlements	3	40	20	40	100	2
٧	ARC 737	Planning of Touristic and Coastal Areas	3	40	20	40	100	2
٨	ARC 738	The Smart City	3	40	20	40	100	2
٩	ARC 739	Planning Models	3	40	20	40	100	2
Maintenance, Restoration and Preservation								
1	ARC 741	Philosophy of maintenance and restoration and international charters	3	40	20	40	100	3
2	ARC 742	Advanced applied research seminars in the Maintenance, Restoration & Preservation	3	60	40	–	100	Oral
3	ARC 743	Culture heritage and urban renewal	3	40	20	40	100	3
4	ARC 744	Rehabilitation of Existing Facilities - Applied Projects	3	60	40	–	100	Oral
5	ARC 745	The Role of Political and Administrative Systems in Supporting Conservation	3	40	20	40	100	3
6	ARC 746	Development of Historic and Heritage Areas	3	40	20	40	100	3

*With the help of the academic advisor, the student chooses (9) credit hours as a minimum from the specialized courses for Doctor of Philosophy in architectural engineering in one of the specializations mentioned in Table (5.1.6) on the recommendation of the main supervisor and as determined by the Scientific Department Council.



Table 7. 1. 7 Doctor of Philosophy in Architectural Engineering Thesis

S. N.	Course Code	Course Name	Perquisites	Credit Hours
1	ARC911	Ph.D. Thesis	1) Average GPA 3.0 and minimum 2.7 in all courses of the basic specialized courses for Doctor of Philosophy in architectural engineering Thesis that were studied in one of the disciplines mentioned in Table (7.1.5) and (7.1.6). 2) Pass the seminar of stage one of the academic research.	12
2	ARC921	Ph.D. Thesis		
3	ARC931	Ph.D. Thesis		
4	ARC941	Ph.D. Thesis		



Connecting matrix between Basic Diploma in Architectural Engineering and graduate specifications

No	Graduate specifications of Basic Diploma in Architectural Engineering															Course Name	Course Code	S. N
.	١٥	١٤	١٣	١٢	١١	١٠	٩	٨	٧	٦	٥	٤	٣	٢	١			
5					√					√	√			√	√	Scientific Writing and presentation skills	GEN 501	1
6	√	√		√			√					√	√			Statistics and Random Processes	GEN 502	2
6			√			√		√		√			√		√	Research Methods	ARC 503	3
Architectural Design																		
5		√				√				√		√	√			Ethics of Professional Practice	ARC 511	4
5					√					√	√			√	√	Architectural Applied Research	ARC 512	5
5	√	√		√					√			√				Buildings Rehabilitation	ARC 513	6
5	√				√		√	√	√							Project Management	ARC 514	7
5			√			√	√				√	√				Environmental Design of Buildings	ARC 515	8
25	2	2	1	1	2	2	2	1	2	2	2	3	1	1	1	Total		
Urban Design																		
5			√			√			√					√	√	Scientific Seminars on Selected Topics in Urban Design	ARC 521	9
5	√							√		√		√	√			Urbanization and Utility Networks	ARC 522	10
4										√	√	√	√			Urban Context of Historic Buildings	ARC 523	11
5		√	√				√					√	√			Urban Rehabilitation and Renovation	ARC 524	12
4					√	√						√	√			Urban Maintenance	ARC 525	13
5	√	√					√			√		√				Urbanization, Traffic and Public Transportation	ARC 526	14
28	2	2	2	0	1	2	2	1	1	3	1	5	4	1	1	Total		
Regional and Urban Planning																		
5			√			√			√					√	√	Research Seminars in Urban Planning	ARC 531	15
5			√	√			√				√		√			Geographic Information Systems	ARC 532	16
5	√	√			√	√		√								Planning Projects Management	ARC 533	17
5			√				√			√		√	√			Service Structures	ARC 534	18
5				√					√				√	√	√	Environmental Impact Assessment	ARC 535	19
5						√			√		√			√	√	Introduction to Regional Development and Planning	ARC 536	20
30	1	1	3	2	1	3	2	1	3	1	2	1	3	3	3	Total		
Maintenance, Restoration and Preservation																		
5			√				√		√			√	√			Finishing Materials and Installation Technologies	ARC 541	21
5					√	√		√		√	√					Conservation of the urban fabric of the heritage areas	ARC 542	22
5	√						√				√			√	√	Building maintenance and restoration techniques	ARC 543	23



5		√		√	√				√			√				Policies regulating the heritage areas	ARC 544	24
20	1	1	1	1	2	1	2	1	2	1	2	2	1	1	1	Total		

Connecting matrix between Advanced Diploma in Architectural Engineering and graduate specifications

No.	Graduate specifications of Advanced Diploma in Architectural Engineering																Course Name	Course Code	Serial
	١٥	١٤	١٣	١٢	١١	١٠	٩	٨	٧	٦	٥	٤	٣	٢	١				
Architectural Design																			
5					√		√					√		√	√	Architectural Criticism	ARC 611	25	
5			√			√			√		√				√	Architectural Design Philosophy	ARC 612	26	
5		√						√		√			√	√		Human Science in Architecture	ARC 613	27	
4							√		√	√			√			Desert and Rural Architecture	ARC 614	28	
5	√					√		√			√	√				Sustainability and Architecture	ARC 615	29	
24	1	1	1	0	1	2	2	2	2	2	2	2	2	2	2	Total			
Urban Design																			
5			√			√			√					√	√	Scientific Seminars for Selected Researches in Urban Design	ARC 621	30	
5	√				√	√		√		√						Urban Management	ARC 622	31	
5			√	√		√		√	√							Introduction to Landscape	ARC 623	32	
5		√					√				√	√	√			Sustainable Urban Design	ARC 624	33	
5		√		√	√				√			√				Theories of Urban Design	ARC 625	34	
25	1	2	2	2	2	3	1	2	3	1	1	2	1	1	1	Total			
Regional and Urban Planning																			
5			√			√			√					√	√	Advanced Research Seminars in Urban Planning	ARC 631	35	
5		√					√				√	√	√			Development of Informal Areas	ARC 632	36	
5		√		√	√				√			√				Environmental Considerations for Urbanization	ARC 633	37	
5	√					√		√			√	√				The Urban Landscaping	ARC 634	38	
5	√	√					√			√		√				Urban Planning and Sustainability	ARC 635	39	
25	2	3	1	1	1	2	2	1	2	1	2	4	1	1	1	Total			
Maintenance, Restoration and Preservation																			
5		√					√				√	√	√			Traditional crafts materials and techniques	ARC 641	40	



Post Graduate Bylaw (Credit Hours System) 2022

5	√					√		√			√	√				Fine Restoration Techniques	ARC 642	41
5		√		√	√				√			√				Documentation of historical buildings	ARC 643	42
5			√				√		√	√			√			Preparing Maintenance and Restoration Projects	ARC 644	43
5					√		√	√						√	√	Specification of maintenance and restoration work items for heritage buildings	ARC 645	44
25	1	2	1	1	1	1	3	2	2	1	2	3	2	1	1	Total		

Connecting matrix between Basic courses of Philosophy doctorate in Architectural Engineering and Graduate Specifications

No.	Graduate specifications of Basic Course for Doctor of Philosophy in Architectural Engineering											Course Name	Course Code	S. N.
	١١	١٠	٩	٨	٧	٦	٥	٤	٣	٢	١			
Architectural Design														
4		√					√			√	√	Concepts Governing Theories and Practice in Architecture	ARC 616	45
5	√				√	√		√	√			Applied Studies in Architecture	ARC 617	46
5			√	√		√		√			√	Global Architecture and Future Projections	ARC 618	47
5	√		√	√	√				√			Built Environment and Energy Conservation	ARC 619	48
19	2	1	2	2	2	2	1	2	2	1	2	Total		
Urban Design														
5	√					√	√			√	√	Culture and Urbanism	ARC 626	49
5			√	√		√		√			√	Housing Development	ARC 627	50
5		√	√	√	√				√			Visual Studies	ARC 628	51
5	√				√	√			√	√		GIS and Urban Data Management	ARC 629	52
20	2	1	2	2	2	3	1	1	2	2	2	Total		
Regional and Urban Planning														
5	√				√	√			√	√		Urban Geoinformatics	ARC 636	53
5		√			√		√		√	√		Urban development Research	ARC 637	54
5			√	√		√		√			√	Planning of Urban Infrastructures	ARC 638	55
5	√				√	√		√	√			Facilities Planning	ARC 639	56
20	2	1	1	1	3	3	1	2	3	2	1	Total		
Maintenance, Restoration and Preservation														



Post Graduate Bylaw (Credit Hours System) 2022

5	√				√	√		√	√			Seminars in the field of specialization	ARC 646	5\
5	√					√		√	√	√		Building maintenance and restoration technology	ARC 647	58
5		√	√	√				√			√	Management of Implementation of Maintenance and Restoration Projects	ARC 648	59
5		√		√	√		√		√			Field studies in the field of specialization	ARC 649	60
20	2	2	1	2	2	2	1	3	3	1	1	Total		

Connecting matrix between Specialized courses of Philosophy Doctorate in Architectural Engineering and graduate specifications

No.	Graduate specifications of Specialized Course for Doctor of Philosophy in Architectural Engineering											Course Name	Course Code	Serial
	١١	١٠	٩	٨	٧	٦	٥	٤	٣	٢	١			
Architectural Design														
5	√	√					√			√	√	Philosophy Studies in Architectural Design	ARC 711	61
5	√				√	√		√	√			Advanced Applied Research Seminars in “Specialty”	ARC 712	62
5	√				√	√			√	√		Smart Architecture	ARC 713	63
5		√	√				√			√	√	Advanced Research in Culture and the Built Environment	ARC 714	64
5	√		√	√	√				√			Selected Topics on Energy and Architectural Design	ARC 715	65
5	√					√		√	√	√		Building Technology and Architectural Concepts	ARC 716	66
30	5	2	2	1	3	3	2	2	4	4	2	Total		
Urban Design														
5	√				√	√		√	√			Advanced Forum in Selected Scientific Studies in Urban Design	ARC ٧٢1	67
5	√	√					√			√	√	Philosophy Studies in Urban Design	ARC ٧٢2	68
5	√				√	√			√	√		Urban Modelling	ARC ٧٢3	69
5	√	√					√			√	√	Scientific Citation and Reference Writing Styles	ARC ٧٢4	70
4		√					√			√	√	Criticism of Urban Design Projects	ARC ٧٢5	71
5			√	√	√			√			√	Urbanism in Egypt	ARC ٧٢6	72
5				√	√	√		√	√			Urban Place making	ARC ٧٢7	73
5	√				√	√			√	√		Smart Urbanism	ARC ٧٢8	74
5				√	√	√			√	√		Environmental Psychology	ARC ٧٢9	75



Post Graduate Bylaw (Credit Hours System) 2022

44	5	3	1	3	6	5	3	3	5	6	4	Total		
Regional and Urban Planning														
5	√				√	√		√	√			Advanced Forum/Applied Research in Urban Planning	ARC 731	76
5	√	√					√			√	√	Policies and regional development theories	ARC 732	77
5	√				√	√			√	√		Computer Aided Planning	ARC 733	78
5		√	√				√			√	√	Studies and sustainable planning research	ARC 734	84
5	√	√					√			√	√	Writing Planning Reports	ARC 735	85
5				√		√		√	√	√		Sustainability in Desert Settlements	ARC 736	86
5	√	√					√			√	√	Planning of Touristic and Coastal Areas	ARC 737	87
5	√			√		√			√	√		The Smart City	ARC 738	88
5	√					√		√	√	√		Planning Models	ARC 739	89
45	7	4	1	2	2	5	4	3	5	8	4	Total		
Maintenance, Restoration and Preservation														
5	√	√					√			√	√	Philosophy of maintenance and restoration and international charters	ARC 741	90
5	√				√	√		√	√			Advanced applied research seminars in the Maintenance, Restoration & Preservation	ARC 742	91
5		√	√				√			√	√	Culture heritage and urban renewal	ARC 743	92
5	√				√	√			√	√		Rehabilitation of Existing Facilities - Applied Projects	ARC 744	93
5				√		√		√	√	√		The Role of Political and Administrative Systems in Supporting Conservation	ARC 745	94
5		√	√				√			√	√	Development of Historic and Heritage Areas	ARC 746	95
30	3	3	2	1	2	3	3	2	3	5	3	Total		



COURSES DESCRIPTION

Course Name	Research Methods				Course Code	ARC 503
Teaching Hours	Lecture	Exercises		Practical	Cridet Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	60	-	-		

Scientific Content:

The scientific research methods and methods course aims to introduce the student to the methods and foundations of scientific research of both quantitative and qualitative types, and how to benefit from them in architectural studies, as well as introducing him to the various research methods and methods of application in this field, which covers how to develop research plans and structures and their components, and develop and formulate hypotheses and methods of testing and measurement And the questionnaire, testing and verifying the validity or lack of credibility of hypotheses, conducting applications and experiments, measuring and analyzing them, and drawing their results, with a focus on how to deal with the qualitative study areas of composition, aesthetics, theories and humanities of each of architecture and urbanism and related fields..

References:

- C. George Thomas “ Research Methodology and Scientific Writing” Springer; 2nd edition, 2021.
- Popper, K. “The Logic of Scientific Discovery” Springer; 2nd edition. 2014
- Prathapan, K “Research Methodology for Scientific Research” Dreamtech Press. 2021

Course Name	Professional Practice Ethics				Course Code	ARC 511
Teaching Hours	Lecture	Exercises		Practical	Cridet Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course introduces the basic principles of ethics in the practice of the profession and introduces the student to the recognized models that govern the relationship between the architect and the client. It reviews the role of international and local organizations in developing and following up the organizational foundations and responsibilities to control the relationship between the practicing architect and the client. The student applies case studies for many examples through exercises and research papers. By achieving the public interest, the safety, health and well-being of the community, and by providing a safe, healthy and comfortable life for all its groups and sects, preserving the honor and dignity of the profession, raising the value of its people, and ensuring that it is always respected and appreciated by society, consolidating the moral values and principles of the profession as part of the public conscience that is stable in the conscience society, and placing the practitioners of this profession in a position of leadership and leadership for the rising generations of its children.

References: Egyptian code for the professional practice ethics

Course Name	Architectural Applied Research				Course Code	ARC 512
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course aims to develop the personality and ethics of the researcher, the ethics of scientific research, the importance of the methodology of scientific research, means of collecting scientific material and data, notes on writing scientific research (elements constituting research), science and scientific performance and its objectives, scientific research (meaning of



scientific research, conditions of scientific research, features The subject of scientific research, the various research fields in the field of architecture, the definition of the research problem, the research hypothesis and its assumptions, the mechanism of the research problem, examples of previous research problems with analysis), the scientific method (the objectives of the scientific method, the features of the scientific method, the mechanism of the scientific method), reasoning, its definition and its divisions (direct, deductive, representative, inductive), errors in scientific research and their most important causes and forms.

References:

- حمدان محمد زياد، ١٩٨٩ - البحث العلمي أنظام. سلسلة التربية الحديثة. دار التربية الحديثة. عمان - الأردن . ٣٠٤ ص.
- ندوة البحث العلمي في دول مجلس التعاون لدول الخليج العربية (الواقع والتطلعات) ١٢ - ١٤ نوفمبر ٢٠٠٠ الرياض - المملكة العربية السعودية.
- www.kacst.edu.sa/ar/support/gdrgp/symp-gcc.as
- دويدري رجاء وحيد، ٢٠٠٠ - البحث العلمي أساسياته النظرية وممارسته العملية. دار الفكر المعاصر - سورية. ٥٠٤ ص.
- معروف محمد أحمد، ٢٠٠٣ - آفية القيام ببحث زراعي متكامل . ندوة نظمها مختبر الآثار النسيجي بإدارة البحوث الزراعية والمائية - دولة قطر . الفترة ٢٢ مايو ٢٠٠٣ - ٢٤
- البهادلي علي أحمد، ٢٠٠١ - أصول البحث العلمي، مؤسسة الفكر الإسلامي . مكتبة النيل والفرات. سورية com.neelwafurat.com.
- عبيدات عبد الحق عدس، ١٩٨٩ - البحث العلمي (مفهومه - أدواته - أساليبه) دار الفكر للنشر والتوزيع ٣٢٠ ص.
- عمر زيان محمد، ١٩٨٣ - البحث العلمي، مناهجه وتقنياته. دار العلم للطباعة والنشر، جدة - المملكة العربية السعودية. ٥٣٦ ص.
- بدر أحمد، ١٩٨٤ - أصول البحث العلمي ومناهجه. والآلة المطبوعات بالكويت. ٥٥٢ ص.

Course Name	Building Rehabilitation				Course Code	ARC 513
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

Studying the building's spatial, absorptive and historical capabilities for the possibility of re-employing it, whether in the same activity or in another new activity, and studying the capabilities and determinants of the site, which is one of the important variables in the re-employment of buildings. It is also exposed to the theoretical foundations, strategies and methods of practical application used in developed and developing countries in the re-employment of buildings, which help to improve and raise the standard of living environment and raise awareness of the residents of the region, with how to preserve the architectural and aesthetic values that lie in the elements and vocabulary of the building, which is a distinct architectural character , and how to maintain it with the new hiring of the building.

References:

- هشام احمد عبد الاخرز الحفاظ واعادة توظيف المباني ذات القيمة و كلية الهندسة و جامعة القاهرة و ٢٠١٠.
- عصام محمد موسى محمد ، اعادة استخدام المباني الاثرية والتاريخية في العرض المتحفي (تطبيقا علي مجموعة من المتاحف العالمية والمصرية ز كلية الهندسة ، جامعة القاهرة ، ٢٠٠٦.

Course Name	Project Management				Course Code	ARC 514
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	2	2		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

This course introduces the student to the most important methods of managing engineering projects, starting with issuing bids and tenders, and leading to the evaluation and pricing processes for existing projects: types of bids and tenders, calculation programs and databases, unloading bids, analyzing and evaluating them, monitoring the statement of work items, item units and their quantities, setting a schedule General executive, detailed execution schedule, determining the quality of receiving works during implementation, operating management of the building, stages of receiving the building, partial operation of the building, inspection of works, full operation of the building and its conditions for maintenance efficiency Determining the



maintenance schedule, works, time cycle, operating systems for maintenance, composition of the team responsible for maintenance, measures of maintenance efficiency, the use of computers in maintenance, the concept of assessment and valuation, knowledge of the principles and standards on which they are based, identification of defects and advantages and ways to fix them or Take advantage of it.

References:

- الدليل المعرفي لإدارة المشروعات، ٢٠١٣ Newtown Square, Pennsylvania 19073-3299 USA، Project Management Institute, Inc.
- الدليل المعرفي لإدارة المشروعات، Project Management Institute, Inc.، Newtown Square, Pennsylvania 19073-3299 USA.

Course Name	Environmental Design for Buildings				Course Code	ARC 515
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course contains the concept and importance of environmental control and its impact on building design, the principles of green and sustainable architecture and their role in saving energy, environmental design strategies in climatic regions, the principles of passive design, identification of passive design methods for cooling and heat gain with applied examples, the development of the integration of negative and positive styles. Low energy consumption in designing buildings to achieve maximum efficiency in rationalizing energy consumption. The course also deals with one of the contemporary topics in the field of environmental design, energy efficiency, and renewable energy in architecture. It also provides a theoretical and applied knowledge background and deals with the study and analysis of regulatory and legal aspects and the nature of engineering services in this field. It studies how energy consumption issues are reflected in the architectural product. As well as analyzing and monitoring all the variables that the natural environment is exposed to and the extent to which it is possible to determine the environmental design approaches that must be adopted to confront these variables.

References:

- Abdulrahman, Hikmat Najeeb, 1977, Studies in Arabic scientific history, Univ. of Mosul, Iraq.
- Al-fandi, Mohammed Jamaludeen, 1975, Weather station, Alam-al-kutob, Cairo.
- Al-Jawadi, Dr. Miqdad, 2010, Model of House Design responsive to Hot-Dry Climate, In, World Congress on Housing, October 26 – 29, 2010, Santander, Spain.
- Jones, C.J. 1981. Design Methods, John Wiley and Sons Ltd., New York
- Saberi, O., Saneii, P. & Javanbakht. A. 2006. Thermal Comfort in Architecture. Comfort And Energy Use In Buildings, Cumberland Lodge, Windsor. on general climate improvement of Baghdad city, Iraqi Journal of Architectural Engineering, Vol. 28, 1st issue, 2014.
- Al-jawadi, Dr. Miqdad, 2002, Role of Urban and Architectural Design in power consumption rationalism in buildings, Seminar of Construction Materials and power rationalism methods and renewable power. Ministry of Housing.

Course Name	Scientific Seminars on Selected Topics in Urban Design				Course Code	ARC 521
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	-	60	-	40		

Scientific Content:

The course aims to train the student on scientific research through scientific discussions of topics that focus on issues related to urban design in the world. Students prepare research on topics of their choice dealing with the application of international urban design ideas to Egypt. The student is also exposed to research and analysis skills for issues related to urbanization and how to prepare a project research.

References:

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Course Name	Urbanization and Utility Networks				Course Code	ARC 522
Teaching Hours	Lecture	Exercises	Practical	Hours		3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the concepts of urbanization and identification of patterns of urban utilities networks and the vital role played by each of the provision of utilities and infrastructure networks for the upgrading and development. The course discusses the impact of defining and phasing utility networks on the development of new communities.

