Hall Ticket No | | | | | | | | | | | Question Paper Code:AEEC07

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal-500043, Hyderabad

B.Tech III SEMESTER END EXAMINATIONS (REGULAR) - FEBRUARY 2022

Regulation:UG-20

DC MACHINES AND TRANSFORMERS

Time: 3 Hours **(EEE)** **Max Marks: 70**

Answer ALL questions in Module I and II

Answer ONE out of two questions in Modules III, IV and V

NOTE: Provision is given to answer TWO questions from among one of the Modules III / IV / V

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

MODULE – I

1. (a) Derive the EMF equation of a DC machine. What is the significance of lap winding and wave winding in the EMF equation? **[7M]**

   (b) A 4 pole generator with wave wound armature has 51 slots each having 24 conductors. The flux per pole is 10 mwb. At what speed must the armature rotate to give an induced emf of 0.24 kV. What will be the voltage developed, if the winding is lap connected and the armature rotates at the same speed? **[7M]**

MODULE – II

2. (a) Draw the legible sketch and explain the different characteristics of shunt, series and compound motors. **[7M]**

   (b) A 220 V DC series motor has an armature resistance of 0.3 Ω and a field resistance of 0.2 Ω. It runs at a speed of 700 rpm taking a current of 15 A. Calculate the resistance to be inserted in series with the armature to reduce the speed to 600 rpm. The input current remains constant. Assume that the magnetization characteristic is a straight line. **[7M]**

MODULE – III

3. (a) Describe the principle of Swinburn's test for testing of DC motor and perform the calculations. **[7M]**

   (b) A 400 V DC shunt machine takes 7 A at no-load when operates as a motor. The armature current and field resistances are 0.25 Ω and 200 Ω, respectively, when measured at room temperature. Calculate the efficiency of the machine:

   i) When runs as a motor taking a line current of 70 A at 400 V

   ii) When runs as a generator delivering a line current of 70 A at 400 V.

   The stray load loss is 1.1 percentage of the output. Neglect the increase in resistance due to temperature rise. **[7M]**

4. (a) Describe the principle of retardation test for separation of losses in a DC motor. **[7M]**

   (b) A DC machine running at 700 rpm is put to a retardation test. The time taken at the speed to fall from 730 rpm to 670 rpm is 27 seconds with no excitation, 10 seconds with full excitation, 6 seconds with full excitation and armature supplying an extra load of 7 A at 200 V. Calculate:

   i) Moment of inertia of the armature

   ii) Mechanical losses and iron losses at mean speed of 700 rpm. **[7M]**

MODULE – IV

5. (a) Draw and explain the equivalent circuit of single phase transformer and draw the necessary phasor diagram under resistive, inductive and capacitive loads. **[7M]**

   (b) A 4 kVA, 400/200 V, 50 Hz, single-phase transformer has the following test data.

   OC test: 200 V, 2 A, 90 W

   SC test: 20 V, 10 A, 100 W

   The instruments during SC test are placed on the side opposite to that of OC test. Find equivalent circuit referred to as primary side (high-voltage side). **[7M]**.

6. (a) With a neat circuit diagram explain in detail Sumpner's test for determining the efficiency and voltage regulation of transformer. **[7M]**

   (b) Find the all-day efficiency of a transformer having maximum efficiency of 98.5 percent at 20 kVA at unity power factor and loaded as follows:

   11 hours: 5 kW at 0.7 power factor lagging

   6 hours: 8 kW at 0.8 power factor lagging

   7 hours: no load

   The maximum efficiency of the transformer occurs at 80 percent of full load. **[7M]**

MODULE – V

7. (a) Give the merits and demerits of a delta/star connected three-phase transformer. **[7M]**

   (b) A three-phase step-down transformer having turns ratio per phase of 10 takes 10 A when connected to 3.3 kV supply mains. Determine the secondary line voltage, line current and output when the transformer windings are connected in

   i) Star/delta

   ii) Delta/star. **[7M]**

8. (a) Discuss about Scott connection for phase conversation in transformer. **[7M]**

   (b) In a Scott connection, the loads on the two-phase side are 400 kW and 500 kW, both at 200 V and 0.8 power factor lagging. The three-phase line voltage is 2,200 V. The 400 kW load is on the leading phase on the two-phase side. Neglecting transformer losses, calculate the value of line currents on the three-phase side. **[7M]**

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