Reg. No.



VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: SOLID STATE DRIVES [ELE 403]

REVISED CREDIT SYSTEM

Time: 3 Hours

Date: 02 December 2016

MAX. MARKS: 50

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Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitable assumed.
- Sine- Graph sheets may be used.
- 1A. Derive expressions for equivalent moment of inertia and torque referred to the motor shaft when a motor is driving two loads; one linear in nature and second rotational in nature.04
- **1B.** 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 25 cm in diameter. Strip tension is maintained constant at 1000 N. The strip moves at a uniform speed of 25 m/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.
- **1C.** Sketch & explain the speed torque characteristics of Ideal transportation drive?
- **2A.** A 2.4 kW, 220 V, 480 rpm, 12.8 Amp DC motor has the armature resistance and inductance of 2.2 Ω and 40 mH. It is fed by a single phase fully controlled rectifier with an AC source voltage of 240 V, 60 Hz. Identify the mode and calculate the speed for $\alpha = 120^{\circ}$, T_a = 60 Nm. *05*
- 2B. Discuss the advantages of controlled freewheeling operation of a converter fed dc motor. Sketch the load voltage and load current waveforms along with the triggering sequence, of a three phase Controlled freewheeling converter fed separately excited DC motor operated with motoring mode. (Assume discontinuous conduction).
- 3A. A 230V, 600 rpm, 4Amp, DC motor has armature resistance of 7.5Ω and Inductance of 50mH. Determine the maximum value of t_{on} for which current is continuous at rated speed, if the motor is controlled by a Class A Chopper fed from a 240V DC source operating at 500 Hz Chopping Frequency.
- 3B. With a neat circuit diagram, load volatage and current waveforms, explain a 1-Φ fully controlled rectifier with controlled freewheeling feeding the armature of a separately excited DC motor operating in motoring mode with discontinuous conduction. Derive the expression relating motor speed and torque.
- **3C.** A 230 V, 500 rpm, 90 Amp separately Excited DC motor has the armature resistance and inductance of 0.115 Ω and 11 mH respectively. The motor is controlled by a chopper operating at 400 Hz. If the motor operation is required in the second quadrant at the rated torque and 300 rpm speed, calculate the duty ratio. *02*

- **4A.** With the help of circuit diagram and relevant waveforms explain the working of class C chopper fed DC motor. **04**
- **4B.** A 3.7 kW, 1000 rpm 230 V, 20 Amp DC motor has an armature resistance and inductance of 1.4 Ω and 16.5 mH respectively. The motor is fed by a three phase fully controlled rectifier with an AC source voltage of 170.3 V(line) 60 Hz. Find the critical torque. Draw the load voltage and current waveforms for a firing angle of 60° when motor develops a torque of 8 N-m.
- 5A. With the help of a suitable torque slip characteristics explain why stator voltage control method of speed is best suited for fan and pump drives. Also, with a suitable schematic, explain how direction of rotation can be reversed while employing stator voltage control technique to an induction motor.
- **5B.** Describe the working principle of direct Field orientation control of induction motor with the help of its neat block diagram. Mention its advantages. *04*
- 5C. Draw the speed torque characteristics of an adjustable frequency induction motor drive showing clearly constant torque region, constant horsepower region and high speed motoring region. Also indicate the control strategy employed for each of these regions.02
- **6A.** What are the types of power line disturbances? With the help of block schematic explain the working of off-line UPS.
- 6B. What are the advantages of closed loop control scheme over open loop control scheme in AC drive systems? Sketch and explain the general block diagram of a position controlled AC drive.04
- 6C. With a block schematic explain how power factor control can be achieved statically in synchronous machine.

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