References:

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Course Name	Urban Context of Historic Buildings				Course Code	ARC 523
Teaching Hours	Lecture	Exercises	Practical	Hours		3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course focuses on the urban context associated with archaeological sites and historic buildings in Egypt, in terms of the urban controls required for them and how to deal with the buffer zones and beautification lines around those places. The course also discusses the features required for the visual character of urban areas adjacent to those places, which ensure the compatibility with their distinct aspects and respect for their historical value. The course also includes the methods of infill design in heritage districts, and the design strategies for new buildings that are allowed to be built next to historic buildings, as well as the levels of intervention in the urban areas surrounding such places, to improve their visual character and to enhance their panoramic image and urban background in a way that preserves their uniqueness. The course also studies the recommendations of international charters and conventions related to this issue.

References:

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Course Name	Urban Rehabilitation and Renovation				Course Code	ARC 524
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		
Scientific Content: The course deals with the concepts of methods and tools for rehabilitation (Rehabitation): in the field of urban renewal, which are reform measures aimed at improving and raising the urban and environmental level of the urban fabric according to planning treatments for the area subject to urban renewal, some parts of which suffer from deterioration, while raising the level of infrastructure, social services and spaces This is in addition to the collective memory of urbanization, the value of the place, the features of land uses, and the efficiency and effectiveness of rehabilitation approaches. The course presents the concept of implementation, controls, legislative laws and ownership.						
References: - عبادة، جلال، " المشهد المعماري العربي المعاصر: تأملات حاضرة ورؤى مستقبلية"، بحث منشور ضمن نشرة منتدى جدة الدولي للعمارة، التحضر والاستدامة في عالم متغير، المملكة العربية السعودية. - الحيدري، عبد الباقي عبد الجبار أمين، " التجديد الحضري لقلعة أربيل - دراسة اجتماعية واقتصادية وعمرانية"، مكتبة الحداثة، الموصل. - شبر، سابا جورج، " العلم وتنظيم المدن العربية " بلدية الكويت – مكتب العلاقات العامة، الكويت. - مكي، محمد شوقي إبراهيم، " المدخل إلى تخطيط المدن"، دار المريخ للنشر، الرياض. - Hillier, Bill; " The Social Logic of Space ",Cambridge University Press, UK,1988. - Sage, D. & Michael Unser; " Easy Java Programming for Teaching Image Processing ", IEEE – 2010						
Course Name	Urban Maintenance				Course Code	ARC 525
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		
Scientific Content: The course deals with identifying the concepts of facilities management and the role of maintenance managers in the process of developing and raising the efficiency of urban areas and how to reduce maintenance costs. Green roads, sidewalks, guiding and traffic signs, and all elements of urban safety.						
References: - الأمم المتحدة – المونل. الحكومات المحلية من أجل الاستدامة. وبرنامج الأمم المتحدة للبيئة (٢٠٠٩) تخطيط الطاقة الحضرية المستدامة: دليل للمدن والحواضر في البلدان النامية، نيروبي: برنامج الأمم المتحدة للبيئة. - Chu, Steven, and Arun Majumdar (2012). Opportunities and challenges for a sustainable energy future. Nature, 488, (August) - Mitchell, Richard (2013). "Is physical activity in natural environments better for mental Health than physical activity in other environments?". Social Science & Medicine. - Luttik, Joke (2000). "The value of trees, water and open space as reflected by house prices in the Netherlands". Landscape and Urban Planning.						
Course Name	Urbanization, Traffic and Public Transportation				Course Code	ARC 526
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	60	-	-		



Scientific Content:

The course deals with the identification of traffic patterns and public transport and how to achieve the integration of the various elements of transport with the presentation of its objectives for the spatial and functional distribution of lands and the density generated from them. This is in addition to identifying the impact of indicators of traffic density volume and physical planning levels (regional / city / urban / local) on the urban environment in addition to the institutional framework, controls and legislative laws.

References:

- مؤئل الأمم المتحدة ، ٢٠١٤ . جيل جديد من السياسات الحضرية الوطنية.
- مؤئل الأمم المتحدة ، ٢٠١٩ . كيفية صياغة سياسة حضرية وطنية: دليل عملي.
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- ينوك ، ماركوس ب. ، ٢٠١٥ . كيف يمكن للتقارب النموذجي السريع في خدمة سيارات أجرة مؤتمنة عالمية أن يكون مستقبلي نقل الركاب المحلي. تحليل التكنولوجيا والإدارة الاستراتيجية ٢٧ ، ال. ٨ ، ٩١٠-٩٢٤.
- البنك الدولي للإنشاء والتعمير ، ٢٠١٤ . صياغة سياسة النقل الحضري.
- Southern, A. (2006), Modern-day transport planners need to be both technically proficient and politically astute, Local Transport Today, no. 448, 27 July 2006

Course Name	Research Seminars in Urban Planning				Course Code	ARC 531
Teaching Hours	Lecture	Exercises	Practical	Hours	3	
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	-	60	-	40		

Scientific Content:

The course deals with an introduction to the science of regional and urban planning, the definition of planning and its gradual levels of national planning, regional planning, urban planning, and urban design, and the essential differences between these levels, with a study of how to evaluate urban and rural life. And training students to find engineering solutions to urban problems such as housing inflation, slums, and traffic crises, with how to organize movement between residents and services. And studying multiple theories of regional and urban planning, aiming at organizing urban life, as well as developing students' knowledge and experience in the field of urban planning, to be able to improve the quality of the built environment (urban and rural), to help meet the different needs of society in a place and time.

References:

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- Ewing R, Pendall R, Chen D. Measuring sprawl and its impact. Washington, DC: Smart Growth America, 2002.

Course Name	Geographic Information Systems				Course Code	ARC 532
Teaching Hours	Lecture	Exercises	Practical	Hours	3	



	2	-	3		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade
	40	40	20	-	100

Scientific Content:

The course deals with the basics and theories of geographic information systems and their applications in urban planning and their use in analysis and evaluation processes. It includes a definition of the importance of geographic information systems, the components of these systems, the functions and basic concepts of data management, the characteristics and types of data and information, and the stages of dealing with information such as input, output, and display processes. The student gets acquainted with the hardware and software components and the important applications of these systems in support of decision-making in the planning process. The course contains an applied research entrance and a practical entrance. The applied approach deals with clarifying the importance of geographic information systems and spatial analysis in the regional and environmental dimensions. As for the practical approach, work is done on one of the GIS programs and training on the program by getting acquainted with the commands, inputs, outputs, and how to display the results from within the program.

References:

- Goodchild, M.F. (1997) What is Geographic Information Science? NCGIA Core Curriculum in GI Science, <http://www.ncgia.ucsb.edu/giscc/units/u002/u002.html>, posted October 7, 1997.
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Course Name	Planning Projects Management				Course Code	ARC 533
Teaching Hours	Lecture	Exercises	Practical		Hours	3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with an approach to learning the necessary tools and techniques by which planning projects can be completed within the budget and estimated time while maintaining the required level of quality, regardless of the size, type, and complexity of the project. The course also introduces students to the basic requirements for project management, operations, and some techniques, for example, CPM & WS is discussed in the areas of project planning, scheduling, productivity, site preparation, and organization. The course contains an integrated research project, in addition to the preparation of an integrated detailed plan by groups of students, by applying all the processes of preparing urban plans, including all urban, economic, demographic, and infrastructure aspects, in addition to setting building requirements.

References:

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Course Name	Service Structures				Course Code	ARC 534
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the importance of the need for services, types, and classifications of services (basic and other), the hierarchy of city service structures, the distribution and structuring of services in city centers, the development of city centers, the redevelopment of service centers, the development of planning standards and rates in line with the era of information technology, the definition of services within The pyramid of satisfying needs, types and levels of services, designing the service rate, and its compatibility with the nature of the study region, factors affecting the geographical distribution of services, the future services program, formulating a plan for distributing services in a region.

In addition to studying the theoretical concept of services by identifying the concept of public services and services, the importance of services in human life, the characteristics of services, and their various aspects and divisions. The course also aims to identify the factors that must be considered when choosing a service location and the most important obstacles that prevent the provision of good services.

References:

- خلف حسين الدليمي، تخطيط الخدمات المجتمعية والبنية التحتية، دار صفاء للنشر والتوزيع، عمان، الأردن، ٢٠٠٩م.
- محمد عبده حافظ، تسويق الخدمات، المكتب العربي للمعارف، القاهرة، مصر، أغسطس ٢٠٠٩م.
- بشر إبراهيم الطيف، وآخرون، خدمات المدن دراسة في الجغرافية التنموية، المؤسسة الحديثة للكتاب، لبنان، ٢٠٠٩م.
- هاني حامد الضمور، تسويق الخدمات، دار وائل للنشر والتوزيع، عمان، الأردن، ٢٠٠٨م.
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- د. إسماعيل عبد العزيز عامر، رؤيا مستقبلية لمراكز الخدمات بالتجمعات العمرانية في عصر ثورة المعلومات والاتصالات، مجلة جمعية المهندسين المصرية، العدد الرابع، ٢٠٠٠م.

Course Name	Environmental Impact Assessment				Course Code	ARC 535
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	60	40	-	-		

Scientific Content:

The course deals with a practical study of evaluating the potential impacts (positive or negative) of a proposed project on the natural environment, with the aim of giving decision-makers a means to decide whether to continue or stop the project. And learn about the objectives of environmental impact assessment (modifying and improving project designs, ensuring optimal use of resources, improving the social impact of projects, measuring and minimizing the main impacts of the project, assessing the situation, preventing any damage to the environment, and studying general procedures for environmental impact



assessment), as well as the benefits of impact assessment Environmental assessment methods, general procedures for environmental impact assessment from first examination and current status, activity study with identification and assessment of environmental impact, prediction and mitigation of environmental impact, management, monitoring, review, and report.

References:

- Canter. L. 1993. "The Role of Environmental Monitoring in Responsible Project Management. ." The Environmental professional 15(1): 76-87.
- Public participation and environmental impact assessment: purposes, implications, and lessons for public policy making Environ Impact Assess Rev (2010).
- J. Persson, Theoretical reflections on the connection between environmental assessment methods and conflict Environ. Impact Assess. Rev. .(2006)

Course Name	Introduction to Regional Development and Planning				Course Code	ARC 536
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the main theories of regional development and planning, the basics and elements of regional planning processes, theories of sectoral development, theories of defining regions (homogeneous planning regions, administrative regions, economic regions, remote regions), manifestations of unbalanced regional development such as manifestations of population concentration in major cities, and differences The wide range of economic development levels between different regions, in addition to presenting regional development strategies and the importance of linking them to economic development policies at the state level. Studying planning levels, and their role as a link between national planning and local planning. It deals with the components of the region and its various characteristics, the relationships and interactions between them, and their role in the spatial distribution of the investments of the national plan, within the framework of the determinants and possibilities dictated by the local urban planning in a manner that does not contradict the sound planning rules.

References:

- Falade, J.B. (2003). The Urban and Regional Planning Process: The Old Order and the New Paradigm. Paper Presented at the MCDDP at Calabar for NITP.
- Friedmann, J. (1964). Regional Planning as a Field of Study in Regional Development and Planning. A Reader, Cambridge: M.I.T. Press, page 64.
- Jelili, M.O. (2014). Situating Planning within Planning: An Attempt to define and delimit the scope of urban planning. A Newsletter of the Department of Urban and Regional Planning, LAUTECH.

Course Name	Finishing Materials and Installation Technologies				Course Code	ARC 541
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course of finishing materials and installation techniques aims to enable students to understand and know the different building materials (traditional - modern), Moreover, knowing the different types of finishing materials and reviewing them in terms of efficiency and installation, and knowing the nature of the composition of these materials and identifying the most important additions that are made to them, and discussing the difference between natural materials and manufactured materials in terms of the composition of each material, and identifying the most important advantages and disadvantages of these materials, in order to know the proper ways to employ them in order to adapt them to the built environment objectively. Then review the different ways and methods used for the installation and fixation process for each material separately, whether by the manual method or the mechanical method, and identify the most important advantages and disadvantages of each method of fixation, to determine the most appropriate methods for fixing these materials.

References:



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- محمود حجازي، ياسمين صبرى، et al. تطبيقات تكنولوجيا المواد في التدعيم بالألياف الكربونية بمشروعات الحفاظ على التراث المعماري دراسة حالة-مدرسة العيني الأثرية بالقاهرة. 331-342 (2016): 11.38 Journal of Al-Azhar University Engineering Sector.
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- F. Smith "Foundation of Materials Science and Engineering" 2nd ed., McGraw Hill (1993).
- D. Askeland "The Science and Engineering of Materials" PWS Engineering (1985).
- T. H. Courtney "Mechanical behavior of materials" McGraw Hill (1989).

Course Name	Conservation of the urban fabric of the heritage areas				Course Code	ARC 542
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The Course of Conservation of the Urban Tissue of Heritage districts aims to enable students to understand and know the concepts related to heritage and conversation, in order to distinguish between what is old (heritage) and what is modern (non-heritage), then knowing the most important characteristic of those areas. The course also aims to study the laws regulating construction in heritage areas, and to review the foundations and methods used in the process of preserving the urban tissue of those heritage areas, which depend mainly on a methodology that is compatible with the place in terms of urban and architectural formation, for the sake of determine the best methods used to preserve and harmonize with the impact. The purpose of the course also is to understand and know the complementary relationship that must occur between modern buildings and heritage buildings and their relationship to the existing urban tissue.

References:

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Course Name	Building maintenance and restoration techniques				Course Code	ARC 543
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The Course of Building Maintenance and Restoration Techniques course aims to enable students to understand and know the concepts related to maintenance and restoration, to know the difference between maintenance and restoration, to know the different stages of those operations, who is responsible for them, how buildings are maintained and restored, and to know their most important objectives. And then identifying the most important types of maintenance in buildings (preventive maintenance - emergency maintenance - periodic maintenance) and how to prepare a periodic plan and schedule maintenance operations in buildings, then knowing the most important buildings that must be restored and knowing the different restoration methods and ways used for that by knowing the restoration of (stones, green bricks, red bricks, gypsum mortar, timber, floors, ...), then knowing the requirements of restoration by using modern materials suitable for each case of restoration.

References:

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Course Name	Policies regulating the heritage areas				Course Code	ARC 544
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		
Scientific Content: The Course of Policies for Dealing with Buildings and Places of Value aims to enable students to understand and know the most important policies related to how to deal with buildings of value, especially historical and heritage areas, and to know the most important stakeholders that set up the policies that establish a clear approach to dealing with such buildings, such as the National Organization for Urban Harmony, knowing how to manage preservation operations by understanding how to establish an integrated administrative system for the preservation process, which helps to face existing and potential problems in the future. Also knowing, identifying and understanding the most important methods of maintenance used for buildings of heritage and historical value, then understanding the critical study that helps to know the shortcomings in legislation and policies related to the preservation of heritage buildings of value and guidance for their development in order to be in line with the policies for preserving this type of buildings, then knowing the most important methods of preservation used in historical cities around the world.						
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Course Name	Architectural Criticism				Course Code	ARC 611
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		



Scientific Content:

The course aims to develop the student's critical abilities by exposing him to models of architectural practice at the global, regional and local levels, while linking them to intellectual and theoretical transformations. This is done by discussing the philosophical, cultural, and political factors that influenced contemporary architectural thought locally and globally. The course is concerned with critically addressing issues of thought and theorizing in architecture. It deals with issues related to tools, methodologies, and standards for criticism of thought and theories in architecture, the impact of global and local visions on architecture, and measuring the impact of architectural theories and thought on architecture. local, regional level 'studying architectural schools and artistic movements that are related to architecture and criticizing those schools in an objective manner, which gives the student a sense of evaluating architectural works with objective and integrated visions. It also provides the student with a clear frame of reference that qualifies him to embark on his advanced specialized studies.

References:

- رضوانى عبدالواحد ، النقد المعماري ، بناء وتشبيد ، مطابع الكوفة الرسمية ٢٠١٨
- الزرقاني جابر ، ايجابيات اكثر من سلبيات ، فى دروس النقد ، دار سارموزى للنشر ٢٠٠٠
- Goldblatt, D. and R. Padden 2011, "Introduction" to "The Aesthetics of Architecture: Philosophical Investigations into the Nature of Building," special issue of The Journal of Aesthetics and Art Criticism,
- Andreea Cutieru. "Architecture Criticism: Cultivating An Understanding on the Practice" 2022 , Hachette
- Matheio, Ethics and the Built Environment, London and New York: Routledge. Fox, W., (ed.), 2000
- Gans, K., , People and Plans: Urban criticism , New York: Basic Books 1968

Course Name	Architectural Design Philosophy				Course Code	ARC 612
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course aims to know the basic concepts of architectural design, theories and modern visions in the relationship of architectural design and the social environment, as well as the relationship of architectural design and culture. And a study of architectural applications that are more difficult or innovative in different fields to raise students' experience in the field of defining architectural thought and architectural visions that they see in order to solve the architectural problem in a deeper way after identifying the variables from the inputs in the modern philosophy of the study of the main theoretical cognitive design processes. The course deals with important questions such as the nature of science, how to form and reshape scientific theory on philosophical bases, and the extent to which architectural thought is affected by the philosophy of science. The student studies some of the pivotal philosophers of the modern era, such as Descartes, Popper, Catos, Thomas Kuhn, and Paul Feyerabend. The course links the natural, rational and human sciences and the various fields of architectural scientific studies.

References:

- جواد ابراهيم- قضية في فلسفة العمارة- الجامعة التكنولوجية - قسم الهندسة المعمارية ٢٠٢١.
- Breitschmid, M. (2010). Architecture & Philosophy: Thoughts on Building.
- Harries K., & K., H. (1987). Philosophy and the Task of Architecture. Journal of Architectural Education, 40(2).
- Ingels, B. (2009). Yes, is More: An Archicomic on Architectural Evolution. Copenhagen: BIG.
- Jencks, C., & Kropf, K. (2006). Theories and Manifestoes of Contemporary Architecture. West Sussex: John Wiley & Sons.
- Johnson, P.-A. (1994). The Theory of Architecture: Concepts, Themes & Practices. New York: Van Nostrand Reinhold Company.
- Lang, J. T. (1987). Creating Architectural Theory: The Role of the Behavioral Sciences in Environmental Design. New York: Van Nostrand Reinhold Company.
- Lawson, B. (2005). How Designers Think: The Design Process Demystified (4th ed.). Oxford: Elsevier.
- Mahmoodi, A. S. M. (2001). The Design Process in Architecture: A Pedagogic Approach Using Interactive Thinking. The University of Leeds.
- Zumthor, P. (2010). Thinking Architecture. Basel: Birkhäuser.

Course Name	Humanities in Architecture				Course Code	ARC 613
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		



Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

An introduction to the study of the relationship between the built environment (existing or new) and patterns of social behavior (whether natural or deviant) and the impact of that study on decision-making in planning new residential environments and urban upgrading projects in existing residential environments alike. Introducing students to some advanced issues in the areas of Academic human research related to housing planning, with a focus on “environmental criminology” as a branch of criminology that deals with the relationship between the built environment (particularly the environment of residential communities) and criminal behavior, targeting, and deviant tendencies ‘With addressing basic theories in this field such as Newman's protective vacuum theory, CPTED, Crime Situation a Preventionl, Brantingham's theory in environmental criminology, "crime exclusion by design", and the so-called early intervention.

References:

- C. Jencks, et al., Meaning in Architecture, London: Barrie and Rockliffe, 1969.
- Ballantyne, A., “Architecture, Life, and Habitat,” The Journal of Aesthetics and Art Criticism. 2011
- Budd, M., Values of Art: Pictures, Poetry and Music, London and New York: Penguin, 1995.

Course Name	Desert and Rural Architecture				Course Code	ARC 614
Teaching Hours	Lecture	Exercises	Practical		Hours	3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course offers seminars that focus on specific special topics of importance in rural and desert design and study the features of the desert and rural environment with a study of the development of rural or desert housing types in developed and developing countries and the policies of countries in the provision and development of models and the disadvantages of other systems. As well as studying the role of architecture in promoting belonging and identity. Students should choose one of the research points that are appropriate to the title of the course, and pay attention to the three main axes of sustainability in rural and desert design: environment, social and economics ‘. And knowing the background of construction costs because it is a major determinant in that system, in order to finally provide the basic and main ingredients for desert and rural cities to be suitable for the sustainability system and provide the necessary uses for users.

References:

- رزق نمر حماد- انماط البناء المناسب للبيئة الصحراوية (الفناء الداخلي كمنظم للاضاءة النهارية) – جامعة عجمان للعلوم والتكنولوجيا
- حسام فتحي احمد – التشكيل العمراني في المجتمعات التقليدية بالواحات في ضوء تغير انساقها الاجتماعية الثقافية – جامعة القاهرة ٢٠٠٢

Course Name	Sustainability and Architecture				Course Code	ARC 615
Teaching Hours	Lecture	Exercises	Practical		Hours	3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course aims to study the relationship of the local community, sustainability, and the impact of local values of the physical, natural, and manufactured environment, ways to activate local architecture and urbanism, study prevailing beliefs and concepts, empowerment, participation, and the right to choose. And social and its reflection in the field of sustainability and architectural characteristics and knowledge of the structures and systems of sustainability and ways of environmental assessment of sustainability in architecture and the development of local activities ,With aspects of energy consumption in buildings, building energy requirements and factors influencing them, means of energy conservation in the initial design stage, means of energy conservation in the construction stage, energy conservation methods in the operation and maintenance stage, control systems inside the building, techniques for outer envelope treatments and openings From the perspective of energy conservation, new and renewable energy technologies in buildings, design considerations, applications for types of



uses.

References:

- الامم المتحدة, (٢٠٠١), تطبيق مؤشرات التنمية المستدامة في بلدان الاسكوا, اللجنة الاقتصادية لغرب اسيا, نيويورك
- الباشا, منى صالح, (٢٠٠٠). التنمية الصناعية في مصر ودورها في تخ يه التوازن البيئي مدخل لتحقيق التنمية الحضرية المستدامة, المؤتمر العربي الاقليمي للتعاون البيئي والتنمية الحضرية المستدامة, القاهرة.
- غادة, موسى روقي, (٢٠١٤), التنمية العمرانية المستدامة في مركز الكرخ التاريخي, جامعة بغداد, كلية الهندسة العدد ١١ المجلد ٢٠.

