INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
(Dundigal-500043, Hyderabad)

B.Tech V SEMESTER END EXAMINATIONS (REGULAR) - DECEMBER 2022
Regulation:UG20
POWER ELECTRONICS

Time: 3 Hours   (ELECTRICAL AND ELECTRONICS ENGINEERING)   **Max Marks: 70**

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Demonstrate different modes of operation of thyristor with the help of its static V-I characteristics.
   [BL: Understand| CO: 1|Marks: 7]

   (b) The trigger circuit of a thyristor has a source voltage of 15V and the load line has a slope of 120V per ampere. The minimum gate current to turn on the SCR is 25mA. Calculate i) Source resistance required in the gate circuit. ii) The trigger voltage and trigger current for an average gate power dissipation of 0.4 watts.   [BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) Illustrate the operation of single – phase fully controlled rectifier. Derive the expression for average DC output voltage. Draw the relevant waveforms.   [BL: Understand| CO: 2|Marks: 7]

   (b) A single phase fully controlled bridge converter is connected to R-L load with R = 10 Ω and L = 6 mH. The converter is supplied from 230 V, 50 Hz ac supply. i) Determine average and rms load current ii) If one SCR of the bridge configuration is open circuited due to fault, what will be the average and rms load current at this condition?   [BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Explain the operating principle of DC chopper with a suitable diagram. Draw the voltage and current waveforms of chopper.   [BL: Understand| CO: 3|Marks: 7]

   (b) A chopper operating from 220V DC supply with for a duty cycle of 0.5 and chopping frequency of 1KHz drives an R L load with R = 1Ω , L=1mH and E = 105V. Find whether the current is continuous and also find the values of I_{max} and I_{min}.

   [BL: Apply| CO: 3|Marks: 7]

4. (a) Demonstrate the working of class-B chopper for resistive load with neat circuit diagram and output voltage and current waveforms.   [BL: Understand| CO: 4|Marks: 7]

   (b) Input to step-up chopper is 100V. The output required is 300V. If the conducting time is 200μs. Calculate chopping frequency If the pulse width is halved for constant frequency of operation find the output voltage.   [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Interpret the working of AC voltage controller with R load using circuit diagrams and waveforms.

   [BL: Understand| CO: 5|Marks: 7]

   (b) A single phase load of resistance 12 Ω in series with an Inductance of 24 mH is fed from a 230V (RMS), 50Hz supply by a pair of inverse parallel thyristors. Calculate mean power in the load at firing angles of i) 0° ii) 60° iii) 135°. Ignore source inductance and device voltage drops.

   [BL: Apply| CO: 5|Marks: 7]

6. (a) List the salient features of cycloconverters, with the help of a neat circuit diagram explicate the performance of mid-point step up cycloconverter.   [BL: Understand| CO: 5|Marks: 7]

   (b) A single-phase to single-phase mid-point cyclo-converter is delivering power to a resistive load. The supply transformer has turns ratio of 1: 1: 1. The frequency ratio is fo/fs = 1/5. The firing angle delay   for all the four SCRs are the same. Show the time variations of the following waveforms for $\alpha = 45°$ and $\alpha = 60°$ i) Supply voltage ii) Output current and iii) Supply current. Indicate the conduction of various thyristors also.   [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) With the help of a neat circuit diagram and waveforms, explain the operation of 3-phase bridge inverter with R load.   [BL: Understand| CO: 6|Marks: 7]

   (b) A single-phase PWM inverter is fed from a 220 V dc supply and it is connected to a RL load with R=10 ohms and L=10 mH. Determine the total harmonic distortion in the load current .Assume width of each pulse is $\pi/2$ and the output frequency is 50 Hz   [BL: Apply| CO: 6|Marks: 7]

8. (a) Illustrate the operation of 3 - phase bridge inverter for 180 degree mode of operation with aid of relevant phase and line voltage waveforms.   [BL: Understand| CO: 6|Marks: 7]

   (b) In a single-phase series inverter, the operating frequency is 50kHz and the thyristor turn-off time tq=10μs. Circuit parameters are: R=3Ω, L=60μH, C=7.5μF and Vs=220V DC. Determine i) The circuit turn-off time ii) Maximum possible operating frequency, assuming a factor of safety = 1.5.

   [BL: Apply| CO: 6|Marks: 7]

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