BITS, Pilani – Dubai
International Academic City – Dubai
III year EEE/ EIE, IInd Semester 2009-10
Course Title - Power Electronics (EEE C461/INSTR C 461)
Comprehensive Exam Date—24/05/2010
Full Marks – 120 (Weight age 40 %) Duration—3 hours
Note: Part A and Part B in separate answer books

PART -A

1. Write Short notes on the following (with block diagram/circuit diagram /necessary equations/plots):
   a) H.V.D.C
   b) Protection of Semiconductor devices against surge voltage
   c) Schottky Barrier Diode [15M]

2. A single phase full bridge inverter feeds power at 50Hz to RLC load with R= 5 ohm, L=0.3 H and C=50μF. The DC input voltage is 220V.
   a) Find an expression for load current up to fifth harmonic.
   b) Calculate the power absorbed by the load and the fundamental power. [15M]

3. Starting from the fundamentals develop the state plane trajectory of a resonant tank shown in Figure 1, loaded with a current sink in voltage excitation. Detailed analysis using Laplace Transform should be presented. [15M]

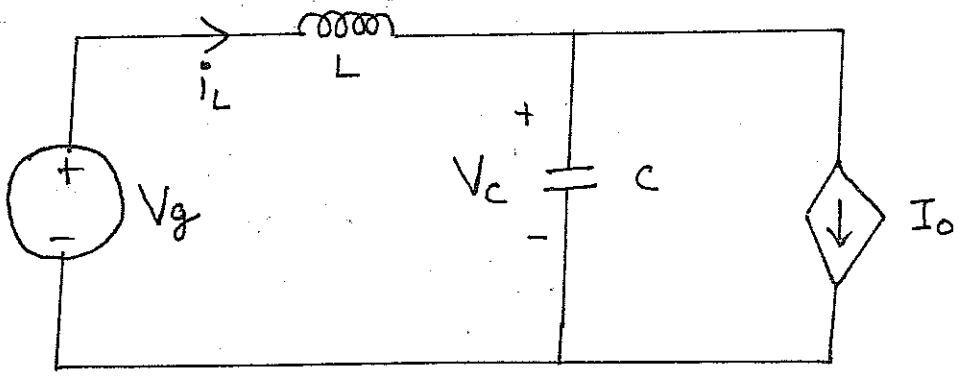


Figure 1

4. The buck -boost regulator has an input voltage of Vs=12V. The duty cycle D=0.25 and switching frequency is 25kHz. The inductance L=150μH and filter capacitance is C=220μF. The average load current is 1.25 A. Determine
   a) The average output voltage
   b) The peak current in the inductor in the boundary case.
   c) The boundary value of the output current for continuous mode of operation
   d) The peak voltage on the switch [15M]

DTA

PART B

5. In context to the figure 2, related to power diode, following are the data: t_1=2 micro seconds, t_2=5 micro seconds, t_3= 7 micro seconds, Qrr = 85% of Q_F. (total area of the curve). Find t_{rr} (reverse recovery time) if Irr =150 ampere. [15M]

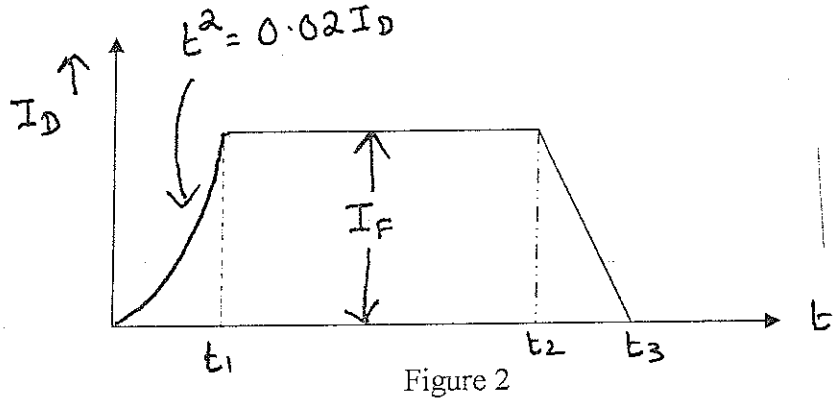


Figure 2

6. a) Show analytically that "v/f" control method of three phase induction motor needs a Voltage Boost at low speeds. Equivalent circuit and equations to be presented in connection with presentation of Voltage Boost method. [8M]

   b) Explain a variable –frequency PWM-VSI drive scheme for three phase Induction Motor, with block diagram and circuit diagrams. [7M]

