CBCS SCHEME

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18EE53

Fifth Semester B.E. Degree Examination, July/August 2022
Power Electronics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Mention the types of power electronics circuits. Explain the different power electronic circuits with neat circuit diagram show the input and out waveforms. **(08 Marks)**

b. With circuit diagram and voltage waveforms, explain control characteristics of i) Thyristor ii) GTO iii) MOSFET iv) BJT. **(06 Marks)**

c. Explain the reverse recovery characteristics of a diode with waveform. **(06 Marks)**

OR

2 a. Explain the significance of freewheeling diode. **(05 Marks)**

b. Explain the types of power diodes. **(07 Marks)**

c. With neat circuit diagram and waveforms, explain single phase full wave rectifier and also derive the expression for average output voltage. **(08 Marks)**

Module-2

3 a. With neat circuit diagram and switching waveforms, explain switching characteristics of MOSFET. **(07 Marks)**

b. Give the comparison between MOSFET and IGBT. **(05 Marks)**

c. The Beta (β) of bipolar transistor shown in Fig Q3(c) varies from 10 to 60, the load resistance $R_c = 5\Omega$, the d.c supply voltage is $V_{CC} = 100V$ and the input voltage to base circuit is $V_B = 8V$, If $V_{CE} = 2.5V$ and $V_{BE} = 1.75V$. Find

i) The value of R_B that will result in saturation with an over drive factor of 20

ii) The forced β

iii) Power losses in transistor.

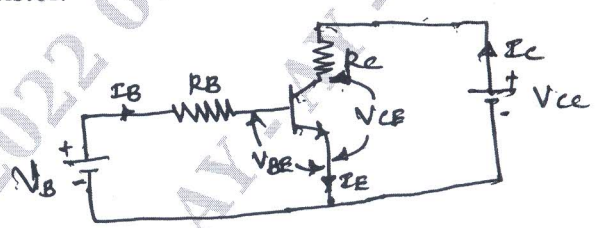

Fig Q3(c) **(08 Marks)**

OR

4 a. Discuss the importance of providing isolation of gate/base drive from power circuits and explain the two methods. **(07 Marks)**

b. List the types of MOSFET's, explain with sketch and structure of n-channel enhancement type MOSFET. **(07 Marks)**

c. Explain the switching limits of BJT. **(06 Marks)**

Module-3

5 a. Using two transistor analogy, derive an expression for anode current of thyristor. **(07 Marks)**

b. Explain the different types of Turn ON in a thyristor. **(06 Marks)**

c. Discuss between series and parallel operation of thyristors with circuit diagrams. **(07 Marks)**

OR

6 a. List the types of thyristor firing circuit, explain any two with suitable circuit diagram with waveforms. **(06 Marks)**

b. Discuss $\frac{di}{dt}$ and $\frac{dv}{dt}$ protection in a thyristors. **(06 Marks)**

c. Ten thyristors are used in string to withstand a D.C voltage of V_s = 15kV. The maximum leakage current and recovery charge differences of thyrisotrs are 10mA and 150μF, respectively. Each thyristor has a voltage sharing resistance of R = 56kΩ and capacitance of C_1 = 0.5μF. . Determine the i) maximum steady state voltage shearing $V_{DS(max)}$ ii) Steady state voltage derating factor iii) maximum transient voltages sharing, $V_{DT(max)}$ iv) transient voltage derating factor. **(08 Marks)**

Module-4

7 a. Explain with circuit diagram and waveforms the single phase dual converters also derive the average output voltage. **(10 Marks)**

b. In a single phase full converter with RLE, has R = 0.5Ω, L = 6.5mH and E = 10V. The input voltage is V_S = 120V at (rms) 60Hz. Determine : i) the load current I_{LO} at wt = α = 60° ii) the average thyristor current I_A iii) the rms thyristor current I_R iv) the rms output current I_{rms} v) the average output current I_{dc} vi) the critical delay angle α_c. **(10 Marks)**

OR

8 a. With the circuit diagram and waveform explain integral cycle control also derive an expression for RMS output voltage. **(08 Marks)**

b. With the circuit diagram and waveform explain single phase bidirectional controllers with resistive loads. **(04 Marks)**

c. A 1ϕ full wave controller supplies an RL load. The input RMS voltage is V_s = 120V, 60Hz. The load is that L = 6.5mH and R = 2.5Ω. The delay angles of thyristors are equal $\alpha_1 = \alpha_2 = \pi/2$. Determine: i) The conduction angle of thyristor T_1, δ ii) The RMS output voltage iii) The RMS thyristor current I_R iv) The RMS output current I_o. **(08 Marks)**

Module-5

9 a. Explain principle of step – down chopper circuit and waveform derive the expression for i) average output voltage ii) Input power under lossless converter iii) Effective input resistance seen by the source iv) RMS output voltage. **(10 Marks)**

b. In a step down chopper has a resistance load of R = 10Ω and the input voltage is V_S = 220V. When the converter switch remains ON, its voltage drop is V_{ch} = 2V, and the chopping frequency is f = 1KHz. If the duty cycle is 50% determine : i) The average output voltage V_a ii) The RMS output voltage V_o iii) The converter efficiency iv) The effective input resistance R_i of the converter. **(10 Marks)**

OR

10 a. With circuit diagram and wave form explain three phase bridge inverter also derive line-to-line RMS voltage. **(10 Marks)**

b. A 1-ϕ full bridge inverter has a resistive load of R = 2.4Ω and the D.C input voltage is V_s = 48V determine :

i) The RMS output voltage at the fundamental frequency V_{01}
ii) The output power P_o
iii) The average and peak current of each transistor
iv) The peak reverse blocking voltage V_{BR} of each transistor
v) The THD. **(10 Marks)**