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Question Paper Code : 31395

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Fourth Semester

Electrical and Electronics Engineering

EE 2251/EE 1251 A/080280003/10133 EE 402/EE 42 — ELECTRICAL MACHINES – I

(Regulation 2008/2010)

(Common to PTEE 2251 – Electrical Machines – I for B.E. (Part-Time) Third Semester – Electrical and Electronics Engineering – Regulation 2009)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Name the main magnetic quantities with their symbols having the following units : Webers, Telsa, AT/Wb, H/m.

2. How will you minimize hysteresis and eddy current losses?

3. Define regulation of a transformer.

4. State the advantages and applications of auto transformer.

5. Draw a schematic diagram indicating flow of energy in the conversion of mechanical energy to electrical form.

6. Why do all practical energy conversion devices make use of the magnetic field as a coupling medium rather than an electric field?

7. What is meant by SPP? What is its significance?

8. Enumerate the advantages of using short – pitched winding in a synchronous machine.

9. Write the emf equation of a d.c. machine.

10. List the merits and demerits of Swinburne's test.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Distinguish between statically and dynamically induced e.m.f. (4)

(ii) The core-loss (hysteresis + eddy-current loss) for a given specimen of magnetic material is found to be 2000 W at 50Hz. Keeping the flux density constant, the frequency of the supply is raised to 75 Hz resulting in a core loss of 3200 W. Compute separately hysteresis and eddy current losses at both the frequencies. (12)

Or

(b) A steel ring has a mean diameter of 20 cm, a cross section of 25 cm^2 and a radial air-gap of 0.8 mm cut across it. When excited by a current of 1A through a coil of 1000 turns wound on the ring core, it produces an air-gap flux of 1 mWb. Neglecting leakage and fringing. Calculate

(i) relative permeability of steel and

(ii) total reluctance of the magnetic circuit.

12. (a) (i) Describe the construction and principle of operation of single phase transformer. (8)

(ii) Derive an expression for maximum efficiency of a transformer. (8)

Or

(b) A 500 kVA transformer has 95% efficiency at full load and also at 60% of full load both at upf.

(i) Separate out the transformer losses.

(ii) Determine the transformer efficiency at 75% full load, upf.

13. (a) Derive an expression for co–energy density of an electromechanical energy conversion device.

Or

(b) The doubly – excited magnetic field has coil self – and mutual – inductances of

$L_{11} = L_{22} = 2$

$L_{12} = L_{21} = \cos\theta$

Where θ is the angle between the axes of the coils. The coils are connected in parallel to a voltage source $V = V_m \sin wt$. Derive an expression for the instantaneous torque as a function of the angular position θ. Find the time – average torque. Evaluate for $\theta = 30°$, $\gamma = 100 \sin 314t$.

14. (a) How is torque developed in round rotor machine? Derive an expression for the same. State the assumptions made.

Or

(b) Find the number of series turns required for each phase of a 3-phase, 50 Hz, 10-pole alternator with 90 slots. The winding is to be star-connected to give a line voltage of 11 kV. The flux/pole is 0.16 Wb.

15. (a) (i) Explain the various methods of commutation. (8)

(ii) Draw a neat sketch of 3–point starter and explain its working. (8)

Or

(b) A 100 kW dc shunt generator driven by a belt from an engine runs at 750 rpm and is connected to 230V dc mains. When the belt breaks, it continues to run as a motor drawing 9 kW from the mains. At what speed would it run? Given: Armature resistance = 0.018 Ω and field resistance = 115 Ω.