Reg No.:_____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Fourth Semester B.Tech Degree Examination July 2021 (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 | Derive the emf equation of a DC generator. | (3) |
| 2 | Explain clearly, the necessity for introducing dummy coils in a 4-pole, double layer, wave wound armature of a DC machine, having 24 slots, with 2 coil sides per slot. | (3) |
| 3 | What is the purpose of providing compensating winding in DC machines? In which part of the machine is the compensating winding embedded? | (3) |
| 4 | Sketch the OCC of a DC shunt generator and explain the possible causes for the failure of the machine to build up voltage. | (3) |
| 5 | List the different losses in DC machines. | (3) |
| 6 | Which are the different methods of electric braking in DC motors? Describe any one of them. | (3) |
| 7 | Explain how the efficiency of a transformer at different loads may be estimated from OC and SC test readings. | (3) |
| 8 | Derive the condition for maximum efficiency in a transformer. | (3) |
| 9 | Compare distribution and power transformers. | (3) |
| 10 | How many vector groups are there in transformers and which are they? | (3) |

## PART B

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

### Module -1

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|---|---|---|---|
| 11 | a) | Draw the developed winding diagram for a 4-pole DC machine armature having 32 coil sides. Number of parallel paths required is 4. Prepare the winding table and mark the position of brushes. | (10) |
| | b) | Explain why equaliser rings are not required in a wave wound DC machine. | (4) |

12 a) With a neat diagram, explain the construction of a DC machine. (10)

b) Explain the function of commutator in a DC generator (4)

**Module -2**

13 Explain armature reaction in a DC generator. What are its effects? Derive expressions for cross magnetising and demagnetising ampere turns/ pole. (14)

14 The OCC of a shunt excited DC machine that runs at 1200rpm is as follows: (14)

| If(A) | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.6 |
|---|---|---|---|---|---|---|---|
| Vo(V) | 47 | 85 | 103 | 114 | 122 | 127 | 135 |

The field winding resistance is 55Ω. Determine:

i) The value of field regulating resistance to enable the machine to generate a maximum voltage of 120V on open circuit, when run at 1200rpm.

ii) The value of the open circuit voltage, when the regulator is set to 20Ω, and the speed is reduced to 800rpm.

**Module -3**

15 a) The armature winding of a 4-pole, 250V DC shunt motor is lap connected. There are 120 slots and each slot contains 8 conductors. The flux per pole is 0.02Wb and the current taken by the motor is 25A. Calculate the torque developed by the armature. The armature and field resistances are 0.1 and 125Ω respectively. If the rotational losses amount to 810W, find the useful torque. (8)

b) Compare the performance characteristics of different DC motors and enumerate the field of application of each of them. (6)

16 a) A 500V, DC shunt motor has a no-load speed of 1200rpm, the line current being 5A. When fully loaded, the line current is 30A. If the shunt field resistance is 250Ω, and the armature resistance is 1.1Ω, calculate the full-load speed. (6)

b) Describe with the aid of a circuit diagram, the Swinburne's test for estimating the efficiency of a DC shunt machine. What are the advantages and disadvantages of this method? (8)

**Module -4**

17 a) What is Sumpner's test? Draw a circuit diagram to conduct this test and explain its principle. (6)

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|---|---|---|---|
| | b) | Calculate the efficiency, voltage at secondary terminals and primary input current when supplying full- load secondary current at power factors i) unity and ii) 0.8pf lag for a 4KVA, 200/400V, single- phase transformer. The following are the test results:<br>Open circuit with 200V applied to lv side(primary), 0.8A, 70W.<br>Short circuit with 20Vapplied to hv side(secondary), 10A, 60W. | (8) |
| 18 | a) | Draw and explain the phasor diagram of a transformer on (i) an inductive load and (ii) a resistive load. | (8) |
| | b) | A transformer has maximum efficiency of 0.98 at 15KVA, upf. During a day, it is loaded as follows:<br>12h: 2 kW, 0.5pf<br>6h: 12kW, 0.8pf<br>6h: 18kW, 0.9pf<br>Calculate the all- day efficiency. | (6) |

**Module -5**

| | | | |
|---|---|---|---|
| 19 | a) | Explain the essential and desirable conditions for parallel operation of three phase transformers. | (5) |
| | b) | An autotransformer is used to step down the voltage level from 230V to 200V. Find the current in different sections of the winding when the load is 20kW at upf. Neglect losses and magnetising current. | (9) |
| 20 | a) | Explain Yd11 and Dy1 grouping of transformers with neat circuit and phasor diagrams. | (10) |
| | b) | Explain the purposes of a third winding in three winding transformers. | (4) |

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