University of Ruhuna- Faculty of Technology
Bachelor of Bio-Systems Technology Honours Degree
Level 1 (Semester II) Examination, December 2023
Academic year 2021/2022

Course Unit: BST1222 Electronics for Bio-Systems Technology (Written) Duration: 1.5 hours

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- All symbols have their usual meanings.
- Answer all **Four (04)** questions.
- Calculators are **allowed** for this examination.

1)

   a. State the definitions of voltage, current and resistance

(3 marks)

   b. Briefly explain what is a capacitor

(2 marks)

   c. Determine whether the following statement is true or false, and explain your answer, using a suitable example.

   "The voltage across **all the conductors** is directly proportional to the current flowing through it, with the constant of proportionality being the resistance.

(5 marks)

   d. An electrician wishes to cut a copper wire (ρ=1.724 × 10−8Ωm) that has no more than 10Ω of resistance. The wire has a radius of 0.725mm. What would be the approximate length of the wire required to have a maximum resistance of 10Ω?

(5 marks)

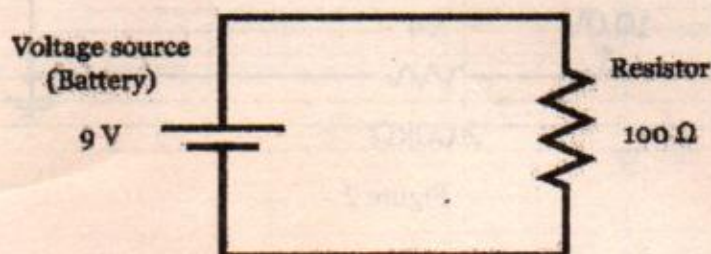   e. Calculate the power dissipation through the resistor in the circuit shown in Figure 1.

(5 marks)

Figure 1

f. How much current will flow through a 20.Ω resistor connected in series with a 40 Ω resistor when a supply voltage across the series combination is 12 V dc? Also calculate voltage drop across each resistor?

(5 marks)

2)

a. Briefly explain the following
   i) Kirchhoff's Current Law
   ii)   Kirchhoff's Voltage Law

(3 marks)

b. The current passing through a resistor in a circuit is 0.01A when the voltage across the resistor is 5 V. What would be the current passes through this resistor when the voltage across it is 7.5 V?

(6 marks)

c. Answers following questions based on the circuit shown in Figure 2.
   i)   Find the current passing through resistors: R1, R2, R3, and R4.
   ii)   Find the nodal voltages at point A, B and C.
   iii)   If R3 and R4 resistors are replaced with two identical bulbs with same resistance of 2 kΩ, which bulb will glow brighter?
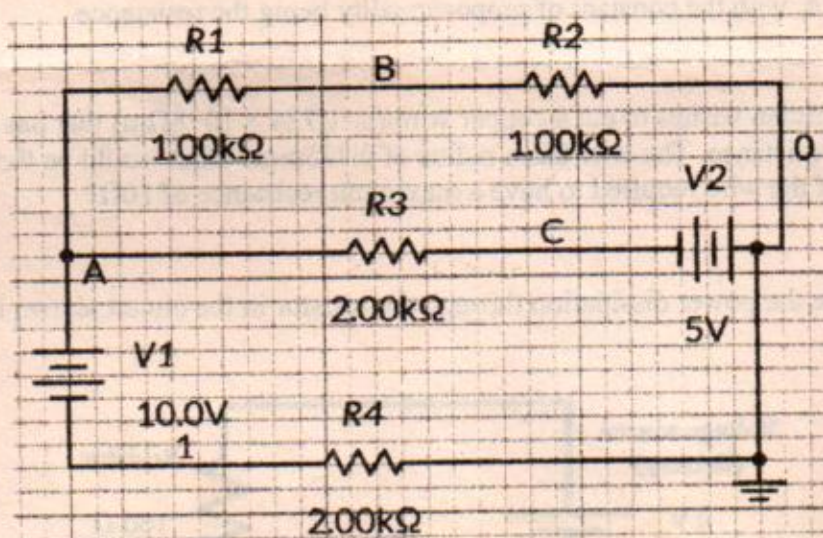
(16 marks)

Figure 2

3)

a. What does it mean by a forward biased diode and a reverse biased diode?

(2 marks)

b. Draw current-voltage characteristic curve of a P-N Junction and clearly mark the following areas.
   i)   Forward Operating Region
   ii)   Reverse Operating Region
   iii) (KNEE Voltage) V_{KNEE}
   iv)   Leakage Current

(6 marks)

c. Write down three diode models used in electronics.

(3 marks)

d. "When a Zener diode is operated in the forward-biased mode in a circuit, it behaves like a regular diode". Briefly explain the above statement?

(3 marks)

e. Answer the following questions referring to the circuit diagram shown in Figure 3. Where D1 is a germanium diode and D2 is a silicon diode. For silicon the threshold voltage is 0.7V and for germanium it is 0.3V. The voltages at point A and B are + 16V and -8V respectively.

