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II/IV B.E. DEGREE EXAMINATION.

Second Semester

Mechanical Engineering

ELECTRICAL TECHNOLOGY

(Common with Metallurgy, Marine and
Naval Architecture Engineering)

(Effective from the admitted batch of 2006–2007)

Time : Three hours   Maximum : 70 marks

Question No. 1 is compulsory.

Answer any FOUR questions from the remaining.

All questions carry equal marks.

1.   (a)   Give the relationship among magnetic flux, reluctance and magnetomotive force.

       (b)   Distinguish between dynamically induced e.m.f. and statically induced e.m.f.

       (c)   Draw the torque-speed characteristics on the same graph of D.C. (i) series motor (ii) shunt motor and (iii) cumulative compound motor.

6. (a) Define the term "Regulation" of a transformer. Distinguish between "All-day efficiency" and "Commercial efficiency" of a transformer. Which efficiency is higher?

   (b) A 10 KVA, 500/250 volts, 1-phase transformer has its maximum efficiency of 94% when delivering 90% of its rated output at unity power factor. Estimate its efficiency when delivering its full load output at a power factor of 0.8 lagging.

7. (a) Explain the principle of operation of 3-phase induction motor.

   (b) The power input to a 500 volts, 50 Hz, 6-pole, 3-phase induction motor is running at 975 rpm is 40 KW. The stator losses are 1 KW and the friction and windage losses total 2 KW. Calculate the efficiency.

8. (a) Show that there is no starting torque available for 3-phase synchronous motor. Name the various starting methods adopted for it.

   (b) Explain the principle of operation of alternator.

   (c) Derive the expression for impedance of a R-L series circuit when it is connected to 1-phase, 50 HZ supply.

(d) If the line current is $10\sqrt{3}$ Amperes in a 3-phase, delta connected balanced load, what is the phase current?

(e) Why is short circuit test performed at reduced voltage on the H.V. side? Why is the core loss almost negligible in this test?

(f) Give the power stages of 3-phase induction motor.

(g) Name the different methods of starting 3-phase synchronous motor.

(h) State the three different torques of a measuring instrument.

2. (a) Define the following with respect to magnetic circuit :

   (i) MMF (ii) Flux and (iii) Reluctance (iv) Permeance.

   (b) An iron ring of cross-section 1 cm × 4 cm has effective iron path of 100 cm. An air gap of 0.5 mm has been made in the ring. The ring is wound with 1500 turns through which a current of 1 Ampere is passed. If the total magnetic flux produced is 0.5 mwb, find the relative permeability of iron and the reluctance of the magnetic circuit. Neglect leakage.

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3. (a) State Faraday's law of electromagnetic induction. Distinguish between self inductance and mutual inductance.

(b) A square coil of 10 cm side and with 100 turns is rotated at a uniform speed of 500 r.p.m. about an axis at right angle to a uniform field of 0.5 Tesla. Calculate the instantaneous value of induced e.m.f. When the plane of the coil is (i) at right angle to the plane of the field and (ii) at 30° to the plane of the field.

4. (a) With suitable diagrams, explain the armature reaction in a d.c. generator with its effects.

(b) A 4 pole d.c. generator has 51 slots each containing 20 conductors. The flux per pole is 20 mwb. The generator is rotating at 1800 r.p.m. Calculate the e.m.f generated if the armature is connected (i) Lap wound and (ii) Wave wound.

5. (a) With a neat circuit diagram, explain how Swinburne's test is conducted on a d.c. shunt motor for finding efficiency.

(b) Explain briefly the various speed control methods of D.C. shunt motor.