BITS, PILANI – DUBAI, ACADEMIC CITY, DUBAI
FIRST SEMESTER 2009 – 2010
ES C241 ELECTRICAL SCIENCES – I
COMPREHENSIVE EXAMINATION (CLOSED BOOK)

MAXIMUM MARKS: 120 WEIGHTAGE: 40%
DATE: 22/10/09 DURATION: 3 HOURS

Write PART A & B & C in separate answer sheets
Answer all questions

PART A

1. Consider the series parallel circuit shown in Figure 1 **[12 Marks]**
   a) Find V_s when v_1=2V
   b) Find V_s when i_3=3A
   c) Find V_s when i_5=4A
   d) Find the Power dissipated in 5Ω resistance when v_1=4V

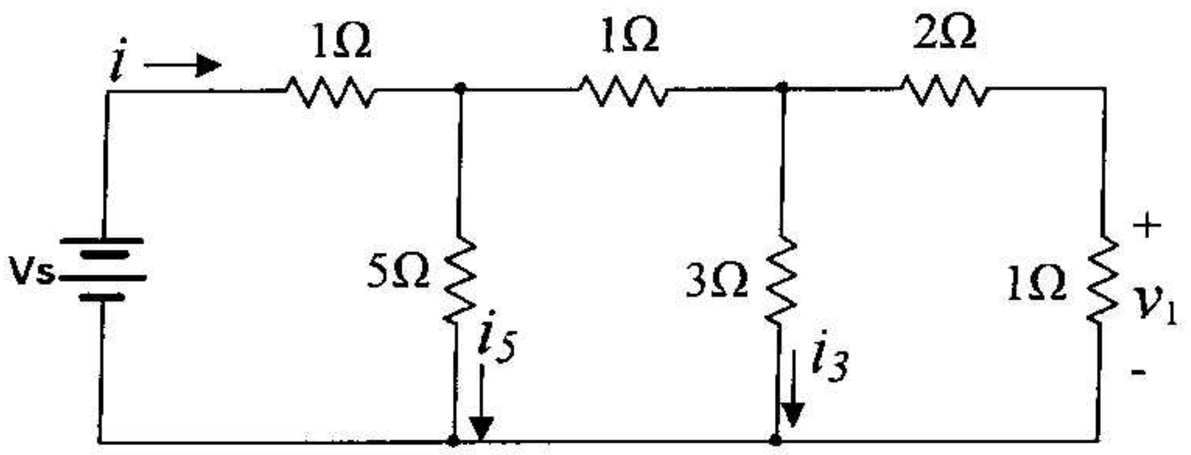

Figure 1

2. Find the node voltages for the circuit shown in Figure 2. **[12 marks]**

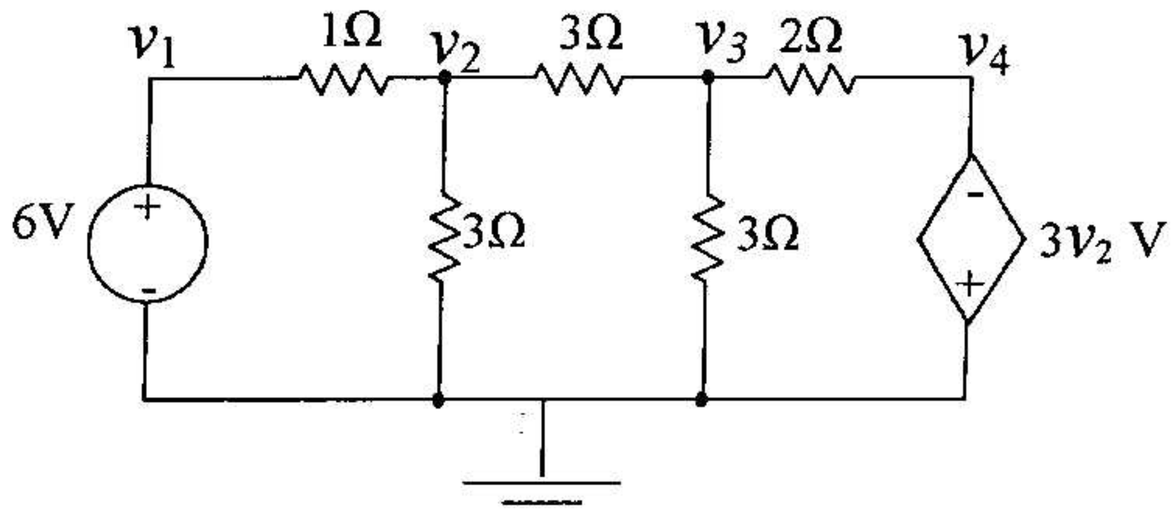

Figure 2

3. For the circuit shown in Figure 3 a) Find the Thevenin equivalent of the resulting circuit to the left of terminals a and b. b) Use the Thevenins equivalent circuit to find the power absorbed by R_L = 2Ω. c) Determine the value of R_L which absorbs the maximum amount of power and find this power. **[12 Marks]**

