BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: M.TECH & PRE-PHD **SEMESTER : II**
BRANCH: M.TECH IN ELECTRICAL ENGINEERING **SESSION : SP/2023**

SUBJECT: EE577 CONTROL OF ELECTRICAL DRIVES

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Write the reasons for using load equalization in an electrical drive. Explain with the help of a graph. Give a classification of different types of load torques	[5]	[CO1& CO2]	02
Q.1(b)	The motor rating is to be selected from a class of motors with heating and cooling time constants of 60 and 90 min respectively. Calculate the motor rating for the following duty cycles: (1) Short-time periodic duty cycle consisting of 100 kW load for 10 minutes followed by no load period long enough for the motor to cool down (2) Intermittent periodic duty cycle consisting of 100 kW load period of 10 min and no load period of 10 min.	[5]	[CO1& CO2]	02
Q.2(a)	Draw speed torque characteristics for armature voltage control and field flux control of a dc separately excited motor. Explain the 1-Φ fully controlled rectifier control of a separately excited dc motor for motoring and regenerative braking operations. Draw the circuit, waveforms and speed torque characteristics. Write the governing equations	[5]	[CO3]	03
Q.2(b)	A 230V, 1000 rpm, 30A separately excited motor has armature resistance and inductance of 0.7Ω and 50mH respectively. Motor is controlled in regenerative braking by a chopper operation at 800Hz from a dc source of 230V. Assuming continuous conduction. (i) Calculate duty ratio of chopper fed for rated torque and the speed of 800rpm. (ii) What will be the motor speed for duty ratio of 0.6 and rated motor torque. (iii) What will be the maximum allowable speed of motor, if chopper has a maximum duty ratio of 0.9 and maximum allowable motor current is twice the rated current. (iv) Calculate power fed to the source for operating conditions in (iii).	[5]	[CO3]&[CO4]	04
Q.3(a)	Explain open loop and closed loop Volts/Hz voltage fed inverter control of a induction machine. Draw the block diagrams, speed-torque characteristics of the drive and effect of load torque variation	[5]	[CO1& CO2]	02
Q.3(b)	A 440V, 50Hz, 6-pole, Y- connected squirrel cage induction motor has following parameters: Rs=0.6Ω, R_r'=0.3Ω, Xs=Xr'=1Ω. The normal full load slip is 0.05. The motor is fed from a voltage source inverter, which maintains a constant V/f ratio. For an operating frequency of 10Hz, (i)calculate the breakdown torque as a ratio of its value at the rated frequency. (ii) What should be V/f ratio at 10Hz so that the breakdown torque at this frequency remains same as at rated frequency. (iii)If the inverter frequency range is from 60 to 5Hz, calculate the starting torque and current of this drive as a ratio of their values when the motor is started at the rated voltage and frequency.	[5]	[CO4 &CO5]	05
Q.4(a)	Draw and explain the principle of vector control of induction machine with suitable block diagram and phasor diagram. Write the governing equations	[5]	[CO1& CO2]	02

PTO

Q.4(b)	A 440V, 50Hz, 6-pole, Y-connected wound rotor induction motor has the following parameters: R_s= 0.5Ω, R_r'=0.4Ω, X_s= X_r'=50Ω. 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 of zero. Calculate the value of external resistance. How duty ratio should be varied with speed so that the motor accelerates at maximum torque	[5]	[CO1, CO2 & CO3]	04
Q.5(a)	Explain the operation of a brushless DC (trapezoidal PMAC) motor drive. Draw the circuit and waveforms. Write the governing equations.	[5]	[CO1, CO2 & CO3]	04
Q.5(b)	A synchronous motor is controlled by a load commutated inverter, which in turn is fed from a line commutated converter. Source voltage is 6.6 kV, 50 Hz. Load commutated inverter operates at a constant firing angle a of 140° and when rectifying a = 0°. dc link inductor resistance Ra=0.1 92. Drive operates in self-control mode with a constant (V/f) ratio. Motor has the details: 8 MW, 3-phase, 6600 V, 6 pole, 50 Hz, unity power factor, star connected, X_2 = 2.8 , R_2 = 0. Determine source şide converter firing angles for the following:(i) Motor operation at the rated current and 500 rpm. Find the power developed by motor? (ii) Regenerative braking operation at 500 rpm and rated motor current. Also calculate power supplied to the source.	[5]	[CO3 & CO4]	05

::::::26/04/2023::::::E