The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Bachelor of Technology Honours in Engineering
Name of the Examination	:	Final Examination
Course Code and Title	:	**MEX3272 Applied electronics**
Academic Year	:	2015/2016
Date	:	25th November 2016
Time	:	9.30am – 12.30pm
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions
2. This paper consists of 8 questions.
3. Answer five(5) questions only.

Question 01

(a) Find the mesh currents I_1, I_2 and I_3 in the circuit shown in Figure Q1.a. Consider $R_1 = 5\Omega$, $R_2 = 7\Omega$, $R_3 = 9\Omega$, $R_4 = 11\Omega$ and $R_5 = 13\Omega$.
[6 marks]

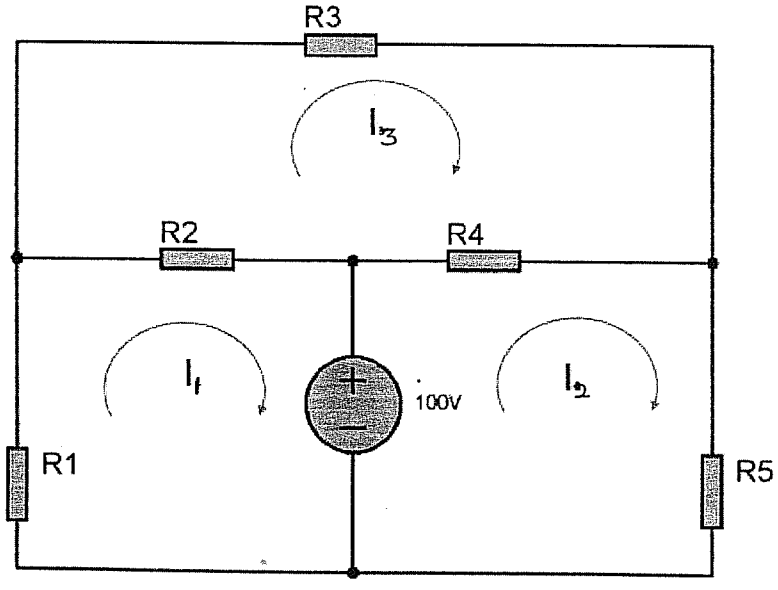


Figure Q1a

(b) Find the Thevenin and Norton equivalent circuits for the two terminal circuit shown in Figure Q1 .b. Consider R_1 as 10Ω and R_2 as 5Ω
[6 marks]

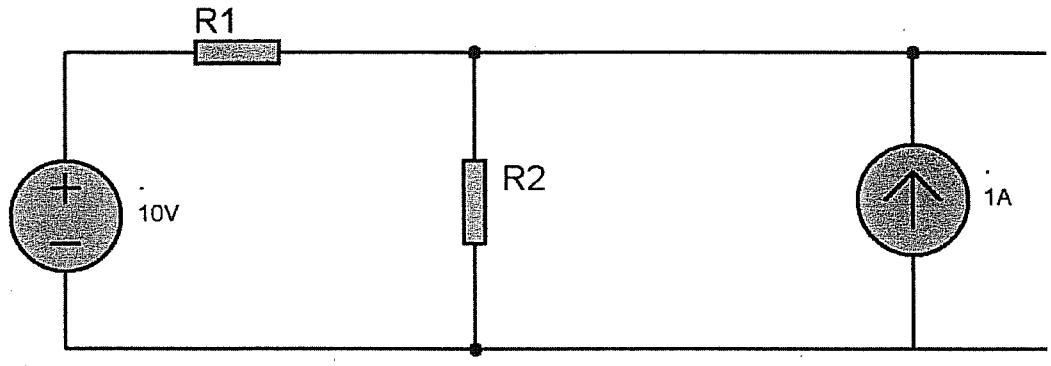


Figure Q1.b

(c) Consider the Wheatstone bridge given in Figure Q1.c to answer the following questions
i. Find R_x if R_4 is 10kΩ, R_2 is 1kΩ, R_3 is 3419kΩ
ii. Find R_x if R_2 is changed to 100kΩ and all other values are unchanged
[8 marks]

