Power Electronics EEE / INSTR UC 461
Comprehensive Examination (Closed Book)

31 – 05 – 05   **Time : 3 hrs.**   Max. Marks : 60   Weightage : 40 %

(Answer any six questions only. Each question carry 10 marks)

1. a. Explain what is forced commutation of thyristors?

   b. What does MOSFET and IGBT stands for? Compare between the performance characteristics of MOSFET and IGBT?

2. a. What is a Buck converter? Derive an expression for the peak-to-peak ripple current in a buck converter.

   b. A Buck converter supplied from a dc source operates with the switching frequency of 10 kHz. The maximum load resistance is 6 ohms, and the output capacitor has the capacitance of 20 uf. Determine
   i) The minimum inductance of the output inductor required for continuous conduction.
   ii) The required duty ratio of the switch to produce the output voltage of 9 V.
   iii) The peak-to-peak amplitude of the ripple of the output voltage.

3. a. Explain the operation of an Isolated Buck-Boost (Flyback) converter in the CCM mode.

   b. A Switching power supply based on a half bridge converter is fed from a 120V ac line via a two-pulse rectifier with a capacitive output filter, such that the average input voltage to the dc-to-dc converter is 165 V. The output voltage of the converter is 24 V and the turn ratio $N2/N1$ of the isolation transformer is 1: 3 Values of the inductance and capacitance of the output filter are 1mH and 25 uF respectively and the converter operates with the switching frequency of 20kHz. Find the required duty ratio of the converter switches and the peak-to-peak amplitude of the ripple at the output voltage.

4. Show that the state trajectory of a resonant tank circuit loaded with a current sink and supplied with voltage source excitation is a circle. Also prove that the co-ordinates of the center of the circle corresponds to the normalized voltage source (unity) and the normalized current sink I_{no} in the v_{nc} - i_{nl} state plane
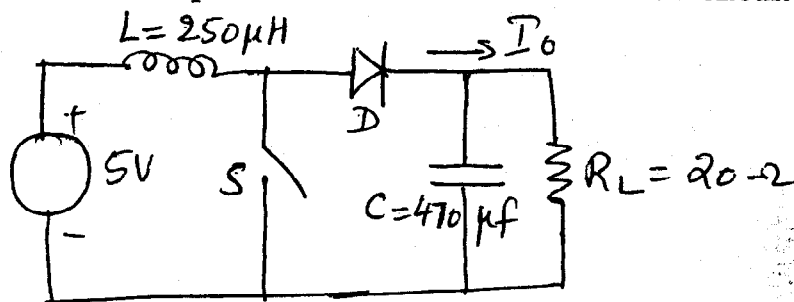
5. a. Explain the different modes of operation of a DC motor drive with the line diagrams.

   b. With the help of a neat block diagram, describe a dc servo speed control system with internal current loop and explain each block.

6. A single phase full wave ac voltage controller shown in figure has a resistive load of R = 10 ohms and input voltage is $V_s = 120$ V (rms), 60 Hz. The delay angles of thyristors T_1 and T_2 are equal $\alpha 1 = \alpha 2 = \Pi / 2$.
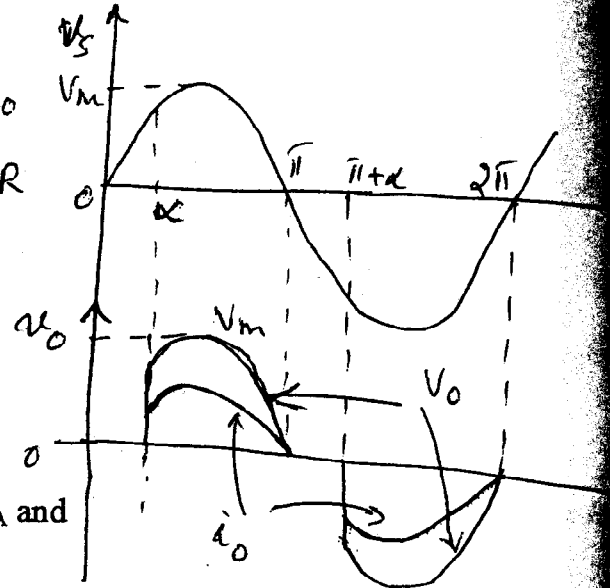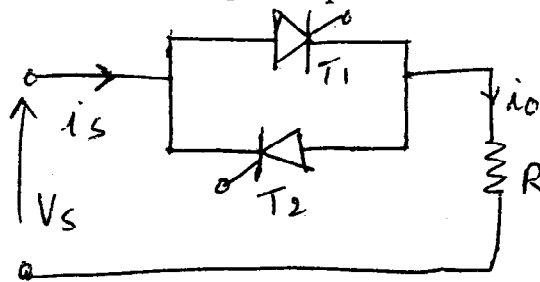
   Determine
   a. the rms output voltage V_o
   b. the input power factor
   c. the average current of thyristors I_A and
   d. the rms current of thyrisors I_R