Course Name	Concepts Governing Theories and Practice in Architecture				Course Code	ARC 616
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course aims to introduce the student to the governing concepts as a frame of reference for thought and practice in a certain period of time, as well as the mechanisms of transformation and change in thought and practice along with defining the relationship of the basic concepts governing the architectural thought and works and its correlation with the intellectual and cultural variables of the period under study in general terms. Through this framework, the vision of global transformation is studied in chronological sequence from traditionalism to modernity and beyond, leading to contemporary theoretical and intellectual trends within the framework of the transition to globalization, digitization, and the age of information technology.

References:

- Eco, U., , "Function and Sign: Semiotics of Architecture," reprinted in Rethinking Architecture: A Reader in Cultural Theory, N. Leach (ed.), New York: Routledge, 1977
- Lawson, B, "How Desingers Think" Architectural Press; 4th edition, 2005
- Nikos, A, S, "A Theory of Architecture" Mijnbestseller.nl; 1st edition, 2021

Course Name	Applied Studies in Architecture				Course Code	ARC 617
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course aims to introduce the student to scientific methods for analyzing multi-faceted architectural projects with interrelated architectural, urban, and societal dimensions in order to benefit from these approaches in analyzing projects and samples that serve the doctoral dissertation. This is done by reviewing and analyzing case studies of architectural projects from the contemporary local, regional or global reality that have the characteristic of distinction and uniqueness in the ambit of different types of buildings. Further, the course focuses on studying the design determinants related to basic needs, site selection criteria, pre-design studies, reaching selection criteria between different design alternatives, evaluating them, and proposing solutions that meet the appropriate environmental, cultural, visual, and economic requirements.

References:

- Foucault, M. 1982, "Space, Knowledge and Power," in The Foucault Reader, P. Rabinow (ed.), New York: Pantheon, 1984,
- Kushner, M "The Future of Architecture in 100 Buildings" Simon & Schuster/ TED; Later part. Edition 2015
- Architizer, "The World's Best Architecture Practices" Phaidon Press, 2021



Course Name	Global Architecture Trends and Future Visions				Course Code	ARC 618
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course aims to study architecture, globalization, contemporary architectural styles, and smart design in architecture. In addition, it sights to provide the student with the necessary knowledge and theoretical foundations for intellectual transformations in architecture by focusing on Western architecture. The course reviews postmodern style, deconstructive architecture, and new modernity, as well as studies the concepts related to digital and smart architecture as a modern and future trend in architectural thought, as a future trend in architectural notions. Thus, it presents a set of intellectual trends and architectural concepts in a systematic manner that helps the student to strengthen his knowledge background, upgrade his research skills, and his ability to historical interpretation and critical analysis.

References:

- Kottas, D, "Digital Architecture: A Radical Future" UNKNO; Slp Pap/Ps edition, 2013,
- Cody, R & Amoia, A "Alvar Aalto and the Future of Architecture" Routledge; 1st edition , 2022
- Wallance, D, " The Future of Modular Architecture" Routledge; 1st edition, 2021
- Peters, B & Peters, T " Computing the Environment: Digital Design Tools for Simulation and Visualization of Sustainable Architecture" Wiley; 1st edition, 2018

Course Name	Built Environment and Energy Conservation				Course Code	ARC 619
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course aims to study the concept and importance of environmental control and its impact on the built environment, the principles of green and sustainable architecture and their role in energy conservation, environmental design strategies in different climatic regions, the concept and foundations of passive design, methods of providing thermal comfort using the least amount of energy, maximizing the utilization of renewable and clean energy in architecture, and the development of integrating the negative and positive low-consumption style into architectural design to achieve maximum efficiency in energy conservation and consumption. This is done through reviewing the theoretical concepts related to the subject by the student, along with studying and analyzing successful case studies in saving energy and preserving the environment for distinguished architectural projects.

References:

- Heywood, H, "101 Rules of Thumb for Low Energy Architecture" RIBA Publishing; 1st edition, 2019.
- Thorpe, D. " Passive Solar Architecture Pocket Reference" Routledge; 1st edition, 2017.
- Fathy, H. "Natural Energy and Vernacular Architecture: Principles and Examples with Reference to Hot Arid Climates" University of Chicago Press; 1St Edition, 1986.

Course Name	Scientific Seminars for Selected Researches in Urban Design				Course Code	ARC 621
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	-	60	-	40		

Scientific Content:

The course deals with presenting and defining limited research and studies that deal with topics, issues and problems,



concepts and applications: urban design, presenting, discussing, evaluating and developing these researches, through panel discussions and workshops, in a way that enables the development of research capabilities, architectural and urban criticism skills among students, and participates in Discussing and evaluating research and studies, some academics, designers and practitioners, in a manner that can link theories with applications, and crystallizing the foundations and criteria for critiquing urban design.

References:

- يان جيل، (٢٠١٧)، مدن للناس، ترجمة بلدية مسقط، دار الغشام للطباعة والنشر، مسقط، سلطنة عمان.
- ريتشارد مارشال، (٢٠١٠)، نشأة وتطور التصميم العمراني، مجلة التصميم – جامعة هارفارد، ترجمة: صالح بن علي الهذلول، الجمعية السعودية لعلوم العمران، الطبعة الأولى.
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- J. Jacobs, (1961). The Death and Life of Great American Cities. New York: Vintage.
- Jacobs, J. (1970). The Uses of City Neighborhoods, In R. Gutman, & D. Popenoe, Neighborhood, city, and metropolis: an integrated reader in urban sociology, New York, Random House.
- Gehl, Jan, (2010), Cities for People, Island Press; None edition.

Course Name	Urban Management				Course Code	ARC 622
Teaching Hours	Lecture	Exercises	Practical		Hours	3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	60	-	-		

Scientific Content:

The urban management course deals with the principles of urban settlement management, urban local authority, and the role of governmental and non-governmental organizations in urban management at all levels. This is in addition to work systems, administrative follow-up, maintenance management programs, development concepts and sustainable development for daily operation and maintenance work, as well as control of various traffic systems and mass transit systems within urban settlements. The study of the features and problems of urban management systems, the relationship between the environment and the city, and the spatial distribution of urban activities. Improving the distribution of public and private services. The urban management course also discusses distinguished local and global urban experiences that are related to the topic of the lectures in the course.

References:

- حسين عبد الحميد أحمد رشوان، (٢٠٠٢)، مشكلات المدينة، المكتب العربي الحديث، الإسكندرية.
- Golany, G., (1976) New Town Planning Principles and Practice. London : John Wiley and sons.
- Golany, G., (1978) International Urban Growth & polices – New towns contribution, London : Wiley inter science publication.

Course Name	Introduction to Landscape				Course Code	ARC 623
Teaching Hours	Lecture	Exercises	Practical		Hours	3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The "landscape "course deals with the meaning, concept, importance and components of landscape. In addition to processing existing sites or virgin sites that have not been previously coordinated. The course also presents the relationship between the natural environment and the landscaping of the site through plants used in covering, geomorphology of the land, climate, geotechnical features, and environmental features. The course discusses historical and contemporary examples showing the location and ground levels in the historical and horticultural Egyptian fabric. The course also consists of a set of lectures and discussions for a group of current issues in the field of landscaping, including the philosophy of the thought of landscaping, a group of research, the economic and social view of landscaping, and the related fields of project integration.



References:

- د. محمد حماد، م. ي. محمد فتحى سالم، "التشجير المعماري، في زراعة انواع نباتات الزينة لتنسيق الحدائق، ١٩٧١.
- د. مصطفى بدر، "تنسيق وتجميل المدن والقرى، منشأة المعارف، الاسكندرية، ١٩٩٢.
- Simonds, John Ormsbee, "Landscape Architecture," MC Graw-Hill Book Company, 2010.
- W.Reid, Grant, "Landscape Graphics," Watson-Guptill; First, 2002.

Course Name	Sustainable Urban Design				Course Code	ARC 624
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the meaning and role of urban sustainability within the framework of regulating the relationship between man and the built environment that man makes in the structural formation. The course discusses the various dimensions of sustainable development in urbanization, such as the social-cultural dimensions and economic sustainability. The course presents the study of sustainability methods and rules in the field of urban design for the various organizations and bodies of sustainability from the urban point of view and their strategies through urban design applications so that we can preserve resources for future generations.

References:

- Anne R. Beer and Catherine Higgins, 2000 (Environmental Planning for Site Development – A Manual for Sustainable Local Planning and Design). Second Edition E&FN Spon: New York, USA
- City of San Diego General Plan, 2008 (Urban Design Elements). UD Vermont Street Bridge by Stone Paper Scissors.
- C. Girling, R. Kellett. (2005), Skinny Streets and Green Neighborhoods: Design for Environment and Community, Washington, DC: Island Press. Paperback.
- D. Farr, (2008), "Sustainable Urbanism: Urban Design with Nature", John Wiley & Sons, Inc., New Jersey.
- Abu Dhabi Urban Planning Council, (2011), "Abu Dhabi Urban Street Design Manual, Vision 2030", Abu Dhabi Urban Planning Council, Abu
- Dhabi, United Arab Emirates. Stephen M. Wheeler and Timothy Beatley, (2009), Sustainable Urban Development Reader (Routledge Urban Reader Series) 3rd Edition.
- S. M. Wheeler, T. Beatley, (2009), "The Sustainable Urban Development Reader", second edition, Routledge, London and New York.

Course Name	Theories of Urban Design				Course Code	RC 625
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The urban design theories course deals with the most important theories that explained urban design, the important determinants, the meaning and role of each urban design, visual perception, and the function of the space. History and evolution of urban design. The course studies the applications of urban design in our daily lives, urban form, human activities, security, and safety. In addition to preserving historical places and the principles of their rehabilitation and reuse. The course also deals with the basic theoretical frameworks of urban design and its development, and the various analytical trends and approaches to analyze the built environment, with a focus on the concept of sustainable urban design and its cultural, social, economic, and environmental characteristics. By presenting local and international research models and applications on various scales and interventions.

References:

- Carmona, M. (2013). The place-shaping continuum: A theory of urban design process. Journal of Urban Design, 19(1), 2–36.
- Carmona, M. (2021). Public places urban spaces the dimensions of urban design. Routledge.
- Corbusier, L. (1929). The City of Tomorrow and its planning: Trans. from the 8th French edition of "urbanisme". Rodker.



- Eisenman, P., & Somol, R. E. (2001). Peter Eisenman: Diagram, diaries. Thames & Hudson.
- Gehl, J. (2011). Life between buildings: Using public space. Island Press.
- Grosz, E. A., & Eisenman, P. (2006). Architecture from the outside: Essays on virtual and real space. The MIT Press.

Course Name	Culture and Urbanism				Course Code	ARC 626
Teaching Hours	Lecture	Exercises	Practical	Hours	3	
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the interrelationships between man and the built environment and the economic, cultural and economic influences on urban design in addition to the concepts of culture and the approaches to addressing them and the interrelationships that link the urban environment with human behavior through a cultural perspective in the fields of human and social sciences, by presenting a set of comparative studies between different cultures and their reflections on different cultures. built environment.

References:

- يان جبل، (٢٠١٧)، مدن للناس، ترجمة بلدية مسقط، دار الغشام للطباعة والنشر، مسقط، سلطنة عمان.
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Course Name	Housing Development				Course Code	ARC 627
Teaching Hours	Lecture	Exercises	Practical	Hours	3	
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the retrieval and crystallization of knowledge backgrounds, directions and outputs of courses closely related to housing and the development of residential areas. It also focuses on the foundations and entrances to the development of urbanization of residential areas, existing and new, and the associated societal, economic, political and urban dimensions. The course relies on presenting and evaluating models of Local and international experiences, in addition to presenting a group of limited research related to the topics of the course to the participating students, and presenting, discussing and developing them in panel discussions, with the participation of some academics and practitioners, who are closely related to the field.

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Course Name	Visual Studies				Course Code	ARC 628
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The visual studies course deals with the meaning and fields of visual studies of urbanization, in addition to its importance in the perception and development of the city. The course also discusses the physical composition of the components of the built environment, their visual signs, symbols, and elements present in the urban fabric, and their immaterial meanings. The course studies how to document, analyze and evaluate the built environment of the city This is done through a group of theoretical lectures to get acquainted with the basics of the visual image and the methods and means of analysis, as well as helping students to link the elements of planning in the city with formation and visual perception, whether at the level of existing cities or preparing for new city plans, through an applied part to monitor one of the elements of the visual image in the city and develop a proposed approach for analysis and the means of dealing.

References:

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Course Name	GIS and Urban Data Management				Course Code	ARC 629
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	2	-		2		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	20	-		

Scientific Content:

The geographic information systems and urban data management course deals with the study of geographic information systems models and programs, the analysis of land morphology, and the analysis techniques of spatial patterns, colonies, geographical patterns, and spatial development. The course also studies road networks and mutual support of urban distribution. also, the basics and theories of geographic information systems and their applications in urban planning, and their use in analysis, evaluation, and decision-making processes. The study includes a definition of the importance of geographic information systems in general and a specialist in urban design. studying the components of geographic information systems, the basic functions and basic concepts of data management, the characteristics of data and information, their types, and the stages of dealing with them in terms of input, output, and display operations.

References:

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- 31. Ibrahim Mohamed Badwi -GIS AS ADECISION TOOL FOR URBAN AND REGIONAL PLANNING(the case of the second ring-road)-M.SC 2002



Course Name	Advanced Research Seminars in Urban Planning				Course Code	ARC 631
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	-	60	-	40		

Scientific Content:

The course deals with an introduction to the science of regional and urban planning, the definition of planning and its gradual levels of national planning, regional planning, urban planning, and urban design, and the essential differences between these levels, with a study of how to evaluate urban and rural life. And training students to find engineering solutions to urban problems such as housing inflation, slums, and traffic crises, with how to organize movement between residents and services. And studying multiple theories of regional and urban planning, aiming at organizing urban life, as well as developing students' knowledge and experience in the field of urban planning, to be able to improve the quality of the built environment (urban and rural), to help meet the different needs of society in a place and time.

References:

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Course Name	Development of Informal Areas				Course Code	ARC 632
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the phenomenon of informal housing areas in Egypt, by studying the history of this phenomenon and explaining the reasons and motives for its growth and expansion in Egyptian cities and villages. And studying the characteristics of the population and their social and economic levels, their priorities and needs in terms of shelter, economy, infrastructure, services and facilities, in order to take that into consideration when dealing with those areas and how to choose the suitable development approaches for such areas and the appropriate levels of intervention such as removal, replacement, improvement, rehabilitation and comprehensive upgrading, in addition to the steps and requirements for their application, the advantages and disadvantages of them, the factors influencing the decisions related to them, as well as how to encourage community participation and its role in developing and formulating appropriate policies to deal with those areas.

References:

- ليلي علاء الدين. ٢٠١٧. "آليات وحلول تصميمية لتطوير مسكن المناطق العشوائية".
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- أشرف أبو العيون، "دور سياسة التنمية الحضرية نحو تلبية متطلبات اسكان الفقراء في مصر"، المؤتمر المعماري الدولي السابع "اسكان الفقراء : مشكلات و حلول"، جامعة أسيوط، ٢٠٠٧
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- أ. ز. راجح، العمران المصري: رصد التطورات في عمران أرض مصر في أواخر القرن العشرين واستطلاع مساراتها المستقبلية حتى عام ٢٠٢٠، القاهرة: المكتبة



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- Ninik Suhartini, Paul Jones. (2019). Urban Governance and Informal Settlements. Springer International Publishing
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Course Name	Environmental Considerations for Urbanization				Course Code	ARC 633
Teaching Hours	Lecture	Exercises	Practical		Hours	3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the most important urban service theories related to the green environment and how to preserve the environment. The student studies the city’s problems related to environmental pollution processes. The course also aims to teach the student various urban analysis mechanisms for the environment, and the basic concepts of the environmental urbanization system (balance environmental, green architecture, environmental sustainability, balanced urban development...), a mechanism for identifying important indicators of the existing urbanization through urban and social surveys, Identifying the general methodology of urban ecology studies as a multidimensional analysis of the system of human, land and resource interactions within the framework of case studies, and its historical development and analysis of scientific theories associated with the studies of urban ecology.

References:

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Course Name	The Urban Landscaping				Course Code	ARC 634
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		
Scientific Content: The course deals with the meaning, importance, and basic components of landscaping, treatment of existing sites or pristine sites, methods of dealing with topography, the relationship between the natural environment and landscapes, plants, land geomorphology, climate, geotechnical features and environmental features, discussion of historical and contemporary examples, location and levels of sites in context. Historical and gardening, studying the determinants and requirements of coordination. The importance of this course lies in presenting a set of sciences and knowledge that form the perception necessary to achieve the required interaction between man and the environment. The site coordination also aims to get out of the state of monotony in architecture and add excitement to the urban environment and meet the human desire to get close to the natural ingredients of the environment.						
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- Lohmann, K.B. 1963, Fundamentals of Landscape Architecture. Second edition. International Correspondence Schools, Scranton, Pennsylvania, USA

Course Name	Urban Planning and Sustainability				Course Code	ARC 635
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the meaning and role of urban sustainability, optimal utilization of available capabilities and natural resources, the relationship between man and the built environment, the natural and artificial elements of the built form, discussion of the various dimensions of sustainability in urbanization (social, cultural and economic sustainability), the urban development process, sustainability, and urban environmental institutions, and the framework of legislation and policies. The effect of population size, density, and demand on natural and man-made resources, and how to apply theories of sustainability and resilience in the design, management, and operation of urban communities. Specifically, it aims to make cities based on environmentally friendly principles while cities are flexible in design so that resources are saved from depletion through appropriate distribution and appropriate use to replace the global consumption of environmental resources that is in a state of turbulence and poor regulation.

References:

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- Farr, Douglas . (2007) Sustainable Urbanism: Urban Design with Nature. Thousand Oaks: Wiley.

Course Name	Urban Geoinformatics				Course Code	ARC 636
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	2	-		3		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	20	-		

Scientific Content:

The course aims to enhance skills in applying remote sensing and geographic information systems to environmental planning projects. In this course, Students learn how to select RS images for specific applications and analysis at urban and regional levels, and how to apply the global positioning system in planning. The student also gets acquainted with the hardware and software components and the important applications of these systems to support



decision-making in the planning process.

The course contains an applied research entrance and a practical entrance. Where the applied approach deals with clarifying the importance of geographic information systems and spatial analysis in the regional and environmental dimensions. As for the practical approach, work is done on one of the GIS programs and training on the program by getting acquainted with the commands, inputs, outputs, and how to display the results from within the program.

References:

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Course Name	Urban development Research				Course Code	ARC 637
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	-	60	-	40		

Scientific Content:

The course aims to train the student in scientific research through discussions related to urban design and planning, the concept of urban studies aimed at evaluating urban and rural life and finding engineering solutions to urban problems such as population inflation, slums, traffic crises, and regulating movement between residents and services. Development is a process of comprehensive or partial continuous changes that takes various forms, aiming to advance the human condition to well-being, stability, and development in accordance with its needs and its economic, social, and intellectual capabilities, and sustainable development that meets human needs at the present time without compromising the ability of future generations to achieve their goals, and focuses on sustainable integrated economic growth, environmental stewardship and social responsibility. Students prepare research on topics of their choice dealing with the application of global urban planning and design ideas to Egypt. Students are also exposed to research and analysis skills on issues related to urbanization and how to prepare a research project.

References:

- Sustainable Design of Research Laboratories: Planning, Design, and Operation. Wiley, 2010.
- Rouse, David C., and Rocky Piro. The Comprehensive Plan: Sustainable, Resilient, and Equitable Communities for the 21st Century. Routledge Taylor & Francis Group, 2022.
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- Calthorpe, Peter, and William B. Fulton. The Regional City: Planning for the End of Sprawl. Island Press, 2001.

Course Name	Planning of Urban Infrastructures				Course Code	ARC 638
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with an introduction to infrastructure planning, preliminary studies of road networks, water supply, energy and communications, sewage and solid waste disposal, and firefighting systems. It studies the interactions between the different utility sectors. It also presents practical methods for planning and designing various infrastructure networks to serve the multiple levels of planning. (Strategic - Detailed), the mechanism for implementing utilities, road networks, and priorities for each sector. As well as methods of evaluating these strategies in a complex urban environment due to population density,



in addition to studying the impact of social, economic, and cultural dimensions and their reflection on the urban infrastructure planning process, quantitative and qualitative planning mechanisms to achieve the concept of sustainability in infrastructure, and the economic dimensions of urban infrastructure planning.

References:

- Wellman, K. and Pretorius, F. (2012). Urban Infrastructure: Productivity, Project Evaluation, and Finance. In Urban Infrastructure (eds K. Wellman and M. Spiller).
- Neilson, L.R. (2012). Urban Management Principles and Instruments. In Urban Infrastructure (eds K. Wellman and M. Spiller).
- Spiller, Marcus & Thakur, Praveen & Wellman, Kath. (2012). Urban Infrastructure: Finance and Management. 10.1002/9781118401637.ch9.

Course Name	Facilities Planning				Course Code	ARC 639
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with an introduction to the planning of facilities and the methods used, and the study of mechanisms for coordinating works between buildings, individuals, infrastructure, energy, water, and drainage services in order to achieve harmony between overlapping services, and extend the life span of the assets and services concerned, including determining the number, size, and location of facilities, and considering planning for facilities as extremely Importance in case of emergency, and case studies of facilities in different contexts.

