Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S, FE) / S4 (PT) (S,FE) Examination May 2023 (2015 Scheme)

Course Code: EE308

Course Name: Electric Drives

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries5 marks. Marks

1	Draw the block diagram of an electric drive. What are the functions of power modulator used in electric drive	(5)
2	Draw and explain the torque slip characteristics of fan load, hoist load and traction load.	(5)
3	Draw and explain the circuit diagram of a class-D chopper fed DC motor	(5)
4	List the advantages of variable frequency control over variable voltage control for the speed control of induction motor. Why variable voltage control is well suitable for fan type of loads	(5)
5	Why closed loop control is must for CSI fed induction motor drive	(5)
6	Explain the field oriented control of induction motor drive. What are its advantages	(5)
7	Draw and explain the block diagram of a self controlled mode of operation of a synchronous motor	(5)
8	Draw and explain the torque and power capability curves of synchronous motor	(5)

PART B

Answer any two full questions, each carries10 marks.

9	a)	Explain the speed control of separately excited DC motor using combined armature voltage and flux control method. Draw and explain the torque and power capability curves.	(6)
	b)	A separately excited dc motor rated at 10 kW, 240 V, 1000 rpm is supplied from a fully controlled two pulse bridge converter. The converter is supplied at 250 V, 50 Hz supply. An extra inductance is connected in the load circuit to make the conduction continuous. Determine the speed of operation of the motor for thyristor firing angle of 60° assuming the armature resistance of 0.4 Ω and an efficiency of 87% at rated conditions. Assume constant torque load.	(4)

10 a) Derive the speed torque characteristics of a DC series motor. Draw and explain the characteristics during variable voltage control (5)

b) A three phase dual converter feeds a 500 V, 60 A dc motor with separate excitation. The armature resistance is 1.5 Ω. The converter is fed from a 420 V, 50 Hz supply. Assuming a voltage drop of 20 V in the converter determine the firing angle and back emf for (i) motoring operation at full load current with motor terminal voltage of 450 V and (ii) Regeneration operation at full load current with terminal voltage of 450 V. (5)

11 a) What is load equalisation. What are the reasons for using load equalisation in electric drive (4)

b) A three phase, half controlled bridge rectifier fed from a 300 V, 60 Hz provides a variable voltage supply to the armature of a separately excited dc motor. The specifications of the motor are R = 0.02 Ω, L = 0.002 H, the constant of the motor 2.25 Vs/rad, rated current is 500 A. Determine the firing angle so that the motor runs at a rated speed of 1500 rpm (6)

PART C

Answer any two full questions, each carries10 marks.

12 a) Draw the circuit diagram and explain the operation of a four quadrant chopper fed dc motor drive (6)

b) A dc chopper feeds a dc series motor. The supply voltage to the chopper is 500 V. The total current is found to vary between two current limits having a difference of 15 A. The time ratio of the chopper is 0.6 and its pulse frequency 80 cycles/s. Determine the armature inductance of the motor. (4)

13 a) With a neat diagram, explain static rotor resistance control of three phase wound rotor induction motor. Explain its torque speed characteristics for variable rotor resistance (5)

b) A 3 phase, 400 V, 6 pole, 50 Hz delta connected slip ring induction motor has rotor resistance of 0.2 Ω and leakage reactance of 1 Ω per phase referred to stator. When driving a fan load it runs at full load at 4% slip. What resistance must be inserted in the rotor circuit to obtain a speed of 850 rpm. Stator to rotor turns ratio is 2.2. Neglect stator impedance and magnetizing branch. (5)

14 (a) Explain the closed loop operation of a static Scherbius drive (5)

(b) A 2.8 kW, 400 V, 50 Hz, 4 pole, 1370 rpm, Y connected induction motor has the following parameters. Rs= 1.9 Ω, Rr'= 4.757 Ω, Xs= Xr'=3 Ω. Load characteristics are matched with motor such that the motor runs at 1370 rpm with full voltage across its terminals. The motor is controlled by terminal voltage control and load torque is proportional to speed. Calculate the motor terminal voltage and current at half the rated speed (5)

PART D

Answer any two full questions, each carries 10 marks.

15 a) When a synchronous motor drive is operating in true synchronous mode, why the frequency must be changed in small steps. (4)

b) A 5 MW, 3 phase, 11 kV, Y connected , 6 pole, 50 Hz, 0,9 leading power factor synchronous motor has Xs = 8 Ω and neglect Rs. Rated field current is 50 A. Machine is controlled by variable frequency control at constant V/f ratio upto the base speed and at constant voltage, above rated speed. Determine (i) Torque and field current for the rated armature current, 750 rpm and 0.8 leading power factor and (ii) Armature current and power factor for half the rated motor torque, 150 rpm and rated field current. (6)

16 a) Explain the difference between the VSI fed induction motor drive and CSI fed induction motor drive (5)

b) What are the various types of permanent magnet synchronous motors. Explain (5)

17 a) Define space vector. Write down Park's transformation matrics. (4)

b) With a block diagram, explain the operation of a microcontroller based permanent magnet synchronous motor drive (6)

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