

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF
SCIENCE IN ENGINEERING

EENG 393: ANALOGUE ELECTRONICS

STREAMS: BSc. EENG

TIME: 2 HOURS

DAY/DATE: TUESDAY 19/12/2023

8.30 A.M. – 10.30 A.M.

Question 1

- a) Explain briefly what doping is and its importance in semiconductors. **(2 marks)**
- b) In a differential amplifier with two input resistors (R_{in}) of $4.7\text{ k}\Omega$ each, two collector resistors (R_C) of $10\text{ k}\Omega$ each, and a transconductance (g_m) of 2 mS , calculate the voltage gain (A_v) for a differential input voltage (V_d) of 1 V . **(3 marks)**
- c) State what biasing means and briefly explain the two types of bias in semiconductor. **(4 marks)**
- d) In an inverting amplifier circuit with an op-amp, a feedback resistor (R_f) of $10\text{ k}\Omega$, and an input resistor (R_{in}) of $2\text{ k}\Omega$, calculate the voltage gain (A_v) and the output voltage (V_o) when the input voltage (V_{in}) is 2 V . **(4 marks)**
- e) Explain the difference between open-loop gain and closed-loop gain in amplifier systems? **(4 marks)**
- f) In a differential amplifier, if the input to one of the input terminals is 2 mV and the input to the other input terminal is 3 mV , calculate the differential output voltage if the differential gain (A_D) is 200 . **(3 marks)**
- g) State the two golden rules applicable to an ideal operational amplifier (op-amp) amplifier configured with negative feedback. **(4 marks)**

- h) An op-amp has a gain-bandwidth product (GBW) of 1 MHz. Calculate the bandwidth (BW) of an inverting amplifier with a voltage gain of 10. **(2 marks)**
- i) Explain one advantage and one disadvantage of using coupling capacitors in the transistor circuit design for DC operation. **(4 marks)**

Question 2

- a) Using a V-I graph, explain the concept of avalanche breakdown. Use the Zener diode circuit to explain how the avalanche breakdown is stopped by the Zener diode and act as a voltage regulator. **(11 marks)**
- b) There are factors that contribute to operational amplifiers from not being ideal. Analyze the effects of the following terms that make it impossible for operational amplifiers to work at the ideal state. **(9 marks)**
- i. Offset voltage, V_{os}
 - ii. Bias current, I_{bias}
 - iii. Offset current, I_{os}

Question 3

- a) Explain at least six differences between forward bias and reverse bias. **(12 marks)**
- b) In a common base connection, $\alpha = 0.95$. The voltage-drop across 2 k Ω resistance which is connected in the collector is 2V. Draw the circuit and calculate the base current. **(8 marks)**

Question 4

- a) Using circuit diagrams, illustrate the differences between an inverting amplifier and a non-inverting amplifier that are ideal. Derive the equations of Gain (G) that govern the two types of amplifiers. **(10 marks)**
- b) Operational amplifiers (op-amps) and differential amplifiers are both essential components in analog electronics, but they serve different purposes and have distinct characteristics. Explain five difference between op-amps and differential amplifiers. **(10 marks)**
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