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Question Paper Code : 81281

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Third Semester

Electrical and Electronics Engineering

EE 3303 — ELECTRICAL MACHINES — I

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. State the energy conversion principle of generator, motor and transformer.
2. Interpret the energy balance equation of DC motors.
3. The condition to be fulfilled for a DC shunt generator to build up EMF.
4. Define armature reaction and mention its effect on DC generator performance.
5. Illustrate the different speed control methods at above and below rated speeds for a DC Shunt motor.
6. Mention the various losses in DC motor.
7. List the advantages of OC and SC tests on the transformer.
8. State the need of polarity test for a transformer.
9. Compare three phase power transformer with three phase distribution transformer.
10. List the merits of an auto transformer.

PART B — (5 × 13 = 65 marks)

11. (a) Categorise induced emfs in coil/conductor. Examine the initiation of following emfs in electrical machines with diagram and expressions.
- (i) Statically Induced emf. (7)
 - (ii) Dynamically Induced emf. (6)

Or

- (b) The self and mutual inductances of two windings, one on the stator and the other on a rotor, are $L_{11} = 4.5\text{H}$, $L_{22} = 2.5\text{H}$, and $M_{12} = 2.8 \cos \theta$ H, where θ is the angle between the windings' axes. It is possible to overlook the windings' resistance. The current in winding 1 as a function of time is $i_1 = 10 \sin \omega t$, while winding 2 is shorted. In terms of the angle θ , simplify an expression for the numerical value of the rotor's instantaneous torque in N-m.

12. (a) Explain with a neat sketch the functional parts with the role, working principle and hence outline the equivalent circuit of a DC generator.

Or

- (b) Explain demagnetizing and cross magnetizing in DC generator and illustrate the calculation of demagnetizing and cross-magnetizing Ampere-Turns/Pole (ATc/Pole).

13. (a) (i) In a brake test conducted on a DC shunt motor, the full load readings are observed as below. (6)

- (1) 1st end Brake drum tension $W_1 = 9.1$ kg.
- (2) 2nd end Brake drum tension $W_2 = 0.8$ kg.
- (3) Total current = 10 A.
- (4) Supply voltage = 110 V
- (5) Speed = 1320 rpm.
- (6) Radius of the brake drum = 7.55 cm. Calculate the following
 - (A) Torque in N-m
 - (B) Output power
 - (C) Input power
 - (D) Full load efficiency.

- (ii) Examine the necessity of a starter for a DC motor and explain the three point starter with a diagram. (7)

Or

- (b) Explain with circuit diagrams about the different methods of speed control of DC shunt motor with speed control characteristics.

14. (a) (i) Derive the expression for induced phase voltage and line voltage per coil for a transformer. (6)
- (ii) A 4 kVA 200 /400V, 50 Hz single phase transformer has equivalent resistance referred to primary as 15 ohms. Calculate :
- (1) Total copper loss on full load.
 - (2) The efficiency while supplying full load at 0.9 pf lagging.
 - (3) The efficiency while supplying half load at 0.8 lagging.
- Assume total iron losses equal to 60 watts. (7)

Or

- (b) Derive the equivalent circuit of a single phase transformer referring to both primary and secondary.
15. (a) (i) Draw an auto transformer circuit and explain its working. (6)
- (ii) Examine the amount of copper consumed in auto transformer with winding transformer and hence prove "Saving in Cu in auto transformer = $K \times$ Wt. of Cu in two winding transformer". (7)

Or

- (b) With a help of laboratory circuit diagram show Scott connection and illustrate how it performs to convert the 3-phase to 2-phase and 2-phase to 3-phase conversion.

PART C — (1 × 15 = 15 marks)

16. (a) The Hopkinson's test is carried out on DC shunt machines. The circuit and data is shown in Fig:16(a). Calculate the efficiency of the machines at the given load conditions. Assume the armature resistance of each of the machines is 0.05 ohm.

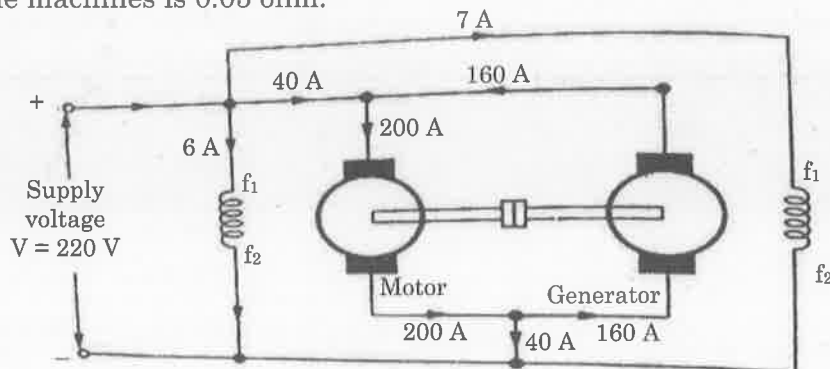


Fig. 16(a)

Or

- (b) With circuit diagram explain Swinburne's test and illustrate how to predetermine the efficiency when the machine is running.
- (i) As a DC generator
 - (ii) As a DC motor.

Hence summarise the merits and demerits of Swinburne's test.

