

**R15**

Code No: 125AF

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, November/December - 2017

**POWER ELECTRONICS**

(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 75

**Note:** This question paper contains two parts A and B. Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

**PART - A**

(25 Marks)

- a) Sketch static V-I characteristics of IGBT and mark the region in which the device is operated as a switch. [2]
- b) Define the ratings of SCR (i) Average ON state current (ii) Forward breakover voltage. [3]
- c) What is the effect of connecting free wheeling diode across R-L load in controlled rectifiers? [2]
- d) Write down general expression for average voltage of p-pulse fully controlled rectifier [3]
- e) Draw the output voltage waveform of single phase AC chopper [2]
- f) A Class B turn-off circuit commutates an SCR. The load current is constant at 10Amps. Dimension the commutating components L and C. The supply voltage is 100V dc. Turn off time spec of SCR is 20 micro sec. [3]
- g) Draw the equivalent circuit of a cyclo-converter. [2]
- h) What are advantages and disadvantages of cyclo-converter as compared to ac voltage controllers. [3]
- i) What type of commutation is used in basic series inverter? How frequency of output can be controlled in series inverter? [2]
- j) How can a PWM control signal be obtained using a carrier wave and reference wave with the help of diagram. [3]

**PART - B**

(50 Marks)

- 2.a) Draw dynamic characteristics of SCR during turn off. Explain how turn off process can be carried out? [5+5]
  - b) Explain the two-transistor analogy of SCR [5+5]
- OR**
- 3.a) What are problems encountered when SCRs are operated in (i) series (ii) parallel. Derive an expression to find the value of resistance to be connected across each thyristor for voltage balancing. [5+5]
  - b) Design RC firing circuit with following specifications: [5+5]  
AC input voltage: 115 V  
Thyristor ratings:  $V_g(\min) : 2.5 \text{ V}$ ,  $V_g(\max) : 5 \text{ V}$   
 $I_g(\min) : 1 \text{ mA}$ ,  $I_g(\max) : 5 \text{ mA}$   
Load: 15 ohms resistance

- 4.a) Explain the operation of single phase half controlled bridge rectifier with R-L-E load. Derive the expression for (i) Average output voltage (ii) RMS value of output voltage
- b) A fully controlled rectifier is used to charge a 115 V battery. The battery is already charged to 60 V. The source voltage of bridge is 230 V at 50 Hz. Find the range of firing angle possible. [5+5]

OR

- 5.a) Draw the output voltage waveform of 3-phase fully controlled rectifier for a firing angle of 60 degrees. Indicate firing sequence. Also derive expression for output voltage
- b) A 3 phase fully controlled bridge rectifier is operating from a 400V, 50 Hz supply. The load is highly inductive and current constant and continuous. Find the load voltage at firing angle of 45 deg. [5+5]
- 6.a) Draw the circuit of class-B commutation circuit. Explain how thyristor is commutated in class-B chopper. What are disadvantages of this commutation circuit?
- b) A class-A chopper circuit has a load resistance of 100 ohms, capacitance of 10 micro farads and inductance of 10 mH. Find the time for which thyristor will remain in ON state. What will be the turn ON time if the load resistance is decreased to 25 ohms. [5+5]

OR

- 7.a) Derive expressions for minimum and maximum values of load current in a step down chopper with R-L-E load.
- b) A step-up chopper has a source of 250 V (dc) in series with inductance of 0.1 H. If the semiconductor switch is operated with different values of duty ratio, plot output voltage vs duty ratio. [6+4]
- 8.a) Distinguish between an ac voltage controller and a cyclo-converter with respect to operation and control aspects
- b) Derive an expression for rms value of output voltage of single phase bridge type ac voltage controller. [5+5]

OR

9. Draw the circuit of single phase voltage controller with antiparallel connection of two thyristors and an R-L load. Explain its working. Sketch load voltage and load current waveforms. Derive an expression for output voltage. [10]
- 10.a) Explain the operation of single phase bridge inverter with the help of load voltage and load current waveforms for R-L Load.
- b) A 3-phase bridge inverter is fed from a dc source of 200 V. If the load is star connected of 10 ohms / phase, determine rms value of load current and required current rating of thyristors. [6+4]

OR

11. Discuss various voltage control techniques employed in inverter circuits. [10]