CBCS SCHEME

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18EE53

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
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 waveforms, explain the different types of power electronic converters. **(10 Marks)**

b. With block diagram, explain the peripheral effects of power electronics equipments. **(06 Marks)**

c. List the major applications of power electronics. **(04 Marks)**

OR

2 a. Explain the reverse recovery characteristics of power diode, with neat waveform. And also obtain an expression for peak reverse current. **(08 Marks)**

b. A single-phase full bridge diode rectifier is supplied from 230V, 50Hz source. The load consists of R = 10Ω and a large inductance so as to render the load current constant. Determine:

i) Average values of output voltage and output current.
ii) Average and rms values of diode currents
iii) rms values of output and input currents and pf. **(06 Marks)**

c. Explain the operation of single phase full wave rectifier with RL load. Derive the expression for RMS o/p current for continuous load current. **(06 Marks)**

Module-2

3 a. Explain the switching characteristics of BJT. **(10 Marks)**

b. A power transistor has its switching waveforms as shown in Fig.Q.3(b). If the average power loss in the transistor is limited to 300W, find the switching frequency at which this transistor can be operated. **(06 Marks)**

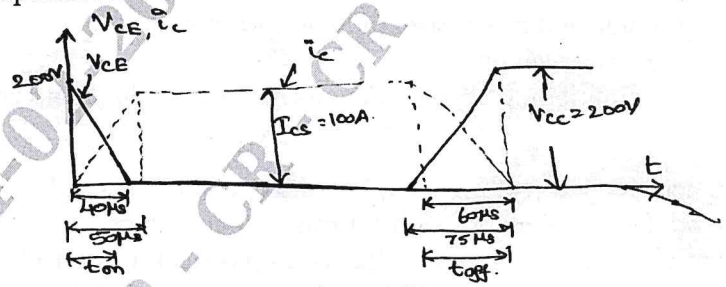

Fig.Q.3(b)

c. List the applications of BJT, MOSFET and IGBT. **(04 Marks)**

OR

4 a. With necessary waveforms explain switching characteristics of IGBT. **(05 Marks)**

b. Sketch the structure of n-channel enhancement type MOSFET and explain its working principle. **(10 Marks)**

c. With neat circuit diagram, explain pulse transformer and optscoupler. **(05 Marks)**

Module-3

5 a. Derive an expression for the anode current of thyristor with the help of two transistor analogy. **(05 Marks)**

b. With the help of neat sketch, explain the static V-I characteristics of an SCR. Define latching and holding current. **(10 Marks)**

c. For an SCR, gate-cathode characteristic is given by $V_g = 1 + 10Ig$. Gate source voltage is a rectangular pulse of 15V with 20μ sec duration. For an average gate power dissipation of 0.3W and a peak gate drive power of 5W, compute:

i) The resistance to be connected in series with the SCR gate.

ii) The triggering frequency

iii) The duty cycle of the triggering pulse. **(05 Marks)**

OR

6 a. Explain different methods of turning on of SCR. **(08 Marks)**

b. Explain the working of UJT triggering technique of SCR with neat waveform. **(06 Marks)**

c. For the circuit shown in Fig.Q.6(c) calculate:

i) The maximum values of di/dt and dv/dt for the SCR

ii) Find the rms and average current ratings of the SCR for firing angle delay of 90° and 150°.

iii) Suggest a suitable voltage rating of the SCR. **(06 Marks)**

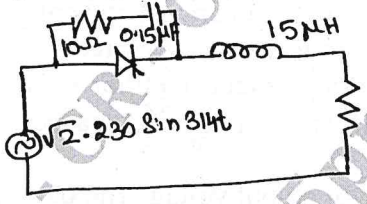

Fig.Q.6(c)

Module-4

7 a. A single phase half wave SCR circuit of RL load, draw waveforms for source voltage, load voltage, load current and voltage across the SCR for a given firing angle α. Hence obtain expressions for average and rms load voltages in terms of source voltage and firing angle. **(08 Marks)**

b. A single phase full converter is supplied from 230V, 50Hz source. The load consists of R = 10Ω, a large inductance so as to render the load current constant. For a firing angle delay of 30°, determine.

i) Average output voltage

ii) Average output current

iii) Average and rms values of SCR currents

iv) The power factor. **(06 Marks)**

c. With neat circuit diagram and waveforms explain dual converters. **(06 Marks)**

OR

8 a. With necessary waveforms, explain the operation of single phase AC voltage controller with RL load. Derive an expression for rms output voltage. **(08 Marks)**

b. A single phase voltage controller is employed for controlling the power flow from 230V, 50Hz source into a load circuit consisting of R = 3Ω, WL = 4Ω. Calculate:

i) The control range of firing angle

ii) Max value of rms load current

iii) Max values of average and rms SCR currents

iv) Max power and power factor

v) Max possible value of di/dt that may occur in SCR

vi) The conduction angle for α = 0° and α = 120° assuming a gate pulse of duration π radian. **(06 Marks)**

c. Briefly explain the application of AC voltage controller. **(06 Marks)**

Module-5

9 a. Classify the different types of choppers with the help of circuit and quadrant diagram. Explain the operation of two quadrant chopper. **(08 Marks)**

b. Derive an expression for average output voltage with a neat circuit and waveform of step up chopper. **(08 Marks)**

c. A step-up chopper has input voltage of 220V and output voltage of 660V. If the non-conducting time of thyristor-chopper is 100μs, compute the pulse width of output voltage. Incase pulse width is halved for constant frequency operation, find the new output voltage. **(04 Marks)**

OR

10 a. With circuit diagram, explain the operation of single phase full bridge inverter. **(10 Marks)**

b. With neat circuit diagram and waveforms explain the operations of transistorized current source inverter. **(10 Marks)**

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