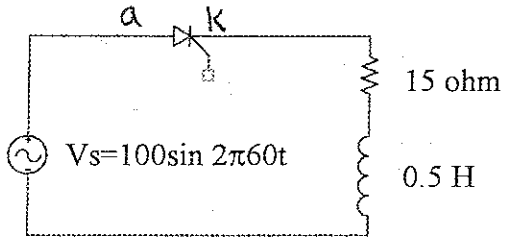
7. Derive the expression for $i_L(t)$ and $V_c(t)$ in connection with ~~impulse~~ Resonance Commutation of Thyristor. (Circuit Diagram to be shown) [15M]

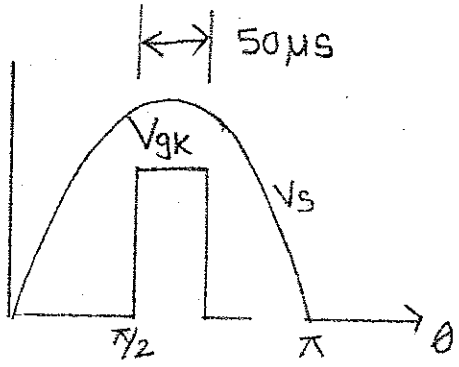
8. Derive the expression for $V_{gs}(t)$ and Turn –off Delay "t_1" to reach V_{gp} in mode 1 of "Turn – off" transients of MOSFET. Also draw the equivalent circuits of all modes during Turn – off Transients of MOSFET with relevant waveform "V_{gs} vs, t" and "V_{ds} vs. t". [15M]

BITS, Pilani – Dubai
International Academic City – Dubai
III year EEE/ EIE, IInd Semester 2009-10
Course Title - Power Electronics (EEE C461/INSTR C461)
TEST -1I Date—25/04/2010
Full Marks – 20 (Weightage 20 %) Duration— 50 min.

---

1 (a). The Thyristor in the circuit below has a holding current of 25 mA. A 40 micro second wide gate trigger pulse is applied at the delay angle of $\pi/2$. Will the Thyristor turn on? Explain your answer.

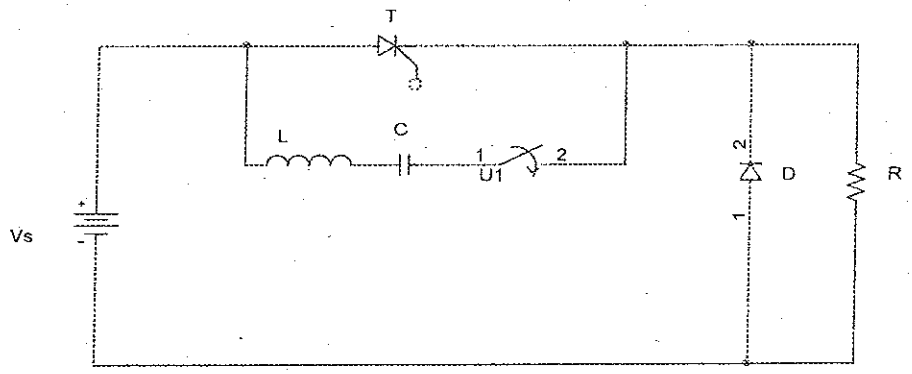




b) In connection with part –a question, if the Thyristor does not turn on, it is suggested to add a resistor in parallel with R-L load. Determine the value of additional resistance that would just enable the Thyristor to turn on. (3M +4M)

2. A boost converter operating in **CCM** has the following parameters.
Vs=10 volts, L= 275μH, Load Resistance R_L = 20 ohm ,C= 500 μF, Switching Frequency=15KHz, Duty Cycle=0.6. Calculate a) Average output voltage, b) Peak to peak ripple in the output c)value of I_{OB}. (2M+ 4M+3 M).

