Hall Ticket N	Io			Question Paper Code: AEE010
INSTITUTE OF AERONAUTICAL ENGINEERING (Autonomous)				

Four Year B.Tech V Semester End Examinations (Supplementary) - January, 2019 Regulation: IARE – R16

POWER ELECTRONICS

Time: 3 Hours

(EEE)

Max Marks: 70

Answer ONE Question from each Unit All Questions Carry Equal Marks All parts of the question must be answered in one place only

# $\mathbf{UNIT} - \mathbf{I}$

1. (a) What are the differences between SCR and GTO? Specify the advantages of GTO over SCR.

[7M]

- (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. Compute
  - 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

[7M]

- 2. (a) Discuss briefly the importance of di/dt rating during the turn on process of a thyristor. Explain the static V-I characteristics of SCR. [7M]
  - (b) An SCR has half cycle surge current rating of 3000A for 50Hz supply. Calculate its one cycle surge current rating and  $I^2$  t rating. [7M]

## $\mathbf{UNIT} - \mathbf{II}$

- 3. (a) With neat circuit presentation and associated waveforms, explain the working of a single phase fully controlled converter with R-L-E load for continuous load current. Also comment on the changes in output waveform if,  $\alpha$ (firing angle) > 90<sup>0</sup>. [7M]
  - (b) A single phase full wave bridge converter is connected to RLE load. The source voltage is 230V, 50Hz. The average load current of 10 A is continuous over the working range. For  $R=0.4\Omega$  and L=2mH, compute [7M]

i) Firing angle delay for E=120V

ii) Firing angle delay for E=  $-120\mathrm{V}$ 

- 4. (a) What is a free wheeling diode? Discuss the effect of free wheeling diode in power converter. [7M]
  - (b) A resistive load of  $10\Omega$  is connected through a half-wave controlled rectifier circuit to 220V, 50 Hz, single phase source. Calculate the power delivered to the load for a firing angle of  $60^{0}$ . Find also the value of input power factor. [7M]

#### $\mathbf{UNIT}-\mathbf{III}$

- 5. (a) Explain the advantages and disadvantages of Cycloconverter and AC voltage controller. [7M]
  - (b) A single phase voltage controller has input voltage of 230V, 50Hz and a load of R=15Ω. For 6 cycles ON and 4 cycles OFF, determine i. RMS output voltage ii. Input power factor iii. Average and RMS thyristor currents. [7M]
- 6. (a) Explain the working of single phase to single phase step down cycloconverter with mid point configuration in continuous mode of operation. [7M]
  - (b) An AC voltage controller uses a TRIAC for phase angle control of a resistive load of 100Ω. Calculate the value of delay angle for having an RMS load voltage of 220 volts. Also calculate the RMS value of TRIAC current. Assume the RMS supply voltage to be 230V. [7M]

### $\mathbf{UNIT} - \mathbf{IV}$

- 7. (a) Explain the Time Ratio Control (TRC) method of controlling the average value of chopper output voltage. Specify the limitations of such strategy as compared to PWM control. [7M]
  - (b) A step-up chopper has input voltage of 220 V and output voltage of 660V. If the non conducting time of the thyristor is 100µs, then compute the pulse width of output voltage. If the pulse width is halved for a constant frequency of operation, find the new output voltage. [7M]
- 8. (a) Explain the working of a step down chopper with R-L load. Also give waveforms for input voltage, gating signal and output voltage [7M]
  - (b) A step-down chopper has input voltage of 230 V with 10Ω load resistor connected, voltage drop across chopper is 2 V when it is ON. For a duty cycle of 0.5, calculate [7M]
    i. Average and RMS values of output voltage and
    - ii. Power delivered to the load.

## $\mathbf{UNIT} - \mathbf{V}$

- 9. (a) Explain the following PWM techniques used in inverter. [7M]
  - i) Sinusoidal PWM
  - ii) Multiple PWM.
  - (b) A single phase bridge inverter, fed from 230V DC, is connected to load,  $R=10\Omega$  and L=0.03mH. Determine the power delivered to load in case the inverter is operating at 50Hz with square wave output. [7M]
- 10. (a) Describe the working of single phase full bridge inverter supplying R, RL loads with relevant circuit and waveforms. [7M]
  - (b) A single phase full bridge inverter has RLC load of R=4Ω, L=35mH and C=155µF. The DC input voltage is 230V and the output frequency is 50Hz. Find an expression for load current up to fifth harmonic. Also calculate the RMS value of fundamental load current. [7M]

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