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Roll No. of candidate | | | | | | | | | | |

2023

B.Tech. 3rd Semester End-Term Examination

ELECTRICAL MACHINES – I

(New Regulation & New Syllabus)

Full Marks – 70 Time – Three hours

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

Answer Question No. 1 and any *four* from the rest.

1. Select the most appropriate answer: (10 × 1 = 10)

(i) The efficiency of a transformer is higher than other electrical machines because

(a) There is no electrical connection between the primary and the secondary

(b) Power is transferred from one circuit to another magnetically

(c) There are no rotating parts and hence, no frictional losses

(d) All of these

(ii) Oil in transformer is used for

(a) Lubrication purpose (b) Insulation

(c) Cooling (d) Both (b) and (c)

(iii) The transformer ratings are usually expressed in terms of

(a) kW (b) volts

(c) kVAR (d) kVA

(iv) Which of the following losses varies with the load in the transformer?

(a) Core loss (b) Copper loss

(c) Both core and copper loss (d) None of the above

[Turn over

(v) The function of starter in d.c. motors is

(a) To avoid excessive current at starting

(b) To control the speed

(c) To avoid armature reaction

(d) All of the above

(vi) A d.c series motor should always be started with some load on its shaft, otherwise

(a) It will draw a very high current from the supply

(b) It will run at an excessively high speed

(c) It will not be able to develop any torque

(d) All of these

(vii) In d.c. machines, the armature windings are placed on the rotor, and not on the stator, because of the necessity for

(a) Electromagnetic energy conversion

(b) Generation of voltage

(c) Commutation

(d) Development of torque

(viii) What happen if the field winding of a d.c. short motor running at normal speed gets open?

(a) The motor will stop

(b) The motor will draw heavy current

(c) The motor will start running at excessive speed

(d) None of the above

(ix) Which of the following rule is used to determine the direction of rotation of D.C motor?

(a) Columb's Law (b) Fleming's Left-hand Rule

(c) Fleming's Right-hand Rule (d) Lenz's Law

(x) A D.C. series motor is widely used in

(a) Electric Traction (b) Air compressor

(c) Centrifugal Pump (d) Machine shop

2. (a) What is armature reaction? Explain its effects on the performance of D.C. machines. (1 + 3)

(b) Describe the functions of compensating winding and interpoles in d.c. machines. What is the essential difference between the two? (4)

(c) A 250 kW, 400 V, 6-pole d.c. generator has 720 lap wound conductors. It is given a brush shift of 2.5 angular degrees (mech.) from the geometrical neutral axis. Calculate the cross and demagnetizing turns per pole. (7)

3. (a) Explain why equalizer connections are necessary in lap wounded machine, but not in wave wounded machines. (2)

(b) Explain the fact that the parallel operation of d.c. shunt generators is inherently stable. Also, explain how is the load transferred from one machine to another keeping the terminal voltage constant. (5)

(c) A shunt generator delivers full-load current of 200 A at 240 V. The rotational losses are 800 W and the shunt field resistance is 60 Ω. The generator's full-load efficiency is 90%. Find the : (8)

(i) Armature resistance, and

(ii) The load corresponding to maximum efficiency.

4. (a) What are the various methods for speed control of d.c. shunt motors? Discuss their essential features. (6)

(b) What is the essential difference between a 3-point starter and a 4-point starter? (2)

(c) A 250 V D.C. shunt motor has an armature resistance of 0.5 Ω and a field resistance of 250 Ω. When driving a constant torque load at 600 RPM, the motor draws 21A. If it is desired to raise the speed from 600 RPM to 800 RPM, what resistance must be inserted in the field circuit, assuming the magnetization curve to be straight line? (7)

5. (a) What is the equivalent circuit of a transformer? How are the parameters of equivalent circuit determined? How are these parameters helpful in determining the performance of transformers? (2 + 4 + 2)

(b) A single – phase 50 Hz transformer has a turn ratio of 6. The resistances are 0.90 Ω and 0.03, and the reactances are 5Ω and 0.13 Ω for the H.V. and L.V. windings respectively. Find (i) the voltage to be applied to the H.V. side to obtain full-load current of 200 A in the L.V. side on short circuit, and (ii) the power factor on short circuit. (7)

6. (a) State and explain the conditions for satisfactory parallel operation of transformers. (6)

(b) Two single-phase transformers rated 600 kVA and 500 kVA respectively, are connected in parallel to supply a load of 1000 kVA at 0.8 p.f. lagging. The resistance and reactance of the first transformer are 3% and 6.5% respectively and of the second transformers 1.5% and 8% respectively. Calculate the kVA loading and the power factor at which each transformer operates. (9)

7. (a) Why and how does the primary of a transformer draw more current when the load on the secondary increases? (2)

(b) What is open-delta connection? Discuss its theory and state the circumstances in which this connection is employed. (5)

(c) The following data were obtained on a 20 KVA, 50 Hz, 2000/200 V, single-phase transformer.

O.C. test (with H.V. side open circuited) : 200 V, 4 A, 120 W

S.C. test (with L.V. side short-circuited) : 60 V, 10 A, 300 W.

(i) Compute the parameters of the approximate equivalent circuit referred to the low-voltage side,

(ii) Find the F.L. efficiency and regulation of the transformer at p.f. 0.8 lagging. (8)