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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (R, S) / S2 (PT) (R, S) Examination June 2023 (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 | Explain why dummy coils are used in DC machines? | (3) |
| 2 | Which are the different types of armature windings used in DC machines? Explain their differences and applications. | (3) |
| 3 | Derive the emf equation of a DC generator. | (3) |
| 4 | What are the conditions for voltage build up in self-excited DC generators? | (3) |
| 5 | Why starters are used in DC motors? | (3) |
| 6 | Explain the significance of back emf in DC motors. | (3) |
| 7 | Define voltage regulation. What is the reason for negative voltage regulation in transformers? | (3) |
| 8 | Derive the condition for maximum efficiency of a transformer. | (3) |
| 9 | Explain the principle of on-load tap changing. | (3) |
| 10 | What is meant by vector groups? What does Yd11 mean? | (3) |

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

- 11 a) Explain the terms (i) winding pitch (ii) front pitch and (iii) back pitch related to DC armature windings. Discuss how these values are selected in lap and wave windings. (6)
- b) A 4 pole machine is wound with 564 conductors. The flux and speed are such that the average emf generated in each conductor is 2 V. The current in each conductor is 100A. Calculate the total current and the emf generated in the armature if the winding is (i) lap connected and (ii) wave connected. (8)
- 12 Draw the developed winding diagram for a 12 slot, 4 pole simplex, progressive (14)

lap connected armature with 12 commutator segments. Prepare the winding table and mark the position of brushes.

Module -2

- 13 a) What are the effects of armature reaction on the operation of dc machine? What are the remedial measures taken to counter the effects of armature reaction? (8)
- b) Explain with neat sketches, the process of commutation in DC machines. (6)
- 14 a) In a long-shunt compound generator, the terminal voltage is 230 V when the generator delivers 150 A. Determine (i) induced e.m.f. (ii) total power generated and (iii) power delivered to load. The shunt field, series field and armature resistance are 92Ω , 0.015Ω and 0.032Ω respectively. (8)
- b) What is meant by critical resistance of a DC shunt generator? How this is calculated from the OCC? (6)

Module -3

- 15 a) Describe the principle of Hopkinson's test for testing of DC motor with the help of a neat circuit diagram. (8)
- b) Explain any two methods of speed control in a DC shunt motor. (6)
- 16 a) A 200-V DC shunt motor takes 4 A at no-load when running at 700 rpm. The field resistance is 100Ω . The resistance of armature at standstill gives a drop of 6 volts across armature terminals when 10 A were passed through it. Calculate (a) speed on rated load (b) torque developed in N-m with rated load applied and (c) efficiency. The rated input to the motor is 8 kW. (10)
- b) Derive the torque equation of a DC motor (4)

Module -4

- 17 a) With neat circuit diagram and relevant equations, explain how the efficiency of a transformer can be predetermined by conducting open circuit and short circuit tests. (10)
- b) Derive emf equation of a transformer. (4)
- 18 The low voltage winding of a 300-kVA, 11,000/2500-V, 50-Hz transformer has 190 turns and a resistance of 0.06Ω . The high-voltage winding has 910 turns and a resistance of 1.6Ω . When the LV winding is short-circuited, the full-load current is obtained with 540-V applied to the HV winding. Calculate (i) the equivalent resistance and leakage reactance as referred to HV side and (ii) Draw the equivalent circuit referred to primary. (14)

Module -5

- 19 a) Explain with neat sketches, the principle of online tap changing. (10)
- b) Explain how the power transfer from primary to secondary of an autotransformer takes place partly by conduction and partly by induction. (4)
- 20 A bank of three single- phase transformers is connected to 11000V supply and takes 15A. If the ratio of turns per phase is 10, calculate the primary and secondary phase currents, voltages and the power output for the following connections (i) stat- star (ii) delta- delta (iii) star-delta (iv) delta- star. (14)
