B.E. Electrical (Electronics & Power) Engineering (Model Curriculum) Semester - VII

PCC-2 / FE105 - Advanced Power Converter

P. Pages : 2 **GUG/S/23/14246**

Time : Three Hours * 2 9 6 2 * Max. Marks : 80

Notes :
1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.
5. Use of slide rule, Logarithmic tables, Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
6. Answer **five** questions.
7. Use of a non-programmable calculator is permissible.

1. a) The Cuk converter of Fig. 6-13a has parameters $V_s = 12\,V$, $D = 0.6$, $L_1 = 200\mu H$, $L_2 = 100\,\mu H$, $C_1 = C_2 = 2\mu F$, and $R = 12\Omega$, and the switching frequency is 250 KHz. Determine (a) the output voltage, (b) the average and the peak-to-peak variation of the currents in L_1 and L_2 and (c) the peak-to-peak variation in the capacitor voltages. **8**

b) The buck-boost converter has parameters $V_s = 12V$, $D = 0.6$, $R = 10\Omega, L = 10\mu H$, $C = 20\mu F$, and a switching frequency of 200 KHz. (a) Determine the output voltage, (b) Determine the average, maximum, and minimum inductor currents, and (c) Determine the output voltage ripple (d) Sketch the inductor and capacitor currents for the buck-boost converter. (e) Determine the rms values of inductor and capacitor. **8**

OR

2. a) Design a buck converter to produce an output voltage 18V across a $10-\Omega$ load resistor. The output voltage ripple must not exceed 0.5 percent. The dc supply is 48 V, Design for continuous inductor current. Specify the duty ratio, the switching frequency, the values of the inductor and capacitor, the peak voltage rating of each device, and the rms current in the inductor and capacitor. Assume ideal components. **8**

b) Describe the boost converter in detail with an analysis of the switch closed and open. Also derive equations for finding inductor and capacitor size along with maximum and minimum inductor currents. **8**

3. a) Explain the operation of a single-phase half-controlled bridge a.c. to d.c. converter with RLE loads. Derive the expression for average load voltage, average load current, and RMS load voltage. Also, sketch the associated waveforms. **8**

b) Give the comparison between the non-circulating current mode and the circulating current mode of a Dual converter. **8**

OR

4. a) A single-phase semi converter 230V, 1KW heater is connected across 1 phase 230V, 50Hz supply through an SCR. For firing angle delay of 45º and 90º, calculate the power absorbed in the heater element. **8**

b) Explain the operation of a three-phase half-controlled bridge rectifier with RLE loads. Sketch the waveforms for $\alpha = 0^o$, $\alpha = 90^o$, and $\alpha = 120^o$. **8**

5. a) A single-phase full-bridge inverter may be connected to a load consisting load of (a) RL or RLC overdamped (b) RLC underdamped. For these loads draw the load voltage and load current waveforms under steady operating conditions. Discuss the nature of these waveforms. Also indicate the conduction of various elements of the inverter circuit. **8**

b) Write a note on CSI. Give the circuit analysis of the Current Source Inverter with resistive load. **8**

OR

6. a) Describe the modified McMurray half-bridge inverter with appropriate voltage and current waveforms. **8**

b) Describe the working of a single-phase half-bridge inverter. What is its main drawback? Explain how this drawback is overcome. **8**

7. a) What is PWM in the case of an inverter? Discuss how the frequency and magnitude of voltage of the inverter can be changed with the help of PWM. **8**

b) Describe in detail about three-phase VSI sine triangle PWM. **8**

OR

8. a) What is the space vector modulation technique (SVM) and how does it work? **8**

b) Describe in detail about single-phase VSI sine triangle PWM. **8**

9. a) Explain single-phase to single-phase step-up cycloconverter with the help of mid-point configuration in detail. **8**

b) A single-phase to single-phase cycloconverter is supplying an inductive load comprising a resistance of 5Ω and an inductance of 40mH form a 230V, 50Hz single-phase supply. It is required to provide an output frequency that is 1/3 of the input frequency. If the converters are operated as semi converters such that and firing delay angle is 120º. Neglecting the Harmonic content of load voltage, determine: a) rms value of output voltage. (b) rms current of each thyristor and (c) input power factor. **8**

OR

10. a) What is an a.c. voltage controller? List some of its industrial applications. Enumerate its merits and demerits. **8**

b) Give the various configuration of the three-phase ac controller. List the important points of comparison between these circuits. **8**

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