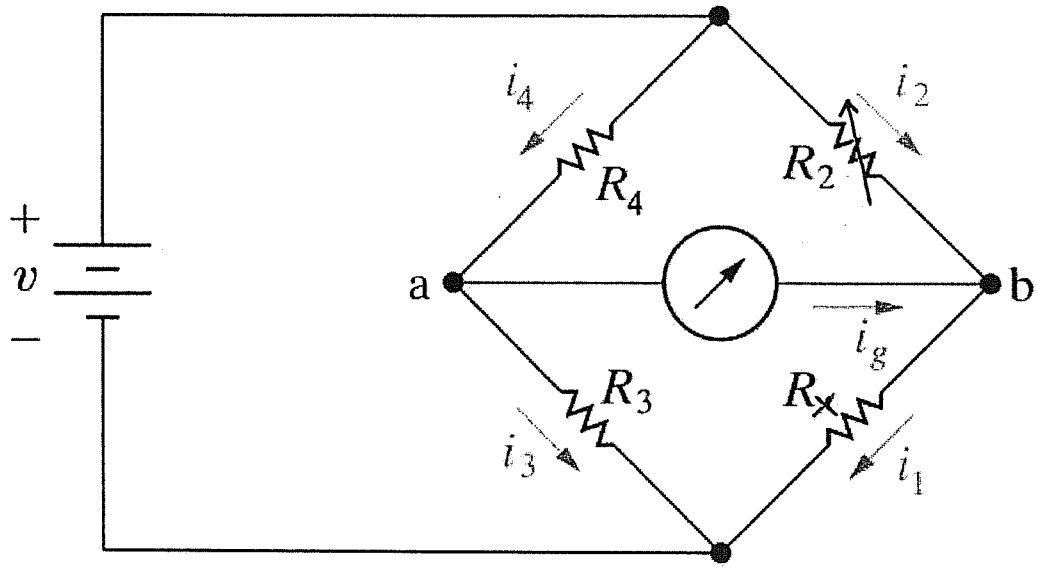


Figure Q1.c

Question 02

(a) Discuss the structure and operation of MOSFETs and JFETs
[10 marks]

(b) Consider the JFET given in Figure Q2. The pinch-off voltage of the JFET is calculated as 6.05V when I_{DSS} = 8mA and V_{DS}=8.82V. Prove that this JFET is in the active region. Consider R_1 as 1MΩ, R_2 as 3.3kΩ and R_3 as 1kΩ.
[10 marks]

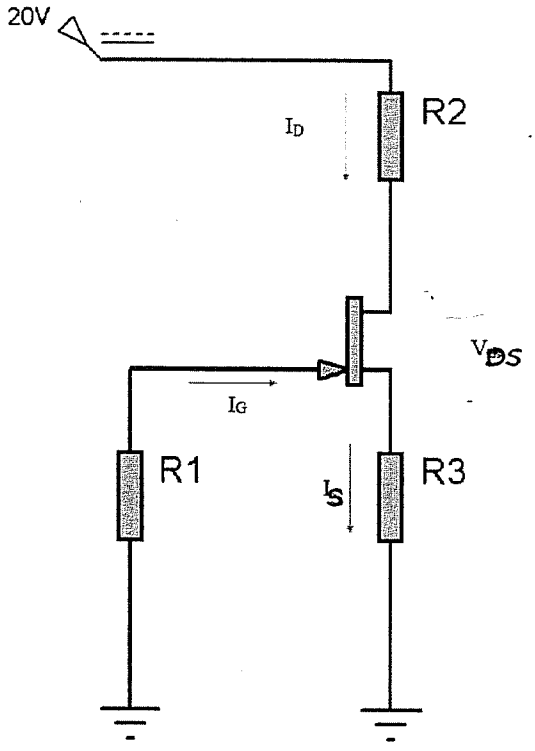


Figure Q2

Question 03

(a) What do you understand by the breakdown of a Diode? Use suitable drawings to support your answer.
[4 marks]

(b) Describe the following types of diodes considering their basic **Operation** and **Applications**.
[4 Marks]

i. LED (Light Emitting Diode)
ii. Photo diode

(c) Figure Q3 shows a regulated voltage supply circuit. The input voltage varies from 8V to 10V. The required output voltage is 6V. Assume that the minimum zener current is 5mA and the required output current from the circuit is 150mA.
Calculate the following

i. the current through R when the output current is 150mA
ii. the voltage across the resister R, when the input voltage is at minimum of 8V
iii. the required resistance R
iv. the voltage across the resister R, when the input voltage is at maximum of 10V
v. maximum current through the resistance R
vi. maximum power dissipated by R at this voltage

[12 Marks]

