00055

THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 3
FINAL EXAMINATION 2009/2010

MEX3272 – APPLIED ELECTRONICS

DATE : 10th MARCH 2010
TIME : 0930 HRS. – 1230 HRS.
DURATION : THREE (03) HOURS

INSTRUCTIONS

- *Question paper consists of **eight** questions. Answer **only five** questions.*
- *All questions carry equal marks.*

Question 01

(a) State the Thevenin's theorem and Norton's theorem.

(b) i. Convert the following Thevenin equivalent circuit in figure Q1 (b1) to the Norton equivalent circuit.

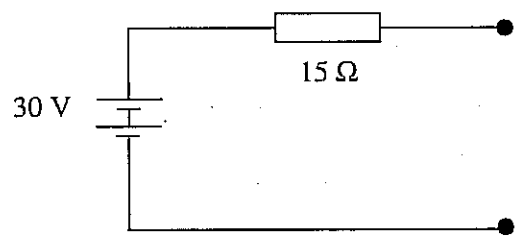


Figure Q1 (b1)

ii. Convert the following figure Q1 (b2) Norton equivalent circuit to the Thevenin equivalent circuit.

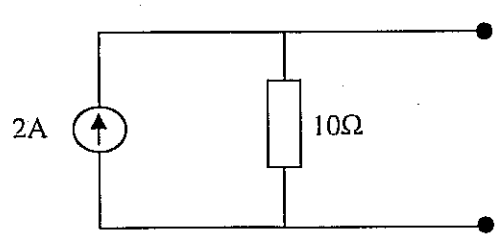


Figure Q1 (b2)

(c) Following Figure Q1(c) represents an active network consisting of one voltage source, one current source and five linear resistors. Find the

i. Thevenin equivalent circuit,
ii. Norton equivalent circuit, at the terminals **A** and **B**.

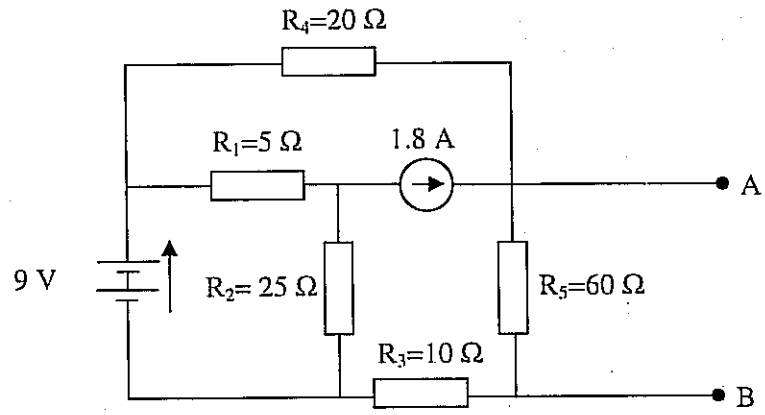


Figure Q1(c)

(d) Following Figure Q1 (d) shows a commercial Wheatstone bridge where, $V_s = 10V$, $R_1 = 10\ k\Omega$, $R_2 = 10\ k\Omega$ and $R_x = 5932\Omega$. The detector can be modeled as a 5 kΩ resistance.

i. What value of R_3 is required to balance the bridge?
ii. Suppose that R_3 is 1Ω higher than the value found in part (a). Find the current through the detector. (***Hint:*** *find the Thevenin equivalent for circuit with the detector removed. Then, place the detector across the Thevenin equivalent circuit and solve for the current*)
iii. Theoretically any value can be used for R_1 and R_3 for the bridge to balance, it is only the ratio R_1/R_3 that is important. Explain

1. What practical problems might occur if the values are very low?
2. What practical problems might occur if the values are very high?

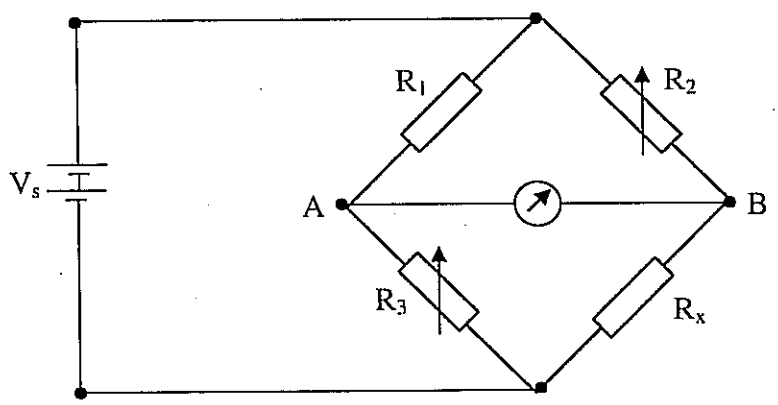


Figure Q1 (d)

Question 02

(a) Describe the **practical** characteristic curves of the basic filters as low-pass, high-pass, band-pass and band-stop.

