The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Mechanical Engineering

086

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	: **DMX3304 Applied Electronics**
Academic Year	: 2021/22
Date	: 16th February 2023
Time	: 0930hr – 1230hr
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Eight (8)** questions in **Eight (8)** pages.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. This is a Closed Book Test (CBT).
6. Answers should be in clear handwriting.
7. Do not use **Red** color pen.

Question 01

a) Briefly explain the Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL).

[4 Marks]

b) Define the terms 'electric network' and 'electric circuit' used in electrical engineering.

[4 Marks]

c) A Wheatstone bridge circuit has the resistances $\mathbf{R_{AB} = 60\Omega}$, $\mathbf{R_{CD} = 60\Omega}$, $\mathbf{R_{AD} = 40\Omega}$, $\mathbf{R_{BC} = 40\Omega}$, $\mathbf{R_{BD} = 100\Omega}$ as given in **Figure Q01(c).** The supply is connected to points A and C. If the current drawn from the supply is 100mA, find the currents through R_{BC}, R_{CD} and R_{BD}.

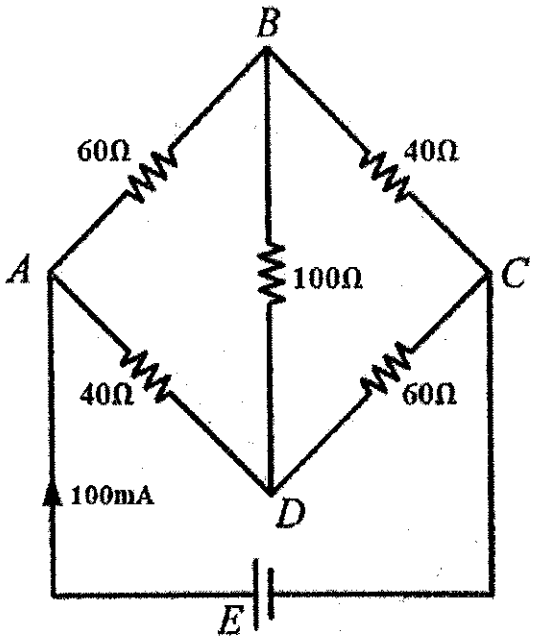

Figure Q01(c)

[6 Marks]

d) Consider the circuit is given in **Figure Q01(d),** using KCL, KVL, and Ohm's law, Calculate:

i. I_1

[2 Marks]

ii. I_2

[2 Marks]

iii. V_o

[2 Marks]

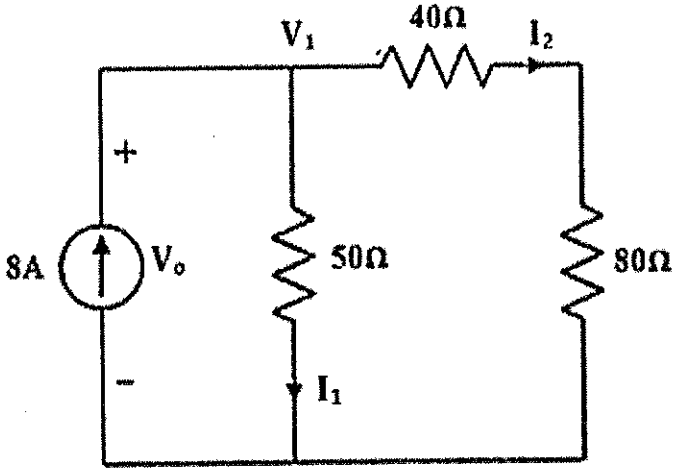

Figure Q01(d)

Question 02

a) Explain briefly why an ordinary junction transistor is called a Bipolar Junction Transistor (BJT).

[3 Marks]

b) State three main advantages of using Field Effect Transistors (FET) in electronic designs.

[3 Marks]

c) Consider the circuit given in **Figure Q02(c).** Calculate the current I and the resistance between terminals A and B.