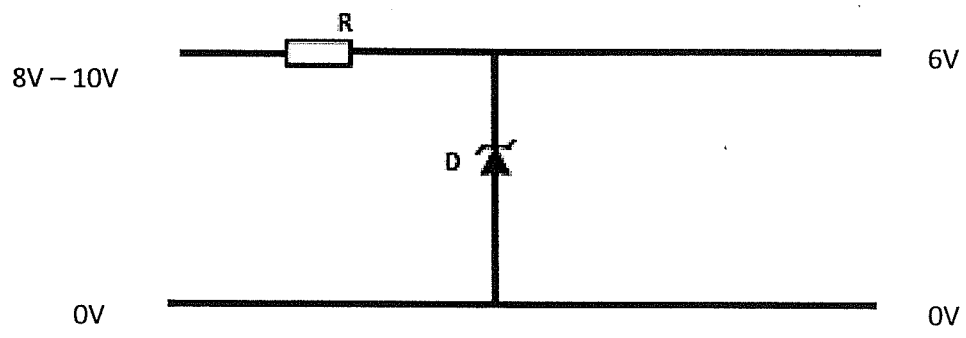


Figure Q3

Question 04

(a) Draw the output characteristics for a BJT (Bipolar Junction Transistor) in CE (Common Emitter) Configuration. Label each region clearly.
[4 marks]

(b) Briefly explain the following with respect to BJT (Bipolar Junction Transistor). You may use any drawing to support your answer.
[4 marks]
i. Active mode
ii. Darlington Pair

(c) The CE(Common Emitter) silicon BJT (Bipolar Junction Transistor) amplifier shown in Figure Q4 has a current gain of 100. If Vcc =15V, $R_1 = 22K\Omega$, $R_1 = 4.7K\Omega$, $R_3 = 1.8K\Omega$ and $R_4 = 390\Omega$ then find the following
i. I_B
ii. I_E
iii. V_B
iv. V_C

[12 marks]

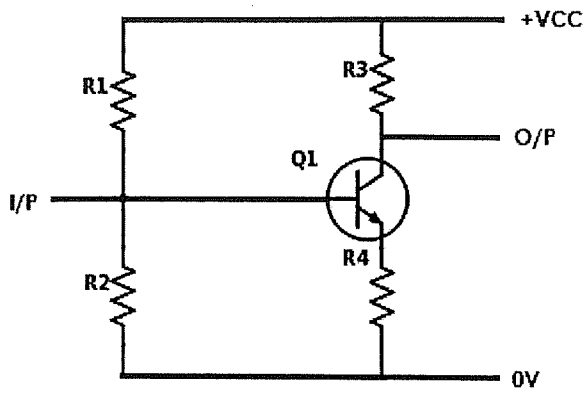


Figure Q4

Question 05

(a) Briefly explain 4 characteristics of an ideal Op-amp
[4 marks]

(b) An Op-amp circuit is shown in Figure Q5-b.

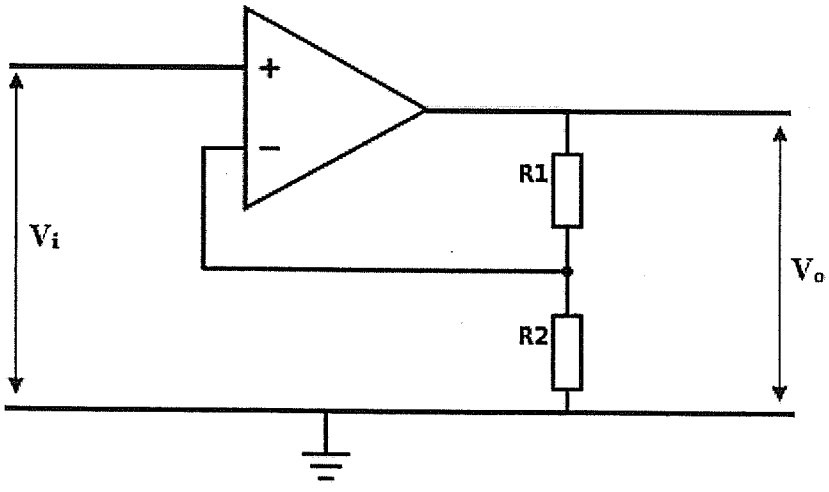


Figure Q5-b

i. Determine an expression for the closed loop voltage gain A_v. Assume that the Op-amp is an ideal one.
ii. State the function of this Op-amp.

[8 marks]

(c) Figure Q5-c shows a summing amplifier with a feedback resistance of 2kΩ. Consider R_2 as 1kΩ and R_3 as 2kΩ.

