

M.E. ELECTRICAL ENGINEERING FIRST YEAR FIRST SEMESTER EXAM 2025

Sub: STATIC CONVERTERS IN ELECTRIC DRIVES

Time: Three Hours

Full Marks: 100

(50 marks for each part)

Use a separate Answer-Script for each Part

PART-I.

Answer *Any Five* questions from this part.

1.	(a) Sketch the fabrication structure of Power MOSFET and explain its working principle. (CO1)	6
	(b) With the help of necessary sketches, compare the working principles between GTO and SCR.(CO2)	4
2.	(a) Draw the characteristics of IGBT and indicate its application. (CO2)	5
	(b) Draw the block diagram and explain how a DC separately excited motor can be driven with the help of fully controlled single phase rectifier connected with ac supply. (CO3)	5
3.	Draw the schematic diagram and explain how a DC separately excited motor can be driven with the help of PWM rectifier connected with ac supply. Also indicate how a chopper can be used for speed control purpose in the above scheme. (CO3)	10
4.	With the help of necessary sketches, explain how a three phase induction motor can be driven with the help of PWM rectifier connected with ac supply along with a PWM inverter. (CO4)	10
5.	Draw the schematic diagram and explain a three phase induction motor can be driven with the help of diode rectifier connected with ac supply along with a PWM inverter. Also indicate how a chopper can be used for speed control purpose in the above scheme. (CO3)	10
6.	Draw the power and control circuit diagram and explain the protection scheme for the following: (any two) (CO3)	5X2
	(a) Input under and over voltage protection	
	(b) Over current protection	
	(c) Thermal protection	

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PART-II.

Answer *Any three* questions from this part.

Two marks are for neatness and systematic answer

6.	(a) Explain the method of dynamic 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. (CO1)	8
	(b) A 220V, 2.5kW, 1100 rpm DC separately excited motor with $R_a=0.5$ ohm is delivering rated load at rated speed and rated supply voltage. Suddenly the input voltage is reduced to 180V. Find the torque at the instant of change of voltage and the final speed of operation after voltage change. Assume that the current and speed transitions between the two operating points are linear.(CO4)	8
7.	With the help of block diagram, explain the method of speed control technique of a three phase slip ring induction motor using static Scherbius scheme. Also indicate the operating speed range for this method and its limitations.(CO2)	16
8.	(a) Explain the types of losses that occur in three phase induction motor during its operation and methods to reduce the same.(CO3)	6
	(b) 2. A 2.0 kW, 415V, 970 rpm, 3-phase, star connected, cage type induction motor is undergoing variable frequency control. The motor is driving a load and taking a current of 1.5A. Neglecting friction and windage losses, compute its total power losses and hence calculate its efficiency under (i) when it is controlled at rated V/f ratio and (ii) when it is controlled at 70% of rated V/f ratio, all for the above load current. (Assume $L_m=470\text{mH}$, $R_s=R_r=0.9$ ohm, $X_{lr}=X_{ls}=3.1$ ohm, $R_c=1200$ ohm all at 50Hz and per phase basis for the motor and no core saturation). (CO4)	10
9	(a) Explain why the starting current is large when an induction machine is directly connected to its rated supply voltage and methods to reduce the same. (CO2)	6
	(b) A 415V, 50 Hz, three phase, 2.5 kW, 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.	10

Per Phase IM parameters at rated condition: $R_s=R_r=0.8 \text{ ohm}$, $X_{ls}=X_{lr}=2.9 \text{ ohm}$, $X_m=197 \text{ ohm}$, R_c is very large. Assume linear magnetising characteristics for the machine. (CO4)

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| 10 | Explain with proper block diagram how speed, current and voltage sensing can be implemented through different techniques in a static Kramer Drive system for a three phase slip ring induction motor drive system. Indicate also the advantage and disadvantages of all these techniques.(CO3) | 16 |
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