CBCS SCHEME

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21EE54

Fifth Semester B.E. Degree Examination, June/July 2024

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. With neat circuit diagram, input and output waveform, explain the different types of power electronics converters. **(10 Marks)**

b. Explain the control characteristics of the following: (i) SCR (ii) BJT **(06 Marks)**

c. List applications of power electronic system. **(04 Marks)**

OR

2 a. With neat circuit diagram, explain the diode characteristics. **(08 Marks)**

b. With neat circuit diagram, explain the Freewheeling diodes with RL load. **(08 Marks)**

c. The reverse recovery time of a diode is $t_{rr} = 3\ \mu s$ and the rate of fall of the diode current is $\frac{di}{dt} = 30\ A/\mu s$. Determine: (i) The storage charge Q_R and (ii) The peak reverse current I_{RR}. **(04 Marks)**

Module-2

3 a. Draw static characteristic and switching characteristics of a MOSFET and explain the switching characteristics of a MOSFET. **(10 Marks)**

b. For the transistor switch of Fig.Q3(b) has the following parameters are given $V_B = 10$ V, $R_B = 0.75\ \Omega$, $V_{BE} = 1.5$ V, $V_{CE} = 1.0$ V, $R_C = 11\ \Omega$ and $V_{CC} = 200$ Volts. Find:

(i) The value of R_B that results in saturation with over drive factor of 5
(ii) Forced β_f
(iii) The power loss in the transistor

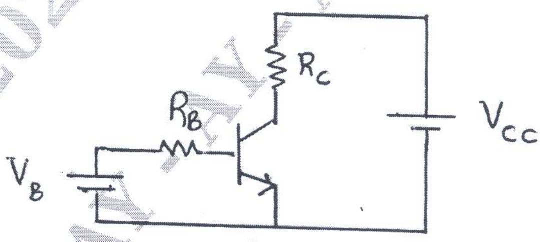

Fig.Q3(b) **(10 Marks)**

OR

4 a. Explain the different types of base drive control circuit for BJT. **(14 Marks)**

b. A simple transistor switch is used to connect a 24 volt DC supply across a relay coil, which has a DC resistance of 200 Ω. An input pulse of 0 to 5 V amplitude is applied through a series base resistor R_B at the base so as to turn ON the transistor switch. Calculate:

(i) I_{CS}
(ii) Value of R_B required to obtain over drive factor of 2
(iii) Total power dissipation in the transistor that occurs during the saturation state.

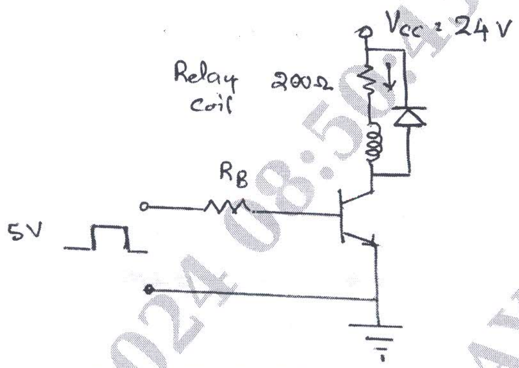

Fig.Q4(b) **(06 Marks)**

Module-3

5 a. Explain the V-I characteristics of SCR. **(08 Marks)**

b. Using two transistor analogy, derive an expression for anode current of SCR. **(08 Marks)**

c. If the latching current in the circuit shown in Fig.Q5(c) is 4 mA. Obtain the minimum width of the gating pulse required to properly turn-ON the SCR.

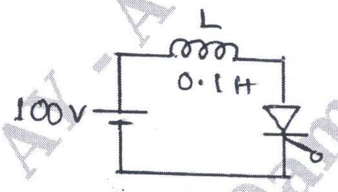

Fig.Q5(c) **(04 Marks)**

OR

6 a. How many SCRs are required in a series string to withstand a DC voltage of 3500 volts in steady-state? If the SCRs have a steady-state voltage rating of 1000 V and the steady-state derating factor is 30%. Assuming the minimum difference in the leakage current of SCRs to be 10 mA. Calculate the value of voltage sharing resistance to be used. Draw the circuit showing the SCRs and the voltage sharing resistance. **(08 Marks)**

b. Explain RC full-wave triggering circuit. **(06 Marks)**

c. Explain UJT triggering circuit. **(06 Marks)**

Module-4

7 a. With neat circuit diagram and waveform, explain single phase semi-converter with R-load. **(08 Marks)**

b. With neat circuit diagram and waveform, explain single-phase full converters with RLE load. **(12 Marks)**

OR

8 a. With the help of neat diagram and explain the operation of single phase bidirectional AC voltage controller for resistive load. **(10 Marks)**

b. An AC voltage controller with ON-OFF control has an input of 230 V, 50 Hz is connected to a resistive load of 20Ω. The circuit is operating with the switch ON for 30 cycles and OFF for 30 cycles. Determine :

(i) RMS output voltage, current

(ii) Input power factor. **(05 Marks)**

c. Why short duration pulses are not suitable for inductive loads? **(05 Marks)**

Module-5

9 a. With the help of a circuit diagram, describe the principle of step-down chopper with R load. **(06 Marks)**

b. With the help of a circuit diagram, describe the operation of set-up chopper. **(06 Marks)**

c. The DC chopper in Fig.Q9(c) has a resistive load of R = 10 Ω and the input voltage is $V_S = 220$ Volts, when the chopper switch remains ON, its voltage drop is $V_{ch} = 2$ Volts and the chopping frequency is f = 1 kHz. If the duty cycle is 50%. Determine:

(i) The average output voltage V_a
(ii) The rms output voltage V_0
(iii) The chopper efficiency
(iv) The effective input resistance R_i of the chopper.

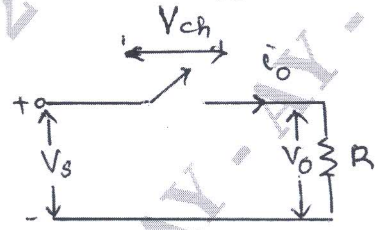

Fig.Q9(c) **(08 Marks)**

OR

10 a. Explain single-phase full-bridge inverter operation with R load. **(10 Marks)**

b. With the help of neat sketches of circuit diagram and waveforms, explain the operation of 3-phase inverter in 180 degree conduction mode. **(10 Marks)**

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