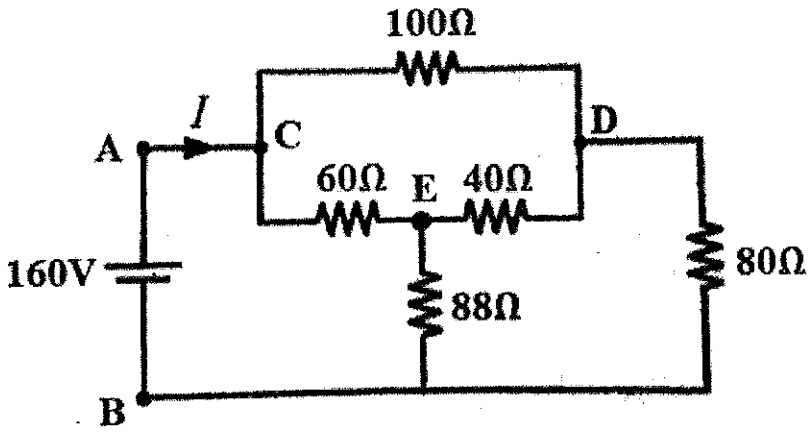

Figure Q02(c)

[6 Marks]

d) Consider the JFET circuit given in **Figure Q02(d).** Determine the value of drain current (I_D) for this circuit.

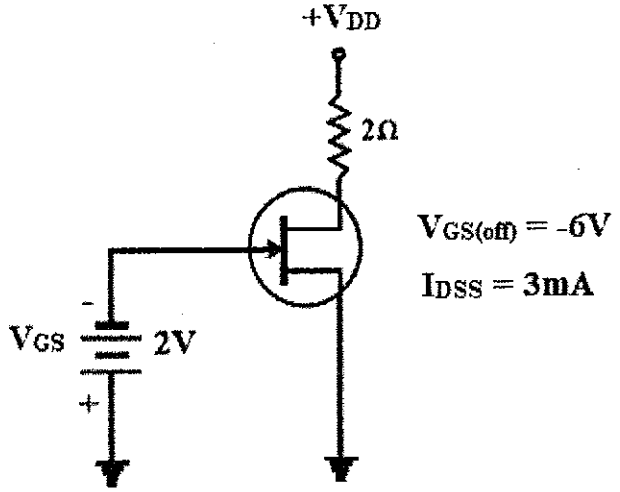

Figure Q02(d)

[8 Marks]

Question 03

a) Briefly explain what is meant by the biasing of a transistor.

[3 Marks]

b) State the definition of Current gain in the Common-Emitter (CE) configuration of a Bipolar Junction Transistor (BJT).

[3 Marks]

c) Design a bias network circuit diagram for the BJT amplifier circuit given below in **Figure Q03(c),** and calculate the values of,
(Assume the Common-emitter current gain is 150, V_{BB} = 5V and V_{BE} = 0.7V)

i. R
ii. I_B
iii. I_C
iv. I_E

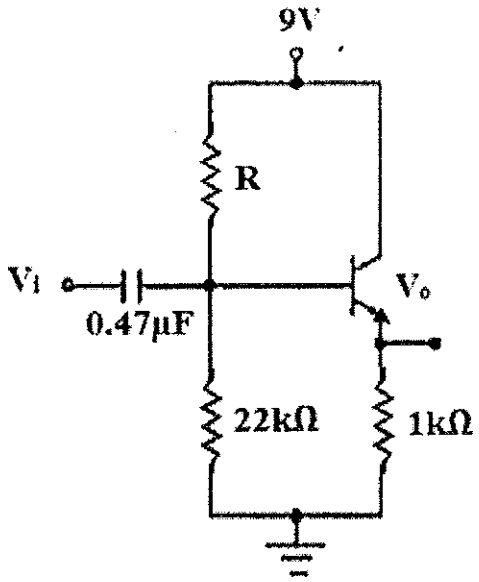

Figure Q03(c)

[14 Marks]

Question 04

a) State 4 characteristics of an ideal Op-amp.

[4 Marks]

b) Consider the Op-amp circuit that is shown in **Figure Q04(b).** If $V_i = 0.5V$, Calculate:

i. The Output voltage V_o.

ii. The current through the 10kΩ resistor.

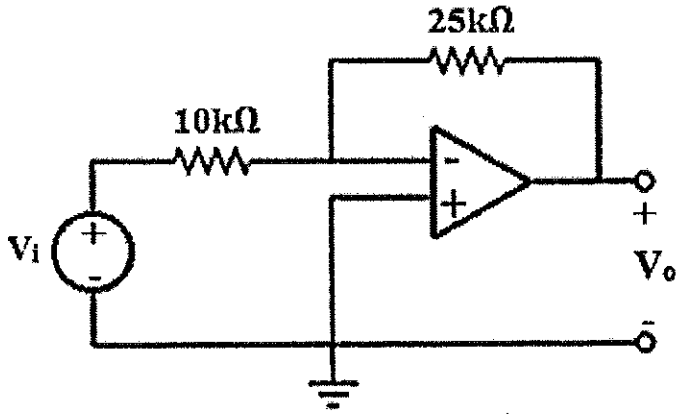

Figure Q04(b)

[6 Marks]

c) Design a two-input summering amplifier that has a voltage gain of 10. You can follow the following steps to complete the design task.

