Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: MODERN POWER CONVERTERS [ELE 455]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 25 November 2016** **MAX. MARKS: 50**

Instructions to Candidates:

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

1A. A buck converter has an input voltage of 15 V from a 40W source, and has an output current of 4 A. The filter inductance is 28 µH and the switching frequency is 100 kHz. Assuming no power losses determine: average input current, the percentage current ripple and the value of the capacitor so that the output ripple does not exceed 2 percent. Will this converter be in continuous conduction? If not suggest a way to move it to continuous conduction. **05**

1B. Discuss the curves of voltage gain versus duty cycle for all the three basic dc-dc converters considering ideal and non-ideal cases. Also derive an expression for the output voltage of a buck converter considering a non-ideal switch and diode. **05**

2A. Design a boost converter that has an output of 48V from an input of 18V. The output power is 48W. The output voltage ripple must not be more than 100 mV p-p. The current ripple has to be limited to 20% of its average value. Determine the duty ratio, values of inductor and capacitor, peak voltage rating of each device. Assume switching frequency of 200kHz. **05**

2B. With the help of neat circuit schematic and relevant waveforms, explain the working principle of SEPIC converter. Assuming continuous mode of operation, determine the selection of the inductors and the capacitors for a particular ripple condition. Hence, obtain an expression for output voltage. **05**

3A. Design a fly-back converter to operate in continuous conduction mode for an input of 100V dc and an output of 2W at 5V. The On-state time of the transistor is 4µs.The switching frequency is 100kHz. Determine (a) Transformer turns ratio (b) Transformer magnetizing inductance L_m such that the variation in inductor current is 30 percent of the average (c) capacitor to limit the ripple to less than 0.5 percent. **04**

3B. Calculate the filter inductor and capacitor values for the forward converter described below: Input dc remains constant at 200 volts, output dc = 10 volts ± 0.1 volt, The load current is 5 amps. N_1:N_2 = 8:1. N_1:N_3=1. Assume continuous conduction of inductor current whose variation is 40 % of the average value. Take f_s= 100 kHz. Also find maximum voltage stress of the switch in the primary winding and diode in the tertiary winding. **04**

3C. Explain the need for isolation with respect to dc-dc converters. Hence develop a transformer model for high frequency application. **02**

4A. With suitable circuit diagram and relevant waveforms, explain the working principle of full bridge dc-dc converter. Hence deduce an expression for the output voltage. **04**

4B. Explain the continuous conduction mode of operation of a SLR dc-dc converter with suitable circuit diagram and waveforms. **06**

5A. The Parallel resonant dc-dc converter has the following parameters: Vs=30V, R_L=15Ω, L_r= 1.2μH, C_r=26nF and f_S=1MHz. Determine the output voltage of the converter. State the mode of operation and sketch i_L and v_C. **05**

5B. Demonstrate how ZCS switching can be achieved in a buck converter with circuit diagram and waveforms. **05**

6A. A ZVS buck converter has the following parameters: Vs=5V, I_O=3A, L_r= 1μH, C_r=0.01μF. Determine the output voltage when f_S=500kHz. **04**

6B. Obtain the state space averaged model of a buck dc-dc converter. **06**