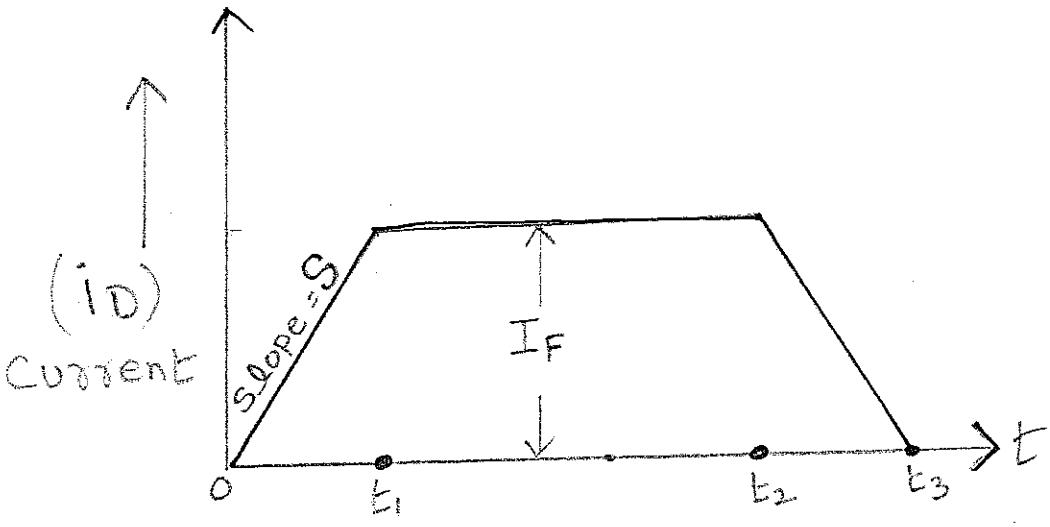
3. Consider the circuit diagram shown below in connection with Resonant Commutation of Thyristor. Given that, the initial voltage across the capacitor is V(0)=V_s Volts and initial current through inductor is $I_L(0)= I_1$ ampere. Calculate the value of turn off time of the Thyristor if L= 39 μ Henry. Given data are I_0 = 50 amps, C= 2μF, Vs=220 Volts, and I_1=0. [4 M]



BITS, Pilani – Dubai
International Academic City – Dubai
III year EEE/ EIE, IInd Semester 2009-10
Course Title - Power Electronics (EEE C461/INSTR C461)
TEST -1 Date—14/03/2010
Full Marks – 25 (Weight age 25 %) Duration— 50 min.

---

1. In context to the figure 1 , related to power diode, following are the data:
   S= 100 A/micro sec, t_1=2 micro seconds, t_2=5 micro seconds, t_3= 7 micro seconds, Qrr=90% of Q_F. Find t_{rr} (reverse recovery time) if Irr=150 ampere.[5M]



2. Explain the Operation of Schottky barrier Diode with necessary diagrams and equations. [6 M]

3. Explain conductivity modulation of power diode with necessary diagrams [6M]

4. A voltage pulse of V_{DD} volts and pulse width = "T" seconds is injected to the gate of MOSFET, in context to the Turn on phenomenon. Derive, starting from fundamentals, the expression for gate to source voltage (Vgs(t)) as function of time using the method of Laplace Transform. Use the equivalent circuit of Mode - 1 of "Turn On phenomenon" for the above said analysis with following assumptions(changes) to be incorporated:

   Gate to drain capacitance is realistic and it is parallel combination of ideal capacitor (C_{gd}) and a resistor (R_{gd}) and
   Gate to source capacitance is realistic and it is parallel combination of ideal capacitor (C_{gs}) and a Resistor (R_{gs}) [8M]

A

BITS, Pilani – Dubai
International Academic City – Dubai
III year EEE/ EIE, IInd Semester 2008-09
Course Title - Power Electronics (EEE C461/INSTR C 461)
QUIZ 2 Date—11/5/2010
Full Marks – 21(Weight age 7%) Duration—15min
Overwriting of answers by any form in the answer table will not be evaluated

---

Name: ID:

Transfer the best answers to the following table

1.	2.	3.	4.	5.	6.
7.	8.	9.	10.		

