M.E. ELECTRICAL ENGINEERING
FIRST YEAR
FIRST SEMESTER EXAM 2024

Sub: STATIC CONVERTERS IN ELECTRIC DRIVES (MC)

Time: Three Hours **Full Marks:** 100

(50 marks for each part)
Use a separate Answer-Script for each Part

Answer any three questions from this part. Two marks are reserved for neat and well organised answer.

PART-I.

1. Classify power diodes according to their reverse recovery time. What is SRD and HRD ? Which one is preferred in real life and why ? Explain the reverse recovery phenomena in power diode. 16

2. What is negative base drive in power BJT and how is it implemented ? Why power BJT is operated in the Quasi-saturation region and how is it implemented ? Explain a forced commutation technique in an SCR . *16*

3. Explain the different harmonic reduction techniques from PCC. How different non-linear loads introduced in the utility supply system reduces the system power factor and also discuss the other bad effects of harmonics . *16*

4. Prove that tuned filter not only eliminates the certain harmonics but also it improves the system power factor. 16

5. Write short notes on the following : *16*

   (a) Ideal properties of ON/OFF type controller.

   (b) SCR

PART-II.

Answer *Any three* questions from this part.

Two marks are for neatness and systematic answer

6.	(a) Explain the method of regenerative braking in a dc separately excited motor drive system with the help of machine characteristics and block diagram. Also discuss its advantages for the drive system.	8
	(b) A 200V, 2.5kW, 1150 rpm DC separately excited motor with Ra=1.0 ohm is delivering rated load at rated speed with rated supply voltage. Suddenly the input voltage is reduced to 160V with load torque remaining same and the speed settles to a different speed in 10 sec. Find the new speed and net energy returned to supply during this process. Assume that the current and speed transitions between the two operating points are linear.	8
7.	With the help of block diagram, explain the method of closed loop speed control technique of a three phase slip ring induction motor using static Kramer drive system. Also indicate the operating speed range for this method and its limitations.	16
8.	(a) Explain the method of energy saving while operating a three phase induction motor.	4
	(b) A 415V, three phase, 2.2 kW, 50 Hz, 1440 rpm, cage type induction motor is running at 25% of its rated torque at rated voltage and frequency. Determine its speed of operation and operating efficiency. Now the input voltage is reduced by 20% where the rated torque appears at 1430 rpm. Determine the new speed of operation and efficiency at same 25% rated torque. Per phase IM parameters under rated condition: Rs=Rr=1.5 ohm, $X_{ls}=X_{lr}$=4.0 ohm, Xm=167 ohm, Rc =1200 ohm. The F&W losses of the machine are 150W. Assume the torque speed characteristics to be linear for the entire operation.	12

9	(a) Explain why the starting current is large when an induction machine is directly connected to its rated supply voltage. (b) A 415V, three phase, 1.5 kW, 50 Hz, 970 rpm, cage type induction motor is directly connected to its rated three phase supply voltage. Determine the starting current and starting torque. Now the motor is started from a power electronic converter supplying 10 Hz at 85V three phase supply. Determine the new starting current and starting torque. Per Phase IM parameters at rated condition: Rs=Rr=1.8 ohm, $X_{ls}=X_{lr}=4.9$ ohm, Xm=207 ohm, Rc is very large. Assume linear magnetising characteristics for the machine.	4 12
10	Explain with proper block diagram how speed, current and voltage sensing can be implemented through different techniques in a static Scherbius Drive system for a three phase slip ring induction motor drive system. Indicate also the advantage and disadvantages of all these techniques.	16