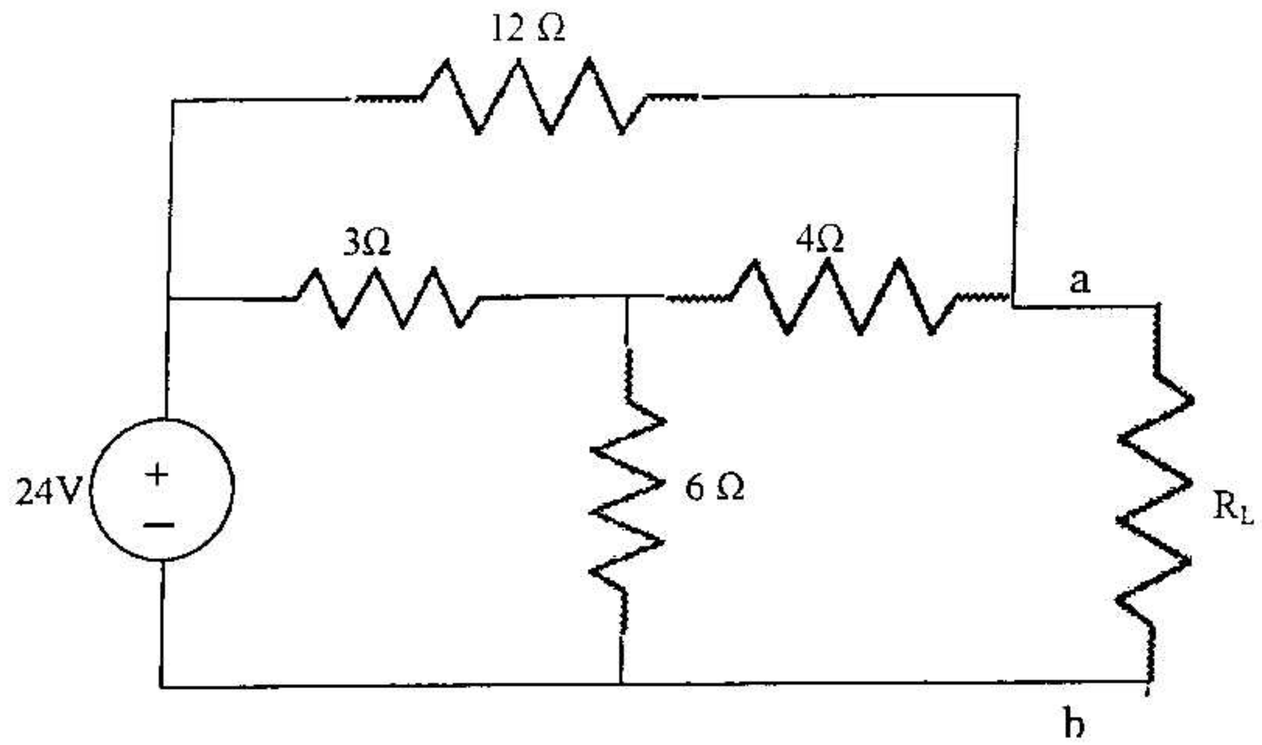

Figure 3

4. Draw the circuit diagram of OPAMP differential amplifier and obtain the expression for the output voltage V_o **[12 Marks]**

PART B

5. For the circuit shown in Figure 4 find V_c and V_R at time t<0, t>0, t= 1.5 m sec. **[15 marks]**

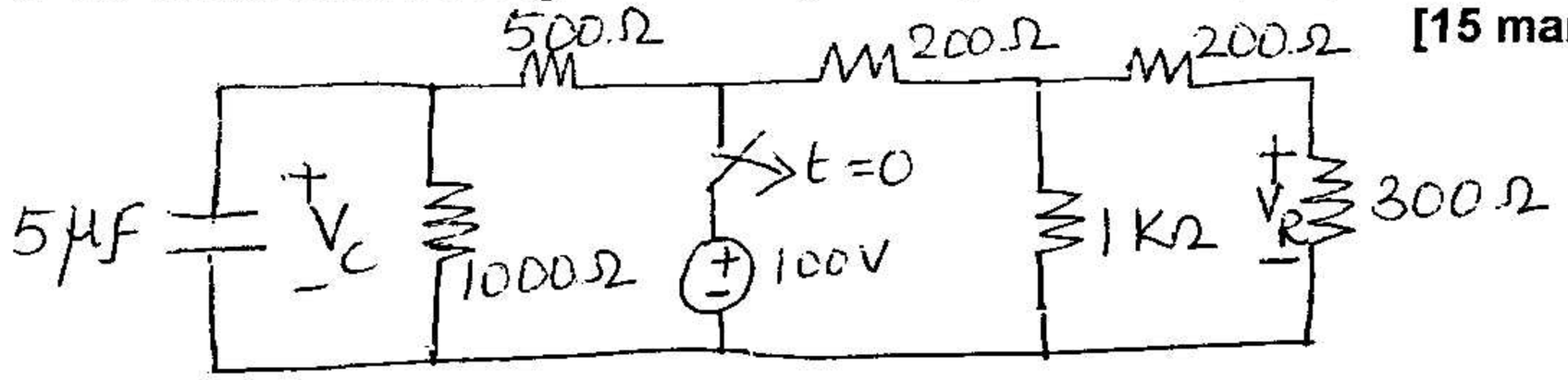

Figure 4

6. For the circuit shown in Figure 5 find the complete response for the current flow through the inductor, i_L (0-)and i_L(0+) and i_L(t) for all values of t. **[9 marks]**

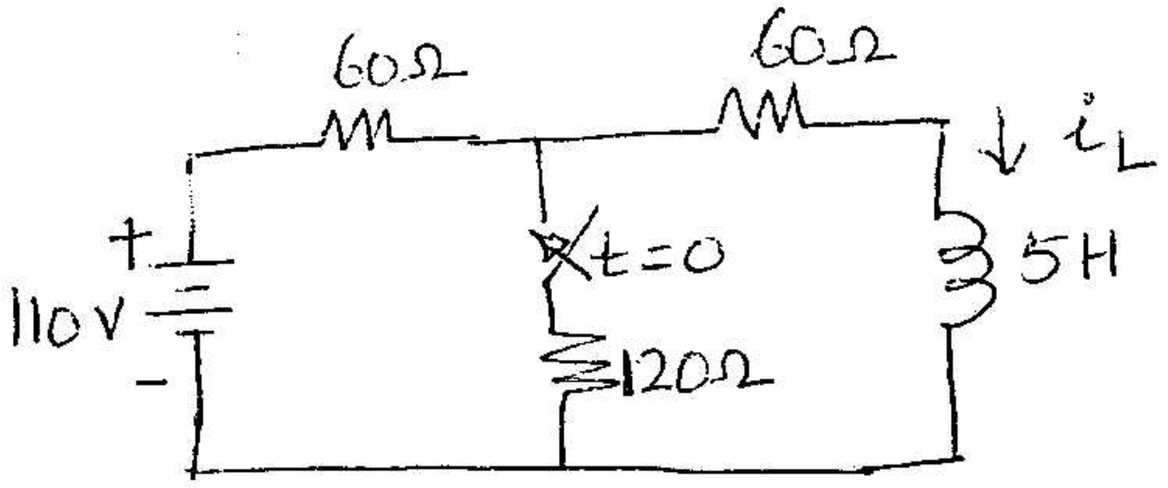

Figure 5

7. For the ideal diode circuit given in Figure 6, determine the output voltage V_o and Sketch this function. **[12 Marks]**