1. The average output voltage in Buck converter (CCM)is
   a) 2D(Vs/2) b) D^2Vs c) (D/2)Vs d) D^2 (Vs/2)
2. The voltage appearing across the inductor in Buck Converter during off state of the switch is given by (CCM)
   a) –Vo b) Vs-Vo, c) Vo d) Vo-Vs.
3. In case of Buck converter, the peak voltage on the switch is (CCM)
   a) Vs b) 2Vs c) Vo + Vs d) Vo-Vs
4. In context to a DC-DC buck converter, I_{OB} becomes maximum for
   a) D=0.4 b) D=0.5 c)D=1 d) D=0.8
5. Full Bridge Dc-Dc Converter with bipolar switching has number of modes of operation is equal to a) 4 b) 1 c) 5 d) 3
6. In connection with a **Resonant Tank loaded with a current sink in voltage source excitation**, the centre of locus will have the coordinates
   a) (0, Vnco) b) (1, Vnco) c) (1, Ino) d) (Ino, Vnco).
7. In context to the circuit stated in question **number 6**, the no of state variables are
   a) 2. b) 1 c) 5 d) 6
8. In connection with VSI Full bridge inverter with square wave switching, the nth harmonic component of the output voltage will have an amplitude
   a) $\frac{2Vs}{n\pi}$ b) $\frac{Vs}{n\pi}$ c) $\frac{8Vs}{n\pi}$ d) $\frac{4Vs}{n\pi}$
9. In connection with a single phase square wave switching inverter with A.C Voltage sink load the inductor "L" is connected as
   a) Parallel connection with A.C Voltage sink load
   b) Series connection with A.C Voltage sink load
   c) In connection with Transistor Q1
   d) In connection with Transistor Q2
10. In context to DC to Controlled AC, the voltage transfer ratio is defined as
    a) the ratio of the rms voltage of the fundamental component to the DC input voltage
    b) the ratio of the average voltage of the fundamental component to the DC input voltage
    c) the ratio of the rms voltage of the fundamental component to the Ac output voltage
    d) the ratio of the Average voltage of the fundamental component to the AC output voltage

A

BITS, Pilani – Dubai
International Academic City – Dubai
III year EEE/ EIE, IInd Semester 2008-09
Course Title - Power Electronics (EEE C461/INSTR C 461)
QUIZ=1 Date—2503/2010
Full Marks – 24(Weight age 8%) Duration—20min
Overwriting of answers by any form in the answer table will not be evaluated

---

Name: ID:

Transfer the best answers to the following table

1.	2.	3.	4.	5.	6.
7.	8.	9.	10.	11.	12.

1. MOSFET is termed as
   a) Bipolar Device
   b) Majority carrier transport device
   c) Minority carrier transport device

2. Transconductance (g_m)of MOSFET

   a) Directly proportional to L
   b) Directly proportional to L^2
   c) Inversely proportional to L
   d) Inversely proportional to L^2

3. In connection with MOSFET turn On mode 1
   a) $v_{gs}(t) = V_{DD}(1-e^{-t/\tau_1})$
   b) $v_{gs}(t) = V_{DD}(1+e^{-t/\tau_1})$
   c) $v_{gs}(t) = 2V_{DD}(1-e^{-t/\tau_1})$
   d) $v_{gs}(t) = 2V_{DD}(1+e^{-t/\tau_1})$

4. "High Level Injection" ---- this term is associated with
   a) BJT **b)** Power Diode **c)** Thyristor **d)** MOSFET

5. In connection with Power Diode under reverse biased condition ,
   a) $Ir = Ir_{P+} - Iri + Ir_{N+}$
   b) $Ir = Ir_{P+} - Iri - Ir_{N+]}$
   c) $Ir = Ir_{P+} + Iri + Ir_{N+}$
   d) $Ir = Ir_{P+} + Iri - Ir_{N+}$

