EEL209/ELL302: Power Electronics

Major Exam. (19-11-2015)   Total Marks: 120   Time: 2 Hours

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Note:- *(i) Answer all questions.*   *(ii) No clarifications on questions.*   *(iii) Assume data if any required.*

1) Explain the working principle of a Step Down Chopper feeding R-L-E load with the help of a circuit diagram, clearly indicating the components and notations of various voltages and currents. Also show all the voltage and current waveforms. Derive the expression for the output voltage. **[12 Marks]**

2) A Step Up Chopper is supposed to give an output voltage of 200 V. It is fed from a 150 V dc source. If the OFF time of the thyristor is 60 microseconds, what will be switching frequency? **[5 Marks]**

3) Draw the circuit diagram of the Buck-Boost converter. Draw the equivalent circuits separately for each and every mode. Explain its operation with the help of all voltage and current waveforms in the circuit when the converter feeds a constant current to a load. **[12 Marks]**

4) A Buck-Boost converter has an input voltage of 15 V. The duty cycle is 0.35 and the switching frequency is 20 kHz. The inductance and filter capacitance of the converter circuit are 120 μH and 200 μF respectively. The average load current is 1.5 A. Determine (a) the average output voltage, (b) the peak-to-peak output voltage ripple, (c) the peak-to-peak ripple current of inductor and (d) the peak current of the switching device. **[8 Marks]**

5) With the help of a circuit diagram, explain the working principle of a Three-Phase Dual Converter feeding a DC Motor. Show the input and output voltage waveforms. **[12 Marks]**

6) (a) A single-phase half-controlled bridge converter has an input voltage of 240 V. Find the average load voltage at a firing angle of 90°. **[2 Marks]**

   (b) A single-phase full bridge converter feeds power to an R-L-E load with R = 20Ω, L = 10mH and E = 50V. The input voltage is 230V. Assuming continuous conduction, find the average value of the output voltage and the load current for a firing angle of 30°. **[4 Marks]**

7) A fully controlled 3-phase bridge rectifier having a source inductance Ls is feeding a constant current load. For a firing angle, α = 30° and the commutation overlap angle, μ = 15°, draw the output voltage waveform indicating the conducting switches for one complete cycle. **[15 Marks]**

8) With the help of a circuit diagram and required waveforms, explain the working principle of a 3-Phase Voltage Source Inverter with 180° conduction feeding star connected R load. Draw all the phase and line voltage waveforms indicating the devices ON during each segment for a complete cycle. **[12 Marks]**

9) A three-phase VSI feeds a star connected load of R = 20Ω with 180° conduction. The inverter frequency is 50 Hz and the dc input voltage is 500 V. Determine (a) the RMS line voltage (b) the RMS phase voltage (c) the fundamental RMS line voltage (d) the fundamental RMS phase voltage (e) total harmonic distortion, THD (f) the distortion factor, DF (g) the harmonic factor, HF and DF of lowest order harmonic, (h) the load power (i) average transistor current (j) the transistor RMS current. **[15 Marks]**

10) With the help of a circuit diagram and appropriate waveforms, explain the three modes of operation of a 3-phase bidirectional AC Voltage controller feeding a star connected R load. **[15 Marks]**

11) Explain the bridge type 1-phase to 1-phase cyclo-converter feeding a resistive load with the help of a circuit diagram and waveforms clearly indicating the step-up and step-down operations. **[8 Marks]**