B.E. Electrical (Electronics & Power) Engineering (MODEL CURRICULUM) Semester-VII

FE105 / PCC-2 : Advance Power Converter

P. Pages : 2 **GUG/W/22/14246**

Time : Three Hours * 3 5 4 6 * Max. Marks : 80

Notes : 1. All questions carry equal marks.
2. Answer **five** questions.
3. Due credit will be given to neatness and adequate dimensions.
4. Illustrate your answers wherever necessary with the help of neat sketches.
5. Use of a non-programmable calculator is permissible.
6. Assume suitable data wherever necessary.

1. a) The buck converter has the following parameters: $V_s = 50$ V, $D = 0.4$, $L = 400\mu H$, $C = 100\,\mu F$, and $R = 20\,\Omega$. The switching frequency is 20 kHz. Determine (a) the output voltage, (b) the maximum and minimum inductor currents, and (c) the output voltage ripple and (d) draw the converter circuit diagram with necessary waveforms. **8**

b) Design a boost converter that will have an output of 30 V 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 50Ω. Draw the converter circuit diagram. Assume ideal components for this design. **8**

OR

2. a) The buck-boost converter has $Vs = 24\,V$, $Vo = -36\,V$, and a load resistance of 10Ω. If the switching frequency is 100 kHz, (a) Draw the converter circuit diagram, (b) sketch the buck-boost converter waveforms, (c) determine the inductance such that the minimum current is 40 percent of the average, (b) determine the capacitance required to limit the output voltage ripple to 0.5 percent. **8**

b) Design a buck converter to produce an output voltage of 18 V 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**

3. a) The single-phase fully-controlled bridge is connected to the RLE load. The source voltage is 230 V, 50 Hz. The average load current of 10A is continuous over the working range. For $R = 0.4\Omega$ and L = 2 mH, Compute (a) the firing angle for E = 120 V (b) the firing angle for E = –120V (c) in case the output current is constant find the input power factors for both parts a and b. **8**

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

OR

4. a) Describe the working of a single-phase fully-controlled bridge converter with RLE load under continuous conduction. Also, sketch the supply voltage and current waveforms, output voltage and current waveforms, and thyristor voltage waveforms for (i) $\alpha = 30^o$, (ii) $\alpha = 145^o$. **8**

b) Explain with a neat circuit diagram the basic principle of a dual converter. **8**

5. a) Draw and explain the operation of a single-phase Current Source Inverter. Draw also the related voltage ad current waveforms. **8**

b) Explain the operation of a three-phase bridge inverter in 180^o VSI conduction mode. Draw output phase and line voltage waveforms. **8**

OR

6. a) A single-phase full-bridge inverter may be connected to a load consisting to a 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) 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 the three-phase VSI sine triangle PWM in detail. **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) Give the various configuration of the three-phase a.c. controller. List the important points of comparison between these circuits. **8**

b) For a single-phase a.c. controller feeding a restive load, show that the power factor is given by the expression: **8**

$$\left[\frac{1}{\pi\{\pi-\alpha\}}+\frac{\sin 2\alpha}{2}\right]^{1/2}$$

OR

10. a) Describe the three-phase to three-phase cycloconverter with relevant circuit arrangements using 18 SCRs. **8**

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

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