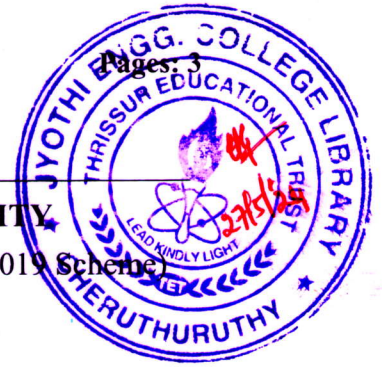


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Name: _____

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° . (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 $\alpha=60^\circ$. (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 0.1Ω 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)

$$R_a = 0.03 \Omega, R_s = 0.05 \Omega, k = 4 \times 10^{-3} \text{ Nm / amp}^2$$

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)

$$R_s = 0.5 \Omega, R_r' = 0.4 \Omega, X_s = X_r' = 1.2 \Omega, X_m = 50 \Omega$$

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)
