Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree (S, FE) Examination May 2024 (2019 Scheme)

Course Code: EET413

Course Name: ELECTRIC DRIVES

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer all questions, each carries 3 marks. Marks

1		Draw the block diagram of a closed loop speed control of an electric drive.	(3)
2		Derive the fundamental torque equations of motor - load system.	(3)
3		For a single phase half controlled rectifier fed separately excited dc motor, the armature current is assumed to be continuous and ripple free. Draw the armature voltage and source current for a firing angle of 30^0.	(3)
4		Give the concept of critical speed in electric drives.	(3)
5		Explain the operation of a two quadrant chopper in dc motor drives.	(3)
6		Draw the circuit diagram of a class-C chopper fed DC motor. Draw its V/I characteristics.	(3)
7		Describe static rotor resistance control technique for the speed control of a 3-phase induction motor.	(3)
8		Why is stator voltage control not suitable for the control of induction motors with constant load torque?	(3)
9		Explain the frame transformation from three phase to synchronous reference frame.	(3)
10		What are the important features of 'True Synchronous Mode' of operation of a Synchronous motor.	(3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

11	a)	Differentiate between passive and active load torques.	(4)
	b)	Explain the multi-quadrant operation of a motor driving a hoist load.	(10)

OR

12 a) Derive the mathematical expression for steady state stability analysis of equilibrium operating point. (6)

b) A motor is required to drive the take-up roll on a plastic strip line. The mandrel on which the strip is wound is 15cm in diameter and the strip builds up to a roll 25cm in diameter. Strip tension is maintained constant at 1000N. The strip moves at a uniform speed of 25m/s. The motor is coupled to a mandrel by a reduction gear with a=0.5. The gears have an approximate efficiency of 87% at all speeds. Determine the speed and power rating of the motor required for this application. (4)

(c) Draw the torque-speed characteristics of 1) Traction load 2) high speed hoist. (4)

Module II

13 a) With neat circuit diagrams and waveforms explain the operation of single phase fully controlled rectifier fed separately excited dc motor for $\alpha=60^{o}$. (7)

b) Explain the working of a dual converter (circulating current type only) fed separately excited DC motor. (7)

OR

14 a) Explain the working of a three phase full converter feeding a separately excited dc motor. Draw the torque-speed curve of the drive and obtain the expression for motor speed at continuous conduction mode. (8)

b) A 220 V, 1000 rpm, 60 A separately excited dc motor with an armature resistance of 0.1 Ω is fed from a single-phase full converter with an ac source voltage of 230V,50Hz. Assuming continuous mode of conduction, determine the value of firing angle when: (i) the motor is running at 600 rpm at rated torque and (ii) the motor is running at -500 rpm at rated torque. (6)

Module III

15 a) Explain how regenerative braking can be implemented in dc motors by using chopper circuits. (4)

b) Describe how a four-quadrant drive can be obtained from a chopper-fed separately-excited dc motor. (10)

OR

16 a) Explain the characteristics of constant torque and constant power speed control of dc motor. (6)

b) A dc series motor is fed from 600 V dc source through a chopper. The dc motor has the following parameters: (8)

R_a =0.03 Ω, R_s= 0.05Ω, k =4 x 10^{-3} Nm / amp^2

The average armature current of 400 A is ripple free. For a chopper duty cycle of 60%, determine (i) Motor speed, (ii) Motor torque

Module IV

17 a) Derive the condition for maximum torque of an induction motor. Also derive the value of the maximum torque the machine can develop. (6)

b) Explain Static Scherbius and Static Kramer drive for induction motor with the help of circuit diagrams. (8)

OR

18 a) Explain V/f control of 3-phase induction motor using necessary speed - torque characteristics. (7)

b) A 440V, 50 Hz, 6 pole, Y connected wound rotor motor has the following parameters: (7)

R_s=0.5Ω R_r'=0.4Ω X_s= X_r'=1.2Ω X_m=50 Ω

Stator to rotor turns ratio is 3.5. Motor is controlled by static rotor resistance control. External resistance is chosen such that the breakdown torque is produced at standstill for a duty ratio of zero. Calculate the value of external resistance. How duty ratio should be varied with speed so that the motor accelerates at maximum torque?

Module V

19 a) Explain the working of load commutated CSI fed synchronous motor. (7)

b) Explain the principle of operation of vector control in induction motors. (7)

OR

20 a) Explain Park's Transformation with reference to space vectors. Write down the transformation matrices. (7)

b) Explain the variable frequency control of multiple synchronous motor. (7)

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