CBCS SCHEME

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21EE54

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
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. Explain five different types of power electronic converter circuits with neat circuit diagram, input and output waveforms. **(10 Marks)**

b. With neat figure, explain the V-I characteristics of diode. **(05 Marks)**

c. Explain peripheral effects of power electronics equipments with block diagram. **(05 Marks)**

OR

2 a. With neat circuit diagram and waveforms explain single phase full wave rectifier with R load. And also derive the expression for average output voltage. **(10 Marks)**

b. Explain reverse recovery characteristics of a diode with waveforms. **(06 Marks)**

c. Explain the significance of free-wheeling diode. **(04 Marks)**

Module-2

3 a. Explain steady state and switching characteristics of BJT. **(10 Marks)**

b. Explain the switching limits of BJT. **(04 Marks)**

c. The bipolar transistor in Fig.Q.3(c) is specified to have β_F in the range of 8 to 40. The load resistance is $R_C = 11\Omega$. The dc supply voltage is $V_{co} = 200$ V and the input voltage to the base circuit is $V_B = 10$ V. If $V_{CE(sat)} = 1.0$ V and $V_{BE(sat)} = 1.5$ V. Find : i) The value of R_B that results in saturation with an ODF of 5 ; ii) The B_{forced} ; iii) The power loss P_T in the transistor.

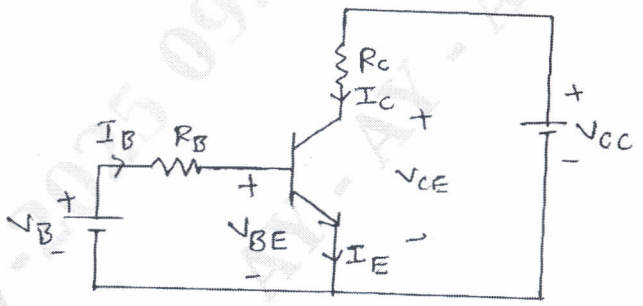

Fig.Q.3(c)

(06 Marks)

OR

4 a. With the help of neat figures, explain steady state and switching characteristics of MOSFET. **(10 Marks)**

b. With neat circuit diagram, explain pulse transformer and opto coupler. **(06 Marks)**

c. The maximum junction temperature of a transistor is $T_J = 150°C$ and the ambient temperature is $T_A = 25°C$. If the thermal impedances are $R_{JC} = 0.4°C/W$, $R_{CS} = 0.1°$ C/W and $R_{SA} = 0.5°$ C/W, calculate

i) The maximum power dissipation

ii) The case temperature. **(04 Marks)**

Module-3

5 a. Explain V – I characteristics of SCR. And also define i) Latching current ii) Holding current. **(12 Marks)**

b. Ten thyristors are used in a string to withstand a dc voltage of V_S = 15 kV. The maximum leakage current and recovery charge differences of thyristors are 10 mA and 150 μC, respectively. Each thyristor has voltage sharing difference of R = 56 KΩ and capacitance of C_1 = 0.5 μF. Determine : i) The maximum steady state voltage sharing ii) The steady-state voltage derating factor iii) The maximum transient voltage sharing $V_{DT(max)}$ iv) The transient voltage derating factor. **(08 Marks)**

OR

6 a. Explain with neat figure two-transistor model of thyristor and also write relevant equations. **(08 Marks)**

b. Explain briefly different thyristor turn-on methods. **(06 Marks)**

c. Explain $\frac{di}{dt}$ protection and $\frac{dv}{dt}$ protection. **(06 Marks)**

Module-4

7 a. With circuit diagram and waveforms explain single phase half wave controlled rectifier with R-L load. **(08 Marks)**

b. A single phase full converter bridge is connected to RLE load. The source voltage is 230 V, 50Hz. The average load current of 10 A is continuous over the working range. For R = 0.4Ω and L = 2 mH, compute i) Firing angle for E = 120 V ii) Firing angle for E = -120 V. **(06 Marks)**

c. With neat circuit diagram and waveforms explain J-ϕ dual converter. **(06 Marks)**

OR

8 a. With circuit diagram and waveforms explain phase control in ac voltage controller and also derive expression for RMS output voltage. **(08 Marks)**

b. An ac voltage controller has a resistive load of R = 10Ω and rms input voltage is V_s = 120 V, 60 Hz. The thyristor switch is on for n = 25 cycles and is off for m = 75 cycles. Find : i) rms output voltage Vo ii) The input power factor iii) The average and rms current of thyristors. **(06 Marks)**

c. With circuit diagram and waveform explain single phase bidirectional controllers with resistive loads. **(06 Marks)**

Module-5

9 a. Explain the principle operation of step down converter with RL load and also draw the waveforms. **(10 Marks)**

b. For the stepdown chopper consisting of a resistive load of R = 10Ω and the input voltage is V_S = 220 V. When the converter switch remains on, its voltage drop is V_{ch} = 2 V and chopping frequency is f = 1 kHz. If the duty cycle is 50%, determine: i) average output voltage V_a ii) rms output voltage V_o iii) The converter efficiency iv) effective input resistance R_i of the converter v) rms value of the fundamental component of output harmonic voltage. **(10 Marks)**

OR

10 a. Explain :

i) Single pulse – width modulation

ii) Multiple – pulse – width modulation techniques used for voltage control of single phase inverters. **(10 Marks)**

b. Describe 180 – degree conduction operation of three phase bridge inverter with circuit diagram and waveforms of line voltages and phase voltages. **(10 Marks)**

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