A study of the impact of social, economic, and cultural dimensions and their reflection on the facility planning process and quantitative and qualitative planning mechanisms to achieve the concept of sustainability in facility planning. In addition to studying some important concepts such as strategic and financial planning, engineering design, automation and maintenance, operations, and activities necessary to effectively manage facilities: such as operational, environmental, contractual, and technical activities to reach the best appropriate decisions for their facilities.

References:

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- Elmer, V., & Leigland, A. (2013). Infrastructure Planning and Finance: A Smart and Sustainable Guide (1st ed.). Routledge.
- Humphries, Michael. National Infrastructure Planning Handbook 2022. Bloomsbury Professional, 2022.

Course Name	Traditional crafts materials and techniques				Course Code	ARC 641
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course of Materials and Techniques of Traditional Crafts aims to enable students to understand and know what traditional crafts are and their importance, and to know the most important types of these traditional crafts, and the most important materials used in those crafts. This is done through a historical knowledge of the origin of traditional crafts, then an orientation towards automated manufacturing, then a review and understanding of how to deal with traditional and manual crafts. Also know the economic importance behind the interest in these traditional, handicrafts and industries, which in turn helps to benefit from the various local materials that are different in each region, which give a distinctive character and spatial specificity, which requires understanding and knowledge of the properties of materials so that they can benefit to the maximum extent possible from them. Then the student will be able to know the most important antique crafts products, which are considered as a tool for preserving heritage and promoting tourism.



References:

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- محمود حجازي, ياسمين صبرى. et al. تطبيقات تكنولوجيا المواد في التدعيم بالألياف الكربونية بمشروعات الحفاظ على التراث المعماري دراسة حالة-مدرسة العيني الأثرية بالقاهرة. Journal of Al-Azhar University Engineering Sector 11.38 (2016): 331-342.
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Course Name	Fine Restoration Techniques				Course Code	ARC 642
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course of Techniques of Fine Restoration course aims to enable students to understand and know the different types and techniques related to restoration in general and finerestoration in particular, then understand and identify the most important different restoration processes such as restoration of gypsum and stone decorations, preservation and restoration of colors, restoration of textiles, restoration of biological elements, restoration Wooden elements, restoration of metal decorations and various materials, and knowing the most important steps of careful restoration: (cleaning stage - removal and extraction of salts - strengthening and stabilization stage - restoration stage which includes: (collecting - completion). One of these phases may precede the other, and this applies to each of the immovable antiquities such as (cemeteries - temples - churches - monasteries - mosques - schools - palaces (built of stone, mud bricks or burnt bricks). This also applies to movable antiquities, such as antiquities in museums and palaces holdings of stone antiquities such as (small statues (tangra), pots and coffins) and glass antiquities such as (inlays and utensils) and this is in addition to the wall paintings displayed in museums.

References:

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- Rodwell, Dennis. "Sustainability and the holistic approach to the conservation of historic cities." Journal of architectural conservation 9.1 (2003): 58-73.

Course Name	Documentation of historical buildings				Course Code	ARC 643
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course of Documentation of Heritage Buildings aims to enable students to understand and know the documentation process and its importance, and how documentation is considered one of the most important methods that help in the preservation of heritage and historical buildings, which helps to identify and inventory the cultural wealth of the heritage buildings and to conduct a preliminary study to determine the identity of the monument, its location, its surroundings and its current condition, which helps greatly to preserve it and do the necessary maintenance for it if necessary. The course also helps to know the most important methods used for the documentation process, such as photogrammetric, Three-dimensional documentation using laser beams, building virtual environments, uses of the virtual environment, identifying the most important buildings that must be documented, and the most important steps involved in the process of architectural documentation of buildings as well as decorative documentation.

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- الهيبي، ياسر. ٢٠١٦. دور المنظمات الدولية والاقليمية في حماية التراث الثقافي وإدارته وتعزيزه. مجلة أدوماتو. العدد ٣٤. مركز عبد الرحمن السديري الثقافي.
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- المحاري، سلمان. ٢٠١٧. حفظ المباني التاريخية- ميان من مدين المحرق. ايكروم. الشارقة. الامارات العربية المتحدة.
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- Feilden, Bernard. Conservation of historic buildings. Routledge, 2007.
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- Larsen, Knut Einar, and Nils Marstein. Conservation of historic timber structures. An ecological approach. Riksantikvaren, 2016.

Course Name	Preparing Maintenance and Restoration Projects				Course Code	ARC 644
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:



The course of Maintenance and Restoration Projects aims to enable students to understand and know the importance of maintenance and restoration projects in general and their importance in particular for heritage buildings, and then how to prepare these projects for all types of modern and heritage buildings and how to prepare a project for both, and the steps used to prepare these projects, which include determining the identity of the building, its type and its history, then recording and documenting the state of the building and analyzing its structural condition, determining the most important methods of dealing with it, and the levels and alternatives of various solutions for the necessary maintenance operations. All of that helps to preserve those heritage and historical buildings.

References:

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- Roaf, Susan. "A History of Architectural Conservation." (1999): 58-61.
- Stubbs, John H., and Emily G. Makaš. Architectural conservation in Europe and the Americas. John Wiley & Sons, 2011.
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Course Name	Specification of maintenance and restoration work items for heritage buildings				Course Code	ARC 645
Teaching Hours	Lecture	Exercises	Practical		Hours	3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course of Specifications of Maintenance and Restoration Work Items for Heritage Buildings aims to enable students to understand and know the most important items of maintenance and restoration work for heritage buildings in particular and to identify the most important specifications that help describe these items, and to review the most important of these items, for example but not limited to, which is knowledge of the most important practical experiences, analyzes and the necessary tests to know the quality of building materials, their composition, installations and additions to them, whether the building materials or the materials used in the maintenance operations, and to identify the most important items that relate to the standard specifications for all modern additions to those materials used in the restoration operations. The course also aims to arrange and review all the items related to maintenance and restoration listed and used at the local level and the international level as well.

References:

- العربي حجلة. أسس ومبادئ صيانة مجموعة برونزية بمدينة تيفزيرت الأثرية. Diss. جامعة أبو القاسم سعد الله الجزائر ٢٠١٤.
- Glendinning, Miles. The conservation movement: a history of architectural preservation: antiquity to modernity. Routledge, 2013.
- Yudiantini, Ni Made, and David Jones. "The Catuspatha pattern in Balinese palace: architectural conservation and challenges." Procedia Environmental Sciences 28 (2015): 538-548.
- Feilden, Bernard. Conservation of historic buildings. Routledge, 2007.
- Elert, Kerstin, et al. "Lime mortars for the conservation of historic buildings." Studies in Conservation 47.1 (2002): 62-75.

Course Name	seminars in the field of specialization					Course Code	ARC 646
Teaching Hours	Lecture		Exercises		Practical	Hours	3
	3		-		-		
Course Grades	Final Exam	Class Works	Practical grade		Oral Grade	Final Grade	100
	-	60	-		40		
Scientific Content:							

Scientific Content:



The course of Panel Discussions in the Area of Specialization aims to enable students to understand and know the most important areas of specialization, which discuss in general the maintenance and restoration operations - specifications of materials used in restoration operations - identifying the most important items of necessary work for the maintenance and restoration works of heritage and historical buildings - how to prepare maintenance and restoration projects – How to document heritage buildings – Discussing the most important policies for how to deal with heritage buildings – Knowing and discussing the objectives of finemaintenance operations and to which type of maintenance is carried out – Discussing the types of handicrafts and traditional crafts and the most important materials used in that type of crafts – Emphasizing the role of the existence of technical systems Inside buildings - highlighting the important role of governance and management in preserving buildings.

References:

- حشمت عصام. "تقييم أعمال الترميم السابقة بجامعة سامراء ذو الملوية بدولة العراق (٢٣٤هـ-٢٣٧هـ/٨٤٨م-٨٥١م)، وفق الاشتراطات الدولية". مجلة كلية الآثار بقنا-جامعة جنوب الوادي. 12.1 (2017): 122-154.
- Butler, Howard Crosby. [Ancient Architecture in Syria: Djebel Sim'ân]. Brill, 2022.
- Yaghi, Ghazwan. :[Mamluk Palaces and Houses in Cairo: An Archaeological and Civilizational Study]. Brill, 2021.
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- Illampas, Rogiros, Ioannis Ioannou, and Dimos C. Charmpis. "Overview of the pathology, repair and strengthening of adobe structures." International Journal of Architectural Heritage 7.2 (2013): 165-188.
- Fukuyama, Kunio, Yasuo Higashibata, and Yasuyoshi Miyauchi. "Studies on repair and strengthening methods of damaged reinforced concrete columns." Cement and Concrete Composites 22.1 (2000): 81-88.

Course Name	Building maintenance and restoration technology				Course Code	ARC 647
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course of Technology of Building Maintenance and Restoration course aims to enable students to understand and know the role of modern technology in the process of maintenance and restoration, where modern technology produced many manufactured and sustainable building materials and produced tools and materials to treat and improve the properties and efficiency of traditional materials (natural and manufactured), then Discussing and clarifying the most important smart and nano applications that help to be entry points for smart maintenance. Then knowing the role of smart sensors in monitoring and evaluating the extent of deterioration of natural and manufactured stones and wood, and explaining how the maintenance operations have become elaborate, of high quality and efficiency. The role of modern nanomaterials in treating and protecting the surfaces of materials and their internal molecules is also explained without compromising their shape or color.

References:

- Zeynep Aygen. 2013. International Heritage and Historic Building Conservation. Taylor & Francis
- Abdul Lateef Olanrewaju, Abdul-Rashid Abdul-Aziz. 2014. Building Maintenance Processes and Practices. Springer Nature Singapore
- Jeffrey L. Erdly, Thomas A. Schwartz · 2004. Building Facade Maintenance, Repair, and Inspection. Journal of ASTM International: Selected technical papers
- Barrie Chanter, Peter Swallow · 2008. Building Maintenance Management. Wiley
- Alexander Leontyev, Huerta Santiago, Sergey Sementsov . 2021. Reconstruction and Restoration of Architectural Heritage. CRC Press

Course Name	Management of Implementation of Maintenance and Restoration Projects				Course Code	ARC 648
Teaching Hours	Lecture	Exercises	Practical		Hours	3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course of Execution Management of Maintenance and Restoration Projects aims to enable students to understand and



know the importance of management (governance) in implementation of maintenance and restoration projects in historic and heritage buildings. This is done by clarifying the most important requirements related to dealing with archaeological sites, discussing and reviewing the most important timetables, which are mainly related to risk management, discussing and reviewing how variables are controlled during execution, and managing careful restoration work and quality control methods. Discussing the required resources and guidelines for programming, implementation, maintenance and operation, monitoring the efficiency measurement of the building condition after operation, making periodic programs for the evaluation process, identifying the most important emerging problems, and then making a correct operation of the evaluation process for it.

References:

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- أحمد إبراهيم عطيه، حماية وصيانة التراث الأثري، دار الفجر للنشر والتوزيع ٢٠٠٣ ص 138-155.
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- توفيق، سيد، معالم تاريخ وحضارة مصر الفرعونية، مطبعة جامعة القاهرة، 1983م.
- عبد الوهاب، محمد فهمي: دراسات نظرية وعلمية في حقل الفنون الأثرية وطرق ومواد الترميم الحديثة، القاهرة، 1985.

Course Name	Field Studies in the Field of Specialization				Course Code	ARC 649
Teaching Hours	Lecture	Exercises	Practical	Hours	3	
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	-	60	-	40		

Scientific Content:

The course of Field studies in the Area of Specialization aims to enable students to review the practical experiments necessary to know the quality of building materials, types of mortar and methods of construction, the standard specifications for modern additions to restoration operations. The specifications of arranging business items are also clarified in accordance with international standards. The student is also enabled to understand, know, observe and review the most important maintenance operations that are carried out in a practical way, as well as restoration work. This is done through field visits to heritage buildings as well as historical buildings in which this type of maintenance and restoration work takes place. So, the student can directly discuss technicians, professionals and workers in the field, in which the student will be able to supervise such work in the future.

- **References:** محمود الألفي، فلسفة ترميم وإعادة تأهيل المنشآت التاريخية، المؤتمر العربي لترميم وإعادة تأهيل المنشآت، القاهرة، ١٩٩٨.
- عماد علي الدين الشربيني، دراسات في المدخل المتكامل لعمليات الصيانة والحفاظ العمراني / المهام والأدوار مع ذكر خاص لحالة القاهرة الفاطمية / ساحتي الأزهر والحسين، مؤتمر الحفاظ المعماري بين النظرية والتطبيق، دبي، ٢٠٠٤.
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- Zeynep Aygen. 2013. International Heritage and Historic Building Conservation. Taylor & Francis

Course Name	Philosophy Studies in Architectural Design				Course Code	ARC 711
Teaching Hours	Lecture	Exercises	Practical	Hours	3	
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course aims to introduce the student to the general concept of the term philosophy and how to benefit from philosophical thought in formulating research problems, hypotheses, and objectives that qualify the student to write a doctoral research plan, as well as the mechanism of converting a research topic in the field of architectural design into a sound scientific approach through one of the research methods with a general non-specific vision that can be applied in general terms. Moreover, the student is oriented to study problems related to the existing or innovative architectural design, problems related to the urban reality of society, and the theories ruling the thoughts of architectural design via a group of research carried out



by the student in the course under the supervision of the course professor.

References:

- صلاح اسماعيل ، فلسفة اللغة والمنطق ، دار المعارف ١٩٧١
- يمنى طريف الخولي ، فلسفة كارل بوبر منهج العلم.. منطق العلم ، الهيئة المصرية العامة للكتاب ، ٢٠٠٣
- المسعودي، عيد، الكليات في المفاهيم الفلسفية، مؤسسة العرائس ٢٠٢٠
- Ballantyne, A., 2011, "Architecture, Life, and Habitat," The Journal of Aesthetics and Art Criticism
- Barthes, R., 1971, "Semiology and the Urban," reprinted in The City and the Sign: An Introduction to Urban Semiotics, M. Gottdiener and A. Lagopoulos (eds), New York: Columbia University Press, 1986,
- Brain, D., 2005, "From Good Neighborhoods to Sustainable Cities: Social Science and the Social Agenda of the New Urbanism," International Regional Science Review, 28 (2): 217-238.
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Course Name	Advanced Applied Research Seminars in "Specialty"				Course Code	ARC 712
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	-	60	-	40		

Scientific Content:

The course aims to direct the student to choose the research topic that best suits his research capabilities within the framework of the chosen research specialization. His readings and studies are followed up and a list of references and sources on that subject is prepared through seminars, as well as a review of a group of research and scientific theses related to the student's topic and finding out its problems, goals and results, in addition to following up and attending similar seminars for other students in the same specialization, and it is assumed that the student will be able to prepare his initial plan for doctoral research by the end of this course.

References:

- C. George Thomas " Research Methodology and Scientific Writing" Springer; 2nd edition, 2021.
- Popper, K. "The Logic of Scientific Discovery" Springer; 2nd edition. 2014.
- Prathapan, K "Research Methodology for Scientific Research" Dreamtech Press. 2021.

Course Name	Smart Architecture				Course Code	ARC 713
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	2	2		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course aims to introduce the student to the general concept of smartness in architecture, how to benefit from modern technologies in the design and operation of buildings, as well as the principles of interactive media and responsive systems, human-computer interaction, architecture using robots, in addition to the latest media and digital environments such as sensory and natural user media. Emphasis is placed on the use of ideas and principles related to computing in designing smart systems and maximizing the utilization of the role of computers, through the use of interactive and responsive applications between buildings, humans and the environment to achieve maximum benefit.

References:

- Markovics, J, " Smart Architecture" Cherry Lake Publishing, 2023
- Peters, B & Peters, T " Computing the Environment: Digital Design Tools for Simulation and Visualization of Sustainable Architecture" Wiley; 1st edition, 2018.



- Beesley, P. & Hirose, S. "Responsive Architectures : Subtle Technologies" Riverside Architectural Press, 2006
- Bullivant, L. " Responsive Environments: Architecture, Art & Design" Victoria and Albert Museum, 2006

Course Name	Advanced Research in Culture and the Built Environment				Course Code	ARC 714
Teaching Hours	Lecture	Exercises	Practical	Hours	3	
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course aims to introduce the student to the concepts of culture and its entrances, it also deals with its mutual relationship with the urban and architectural environment, through a cultural-historical perspective in the fields of anthropology, sociology, psychology, anthropology, contemporary literature, and fine arts. It reviews the relationship between culture and the built environment through research and studies carried out by the student to make comparisons between different cultures and their reflections on the built environment, as well as methods and techniques for measuring human interaction with the built environment and extrapolating behavior in the architectural space. The student reviews and crystallizes the results of his research and studies in the course through workshops and discussion boards.

References:

- C. Jencks, et al., Meaning in Architecture, London: Barrie and Rockliffe.1969.
- 4 - Ballantyne, A., "Architecture, Life, and Habitat," The Journal of Aesthetics and Art Criticism. 2011
- Budd, M., Values of Art: Pictures, Poetry and Music, London and New York: Penguin.1995.

Course Name	Selected Topics on Energy and Architectural Design				Course Code	ARC 715
Teaching Hours	Lecture	Exercises	Practical	Hours	3	
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course aims to introduce the student to aspects of energy consumption in buildings, energy requirements of buildings and the factors affecting them, means of energy conservation in the preliminary design stage, the method and ways of energy conservation in the construction stage, as well as in the operation stage, control systems inside buildings and techniques for treating the outer envelopes of buildings and openings from the perspective of energy conservation and availability, and new renewable energy technologies in buildings. This is done through studies carried out by the student applied on architectural projects that aimed at saving and conserving energy.

References:

- Heywood, H, "101 Rules of Thumb for Low Energy Architecture" RIBA Publishing; 1st edition, 2019.
- Thorpe, D. " Passive Solar Architecture Pocket Reference" Routledge; 1st edition, 2017.
- The Plan, " Sustainable Architecture: Contemporary Architecture in Detail" Hoaki, 2022
- Cardelus, C. "Green Architecture for a Sustainable Future" Booq Publishing, 2021



Course Name	Building Technology and Architectural Concepts				Course Code	ARC 716
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course aims to introduce the student to the modern intellectual orientations of building techniques and the optimal use of resources and the impact of buildings on the environment , as well as new and modern materials and ores that support contemporary architectural thought, and various non-traditional construction techniques and systems that support and achieve modern architectural designs. This is done by reviewing a group of projects that were characterized by unconventional building techniques and contributed to creating contemporary architectural thought on the ground. Besides, the student presents his findings in discussion sessions.

References:

- Steven, P. & Dagostino, F. "Estimating in Building Construction (What's New in Trades & Technology)" Pearson; 9th edition, 2018.
- Mehta, M. & Scarborough, W. "Building Construction: Principles, Materials, and Systems (What's New in Trades & Technology)" Pearson; 3rd edition, 2017
- Maclay, B. "The New Net Zero: Leading-Edge Design and Construction of Homes and Buildings for a Renewable Energy Future" Chelsea Green Publishing; 1st edition, 2014

Course Name	Advanced Forum in Selected Scientific Studies in Urban Design				Course Code	ARC 721
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	-	60	-	40		

Scientific Content:

The course deals with presenting and defining limited research and studies that deal with topics, issues and problems, concepts and applications: urban design, presenting, discussing, evaluating and developing these researches, through panel discussions and workshops, in a way that enables the development of research capabilities, architectural and urban criticism skills among students, and participates in Discussing and evaluating research and studies, some academics, designers, and practitioners, in a manner that can link theories with applications, and crystallize the foundations and criteria for critiquing urban design. The content of the course is also organized to allow students to carry out research studies in approved research topics that serve the subject of the chosen course under the supervision of the teacher who teaches the course.

References:

- يان جيل، (٢٠١٧)، مدن للناس، ترجمة بلدية مسقط، دار الغشام للطباعة والنشر، مسقط، سلطنة عمان.
- ريتشارد مارشال، (٢٠١٠)، نشأة وتطور التصميم العمراني، مجلة التصميم - جامعة هارفارد، ترجمة: صالح بن علي الهذلول، الجمعية السعودية لعلوم العمران، الطبعة الأولى.
- حسين عبد الحميد أحمد رشوان، (٢٠٠٢)، مشكلات المدينة، المكتب العربي الحديث، الإسكندرية.
- J. Jacobs, (1961). The Death and Life of Great American Cities. New York: Vintage.
- Jacobs, J. (1970). The Uses of City Neighborhoods, In R. Gutman, & D. Popenoe, Neighborhood, city, and metropolis: an integrated reader in urban sociology, New York, Random House.



- Gehl, Jan, (2010), Cities for People, Island Press; None edition.

Course Name	Philosophy Studies in Urban Design				Course Code	ARC 722
Teaching Hours	Lecture	Exercises	Practical		Hours	3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	60	-	-		

Scientific Content:

A course of "studies in the philosophy of urban design" deals with scientific understanding, hypotheses, and various philosophical theories. The course also deals with the concept of philosophy in general, up to issues related to urban design, how to study problems and issues related to urban design, how to develop them, and aspects of their study and solution. Some issues, problems, and prominent urban issues that are the subject of interest in the field of urban design. Students do a set of exercises and research to solve the research problems raised and clarify the comprehensive research methodology that has been relied upon. Students are trained to present and discuss their research periodically to develop research, methods of presentation, and discussion among students. The course also discusses the meaning of the signs and symbols of urban formation.

