

**B. TECH**  
**(SEM IV) THEORY EXAMINATION 2022-23**  
**ELECTRICAL MACHINES- I**

Time: 3 Hours

Total Marks: 100

**Note:** Attempt all Sections. If require any missing data; then choose suitably.

**SECTION A**

- 1. Attempt all questions in brief. 2 x 10 = 20**
- (a) A magnetic circuit is used as a coupling medium for electromechanical energy conversion. State the reason.
  - (b) Develop a block diagram indicating the process of electromechanical energy conversion.
  - (c) The role of the commutator in the DC machine is that of a mechanical rectifier. Justify the statement.
  - (d) Differentiate between the lap and wave windings employed in armature windings of a DC machine.
  - (e) Enumerate the types of speed control in DC machines.
  - (f) Justify the necessity of starters in the operation of DC motors.
  - (g) State and prove the condition for maximum efficiency of a transformer.
  - (h) Discuss the significance of voltage regulation in transformers. How the same is arrived at?
  - (i) State the conditions for parallel operations of transformers.
  - (j) Draw the connection diagram for a 3-phase to 2-phase conversion. Name the connection of such a configuration

**SECTION B**

- 2. Attempt any three of the following: 10x3=30**
- (a) Distinguish between singly-excited and doubly-excited systems. For a singly-excited linear magnetic system, derive an expression for the electromagnetic torque.
  - (b) Draw the magnetization, internal and external characteristics of DC shunt generator.
  - (c) Describe a 3-point starter, having a no-volt coil and overload protection for a dc shunt motor. What modification is made in a 4-point starter?
  - (d) Develop the equivalent circuit of a two-winding transformer.
  - (e) Discuss the open-Delta connection in 3- $\Phi$  transformers with reference to the VA rating. Draw the connection diagram of the open-delta connection and the phasor diagram corresponding to a balanced load of lagging power factor. State the applications

**SECTION C**

- 3. Attempt any one part of the following: 10x1=10**
- (a) Discuss the components of electro-mechanical torque produced in a doubly excited system with suitable derivation.
  - (b) Based on the principle of conservation of energy, develop an energy balance equation for a motor, Also explain the various energy terms involved.

**4. Attempt any one part of the following: 10x1=10**

- (a) Explain the commutation process in D.C. machines citing the causes of poor Commutation. What are the ways of improving the commutation process?
- (b) (i) Draw the external characteristics and state the applications of compound generators based on the characteristics.  
(ii) A 440 V, D.C compound generator has an armature winding, series field, and shunt field resistances of  $0.5 \Omega$ ,  $1.0 \Omega$ , and  $200 \Omega$  respectively. Calculate the generated voltage while delivering 40A to the external circuit for both long and short shunt connections.

**5. Attempt any one part of the following: 10x1=10**

- (a) (i) Describe different zones of speed control for DC motors  
(ii) Discuss in detail the method of speed control by the flux control method indicating the ranges of speed control by flux control method.
- (b) Explain Swinburne's test to estimate no-load losses in a DC machine. What are its limitations as compared to Hopkinson's test.

**6. Attempt any one part of the following: 10x1=10**

- (a) A 10 KVA, 200/400 V, 50 Hz, single-phase transformer gave the following test results:  
Open circuit test from L.V. side: 200 V, 1.3 A, 120 W  
Short circuit test from H.V. side: 22 V, 25A, 200 W  
(i) Draw the equivalent circuit of the transformer referred to on the H.V. side.  
(ii) Determine the efficiency of the transformer at 90% loading with a load of 0.8 powerfactor.  
(iii) Calculate the regulation of the transformer at full load 0.8 power factor lagging.
- (b) (i) Derive the expression for saving conductor material in an autotransformer over a two-winding transformer of equal rating.  
(ii) A 20 kVA, 2000/200 V, two-winding transformer is to be connected as an autotransformer, with a constant source voltage of 2000 V. At a full load of unity power factor, calculate the power output, power transformed and power conducted.

**7. Attempt any one part of the following: 10x1=10**

- (a) Discuss the vector groups in 3-phase transformers along with relevant connection diagrams. Draw the corresponding phasor diagrams.
- (b) A three-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 the primary line current is 10A, calculate the secondary line voltage, line current, and output kVA for the connections of star-delta (Y- $\Delta$ ). Turns ratio is 12.