Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

SEVENTH SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION - NOV/DEC 2016
SUBJECT: POWER ELECTRONICS (ECE - 403)

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

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

1A. What is energy recovery? Explain the two methods of energy recovery with suitable circuit diagrams and waveforms.

1B. A half wave controlled rectifier is connected to a 230V source through a step-down transformer of turns ratio 10:1. Calculate the firing angle necessary to deliver 20W of average power to a 10Ω load. Also, determine the efficiency.

1C. For the power BJT constructed in Darlington pair as shown in the figure Q1C, calculate the individual and overall β values.

(5+3+2)

2A. Explain the construction, operation and characteristics of IGBT.

2B. Draw the waveform for current in diode and capacitor for the circuit shown in figure Q 2A. Assume inductor current is continuous. Derive an expression for $\Delta V_0/V_0$ (ripple).

2C. The following statements are made with respect to single phase cycloconverter. Say true or falls. If any statement is wrong, correct the wrong statement.

i) It converts fixed dc to variable dc voltage
ii) It does not use any intermediate dc stage for power conversion.

(5+3+2)

3A. For the circuit shown in Figure Q 3A assume continuous load current and arbitrary firing angle. i) Draw the output voltage waveform. ii) Derive the output voltage expression. iii) In which quadrants, the circuit will operate? iv) Repeat part i) and iii), if freewheeling diode is connected.

3B. In a buck converter average inductor current (I_L) and the load current (I_0) are the same. Peak to peak change in inductor current (Δi_L) is given by $\frac{(V_S - V_0)D}{fL}$. i) Obtain an expression for minimum inductor current assuming continuous load current. ii) Draw the capacitor current waveform.

3C. A 3-phase half wave converter is operated from a 3 phase Y-connected 208V, 60Hz supply and load resistance is 10Ω. If it is required to obtain an average output voltage of 50% of the maximum possible output voltage. Calculate average output voltage and the delay angle. Assume load current is discontinuous.

(5+3+2)

4A. Draw the circuit diagram of zero current resonant converter. Analyse the circuit along with the equivalent circuit diagram and waveforms.

4B. The square-wave inverter shown in figure Q 4B has V_{dc} = 125 V, an output frequency of 60 Hz, and an inductive load with R = 12.5Ω and L = 30mH. Determine the expression for output voltage and sketch the currents in the load, and the source.

4C. Draw the circuit diagram of a current fed converter and derive the expression for its output voltage.

(5+3+2)

5A. Draw the circuit diagram of a forward converter. Derive the expression for its output voltage along with the equivalent circuit diagram and waveforms across output inductance (L_x), Magnetizing inductance (L_m) and transformer primary current (i_1).

5B. Explain the switching scheme and generation of bipolar PWM wave. What are its applications?

5C. List various power conditioners used to prevent power line disturbances.

(5+3+2)

6A. Draw the block diagram of a UPS. Explain the components and functions of each block in detail.

6B. Draw a full bridge inverter circuit using IGBTs. Explain its working. Draw the output waveforms for resistive and inductive loads.

6C. Explain the following terms with respect to half bridge inverter

(i) Feedback diodes

(ii) Blanking time

(5+3+2)

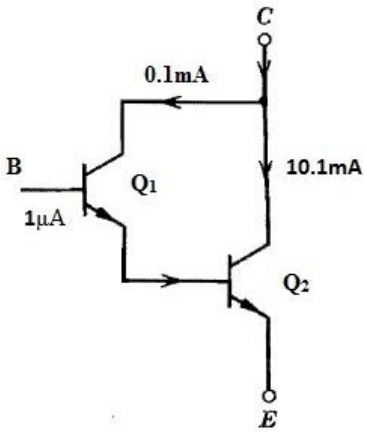

Figure Q 1C

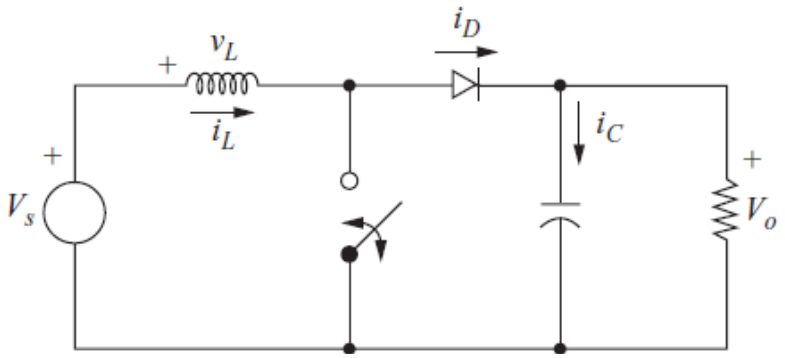

Figure Q 2A

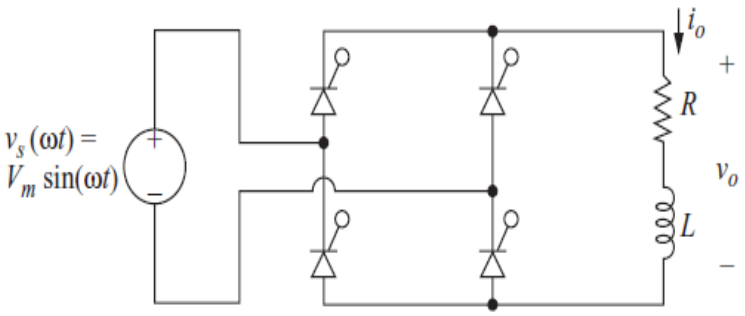

Figure Q 3A

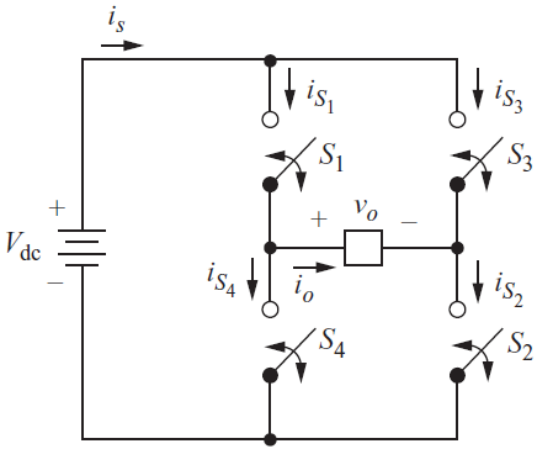

Figure Q 4B