USN ☐☐☐☐☐☐☐☐☐☐ **18EE53**

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.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. List the major types of power electronic devices with their symbols. Draw their VI characteristics and give applications of each. **(10 Marks)**
    b. Explain the peripheral affects caused by power electronic converters and remedies for them. **(05 Marks)**
    c. Explain the reverse recovery characteristics of diode. **(05 Marks)**

OR

2   a. With circuit diagram and waveform explain bridge rectifier. Also obtain expression for average and RMS output voltage of fullwave rectifier. **(08 Marks)**
    b. Explain power electronic converters with an example **(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 $\dfrac{di}{dt} = 30A/\mu\,sec$. Determine :
      i) the storage charge Q_{RR} and
      ii) the peak reverse current I_{RR}. **(04 Marks)**

Module-2

3   a. Explain input and output characteristics of n-channel E-MOSFET. **(06 Marks)**
    b. What is the need for isolation of gate and base drive circuits? Also explain base drive circuit using pulse transformer. **(06 Marks)**
    c. For the transistor switch given $V_{BB} = 10V$, $R_B = 0.75\Omega$, $R_c = 11\Omega$, $V_{BE} = 1.5V$, $V_{CEsaf} = 1V$ and $V_{CC} = 200$ volts.
      i) Calculate forced beta, B_f of transistor
      ii) If specified 'β' is in the range 8 to 40, calculate the minimum overdrive factor
      iii) Obtain the power less P_T of the transistor. **(08 Marks)**

OR

4   a. Explain switching characteristics of MOSFET. Also draw switching model. **(06 Marks)**
    b. Discuss low proportional base drive control and anti-saturation control improves the switching performance of a BJT. **(08 Marks)**
    c. Give the comparison between BJT Vs MOSFET and MOSFET Vs IGBT. **(06 Marks)**

Module-3

5   a. Obtain the expression for anode current of SCR using two transistor model and explain its working. **(08 Marks)**
    b. With neat circuit diagram and waveform explain UJT triggering circuit. **(06 Marks)**
    c. How many SCR are required in a series string to withstand a DC voltage of 3.5kV in steady state, if the SCRs have steady state voltage rating of 1kV and steady state derating factor of 30%? Assume maximum difference in leakage current of SCR to be 10mA, calculate the value of voltage sharing resistance to be used. Draw the circuit showing the SCR and the voltage sharing resistance. **(06 Marks)**

OR

6 a. Explain V-I characteristics of SCR. Also define latching and holding currents. (06 Marks)

b. What is the need for thyristor protection? Also explain $\dfrac{di}{dt}$ and $\dfrac{dv}{dt}$ protection of SCR.

(08 Marks)

c. In the thyristor circuit shown in Fig Q6(c). The SCR has a latching current of 50mA and in fired by a pulse of length 50μsec. Show that without resistor 'R' the thyrisotr will fail to remain on. When the firing pulse ends and then find the maximum value of 'R' ensure firing.
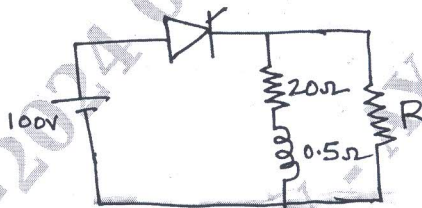

Fig Q6(c) (06 Marks)

Module-4

7 a. With neat circuit and waveforms derive an expression for the rms value of output voltage of single phase full wave controlled rectifier with RL load. (08 Marks)

b. In an ON-OFF control circuit using 1φ, 230V 50Hz supply the ON time is 10 cycles and OFF time is 4 cycles. Calculate the R.M.S value of the output voltage. (06 Marks)

c. Explain principle of phase control. Also drive expression for RMS and average output voltage for resistive load. (06 Marks)

OR

8 a. Explain the working of single phase dual converter circuit with the help of waveform for RL load. (08 Marks)

b. Briefly explain applications of AC – voltage controllers. (05 Marks)

c. A single phase fully controlled bridge rectifier is fed from 230v, 50Hz supply. The load is highly inductive, find the average load voltage and current if the load resistance is 10Ω and firing angle is 45°. Draw the waveforms of output voltage and current. (07 Marks)

Module-5

9 a. Obtain an expression for the output voltage for a step down chopper. Also explain the working. (06 Marks)

b. Explain the working of full bridge inverter with neat diagram and waveforms. Obtain expression for output voltage. (08 Marks)

c. Explain performance parameters of invertors. (06 Marks)

OR

10 a. Briefly explain the classification of choppers. (06 Marks)

b. Input to the step up chopper is 200V. The output required is 600V. If the conducting time of thyristor is 200μs, calculate :
   i) Chopping frequency
   ii) If pulse width is halved for constant frequency of operation find the new output voltage. (08 Marks)

c. Write a note on voltage control of single phase inverters by sinusoidal pulse width modulation techniques. (06 Marks)

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