Reg. No.



VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2022

SOLID STATE DRIVES [ELE 4088]

REVISED CREDIT SYSTEM

Time:	3 Hours	Date: 23 NOV 2022	Max. Marks: 50
Instructions to Candidates:			
	✤ Answer Al	LL the questions.	
 Missing data may be suitably assumed. 			
1A.	Compare tl controlled controlled continuous analyze the	he waveforms of armature voltage and current or rectifier-fed separately excited DC motor w freewheeling in the motoring mode of ope conduction. The firing angle may be suitably e effects of controlled freewheeling.	of a single-phase ith and without eration. Assume assumed. Also, (04)

A class A DC chopper circuit is feeding 1.2 kW of power from the DC source **1B**. of 240 V to a separately excited DC machine operating with 10 Nm torque. The back EMF constant of the machine is 1.2 V/(rad/sec). Calculate the duty cycle at which the chopper is operating, if continuous conduction is ensured. Assume armature resistance of 1Ω .

- Identify the constraints in controlling the supply frequency in the variable 1C. frequency control scheme of AC drives. Justify your answer.
- 2A. A motor in a chocolate manufacturing industry drives two loads. One has rotational motion. It is coupled to the motor through a reduction gear with a gear ratio of 0.1. This load has a moment of inertia of 10 kgm2. Other load has translational motion and consists of 1000 kg to be lifted up at a uniform speed of 1.5 m/s. The motor has a moment of inertia of 0.2 kgm2 and runs at a constant speed of 1420 rpm. Find the dynamic torque required to accelerate the system from the standstill to 1420 rpm in 10 sec
- A separately excited DC motor rated at 220V, 10A, 900rpm, $Ra=2\Omega$, 2B. La=25mH is controlled by a three-phase controlled rectifier. AC supply line voltage is 400V at 50Hz. At what angle the rectifier has to be fired to achieve a load torgue of 20Nm at a speed of 500 rpm in the motoring mode? Assume continuous conduction is ensured
- **2C**. Consider a 200 V, 500 rpm, 800kW, 4 A separately excited DC motor with armature resistance of 1.5Ω and inductance of 50mH. This motor needs to be controlled only in the forward motoring mode for a particular application. The DC supply voltage to the converter is 250V. What is the power output at 400rpm at a duty cycle of 65%. The motor inductance is large enough to ensure continuous conduction at this duty cycle. Explain how the power output can be increased at the same speed of operation at 400rpm

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- **3A.** Consider a drive system in a paper mill. Explain the regenerative mode of operation of the separately excited DC motor in the drive system, controlled by a single-phase controlled rectifier. Discontinuous conduction is observed at a particular load condition. Draw the waveforms of armature current and voltage in this case. Demonstrate the triggering sequence. Derive the expression for average voltage developed across the armature.
- **3B.** The source current of a Class D chopper-fed DC motor is observed for the analysis of harmonics in its fourth quadrant mode of operation. Explain the nature of the observed signal and this particular mode of operation of the circuit.
- **3C.** Identify and list the factors deciding the nature of armature current in a three-phase controlled rectifier-fed separately excited DC motor.
- **4A.** Suggest a comparatively efficient alternative method for rotor-resistance control of induction motor, in which control is done from the rotor side itself. Can the suggested method be implemented with the help of power electronic converters? Is there any possibility of bidirectional power flow in this case? Justify your suggestion with the necessary circuit diagram, the principle of working, and the explanation of possible operating modes.
- **4B.** An AC drive system to be used in a manufacturing industry require precise speed control using inverters. Select a suitable variable frequency scalar-control strategy to be used here. Justify your answer with suitable block diagram representations.



Fig.1

Analyze the steady-state stability of the operating point 'A' in the given figure.

- **5A.** Establish the analogy between the control of separately excited DC drives and Field oriented control of three-phase induction motor drives with suitable block diagram-based explanations.
- **5B.** Explain how Power electronic converters can help in controlling the operation of a BLDC motor-based drive system with suitable schematic diagrams.
- 5C. A drive system to be designed in an industry aims at power factor improvement along with driving mechanical loads. Select a suitable AC motor for this drive system. Justify your answer
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