Total No. of printed pages = 3

EI 181304

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

2/3/22 2021

B.Tech. 3rd Semester End-Term Examination

EE, EEE

ELECTRICAL MACHINES – I

(New Regulation and New Syllabus)

Full Marks – 70 Time – Three hours

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

1. Explain the followings: (10 × 2 = 20)

   (a) The shunt field winding of a d.c. machine consists of a large number of turns of thin wire while the series field winding consists of few turns of thick wire. Why?

   (b) The armature of a d.c. machine is placed on the rotor and the field winding on the stator, and not otherwise, why?

   (c) Why are equalizer connections necessary in lap wounded machine, but not in wave wounded machines?

   (d) Why should a d.c. series motor not be started without some load on it?

   (e) Why do we not get linear commutation in d.c. machine?

   (f) Why does the terminal voltage of a d.c. shunt generator fall as the load on it is increased?

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

   (h) Why, in transformer construction, the L.V. windings are placed near the core?

   (i) Why, in the open circuit test of transformer, the instruments are placed on the L.V. side while in the short circuit test; these are placed on the H.V. side?

   (j) Why should the turn-ratios of the transformers connected in parallel be same?

[Turn over

2. Answer any five: (5 × 3 = 15)

(a) What is armature reaction? Describe, with suitable sketch(es), its effect on the operation of d.c. machines.

(b) Explain the fact that the parallel operation of d.c. shunt generators is inherently stable.

(c) Explain the necessity of starter in d.c. motors. What are the two protective features in 3-point starter? Describe their working. What is the essential difference between a 3-point starter and a 4-point starter?

(d) Draw and describe the 'armature current versus torque' and the 'armature current versus speed' characteristics of series, shunt and compound motors, and hence, comment on their applications.

(e) What is 'equivalent circuit' of a transformer, and how does it help in determining the performance of transformers? How are the parameters of the equivalent circuit determined?

(f) Derive an expression for saving of copper in an auto-transformer as compared to an equivalent two-winding transformer.

(g) What is open-delta connection of transformer? When is it employed? Derive the expression for kVA rating of such transformers in terms of normal delta-connected transformers.

3. Answer any FIVE: (5 × 7 = 35)

(a) A 4-pole lap wound d.c. shunt generator supplies current of 143 A. The field current is 10 A. When delivering full-load, the brushes are given a lead of 10° (mech.). Find (i) the demagnetizing amp-turns, and (ii) the number of extra shunt field turns needed to neutralize the demagnetization.

(b) A 100-KW, belt-driven shunt generator running at 300 RPM on 220-V bus-bars continues to run as a motor when the belt breaks, then taking 10 kW. What will be its speed? Armature resistance = 0.025Ω; field resistance = 60 Ω; contact drop due to each brush = 1 V. Ignore armature reaction.

(c) A 440-V D.C. shunt motor takes a current of 5.6 A on no-load and 68.3 A on full-load. Armature reaction weakens the field by 3% on full-load. Calculate the ratio of full-load speed to no-load speed. The armature and the field resistances are 0.18 Ω and 200 Ω respectively, and the total brush drop is 2V.

(d) Hopkinson's test on two identical d.c. machines gave the following test results:

Input voltage = 250 V, Input current = 10 A, Output current of generator = 60 A, Field current of generator = 4 A, Field current of motor = 3 A Armature resistance of each machine is 0.06 Ω. Calculate the efficiencies of both the machines.

(e) The following data were obtained on a 4 KVA, 50 Hz, 230/460 V, single-phase transformer.

O.C. test (with H.V. side open circuited): 230V, 0.6 A, 75 W

S.C. test (with L.V. side short -circuited): 20 V, 10 A, 60 W

(i) Compute the parameters of the approximate equivalent circuit referred tc the high voltage side.

(ii) Find the efficiency and the voltage at the secondary terminals when supplying full-load current at p.f. 0.8 lagging.

(f) Two single-phase transformers with equal voltage ratios have impedances (0.819+ j2.503) Ω and (C.819+ j2.503) Ω respectively as referred to their secondaries. If they operate in parallel to share a load of 2000 kW at 0.8 p.f. lagging, how will they share the load?

(g) A 400/100 V, 10 KVA 2-winding transformer is to be used as auto-transformer to supply a 400 V circuit from a 500 V source. When tested as a 2-winding transformer at rated load, and 0.85 p.f. lagging, its efficiency is found to be 0.97. Determine (i) its KVA rating as an auto-transformer, (ii) the efficiency as an auto-transformer.