Reg. No.															

Question Paper Code	14699

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2026

Third Semester

Electrical and Electronics Engineering

20EEPC302 - DC MACHINES AND TRANSFORMERS

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART – A (i) (MCQ)
(16 × 1 = 16 Marks)
Answer ALL Questions

		Marks	K – Level	CO
1.	Recall, the SI unit of magnetic flux is _____ a) Weber b) Tesla c) Henry d) Ampere-turn	1	K1	CO1
2.	Identify the Hysteresis loss in magnetic materials mainly depends on _____ a) Frequency b) Core volume c) Area of hysteresis loop d) Resistance	1	K3	CO1
3.	Interpret, In a DC generator the emf generated is directly proportional to _____ a) Armature resistance b) Flux per pole c) Brush contact drop d) Shaft diameter	1	K2	CO1
4.	Interpret the reason of interpoles in DC generators is to _____ a) Increase speed b) Improve commutation c) Reduce flux d) Increase efficiency	1	K2	CO2
5.	Identify the reason that,Wave winding is generally preferred for _____ a) High current output b) Low voltage output c) High voltage output d) Low speed machines	1	K3	CO2
6.	Which DC motor develops the highest starting torque? a) Shunt motor b) Series motor c) Compound motor d) PMDC motor	1	K1	CO2
7.	Infer that, A DC shunt motor is suitable for applications requiring _____ a) Constant speed b) Variable speed c) Very high torque only d) Intermittent duty	1	K2	CO3
8.	Identify the reason, that the back emf in a DC motor acts opposite to _____ a) Supply voltage b) Residual flux c) Field current d) Armature flux	1	K3	CO3
9.	Which braking method returns energy back to the supply? a) Plugging b) Dynamic braking c) Regenerative braking d) Mechanical braking	1	K1	CO3
10.	Show a three-point starter is mainly used to _____ a) Increase efficiency b) Limit starting current c) Improve speed regulation d) Reduce torque ripple	1	K2	CO4
11.	Identify, Swinburne's test is conducted on a DC machine to determine _____ a) Copper loss only b) Mechanical loss only c) Efficiency d) Armature reaction	1	K3	CO4

12.	Identiy the other name of Hopkinson's test is		*1*	*K3*	*CO4*
	a) Open circuit test	b) Short circuit test			
	c) Back-to-back test	d) Retardation test			
13.	The transformer core is generally laminated to reduce _____		*1*	*K1*	*CO5*
	a) Copper loss	b) Eddy current loss			
	c) Mechanical loss	d) Leakage flux			
14.	Identify, an autotransformer uses _____ winding(s).		*1*	*K2*	*CO5*
	a) One	b) Two			
	c) Three	d) Four			
15.	Voltage regulation of a transformer is zero at _____ power factor.		*1*	*K1*	*CO5*
	a) Lagging	b) Leading			
	c) Unity	d) Zero			
16.	Identify, Parallel operation of transformers is preferred to _____		*1*	*K3*	*CO5*
	a) Reduce losses only	b) Improve reliability and load sharing			
	c) Increase frequency	d) Eliminate core loss			

PART – A (ii) (Short Answer Questions)
(8 × 3 = 24 Marks)
Answer ALL Questions

17.	Apply Faraday's laws to explain dynamically induced emf in rotating machines.	*3*	*K3*	*CO1*
18.	Analyze the effect of hysteresis and eddy current losses in magnetic circuits.	*3*	*K4*	*CO1*
19.	Illustrate the role of compensating winding in DC generators.	*3*	*K3*	*CO2*
20.	Analyze the characteristics of DC series and shunt generators.	*3*	*K4*	*CO2*
21.	Develop the torque equation to explain the operation of a DC motor.	*3*	*K3*	*CO3*
22.	Analyze the necessity of starters in DC motors.	*3*	*K4*	*CO4*
23.	Apply regenerative braking in electric traction applications.	*3*	*K3*	*CO4*
24.	Identify the significance of voltage regulation in transformers.	*3*	*K3*	*CO5*

PART - B (Descriptive Answer Questions)
(5 × 12 = 60 Marks)
Answer ALL Questions

25.	a)	A magnetic circuit has a mean path length of 50 cm, cross-sectional area of 10 cm^2, and relative permeability μ_r = 1200. A coil of 500 turns is wound on it. Apply the magnetic circuit laws to calculate: (i) reluctance of the core, (ii) inductance of the coil, (iii) flux produced when a current of 2 A flows, and (iv) energy stored in the magnetic field. If an air gap of 2 mm is introduced, recalculate the flux and compare.	*12*	*K3*	*CO1*
		OR			
	b)	Apply the concept of dynamically induced EMF in a rotating machine. Derive the general EMF equation for a coil rotating in a uniform magnetic field and show that it produces a sinusoidal waveform. Extend the analysis to derive the torque equation using the principle of energy conversion. Examine the relationship between electrical power input, mechanical power output, and core losses.	*12*	*K3*	*CO1*
26.	a)	A 6-pole DC generator has 480 conductors, lap winding, and runs at 1000 rpm. The flux per pole is 0.04 Wb. Apply the EMF equation to calculate the generated EMF. If the generator is reconnected with wave winding, recalculate the EMF. The armature resistance is 0.2 Ω and the generator supplies a load of 50 A. Calculate the terminal voltage for both winding configurations.	*12*	*K3*	*CO2*

OR

	b)	Apply the phenomenon of armature reaction in a DC generator. Derive the expression for the resultant air-gap flux distribution considering both the main field and armature MMF. Determine the shift of the magnetic neutral axis and analyze the effect on commutation. Examine the effectiveness of interpoles and compensating windings in neutralizing armature reaction	*12*	*K3*	*CO2*
27.	a)	A 220 V DC shunt motor has armature resistance Ra = 0.4 Ω and field resistance Rf = 200 Ω. At full load it draws a line current of 30 A and runs at 1200 rpm. Analze the motor equations to calculate: (i) back EMF, (ii) armature current, (iii) torque developed, (iv) mechanical power output, and (v) efficiency. Also determine the no-load speed assuming the no-load armature current is 2 A.	*12*	*K4*	*CO3*
		OR			
	b)	Analyze the suitability of DC shunt, series, and compound motors for the following industrial applications: (i) textile mills requiring constant speed, (ii) electric locomotives requiring high starting torque and variable speed, (iii) centrifugal pumps requiring moderate starting torque.	*12*	*K4*	*CO3*
28.	a)	Analyze different methods of speed control (Above and Below Rated Speed) of DC motors and explain their practical applications.	*12*	*K4*	*CO4*
		OR			
	b)	Analyze the working principles of plugging, dynamic braking, and regenerative braking in DC motors.	*12*	*K4*	*CO4*
29.	a)	Develop the equivalent circuit of a transformer to determine efficiency and voltage regulation under different loading conditions.	*12*	*K3*	*CO5*
		OR			
	b)	Make use of the parallel operation of transformers and explain the necessity of tap changing and protection devices in transformers.	*12*	*K3*	*CO5*