References:

- اسماعيل بهجت ، تصميم العمران وتعمير المدن ، مؤسسة العلم ، الدار البيضاء ٢٠١٦
- يميني طريف الخولي ، فلسفة كارل بوبر منهج العلم.. منطق العلم ، الهيئة المصرية العامة للكتاب ، ٢٠٠٣
- صلاح اسماعيل ، فلسفة اللغة والمنطق ، دار المعارف ١٩٧١
- بوسعادة ، عامر احمد ، تصاميم البيئة المشيدة ، مؤسسة الثقافة والفكر ، صفاقس ٢٠٢٠

Course Name	Urban Modelling				Course Code	ARC 723
Teaching Hours	Lecture	Exercises	Practical		Hours	3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The "urban modeling" course deals with the importance of mathematical modeling of urban formation, for example, environmental resource management, social service delivery systems, or economic development. In addition to preparing and presenting mathematical models for the philosophical hypothesis presented by the researcher. The student is also exposed to cost analysis, discussion of probabilistic results, their effectiveness, the use of cost-benefit ratios and the internal rate of return and choosing among multiple alternatives. and the appropriateness of each approach. In addition to improvements to linear programming, with additional applications, network and systems analysis, critical path (CPM), and program evaluation. The course contains an integrated research project carried out by the student to conduct statistical analyzes of multiple variables and levels and employ analysis systems to analyze various areas and aspects of urban design, including land uses, environment, public health, and others.

References:

- Joe D. Hoffman, Numerical methods for engineers and scientists, 2nd edition, Marcel Dekker, Inc. New York, 2001
- John Schiller, R. Alu Srinivasan and Murray R. Spiegel, Schaum's Outline of Probability



and Statistics, 4th ed., McGraw Hill 2012.

Course Name	Scientific Citation and Reference Writing Styles				Course Code	ARC 724
Teaching Hours	Lecture	Exercises	Practical	Hours	3	
	2	2	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the concept, methods, importance, patterns and methods of documenting writing and citation in scientific research, language, punctuation marks, indirect quotation within the body and direct quotation, in addition to the rules for quoting from references in all cases and different topics and methods of quotation in particular, as well as scientific methods for writing theses and scientific research with an emphasis on The importance of styles of writing scientific references, their applications and types in general. The course studies the use of computer software that organizes the writing of scientific references.

References:

- البدائية، ذياب. (1999). المرشد إلى كتابة الرسائل الجامعية. الرياض: أكاديمية نايف للعلوم الأمنية.
- محمد مسعود - محسن الخضيرى، (١٩٩٢م)، كتاب الاسس العلمية لكتابه رسائل الماجستير والدكتوراه، الأنجلو المصرية، القاهرة.
- أحمد عودة، فتحي ملكاوي، (١٩٩٢)، أساسيات البحث العلمي، أريد مكتبة الكنانى، القاهرة.

Course Name	Criticism of Urban Design Projects				Course Code	ARC 725
Teaching Hours	Lecture	Exercises	Practical	Hours	3	
	2	2	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The "Criticism of Urban Design Projects" course deals with the concept of criticism and its types in general. Then, the methods of evaluation and criticism used in urban design projects are studied, as well as the criticism of urban patterns and projects, and the evaluation methods used to criticize urban design projects through an understanding of urban design theories and its intellectual trends. Determining evaluation points through digital programs. How to use various computer applications in evaluation and self-evaluation. Students apply what is being studied by presenting a set of research and studies by applying it to one of the urban design projects and using a digital computer application to support their studies, present, and discuss them.

References:

- Moughtin, Cliff, et al. Urban design: Method and techniques. Routledge, 2003.
- Parker, S. "Designing cities: Critical readings in urban design." (2005): 171-173.
- Dovey, Kim. Urban design thinking: A conceptual toolkit. Bloomsbury Publishing, 2016.
- Medrano, Leandro, Luiz Recamán, and Tom Avermaete, eds. The New Urban Condition: Criticism and Theory from Architecture and Urbanism. Routledge, 2021.



Course Name	Urbanism in Egypt				Course Code	ARC 726
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:
Introducing the students to the historical background of Urban Growth and Urbanism structure and processes. The role of the power networks in urbanism. Urbanization problems and policy in Egypt.

References:

- عباس، فاروق حيدر، (١٩٩٤م). تخطيط المدن والقرى، منشأة المعارف، الطبعة الأولى، الإسكندرية.
- حمدان، جمال. (١٩٧٧م)، جغرافية المدن، عالم الكتب، الطبعة الثانية، القاهرة.
- جابر، محمد مدحت. (٢٠١٠م)، جغرافية العمران الريفي والحضري، مكتبة الأنجلو المصرية، القاهرة.
- الهيئة العامة للتخطيط العمراني، (٢٠١٦م)، دليل المعدلات والمعايير التخطيطية للخدمات بجمهورية مصر العربية، خدمات الاتصالات، المجلد العاشر، القاهرة.
- Bridge G., (2009), Urbanism, INTERNATIONAL ENCYCLOPEDIA OF HUMAN GEOGRAPHY, Elsevier Ltd., Oxford, UK

Course Name	Urban Place making				Course Code	ARC 727
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The "place urban design" course studies formal and informal urban place design, the social and cultural dimensions of urban place design, human attraction factors, the activities that can be carried out, and how to meet the needs of establishing various activities through the urban design of the place. The place urban design course also deals with the main theories of development and the design of urban places, the student studies the basics of the process of designing urban places. And statistical methods for analyzing the factors and variables affecting the urban design process, in addition to presenting the relationship and impact of economic, social, environmental, and cultural thought on urban design processes. Many local, regional, and global examples are presented illustrating and expressing how the design of urban spaces responds to multiple intellectual variables.

References:

- Golany, G.,(1976) New Town Planning Principles and Practice. London : John Wiley and sons.
- Golany, G., (1978) International Urban Growth & polices – New towns contribution, London : Wiley inter science publication.
- Joseph Dechiara, Gulius Panero, and Martin Zelnik, "Time-saver Standards for Interior Design and Spaces planning", Second Edition, by The McGraw-Hill companies, 2001 .
- City of Victoria Planning. (2006) Downtown Core Area Plan. 14-21. BC Canada:



Planning Department

Course Name	Smart Urbanism				Course Code	ARC 728
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade		Final Grade	100
	40	40	-			

Scientific Content:

The "Smart Urbanization" course is concerned with improving students' mental and creative abilities, professional qualities, and their orientations. The course focused on improving their awareness of work practices on the ground, their knowledge of public expectations, their understanding of the practical nature of their decisions, their effectiveness and independence, the legislative principles that must be adhered to, and the necessary procedures for professional practice, such as professional ethics, customer relations, and cooperation among professional colleagues And how to market professional services and study legislation and labor market requirements. The course depends mainly on the continuous discussion of the studies submitted by the students to exchange information and experiences, as the students work on presenting a group of studies on a group of different projects in order to study several aspects that are determined during the study of the course to cover its various aspects.

References:

- Benninger C. (2001): "Principles of Intelligent Urbanism," in Ekistics, Volume 69, Number 412, pp. 39 –65, Athens.
- Bakici, T., Almirall, E., & Wareham, J. (2013). A Smart City Initiative: The Case of Barcelona. Journal of the Knowledge Economy, 4(2), 135-148
- Calthorpe, Peter ,The Next American Metropolis :Ecology , Community and American dream Princeton Architectural Press, 1993.
- Caragliu, A., Del Bo, C., & Nijkamp, P. (2009). Smart Cities in Europe. Paper presented at the 3rd Central European Conference on Regional Science (CERS).
- Clayton, Dalal, B., and Bass.S. Sustainable Development Strategies: A Resource Book London : Earthscan.2002.
- Geller, H.(2003), "Energy Revolution", Washington: Island Press ,U.S.A.S. Lehmann, Green Urbanism: Formulating a Series of Holistic Principles, S.A.P.I.EN.S., 2010.
- Giffinger, R. (2007) Smart cities Ranking of European medium-sized cities. Centre of Regional Science, Vienna UT.
- Jacobs, Jane. The Nature of Economies. New York: Modern Library, 2000 .-Liu, F. and Singh ,J. (2009) " The Energy Sector Management Assistance Program :ESMAP'S Working Paper", prepared for Eco Cities , Energy Sector Management Assistance Program ,U.S.A
- Mechant, P., and other "Crowdsourcing for smart engagement apps in an urban context: an explorative study", biblio.ugent.be/publication .2011.
- Oliveria, F. (2011) "New Eco-Cities New Open Spaces :the Future of Green and Blue Infrastructures", UIA Conference Tokyo, Japan.-Ralf Fücks, "Smart Growth: the Green Revolution" Heinrich Böll Stiftung Heinrich Boell Foundation 2013.
- Rogers, R. Cities for Small Planet. Faber and Faber, Limited, London.1997.
- Thimphu Structure Plan Interest in the concept of Intelligent Urbanism has spread to other contexts (Williams, 2003)and its application is being widely discussed (Graz Biennial, 2001.
- Yeang, K.(1999) "The Green Designing Skyscraper the Basic for Designing Sustainable Intensive Building". Pestle ,Munich, Germany.



Course Name	Environmental Psychology				Course Code	ARC 729
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the foundations and theories of the behavior of the built environments through the study of the spatial relations that link the human being with the urban environment. The focus is on monitoring the behavioral patterns associated with the urban spaces, in addition to identifying the human aspect of urban design, perception and behavioral uses of spaces and the needs of users. The course also shows that urbanization is a multidisciplinary field that focuses on the interaction between humans and their surrounding environment. The course defines the term environment broadly but focuses on natural environments, social conditions, built environments, and learning environments.

References:

- إيناس سيد أحمد، (٢٠١٢م). تأثير جودة الحياة على سلوك الأفراد في المجتمعات العمرانية، مؤتمر جودة الحياة- نحو مستقبل أفضل.
- Max-Neef, M. A. (1991). Human Scale Development Conception, Application and Further Reflections, New York and London: The Apex Press. Library of Congress Cataloguing-in Publication Data
- H. Shaftoe, (2012), Convivial Urban Spaces: Creating Effective Public Places, Earthscan.
- Rapoport, (1982). The Meaning of the built environment, Beverly Hills: saga publications.
- S. Kaplan & R. Kaplan. (١٩٨٢). Cognition and Environment: Functioning in an Uncertain World. New York: Praeger Press.
- Broadbent, G. (1973). Architecture and the Human Sciences, London: John Wiley and Sons Inc.

Course Name	Advanced Forum/Applied Research in Urban Planning				Course Code	ARC 731
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	-	60	-	40		

Scientific Content:

The course aims to give a general background in the science of regional and urban planning to students. The course deals with the definition of planning and its gradual levels of national planning, regional planning, urban planning, and urban design, and the essential differences between these levels. and how to evaluate urban and rural life to find engineering solutions to urban problems such as housing inflation, slums, and traffic crises. how to organize movement between population and services, and study multiple theories of regional and urban planning aimed at organizing urban life as well as developing students' knowledge and experience in the field of urban planning in order to be able to improve the quality of the urban environment (urban and rural) built where It is a fulfillment of the needs of society in a place and a time. Then the course is organized to allow students to conduct research studies on approved topics that serve the chosen course subject under the supervision of the course supervisor.

References:

- Brian Stone, Gerald Mills, Joel Towers, Lutz Katzschner, Mattia Federico Leone, Pascaline Gaborit, Matei Georgescu, Maryam Hariri "Urban planning and design.", Cambridge University Press. New York, 2018.
- Adam Robert. Traditional Urban Design. Adam Architecture; 2009.
- Sharma, Shashikant Nishant, "Urban Forms in Planning and Design", International Journal of Research (IJR), Volume-1, Issue-1, 2014.
- Bahrainy Hossein, Bakhtiar Ameneh. Toward an integrative theory of urban design. Tehran: Springer; 2016.
- Frey Hildebrand. Degrining the city towards a more sustainable urban form. London and New York: Spon



Press; 1999.

- Gunder Michael. Commentary: is urban design still urban planning? An exploration and response. J Plan Educ Res 2011:184-95.
- Healey Patsy. Making better places: the planning project in the twenty-first century. New York: Palgrave; 2010. [19] Knox Paul, Ozolins Peter. Design professionals and the built environment: an introduction. London: Wiley; 2000.

Course Name	Policies and regional development theories				Course Code	ARC 732
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the concept of regional development and its role in formulating planning policies capable of finding solutions to problems and issues in contemporary society determined by regional development plans (economic, social, urban, political, and cultural), to reconcile economic, social, and urban planning at all levels, and to bridge the gap between Formation of development planning goals and their implementation at the regional and local levels. It is considered one of the advanced courses in which the student learns how to integrate the economic, social, natural, political, administrative, and legal influences into the regional development system, whether at the level of countries or a country or regions within the country. The course includes discussions on the concept of regional development, its objectives, and its role in addressing many planning problems. Such as controlling urban communities, regional development strategies, and the impact of industry and technological development on regional development.

References:

- Higgins, Benjamin, and Donald J. Savoie. Regional Development Theories and Their Application. Transaction Publishers, 2009.
- Capello, Roberta, and Peter Nijkamp. Handbook of Regional Growth and Development Theories. Elgar, 2019.
- Regional Development: Concepts, Methodologies, Tools and Applications. Information Science Reference, 2012.

Course Name	Computer Aided Planning				Course Code	ARC 733
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	2	2		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	20	-		

Scientific Content:

The course is based on developing the student's knowledge and techniques necessary to implement computer-based planning, using a simplified algorithm through computer language, related software, and advanced programming. The course aims to provide students with the ability to improve and computerize process planning; Manual Classification, Standard Operation Plans, Computer Maintained Operation Plans, Variable CAPP, Generative CAPP, and Dynamic Generative CAPP. and preparing students to be able to produce and create a new computer-based model. Depending on the language (Visual C#) and the Microsoft



Project program, to prepare the process plan and the (Microsoft Access) program to create the database of this system, which helps to prepare a standard plan for the production process and save it in an organized manner that can be retrieved and modified easily as well For the efficient use of time, and before that getting rid of the routine clerical operations adopted in the numbering process, which contributes to providing a wide database through which all data for all models can be stored and referred to when needed, modified and updated with ease.

References:

- Corpor, Architecture Technology. Computer Aided Process Planning (CAPP) 2nd Edition. Elsevier Science, 2013.
- Tulkoff, J. Capp - Computer Aided Process Planning. Computer and Automated Systems Association of SME, 1985.
- Wang, Hsu-Pin, and Jian-kang Li. Computer-Aided Process Planning. Elsevier, 1991.

Course Name	Studies and sustainable planning research				Course Code	ARC 734
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the preparation, follow-up, and evaluation of plans, considering the goals of sustainable development. Focusing on the applied aspects associated with various areas of planning and development. What is important in providing the student with the following scientific and practical skills: Preparing strategic plans and executive action plans for all parties with the aim of achieving sustainable development goals Preparing budgets for implementing plans - Preparing feasibility studies and evaluating projects - Preparing indicators for a follow-up to executive plans - Studying the entrances and methods of evaluating plans - Writing special reports Follow-up and evaluation of plans. With the training of students on scientific research through discussions focusing on issues related to the visions of planning studies, and development prospects through studying one of the political, economic, or social inputs, student groups prepare a research proposal that deals with a new vision for planning communities and centers.

References:

- Rouse, David C., and Rocky Piro. The Comprehensive Plan: Sustainable, Resilient, and Equitable Communities for the 21st Century. Routledge Taylor & Francis Group, 2022.
- Thomas, Ken D. Handbook of Research on Sustainable Development and Economics. Business Science Reference, 2015.
- Green Planning for Cities and Communities: Novel Incisive Approaches to Sustainability (Research for Development). SPRINGER NATURE, 2021.

Course Name	Writing Planning Reports				Course Code	ARC 735
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course aims to train students to produce a good planning report, it is as vital as the project itself, no matter how excellent and original the work may be, it may not be implemented unless the results are



communicated to other people, presenting the plan strategies in a clear and useful way is an essential part of the science Which is the reason for devoting a lot of effort to this aspect. The course discusses (why to write planning reports, what kind of details should be included, what level and format of reports, evaluation criteria used and types of reports, stages of report writing from preparation and processing, arrangement and coordination, writing, and finally revision). Then the course organizes for students several approved topics that serve the subject of the chosen course under the supervision of the course supervisor. Students are required to write reports that discuss these topics by conducting research studies.

References:

- Bowden, John. Writing a Report: How to Prepare, Write and Present Really Effective Reports. How To Books, 2009.
- Mort, Simon. Professional Report Writing. Routledge, 2017.
- Reid, Michelle. Report Writing. Palgrave Macmillan, 2018.

Course Name	Sustainability in Desert Settlements				Course Code	ARC 736
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

Desert regions constitute the majority of Arab lands, which prompts us to think about using them as a suitable ground to accommodate urban expansion, by studying the characteristics of the desert environment as well as what is appropriate for that environment in terms of urban patterns that suit life in desert regions, and discussing urban patterns (their advantages and disadvantages) so that we can lay planning foundations to deal with the desert environment, as well as access to an urban formation suitable for desert cities. The course addresses individual aspects of the built environment in desert areas, energy use, transportation, land use and local decision-making, water infrastructure and on-site reuse, solid waste, green waste, public health, and neighborhoods. The relationship between the natural environment and the city is also considered.

References:

- Webb, Robert H., et al. Design with the Desert: Conservation and Sustainable Development. CRC Press, 2013.
- Planning Sustainable Cities. Earthscan, 2009.
- Sustainable Energy-Water-Environment Nexus in Desert Climate: Proceeding of the First International Conference on Sustainable Energy-Water-Environment Nexus in Desert Climates. SPRINGER NATURE, 2021.

Course Name	Planning of Touristic and Coastal Areas				Course Code	ARC 737
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course deals with the planning of tourist and coastal areas, their definitions and their relationships with urban and regional planning, and the difference between general planning for coastal and tourist areas and any type of underdeveloped housing, where the sense of freedom, psychological comfort, familiarity with nature, and optimal use of the elements of public site coordination must be considered. It covers planning considerations for those areas and emphasizes the cultural role of tourism and coastal recreation, understanding the systematic and conceptual strategic plans for different types of tourist and coastal areas.



And what it requires of working on an inventory of tourism resources to determine the objectives of the region's planning plans, in a way that ensures the achievement of regular development through the preparation and implementation of a coherent program that draws an estimated future picture of the tourism / coastal development of the region in a specific period.

References:

- Sustainable Coastal Tourism: An Integrated Planning and Management Approach. UNEP, 2009.
- Krishnamurthy, R. R. Coastal Management: Global Challenges and Innovations. Academic Press, an Imprint of Elsevier, 2019.
- Mónica Morais de Brito, et al. Managing, Marketing, and Maintaining Maritime and Coastal Tourism. Business Science Reference (an Imprint of IGI Global), 2020.

Course Name	The Smart City				Course Code	ARC 738
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course introduces the concept and meaning of a smart city as a technologically modern urban area that uses different types of electronic methods, voice-activated methods, and sensors to collect specific data. The information gained from that data is used to efficiently manage assets, resources, and services; In turn, this data is used to improve operations across the city.

The course includes an introduction to the history and origin of the term smart city, its characteristics, data collection, and its role in activating the capabilities of the smart city, smart city frameworks (economic, political, administrative, and sustainability), civil society and its impact on the concept of smart city, smart transition, and its effective role in achieving the goals of smart cities). to address the role of digital transformation in the emergence of the term smart city and defining fourth-generation cities and their relationship to the same concept.

References:

- Augusto, Juan Carlos. Handbook of Smart Cities. Springer, 2021.
- Alavi, Amir, and William G. Buttlar. Data Analytics for Smart Cities. CRC Press, Taylor & Francis Group, 2019.
- McNeill, Donald. Global Cities and Urban Theory.
- Smart Cities - Opportunities and Challenges Select Proceedings of ICSC. SPRINGER, 2020.
- Inkinen, Tommi, et al. Smart Cities and Innovative Urban Technologies. Routledge, 2021.

Course Name	Planning Models				Course Code	ARC 739
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course introduces the mechanisms of developing urban growth models and their role in studying urban expansion and its impact on the surrounding environment and using them in making urban policies or analyzing development scenarios. Urban models are computer-based simulations used to test theories about spatial location and the interaction between land uses and related activities, providing digital environments to test the consequences of physical planning policies on the future shape of cities. Urban modeling falls between the search for simplicity in explaining the structure of cities and the need to embrace the apparent complexity that confronts our understanding and intervention in such systems. The course aims to teach the



student the skills of preparing mathematical models related to the subject of the doctoral study, how to prepare hypotheses of the mathematical model and its relationship to the subject, and how to convert philosophical topics into digital topics.

References:

- S., Foot David H. Operational Urban Models: An Introduction. Routledge, 2019.
- Putman, Stephen H. Integrated Urban Models. Routledge, 2015.
- Bianca, Stefano. Urban Form in the Arab World - Past and Present. Zurich: vdf, 2000
- Longa, Remo Dalla. Urban Models and Public-Private Partnership. Springer, 2011.
- Helly, Walter. Urban Systems Models. Acad. Press, 1980.

Course Name	Philosophy of maintenance and restoration and international charters				Course Code	ARC 741
Teaching Hours	Lecture	Exercises	Practical		Hours	3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course of Philosophy of Maintenance and Restoration within the Framework of International charters aims to enable students to understand and know the most important global and international conventions and policies specialized in the field of maintenance and restoration of heritage and historic buildings such as (Florence Charter on Historical Gardens) and (Washington Charter on Preserving Historic Cities and Regions) and (Charter for the Protection and Management of Archaeological Heritage) and (Burra Charter) and The course also discusses all the steps on which these charters are based, starting from the documentation process for buildings, through the stages of operation, maintenance and restoration. The course is also concerned with studying the gap between most of the relevant systems, policies and laws, this is to identify the strengths and weaknesses of each of these systems, and to adopt a general idea through which the most important basic frameworks that must be followed in the maintenance and restoration of heritage and historical buildings can be established.

