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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 × 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 cm² 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 $V = V_m \sin \omega t$. Derive an expression for the instantaneous torque as a function of the angular position θ . Find the time - average torque. Evaluate for $\theta = 30^\circ$, $\gamma = 100 \sin 314t$.

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 = 0.018Ω and field resistance = 115Ω .
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