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Total Number of Pages: 02

Course: B.Tech/IDD  
Sub\_Code: EEPC2002

3<sup>rd</sup> Semester Regular/Back Examination: 2025-26  
SUBJECT: ELECTRICAL MACHINES – I  
BRANCH(S): EE, EEE, ELECTRICAL  
Time: 3 Hours  
Max Marks: 100  
Q.Code: U674

Answer Q1 (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)
- Explain Lenz's law and its physical significance.
  - Define permeability and reluctance.
  - What is critical field resistance? Define critical speed of a DC generator.
  - Why interpoles are used in DC machines? How their polarities differ from generator to motor?
  - Why is a starter required for a DC motor?
  - 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?
  - What is all-day efficiency? Where is it used?
  - What is the purpose of open circuit test? What information is obtained from short circuit test?
  - Mention two advantages of an auto-transformer over a two-winding transformer.
  - List two advantages of three-phase transformers over single-phase transformers.

**Part-II**

- Q2** Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)
- Explain the B–H curve of a magnetic material and discuss its importance in electrical machines.
  - Explain the process of EMF build-up in a self-excited DC generator.
  - A 4-pole wave wound DC generator has 51 slots on its armature and each slot has 24 conductors. The flux per pole is 0.01 weber. At what speed must the armature rotate to give an induced EMF of 220 V. What will be the EMF developed if the winding is lap connected and the armature rotates at the same speed?
  - Draw and compare the load characteristics of different types of DC generators.
  - What do you understand from the term armature reaction? Describe the role of compensating windings in a DC generator.
  - A 220 V shunt motor having armature resistance of 0.4  $\Omega$  takes an armature current of 30 A on a certain load. By how much must the main flux be reduced to raise the speed by 30 % if the developed torque is constant? Neglect saturation and armature reaction.

- g) Explain with neat sketch, the diagram of a 3-point starter and its principle of operation.
- h) A 440 V, DC shunt motor takes no load current of 2.5 A. The resistance of shunt field and armature are 550  $\Omega$  and 1.2  $\Omega$  respectively. The full load line current is 32 A. Determine the full load efficiency of the motor.
- i) Discuss the working principle of single-phase transformer and also explain the constructional details.
- j) What are the conditions for parallel operation of two single phase transformers?
- k) Explain Scott connection with a neat diagram and mention its applications.
- l) A 3-phase transformer bank consisting of three 1-phase transformers is used to step-down the voltage of a 3-phase, 6600 V transmission line. If primary line-current is 10 Amp, calculate the secondary line voltage, line current, and output KVA for the following connections. I) Y/Delta and II) Delta/Y. The turn's ratio is 12. Neglect losses.

### Part-III

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

- Q3** What are the benefits of parallel operation of DC generators? Explain the conditions and procedure for parallel operation of two DC compound generators. Also, discuss the use of equalizer bar. **(16)**
- Q4** What is DC motor? Derive its torque equation. Draw the speed-torque characteristics of DC shunt, series and compound motors in one figure and compare them. Which characteristic is more suitable for traction purposes and why? **(16)**
- Q5** The OC and SC test data of 4 kVA, 200/400 V, single phase transformer when supplying full load at 0.8 lagging p.f. is given below.  
 OC test: 200 V, 0.8 A, 70 W (HV open circuit)  
 SC test: 20 V, 10 A, 60 W (LV short circuit)  
 Calculate efficiency at a) full load, b)  $\frac{1}{2}$  Full load and c) Voltage regulation at Full load. **(16)**
- Q6** What is meant by vector group of a transformer? Draw the phasor diagrams and winding connections of three phase transformer for,  
 a) Phase displacement of zero degrees.  
 b) Phase displacement of minus 30 degrees. **(16)**