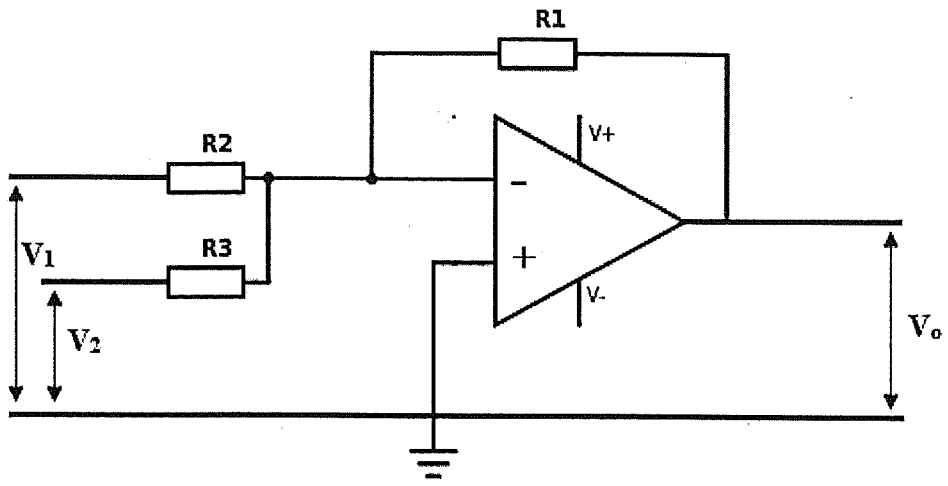


Figure Q5-b

i. State the type of feedback used in this circuit
ii. Determine the output voltage if the input voltages are $V_1 = -6V$ and $V_2 = -4V$

[8 marks]

Question 06

(a) Explain the operation of following using suitable diagrams
   i. Sample and Hold circuit
   ii. Voltage follower
   iii. ADC circuit
   iv. Active filter circuit
   v. R-2R Ladder network

   [15 marks]

(b) Express the decimal number -59 in
   i. Sign magnitude method
   ii. 1's compliment method
   iii. 2's complement method

   NOTE :- Use 8 bit binary representation
   [5 marks]

Question 07

(a) Simplify the following Boolean expression using a **K-map.**
[4 marks]

$$X = AB\overline{C} + A\overline{B}\,\overline{C} + \overline{A}BC + A\overline{B}C + ABC$$

Hint:- Indicate the grouping properly to gain marks for this question

(b) Prove the following identity using **Boolean Theorems**
[4 marks]

$$A\overline{B}C + ABC + AB\overline{C} = A(B + C)$$

(c) Consider the gate circuit shown in Figure Q7.
[6 marks]

i. Obtain the boolean expression (or logic function) of Q
ii. Tabulate the truth table
iii. State a single gate which can represent this logic function

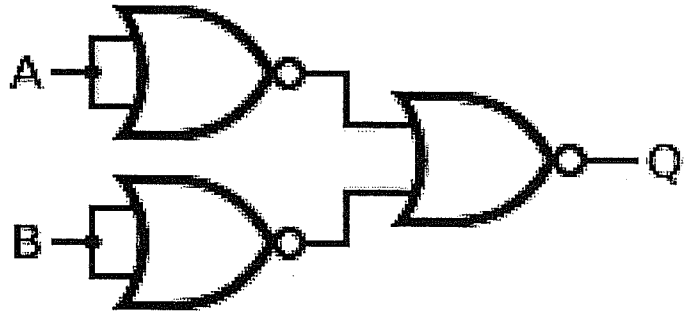


Figure Q7

(d) A lamp available in a laboratory will be operated using 2(two) switches located near the front door and the back door.
The lamp will be switched ON

- if the front switch is ON and the back switch is OFF
  OR
- if the front switch is OFF and the back switch is ON.

Construct the logic circuit clearly mentioning all assumptions.
[6 marks]

Question 08

(a) Explain the operations of Serial – In Serial – Out Shift Register and Serial – In Parallel – Out Shift Registers. You may use any drawings to support your answer.
[6 marks]

(b) The waveform shown in the Figure Q8 is applied to a D flip flop. Determine the Q output assuming that the positive edge-triggered D flip flop is initially RESET. [4 marks]

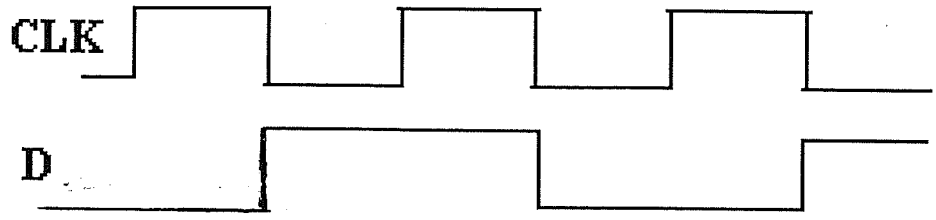


Figure Q8

(b) Design a 3 bit Synchronous up down counter with the regular binary count sequence 0 to 7 and 7 to 0. Use JK Flip-Flops to design the circuit. To count upwards use the select line clock as clk = 0 and to count downwards use select line clock as clk = 1.
Clearly state all six steps when building this circuit.
[10 marks]

END