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# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech V Semester End Examinations (Regular) - November, 2018

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**

## UNIT – I

1. (a) Distinguish between the power MOSFET and BJT. [7M]  
 (b) The trigger circuit of a thyristor has a source voltage of 15V and line has a slope of -120V per ampere. The minimum gate current to turn-on the SCR is 25mA. Compute the [7M]
  - i. Source resistance required in the gate circuit
  - ii. The trigger voltage and trigger current for an average gate power dissipation of 0.4Watts.
2. (a) Explain the various types of commutation circuits for SCR. [7M]  
 (b) For an SCR, gate-cathode characteristics is given by  $V_g = 1 + 10I_g$ . Gate source voltage is a rectangular pulse of 15V with 20 $\mu$  sec duration. For an average gate power dissipation of 0.3W and a peak gate drive power of 5W, compute [7M]
  - i. The resistance to be connected in series with the SCR gate,
  - ii. The duty cycle of the triggering pulse.

## UNIT – II

3. (a) Explain the working of a single phase fully - controlled bridge converter in the inversion mode. [7M]  
 (b) With suitable circuit topology, voltage and current waveforms, reflect the effect of input source impedance on the average output of a single phase fully controlled converter. [7M]
4. (a) Discuss the various performance factors of line commutated converters. [7M]  
 (b) A single phase fully controlled bridge converter supplies an inductive load. Assume that the output - current is virtually constant, and is equal to  $I_d$ , determine the following performance parameters. The supply voltage is 230V and firing angle is maintained at  $(\pi/6)$  radians. [7M]
  - i. Average output voltage
  - ii. Supply RMS
  - iii. fundamental power factor.
  - iv. Voltage ripple factor.

### UNIT – III

5. (a) Describe the operation of single phase full wave AC voltage controller with the help of voltage and current waveforms. [7M]
- (b) A single phase voltage controller is employed for controlling the power flow from 230V, 50 Hz source into a load circuit consisting of  $R=3\Omega$  and  $\omega L=4\Omega$ , Calculate [7M]
- The control range of firing angle
  - The Maximum value of rms load current
6. (a) Explain the principle of operation and working of single phase to single phase step-up cycloconverter. [7M]
- (b) Explain the advantages and disadvantages of Cycloconverter and AC Voltage controller. [7M]

### UNIT – IV

7. (a) Explain the current limit control method of the output voltage control of choppers. A step - up chopper is used to deliver load voltage of 500 V from a 220 V DC source. If the blocking period of the thyristor is  $80 \mu s$ . Compute the required pulse width. [7M]
- (b) Explain the working of a Cuk converter with a neat circuit diagram and associated voltage and current waveforms. [7M]
8. (a) Describe the working principle of buck-boost converter with necessary circuit and waveforms. [7M]
- (b) For type A chopper feeding RLE load, obtain maximum value of average current rating for the thyristor in case load current remains constant. [7M]

### UNIT – V

9. (a) Discuss the functioning of three phase voltage source inverter in 120 degree operating mode with relevant waveforms and obtain the expression for voltage. [7M]
- (b) A single phase full bridge inverter is fed from a DC source such that fundamental component of output voltage is 230V. Find the RMS value of thyristor and diode current for  $R=2 \Omega$  load. [7M]
10. (a) Compare the Voltage Source and Current Source Inverters. [7M]
- (b) Explain the working of a basic parallel inverter with neat circuit and related circuit voltage and current waveforms. [7M]



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# 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

## UNIT – I

- (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

  - Source resistance required in the gate circuit
  - The trigger voltage and trigger current for an average gate power dissipation of 0.4 watts [7M]
- (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]

## UNIT – II

- (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)  $> 90^\circ$ . [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  $L=2\text{mH}$ , compute

  - Firing angle delay for  $E=120\text{V}$
  - Firing angle delay for  $E= -120\text{V}$
- (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  $60^\circ$ . Find also the value of input power factor. [7M]

### UNIT – 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  $R=15\Omega$ . 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  $100\Omega$ . 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]

### UNIT – 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  $100\mu s$ , 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  $10\Omega$  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.

### UNIT – 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  $R=4\Omega$ ,  $L=35mH$  and  $C=155\mu F$ . 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]

