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

FE105 / PCC-2 - Advanced Power Convertor

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

Time : Three Hours * 7 8 1 3 * 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. Non programmable calculator is permitted.

1. a) Design a buck converter to produce an output voltage of 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**

OR

2. a) 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. **8**

i) Determine the output voltage,
ii) Determine the output voltage ripple,
iii) Sketch the inductor and capacitor currents for the buck-boost converter,
iv) Determine the rms values of inductor and capacitor.

b) Design a boost converter that will have an output of 30V from a 12-V source. Design for continuous inductor current and an output ripple voltage of less than one percent. The load is a resistance of $50\,\Omega$. Draw the converter circuit diagram. Assume ideal components for this design. **8**

3. a) 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**

b) 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**

OR

4. a) Describe the working of a single-phase fully-controlled bridge converter with RLE load under continuous conduction in the following 2 modes: **8**
i) Rectifying mode
ii) Inverting mode, Also, sketch the associated waveforms for $\alpha = 30^{o}$.

b) 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**

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

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

OR

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

b) Give the performance comparison of Voltage Source Inverter and Current Source Inverter. **8**

7. a) What are the techniques for harmonic reduction in inverters? Discuss the PWM technique. **8**

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

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

b) Describe the three-phase to three-phase cycloconverter with relevant circuit arrangement using 18 SCRs. **8**

OR

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

b) A single-phase to single-phase cycloconverter is supplying an inductive load comprising a resistance of 5Ω and an inductance of 40 mH from 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 : **8**
i) rms value of output voltage ii) rms current of each thyristor and
iii) input power factor.

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