Benha University

Faculty of Engineering- Shoubra

Electrical Engineering Department

Third year power

23 January 2017

Electrical Machines(2)

- Answer all the following questions
- Illustrate your answers with sketches when necessary.
- The examination consists of one page
- No. of questions: 3
- Total Mark: 100 Marks

2.a) What are the various methods of starting of three-phase induction motors? Discuss them. **(12 Marks)**

b) A 50 h.p., 3-phase, 4-pole , 50 Hz induction motor has a full-load efficiency of 85%. The friction and windage losses are one-third of the no-load losses and rotor copper losses equal the iron losses at full-load. stator resistance can be neglected. Find

(i) The input power. (ii) Iron losses. (iii) Input power to the rotor. (iv) Output mechanical power. (v) Rotor copper losses. (vi) Full-load slip. (vii) Full-load speed.

(22 Marks)

Solution of Question No. (2)electrical machines(2)3rd year power

Question No. (2)

a) Method of starting of three-phase induction motors

(i) Direct-on line starting

used for motor up to 10 Hp

(ii) stator resistance starting

(iii)stator reactance starting

(iv) auto transformer starting

(v) star/delta starting

for wound rotor in addition to the previous method control the rotor resistance used in starting induction motor

b) P_{out}=50x746=37300 W

(i) P_{in}=P_{out}/η P_{in}=37300/0.85=43882.4 W

total losses=iron losses +stator copper losses +rotor copper losses +friction and windage losses

stator copper losses are neglected as the stator resistance is neglected

No-load losses= iron losses +friction and windage losses

Total losses= input power-output power

total losses=43882.4-37300=6582.35W

No-load losses=iron losses +(1/3) (No-load losses)

iron losses=(2/3) No-load losses

rotor copper losses=iron losses

Total losses=(7/3)iron losses

6582.35=(7/3)iron losses

(ii) iron losses=2821 W

(v) rotor copper losses=2821 W

input power to the rotor =rotor copper losses/s(iii) P_g=2821/0.068=41485.3 W

friction and windage =(1/2) iron losses   friction and windage=1410.5W

mechanical power=output power+friction and windage

(iv) mechanical power=37300+1410.5=38710.5 W

mechanical power=rotor copper losses (1-s)/s

$38710.5=2821(1-s)/s$

$13.72=(1-s)/s$ (vi) $s=0.068$

$n_s=60xf/p$ $n_s=60x50/2=1500rpm$

(vii) $n=n_s(1-s)=1500x(1-.068)=1398$ rpm