CBCS SCHEME

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15EE53

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Power Electronics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. With the help of circuits and waveforms, explain the various types of power electronic converters. **(10 Marks)**

b. Analyse the Reverse recovery characteristics of a diode and write equations of reverse recovery time t_{rr} and reverse recovery current I_{RR} **(06 Marks)**

OR

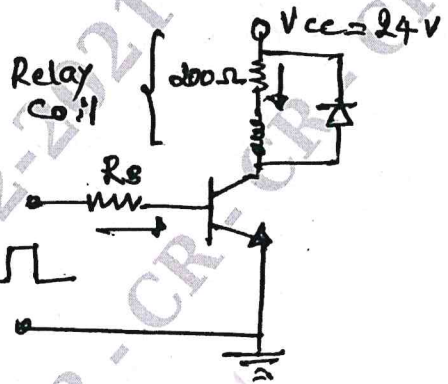
2 a. Explain the working operation of 1ϕ full wave bridge rectifier circuit with R load. With necessary waveforms. **(08 Marks)**

b. Mention the various types of power diodes and explain freewheeling diodes with switched RL load circuit along with various modes. **(08 Marks)**

Module-2

3 a. With the help of necessary waveform, explain the switching characteristics of power MOSFET. **(08 Marks)**

b. A simple transistor switch is used to connect a 24V DC supply a cross a relay coil, which has a DC resistance of 200Ω. An input pulse of 0 to 5V amplitude is applied through a series base resistor R_B at the base so as to turn on the transistor switch. Sketch the device current waveform with reference to the input pulse. Calculate: i) I_{CS} ii) Value of resistor R_B, required to obtain over drive factor of 2. iii) Total power dissipation in the transistor. [Refer Fig Q3(b)]



$\beta = 25$ to 100
$V_{CE(sat)} = 0.2V$
$V_{BE(sat)} = 0.7V$

Fig Q3(b) **(08 Marks)**

OR

4 a. What is the necessity of base drive control in a power transistor? Explain proportional base control. **(08 Marks)**

b. Write Merits, Demerits and Applications of power MOSFETs. **(04 Marks)**

c. With circuit diagram, explain electric isolation using pulse transformer. **(04 Marks)**

Module-3

5 a. Derive an expression for the anode current of a thyristor with the help of a two transistor analogy. **(08 Marks)**

b. Distinguish between holding current and latching current of thyristor. **(04 Marks)**

c. A SCR is connected in series with a 0.5H inductor and 20Ω resistance. A 100V DC voltage is applied to this circuit. If the latching of the SCR is 4mA. Find the maximum width of the gate trigger pulse required to properly turn-on the SCR. [Refer Fig Q5(c)]

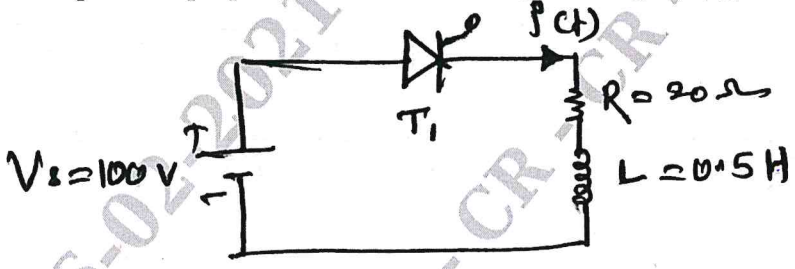


Fig Q5(c) **(04 Marks)**

OR

6 a. What is the need for protection of thyristors? Explain how thyrisors are protested against high $\frac{di}{dt}$ and $\frac{dv}{dt}$. **(10 Marks)**

b. A string of series connected thyristors is to withstand a dc voltage of 16kV. The maximum leakage current and recovery charge differences of the thyristors are 10mA and 100μC respectively. The derating factor for steady state and transient voltage sharing are 20%. For a maximum steady state voltage sharing of 1kV. Determine :

i) The steady voltage sharing resistance R for each thyristor

ii) The transient voltage capacitance C_1 for each thyristor. **(06 Marks)**

Module-4

7 a. With the help of circuit diagram and waveforms explain the working of 1ϕ fully controlled converter with inductive load. Derive the expression for rms output voltage and rms output current. **(08 Marks)**

b. A single phase full wave A.C voltage controller operates on a single phase supply voltage of 230V rms, at 50Hz. If the triac is triggered at a delay angle of 45°, during each half cycle of input supply. [Refer Fig Q7(b)] Calculate :

i) RMS value of output voltage

ii) RMS value of output current

iii) RMS value of Triac current

iv) Input power factor.

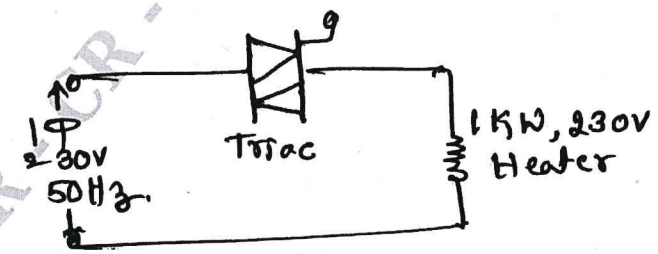


Fig Q7(b) **(08 Marks)**

OR

8 a. Explain the working of a bidirectional A.C voltage controller with R load, with the help of neat circuit's diagram, and relevant waveforms. Derive the equation for V_o(RMS). **(08 Marks)**

b. A 3ϕ full converter operated from 3ϕ, γ, connected 208V, 60Hz supply with R_L= 10Ω. It is required to obtain 50% of the maximum possible output voltage. Calculate :
   i) Delay angle α
   ii) rms and average current
   iii) rms and average thyristor current
   iv) efficiency of rectification
   v) Power factor. **(08 Marks)**

Module-5

9 a. Explain the operation of step up chopper. **(06 Marks)**

b. Analyse the performance parameters of DC choppers. **(04 Marks)**

c. The 1ϕ full bridge inverter has a resistive load of R = 2.4Ω, and the DC input voltage of V_s = 48 Volts. Determine :
   i) rms output voltage at the fundamental frequency
   ii) The output power
   iii) The peak and average currents of each transistor. **(06 Marks)**

OR

10 a. Explain 1ϕ transistorized current source inverter with the help of necessary circuit and waveforms. Also write its advantages and disadvantages. **(06 Marks)**

b. Write comparison between VSI and CSI. **(04 Marks)**

c. A dc chopper has an input voltage of 200V and a load resistance of 8Ω. The voltage drop across thyristor is 2V, and the chopper frequency is 800 Hz. The duty cycle α = 0.4. Find :
   i) Average output voltage
   ii) RMS output voltage
   iii) Chopper efficiency. **(06 Marks)**

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