Reg. No.



VII SEMESTER B. TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, DECEMBER 2023

SOLID STATE DRIVES [ELE 4088]

REVISED CREDIT SYSTEM Data: 05 DECEMBED 022

Time: 3	3 Hours	Date: 05 DECEMBER 023	Max. Marks: 50
Instruct	tions to Candidates:		
•	Answer ALL the que	stions.	
•	Missing data may be	suitably assumed.	
1A.	An industrial applic braking mode of op suitable chopper ci the help of output waveforms of the o	cation requires controlled motoring and re-ge peration with bidirectional current input. Sug ircuit for this application. Explain its operatio voltage, output current and source current converter.	enerative gest a on with (04)
18.	Consider a three seperately excited The converter is su (a) The firing ar mode at rate (b) The firing ar speed.	phase controlled rectifier fed 200V, 13A, 1 DC motor.The motor has armarure resistance upplied with 415V three-phase AC supply. De ngle required to develop 15Nm torque in the ed speed. ngle required to develop 15Nm braking torque	L200 rpm e of 1.5Ω. etermine, motoring e at rated
	Assume that, enou conduction.	ugh filter inductance is added to ensure co	ontinuous (04)
1C	A drive system har moment of inertia 1000rpm. The spe 500rpm in the reve torque to be deve	as an equivalent load torque of 62Nm and e a of 1.2kgm ² , and running at a steady eed of the motor need to be changed from 10 erse direction in 2 seconds. What should be loped by the motor?	equivalent speed of 000rpm to the total (02)
2A.	A 200V 1000rpm resistance and ind controlled by a sin 40 degrees, with a armature current i the average outpu	10 A separately excited motor has the uctance of 2Ω and 18 mH, respectively. The gle phase fully controlled rectifier at a firing an ac source voltage of 230V, 50Hz. Is a consured at this firing angle at rated speed of the converter & draw the wave	armature motor is angle of ontinuous d? Derive eforms of
2B.	armature voltage a A DC chopper whic power to DC source operating with 10N Calculate the duty	and current in this case. Th is operating as class B is feeding back 1.2 e of 240V from a separately excited DC mac Im torque. Machine constant is 1.2 V/(rad/se cycle at which chopper is operating.	(05) kW of hine ec).
2C.	With the help of configurations, exp system. Also mentions	of necessary circuit diagrams of the plain an example of brushless DC motor-ba tion the advantages and disadvantages of	(02) converter sed drive this drive

system.

3A. Analyse the waveforms of armature voltage and current of a $3-\Phi$ fully controlled rectifier fed DC drive with $a = 75^{\circ}$. Clearly show the triggerring sequence. Derive the expression for average output voltage. Assume discontinuous conduction. To plot the waveform the given template in Fig. Q 3A may be used.



Fig. Q 3A

- **3B.** A variable frequency induction motor-based drive system needs to be operated in <50% of rated speed. Which type of control strategy out of V/f control or E/f control you prefer for this application? Justify your answer with necessary block schematics and characteristics.
- **3C.** Compare the converter output voltages of a class A & class B chopper fed DC drives, fed with 220V DC supply. Assume the duty cycle of power semiconductor switch is 40% in both cases. Comment on the results obtained.
- 4A. Will a 1kW motor be a suitable choice for the following drive system? A drive system has two loads. One has rotational motion. It is coupled to the motor through a reduction gear with gear ratio 0.2 and efficiency 80%. The load has a torque of 8 Nm. Also note that the gearbox has a load torque of 1Nm referred to motor shaft.

Other 10N load has translational motion at a uniform speed of 1.5 m/s. The coupling between motor and the translational load has an efficiency of 85%. The motor runs at a constant speed of 1420rpm.

- **4B.** A three-phase induction motor-based AC drive system is designed to apply slip power recovery scheme for its speed control in the sub-synchronous speed range. Draw the schematic diagram of such a system and explain the principle behind it. Can this be modified to work in super synchronous speed range? If 'Yes' explain the method. If 'No' explain the reason.
- **4C.** Is flux weakening mode of control suitable for constant power drives? Justify your answer with suitable characteristics & block schematics.

(03)

(04)

5A. Analyze the steady state stability of operating points **a** in Fig. 5A. **(02)**

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(02)

(04)

(04)

(03)



- 5B. Why vector control of induction motor drives has become a popular control strategy in variable frequency drives. Explain the concept. Also, using a block schematic discuss the indirect vector control scheme. (04)
- **5C.** A reluctance motor needs to be selected to drive a robotic arm which require a smooth torque. Which type of reluctance motor will you select? Justify your choice. Also explain the fundamental difference in construction & working of different types of reluctance motors.

(04)