(b) Determine the center frequency (f_c), bandwidth (BW), quality factor (Q) and damping factor (DF) of a band-pass filter.

(c) Describe the Butterworth, Chebyshev and Bessel filter response characteristics.

(d) Consider the circuit given in the Figure Q2 (d).

Determine the capacitance values (C) required to produce an f_c=2680 Hz if all R are 1.8 kΩ. Select suitable values for feedback resistors for Butterworth response. (***Hint:*** *Use following Butterworth response table Q2(d)*)

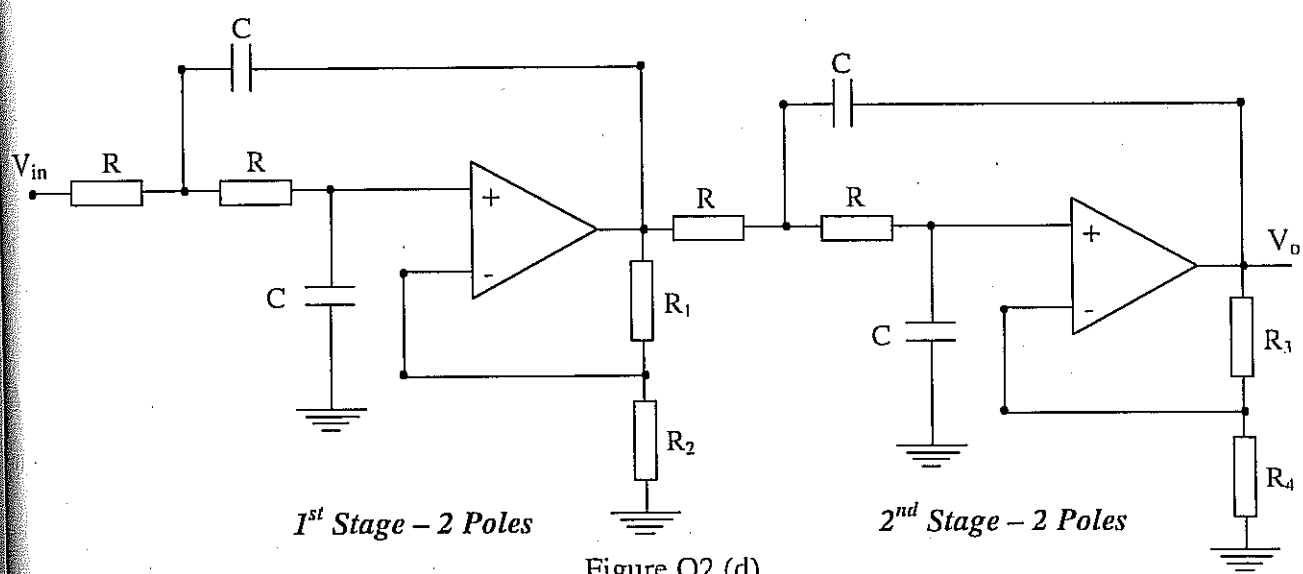


Figure Q2 (d)

Values for the Butterworth response

Order	Roll-off dB/Decade	1st Stage			2nd Stage			3rd Stage		
		Poles	DF	R1/R2	Poles	DF	R3/R4	Poles	DF	R5/R6
1	-20	1	Optional							
2	-40	2	1.414	0.586						
3	-60	2	1.000	1	1	1.000	1			
4	-80	**2**	**1.848**	**0.152**	**2**	**0.765**	**1.235**			
5	-100	2	1.000	1	2	1.618	0.382	1	0.618	1.382
6	-120	2	1.932	0.068	2	1.414	0.586	2	0.518	1.482

Table Q2 (d)

Question 03

(a) Sketch the characteristic curve of a Diode for ***Si*** and ***Ge***.

(b) What are the half wave and full wave rectification methods (two methods). Explain it using circuit diagrams, and show the output for a sinusoidal input.

