Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

SEVENTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
NOV 2017
SUBJECT: POWER ELECTRONICS (ECE - 403)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ANY FIVE** questions.
- Missing data may be suitably assumed.

1A. For the circuit shown in Figure Q1A, derive the expression for instantaneous inductor current and instantaneous source current. If V_{CC} = 100V, L = 100mH, R = 10Ω, t_1 = 10msec, T = 100msec, determine instantaneous power supplied by the source.

1B. With the help of the two-transistor model of SCR derive the expression for anode current and explain latching.

1C. The capacitance of reverse-biased junction J_2 in a thyristor is C_{j2} = 20pF and can be assumed to be independent of the off-state voltage. The limiting value of the charging current to turn ON the thyristor is 16mA. Determine the critical value of dv/dt.

(5+3+2)

2A. Identify the type of DC-DC converter circuit shown in Figure Q2A. What is the main difference between this converter and other dc-dc converter topologies? Derive the output voltage expression for this converter and draw the current waveform in C1 for large inductance.

2B. In a single phase full-wave, fully controlled, center tap converter without free-wheeling diode, draw voltage waveform across the load and the voltage across one of the device assuming continuous load current. Obtain the expression for average and rms value of output voltage. Assume α =120°.

2C. Explain with the help of circuit diagram, the operation and use of snubbers.

(5+3+2)

3A. Draw the circuit diagram, waveforms of inductance current, capacitor voltage, switch voltage and output voltage and derive an expression for output voltage, minimum value of inductance and output voltage ripple for a buck-boost converter.

3B. Design a buck converter to produce an output voltage of 18V across a 10Ω load resistor. The output voltage ripple must not exceed 0.5 percent. The dc supply is 48V and the switching frequency is 40 kHz. Design for continuous inductor current. Specify the duty ratio, the values of the inductor and capacitor. Assume ideal components.

3C. i) Cycloconverter alters _____of the input waveform.

(a) Voltage (b) Frequency (c) Phase (d) All the above

ii) Define circulating current in case of dual converter.

(5+3+2)

4A. The forward converter has parameters $V_s = 100V$, $D = 0.35$, the switching frequency is 250 KHz, $N_1/N_2 = N_1/N_3 = 1, L_m = 1mH, L_x = 70\mu H, R = 20\Omega, C = 33\mu F$. Determine (i) the output voltage and output voltage ripple (ii) Average, minimum and maximum values of current in output inductance L_x (iii) the peak current in magnetizing inductance L_m (iv) the peak current in the switch and the physical transformer primary.

4B. A flyback converter has the following circuit parameters: V_s = 24 V, N_1/N_2 = 3.0, L_m = 500µ H, R = 5Ω, C = 200µF, F = 40 kHz, V_o = 5 V. Determine (*a*) the required duty ratio D (*b*) the average, maximum, and minimum values for the current in L_m and (*c*) the output voltage ripple. Assume that all components are ideal.

4C. Differentiate soft switching and hard switching. Also explain how soft switching is achieved.

(5+3+2)

5A. Explain a three phase full-bridge inverter for a Y-connected resistive load with 120° conduction mode. Derive the expression for line and phase voltages and sketch the waveforms.

5B. The push-pull converter has the following parameter V_s = 30V, D=0.3, R=6Ω , L_x=0.5mH, C=50µF, f=10KHz , N_p/N_s=2 , Determine output voltage, the maximum and minimum values of i_{Lx} and output voltage ripple. Derive the required equations with waveforms and circuit diagram.

5C. Draw the circuit diagram of ideal transformer model and approximate transformer model that is used in the DC power supplies. Explain the approximations assumed in order to arrive at the approximate model.

(5+3+2)

6A. Define total harmonic distortion. What is the need for PWM wave in an inverter? With the help of switching scheme and waveforms, explain the unipolar switching scheme for PWM generation.

6B. List various sources of power line disturbances. Explain its effect on sensitive equipment.

6C. Explain the two major benefits of SMPS.

(5+3+2)

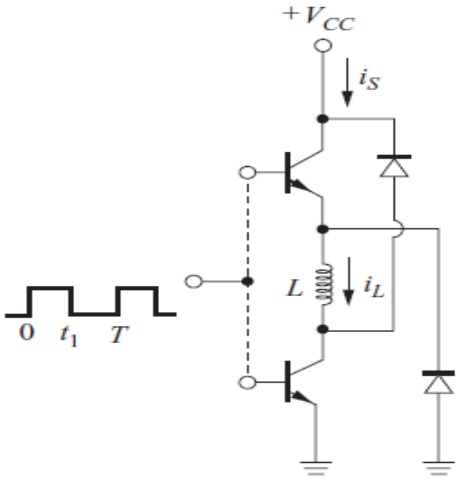

Figure: Q1A

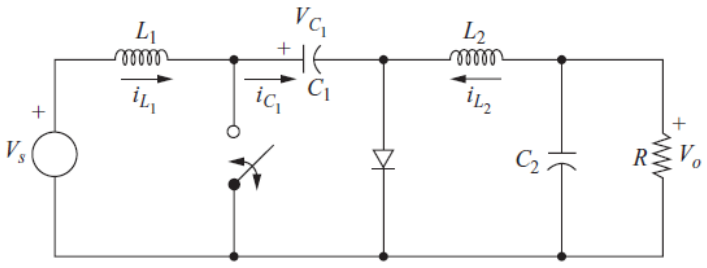

Figure: Q2A