References:

- ICOMOS, (1964),The Venice Charter:International Charter for the Conservation and Restoration of Monuments and Sites, International Council on Monuments and Sites.
- ICOMOS,The Burra Charter (1979 and 1999 Versions): the Australia ICOMOS Charter for Places of Cultural Significance, International Council on Monuments and Sites.
- ICOMOS, (1982), The Declaration of Dresden, International Council on Monuments and Sites.
- ICOMOS,(1982), The Florence Charter for Historic Gardens, International Council on Monuments and Sites.
- ICOMOS, (1990), Charter for the Protection and Management of The Archaeological Heritage, Lausanne, International Council on Monuments and Sites.
- ICOMOS of New Zealand, (1992), Charter for the Conservation of Places of Cultural Heritage Value, International Council on Monuments and Sites.
- ICOMOS, (1994), Nara Document on Authenticity, International Council on Monuments and Sites.
- ICOMOS, (1996),The Declaration of San Antonio, International Council on Monuments and Sites.
- ICOMOS,(1999),Principles for The Preservation of Historic Timber Structures, Mexico, International Council on Monuments and Sites.
- ICOMOS, (2008), Charter for the Interpretation and Presentation of Cultural Heritage Sites, Québec – Canada, International Council on Monuments and Sites.



Course Name	Advanced applied research seminars in the Maintenance, Restoration & Preservation				Course Code	ARC 742
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	-	60	-	40		

Scientific Content:

The course of Advanced Applied Research Seminars in the Area of Specialization aims to enable students to understand and know the most important areas of specialization, which generally discuss the philosophy of maintenance and restoration within the framework of international conventions - the role of cultural heritage in upgrading urban communities - rehabilitation of existing buildings- how to prepare maintenance and restoration projects - Discussing the most important policies on how to deal with heritage buildings - knowing and discussing the objectives of critical maintenance operations - emphasizing the role of technical systems inside buildings - and noting the important role of governance and management in preserving buildings. Reviewing and discussing the most important laws and charters that help consolidate the concept of heritage - cultural - urban communities, and other concepts that enhance the student's understanding and awareness of the surrounding environment and enhance the role of preserving and upgrading that environment in a way that does not harm the existing urban formation.

References:

- مصطفى، بسام محمد , "دور عمليات إعادة البناء في الحفاظ على المباني الأثرية والمواقع التاريخية". مجلة الإتحاد العام للآثار بين العرب 10.10 (2009): 100-152.
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Course Name	Culture heritage and urban renewal				Course Code	ARC 743
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course of the Role of Cultural Heritage in Upgrading Urban Communities aims to enable students to understand and know the concept of tangible and intangible heritage as well as the characteristics of urban communities, also to study and understand the interrelationship between cultural heritage and its impact on the components of urban communities, in order to consolidate the link between the old, which is represented in the cultural heritage, and the new, which is represented in the contemporary urban societies. Starting with thinking seriously about our heritage and environmental wealth and working to establish a new awareness that helps to improve societies and establish real projects that contribute to maintaining a safe condition of the remaining components of this climatic, heritage, urban and cultural environment, and recruit the heritage in an integrated manner in its various natural, cultural and urban aspects as an economic resource within



sustainable development plans. In addition to benefiting from preserving the local urban heritage as an economically feasible mechanism for local communities.

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Course Name	Rehabilitation of Existing Facilities - Applied Projects				Course Code	ARC 744
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	-	60	-	40		

Scientific Content:

The course of Rehabilitation of Existing Buildings – Applied Projects aims to enable students to understand, audit and analyze the performance of the building, which is called the evaluation process for the building. The course also enables the student to know the most important and basic points that need rehabilitation inside or outside the building by presenting the general ideas of the rehabilitation methods used, which help to develop the building in order to obtain the largest return on investment for the building as a material asset in the society's economy system as a whole. The course also enables the student to study and know the qualification axes using the available technology of the age, at all levels, whether in the execution stage through the use of available modern materials or following advanced execution methods. This is done in a practical training manner on existing projects.

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Course Name	The Role of Political and Administrative Systems in Supporting Conservation				Course Code	ARC 745
Teaching Hours	Lecture	Exercises		Practical	Hours	3
	3	-		-		
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	-	-	-	-		



	40	40	-	20	
Scientific Content: The course of The Role of Political and Administrative Systems in Supporting Conservation aims to enable students to understand and know the role of political, global and international systems specialized in the field of maintenance, restoration and support of preservation, in addition to clarify the role of administrative systems and the role of laws in supporting these concepts. The course also discusses all the steps on which these laws are based, starting from the process of documenting buildings, through the stages of operation, maintenance, restoration and preservation. Moreover, the course is interested in studying the gap between those policies and laws concerned with that and what is in place and what is actually being executed, in order to determine the most important points that must be taken from these laws and what can be left, and to adopt a general idea through which the most important basic frameworks that must be followed in maintenance, restoration and preservation of heritage and historical buildings and areas.					
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Course Name	Development of Historic and Heritage Areas				Course Code	ARC 746
Teaching Hours	Lecture	Exercises	Practical		Hours	3
	3	-	-			
Course Grades	Final Exam	Class Works	Practical grade	Oral Grade	Final Grade	100
	40	40	-	20		

Scientific Content:

The course of Development of Historic and Heritage Areas aims to enable students to understand and know the concepts related to heritage, preservation and development of heritage areas, in order to distinguish between the existing old (heritage) areas and the existing modern areas (non-heritage), then knowing the most important characteristic of these areas in order for them to be heritage. The course also aims to study the laws regulating construction in heritage areas that make their development in those areas, and to review the foundations and methods used in the process of preserving and developing the urban tissue of those heritage areas, which depend mainly on a methodology that is compatible with the place in terms of urban and architectural formation in order to determine the best methods used. To maintain and adapt to the impact as well as its development. The course also aims to understand and know the complementary relationship that must occur between modern buildings and heritage buildings and their relationship to the existing urban tissue.

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- شحاته إبراهيم، القاهرة تاريخها ونشأتها، الهيئة المصرية العامة للكتاب، مكتبة الأسرة، القاهرة، ٢٠٠١.
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- محمد أبو المحاسن عصفور، معالم تاريخ الشرق الأدنى القديم، دار النهضة العربية، بيروت، لبنان، ٢٠١٠.
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CHAPTER (8)

BASIC SCIENCE DEPARTMENT

The basic science department includes two programs:

1. Engineering Mathematics Program
2. Engineering Physics Program

1) Engineering Mathematics Program

1. Advanced Diploma in Engineering Mathematics

By the end of the program, the student should be able to:

1. Identify theories and principles of engineering mathematics.
2. Describe suitable methods for solving engineering problems.
3. Explain the mathematical models of engineering problems.
4. Analyze data using mathematical tools and statistical methods.
5. Determine the optimal solutions to the real problems.
6. Using information technology to serve the development of professional practice.
7. Obtain information and knowledge from various sources.
8. Conduct self-learning and continuous education practices.

Table 8. 1. 1 Qualifying courses of basic diploma in Engineering Mathematics*

S. N.	Course Code	Course Title	Prerequisite(s)	Credit Hours	Grades				Exam duration
					course work	Oral / practical	Written exam	Total	
1	BAS 410	Linear algebra	–	3	60	0	40	100	2
2	BAS 411	Operations research	–	3	60	0	40	100	2
3	BAS 412	Differential equations	–	3	60	0	40	100	2
4	BAS 413	Numerical analysis	–	3	60	0	40	100	2
5	BAS 414	Differential geometry and topology	–	3	60	0	40	100	2
6	BAS 415	Probability and statistics	–	3	60	0	40	100	2
7	BAS 416	Transformations and integral equations	–	3	60	0	40	100	2
8	BAS 417	Fluid mechanics	–	3	60	0	40	100	2
9	BAS 418	Analytical mechanics	–	3	60	0	40	100	2
10	BAS 419	Theory of elasticity	–	3	60	0	40	100	2

* The student should have a bachelor of engineering degree from Egyptian universities or a degree accredited by the Egyptian Supreme Council of Universities and wishes to complete postgraduate studies in engineering mathematics chooses (8) courses (24 credit hours) from Table (8.1.1) according to the specialization determined by the department council, to study them in two semesters (other than the summer semester) and passed with a cumulative average (3) points or more.



Table 8. 1. 2 Compulsory courses of basic diploma in engineering mathematics

S. N	Course Code	Course Title	Prerequisite(s)	Credit Hours	Grades				Exam duration
					course work	Oral / practical	Written exam	Total	
1	GEN 501	Technical writing and presentation skills	–	2	60	0	40	100	2
2	GEN 502	Statistics and random processes	–	2	60	0	40	100	2

Table 8. 1. 3 Elective courses of basic Diploma in Engineering Mathematics*

S.N.	Course Code	Course Title	Prerequisite(s)	Credit Hours	Grades				Exam duration
					course work	Oral / practical	Written exam	Total	
1	BAS 510	Linear spaces	–	3	60	0	40	100	2
2	BAS 511	Advanced engineering mathematics	–	3	60	0	40	100	2
3	BAS 512	Real analysis	–	3	60	0	40	100	2
4	BAS 513	Numerical methods	–	3	60	0	40	100	2
5	BAS 514	Applied mathematics	–	3	60	0	40	100	2

The student chooses (with help of the academic advisor) (3) courses from Table (8.1.3) according to the specialization determined by the department council to study.

Table 8. 1.4 Elective Courses of advanced Diploma in Engineering Mathematics*

S. N.	Course Code	Course Title	Prerequisite(s)	Credit Hours	Grades				Exam duration
					course work	Oral / practical	Written exam	Total	
1	BAS 610	Functional analysis	BAS 511	3	60	0	40	100	2
2	BAS 611	Optimization and expert systems	BAS 411	3	60	0	40	100	2
3	BAS 612	Statistics and probability distributions	–	3	60	0	40	100	2
4	BAS 613	Differential equations and integral equations	BAS 412	3	60	0	40	100	2
5	BAS 614	Fluid dynamics	BAS 417	3	60	0	40	100	2
6	BAS 615	Mechanics of water waves	BAS 417	3	60	0	40	100	2



*The student chooses (with help of the academic advisor) (4) courses from Table (8.1.4) according to the specialization determined by the department council to study.

2. Master of Science in Engineering Mathematics (M. Sc.)

The graduate of the M. Sc. program should be able to:

1. Apply effectively theories and concepts of mathematics to advanced research.
2. Have understanding of mathematics needed for solving engineering problems.
3. Apply their comprehensive understanding and knowledge of mathematics to treat engineering problems.
4. Show good reasoning and creativity in the solutions of theoretical and practical problems.
5. Integrate information and numerical data from different sources.
6. Demonstrate the methodology and research planning.
7. Communicate effectively by oral presentations and a research dissertation.

Table 8. 1. 5 M.Sc. Thesis in Engineering Mathematics

Code	Course	Prerequisite(s)	Credit Hours
BAS 811	Master Thesis	Average GPA (3) in advanced diploma and at least grade (2.7) in all courses of basic and advanced diploma.	12

3. Doctor of Philosophy in Engineering Mathematics

By the end of the program student should be able to:

1. Understand the theories and concepts of mathematics and able to evaluate them critically and to apply them effectively.
2. Use the theories and concepts of mathematics to investigate new.
3. Apply mathematical analysis and methods for solving problems.
4. Analyze research data and to use appropriate mathematical tools in tackling unfamiliar problems with uncertain or incomplete data.
5. Develop knowledge and comprehensive understanding of development processes in engineering mathematics and the ability to apply.
6. Develop advanced level knowledge and understanding of a wide range of engineering mathematics.

7. Innovate new mathematical methods for modeling and obtaining optimal solutions real problems.
8. Understand different roles within a team (member or leader) and the ability to exercise initiative and personal responsibility.
9. Enable planning of self-learning and improvement of performance, as the foundation for lifelong learning and research.

Table 8. 1. 6 Basic courses of doctor of philosophy in engineering mathematics*

S. N.	Code	Course Title	Prerequisite(s)	Credit Hours	Grades				Exam duration
					course work	Oral / practical	Written exam	Total	
1	BAS 616	Discrete mathematics	–	3	60	0	40	100	2
2	BAS 617	Differential equations and numerical methods	BAS 513	3	60	0	40	100	2
3	BAS 618	Fractional calculus	–	3	60	0	40	100	2
4	BAS 619	Solid mechanics and structural dynamics	BAS 514	3	60	0	40	100	2

* With the help of the academic advisor, the student chooses (3) courses from table (8.1.6) according to the specialization determined by the department council to study.

Table 8. 1. 7 Specialized courses of Doctor of Philosophy in engineering mathematics*

S. N.	Code	Course Title	Prerequisite(s)	Credit Hours	Grades				Exam duration
					course work	Oral / practical	Written exam	Total	
1	BAS 710	Advanced topics in operations research	BAS 611	3	60	0	40	100	2
2	BAS 711	Advanced topics in engineering mathematics	BAS 610	3	60	0	40	100	2
3	BAS 712	Probability and statistical analysis	BAS 612	3	60	0	40	100	2
4	BAS 713	Integral equations	BAS 613	3	60	0	40	100	2
5	BAS 714	Waves and vibration theory	BAS 619	3	60	0	40	100	2

*By the recommendation of the supervisor, the student chooses 3 courses from Table (6.1.7) according to the specialization determined by the department council to study.



Table 8. 1. 8 Philosophy Doctorate (Ph. D) Thesis in Engineering Mathematics

Code	Title	Prerequisite(s)	Credit Hours
BAS 911	Ph. D. Thesis	1. Average GPA (3) and at least grade (2.7) in all courses in basic and specialized Ph.D. 2. Pass the seminar of stage one of the academic research.	12

Matrices of Relation between Courses and Graduate Competencies

Matrix 8.1.1: Relation of Courses of Advanced Diploma In Engineering Mathematics and Graduate Competencies

S.N	Code	Course Title	Graduate Competencies							
			1	2	3	4	5	6	7	8
1	GEN 501	Technical writing and presentation skills						•	•	•
2	GEN 502	Statistics and random processes				•			•	•
3	BAS 510	Linear spaces	•						•	•
4	BAS 511	Advanced engineering mathematics	•						•	•
5	BAS 512	Real analysis	•						•	•
6	BAS 513	Numerical methods		•	•				•	•
7	BAS 514	Applied mathematics		•					•	•
8	BAS 610	Functional analysis	•						•	•
9	BAS 611	Optimization and expert systems		•			•		•	•
10	BAS 612	Statistics and probability distributions				•			•	•
11	BAS 613	Differential equations and integral equations		•					•	•
12	BAS 614	Fluid dynamics		•					•	•
13	BAS 615	Mechanics of water waves		•					•	•

Matrix 8.1.2: Relation of Courses of Master of Science In Engineering Mathematics and Graduate Competencies

S.	Code	Course Title	Graduate Competencies						
			1	2	3	4	5	6	7
1	GEN 501	Technical writing and presentation skills							•
2	GEN 502	Statistics and random processes		•			•		
3	BAS 510	Linear spaces	•						
4	BAS 511	Advanced engineering mathematics	•	•	•				
5	BAS 512	Real analysis	•						
6	BAS 513	Numerical methods	•	•	•				
7	BAS 514	Applied mathematics	•						
8	BAS 610	Functional analysis	•						
9	BAS 611	Optimization and expert systems	•		•		•		
10	BAS 612	Statistics and probability distributions	•	•			•		



11	BAS 613	Differential equations and integral equations	.	.					
12	BAS 614	Fluid dynamics	.		.				
13	BAS 615	Mechanics of water waves	.		.				
14	BAS 811	Master Thesis	.	.	.	.	.	.	.

Matrix 8.1.3: Relation of Courses of Doctor of Philosophy In Engineering Mathematics and Graduate Competencies

S.	Code	Course Title	Graduate Competencies								
			1	2	3	4	5	6	7	8	9
1	BAS 616	Discrete mathematics	.		.						
2	BAS 617	Differential equations and numerical methods	.								
3	BAS 618	Fractional calculus	.								
4	BAS 619	Solid mechanics and structural dynamics	.								
5	BAS 710	Advanced topics in operations research	.						.		
6	BAS 711	Advanced topics in engineering mathematics	.		.						
7	BAS 712	Probability and statistical analysis	.			.					
8	BAS 713	Integral equations	.								
9	BAS 714	Waves and vibration theory	.								
10	BAS 911	Ph. D. Thesis	.	.	.	.	.	.	.	.	.

**COURSES DESCRIPTION**

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 410	Linear algebra		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Algebra of matrices, Partition of matrices, Linear dependence and independence, Eigenvalues and Eigenvectors, Rank of matrix, Trace of matrix, Norm of matrix, Spectral radius of matrix, Symmetric and skew symmetric matrices, Hermitian matrices, Idempotent matrix, Nilpotent matrix, Orthogonal matrix, Canonical form, Quadratic forms, Positive definite and negative definite matrices, Hessian matrix, Matrix function, Functions of matrices, Solving linear systems by matrices.

References:

- Peter J. Olver and Cheharzad Shakiban, Applied Linear Algebra, Pearson Education, U.S.A, 2018.
- Gilbert Strang, Linear Algebra and Its Applications, 3rd Edition, Thomson Brooks / Cole, U.S.A, 2016.
- Jorg Liesen and Volker Mehrmann, Linear Algebra, Springer International Publishing Switzerland, 2016.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 411	Operations research		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Introduction to operations research, Deterministic mathematical programming problems, Linear, Quadratic, Nonlinear, Integer, Non deterministic mathematical programming problems, Stochastic problems, Mathematical formulation of linear programming problems, Methods for solving linear programming problems, Simplex method, Two phase method, Dual problem, Dual Simplex method, Sensitivity analysis, Transportation problem, Assignment problem.

References:

- Joao Luis De Miranda, Introduction to Optimization-Based Decision-Making, Taylor & Francis Ltd, 2021.
- Jorge Nocedal and Stephen J. Wright, Numerical optimization, Springer Science+Business Media, New York, 2018.
- Hamdy A. Taha, Operations Research, Pearson Prentice Hall, New Jersey, 2017.
- David G Luenberger and Yinyu Ye, Linear and Nonlinear Programming, Springer Science+Business Media, New York, 2016.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 412	Differential Equations		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Introduction to differential equations, First order differential equations, Modeling with first order differential equations, Higher order linear differential equations with constant coefficients, Methods of solutions by inverse differential operators, Undetermined coefficients- variation of parameters, Cauchy–Euler Equation- Higher order linear differential equations with variable coefficients, Methods of solutions, Reduction of order-Reduction to the Normal form, Factorization of operator, Modeling with higher order differential equations.

References:



- Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons Inc, New York, 2018.
- Dennis Zill, A First Course in Differential Equations with Modeling Applications, International Metric Edition, Cengage Learning, 2017.
- William A. Adkins and Mark G. Davidson, Ordinary Differential Equations, Springer Science+Business Media, New York, 2016.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 413	Numerical Analysis	3	2	2	0	60	0	40

Contents:

Introduction to numerical analysis, Approximation and numerical methods, Errors analysis, Numerical solution of equations of one variable, Numerical solution of systems of linear equations, Numerical solution of systems of nonlinear equations, Interpolation, Lagrange polynomials, Curve fitting, Numerical integration and differentiation. Numerical solution of ordinary and partial differential equations.

References:

- Brian Sutton, Numerical Analysis : Theory and Experiments, Society for Industrial and Applied, 2019.
- Kendall Atkinson, Theoretical numerical analysis, Springer Science+Business Media, New York, 2019.
- Timothy Sauer, Numerical analysis, Pearson Education, Inc. New York, 2018.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 414	Differential geometry and topology	3	2	2	0	60	0	40

Contents:

Differential geometry: Representation of curves in plane, Cartesian coordinates, Polar coordinates, Parametric form, Representation of curves in space, Representation of surfaces in cartesian coordinates, Cylindrical coordinates, Spherical coordinates, Gradient, Curvature in cartesian coordinates, Polar coordinates, Parametric form, Skewness, Torsion, Curves on surface, Asymptotic lines, Orthogonal curvilinear systems. Topology: Open set and closed set, Compact set, Accumulation points, Interior, exterior, boundary, Convergent sequences, Topological spaces, Subspaces, Bases, Separable spaces, Covers, Compact spaces.

References

- Marshall A. Whittlesey, Spherical Geometry and Its Applications, CRC Press, 2020.
- John Opera, Differential Geometry and Its Applications, The Mathematical Association of America, 2017.
- Gerd Rudolph and Matthias Schmidt, Differential Geometry and Mathematical Physics, Springer Science+Business Media, 2017.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 415	Probability and statistics	3	2	2	0	60	0	40

Contents:

Introduction to statistics, data collection and analysis, Measures of the central tendency and dispersion, Regression analysis, Probability in discrete and continuous cases, Discrete random variable, Probability density function, Probability function, Binomial distribution, Poisson distribution, Continuous random variable, Normal distribution, Gamma distribution, Moment generating function.

References

- David Forsyth, Probability and Statistics for Computer Science, Springer International Publishing, Switzerland



AG, 2018.

- Ronald Walpole, Raymond Meyers, Probability and Statistics for Engineers and Scientists, Pearson Education Limited, 2016.
- Prasanna Sahoo, Probability and Mathematical Statistics, University of Louisville, U.S.A, 2016.
- Ronald E. Walpole, Raymond H. Myers, Probability and Statistics for Engineers and Scientists, Pearson Education Inc., 2016.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 416	Transformations and integral equations		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Laplace transforms, Fourier's transforms, Z-transform, Types of integral equations, Replacement Lemma, BVP and Fredholm integral equation, IVB and Volterra integral equation, Abel's integral equation, Integral equation and its relation to algebraic equations, Domain decomposition method for solving Fredholm integral equation, Domain decomposition method for solving Volterra integral equation, Resolvent kernel

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- K.A. Stroud and Dexter J. Booth, Advanced Engineering Mathematics, Bloomsbury Publishing, 2020.
- Andrei D. Polyanin and Alexander V. Manzhirov, Integral Equations, CRC Press, New York, 2018.
- Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons Inc, New York, 2018.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 417	Fluid mechanics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Equation of continuity and boundary conditions, Rate of change of linear motion – Equation of motion of an inverted fluid, Energy equation, Rotational motion, Presume equation, Theorems of Blazes theorem, Katte and Jorukousbi, two dimensional motion steam, Recline monition vortex sheet.

