VASAVI COLLEGE OF ENGINEERING (Autonomous), HYDERABAD
M.E. (CBCS : EEE) I-Semester Make up Examinations, March-2017
(Power Systems & Power Electronics)
Power Electronic Converters

Time: 3 hours

Max. Marks: 70

Note: Answer ALL questions in Part-A and any FIVE from Part-B

Part-A (10 × 2 = 20 Marks)

1. In most of the circuit analysis using a power semiconductor device, it is assumed that "the device is ideal". Which two parameters of the "ideal" device are assumed to be negligibly small?

2. When carrying out circuit analysis of a converter feeding a DC motor load, how the DC motor is represented in the circuit?

3. A single-phase half-controlled converter is supplying R-L load with a large value of L, and has input AC supply of 314 volts, 50 Hz. If the firing angle is 60^0, calculate the approximate value of voltage across the output DC terminals.

4. A three-phase fully-controlled bridge converter is supplying R-L load with a large value of L and with input AC supply of 50 Hz. Give the duration in degrees, for which each thyristor conducts in 20 ms.

5. Draw the basic circuit diagram of a step-down DC-to-DC converter (buck chopper) with a DC supply, IGBT, diode, inductor and load.

6. A step-down DC-to-DC converter is fed with input DC voltage of 400 V. For the on-time of 5 ms. Calculate the chopper frequency for the output DC voltage of 100 V.

7. For PWM inverters, give the definition of amplitude-modulation index.

8. For inverters, give the main advantage of using IGBTs as compared to the use of thyristors.

9. Give the two main disadvantages of using ac voltage regulator for ac-to-ac voltage conversion.

10. Describe in a few sentences, the principle of a system to obtain single-phase 16.66 Hz supply from a single-phase 50 Hz supply.

Part-B (5 × 10 = 50 Marks)

11. a) For a DC supply charging the R-C circuit through a diode, derive the expressions and [5] show the waveforms of the charging current and the capacitor voltage from the instant of switch-on up to three times the time constant.

    b) A diode and switch are used to dissipate the energy stored in a capacitor across a resistor. [5] Derive the expressions for the discharge current and the capacitor voltage. For a capacitor of 0.1 microfarad, having initial capacitor voltage of 220 V, and a series resistor of 44 Ohms, calculate (a) the peak value of diode current and (b) the capacitor voltage after 2 microseconds.

12. a) For a three-phase fully-controlled bridge converter(rectifier) working at a firing angle of   [7]
       60^0 and operating with R-L load (having a large value of L), give the waveforms of
       input AC voltages and output DC voltage. Derive the expression for the output DC
       voltage.

   b) A single-phase fully-controlled bridge rectifier has an input voltage of 200 V at 50 Hz   [3]
      and is working at a firing angle of 60^0. It is operating with R-L load (having a large
      value of L) at a constant and uniform DC current of 10 A. Calculate the values of output
      DC voltage and RMS fundamental component of AC supply current.

13. a) With the help of circuit diagram and the waveforms of voltages & currents, explain the   [7]
       principle of operation of a step-up (boost) DC-to-DC converter with R-L load. Derive
       the expression for the output DC voltage.

   b) A step-up (boost) DC-to-DC converter is operating at a frequency of 2 kHz on a dc input   [3]
      supply of 100 V. If the output dc voltage is 300 V, calculate the on-period of the chopper.

14. a) For a three-phase bridge inverter operating in 180° conduction mode scheme, give a   [7]
       table showing the conducting devices in each of the six intervals in one cycle of output
       ac voltage. Discuss the principle of operation of the inverter with the help of waveforms
       of six gate currents, ac output voltage of each phase, and the ac output line voltages.

   b) Give comparison between the voltage source inverter and the current source inverter.   [3]

15. a) Giving the circuit diagram and the waveforms of voltages, explain the principle of   [6]
       operation of a three-phase to three-phase half-wave cycloconverter.

   b) With the help of circuit diagram and waveforms of input and output ac voltage, explain   [4]
      the principle of operation of a three-phase ac voltage regulator feeding a three-phase
      star-connected R load.

16. a) For a DC source feeding the R-L circuit through a diode, derive the expressions and show   [5]
       the waveforms of the circuit current and the voltage across the inductor from the instant
       of switch-on up to four times the time constant.

   b) Explain why the power factor is low for AC-to-DC three-phase bridge converter using   [5]
      thyristors and when operating at higher firing angles. Discuss one method of reactive
      power compensation.

17. Answer any *two* of the following:
   a) For a Cuk converter, give the circuit diagram, principle of operation and the   [5]
      waveforms of various voltages & currents. Derive the expression for the output dc
      voltage.

   b) With the help of waveforms of carrier signal and reference signal for sinusoidal   [5]
      pulse-width modulation for an inverter, explain the principle of operation and give
      the waveforms of the resulting gate pulses obtained, and hence, the waveform of
      the output voltage.

   c) With the help of a circuit diagram, give the concept of Voltage regulator.   [5]