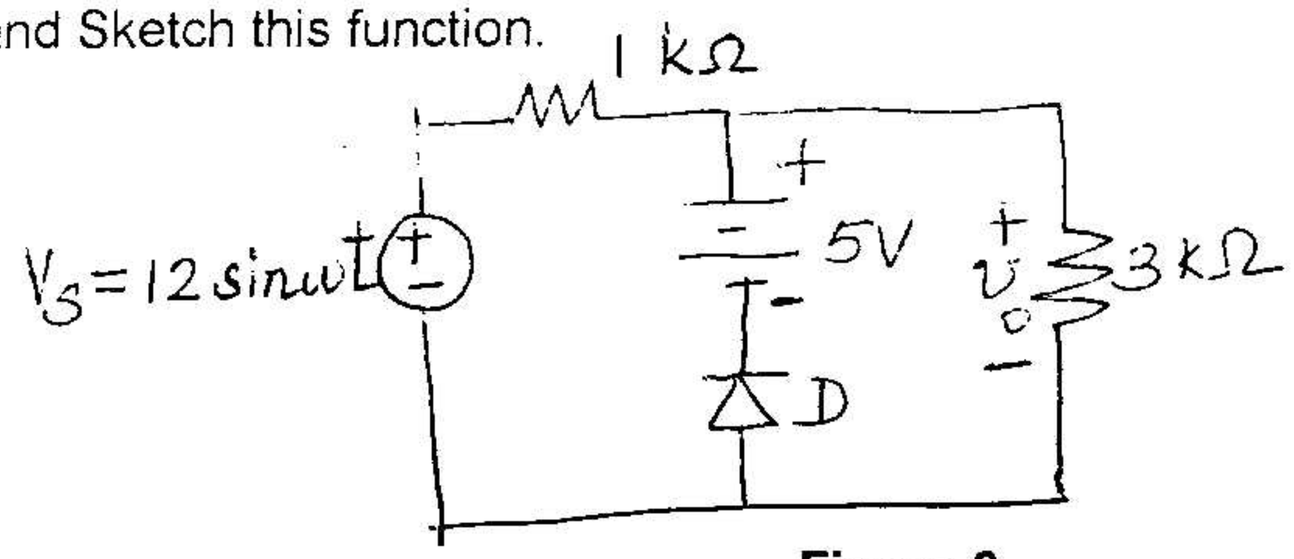

Figure 6

8. The Zener diode in the voltage regulator circuit shown in Figure 7 has a breakdown voltage of 9V and is to operate with a reverse current between10mA and 100mA. Given that R=200Ω, Find

(a) Range of load resistance (R_L) that results in a 9V load voltage when V_s=24V.
(b) Range of Supply voltage (V_s) that results in a 9 V load voltage when R_L=600 Ω.

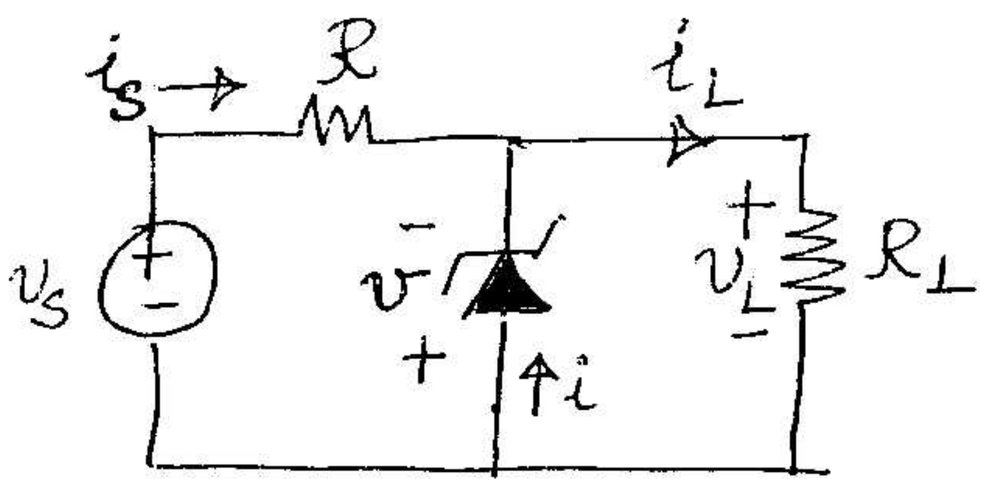

Figure 7

PART C

9. For the circuit given in Figure 8, suppose that R_C=3 kΩ, R_B=50 kΩ, V_{BB} = V_{CC}= 5V and β=100. Assume that the BJT operates in the active region and find i_B, i_C and v_{CE}. Comment about the assumption made. **[8 marks]**

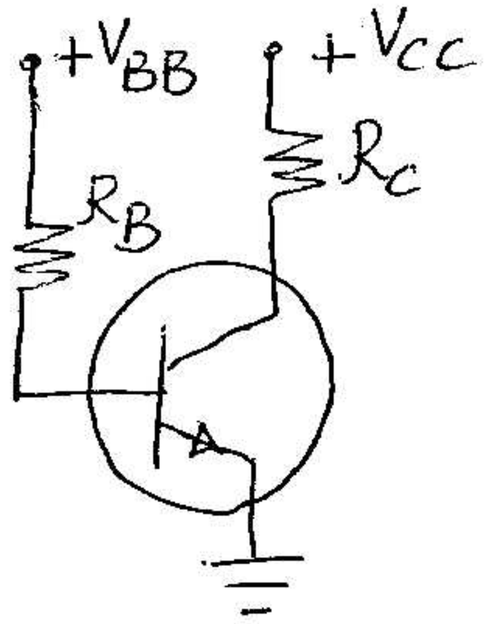

Figure 8

10. For the circuit shown in Figure 9, the enhancement MOSFET has K=0.25 mA/V^2 and V_t=2 V. Given that R_S=0 Ω and V_{DD} = 12 V, determine the value of R_D for which the MOSFET will operate on the border between the active and ohmic regions when V_{GG}=4 V. **[8 marks]**

