(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2022 Roll No. 2 4 0 3 5 9 0 6 4

B.Tech.

FOURTH SEMESTER EXAMINATION, 2004-2005

ELECTRICAL MACHINES

Time : 3 Hours *Total Marks : 100*

Note : *(i) Answer all the **five** questions.*

(ii) All questions carry equal marks.

(iii) In case of numerical problems assume data wherever not provided.

1. Answer ***any four*** of the following : **(5x4=20)**

(a) Based on field winding and armature winding connections and schematic diagrams, explain different types of d.c. machines.

(b) A 1500 kW, 600 V, 16-pole separately excited dc generator runs at 200 rpm. It has 2500 lap connected conductors and full load copper losses are 25 kW. Calculate the useful flux per pole.

(c) Draw and explain the following characteristics of dc generators.

(i) No-load and load magnetisation characteristics

(ii) External and Internal characteristics

(d) A series motor takes 20 A at 400 V to drive a load whose torque is proportional to square of the speed at 250 rpm. Determine the necessary applied voltage and current to drive the said load at 350 rpm. Assume straight line magnetising characteristic.

00 435

(e) A 120 V dc shunt motor has an armature resistance of 0.2 Ω and a brush volt drop of 2 V. The rated full load armature current is 75 A. Calculate the current at the instant of starting and its value in terms of percentage of full load armature current. Assume field winding resistance of 120 Ω.

(f) Define armature reaction and discuss its effects on the performance of dc machines.

2. Answer *any four* of the following : **(5x4=20)**

(a) Considering a dc shunt motor driver hoist, explain motoring and counter current braking quadrant operation of dc motor. Supplement answer with the help of speed torque characteristic.

(b) A 10 kW, 250 V dc shunt motor with an armature resistance of 0.8 Ω and a field resistance of 275 Ω takes 3.91 A, when running light at rated voltage and speed. Calculate the efficiency when the machine runs as a generator delivering an output of 10 kW at rated voltage and speed.

(c) Define Transformer. Explain its construction and working.

(d) Draw no-load phasor diagram of transformer and explain significance of each phasor. Also draw corresponding equivalent circuit.

(e) Discuss the effects of load and load power factor on the efficiency of transformer. Obtain expression for fraction of load at which maximum efficiency occurs.

(f) Define voltage regulation of transformer and explain its significance. With the help of approximate equivalent circuit and phasor diagram, obtain an expression for it.

3. Answer *any two* of the following : **(10x2=20)**

(a) A 5 hp, 230 V, 50 Hz induction motor has a rated full load slip of 950 rpm. The induced voltage per phase of rotor at stand still is 100 V. Calculate.

(i) Number of poles and percentage full load slip.

(ii) Rotor induced voltage and its frequency at full load.

(b) Discuss the advantages and limitations of three single phase transformer connected in a bank over one three phase transformer. Also explain the principal features of any four common three phase transformer connections.

(c) What is an autotransformer ? Also show that for the same capacity and voltage ratio, the autotransformer requires less copper than a two winding transformer.

4. Answer *any two* of the following : **(10x2=20)**

(a) Explain construction and working of any one type of capacitor split phase induction motor. What type of capacitors are used ?

(b) Describe methods of speed control of three phase induction motors. Also mention advantages, limitations and application areas of each.

(c) With single line diagram, describe power flow in a three phase induction motor. Also explain why it is advantageous to operate induction motor with a slip as small as possible.

5. Answer *any two* of the following : **(10x2=20)**

(a) Define form factor, chording factor and breadth factor. Also derive emf equation of an alternator.

(b) Draw phasor diagram of a non-salient pole machine supplying full load at

(i) lagging power factor and

(ii) leading power factor

(c) Explain the operation of synchronous motors. Also describe their industrial applications.

- o O o -