Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S) Examinations (FT/WP) May 2026 (2024 Scheme)

Course Code: PCEET303

Course Name: DC MACHINES & TRANSFORMERS

Max. Marks: 60 Duration: 2 hours 30 minutes

Use Graph sheets wherever required

PART A

(Answer all questions. Each question carries 3 marks)

		CO	Marks
1	Derive the emf equation of a DC Generator	2	(3)
2	Compare lap and wave windings in DC machines.	1	(3)
3	What are the different losses in a DC motor and discuss the power stages in a DC motor.	3	(3)
4	With the aid of a neat circuit diagram, explain the Armature Voltage Control of DC Shunt Motor. List the salient features and drawbacks of this method of speed control.	3	(3)
5	Draw the phasor diagram of a practical single-phase transformer supplying lagging power factor load.	4	(3)
6	Derive the condition for maximum efficiency in a single-phase transformer.	4	(3)
7	What are the conditions for parallel operation of three phase transformers? State whether these conditions are essential conditions, or desirable conditions.	5	(3)
8	List down any two advantages and two drawbacks of Auto-transformer in comparison to a two-winding transformer	5	(3)

PART B

(Answer any one full question from each module, each question carries 9 marks)

Module -1

9	a)	Draw the OCC of a DC Shunt Generator. Then explain the Voltage Built-up process of the DC shunt generator. Specify the importance of critical field resistance.	2	(5)
	b)	An 8-pole lap connected DC armature has 960 conductors and runs at 400 rpm. The flux per pole is 40mWb. Calculate the induced emf. If the same armature is wave connected, calculate the speed at which the generator must be run to generate 400V.	2	(4)
10	a)	Derive the condition for maximum efficiency of a DC generator.	2	(3)
	b)	The O.C.C. of a DC generator driven at 400 rev/min is as follows:	2	(6)

Field current (A)	2	3	4	5	6	7	8	9
Terminal voltage (V)	110	155	186	212	230	246	260	271

Find :

(i) the maximum voltage to which the machine will excite when run as a shunt generator at 400 rev/min with shunt field resistance equal to 34 Ω.

(ii) the additional resistance to be inserted in the shunt field circuit to reduce the O.C. voltage to 220 V.

(iii) the critical value of the shunt field circuit resistance.

(iv) the critical speed when the field circuit resistance is 34 Ω.

Module -2

11	a)	Explain the working of a three point starter with the help of neat diagrams.	3	(3)
	b)	Explain the significance of back emf in a DC motor,	3	(2)
	c)	A 200 V DC shunt motor takes a no-load current of 2A and runs at 1500 rpm. If the full-load current drawn by the motor is 30 A, find the speed of the motor on full load, and the percentage speed regulation. Assume that flux is	3	(4)

constant from no-load to full-load. Resistance of armature circuit and field circuit is 0.25Ω and 200Ω respectively.

12	a)	Derive the torque equation of a DC motor.	3	(3)
	b)	A 4-pole, 11.19 kW, 240 V, wave connected DC shunt motor draws armature and field currents of 50 A and 1.0 A respectively while running at 1000 rpm. Its armature has 540 conductors and the armature resistance is 0.1 Ω. Assuming a drop of 1 volt per brush, find (a) the torque developed (b) the shaft torque (c) useful flux / pole (d) rotational losses and (e) efficiency.	3	(6)

Module -3

13	a)	Explain Voltage-Regulation in a transformer. Using phasor diagram, derive the expression for voltage regulation. Derive the condition for zero regulation.	4	(5)
	b)	A 150kVA, 11000/230V, 50Hz 1-phase transformer has iron loss of 1.4kW and copper loss of 1.6kW on full-load. Determine (a) the maximum efficiency at unity p.f. (b) the efficiency of the transformer at half load, when the load is having a power factor of 0.8 p.f. leading.	4	(4)
14	a)	Derive the EMF equation of single-phase transformer.	4	(4)
	b)	An OC and SC test was conducted on a 10kVA, 250/500 V, 50Hz, single-phase transformer. The results are given below: OC Test (conducted on LV side) : 250 V, 1.2 A, 48 W SC Test (conducted on HV side) : 45 V, 18 A, 560 W Develop the equivalent circuit of the transformer referred to the LV side.	4	(5)

Module -4

15	a)	Derive an expression to justify the saving of copper in auto transformer with respect to an ordinary two winding transformer with same rating.	4	(3)
	b)	A 3 φ step down transformer is connected to 3.3 kV supply mains and takes 30A. Calculate its secondary line voltage and line current for the following connections if the ratio of turns per phase is 14 (i) Y-Y (ii) Y- Δ (iii) Δ – Y (iv) Δ – Δ.	5	(6)

16 a) Explain the Scott connection of transformers for 3-phase to 2-phase conversion. 5 (3)

b) Find the all-day efficiency of a 500kVA distribution transformer whose iron loss and full-load copper loss are 1.5kW and 6kW respectively. In a day, it is loaded as follows. 5 (6)

Hours	P_{out} in kW	p.f.
6	400	0.8
10	300	0.75
4	100	0.8
4	0	--

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