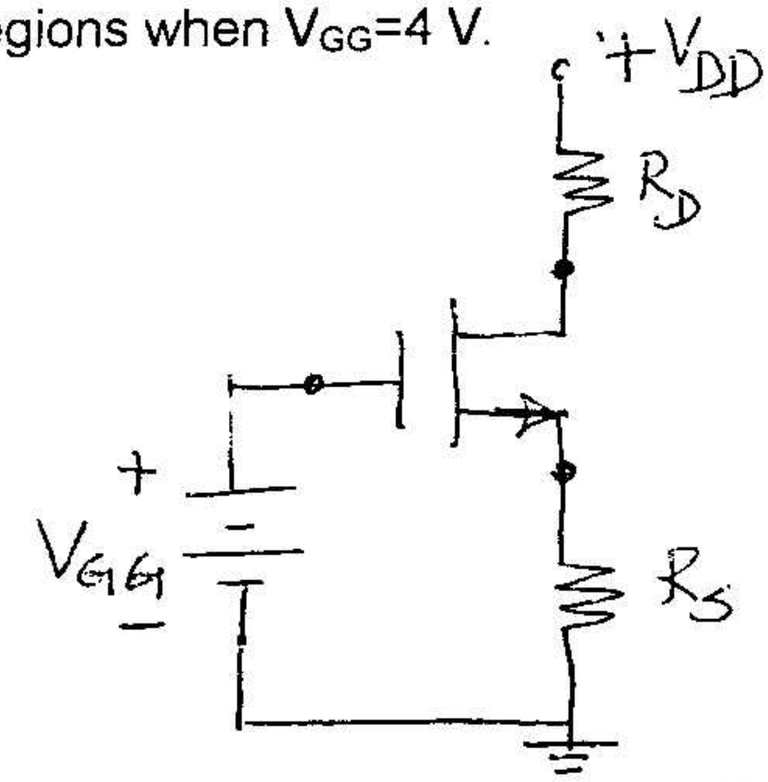

Figure 9

11. Use De Morgan's theorem to obtain a NOR-gate realisation of the expression

$$Y = (A+B+C)(A+B+\overline{C})(A+\overline{B}+C)(A+\overline{B}+C)(\overline{A}+B+C)$$ **[4 marks]**

12. Draw the drain characteristics of a p-channel JFET, showing typical values. **[4 marks]**

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TEST 2(OPEN BOOK)

MAXIMUM MARKS: 60 **WEIGHTAGE: 20%**
DATE: 15/10/09 **DURATION: 50 MINUTES**

1. For the circuit shown in Figure 1, suppose that $i_s(t) = 10$ A for $t < 0$ s and $i_s(t) = 0$ A for $t >= 0$ s. Determine (i) the capacitor voltage v(t) for all time t and sketch this function. (ii) Hence find current through the capacitor i(t) for all time t and sketch this function. **[12 marks]**

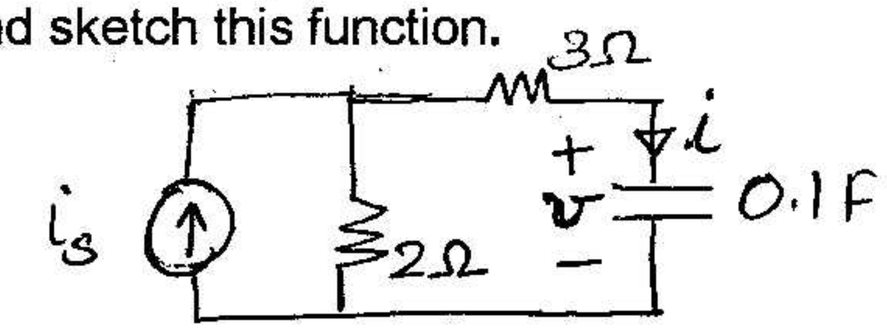

Figure 1

2. The input voltage to a clipper circuit shown in the figure below is $V_s = 4$ Sin ωt V. Determine the output voltage V_o and sketch this function. **[12 marks]**

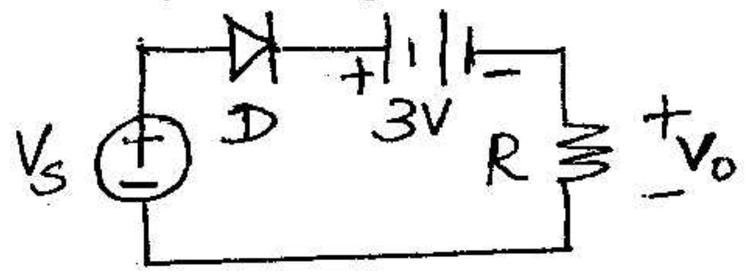

Figure 2

3. For the circuit shown in Figure3, find the complete response of the current flow through the inductor for all values of t. **[12 marks]**

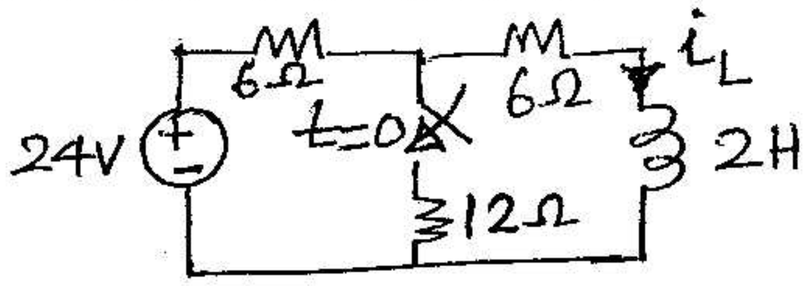

Figure 3

4. The zener diode in the voltage regulator circuit given in Figure no. 4 has a breakdown voltage of 9V. Suppose that a diode has a resistance of 100Ω in the breakdown state and the diode is to operate with a reverse current between 10 and 100mA. **[12 marks]**