References:

- Cengel, Fluid Mechanics: Fundamentals and Application, Mc Graw Hill, India, 2019.
- Jiyuan Tu, Computational Fluid Dynamics: A Practical Approach, Butterworth-Heinemann, 2018.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 418	Analytical mechanics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Newtonian Mechanics, Rectilinear motion of a particle, Lagrange's equation of motion, Non-inertial reference systems, Gravitation and central forces, Dynamics of systems of particles, Mechanics of rigid bodies in three dimensions, Oscillations.

References:

- Hanspeter Schaub and John L. Junkins, Analytical Mechanics of Space Systems, AIAA American Institute of Aeronautics and Ast., 2018.
- Mark H. Holmes, Introduction to the Foundations of Applied Mathematics, Springer, 2019.



Code	Title	Credit Hours	Contact Hours			Grades		
BAS 419	Theory of Elasticity		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Elasticity, Stress, Hooke's law, Plane stress and plane strain, Measurement of surface strains, Equilibrium compatibility equations, Stress function, Two dimensional problems in the form of a Fourier series, Gravity Loading, small distortions in homogeneous solid objects, Manufacturing operations and the formation of minerals are distortions plastic metal.								
References: E. H. Love, A Treatise on the Mathematical Theory of Elasticity, Wentworth Press, 2019. - Mark H. Holmes, Introduction to the Foundations of Applied Mathematics, Springer, 2019.								

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 510	Linear spaces		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Algebra of vectors in n- dimensional space, Linear spaces, Linear subspaces, Euclidian vector space, Base and dimension, Linear transformations, Matrix of Linear transformation, Kernel and image, Functions of matrices of repeated eigenvalues, Graph theory, Matrix of graph, Directed graphs.								
References: - Mukesh Kumar, Linear Algebra, Medtech, India, 2021. - Gregory T. Lee, Abstract Algebra, Springer International Publishing AG, 2018. - Peter J. Olver and Cheharzad Shakiban, Applied Linear Algebra, Pearson Education, U.S.A, 2018.								

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 511	Advanced engineering mathematics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Linear dependence and independence vectors and functions, Wronskian, Second and higher order linear differential equations, The operator D and its inverse with its application on particular solutions, Euler's equation, Fourier series and kinds of functions, Fourier integrals, Laplace transforms and its inverse with its applications on differential equations with constant coefficients, Special functions (Gamma, Beta and the relation of them), Partial differential equations with constant coefficients, Solution of ordinary differential equations in series.								
References - Frank T. Smith, Hemen Dutta and John N. Mordeson, Mathematics Applied to Engineering, Modelling, Springer Nature Switzerland AG, 2020. - K.A. Stroud and Dexter J. Booth, Advanced Engineering Mathematics, Bloomsbury Publishing, 2020. - Donald E. Marshall, Complex Analysis, Cambridge University Press, 2019. - Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons Inc, New York, 2018.								



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Code	Title	Credit Hours	Contact Hours			Grades		
BAS 512	Real analysis		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Set of real numbers, Countable sets, Sequences of real numbers, Differentiation of real functions, Sequences and series of real functions, The mean value theorem in integration, Theory of measure, Measure of sets, Lebesgue's conditions for measure, Sequences of sets, Lebesgue's integration theory, Comparison between Riemann's and Lebesgue's integration, Homeomorphic spaces.								
References - K.A. Stroud and Dexter J. Booth, Advanced Engineering Mathematics, Bloomsbury Publishing, 2020. - Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons Inc, New York, 2018. - John Bird, Engineering Mathematics, Elsevier, New York, 2017. - Alan Jeffrey, Advanced Engineering Mathematics, Harcourt Academic Press, New York, 2016.								

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 513	Numerical methods		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Errors analysis, Approximation, Finite difference discretization for solving second order ordinary differential equation, Numerical solution of partial differential equations, Wave equation, Heat equation, Laplace equation, Chebyshev Polynomials. Method of stability of linear systems, Bifurcation and topological methods and Non-linear systems, Repetition and anxiety, Splines and its applications.								
References - Hari Arora, Numerical Methods for Engineers and Scientists, S.K. Kataria and Sons, 2021. - Kendall Atkinson, Theoretical numerical analysis, Springer Science+Business Media, New York, 2019. - Timothy Sauer, Numerical analysis, Pearson Education, Inc. New York, 2018.								
Code	Title	Credit Hours	Contact Hours			Grades		
BAS 514	Applied mathematics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Coordinates and constraints, Vectorial equations of motion, Lagrange and Hamilton equations, Variational principles, Rigid body motion, Stability, Linear vibration of multi-degree of freedom systems, Vibration of continuous systems, longitudinal and tensional vibrations, Approximate methods, Theory of special relativity through analytical mechanics.								
References - Mark H. Holmes, Introduction to the Foundations of Applied Mathematics, Springer, 2019. - Church Irving Porter, Mechanics of Engineering: Comprising Statics and Dynamics of Solids, the Mechanics of the Materials, Wentworth Press, 2019.								



Code	Title	Credit Hours	Contact Hours			Grades		
BAS 610	Functional analysis		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Normed spaces, Hilbert spaces, Dual spaces, Linear operators, Bounded linear operators, Spectral theory, Dual Operators, Self-adjoint bounded operators, Normed operators, Unitary operators, Banach algebras, Symmetric operators.								
References: - K.A. Stroud and Dexter J. Booth, Advanced Engineering Mathematics, Bloomsbury Publishing, 2020. - Donald E. Marshall, Complex Analysis, Cambridge University Press, 2019. - John Bird, Engineering Mathematics, Elsevier, New York, 2017.								

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 611	Optimization and expert systems		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Integer linear programming problems, cutting plane method, Branch and bound method, Multiple objective programming problems, Scalarization method, Interactive methods, Goal programming problems, Modified simplex method, Large scale problems, Fuzzy problems, Stochastic problems, Meta-heuristic optimization techniques, Expert systems.								
References: - Hari Arora, Numerical Methods and Optimization, S.K. Kataria and Sons, 2021. - Jorge Nocedal and Stephen J. Wright, Numerical optimization, Springer Science+Business Media, New York, 2018. - Hamdy A. Taha, Operations Research, Pearson Prentice Hall, New Jersey, 2017.								
Code	Title	Credit Hours	Contact Hours			Grades		
BAS 612	Statistics and probability distributions		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Random variables (discrete, continuous), Probability density function(discrete, continuous), Probability function(discrete, continuous), Expectation, Variance, Standard deviation, Transformation of random variables, Moment generating function(discrete, continuous), Probability density function of two variables (discrete, continuous), Correlation coefficient, Covariance, Exponential distribution, Chi –squared distribution, Gamma distribution, Beta distribution, t-Distribution, Testing of assumptions (hypothesis), Markov Chains, Statistics and quality control.								
References: - David Forsyth, Probability and Statistics for Computer Science, Springer International Publishing, Switzerland AG, 2018. - Ronald Walpole, Raymond Meyers, Probability and Statistics for Engineers and Scientists, Pearson Education Limited, 2016. - Prasanna Sahoo, Probability and Mathematical Statistics, University of Louisville, U.S.A, 2016. - Ronald E. Walpole, Raymond H. Myers, Probability and Statistics for Engineers and Scientists, Pearson Education Inc., 2016.								



Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 613	Differential and integral equations	3	2	2	0	60	0	40

Contents:

The Existence and the uniqueness of a solution of the initial value problem, Linear systems of differential equations, Existence and uniqueness of solution of linear systems, Nonlinear systems, Stability in nonlinear systems, Lyapunov method for determining stability, Perturbation method, Applications in electric circuits theory, Applications in dynamic systems, Conservative systems.

References

- Andrei D. Polyanin and Alexander V. Manzhirov, Integral Equations, CRC Press, New York, 2018.
- William A. Adkins and Mark G. Davidson, Ordinary Differential Equations, Springer Science+Business Media, New York, 2016.
- J. David Logan, Applied Partial Differential Equations, Springer International Publishing, Switzerland, 2015.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 614	Fluid dynamics	3	2	2	0	60	0	40

Contents:

The motion of an electrically conductive fluid in the presence of magnetic fields, Survival of mass and the amount of movement and energy, Hydromagnetic flow of viscous and incompressible fluids, Magnetic fluid waves, Wave patterns that propagate in fluids, Linear theory of water waves, Transmission, Decay, Refraction and diffraction of waves, Effect of friction and the Earth's rotation, Forces resulting from the waves, Nonlinear waves.

References:

- Cengel, Fluid Mechanics: Fundamentals and Application, Mc Graw Hill, India, 2019.
- Jiyuan Tu, Computational Fluid Dynamics: A Practical Approach, Butterworth-Heinemann, 2018.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 615	Mechanics of water waves	3	2	2	0	60	0	40

Contents:

Transformation of surface waves diffused by the coastal structures and by the prevailing water currents, Coincidence of diffraction with refraction, Synchronization of absorption with the reflection, Synchronization of decay with the shatter, Propagation of irregular surface waves, Distribution of the spectra of wave directions and heights, Forces that the long waves affect and the possibilities of generating energy from them, Surface waves limited altitude and nonlinear theories of waves, Deep sea waves during seasons that form layers of density.

References

- Thomas J. Bridges, "Lectures on the Theory of Water Waves", Cambridge University Press; 1st edition, 2016.
- Cengel, Fluid Mechanics: Fundamentals and Application, Mc Graw Hill, India, 2019.
- Jiyuan Tu, Computational Fluid Dynamics: A Practical Approach, Butterworth-Heinemann, 2018.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral /	Course	Oral /	Final
BAS	Discrete							



616	Mathematics				Practical	Work	Practical	Exam
		3	2	2	0	60	0	40
<u>Contents:</u> Set theory, Power sets, Classes of sets, Relations and equivalence relations, Functions and algorithms, Logic and propositional calculus, Counting techniques, Graph theory, Regular graphs, weighted graphs, Directed graphs, Tree graphs, Planar graphs, Properties of integer numbers, Fundamental theorem of arithmetic, Ordered sets and lattices, Applications on computer.								
<u>References</u> - Harry Lewis and Rachel Zax, Essential Discrete Mathematics for Computer Science, Princeton University Press, U.S.A, 2019. - Kenneth H. Rosen, Discrete Mathematics and Its Applications, McGraw Hill Education, 2018. - Kenneth H. Rosen, Discrete Mathematics and Its Applications, McGraw-Hill Higher Education, 2018.								

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 617	Differential equations and numerical methods	3	2	2	0	60	0	40
Contents: Finite differences method, Consistency and accuracy, Convergence of the schemes, Nonlinear implicit finite difference equations. Higher order ordinary differential equations, Systems of first order ordinary differential equations, The equilibrium (boundary-value) method, Higher order equilibrium methods, The equilibrium method for nonlinear boundary-value problems, Elliptic equations, Parabolic equations, Hyperbolic equations, Heat equation, Wave equation, Dirichlet boundary conditions, Neumann boundary conditions, Finite element method, Finite difference solution of the Poisson equation, Finite element method for the Poisson equation.								
References - Hari Arora, Numerical Methods for Engineers and Scientists, S.K. Kataria and Sons, 2021. - Steven Krantz, Differential Equations : A Modern Approach with Wavelets, Taylor and Francis Ltd, 2020. J. David Logan, Applied Partial Differential Equations, Springer International Publishing, Switzerland, 2015. T. Witelski and M. Bowen, Methods of Mathematical Modeling: Continuous systems and differential equations, Springer International Publishing, Switzerland, 2015.								

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 618	Fractional calculus	3	2	2	0	60	0	40
Contents: Gamma Function and its properties, Beta Function, Mittag Leffler function and its relation to other functions, The Laplace transform of Mittag Leffler function in two parameters, Derivative of Mittag Leffler function, Integration of Mittag Leffler function, Generalized replacement lemma and fractional integral, Crinwald Letnikov fractional derivative, Riemann Liouville fractional derivative, Relation between Riemann Liouville and Crinwald Letnikov, Fractional derivative, Caputo fractional derivative, Leibniz rule for fractional derivative, Laplace transform for fractional derivative, Introduction to fractional differential equations, Weyl transform and Weyl fractional calculus.								
References								



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- Glyn James and Phil Dyke, Modern Engineering Mathematics, Pearson Education Limited, 2020.
- Frank T. Smith, Hemen Dutta and John N. Mordeson, Mathematics Applied to Engineering, Modelling, Springer Nature Switzerland AG, 2020.
- K.A. Stroud and Dexter J. Booth, Advanced Engineering Mathematics, Bloomsbury Publishing, 2020.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 619	Solid mechanics and construction dynamics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Wave propagation in solids, System response, Shift function and influence coefficients, Normal vibration patterns, Resonance of discrete and continuous mass distributions, Forced diminished vibrations, Reflection and transmission of elastic surface waves, Stress waves in multi-layer medium, Rods, Plates, Rings.

References

- Thomas J. Bridges, Lectures on the Theory of Water Waves, Cambridge University Press, 2016.
- Li-Feng Ge, Solid Acoustic Waves and Vibration: Theory and Applications, World Scientific Publishing Company, 2021.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 710	Advanced topics in operations research		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Mathematical techniques for solving vector optimization problems, Linear and nonlinear, Parametric analysis of mathematical programming problems, Methods of solution of fuzzy optimization problems, Methods of solution of rough problems, Multi-level optimization problems, Evolutionary approaches for solving optimization problems.

References

- Nicholas N. Olenov, Yuri G. Evtushenko, Optimization and Applications, Springer Nature Switzerland AG, 2021.
- Hari Arora, Numerical Methods and Optimization, S.K. Kataria and Sons, 2021.
- Jorge Nocedal and Stephen J. Wright, Numerical optimization, Springer Science+Business Media, New York, 2018.
- Hamdy A. Taha, Operations Research, Pearson Prentice Hall, New Jersey, 2017.
- David G Luenberger and Yinyu Ye, Linear and Nonlinear Programming, Springer Science+Business Media, New York, 2016.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 711	Advanced topics in engineering mathematics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Boundary value problems and Sturm, Liouville theory, Linear homogeneous boundary value problems, Eigenvalues and Eigen functions, Sturm Liouville B.V.P, Non homogeneous BVP, Construction of Green's function for ordinary differential equations, Using Green's function in the solution of boundary value problems, Boundary, value problems containing a parameter reducing them to integral equations, Singular integral equations, Approximate methods of solving integral equations, Differential equations with deviating arguments, Types of equations with a deviating argument, Existence and uniqueness theorems for the solution.

References

- Glyn James and Phil Dyke, Modern Engineering Mathematics, Pearson Education Limited, 2020.



- Frank T. Smith, Hemen Dutta and John N. Mordeson, Mathematics Applied to Engineering, Modelling, Springer Nature Switzerland AG, 2020.
- K.A. Stroud and Dexter J. Booth, Advanced Engineering Mathematics, Bloomsbury Publishing, 2020.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 712	Probability and statistical analysis		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Data analysis, sampling techniques, qualitative and quantitative data, Hypothesis testing using the binomial distribution, choosing significance level, Hypothesis testing the confidence intervals using the normal distribution, The approximation, The linear combination of random variable, Bayesian statistics, Statistical quality control.

References:

- L. Montgomery, Applied Statistics and Probability and Statistics for Engineers, John Wiley and Sons Ltd, 2020.
- Kishor S. Trivedi, Probability and Statistics With Reliability, Queuing And Computer Science, John Wiley and Sons INC, 2018.
- Sheldon Ross, Stochastic Processes, John Wiley and Sons INC, 2018.
- David Forsyth, Probability and Statistics for Computer Science, Springer International Publishing, Switzerland AG, 2018.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 713	Integral equations		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Linear equations of the first kind and second kind with variable limit of integration, equations whose kernel contains exponential functions, hyperbolic functions, logarithmic functions, trigonometric and inverse trigonometric functions, Bessel functions, Legendre functions, Nonlinear equations of the first kind and second kind with constant limit of integration, Methods for solving the integral equations.

References

- Samad Noeiaghdam and Denis N. Sidorov, Integral Equations : Theories, Approximations and Applications, MDPI AG, 2021.
- Andrei D. Polyanin and Alexander V. Manzhirov, Integral Equations, CRC Press, New York, 2018.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 714	Waves and Vibration Theory		Lect.	Tut.	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

The theory of elasticity rate of stress and rate of strain, The basic elasticity equation, The basic relationships, Three-dimensional fatigue, Issue of level stress, The state of flat strain, The implicit work theory of the plane stress issue, Free and short vibrations for systems with one degree of freedom, Free and short vibrations for systems with multiple degrees of freedom, Vibrations, Continuous systems and vibratory analysis.

References

- Li-Feng Ge, Solid Acoustic Waves and Vibration: Theory and Applications”, World Scientific Publishing Company, 2021.
- Church Irving Porter, Mechanics of Engineering: Comprising Statics and Dynamics of Solids, The Mechanics of the Materials, Wentworth Press, 2019.



2) Engineering Physics Program

1. Advanced Diploma in Engineering Physics

A graduate of the advanced diploma in engineering physics should be able to:

1. Apply the specialized knowledge he has acquired in his practice.
2. Understand and assimilate all theories and basics in the field of engineering physics.
3. Understand and understand physical and mathematical equations in addition to analyzing them.
4. Identifying and analyzing problems in the field of specialization and arranging them according to their priorities.
5. Acquiring extensive knowledge in the basic fields of applied physics and advanced knowledge in practical training in one of the applied physics disciplines.
6. Dealing with accurate devices and preparing to work in scientific laboratories.
7. Completion of research projects that contribute to scientific progress in one of the fields of experimental or computational physics or theoretical modeling.
8. Decision making in the light of the available information.
9. Commitment to integrity, credibility, the rules of the profession and accepting accountability.
10. Realizing the necessity of self-development professionally and scientifically.
11. The ability to use the techniques, skills, scientific tools and modern techniques necessary for professional practice.

Table 8. 2. 1 Qualifying courses of basic diploma in Engineering Physics*

S. N	Code	Course Title	Prerequisite(s)	Credit Hours	Grades				Exam duration
					course work	Oral / practical	Written exam	Total	
1	BAS 420	Solid State Physics	–	3	60	0	40	100	2
2	BAS 421	Physics of Semiconductors	–	3	60	0	40	100	2
3	BAS 422	Nuclear physics	–	3	60	0	40	100	2
4	BAS 423	General Engineering Physics	–	3	60	0	40	100	2
5	BAS 424	Atomic Physics	–	3	60	0	40	100	2
6	BAS 425	Quantum Mechanics	–	3	60	0	40	100	2
7	BAS 426	Mathematical Physics	–	3	60	0	40	100	2
8	BAS 427	Electromagnetics	–	3	60	0	40	100	2
9	BAS 428	Statistical Mechanics	–	3	60	0	40	100	2
10	BAS 429	Materials Science	–	3	60	0	40	100	2

*The student should have a bachelor of engineering degree from Egyptian universities or a degree accredited by the Egyptian Supreme Council of Universities and wishes to complete postgraduate studies in engineering physics chooses (8) courses (24) credit hours) from Table (8.2.1) according to the specialization determined by the department council, to study them in two semesters (other than the summer semester) and passed with a cumulative average (3) points or more.



Table 8. 2. 2 Compulsory courses of basic diploma in Engineering Physics

S. N.	Code	Course Title	Prerequisite(s)	Credit Hours	Grades				Exam duration
					course work	Oral / practical	Written exam	Total	
1	GEN 501	Technical writing and presentation skills	–	2	60	0	40	100	2
2	GEN 502	Statistics and random processes	–	2	60	0	40	100	2

Table 8. 2. 3 Elective courses of basic diploma in engineering physics*

S. N.	Code	Course Title	Prerequisite(s)	Credit Hours	Grades				Exam duration
					course work	Oral / practical	Written exam	Total	
1	BAS 520	Materials Characterization	–	3	60	0	40	100	2
2	BAS 521	Principles of Laser Physics	–	3	60	0	40	100	2
3	BAS 522	Advanced semiconductor Physics	–	3	60	0	40	100	2
4	BAS 523	Advanced Light Physics	–	3	60	0	40	100	2
5	BAS 524	Advanced Mathematical Physics	–	3	60	0	40	100	2

*The student chooses (with help of the academic advisor) (3) courses from Table (8.2.3) according to the specialization determined by the department council to study.

Table 8. 2. 4 Elective Courses of advanced diploma in Engineering Physics*

S. N.	Code	Course Title	Prerequisite(s)	Credit Hours	Grades				Exam duration
					course work	Oral / practical	Written exam	Total	
1	BAS 620	Advanced Quantum Mechanics	–	3	60	0	40	100	2
2	BAS 621	Advanced Laser Physics	–	3	60	0	40	100	2
3	BAS 622	Laser Spectroscopy	–	3	60	0	40	100	2
4	BAS 623	Nuclear Reaction Physics	–	3	60	0	40	100	2
5	BAS 624	Selected Topics in Solid State Physics	–	3	60	0	40	100	2



*The student chooses (with help of the academic advisor) (4) courses from Table (8.2.4) according to the specialization determined by the department council to study.