(c) Sketch the current-voltage relationship of a Zener diode in forward-biased and reverse-biased conditions.

(d) The circuit shown in Figure Q3 (d) is an emitter follower regulation circuit. Calculate the values of V_L , I_L , V_{CE} and the power dissipated by T_1.Assume that the transistor is ***Si(Silicon)***.

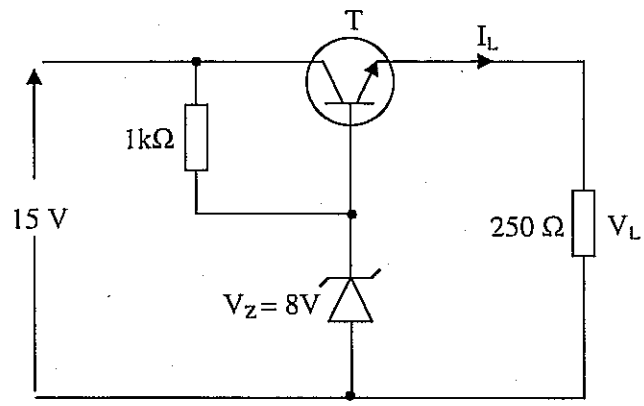


Figure Q3 (d)

Question 04

(a) Write down the three BJT amplifier configurations for a NPN transistor.

(b) Draw the input and output characteristics of a BJT for CE configuration.

(c) Explain three biasing techniques used for a BJT with the aid of circuit diagrams.

(d) Consider the circuit shown in Figure Q4 (d1) and convert it into the circuit shown in Figure Q4 (d2) using Thevenin's theorem and find,

(i) R_{th} (ii) V_{th} (iii) I_B (iv) I_C (vi) I_E (vi) V_{CE}

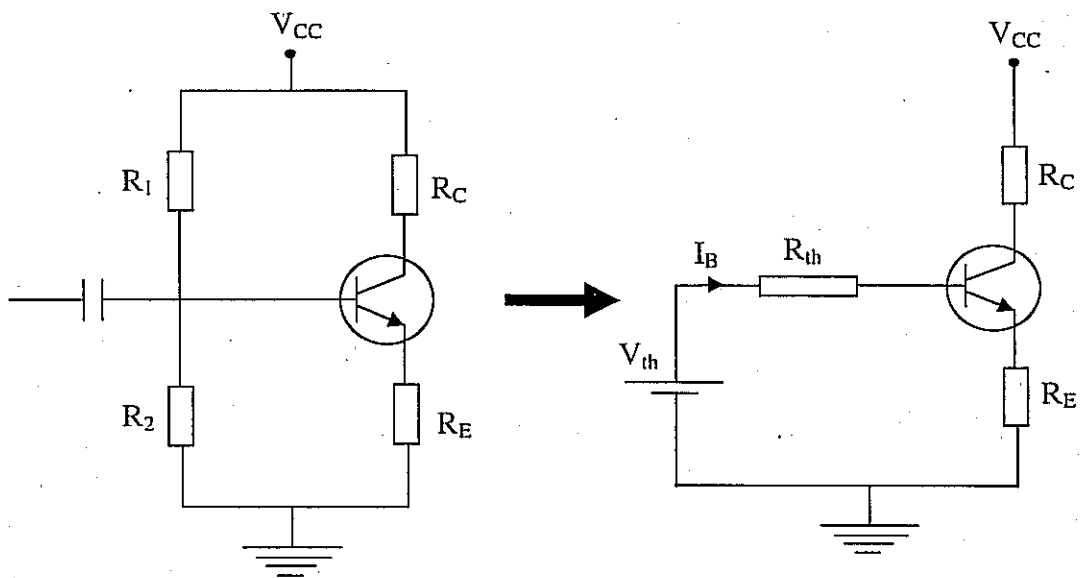


Figure Q4 (d1) Figure Q4 (d2)

Where: V_{CC}=20V, V_{BE} = 0.3V, R_1=100kΩ, R_2 = 25kΩ, R_C = 4kΩ, R_E = 6kΩ, β = 50

Question 05

(a) Compare ideal and practical values of four parameters of an operational amplifier (Op-Amp).

(b) Explain the following terms with regards to an operational amplifier

i. Output offset voltage
ii. Common Mode Rejection Ratio (**CMRR**)
iii. Slew rate.