Find the range of v_s for the case that R=200Ω and RL=6 Ω

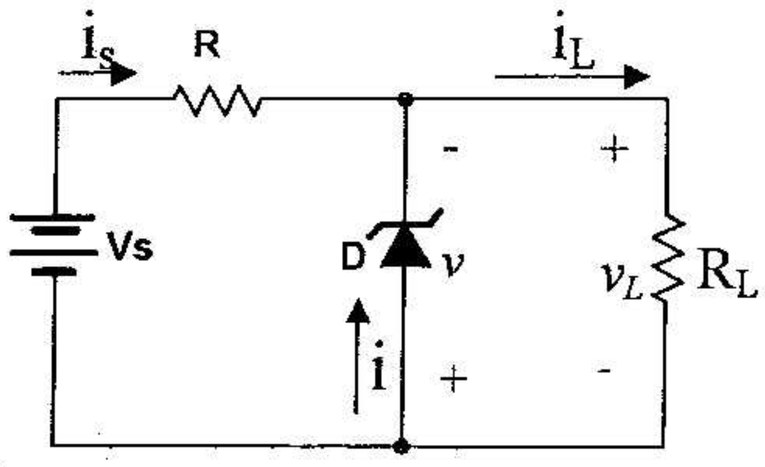

Figure 4

5. Consider a series RLC circuit with L = 1.7 H, R = 2800 Ω, C = 0.001μF, i(0)= 2mA and Capacitor voltage $V_c(0) = 2$V. Sketch i(t) **[12 marks]**

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ES C241 ELECTRICAL SCIENCES – I
TEST 1(CLOSED BOOK)

MAXIMUM MARKS: 25 **WEIGHTAGE: 25%**
DATE: 27/09/09 **DURATION: 50 MINUTES**

1. Consider the circuit shown in Figure1. Use the current divider formula to find i1, i2, i3, i4, i5 and i6. **[6 marks]**

