



MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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UNIVERSITY EXAMINATIONS 2023/2024

FIRST YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR
OF MATHEMATICS AND COMPUTER SCIENCE

SPS 3125: BASIC ELECTRONICS

DATE: APRIL 2024

TIME: 2 HOURS

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

Boltzmann constant = 1.380649×10^{-23} J/K

Charge = $160217663 \times 10^{-19}$

QUESTION ONE (30 MARKS)

- a) Determine the thermal voltage of a diode operating at 27 0 C
- b) Explain the following concepts: (4 Marks)
 - i. Electron-hole pair formation (2 Marks)
 - ii. Recombination
- c) Differentiate between: (2 Marks)
 - i. Zener and Avalanche breakdown (2 Marks)
 - ii. Majority and minority charge carrier in semiconductors (2 Marks)
- d) With the aid of a diagram, explain how to BJT is activated as an amplifier (3 Marks)
- e) With the aid of a diagram, explain the reverse biasing of a PN-junction diode (4 Marks)
- f) Discuss the main properties of OP-AMP (3 Marks)
- g) Sketch the graph of I_{DS} versus V_{DS} in FET transistors (3 Marks)



MUST is ISO 9001:2015 and



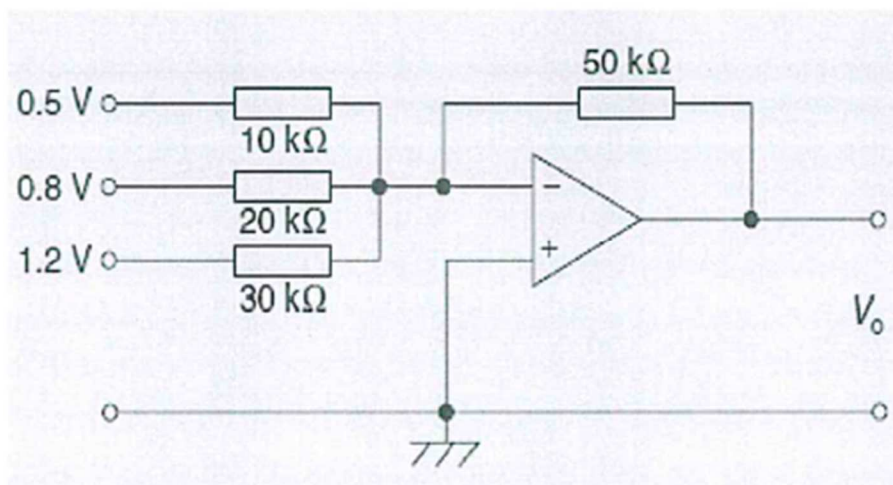
ISO/IEC 27001:2013 CERTIFIED

h) Briefly explain the working of JFET transistor (5 Marks)

QUESTION TWO (20 MARKS)

a) A differential amplifier has an open-loop voltage gain of 110. The input signals are 2.55V 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 120 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)

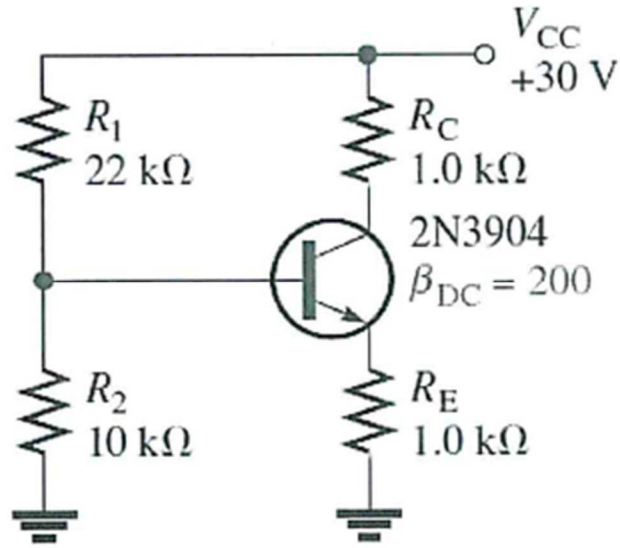
QUESTION THREE (20 MARKS)

a) Determine the current gain β and the emitter current I_E transistor where $I_E=50\mu A$ and I_C (3 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) Determine $V_B, V_E, V_C, I_E,$ and I_C in the figure below. The 2N3904 is a general purpose transistor with a typical $\beta_{DC}=200$ (6 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} at a temperature of 27°C and 10^{-9}A at temperature of 125°C . The diode was forward biased with a constant current source of 1mA at 27°C . If the current is assumed to remain constant, calculate the junction barrier voltage at 27°C and 125°C (8 Marks)
- c) Briefly explain the working of a LED (5 Marks)