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# Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

## II SEMESTER M.TECH (EMAL / PESC) END SEMESTER EXAMINATIONS, MAY 2016

SUBJECT: ADVANCED POWER ELECTRONIC CONVERTERS [ELE 528]

(PROGRAM ELECTIVE – III)

**REVISED CREDIT SYSTEM**

Time: 3 Hours | 12 MAY 2016 | MAX. MARKS: 50

**Instructions to Candidates:**

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitable assumed.

1A. For the circuit shown in Fig.Q1A, determine the voltage conversion ratio $V_o/V_s$ when both switches are operated synchronously i.e. each is in position 1 for $0 \le t \le DT_s$, and in position 2 for $DT_s \le t \le T_s$. ***03***

1B. Consider a buck converter with the following parameters: $V_s$ = 80 V, R = 18 Ω, $P_o$ = 100 W, L = 0.4 mH and $f_s$ =150 kHz. (a) Determine the mode of operation. (b) Determine the range of R for the converter to remain in continuous current mode. ***04***

1C. A boost converter has the following parameters: $V_s$ = 20 V, D = 0.6, L = 100 µH, R = 50 Ω, C = 100 µF and $f_s$ = 15 kHz. Comment on the nature of inductor current and hence find the output voltage. ***03***

2A. Design a Cuk converter that has an input of 25 V and an output of -30 V. The load is 60 W. Specify the duty ratio and the inductor values if the switching frequency is 20 kHz and the maximum change in inductor currents should be less than 20 % of average currents. ***04***

2B. Derive an expression for the output voltage of a Buck-Boost converter operating in continuous current mode. Assume the switch and the diode to be non-ideal. ***03***

2C. Briefly discuss the steps involved in design of a high frequency inductor. ***03***

3A. Design a forward dc-dc converter to produce an output voltage of 30 V when the input dc voltage is unregulated and varies from 150 V to 175 V. The output power varies from 20 W to 50 W. Output voltage and inductor current ripples to be restricted to 5%. Employ switching frequency of 100 kHz. Transformer is used for the purpose of isolation only. ***04***

3B. A flyback dc-dc converter has an input voltage of 44 V and an output voltage of 3 V. The duty ratio is fixed at 0.32 and the switching frequency is 300 kHz. The load is 1 Ω. (a) Determine the transformer turns ratio. (b) Determine the transformer magnetizing inductance such that the minimum inductor current is 40% of the average inductor current. ***03***

3C. With a block schematic, explain the working of an Online UPS. ***03***

4A. A full bridge dc-dc converter has the following parameters: $V_s$ = 30 V, $N_P/N_S$ = 2, D = 0.3, Lx = 0.5mH, R = 6Ω, C = 50 µF and f = 10 kHz. Determine average output voltage, minimum value of inductor current and the percentage output voltage ripple. Assume all components to be ideal. ***04***

4B. A zero current switch dc-dc converter has the following specifications: Po= 30 W, Vo = 15 V, Zo = 2.5 Ω, Cr = 0.02 μF, the time between diode turn-off and the switch turn-off is 4 μsec. Find the input voltage and the switching frequency for suitable implementations. ***04***

4C. With relevant sketch, explain direct duty ratio control technique. ***02***

5A. A dc - dc converter with zero voltage switching has Vs = 20 V, Cr = 0.047 μF, Io = 5 A, Zo= 4.6 Ω, the time for which diode Dr is on is 0.37μsec. Determine the switching frequency such that the output voltage is 10 V. Hence determine the ratings of the switch. ***04***

5B. The Parallel loaded Resonant dc - dc converter has following parameters: $V_s$ = 15 V, $L_r$ = 1.3 μH, $C_r$ = 0.12 μF, $R_L$ = 10 Ω, f = 500 kHz. Determine output voltage of the converter. Estimate the changes in the output voltage if the load resistance is changed to 5 Ω. ***04***

5C. List the steps involved in developing the small signal model of a converter. ***02***

6A. A series loaded resonant dc-dc converter has the following parameters: $V_s$ = 10 V, $L_r$ = 6 μH, $C_r$ = 6 nF, f = 900 kHz, $R_L$ = 10 Ω. Determine the output voltage. ***03***

6B. With a neat circuit schematic and relevant waveforms explain how zero voltage transition technique as applied to a boost converter. ***05***

6C. Make a technical comparison of linear power supply and switched mode power supply. ***02***

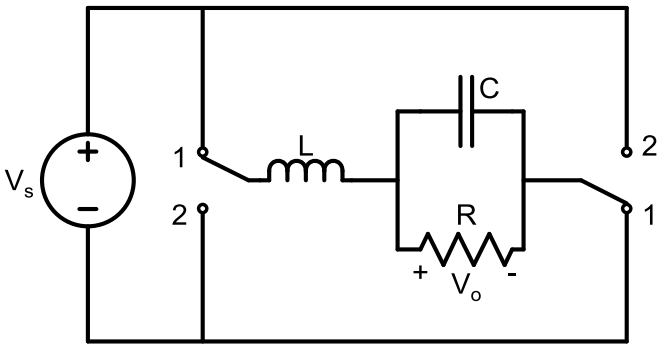


Fig.Q1A