   i)   Calculate the voltage difference between A and B.
   ii)   Find the current flowing through R1 and R2
   iii) Find the output voltage (V_o)
   iv)   What are the changes that you would observe in the current flow if the Ge diode is replaced with a Silicon diode.
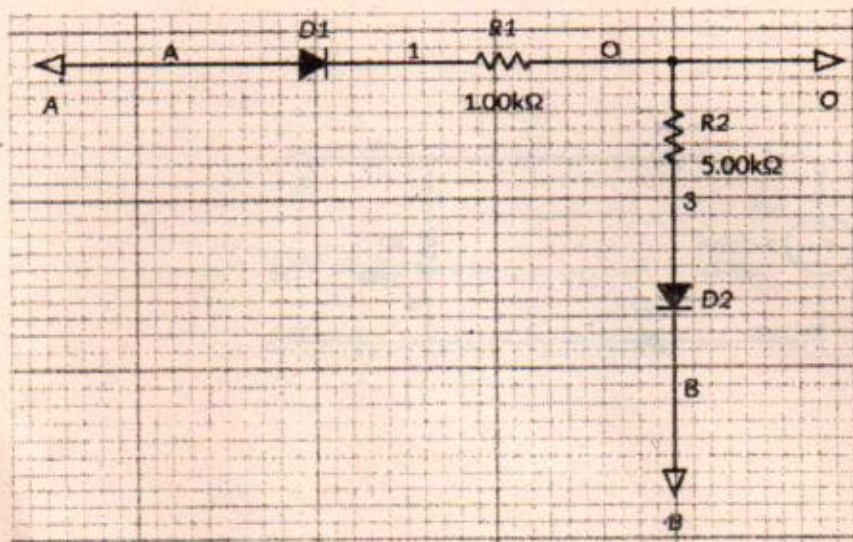
(11 marks)

Figure 3

4)

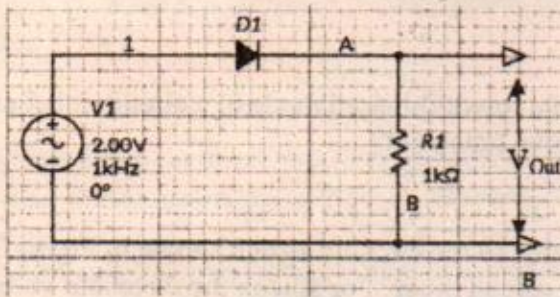a. Write three applications of operational amplifiers?

(3 marks)

b. What are the main steps in converting AC voltage to DC voltage in an AC to DC converter?
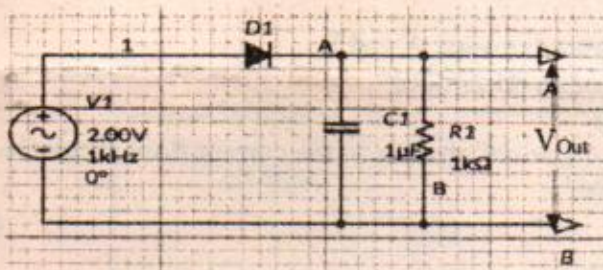
(3 marks)

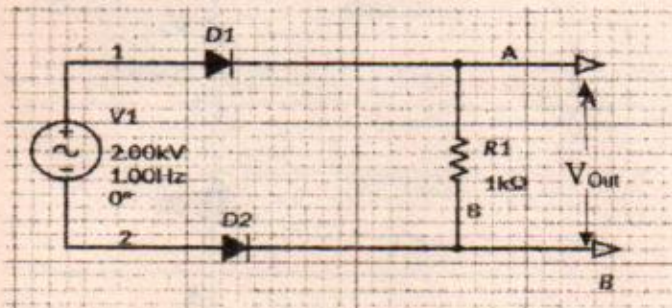c. Draw V_{out} vs. time diagram for the following circuits.

i)

ii)

iii)

(6 marks)

d. Calculate the following parameters of the given circuit in Figure 4. All these symbols have usual meanings. Subscripts B, C and E stand for base, collector and emitter respectively.

  i) V_B
  ii) V_E
  iii) I_E
  iv) I_C
  v) I_B
  vi) V_C
  vii) V_{CE}
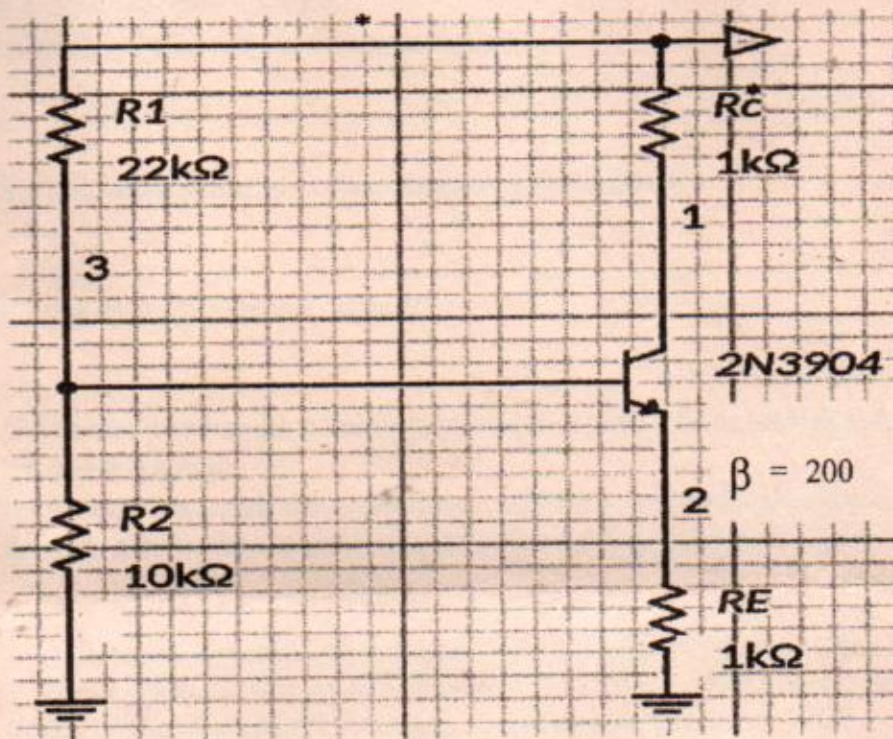
(13 marks)

Figure 4

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