



# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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## UNIVERSITY EXAMINATIONS 2023/2024

SECOND YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE COMPUTER SCIENCE, BACHELOR OF SCIENCE IN COMPUTER TECHNOLOGY AND BACHELOR OF SCIENCE IN COMPUTER SECURITY AND FORENSICS

### SPS 3200: BASIC ELECTRONICS

DATE: JANUARY 2025

TIME: 2 HOURS

**INSTRUCTIONS: Answer Question ONE and any other TWO questions.**

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#### QUESTION ONE (30 MARKS)

- a) Determine the thermal voltage of a diode operating at  $28^0\text{ C}$  (3 Marks)
- b) Explain the formation of electron-hole pair in intrinsic semiconductors (2 Marks)
- c) Define the following terms:
  - i. Recombination (2 Marks)
  - ii. Electroluminescence (2 Marks)
- d) Differentiate between Zener and Avalanche breakdown (2 Marks)
- e) With the aid of a diagram, explain how BJT is activated as an amplifier (3 Marks)
- f) Explain the reverse biasing of a PN-junction diode with the help of a diagram (4 Marks)
- g) Discuss the main properties of OP-AMP (3 Marks)
- h) Sketch the graph of  $I_{DS}$  versus  $V_{DS}$  in FET transistors (3 Marks)

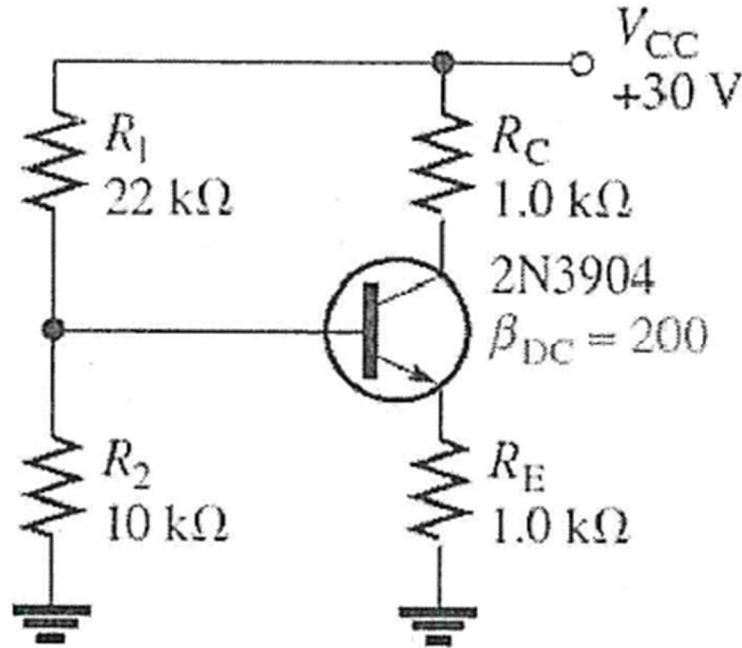


MUST is ISO 9001:2015 and



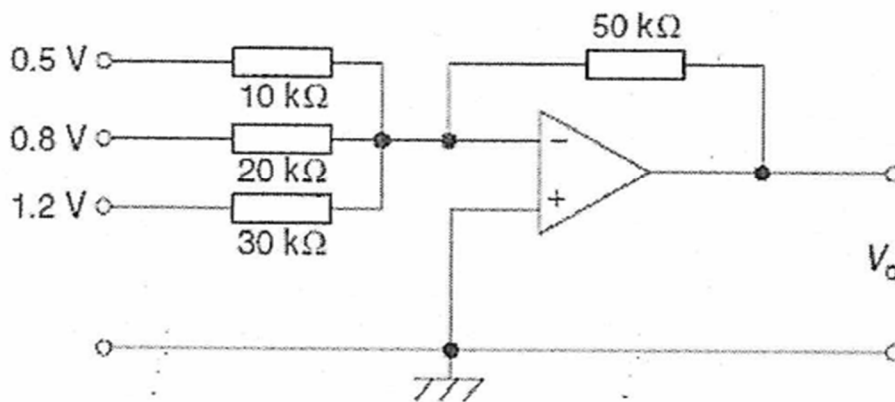
ISO/IEC 27001:2013 CERTIFIED

- i. Determine  $V_B, V_E, I_B, I_E,$  and  $I_C$  and the figure below. The 2N3904 is a general purpose transistor with a typical  $\beta_{DC} = 210$  (6 Marks)



**QUESTION TWO (20 MARKS)**

- a) A differential amplifier has an open-loop voltage gain of 110. The input signals are 2.45V and 2.35V. Calculate the output voltage of the amplifier (4 Marks)
- b) The figure below shows a summing Op-Amp, determine the output voltage (5 Marks)



- c) A differential amplifier has an open-loop voltage gain of 100 and a common input signal of 3.0V to both terminals. An output signal of 24mV results. Calculate the common-mode gain and the CMRR (5 Marks)
- d) Discuss three (3) Op Amp parameters (6 Marks)

### QUESTION THREE (20 MARKS)

- a) Determine the dc current gain  $\beta$  and the emitter current  $I_E$  a transistor where  $I_E = 60\mu A$  and  $I_C = 3.65 \text{ mA}$  (4 Marks)
- b) i. Describe four (4) operation modes of BJT transistor (8 Marks)  
ii. Sketch and explain the V-I collector characteristics graph of a BJT transistor (3 Marks)
- c) Briefly explain the working of JFET transistor (5 Marks)

### QUESTION FOUR (20 MARKS)

- a) With aid of a diagram, discuss the difference between a conductor, semiconductor and insulator using the energy band theory (7 Marks)
- b) A PN-junction diode has a leakage current of  $10^{-14} \text{ A}$  at a temperature of  $27^\circ \text{C}$  and  $10^{-9} \text{ A}$  at temperature of  $125^\circ \text{C}$ . The diode was forward biased with a constant current source of  $1 \text{ mA}$  at  $27^\circ \text{C}$ . If the current is assumed to remain constant, calculate the junction barrier voltage at  $27^\circ \text{C}$  and  $125^\circ \text{C}$  (8 Marks)
- c) Briefly explain the working of a LED (5 Marks)