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Question Paper Code : 51435

B.E/B.Tech. DEGREE EXAMINATION, MAY/JUNE 2014.

Fourth Semester

Electrical and Electronics Engineering

EE 2251/EE 1251 A/ 080280003/EE 42/10133 EE 402 — 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. What are quasi-static fields?

2. Define magnetic reluctance.

3. Differentiate between a core and shell type transformer.

4. What is the basic purpose of tertiary winding?

5. Define co-energy.

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

7. What is the difference between lap winding and wave winding of a DC machine armature?

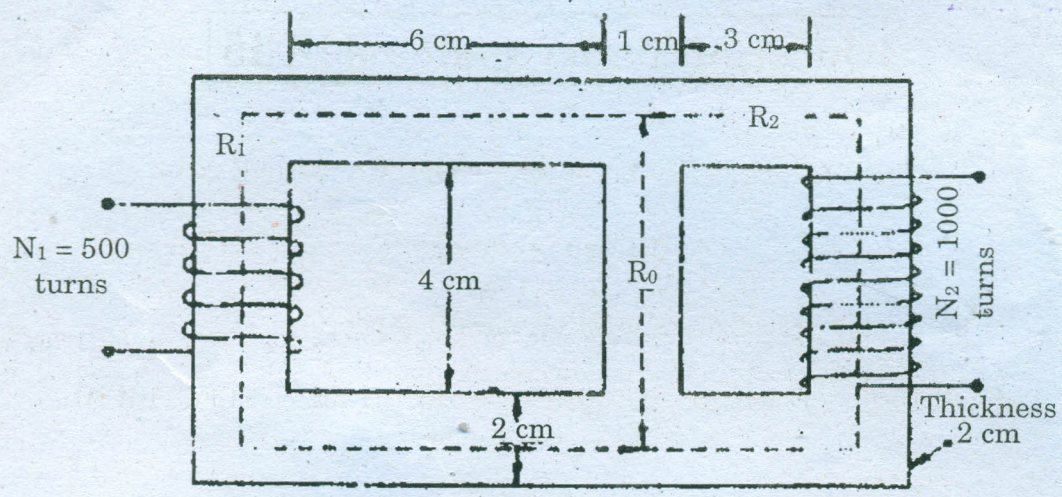
8. Why synchronous machine does not produce torque at any other speed?

9. List the factors involved in the voltage build up of a shunt generator.

10. Why the external characteristics of a DC shunt generator is more drooping than that of a separately excited generator?

PART B — (5 × 16 = 80 marks)

11. (a) For the magnetic circuit as shown below, find the self and mutual inductance between the two coils. Assume core permeability = 1600. (16)



Or

(b) (i) Explain the AC operation of magnetic circuits. (8)

(ii) What is the principle a typical magnetic circuit with air-gap and explain. Also prove that the core reluctance may be neglected in practice. (8)

12. (a) (i) Explain the principle of operation of a transformer. Derive its emf equation. (8)

(ii) A 1-phase transformer has 180 turns respectively in its secondary and primary windings. The respective resistances are 0.233 and 0.067. Calculate the equivalent resistance of

(1) the primary in terms of the Secondary winding.

(2) the secondary in terms of the primary winding, and

(3) the total resistance of the transformer in terms of the primary. (8)

Or

(b) (i) Draw the phasor diagram of transformer when it is operating under load and explain. (8)

(ii) The parameters of approximate equivalent circuit of a 4 KVA, 200/400V, 50 Hz, 1Φ transformer are: $R'_p = 0.15\,\Omega; X'_p = 0.37\,\Omega;$ $R_o = 600\,\Omega; X_m = 300\,\Omega$ When a rated voltage of 200V is applied to the primary, a current of 10A at lagging power factor of 0.8 flows in the secondary winding. Calculate

(1) The current in the primary, I_p

(2) The terminal voltage at the secondary side. (8)

13. (a) (i) Show that the torque developed in doubly excited magnetic system is equal to the rate of increase of field energy with respect to displacement at constant current. (8)

(ii) The $\lambda - i$ characteristics of singly excited electromagnet is given by $i = 121\lambda^2 x^2$ for $0 < i < 4\,A$ and $0 < x < 10\,cm$. If the air gap is 5cm and a current of 3A is flowing in the coil, calculate

(1) Field energy

(2) Co-energy

(3) Mechanical force on the moving part. (8)

Or

(b) Discuss in detail the production of mechanical force for an attracted armature relay excited by an electric source. (16)

14. (a) (i) What is meant by the current sheet concept? Explain briefly. What is the phase angle difference between a sinusoidally distributed current sheet and its accompanying mmf wave? (8)

(ii) A 4-pole, lap wound dc machines has 728 armature conductors. Its field winding is excited from a dc source to create an air gap flux of 32 mWb/pole. The machine is run from a prime mover at 1600rpm. It supplies a current of 100A to an electric load.

(1) Calculate the electromagnetic power developed.

(2) What is the mechanical power that is fed from the prime mover to the generator?

(3) What is the torque provided by the prime mover? (8)

Or

(b) Explain briefly the production of rotating magnetic field. What are the speed and direction of rotation of the field? Is the speed uniform? (16)

15. (a) (i) Derive from the fundamental, emf and torque equations and explain the characteristics of DC shunt motor. (12)

(ii) What are the merits and demerits of Hopkinson's test? (4)

Or

(b) (i) Discuss in detail about shunt armature speed control of dc shunt motor. (8)

(ii) A 500V dc shunt motor running at 700 rpm takes an armature current of 50A. Its effective armature resistance is 0.4Ω. What resistance must be placed in series with the armature to reduce the speed to 600 rpm, the torque remaining constant? (8)