(c)

i. Explain the voltage follower using a circuit diagram and find the voltage gain of it?

ii. Design a circuit that gives ±12V using following component and device.
Two Op-Amps, +15V voltage source, one 3kΩ, one 12kΩ and two 10kΩ resistors.
(***Hint:*** *You may use one voltage follower and one inverting amplifier*)

(d) Determine an expression for the output voltage V_{out} in the circuit shown in Figure Q5 (d). Assume that the operational amplifier is ideal.

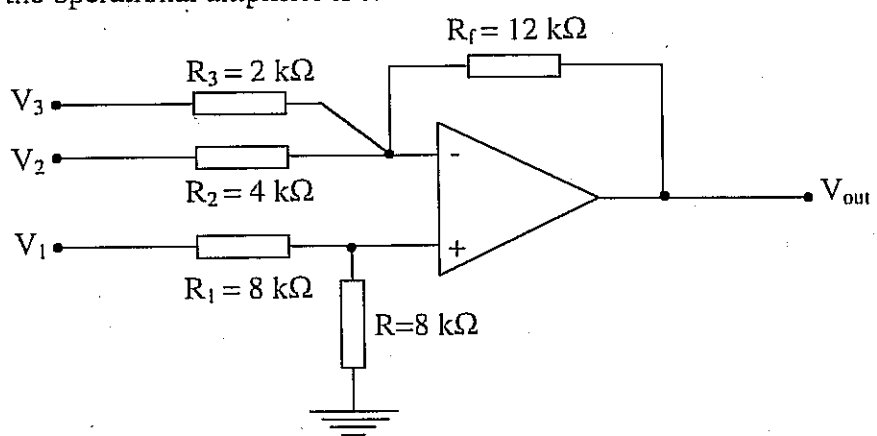


Figure Q5 (d)

If V_2=2V and V_3=1V, then find the value of V_1 in order to get V_{out} = 0 V.

Question 06

Explain briefly any five of the following using diagrams and mention one application for each of them.

i. LDR
ii. The Push Pull Power Amplifier
iii. The Darlington Pair
iv. Thermo couple
v. Sample and Hold Circuit
vi. Digital Ramp Analog to Digital Converter
vii. Astable Multivibrator

Question 07

(a) i. Convert 10111100_2 to Octal and Hexadecimal numbers.

ii. Express the decimal number -41 in

a. Sign magnitude method
b. 1's compliment method
c. 2's compliment method

(b) i. State De Morgan's theorem for two Boolean variables A and B.

ii. Define the following 2-input logic elements using truth tables.

a. AND gate
b. NOR gate
c. Exclusive NOR gate

(c)

i. Given that,

$$A \oplus B = A\overline{B} + \overline{A}B$$

Show that

1. $A \oplus A = 0$
2. $A \oplus B \oplus AB = A + B$

ii. Implement the following Boolean function using 2-input NOR gates.

1. $f_1 = A(\overline{A} + \overline{B})(B + \overline{C}D)$

(d) The executive board of a small company consists of

- A managing director **A**
- A chief executive **B**
- Two non-executive directors **C** and **D**

In order for a decision to be made **A** requires the support of one other board member, a similarly **B** requires the support of two other board members. Construct a truth table f the decision-making process and indicate clearly where voting goes,

(i) against **A**

(ii) against **B**

i. Write the Boolean expression for each decision and simplify those using Karnau map, Show the steps very clearly.

ii. Design two circuits using 2-input logic gates (OR, AND and NOT) to carry out e decision.

Question 08

(a) Explain briefly the meaning of the term **Combinational-logic**.

(b) Explain the following using circuit diagrams and truth tables,

i. JK edge-triggered Flip-Flop
ii. SR edge-triggered Flip-Flop
iii. Construct a D edge-triggered Flip-Flop using a JK Flip-Flop and a NOT gate.

(c) A 5-bit weighted resistor DAC consisting with minimum resistance value R has a V_{ref} = 12V and a feedback resistor R_f.

i. Derive an expression for V_{out}.
ii. If $R_f = R$ Find the resolution and the full scale analog output voltage.
iii. Find the V_{out} when the input is 11101.

(d) Design a synchronous counter with the irregular binary count sequence 1,2,5 and 7 using JK Flip-Flops and logic gates(if required). You have to show the state diagram, state table, transition table, K-map, logic expressions and the circuit implementation very clearly.

-END-