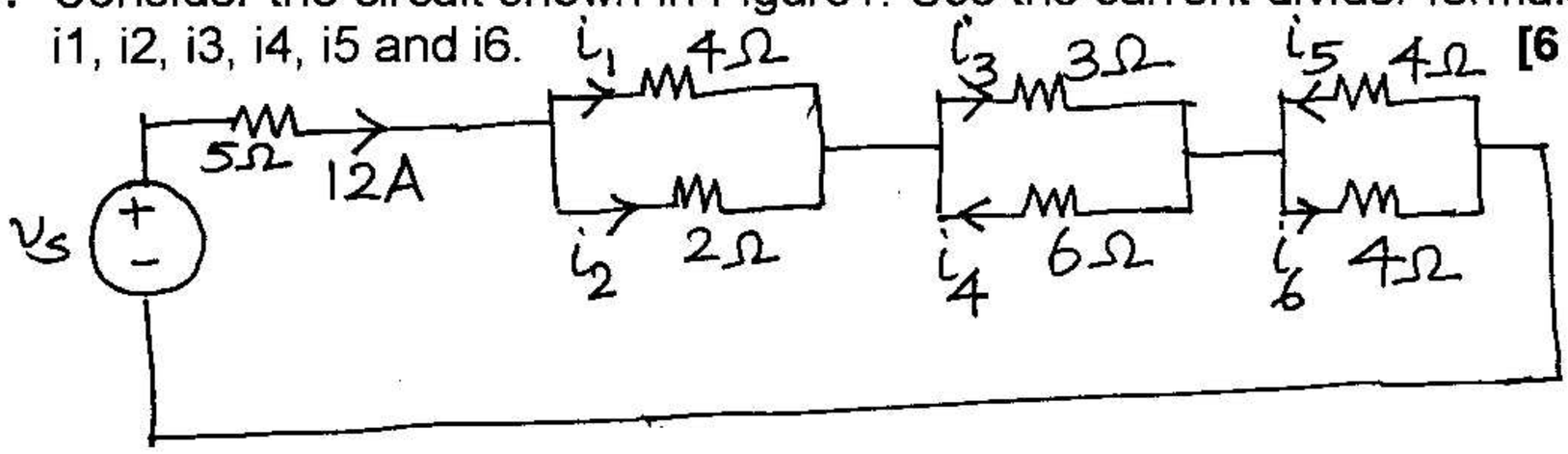

Figure 1

2. For the circuit shown in Figure 2, find current I. **[5 marks]**

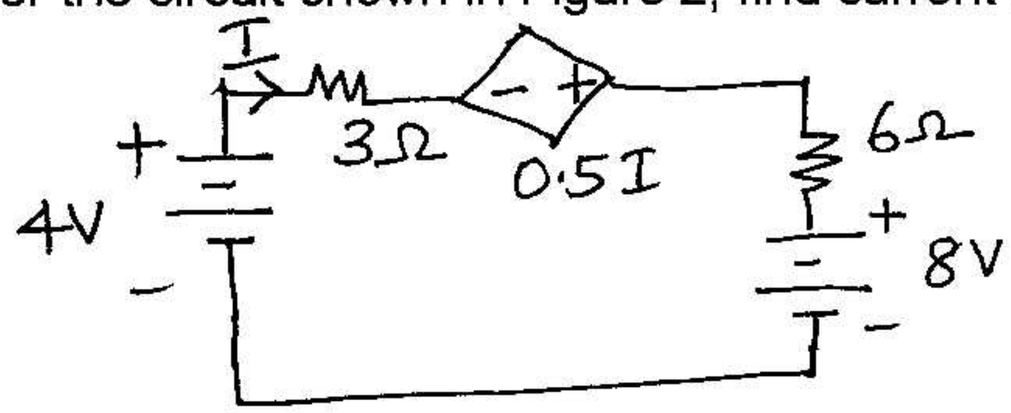

Figure 2

3. For the circuit shown in Figure3, using nodal analysis find the voltages V1, V2 and V3. **[7 marks]**

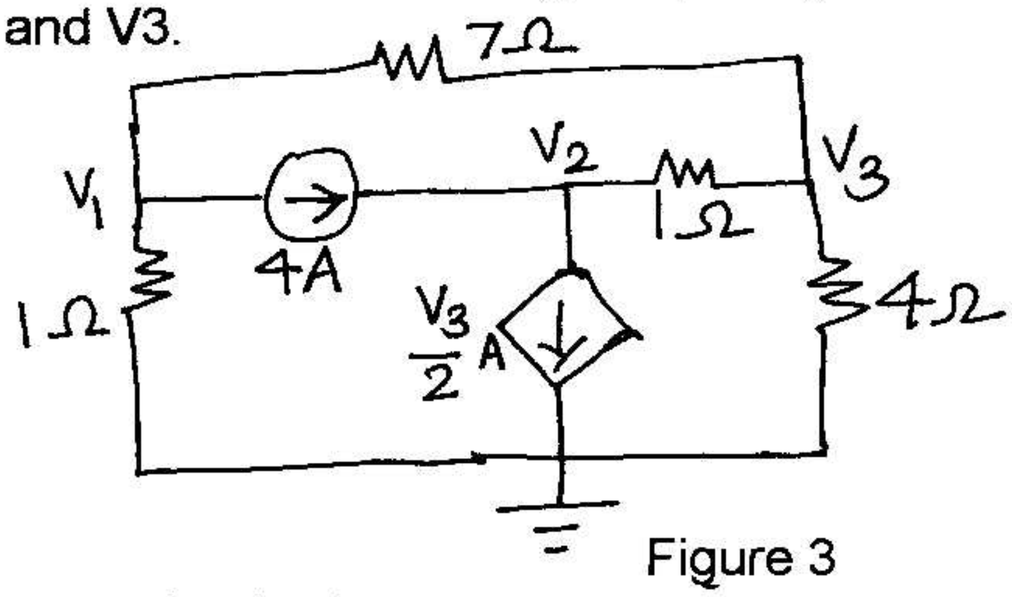

Figure 3

4. For the circuit shown in Figure 4, using mesh analysis find the mesh currents I1,I2, and I3. **[7 marks]**

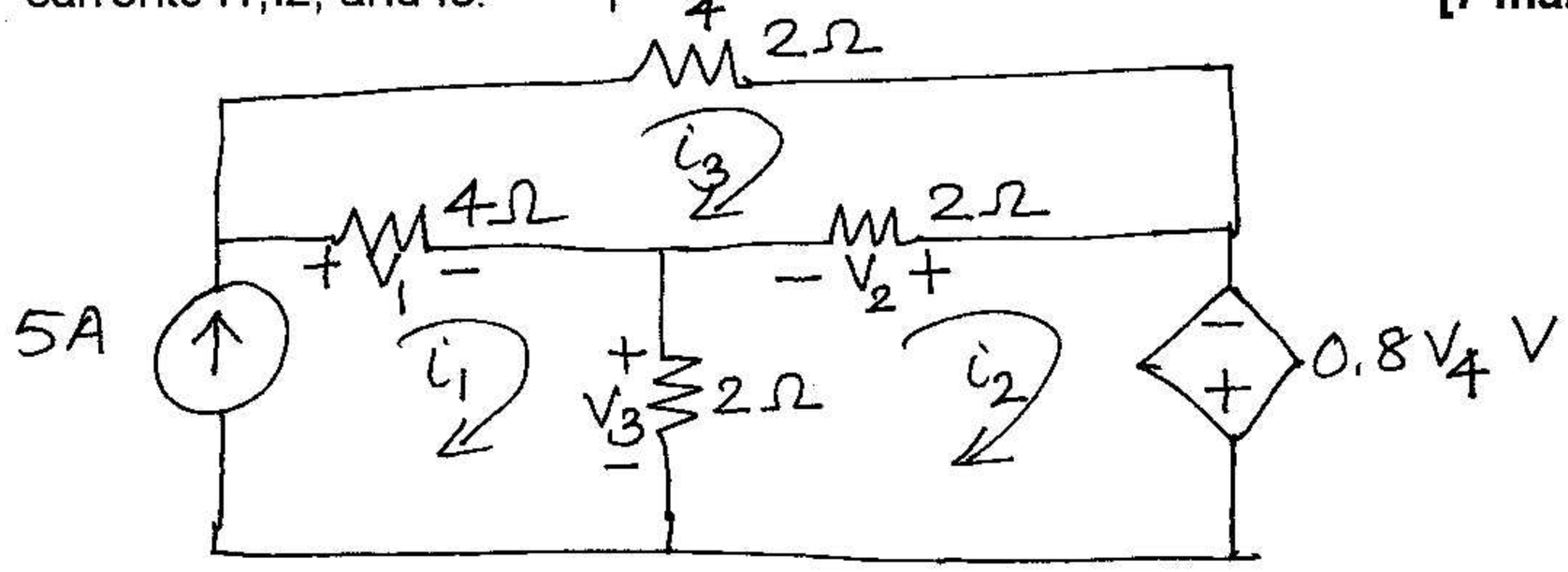

Figure 4

BITS, PILANI – INTERNATIONAL ACADEMIC CITY, DUBAI
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ES UC 241 ELECTRICAL SCIENCES – I
QUIZ 2 (CLOSED BOOK)