2. Master of Science (M. Sc.) Degree in Engineering Physics

A holder of a Master of Science in engineering physics should be able to:

1. Apply the basics and methodologies of scientific research and use its various tools.
2. Using the analytical and applied method in the field of specialization.
3. Applying specialized knowledge and merging it with relevant knowledge in research studies.
4. Show awareness of current problems and modern visions in the field of specialization.
5. Defining research problems and finding solutions to them.
6. Using appropriate technological means to serve research studies.
7. Develop himself academically and research and capable of continuing education.
8. Understand the ethical and legal principles of scientific research in the field of specialization.
9. Presenting suggestions to solve specialized problems with the lack of some data.
10. Conducting a research study or writing a systematic scientific study on a research problem.
11. Mastering basic and modern research skills in the field of specialization.
12. Writing reports and research papers.

Table 8. 2. 5 Thesis of Master of Science (M. Sc.))in Engineering Physics

Code	Title	Prerequisite(s)	Credit Hours
BAS 821	M. Sc. Thesis	Average GPA 3 in advanced diploma and at least grade 2.7 in all courses of basic and advanced diploma.	12



3. Doctor of Philosophy (Ph. D.) in Engineering Physics

A holder of a Ph.D. in Engineering Physics should be able to:

1. Mastering the basics and methodologies of scientific research.
2. Continuous work to add knowledge in the field of specialization.
3. Applying the analytical and empirical critical approach to knowledge in the field of specialization and related fields.
4. Show awareness of current problems and modern visions in the field of specialization.
5. Identifying research problems and finding solutions to them.
6. Using appropriate technological means to serve research studies.
7. Mastering the scientific skills in the field of specialization.
8. Suggest solutions to specialized problems in light of the available information.
9. Act in a manner that reflects commitment to integrity, credibility and the rules of scientific research.
10. Mastering basic and modern research skills in the field of specialization.
11. Writing and evaluating reports and research papers.

Table 8. 2. 6 Basic courses of Philosophy Doctorate in Engineering Physics*

S. N.	Code	Course Title	Prerequisite(s)	Credit Hours	Grades				Exam duration
					course work	Oral / practical	Written exam	Total	
1	BAS 625	Selected Topics in Nano Technology	–	3	60	0	40	100	2
2	BAS 626	Selected Topics in Nuclear Physics	–	3	60	0	40	100	2
3	BAS 627	Solar Energy	–	3	60	0	40	100	2
4	BAS 628	Heat Transfer in Solids	–	3	60	0	40	100	2
5	BAS 629	Semiconductor Nano-Particles	–	3	60	0	40	100	2

*With the help of the academic advisor, the student chooses (3) courses from table (8.2.6) according to the specialization determined by the department council to study.

Table 8. 2. 7 Specialized courses of Philosophy Doctorate (Ph. D) in Engineering Physics*

S. N.	Code	Course Title	Prerequisite(s)	Credit Hours	Grades				Exam duration
					course work	Oral / practical	Written exam	Total	
1	BAS 720	Standard Model for Nuclear Forces	--	3	60	0	40	100	2
2	BAS 721	Selected Topics in Photothermal	--	3	60	0	40	100	2



		Science							
3	BAS 722	Metal Science	--	3	60	0	40	100	2
4	BAS 723	Advanced Accurate Measurements	--	3	60	0	40	100	2
5	BAS 724	Selected Topics in New Energy	--	3	60	0	40	100	2

*By the recommendation of the supervisor, the student chooses (3) courses from Table (8.2.7) according to the specialization determined by the department council to study.

Table 8. 2. 8 Thesis of Doctor of Philosophy in engineering physics

Code	Name	Prerequisite(s)	Credit Hours
BAS 921	Ph. D Thesis	1. Average GPA 3 and at least grade 2.7 in all courses in basic and specialized Ph.D. 2. Pass the seminar of stage one of the academic research.	12

Matrices of Relation between Courses and Graduate Competencies

Matrix 8.2.1: Relation of Courses of Advanced Diploma In Engineering Physics and Graduate Competencies

س	Code	Course Title	Graduate Competencies										
			1	2	3	4	5	6	7	8	9	10	11
1	GEN 501	Technical writing and presentation skills									•	•	•
2	GEN 502	Statistics and random processes				•				•	•	•	
3	BAS 520	Materials Characterization	•	•							•	•	
4	BAS 521	Principles of Laser Physics	•	•							•	•	
5	BAS 522	Advanced semiconductor Physics	•	•			•		•		•	•	
6	BAS 523	Advanced Light Physics	•	•							•	•	
7	BAS 524	Advanced Mathematical Physics	•	•	•								
8	BAS 620	Advanced Quantum Mechanics	•	•	•						•	•	
9	BAS 621	Advanced Laser Physics	•	•							•	•	
10	BAS 622	Laser Spectroscopy	•	•			•	•	•		•	•	
11	BAS 623	Nuclear Reaction Physics	•	•			•	•	•		•	•	
12	BAS 624	Selected Topics in Solid State Physics	•	•	•						•	•	

Matrix 8.2.2: Relation of Courses of Master of Science In Engineering Physics and Graduate Competencies

S.	Code	Course Title	Graduate Competencies											
			1	2	3	4	5	6	7	8	9	10	11	12
1	GEN 501	Technical writing and presentation skills									•	•	•	



2	GEN 502	Statistics and random processes				.				.	.	.		
3	BAS 520	Materials Characterization	.	.							.	.		
4	BAS 521	Principles of Laser Physics	.	.							.	.		
5	BAS 522	Advanced semiconductor Physics	.	.			.		.		.	.		
6	BAS 523	Advanced Light Physics	.	.							.	.		
7	BAS 620	Advanced Quantum Mechanics	.	.	.									
8	BAS 621	Advanced Laser Physics	.	.	.						.	.		
9	BAS 622	Laser Spectroscopy	.	.							.	.		
10	BAS 623	Nuclear Reaction Physics	.	.			.	.	.		.	.		
11	BAS 624	Selected Topics in Solid State Physics	.	.			.	.	.		.	.		
12	BAS 821	M. Sc. Thesis	.	.	.	.	.	.	.	.	.	.	.	.

Matrix 8.3.3: Relation of Courses of Doctor of Philosophy In Engineering Physics and Graduate Competencies

S.	Code	Course Title	Graduate Competencies										
			1	2	3	4	5	6	7	8	9	10	11
1	BAS 625	Selected Topics in Nano Technology	.	.									
2	BAS 626	Selected Topics in Nuclear Physics	.	.									
3	BAS 627	Solar Energy	.	.									
4	BAS 628	Heat Transfer in Solids	.	.									
5	BAS 629	Semiconductor nano Particles	.	.									
6	BAS 720	Standard Model for Nuclear Forces	.	.									
7	BAS 721	Selected Topics in Photothermal Science	.	.									
8	BAS 722	Metal Science	.	.									
9	BAS 723	Advanced Accurate Measurements	.	.									
10	BAS 724	Selected Topics in New Energy	.	.									
11	BAS 921	Ph.D. Thesis	.	.	.	.	.	.	.	.	.	.	.

**COURSE DESCRIPTION**

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 420	Solid State Physics	3	2	2	0	60	0	40

Contents:

Crystal structure of solid, Periodical functions, Principals lattice theory, Principals of band theory.

References

- Yuri M. Galperin, Introduction to Modern Solid-State Physics, Blindern, Oslo, 2018.
- B.G. Yacobi, Semiconductor materials: An introduction of basic principle, Kluwer academic publishers, 2017.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 421	Physics of Semiconductors	3	2	2	0	60	0	40

Contents:

Crystal structure and electronic state, Charge carrier statistics, Translational motion of semiconductor charges, Attenuation processes.

References

- Donald A. Neamen, Semiconductor Physics and Devices: Basic Principles, Fourth Edition, Unrver5rh' ofh'ew Mei~c , 2019.
- Sze and Simon Min, Semiconductor devices: physics and technology, John Wiley & sons, 2018.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 422	Nuclear physics	3	2	2	0	60	0	40

Contents:

Principal properties of nucleus, Classification of the nuclear reactions, Nuclear accelerators Nuclear reaction and elementary particles detectors, Nuclear reactors.

References

- Close, Frank E., Nuclear Physics: A Very Short Introduction, Oxford University Press, USA, 2015.
- Stadelmann, Thilo, Martin Braschler, and Kurt Stockinger, Introduction to applied data science, Springer, 2019.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 423	General Engineering Physics	3	2	2	0	60	0	40

Contents:

Atomic structure and binding energy, Crystal structure of solid, Mechanical properties of materials, Properties of composed matter, Identification of internal structures, Introduction on wave mechanics, Electrical properties of semiconductors.

References

- Donald A. Neamen, Semiconductor Physics and Devices: Basic Principles, Fourth Edition, Unrver5rh' ofh'ew Mei~c , 2019.



Post Graduate Bylaw (Credit Hours System) 2023

- Sze and Simon Min, Semiconductor devices: physics and technology, John Wiley & sons, 2018.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 424	Atomic Physics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Zeeman effect, X- rays, Molecules and molecular spectra, Nuclear structure.

References

- Dover, Atomic Physics and Human Knowledge: Books on Physics, Paperback – Illustrated, 2016.
- Fujia Yang, Modern Atomic and Nuclear Physics, Fudan University, China, Vanderbilt University, USA, 2019.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 425	Quantum Mechanics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Quantum theory, Basic principles of Schrodinger wave equation, Time independent perturbation theory, Operators of the physical quantities, Wave equation of particles, Applications on Schrodinger equation, Treatments of the hydrogen and helium atoms.

References

- Norsen, Travis, Foundations of quantum mechanics, Springer, 2017.
- Sakurai, Jun John, and Eugene D. Commins, Modern quantum mechanics, Revised edition, 2018.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 426	Mathematical Physics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Basic concepts, Modeling, One dimensional wave equation, Separation of variables method, Delbert's method of wave equation, Two dimensional wave equation, Fourier transform and its properties, Solution of initial boundary value problems.

References

- Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd Edition, 2016.
- K. F. Riley, Mathematical Methods for Physics and Engineering: A Comprehensive Guide, 3rd Edition, 2019.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 427	Electromagnetics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Electrodynamics, Electrostatics, Scalar and vector potentials, energy density, Electric and magnetic fields, Time varying electric and magnetic fields, Maxwell equations of electromagnetic field, Interactions of electromagnetic field with matter, Emission of electromagnetic radiations from material surfaces.

References



Post Graduate Bylaw (Credit Hours System) 2023

- ELECTROMAGNETIC WAVE PROPAGATION, RADIATION, AND SCATTERING, AKIRA ISHIMARU, University of Washington, Seattle, WA, USA, IEE WILEY 2017.
- Electromagnetism: Maxwell Equations, Wave Propagation and Emission, Tamer Becherrawy, WILEY 2012
- MAXWELL'S EQUATIONS AND THE PRINCIPLES OF ELECTROMAGNETISM,, RICHARD FITZPATRICK, PH.D. University of Texas at Austin Infinity, Science Press LLC Hingham, Massachusetts New Delhi, 2008.
- Engineering Electromagnetics, William H. Hayat, Jr and John A. Buck, Mc Graw Hill Connect Learn ,Succeed, 1920

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 428	Statistical Mechanics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Introduction in thermodynamic, Maxwell equations in thermodynamics, Random distributions and entropy, Scientific estimation and equi-distribution functions of matter molecule groups, Maxwell, Boltzmann's statistics.

References

- Salasnich, Luca, Quantum physics of light and matter, 2017.
- K. F. Riley, Mathematical Methods for Physics and Engineering: A Comprehensive Guide 3rd Edition, 2019.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 429	Materials Science		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Material classifications according their internal structure, Different tools for classifications, Volume and surface properties of materials.

References

- Carter, C. Barry, and M. Grant Norton, Ceramic materials: Science and engineering, springer, 2017.
- Singh, Satya Bir, Alexander V. Vakhrushev, and A. K. Haghi, eds., Materials Physics and Chemistry: Applied Mathematics and Chemo-mechanical Analysis, CRC Press, 2020.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 520	Materials Characterization		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Optical Microscopy, X-ray Photoelectron Spectroscopy and Auger Electron Spectroscopy - Scanning Tunneling Microscopy (STM) and Atomic Force Microscopy (AFM), X-ray Diffraction, Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Chromatographic Methods, Infrared Spectroscopy and UV/Vis and Raman Spectroscopy, Macro and Micro Thermal Analyses, Laser Confocal Fluorescence Microscopy.

References

- Singh, Satya Bir, Alexander V. Vakhrushev, and A. K. Haghi, eds., Materials Physics and Chemistry: Applied



Post Graduate Bylaw (Credit Hours System) 2023

Mathematics and Chemo-mechanical Analysis, CRC Press, 2020.

- Klein, Lisa, Mario Aparicio, and Andrei Jitianu, eds., Handbook of sol-gel science and technology: Processing, characterization and applications, Springer, 2018.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 521	Principles of Laser Physics	3	2	2	0	60	0	40

Contents:

Diffraction theory of the Fabry Perot- laser properties, Einstein relations, relation between Einstein coefficient, Beers law, Absorption and Gain coefficient, Boltzmann distribution, Two level laser, Three- level laser, Four- level laser.

References

- Karl, F. Renk, Basics of Laser Physics for Students of Science and Engineering, Springer, 2017.
- Goyal, Rajendra Kumar, Nanomaterials and nanocomposites: Synthesis, properties, characterization techniques and applications. CRC Press, 2017.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 522	Advanced semiconductor Physics	3	2	2	0	60	0	40

Contents:

Electrons and holes in semiconductors, Generation and recombination, Analysis of pure and impure semiconductors, Concentration of charge carriers at balance, Position of Fermi levels, Continuity equation, Manufacturing technology, P-N junction, Continuity potential.

References

- Donald A. Neamen, Semiconductor Physics and Devices: Basic Principles, Fourth Edition, Unrver5rh' ofh'ew Mei~c, 2019.
- Sze, Simon Min, Semiconductor devices: Physics and technology, John Wiley & sons, 2018.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 523	Advanced Light Physics	3	2	2	0	60	0	40

Contents:

Light absorption, Light scattering, Interference of polarized light, Quantum light.

References:

- Grant R. Fowles, Introduction to Modern Optics: Dover Books on Physics) 2nd Edition , 2020.
- Liu, Hanzhe, Generation and Control of Solid-state High Harmonics at the Nanoscale, Stanford University, 2019.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 524	Advanced Mathematical Physics	3	2	2	0	60	0	40

Contents:

Methods of Mont Carlo and modeling, Approximation models for random fields, Solution of initial boundary value problems using Mont Carlo methods, Random processes and Marcophian series, Eigen values for solid matrices and Mont Carlo methods.



References

- K. F. Riley, Mathematical Methods for Physics and Engineering: A Comprehensive Guide, 3rd Edition, 2019.
- Carter, C. Barry, and M. Grant Norton, Ceramic materials: Science and engineering, Springer, 2017.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 620	Advanced Quantum Mechanics	3	2	2	0	60	0	40

Contents:

Principals of quantum mechanics, Quantum mechanics via matrices, Transformation theory, Helbart's space, Matrices and harmonic oscillator, Space and time transformation, Group theory, Density matrix and density operators.

References

- Quantum Mechanics, Concepts and Applications, Nouredine Zettili, Jacksonville State University, Jacksonville, USA, A John Wiley and Sons, Ltd., Publication. 2009 John Wiley & Sons, Ltd
- Quantum Mechanics for Scientists and Engineers, David A. B. Miller, Stanford University, Cambridge University Press 2008
- Quantum Concepts in Physics, An Alternative Approach to the Understanding of Quantum Mechanics, MALCOLM LONGAIR, Cavendish Laboratory, University of Cambridge, Cambridge Books Online © Cambridge University Press, 2014

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 621	Advanced Laser Physics	3	2	2	0	60	0	40

Contents:

Derivation of Planck's statement, Einstein coefficients, Natural broadening, Doppler broadening (Gaussian), Collisional broadening (Lorentzian), Relation between absorption, gain and pumping energy, Absorption coefficient, Rate statement, Saturation, Types of lasers (two energy levels system, Three energy levels system and four energy levels system, Fabry, Perot resonance function, Gain factor for a resonator filled with effective or not effective material, Tubes of Fabry-Perot cavity, Ruby laser, He-Ne laser, Nd-YAG laser principles of Holography.

References

- Goyal, Rajendra Kumar, Nanomaterials and nanocomposites: Synthesis, properties, characterization techniques, and applications, CRC Press, 2017.
- Satya Bir Singh, Materials Physics and Chemistry, Applied Mathematics and Chemo-Mechanical Analysis, 2021.

Code	Title	Credit Hours	Contact Hours			Grades		
			Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
BAS 622	Laser Spectroscopy	3	2	2	0	60	0	40

Contents:

Dependence of optical characterizations on light intensity, Second and third orders nonlinear media, Response of the linear media to the external effects, Optical hormones of polarization, Dependence of the trans mitting of media on light intensity, Photoelectric effect at multi-absorption of photons, Stimulated value of media, Optical gates and its theoretical basis, Self-focusing of laser beam, Conversion of an optical wave into another.

References

- Pradip Narayan Ghosh, Laser Physics and Spectroscopy, 2018.
- Satya Bir Singh, Materials Physics and Chemistry, Applied Mathematics and Chemo-Mechanical Analysis, 2021.



Code	Title	Credit Hours	Contact Hours			Grades		
BAS 623	Nuclear Reaction Physics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Nuclear reactions, Conservation laws of energy and momentum in nuclear reaction, Compound nucleus for projectiles, Nuclear reaction cross section, Nuclear collision at high energies, Methods of recording different nuclear reaction.								
References - Close, Frank E., Nuclear Physics: A Very Short Introduction, Oxford University Press, USA, 2015. - Stadelmann, Thilo, Martin Braschler, and Kurt Stockinger, Introduction to applied data science, Springer, 2019.								

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 624	Selected Topics in Solid State Physics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Identified by departmental council.								

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 625	Selected Topics in Nano Technology		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Identified by departmental council.								

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 626	Selected Topics in Nuclear Physics		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Identified by departmental council.								

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 627	Solar Energy		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40
Contents: Semiconductor Nanoparticles, Nanoscale materials and quantum mechanics, Nanoparticles synthesis. Photovoltaic effect, Current density-voltage (J-V) theory, First generation solar cells. Second generation solar cells, Third generation solar cells (Dye-sensitized solar cell (DSSC and quantum dots solar cells), Adsorption								



techniques of QDs onto the wide band gap nanostructured semiconductor.

References

- Tsurumi, Takaaki, Hiroyuki Hirayama, Martin Vacha, and Tomoyasu, Nanoscale physics for materials science, CRC Press, 2019.
- Satya Bir Singh, Materials Physics and Chemistry, Applied Mathematics and Chemo- Mechanical Analysis, 2021.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 628	Conduction of heat in Solids		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Conduction of heat in an isotropic solid, The differential equation of conduction of heat in an isotropic solid, The differential equation of conduction of heat in a moving medium, Conduction of heat an anisotropic solid, linear flow of heat, cylindrical and spherical flow of heat, Laplace transformation of linear, cylindrical and spherical flow of heat.

References:

- Venkateshan, S. P., Introduction to the Study of Heat Transfer, Springer, 2021.
- Theodore L. Bergman, Fundamentals of Heat and Mass Transfer, 7th Edition, Binder Ready Version, 2019.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 629	Semiconductor nano Particles		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Nanotechnology History, Nanoparticles synthesis and its applications. Semiconductor nanoparticles, From atoms to molecules and quantum dots. Shrinking bulk material to a quantum dot, Three-dimensional systems, Two-dimensional systems, One-dimensional systems, Zero-dimensional systems (quantum dots).

References

- Yuri M. Galperin, Introduction to Modern Solid-State Physics, Department of Physics, Blindern, Oslo, 2018.
- B .G. Yacobi, Semiconductor materials: An introduction of basic principle, Kluwer academic publishers, 2017.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 720	Standard Model for Nuclear Forces		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Electromagnetic interactions, Weak interactions and exchange particles, Unifications of interactions, Strong interactions, Standard model of interactions.

References

- Close, Frank E., Nuclear Physics: A Very Short Introduction, Oxford University Press, USA, 2015.
- Stadelmann, Thilo, Martin Braschler, and Kurt Stockinger, Introduction to applied data science, Springer, 2019.

	Title	Credit	Contact Hours			Grades		



Code		Hours						
BAS 721	Selected Topics in Photothermal Science		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Thermal wave, Optical generation of thermal wave, Photothermal effect, Instrumentation and detection techniques, Thermal wave characterization of semiconductors, Thermal and optical property determination by photothermal techniques.

References:

- Bialkowski, Stephen E., Nelson GC Astrath, and Mikhail A. Proskurnin, Photothermal Spectroscopy Methods, John Wiley & Sons, 2019.
- Tkachenko, Nikolai V., Optical spectroscopy: Methods and instrumentations, Elsevier, 2016.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 722	Metal Science		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Materials states (liquid, amorphous, crystals), Crystal structure of metals, Microscopic investigation (light reflecting microscope, electron microscope), Methods of preparation of samples, Mechanical investigation (measuring of rigidity, stress-strain curves), Crystal defects, Diffusion in solids, Thermal treatment of solids, Reinforcing and its methods.

References

- Gaskell, David R., and David E. Laughlin, Introduction to the Thermodynamics of Materials, CRC press, 2017.
- Smallman, Raymond Edward, Modern physical metallurgy, Elsevier, 2016.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 723	Advanced Accurate Measurements		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Study of material properties using advanced methods like transition electron microscope, thermal and spectroscopic analysis equipment, Training on using of data base for analysis of studying of materials.

References

- Gao, Precision Nanometrology, Springer Series in Advanced Manufacturing, 2020.
- Scordo, Alessandro, High Precision X-Ray Measurements, Condensed Matter, 2019.

Code	Title	Credit Hours	Contact Hours			Grades		
BAS 724	Selected Topics in New Energy		Lecture	Tutorials	Oral / Practical	Course Work	Oral / Practical	Final Exam
		3	2	2	0	60	0	40

Contents:

Identified by departmental council.