Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**ME - SEMESTER– I EXAMINATION – WINTER 2013**

**Subject Code: 714502N** **Date: 26/12/2013**

**Subject Name: Solid State DC Drives**

**Time:10:30 TO 13:00** **Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** Describe the four quadrant of a motor driving a hoist load with the help of a labeled diagram showing the directions of motor torque, load torque and motor speed as applicable in each quadrant. **07**

**(b)** Explain principles of speed control of DC motor with necessary operating modes? Specify their field of applications. **07**

**Q.2** **(a)** Discuss the dynamic braking of separately excited dc motor? During braking, separately excited motor can be converted as self excited generator, why? **07**

**(b)** A 200 V, 875 rpm, 150A separately excited dc motor has an armature resistance of 0.06Ω. It is fed from a single phase fully controlled rectifier with an ac source voltage of 220V 50Hz. Assuming continuous conduction Calculate **07**

(a) Firing angle for rated motor torque and 750rpm.
(b) Firing angle for rated motor torque and (-500) rpm.
(c) Motor speed for $\alpha = 160^0$ and rated torque.

**OR**

**(b)** Explain the operation of dc motor in forward motoring and Reverse braking with proper type of chopper. Explain both quadrant operations with appropriate wave forms? **07**

**Q.3** **(a)** A single phase Fully controlled rectifier is feeding a separately excited motor driving a friction load. Motor is operating in steady state with a rectifier firing angle of $30^0$. Firing angle is now changed from $30^0$ to $60^0$. Explain how the motor current and speed will change with time? **07**

**(b)** Write a brief note on classes of duty for an electric motor. Give there industrial application for each class of duty cycle? **07**

**OR**

**Q.3** **(a)** Explain the modeling of separately excited DC motor with speed control loop. Give the limitation of only speed control loop. **07**

**(b)** Explain the motoring and braking operation of three phase fully controlled rectifier control of DC separately excited motor with aid of diagrams and waveforms of O/P voltage, O/P current and voltage across thyristor2 for α=60°and α=150° for continuous conduction. Also obtain the expression for motor terminal voltage and speed. **07**

**Q.4** **(a)** What are the reasons for using load equalization in an electrical drive? Why current sensing is required in electrical drives? What are the common methods of current sensing? **07**

**(b)** A 230 V, 1100 rpm, 220 Amps separately excited DC motor has an armature resistance of 0.02 Ω. The motor is fed from a chopper, which provides both motoring and braking operations. The source has a voltage of 230V. Calculate **07**

a) The duty ratio of chopper for motoring operation at rated torque and 500 rpm

b) The maximum permissible motor speed obtainable without field weakening, if the maximum duty ratio of the chopper is limited to 0.9 and the maximum permissible motor current is twice the rated current.

**OR**

**Q.4** **(a)** Explain the concept of 'Dual Converter'. Using circuit diagram, briefly explain the working of any one type of dual converter, derive necessary condition of firing angles and list the disadvantages of dual converter. **07**

**(b)** Develop a linearized transfer model of DC series motor. **07**

**Q.5** **(a)** For type-A dc chopper with RLE load and continuous load current condition shows that per unit ripple current is maximum when duty cycle is 0.5. Also draw the necessary waveforms and circuit diagram. **07**

**(b)** With neat schematic Block diagram describe the Micro-computer control of 4 quadrant DC drives with flow chart. **07**

**OR**

**Q.5** **(a)** Explain the method of providing electrical isolation between control circuit and driver circuit using transformer when the switching frequency is very less. Draw relevant waveforms and circuit diagrams? **07**

**(b)** Explain the different types of control strategies for chopper drive? Which is best suited for DC motor control? **07**

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