7. Answer any two of the following.
   a. Explain the basic principle of operation of Sine-PWM inverter using unipolar switching.
   b. Uninterruptible Power Supply Systems.
   c. Write a Pspice program to analyse the inductor current i_L and the voltage ΔV_o at the output of the dc-dc switched converter circuit given below.

$$D = 0.4, \quad f_s = 20 \, kHz.$$

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| Course No.:	EEE / INSTR UC 461		Course:	**Power Electronics**
15 – 05 - 05	Time: 50 Minutes	M.M. = 30		Weightage = 15 %

1. The load current of a three phase full converter in the figure is continuous with a negligible ripple content.

   a) Express the input current shown in figure in Fourier series and determine the harmonic factor HF of input current, Displacement factor DF, and the input power factor PF.

   b) If the delay angle (firing angle) $\alpha = 60°$, Calculate Vo_n, HF, DF, and PF.   (10+6)
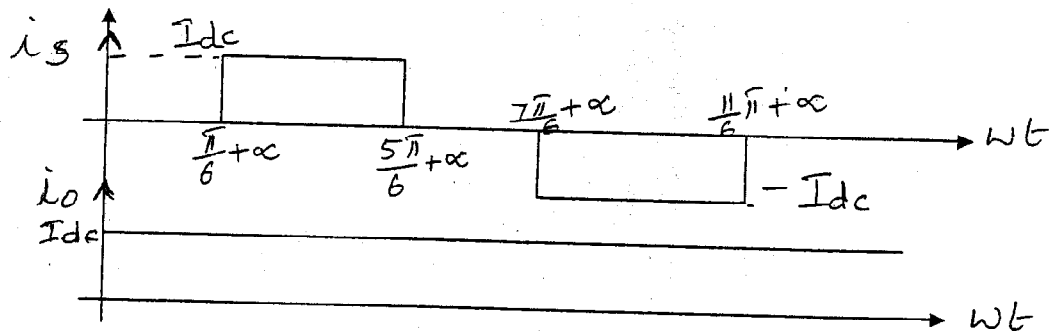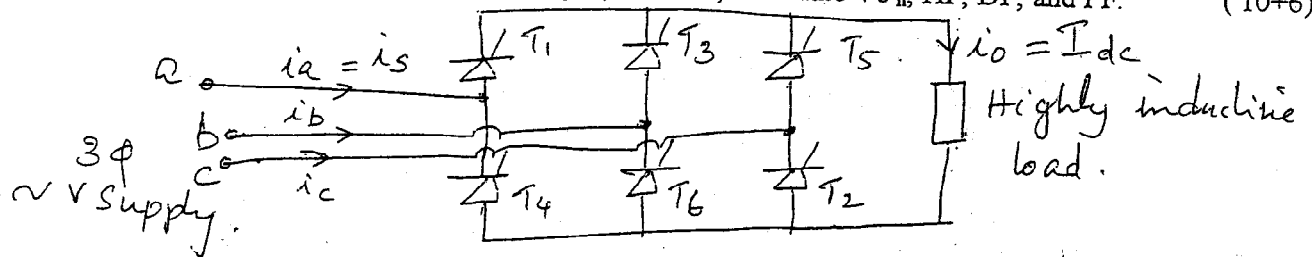
2. Draw the out put voltage waveform of a three phase full wave converter with $\alpha = 45°$ and the input line-line voltage is *157 sin ωt*. Calculate the output voltage.   (4 + 3)

3. a)   Explain why a series resonant converter is not suitable to be used in multi output configuration

   b)   A parallel loaded resonant converter supplied from a 100 V dc operates with the switching frequency of 5kHz. The resonant circuit of the converter is composed of a 0.1 mH inductor and a 4 µF capacitor and the load resistance is 10 ohm. Determine the operating mode of the converter   (3 + 4))

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Year III – Semester II   2004– 2005
Test I (Closed Book)

Course No.:   EEE / INSTR UC 461   Course: Power Electronics

03 – 04 – 05   Time: 50 Minutes   M.M. = 30   Weightage = 15 %

1. A Buck-Boost Regulator has an input voltage of V_s = 12 V. The duty cycle is 0.25 and the switching frequency is 25 kHz. The inductance is 150 uH and filter capacitance C =220 uF. The average load current Io is 1.25 A. Determine

   a. The average out put voltage   b. the peak – peak output voltage ripple, ΔVc

   c. the peak – peak ripple current of inductor, ΔI_L

   d. the peak current of the transistor I_{swmax}

   (2.5 x 4)

2. What is a forward converter?

   a)   Draw a neat circuit diagram of a forward converter with demagnetizing winding and explain its operation in the continuous conduction mode

   b)   Draw the corresponding waveforms   (5+5)

3. Explain the Pulse Width Modulation (PWM) control of a single phase full bridge Voltage Source Inverter. Draw the input and out put voltage and current wave forms of the inverter and hence derive the T_w and T_{ii} (4 + 4 + 2)

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