Roll No.												

PRESIDENCY UNIVERSITY
BENGALURU

School of Engineering

Mid - Term Examinations - Nov 2024

Semester: V | **Date**: 06/11/2024

Course Code: EEE2019 | **Time**: 09.30am to 11.00am

Course Name: Power Electronics | **Max Marks**: 50

Program: B. Tech | **Weightage**: 25%

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. 5QX2M=10M

1	Why does an SCR need a minimum current (holding current) to maintain conduction?	2 Marks	L1	CO1
2	What are the static and dynamic characteristics of an SCR (Silicon Controlled Rectifier)? Draw the characteristic curves for both.	2 Marks	L1	CO1
3	What is the function of a firing circuit in an SCR? Explain how it controls the triggering of the SCR.	2 Marks	L1	CO1
4	Explain how to generate a single-phase full-wave rectifier using a center-tapped transformer and two thyristors. Draw the circuit diagram and describe its operation.	2 Marks	L2	CO2
5	Why is a power MOSFET not suitable for use in a rectifier circuit?	2 Marks	L1	CO2

Part B

Answer ALL Questions. Each question carries 10 marks. 4QX10M=40M

6	6a	Develop a bidirectional switch using one IGBT and four diodes. Provide the circuit diagram and explain its operation.	5 Marks	L4	CO1
	6b	Determine the minimum width of the gating pulse required to turn on the thyristor, given the following parameters: Source voltage V=200 V, Inductance L=0.2 H, and Latching current I_L=3 mA.	5 Marks	L5	CO1

OR

7	7a	Examine the behavior of the two-transistor model and how it simulates the operation of the SCR.	5 Marks	L4	CO1
	7b	For an LC circuit, Determine the duration for which the thyristor conducts. Given Inductance L=(100/π) μH, Capacitance C= (100/π) μF, and Gate pulse width =10 μs.	5 Marks	L5	CO1
8	8a	What role does a Unijunction Transistor (UJT) play in SCR's UJT-based firing circuits?	5 Marks	L4	CO1
	8b	Calculate the maximum allowable resistance Rmax to ensure that the SCR remains in the ON state after the gate pulse is removed. Given the following parameters: Holding Current (I_H): 60 mA, Latching Current (I_L): 80 mA, Supply Voltage (Vs): 100 V, Load Resistance (R): 1 kΩ, Gate Pulse Width (t_p): 50 μs.	5 Marks	L5	CO1

OR

9	9a	Examine the key dynamic characteristics of an SCR, including turn-on time, turn-off time, and recovery time.	5 Marks	L4	CO1
	9b	Evaluate the voltage drop across the MOSFET when it is in the on-state, and assess the power dissipated by the MOSFET in this state, given the following parameters: Drain current (I_D) = 10 A, On-state resistance (R_{DS}(on)) = 0.05 Ω.	5 Marks	L5	CO1
10	10a	Assess the role of freewheeling diodes in mitigating issues related to inductive load.	5 Marks	L4	CO2
	10b	Consider a single-phase half-wave controlled rectifier connected to a 10 Ω resistive load, with the input voltage pattern shown in the figure. Evaluate the following parameters based on the given firing angle ($\alpha = \frac{\pi}{6}$): • Average output voltage • Average power delivered to the load • Average load current.	5 Marks	L 5	CO2

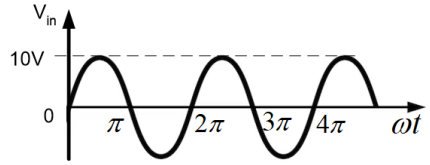

Fig. Input voltage pattern

OR

11	11a	Compare the behavior of the rectifier with a resistive load versus an inductive load.	5 Marks	L5	CO2
	11b	Evaluate the average output voltage and average load current for a three-phase half-wave controlled rectifier connected to a 10 Ω resistive load, with a given firing angle α=π/12. The input supply voltage is a three-phase-balanced sinusoidal waveform with a peak voltage of 440 V (Vm) and a frequency of 50 Hz.	5 Marks	L5	CO2
12	12a	Explain the circuit diagram and output waveforms of voltage and current for a three-phase full-wave converter with a resistive (R) load at a firing angle of 30^0.	5 Marks	L4	CO2
	12b	Determine the effect on the output voltage waveform if the thyristor in Phase-A and Phase-C of a three-phase half-wave controlled rectifier becomes permanently non-conducting due to an internal fault. Assume each thyristor is triggered at a firing angle of 0^0. Draw the output voltage waveform for the faulty circuit.	5 Marks	L5	CO2
		OR			
13	13a	Analyze the impact of a very high inductive load connected to a single-phase full-wave controlled rectifier.	5 Marks	L5	CO2
	13b	Determine the average voltage and current for a given single-phase full bridge rectifier at firing angle α = 45^0, assuming that the thyristor T_3 and T_4 becomes damaged and remains open (non-conducting) at all times. Explain how this failure affects the rectifier's performance and the resulting waveforms. Given input voltage $v = 110 \sin 314t$, and load resistance is 20 Ω.	5 Marks	L5	CO2