Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
MAKEUP EXAMINATIONS, DECEMBER 2019

MODERN POWER CONVERTERS [ELE 4010]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 26, December 2019** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. Design a buck converter that has an input voltage of 3.3 V and an output voltage of 1.2 V. The output current is 4 A. The output voltage ripple must not exceed 2%. Specify the inductor value such that peak-to-peak variation in inductor current does not exceed 40% of the average value. Assume ideal components and switching frequency of 500 kHz. ***(04)***

1B. A boost converter has the following parameters: Vg = 20 V, D = 0.6, L = 100 µH, R = 50 Ω, C = 100 µF and fs = 15 kHz. Comment on the nature of inductor current and hence find the output voltage. ***(04)***

1C. A Cuk converter has the following parameters: Vg = 5 V, Vo = 12 V, Io = 1 A, fs = 100 kHz. Determine the value of the energy storing capacitor (C1) such that the capacitor voltage ripple should be less than 3%. ***(02)***

2A. A buck-boost converter has the following parameters: Vg = 24 V, D =0.4, R = 5 Ω, L = 20 µH, C = 80 µF and fs = 100 kHz. Determine the output voltage, inductor current average and maximum inductor current. ***(03)***

2B. Design a flyback converter to produce an output of 36 V from a 3.3 V source. The output current is 0.1 A and the turns ratio N2/N1 is 16. The magnetizing current ripple should not exceed 40% of the average and the output voltage ripple to be limited to 2%. Assume continuous current mode, ideal components and switching frequency of 100 kHz. ***(04)***

2C. A forward converter has the following parameters: Vg = 100 V, N1/N2 = N1/N3 = 1, Lm=1mH, Lx = 70 µH, R = 20 Ω, C = 33 µF and D = 0.35. The switching frequency is 150 kHz. Determine a) output voltage and b) peak current in Lm in the transformer model. ***(03)***

3A. With a neat circuit schematic and relevant waveforms explain the working principle of a full-bridge dc-dc converter in continuous conduction mode. Derive an expression to estimate the output voltage. ***(03)***

3B. A parallel resonant dc-dc converter supplying a resistive load of 10Ω from a source voltage of 100V. The switching frequency is 20% excess of the resonant frequency of 100 KHz, and characteristic impedance Zo = 5 Ω. Select suitable values of Lr and Cr for the converter and hence determine the output voltage. ***(04)***

3C. A zero voltage switched dc-dc buck converter has the following specifications: Vg = 20 V, Lr = 1 μH, Cr = 0.047 μF, Io = 5 A. Determine the switching frequency such that the output voltage is 10 V. ***(03)***

4A. A zero current switching 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)***

4B. Discuss in detail the basic constraints for the design of a high frequency inductor when the core geometrical factor Kg method is employed for the design. ***(04)***

4C. List the different soft switching techniques that can be developed to enhance the efficiency of the converters. ***(02)***

5A. Assuming continuous conduction mode, obtain the small signal ac state equations for a buck-boost converter using state-space averaging technique. Take the on state resistance of MOSFET as Ron and the drop across the diode as Vd. ***(05)***

5B. Write a technical note on design steps of lead compensator. ***(03)***

5C. Make a technical comparison between linear power supplies and switched mode power supplies. ***(02)***