Step 1 - Draw a two-input summing amplifier.

Step 2 - Determine the values of the resistors.

[10 Marks]

Question 05

a) Draw circuit symbols of a normal diode and a Zener diode and sketch the V/I characteristics of both diodes.

[6 Marks]

b) Consider the diode circuit that is shown in **Figure Q05(b).** Use the Ideal diode model to calculate the current in both diodes and the Voltage at point D.

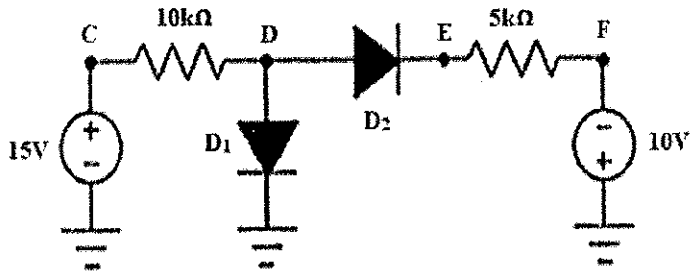

Figure Q05(b)

[8 Marks]

c) Consider the Zener diode regulator that is shown in **Figure Q05(c).** Determine V_L, V_R and I_Z.

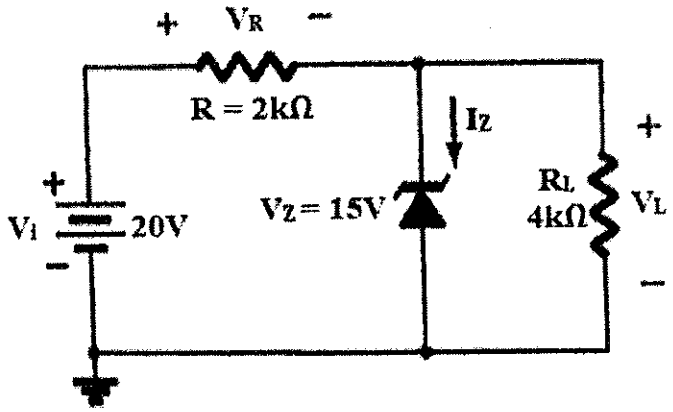

Figure Q05(c)

[6 Marks]

Question 06

a) State three main differences between the Binary number system and the Decimal number system.

[3 Marks]

b) Convert the octal number 623_8 to Decimal, Binary and Hexadecimal number systems.

[3 Marks]

c) Represent the Decimal number -32_{10} as an 8-bit binary number using the **1's complement** and **2's complement representation.**

[5 Marks]

d) Represent the Decimal number 13597_{10} in Binary Coded Decimal **(BCD).**

[4 Marks]

e) Reduce the following Boolean expression to **THREE** literals.

$$(X'Y' + Z)' + Z + XY + WZ$$

[5 Marks]

Question 07

a) State the De'-Morgan's theorem.

[2 Marks]

b) Simplify the following Boolean expression to **THREE literals** and construct the logic gate diagram and truth table for the simplified expression.

$$F = XY'Z + X'Y'Z + W'XY + WX'Y + WXY$$

[7 Marks]

c) Simplify the Boolean expression given below using a **4 Variable K-Map.**

$$F = B'D + A'BC' + AB'C + ABC'$$

[3 Marks]

d) Simplify the following Boolean expression using a **4 Variable K-Map** and express the function as,

$$F = AC' + B'D + A'CD + ABCD$$

i. Sum of Products (SOP)
ii. Product of Sums (POS)

[8 Marks]

Question 08

A building has four floors with staircases, and the staircase lights can be switched on or off at any floor when the switch on that floor is operated. Design a logic circuit for this case using the minimum number of gates. Show the design steps clearly. If the lights are controlled through a relay, show a suitable circuit that meets the above functional requirement. State any assumptions you make.

[20 Marks]

END