6. In schottky barrier diode, the current transport is due to
   a) Majority Carriers **b)** Minority carriers **c)** bipolar

7. The expression for reverse recovery time in power diode is
   a) $trr = \frac{2Q_f}{I_{rr}}$ **b)** $trr = \frac{2\pi Q_f}{I_{rr}}$ **c)** $trr = \frac{2\pi I_f}{I_{rr}}$ **d)** "a" and "c" **e)** "b"and "c"

8 . The reverse recovery time in power diode is

a) toff1 + toff2 **b)** toff1 +toff2+toff3 **c)** toff2 + toff3

9. The resistance of the "i" Layer is _____ under forward bias condition and _____ in Reverse bias condition

a) Very large and very large respectively
b) Very large and very small respectively
c) Very small and very large respectively
d) Very small and very small respectively

10. The maximum operating frequency of the MOSFET is given by the expression

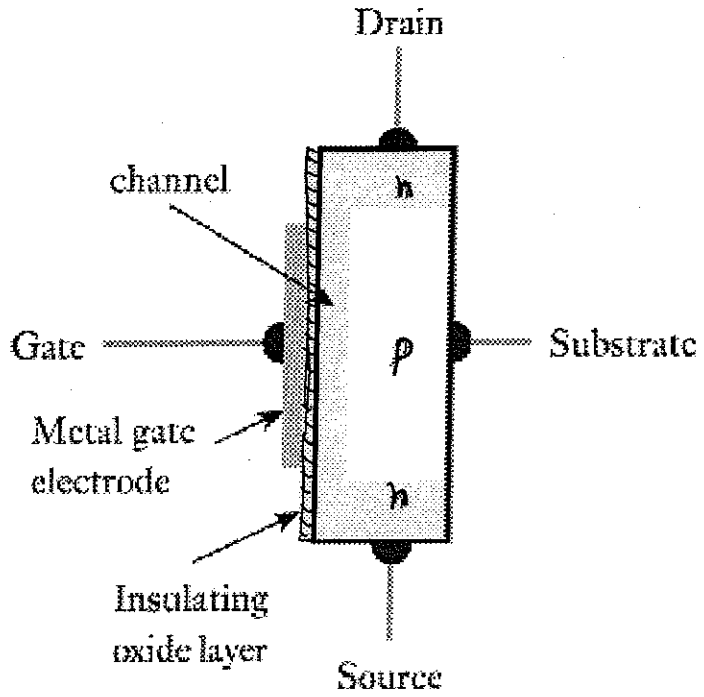
a) $f_{max} = \frac{g_m}{2\pi C_{output}}$ **b)** $f_{max} = \frac{g_m}{4\pi C_{output}}$

c) $f_{max} = \frac{g_m}{2\pi C_{input}}$ **d)** $f_{max} = \frac{g_m}{4\pi C_{input}}$

11. Typical values of threshold value (MOSFET) lies in the range between

a) 5 and 6 volts **b)** 7 and 9 volts **c)** 2 and 3 volts
d) none of the above

12. What form of FET is shown here?



a) A *p*-channel MOSFET **b)** A *p*-channel JFET
c) An *n*-channel MOSFET **d)** An *n*-channel JFET

B

BITS, Pilani – Dubai
International Academic City – Dubai
III year EEE/ EIE, IInd Semester 2008-09
Course Title - Power Electronics (EEE C461/INSTR C 461)
QUIZ=1 Date—2503/2010
Full Marks – 24(Weight age 8%) Duration—20min
Overwriting of answers by any form in the answer table will not be evaluated

---

Name: ID:

Transfer the best answers to the following table

1.	2.	3.	4.	5.	6.
7.	8.	9.	10.	11.	12.

