THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY - LEVEL 5
FINAL EXAMINATION – 2011/2012
MEX5270 – POWER ELECTRONICS AND MOTOR DRIVES

DATE : **10th March 2012**
TIME : **1400HRS – 1700 HRS**
DURATION : **THREE HOURS (3)**

READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE ANSWERING THE QUESTION PAPER.

The question paper has **eight** questions.

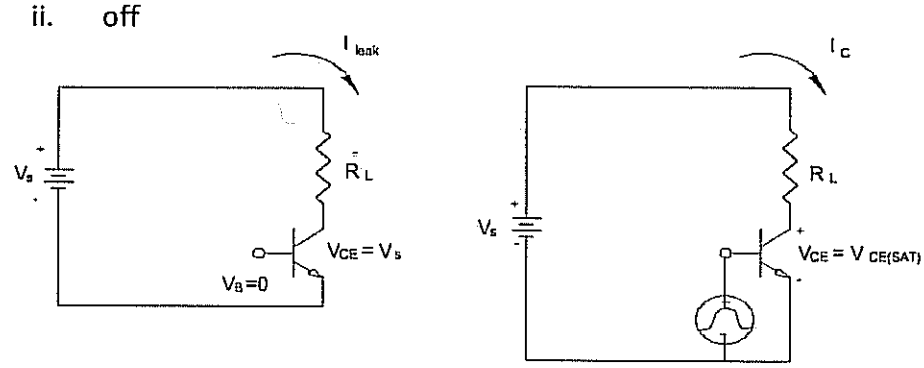
Answer **five** questions only.

Q1.

a) Briefly explain 'Conduction loss' and 'Switching loss' of real power semiconductor switches using appropriate diagrams.

b) The power transistor shown in Figure Q1 has V_s = 100V, R_L= 10Ω, and the switch is considered to be ideal with no switching loss. If the on-state voltage drop is 2.5V and the leakage current is 1.5 mA,
Calculate the power loss in the switch when it is

i. on
ii. off



(a)Transistor on (b) Transistor off

Figure Q1

c) Determine the following if the switching frequency is 500 Hz with a duty cycle (on-period/total-period) of 50%.

i. maximum power loss for the switch
ii. average power loss for the switch

Q2.

a) A fully controlled single phase (AC-DC) converter supplies power to a resistive load of 10 Ω. Input voltage is 230V, 50Hz. Calculate the following
   i. Output Power
   ii. Input power factor at $\alpha = 45^0$ (α is the firing angle)

b) Sketch uncontrolled single phase full bridge convertor that delivers
   i. Single rail output
   ii. Dual rail output
   iii. Single rail output with dual inputs

Q3.

a) A full bridge inverter produces a 200V square wave at 50Hz. Find the expression of load current and its peak value. R= 10 Ω and L = 50mH.
b) Briefly discuss about applications of AC voltage controllers.

Q4. An uncontrolled half wave rectifier circuit has a source voltage of 120V and a resistive load of 10 Ω.

a) Draw the circuit diagram for an uncontrolled half wave rectifier
b) Find the following
   i. the average load current
   ii. the RMS load current
   iii. the power absorbed by the load
   iv. the power factor
   v. the PIV rating of the diode

Q5. The single phase ac voltage controller of Figure Q5 has a 480 V_{rms} 60Hz source and a load resistance of 50 Ω. The delay angle α is 80°. Determine

i. the rms source current
ii. the rms and average currents in the SCRs
iii. power factor
iv. and THD of the source current

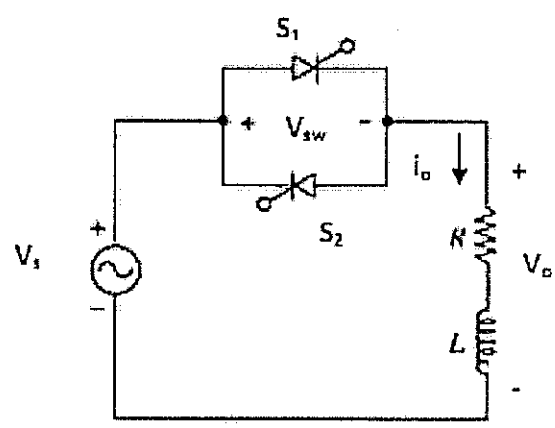


Figure Q5

Q6. A buck converter has an input voltage ,V_d=15V. The required average output voltage V_o = 5V and the peak to peak output ripple voltage is 10mV. The switching frequency is 20KHz. The peak to peak ripple current of the inductor is limited to 1A. Determine

i. the duty cycle D
ii. the filter inductor L
iii. the filter capacitor
iv. and boundary current I_{LB}

Q7. A boost converter has an input voltage V_d=6V. The average output voltage V_o = 15V and the average load current is I_0=1A. The switching frequency is 10KHz. If L=250μH and C= 440μF. Determine

i. the operation mode
ii. the duty Cycle D
iii. the ripple current of the inductor ΔL
iv. and the ripple voltage of the capacitor ΔV_c

Q8.

a) A 230V separately exited dc motor takes 50A at a speed of 800 rpm. It has armature resistance of 0.4Ω. The motor is controlled by a chopper with an input voltage of 230V and frequency of 500Hz. Assuming continuous conduction throughout, calculate the speed of regenerative braking operation at

i. Duty ratios of 0.6
ii. Duty ratios of 0.3

b) Briefly explain 4 characteristics of Brushless DC motors.

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