

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

B.Tech Degree S4 (R,S) (FT/WP) / (S2 PT) Exam April 2025 (2019 Scheme)

**Course Code: EET202****Course Name: DC MACHINES AND TRANSFORMERS**

Max. Marks: 100

Duration: 3 Hours

**PART A***(Answer all questions; each question carries 3 marks)*

Marks

- 1 What is the function of commutator in i) DC generators and ii) DC motors? (3)
- 2 For a 4-pole, 11 slots, 2 coil sides per slot simplex progressive wave winding, select the values of front pitch  $Y_f$ , back pitch  $Y_b$  and winding pitch  $Y$ . (3)
- 3 List any 3 methods for reduction of effects of armature reaction. (3)
- 4 For a 200V, 5kW separately excited DC generator, maximum efficiency occurs at full-load. If armature resistance is  $0.4\Omega$ , find the maximum efficiency. (3)
- 5 What is the necessity of starters in DC motors? (3)
- 6 Name 3 methods for controlling the speed of DC series motors. (3)
- 7 List any 3 characteristics of ideal transformer. (3)
- 8 Comment on the voltage regulation of a 1-phase transformer when the load is i) at unity power factor ii) zero power factor lag and iii) zero power factor lead. (3)
- 9 List any three advantages of auto-transformers over two-winding transformers. (3)
- 10 Draw the HV and LV side phasor diagrams for i)  $Yy0$  ii)  $Yd1$  and iii)  $Yd11$  connections of 3-phase transformer. (3)

**PART B***(Answer one full question from each module, each question carries 14 marks)***Module -1**

- 11 a) Explain the need of equalizer rings and dummy coils in DC machines. (7)

- b) An 8-pole, 12kW, 240V DC machine is wave connected. If this machine is now lap-connected, all other things remaining the same, calculate its voltage, current and power ratings. (7)
- 12 a) List any seven comparisons between simplex-lap and simplex-wave windings of a DC machine. (7)
- b) A progressive simplex lap winding is to be designed for a 4-pole, 8-slot, 2 coil-sides per slot DC armature. Obtain the winding table. (7)

**Module -2**

- 13 a) Describe the process of commutation in DC machines through the reversal of current in the commutating coil, with neat sketches. (8)
- b) An 8-pole lap wound DC generator delivers an output current of 200A at 500V. The armature has 1280 conductors and 160 commutator segments. If the brushes are advanced 4 segments from geometric neutral axis, find the demagnetising and cross-magnetising ampere-turns per pole. (6)
- 14 a) What are the conditions to be satisfied while connecting DC generators in parallel? Explain the parallel operation of DC shunt generators. (7)
- b) A separately excited DC shunt generator has armature circuit resistance of  $0.1\Omega$  and a total drop at brushes is 2V. When running at 1000rpm, it delivers a current of 100A at 250V to a load of constant resistance. If the generator speed drops to 700rpm, with field current unaltered, find the current delivered to the load. (7)

**Module -3**

- 15 a) Derive the torque equation of a DC motor from basics. (6)
- b) A 230V, DC series motor runs at 800rpm when drawing 155A from the supply lines. The armature circuit resistance of the motor is  $0.1\Omega$ . Calculate the speed of the motor at half the torque assuming unsaturated magnetic field. (8)
- 16 a) Explain the speed Vs armature current, torque Vs armature current and speed Vs torque characteristics of a DC series motor. (6)

- b) Describe with the aid of a circuit diagram, the Hopkinson's test for a pair of DC shunt machines and explain the method of calculating the efficiency. (8)

**Module -4**

- 17 a) Derive the emf equation of a single-phase transformer. (7)
- b) The primary of a single-phase transformer is rated at 10A and 1000V. Open circuit readings are 1000V, 0.42A and 100W. Short circuit readings are 126V, 10A, 400W. Determine the approximate equivalent circuit. (7)
- 18 a) Derive the condition for maximum efficiency of a single-phase transformer. (7)
- b) With a neat circuit diagram, explain Sumpner's test on two identical single-phase transformers. (7)

**Module -5**

- 19 a) Differentiate between power transformers and distribution transformers. (6)
- b) The primary and secondary voltages of an auto-transformer are 400V and 300V respectively. The current delivered to the load is 120A. Calculate i) transformation ratio ii) primary current iii) volt-ampere transferred inductively iv) volt-ampere transferred conductively v) saving in copper compared to similar 2-winding transformer. Neglect magnetising current and losses. (8)
- 20 a) List the necessary and essential conditions for satisfactory operation of 3-phase transformers in parallel. (6)
- b) What are the four common ways of connecting 3-phase transformers? Also write the voltage relations in each case. (8)

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