1. MOSFET is termed as
   a) Majority carrier transport device
   b) Bipolar Device
   c) Minority carrier transport device

2. Transconductance (g_m) of MOSFET

   a) Directly proportional to L
   b) Directly proportional to L^2
   c) Inversely proportional to L
   d) Inversely proportional to L^2

3. In connection with MOSFET turn On mode 1
   a) $v_{gs}(t) = V_{DD}(1+e^{-t/\tau}{}_1)$
   b) $v_{gs}(t) = 2V_{DD}(1-e^{-t/\tau}{}_1)$
   c) $v_{gs}(t) = 2V_{DD}(1+e^{-t/\tau}{}_1)$
   d) $v_{gs}(t) = V_{DD}(1-e^{-t/\tau}{}_1)$

4. "High Level Injection" ---- this term is associated with
   a) BJT b) Thyristor **c)** Power Diode **d)** MOSFET

5. In connection with Power Diode under reverse biased condition ,
   a) $Ir = Ir_{P+} + Iri + Ir_{N+}$
   b) $Ir = Ir_{P+} - Iri + Ir_{N+}$
   c) $Ir = Ir_{P+} - Iri - Ir_{N+]}$
   d) $Ir = Ir_{P+} + Iri - Ir_{N+}$

6. In schottky barrier diode, the current transport is due to
   a) Minority carriers **b)** bipolar **c)** Majority Carriers

7. The expression for reverse recovery time in power diode is
   a) $trr = \frac{2Q_f}{I_{rr}}$ **b)** $trr = \frac{2\tau Q_f}{I_{rr}}$ **c)** $trr = \frac{2\tau I_f}{I_{rr}}$ **d)** "a" and "c" **e)** "b"and "c"

8 . The reverse recovery time in power diode is

a) toff1 + toff2 **b)** toff1 +toff2+toff3 **c)** toff2 + toff3

9. The resistance of the "i" Layer is _____ under forward bias condition and _____ in Reverse bias condition

a) Very small and very large respectively
b) Very large and very large respectively
c) Very large and very small respectively
d) Very small and very small respectively

10. The maximum operating frequency of the MOSFET is given by the expression

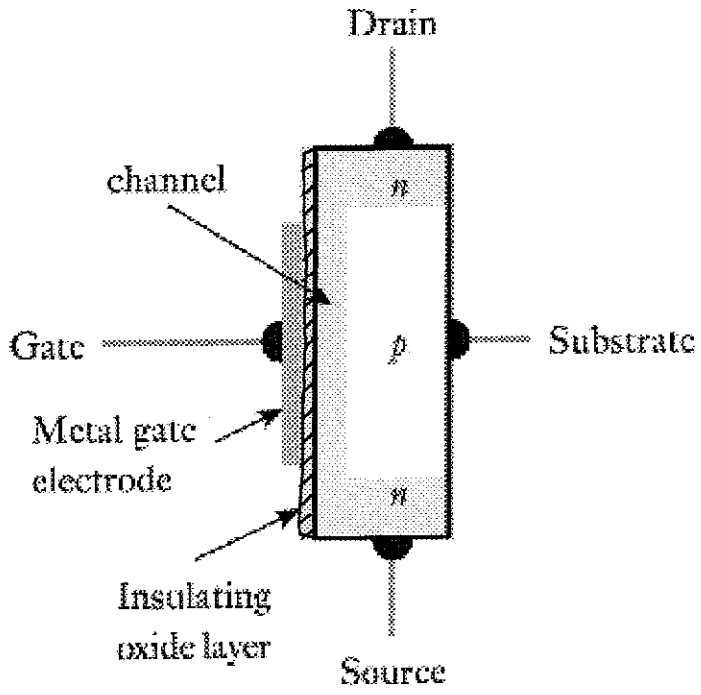
a) $f_{max} = \frac{g_m}{2\pi C_{output}}$ **b)** $f_{max} = \frac{g_m}{4\pi C_{output}}$

c) $f_{max} = \frac{g_m}{2\pi C_{input}}$ **d)** $f_{max} = \frac{g_m}{4\pi C_{input}}$

11. Typical values of threshold value (MOSFET) lies in the range between

a) 5 and 6 volts **b)** 7 and 9 volts **c)** 2 and 3 volts
d) none of the above

12. What form of FET is shown here?



a) A *p*-channel MOSFET **b)** A *p*-channel JFET
c) An *n*-channel MOSFET **d)** An *n*-channel JFET