Total No. of printed pages = 4

19/4th Sem/UEE 401

2022

ELECTRICAL MACHINES

Full Marks – 100

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer *any five* questions.

1. (a) Draw symbolic diagrams of different types of DC generators clearly showing the proper current directions and also write the voltage and current equations for each type. 2×5=10

   (b) Draw a cross-sectional view of a 4-pole DC generator showing the flux path. Also write briefly about the principal components of DC generator. 4+6=10

2. (a) Write about the various types of losses in a DC motor. Show the power stages of a DC motor and find mechanical, electrical and commercial efficiencies. 10

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(b) A 220V shunt motor takes 105A. The armature resistance is 0.08Ω and shunt field resistance is 44Ω. The motor runs at 950 rpm. If iron and frictional losses are equal to 2kW, find : 10

(i) BHP

(ii) Total torque

(iii) Shaft torque.

3. (a) What are the assumptions of an ideal transformer ? What do you mean by the no-load condition of a transformer ? Explain the equivalent circuit and phasor diagram of no-load condition of transformer. 4+1+5=10

(b) A 40 kVA transformer has iron loss of 450W and full load copper loss of 850W. If the power factor of the load is 0.8 lagging, calculate :

(i) full-load efficiency

(ii) the kVA load at which maximum efficiency occurs and

(iii) maximum efficiency. 10

4. (a) Derive an expression for starting torque of three phase induction motor. Also find the condition for maximum starting torque. Is there any effect of change in supply voltage on the starting torque ? 5+3+2=10

(b) A 3-phase, 500V, 50Hz induction motor with 6-poles develops 20 b.h.p. at 950 rpm with a power factor of 0.86 (lag). The mechanical losses total 1 hp. Calculate for this load :

(i) the slip

(ii) the rotor cu-loss

(iii) the input if the stator losses total 1500W

(iv) the line current. 10

5. (a) With neat diagrams, explain the following methods of starting of 3-phase induction motors :

(i) DOL starting

(ii) stator resistance starting

(iii) stardelta starting. 10

(b) A 6-pole, 50Hz, 3-phase induction motor runs at 960 rpm, when the torque on the shaft is 200N-m. If the stator losses are 1500W and friction and windage losses are 500W, find

(i) rotor Cu-loss and

(ii) efficiency of the motor. 10

6. (a) What are stepper motors ? With neat diagrams briefly explain the operation of PM stepper motor. Show the truth table with applied voltage waveforms. 2+8=10

(b) What do you mean by step angle and stepping rate of a stepper motor ? Derive a relation for step angle (α). Calculate the stepping angle for

(i) a 3-phase, 16 tooth rotor VR motor

(ii) a 3-phase, 24-pole PM motor. 5+5=10