

May/June 2024

M.Tech (PE&amp;D)- II- SEMESTER

Digital Control of Power Electronics and Drive Systems (MPED-202)

Time: 3 Hours

Max. Marks:75

- Instructions:**
1. It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.
  2. Answer any four questions from Part -B in detail.
  3. Different sub-parts of a question are to be attempted adjacent to each other.
  4. Any other specific instructions

**PART -A**

- Q1 (a) IGBT is a voltage controlled device. Why ? (1.5)
- (b) Define circuit turn off time. (1.5)
- (c) What is a MOSFET ? (1.5)
- (d) What are the benefits of MOSFET being used in the field of power electronics ? (1.5)
- (e) What is the purpose of modulation ? (1.5)
- (f) Mention the important applications of single- phase inverters. (1.5)
- (g) Mention the advantages and disadvantages of DC chopper. (1.5)
- (h) What is meant by frequency modulation control? (1.5)
- (i) What is snubber circuit ? (1.5)
- (j) Define the term duty cycle. (1.5)

**PART -B**

- Q2 (a) A chopper is operated with R load of  $20\Omega$  and input voltage of 220V. During the on state of the chopper the voltage drop is 1.5V and the frequency is 10kHz. Determine the average output voltage and the chopper on time, when the duty cycle is 80 percent. (8)
- (b) A step-up chopper operates at an input supply of 200V and output voltage of 600V. Considering the conducting time to be  $200\mu s$ , calculate the chopping frequency, new output voltage when the pulse width is halved for constant frequency. (7)
- Q3 (a) Design a circuit of a single phase full wave inverter which supplies power to a resistive load of  $20\Omega$  by a DC source of 200 V. In this circuit determine the rms output voltage, power delivered to the load, peak current of each switch and plot the output voltage of the inverter. The switching frequency of the inverter is 10kHz. The PWM can be based on triangle carrier signal. Plot the inverter output voltage waveform. (15)

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- Q4 (a) A buck regulator has an input voltage of 12V and it is required to supply an average output voltage of 10V. Take the switching frequency as 5 KHz, determine the duty cycle of the switch and load inductance & resistance to limit load current to 0.5A. (8)
- (b) Draw and Explain a gate/base drive circuit for MOSFET/IGBT. (7)
- Q5 (a) Define the performance parameters of 3-phase inverter. (7)
- (b) Describe the sinusoidal PWM technique with necessary diagram. (8)
- Q6 (a) Power supplies for telecommunication applications may require high currents at low voltages. Design a buck converter that has input voltage of 3.3V and an output voltage of 1.2V. The output current varies between 4A and 6A. The output ripple must not exceed 2 percent. Specify the inductor value such that peak to peak variation in inductor current does not exceed 40 percent of the average value. (15)
- Q7 (a) A 96 V DC source is to be used to charge a 110V battery. Construct & design a boost converter operating at a switching frequency of 20 KHz. The peak load current required for charging the battery is 50A. (9)
- (b) Discuss the suitable methods for improving the power factor of a converter, (6)

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