

Code No: 5843AA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech I Semester Examinations, March - 2023

ADVANCED POWER ELECTRONIC CONVERTERS-I

(Power Electronics)

Time: 3 Hours

Max. Marks: 60

**Note:** This question paper contains two parts A and B. i) **Part- A** for 10 marks, ii) **Part - B** for 50 marks.

- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of **ten questions** (numbered from 2 to 11) **carrying 10 marks each**. From each unit, there are two questions and the student should answer one of them. Hence, the student should answer five questions from Part-B.

**PART - A****(10 Marks)**

- What is the full form of IGBT? [1]
- What is the circuit symbol of MTO? [1]
- What is extinction angle? [1]
- What is harmonic factor? [1]
- What an inverter does? [1]
- What is delta modulation? [1]
- Why space vector modulation is used? [1]
- What is 60 degree PWM? [1]
- What is a DC link capacitor? [1]
- What is multilevel concept? [1]

**PART - B****(50 Marks)**

- Describe the structure of IGBT in detail. [5+5]
- Compare the features of MTO and ETO in detail.

**OR**

- Describe the structure of Integrated Gate-commutated thyristor in detail. [5+5]
- Explain the principle of working of MOSFET with neat waveforms.

- Derive the expression for the input power factor of a single phase fully controlled converter with resistive load. [5+5]
- A three-phase half controlled converter is operated from a three-phase Y-connected 230-V, 50-Hz supply and the load resistance is  $R = 20 \Omega$ . If it is required to obtain an average output voltage of 60% of the maximum possible output voltage, calculate the delay angle and the rms output current.

**OR**

- What is a twelve pulse converter? Explain its working with neat sketch. [5+5]
- The single-phase fully controlled converter has an RL load of  $L = 5\text{mH}$  and  $R = 2 \Omega$ . The input voltage is 100V (rms) at 50 Hz. Determine the average and rms thyristor currents for the firing angle of  $30^\circ$ .

- 6.a) How the voltage of single phase inverters is controlled? Explain.  
b) The single-phase half-bridge inverter has an RL load of  $R = 5 \Omega$  and  $L = 10 \text{ mH}$ . The dc input voltage is 100V. Determine the average, rms, and peak currents of each transistor [5+5]

**OR**

- 7.a) Compare different PWM techniques in detail.  
b) The full-bridge inverter has an RLC load with  $R = 5 \Omega$ ,  $L = 10 \text{ mH}$ , and  $C = 20 \mu\text{F}$ . The inverter frequency,  $f_o = 400\text{Hz}$ , and the dc input voltage,  $V = 200\text{V}$ . Express the instantaneous load current in a Fourier series and calculate the rms load current at the fundamental frequency. [5+5]

- 8.a) What is a three phase inverter? Explain its working for  $180^0$  conduction.  
b) The three-phase full-bridge inverter has a Y-connected load and each phase consists of  $R = 4 \Omega$  and  $L = 10\text{mH}$ . The inverter frequency is  $f_o = 100\text{Hz}$  and the dc input voltage  $V = 200\text{V}$ . Determine the rms, average, and peak currents of the transistors. [5+5]

**OR**

- 9.a) Give the detailed analysis of 120 degree conduction of three phase inverters.  
b) The three-phase inverter has a delta-connected load of  $R = 5 \Omega$  and  $L = 10 \text{ mH}$ . The inverter frequency is  $f_o = 50\text{Hz}$  and the dc input voltage is  $V = 120\text{V}$ . Determine the rms line voltage at the fundamental frequency and the load power. [5+5]

- 10.a) Draw the circuit diagram of flying capacitor multi level inverter and explain its working.  
b) A single-phase cascaded multi-level inverter has  $m = 5$ . Find the switching angles to eliminate the 5th, 7th, 11th, and 13th harmonics. [5+5]

**OR**

- 11.a) Explain in detail about the working of back to back intertie system.  
b) A single-phase diode-clamped inverter has  $m = 5$ . Find the generalized Fourier series and THD of the phase voltage. [5+5]

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