

Code No: 115AF

R13

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, November - 2015

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)

- 1.a) What are the applications of power MOSFET? [2]
- b) What are the factors that affect the turn off time of SCRs? [3]
- c) What is phase control technique? [2]
- d) What are the applications of dual converters? [3]
- e) What is an AC chopper? [2]
- f) What are the different kinds of power losses in Choppers? [3]
- g) What is an AC voltage controller? [2]
- h) What are the applications of Cyclo converters? [3]
- i) What is sinusoidal PWM technique? [2]
- j) What are the applications of parallel inverter? [3]

PART - B (50 Marks)

- 2.a) Explain in detail about the series connection of SCRs.
- b) Following are the specifications of a Thyristor operating from a peak supply of 400V:

$$\text{Repetitive peak current } I_p = 200 \text{ A, } \left(\frac{di}{dt} \right)_{\max} = 50 \frac{\text{A}}{\mu\text{s}}, \left(\frac{dv}{dt} \right)_{\max} = 180 \frac{\text{V}}{\mu\text{s}}$$

Design a Snubber circuit if the minimum load resistance is 15Ω . Take damping ratio as 0.7 and the factor of safety as 2 [5+5]

OR

- 3.a) What are the main specifications and ratings of SCR to be considered while designing? Explain.

- b) An UJT circuit has the following parameters:

$$\eta = 0.67, V_D = 0.6 \text{ V}, I_V = \text{mA}, V_V = 1 \text{ V}, I_P = 10 \mu\text{A}, V_{BB} = 20 \text{ V}$$

Find the values of V_{FE} so as to turn on UJT if R_E is (i) $1 \text{ k}\Omega$ (ii) 1500Ω [5+5]

- 4.a) Derive the expression for the average load voltage of single phase half controlled converter with RLE load.
- b) A three phase half wave SCR converter delivers constant load current of 20A over the firing angle range of 0° to 60° . At these two firing angles, compute the power delivered to load for an ac input voltage of 300V from a delta star transformer. [5+5]

OR

- 5.a) Derive the expression for the RMS load voltage of six pulse converter with R load.
- b) In a single phase midpoint converter turns ratio from primary to each secondary is 2. The source voltage is 230V, 50 Hz. For a resistive load of 5Ω , calculate the maximum value of average output voltage and load current and the corresponding firing and conduction angles [5+5]

- 5.a) Explain in detail about the time ratio control.
b) A step down chopper is fed from 200V DC and its duty cycle is 0.6. Calculate the RMS value of output voltages for fundamental and third harmonic components. [5+5]

OR

- 7.a) Derive the expression for the output voltage of step up chopper.
b) A chopper fed from a 200V DC source, is working at a frequency of 50 Hz and is connected to an RL load of $R = 4\Omega$ and $L = 30 \text{ mH}$. Determine the value of duty cycle at which the minimum load current will be (i) 5 A (ii) 10 A [5+5]

- 8.a) Explain the operation of a single phase mid-point step up cyclo converter with the help of circuit diagram and waveforms
b) A single phase voltage controller with resistive load has the following data: supply mains: 230V, 50 Hz, $R = 5\Omega$. Calculate the firing angle at which the greatest forward or reverse voltage is applied to either of the thyristors and the magnitude of these voltages [5+5]

OR

- 9.a) Explain the operation of a single phase bridge type step down cyclo converter with the help of circuit diagram and waveforms
b) A single phase voltage controller with RL load has the following data: Supply mains: 230V, 50 Hz, $Z = (3+j4)\Omega$. Calculate the control range of firing angles and the maximum value of RMS load current [5+5]

- 10.a) Draw the circuit diagram of a single phase half bridge inverter and explain its operation.
b) A three phase bridge inverter delivers power to a resistive load from a 400V DC source. For a star connected load of 8Ω per phase. determine RMS value of load current and RMS value of thyristor current for 120° conduction mode of operation. [5+5]

OR

- 11.a) Explain the 180° conduction mode of operation of three phase inverters with necessary circuit diagram and waveforms.
b) A single phase bridge inverter is fed from a 200 DC. In the output voltage wave, only fundamental component of voltage is considered. Determine the RMS current ratings of an SCR and a diode of the bridge for a resistive load of $R = 5\Omega$. [5+5]

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