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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: V**
Branch: Electrical & Electronics Engineering **Duration: 3 hrs.**
Course Code: 19EE5PCPEN **Max Marks: 100**
Course: POWER ELECTRONICS **Date: 25.09.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1	a)	Draw the block diagram representation showing the interrelationship of power electronics with power, electronics and control. Mention any four applications of power electronics.	**06**
	b)	Explain with sketches the control characteristics of Thyristor, BJT and MOSFET.	**09**
	c)	Explain with relevant circuit diagram and equations the MOSFET fast turn ON gate drive circuit.	**05**

OR

2	a)	The reverse recovery time of a power diode is t_{rr} = 3μs and the rate of fall of the diode current is di/dt = 30A/ μs. Determine (i) the storage charge Q_{RR} and (ii) the peak reverse current I_{RR}.	**05**
	b)	Explain the operation of Thyristor with the help of sketches. Draw the V-I characteristics of the Thyristor. Define the terms Latching current and Holding current.	**10**
	c)	Explain with neat circuit diagram, the Optocoupler gate isolation.	**05**

UNIT - II

3	a)	Classify the DC - DC converters based on the quadrant operation and briefly explain its operation with the help of circuit diagrams.	**10**
	b)	With relevant circuit diagram, explain the principle of step down chopper operation with R load. Draw the waveforms for output voltage, current, effective input resistance versus duty cycle. Derive the expressions for the average and RMS values of output voltage.	**10**

UNIT - III

4	a)	Briefly explain the wide band gap materials SiC and GaN.	**07**
	b)	Enumerate any three features, three benefits and one application of SiC MOSFETS.	**07**
	c)	Give a brief comparison of SiC power module with Si-IGBT power module.	**06**

UNIT - IV

5 a) With a neat circuit diagram, quadrant diagram and waveforms for output voltage, output current and source current, briefly explain the operation of a single phase full converter circuit with a highly inductive load. Derive the expressions for the average value of output voltage. **10**

b) If the converter in Figure 1 has a purely resistive load of R and the delay angle $\alpha = \pi/2$, determine (i) the Rectification efficiency, (ii) the Form factor (FF), (iii) Ripple factor (RF), (iv) the peak inverse voltage (PIV) of the Thyristor T_1. **10**

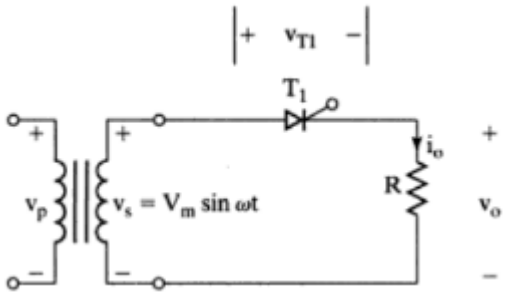

Figure 1

OR

6 a) With a neat circuit diagram and waveforms for output voltage, Thyristor currents T_1 and T_4, source current and output current, briefly explain the operation of a three phase full converter circuit with a highly inductive load. **10**

b) Explain why power factor correction is necessary in rectifier circuits with a relevant example and its impact. **06**

c) A three-phase controlled rectifier has an input voltage which is 480 V rms at 60 Hz. The load is modeled as a series resistance and inductance with R=10Ω and L = 50 mH. (i) Determine the dc component of output voltage (ii) Determine the delay angle required to produce an average current of 50 A in the load. **04**

UNIT - V

7 a) With neat circuit diagram and waveforms, explain the principle of operation of single phase full bridge inverter with a highly inductive load. Derive the expression for RMS value of output voltage. Write down the expressions for instantaneous output voltage and instantaneous load current for this RL load. **10**

b) A three phase inverter has a star connected load of R = 5Ω and L = 23mH. The inverter frequency is 60 Hz and the dc input voltage is 220V. (i) Express the instantaneous line to line voltage $v_{ab}(t)$ and the line current $i_a(t)$ in Fourier series. Determine (ii) the RMS line voltage V_L ; (iii) the RMS phase voltage V_p; (iv) the RMS line voltage V_{L1} at the fundamental frequency; (v) the RMS phase voltage V_{P1} at the fundamental frequency; **10**

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