Ref. No.: Ex/PG/PE/T/127B/2024

M. POWER ENGINEERING EXAMINATION-2024

(2nd Semester)

SUBJECT – Advanced Electrical Drives

Time: Three hours Full Marks: 100

Answer any ***four*** questions as directed under each group

Assume suitable value for missing data, if any

All parts of a question to be answered at one place

No. of Question		Marks
	Group A (CO1) Answer **any one** questions	
Q. 1. (a)	Derive the fundamental torque equation in connection with electric drive. Also explain the components of load torque.	12
(b)	Discuss the motor and input supply performance parameters of phase controlled dc electric drives with relevant expressions of the parameters. State their importance in the design of electric drives.	13
2. (a)	Briefly describe the operation of a separately excited dc motor fed from a single-phase semi converter. Sketch and explain the waveforms for armature voltage, input supply current, free-wheeling diode current and load current. Derive the expression for average motor voltage. Assume continuous motor current.	12
(b)	An inductor is added in the motor circuit in part (a) so that motor current is now ripple free and constant. Express the input supply current in Fourier series and hence derive the expressions for input performance parameters in terms of firing angle (α).	13
	Group B (CO2) Answer **any one** questions	
3. (a)	Explain the operation of a separately excited dc motor fed from a three phase full converter with the neat sketches of circuit diagram and waveforms of armature voltage, input current and load current. Derive the expression for average motor voltage.	13
(b)	Assuming motor current in (a) is constant and ripple free, derive Fourier series coefficients of input current and hence derive the expressions for input performance parameters in terms of firing angle (α)	12

4.	A 1-ph, 230 V, 50 Hz feeds a separately excited dc motor through two 1-ph-semi converters, one for the field circuit and other for the armature circuit. The firing angle for the semi converter in the field circuit is zero and the field resistance is 200 Ω. The armature resistance $R_a = 0.30$ Ω. The load torque is 50 Nm at 900 rpm. The voltage constant is 0.8 V/A-rad/sec and the torque constant is 0.8N-m/A^2. Assume the armature and field currents are continuous and ripple free. Neglect the losses. Determine (i) The field current (ii) The firing angle of the semi-converter at the armature circuit (iii)The power factor of the armature circuit	5+10+5
	Group C (CO3) Answer **any one** questions	
5. (a)	Describe the operation of a separately excited dc motor controlled by a Class A chopper with relevant circuit diagram and wave forms. Consider both Continuous and discontinuous motor current.	10
(b)	The speed of a 1.0 HP, 500 rpm, 4.1 A separately dc motor and has an armature resistance and inductance of 7.56 Ω and 55 mH respectively. The motor is driven with the armature supplied from a Class A chopper from a 240 V dc source. The field current is held constant at the value that gives rated operation at 230 V and chopping frequency is 500 Hz. The minimum load torque is 5 Nm. Determine (i) the value of t_{on} for minimum load torque at 500 rpm (ii) whether I_a is continuous in part (i) (iii) the minimum value of t_{on} for which current is continuous at 500 rpm and the corresponding coupling torque.	15
6. (a)	Describe the operation of regenerative braking control of dc motors using chopper with relevant circuit diagrams, waveforms and speed torque characteristics.	10
(b)	A dc series motor has an armature current of 80 A and is running at 1200 rpm with 210 V DC. Assuming linear magnetization circuit, calculate the braking current and braking resistance when the motor is at twice the rated torque and running at 1000 rpm under dynamic braking condition.	15
	Group D (CO4) Answer **any one** questions	
7. (a)	What are the different methods of speed control of induction	

	motors? Describe the method of static rotor resistance control using a chopper in rotor circuit employed for the speed control of induction motors with relevant circuit diagrams and speed torque characteristics.	13
(b)	Describe the method of stator current control used for the speed control of induction motors. Also draw and explain the speed torque characteristics.	12
8. (a)	A 3-ph, 1500 rpm SCIM drives a blower type load. No load rotational losses are negligible. (i) Show that rotor current is the maximum when the motor runs at a slip of $s = \frac{1}{3}$ (ii) If the 3-ph SCIM runs at (a) 1455 rpm and (b) 1350 rpm, determine the maximum current in terms of rated current at these speeds. The SCIM drives a fan load and rotational losses are negligible	15
(b)	Discuss the principle of operation of Static Schervious drive with suitable circuit diagram.	10