MAXIMUM MARKS: 21 **WEIGHTAGE: 7 %**
DATE: 15.12.09 **DURATION: 25 MINUTES**

NAME: **Id. No.:**

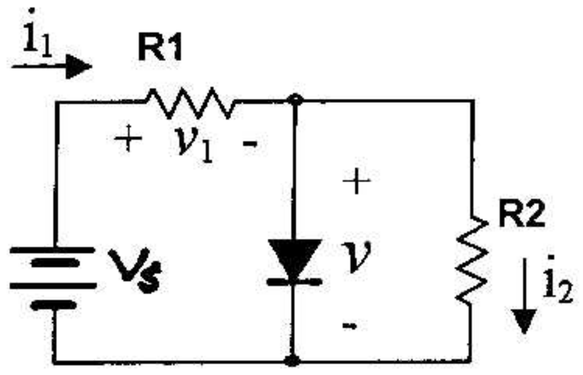
1. What kind of a device is a diode? [1 Mark]
a) Bilateral
b) Linear
c) Nonlinear
d) Unipolar

2. Which of these is the best description of a Zener diode? [1 Mark]
a) It is a rectifier diode
b) It is a constant voltage device
c) It is a constant current device
d) It works in the forward region

3. For a silicon diode the saturation current at 300K is 10 nA. Find the saturation current at temperature 316 K. [2 marks]

Ans:

4) For the diode circuit shown $V_s = 2$ volts and the silicon diode has a saturation current of 1 n A at 300 K. Given that $v = 0.7$ volts, $\eta = 2$, find R_2 when $R_1 = 1$ KΩ. [4 marks]



Ans: $v_1 =$ $i_1 =$ $i_2 =$ $R_2 =$

5) In an npn transistor with Common Emitter configuration, is operating under active region. Its collector current is 4.9 mA, and the emitter current is 5 mA. The value of Alpha (α) is _____ and beta (β) is _____ [2 marks]

6) In a pnp transistor with Common Base configuration, is operated with Emitter-Base junction forward biased and Collector-Base junction reverse biased. Neglecting the total reverse current I_{CO}, a reasonable approximation relating the collector current to the emitter current is _____. [2 marks]

7) In an npn transistor with Common Emitter configuration, the excessive current resulting from transistor breakdown can be due to either _____ or to another phenomenon known as _____. [2 marks]

(8) Which of the following relation is correct in the case of BJT [1 mark]

(a) $\alpha=\beta/(1-\beta)$

(b) $\alpha=\beta/(1+\beta)$

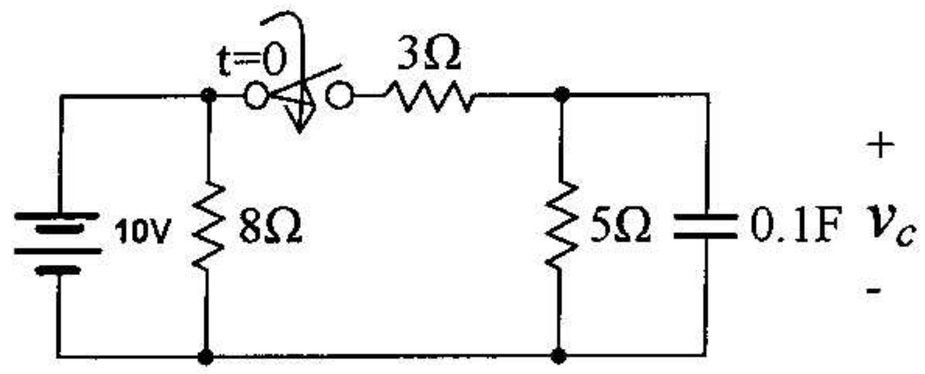
(c) $\beta=(\alpha+1)/\alpha$

(d) $\beta=(\alpha-1)/\alpha$

(9) Draw the circuit diagram for zener voltage regulator [2 marks]

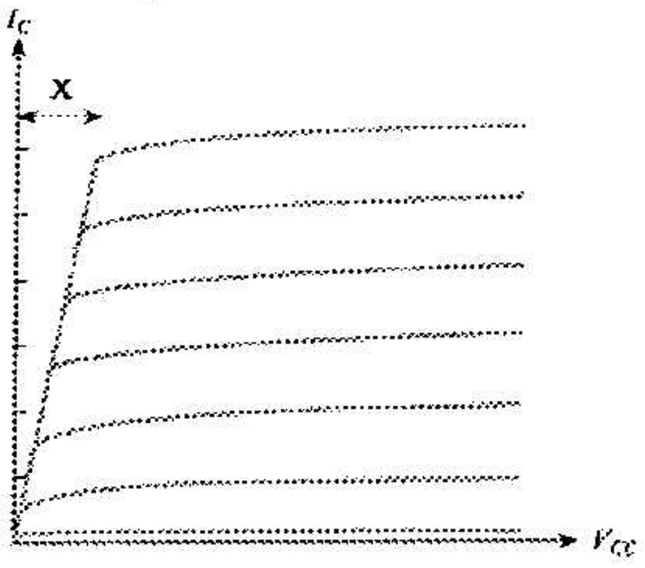
Ans:

10. For the circuit shown below find the voltage across the capacitor Vc at steady state (t $=\infty$). [3 marks]



Ans:.....

11. In the bipolar transistor output characteristics shown below, what region is represented by the symbol 'x'? [1 Mark]



Ans:

Rough Work

BITS, PILANI – INTERNATIONAL ACADEMIC CITY, DUBAI
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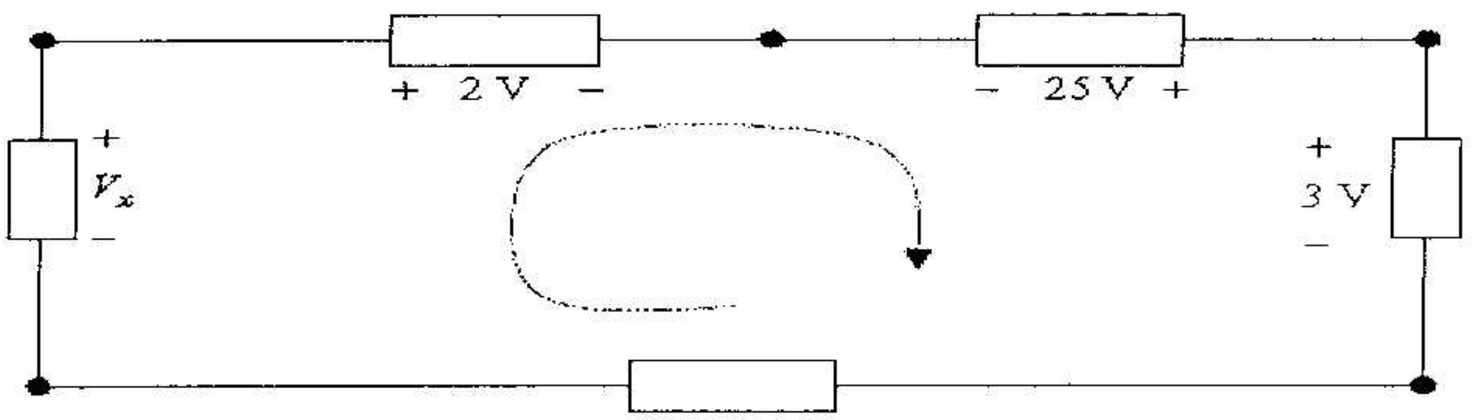
ES UC 241 ELECTRICAL SCIENCES – I
QUIZ 1 (CLOSED BOOK)

MAXIMUM MARKS: 24 **WEIGHTAGE: 8 %**
DATE: 06.10.09 **DURATION: 25 MINUTES**

NAME:	**Id. No.:**

1. Two resistors R1 and R2 are connected in series to a voltage source Vs. The voltage across the first resistor is _____ [2M]

2. Find the unknown voltage in the circuit shown below _____V [2M]



3. Identify the incorrect statements with respect to the Thevenin theorem [1M]

I. Remove the load to find open circuit voltage
II. Short circuit the load to find the open circuit voltage
III. Open circuit all voltage sources to find Thevenin's equivalent resistance R_0
IV. Short all the voltage sources to find Thevenin's equivalent resistance R_0

A. III , IV
B. II, III
C. I,II
D. All are incorrect

4. If a resistor has 5.5 V across it and 3 mA flowing through it, what is the power _____ w [1M]

5. A certain series circuit has a 100Ω, a 270 Ω and 330 Ω resistors in series if the 270 Ω resistor is short circuited from the circuit, the current _____ [1M]
(a) Increases (b) decreases (c) exactly doubles (d) becomes zero.

6. If one of the resistors in a parallel circuit is removed, what happens to the total resistance _____.
[1M]

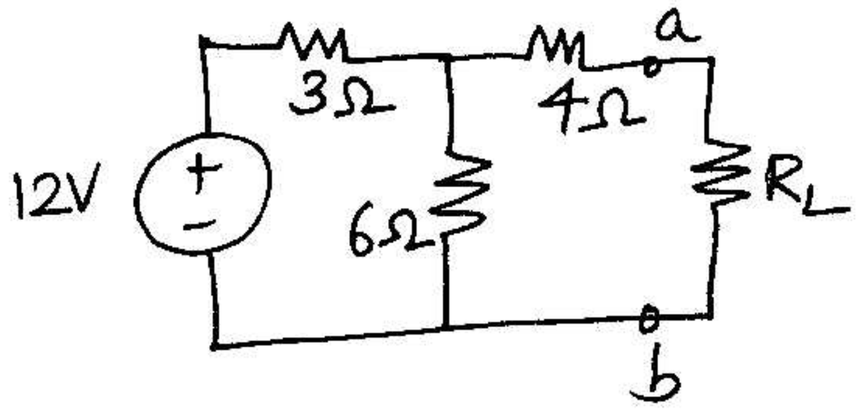
7. Six light bulbs are connected in parallel across 110V, each bulb is rated 75W, Find the current flowing through each bulb _____ [2M]

8. For the circuit shown below find out Norton equivalent resistance R_N _____ and the Current Source value _____ [2M]

9. In a series circuit, with unequal resistances [1M]
A) the lowest resistance has the highest voltage drop
B) the highest resistance has the highest voltage drop
C) the lowest resistance has the highest current through it
D) the highest resistance has the most of the current through it

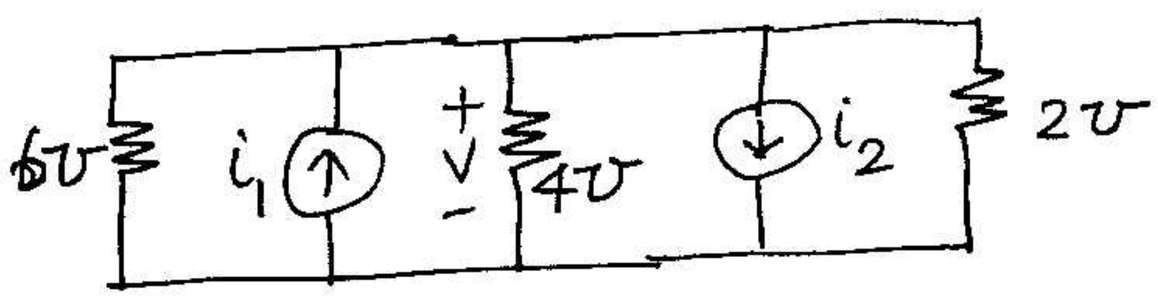
10. A 90A current flows into two parallel resistors having resistances of 12 Ω and 24 Ω. The current in the 24 Ω resistor is _____A [1M]

11.. Refer to the following figure, thevenin's equivalent resistance is _____. The value of R_L that absorbs maximum power is _____Pmax=_____ [2+1+1M]



12. An ideal voltage source is described by a function v(t) = 5 Sin(∏/2)t. The value of this voltage source when t= 1 sec is _____V
[1M]

13. For the circuit shown below suppose i1 is 2A. The value of v when i2 is 3A is _____
[2M]



14. For the circuit shown below the values for the current(T)_____A, Equivalent Resistance _____ and voltage _____v [3M]