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Total Number of Pages: 02

Course: B.Tech/IDD
Sub_Code: EEPC2002

3rd Semester Regular Examination: 2024-25

SUBJECT: ELECTRICAL MACHINES - I

BRANCH(S): EEE, EE, ELECTRICAL

Time: 3 Hours

Max Marks: 100

Q.Code: R602

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions: (2 x 10)

- Distinguish between shunt and series field coils construction.
- Define critical field resistance and critical speed of a DC shunt generator.
- A DC generator is found to develop an armature voltage of 220 V. If the flux is reduced by 25% and speed is increased by 40%, what will be the armature generated voltage?
- Why is it necessary to operate generators in parallel for supply of power?
- State the applications of DC series motor.
- Why is the low voltage winding placed near the core?
- Why distribution transformers are designed for lower iron losses?
- A 22 kVA, 110 V / 220 V, 50 Hz transformer is connected in such a way that it steps up 110 V supply to 330 V. What is the maximum kVA that can be handled by the transformer?
- Explain why OC test and SC tests are conducted on LV and HV sides of the transformer respectively.
- What are the merits and drawbacks of single three phase transformer unit over a bank of single phase transformers?

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- A DC long shunt compound generator supplies a load of 110 V through a pair of feeders of total resistance of 0.04 Ω . The load consists of five motors, each taking 30 A and a lighting load of 150 bulb each of 60 W. The armature resistance is 0.03 Ω , series field resistance 0.04 Ω and shunt field resistance 55 Ω . Find the load current, terminal voltage, and emf generated.
- A 110 V shunt generator has a full-load current of 100 A, shunt field resistance of 55 ohm and constant losses of 500 W. If full load efficiency is 88%, find armature resistance. Assuming voltage to be constant at 110 V, calculate the efficiency at half F.L. and at 50% overload. Find the load current.

- c) Distinguish between GNA and MNA. Describe the role of interpoles in a DC generator.
- d) A four pole, simplex lap wound armature contains 16 slots and two coil sides per slot, find (I) back pitch and (II) front pitch for progressive winding.
- e) Explain principle of operation of a DC motor. What do you understand by the term 'back emf'?
- f) Why starters are used for DC motors? Explain with neat sketch, the diagram of a 4-point starter and its principle of operation.
- g) What would happen if the armature of a DC motor is switched on to power supply, while the field circuit is open?
- h) A DC series motor having a resistance of 1ohm drives a fan for which the torque varies as the square of the speed. At 220 V, the set runs at 350 r.p.m. and takes 25 A. The speed is to be raised to 500 r.p.m. by increasing the voltage. Determine the necessary voltage and the corresponding current assuming field current to be unsaturated.
- i) The iron and full load copper losses in a 50 kVA single phase two winding transformer are 700 watts and 1000 watts respectively. Compute the efficiency at (I) full load unity power factor and (II) 80% of full load at 0.8 lagging power factor. What is the kVA load for maximum efficiency?
- j) What is voltage regulation of a transformer? Derive the conditions for maximum and zero voltage regulation in a transformer.
- k) A 1-phase transformer when supplied from 220 V, 50 Hz supply has eddy current loss of 50 W. If the transformer is connected to 330 V, 50 Hz supply, what would be the eddy current loss?
- l) On the two sides of a star-delta transformer, what is the phase angle between the voltages and what is the phase angle between the currents?

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** Derive EMF equation of DC generator. What are the possible causes for not building up EMF in self excited DC generators? What are the remedial measures to be taken? **(16)**
- Q4** a) What are the advantages of Hopkinson's test over Swinburne's test and what are their limits? **(8x2)**
 b) A 220 V dc shunt motor at no-load takes a current of 2.5A. The resistances of the armature and shunt field are 0.8 Ω and 200 Ω respectively. Determine the efficiency of the motor when input current is 32 A.
- Q5** What is autotransformer? Explain the advantages of autotransformer over two winding transformer. Derive the expression for saving of copper. **(16)**
- Q6** Draw the phasor diagrams and winding connection of three phase transformer for **(4 x 4)**
 (i) Phase displacement of zero degrees
 (ii) Phase displacement of -30 degrees
 (iii) Phase displacement of +30 degrees
 (iv) Phase displacement of 180 degrees