



(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

**UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR**

**SECOND YEAR SECOND SEMESTER MAIN EXAMINATIONS
FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN PHYSICS**

COURSE CODE: SPH 343

COURSE TITLE: ELECTRONIC DEVICES AND CIRCUITRY

DATE: TUESDAY 26TH APRIL, 2022

TIME: 12:00 PM - 2:00 PM

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWO of the remaining.

Symbols used bear the usual meaning.

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over. ►

QUESTION ONE (30 MARKS)

- a) State two main disadvantages of discrete circuits **(2marks)**
- b) Explain the following processes in the production of monolithic integrated circuits
 - i) Etching **(2 marks)**
 - ii) Packaging **(2 marks)**
- c) State the four basic types of constructions that are employed in the manufacture of Integrated circuits. **(4 marks)**
- d) Show that gain of a non-inverting ideal operational amplifier is given by **(4 marks)**

$$A = 1 + \frac{R_2}{R_1}$$

where R_2 is the feedback resistor and R_1 is the input resistor of the Op-Amp.

- e) A differential amplifier has an open circuit gain of 100. Determine the output voltage if the input signals are 3.15V and 3.25V. **(2 marks)**
- f) Outline four advantages of using integrated circuits over discrete circuits in electronic designs or constructions. **(4 marks)**
- g) Figure 1 shows an inverting operational amplifier. Determine the closed loop voltage gain and the maximum operating frequency if the slew rate is 0.5V/ μ s. **(6 marks)**

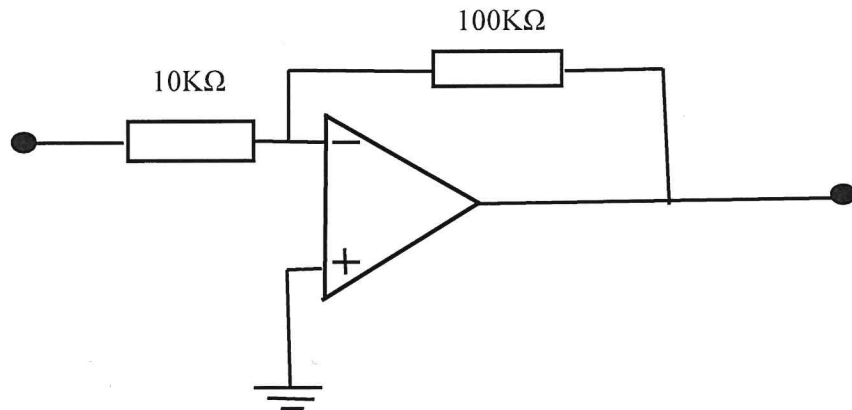


Figure 1

- h) A differential amplifier has an output of 1.0V and with a differential input of 10.0mV and an output of 5.0mV with a common mode input of 10.0mV. Determine the Common mode rejection ration (CMRR) in dB. **(4 marks)**

QUESTION TWO (20 MARKS)

- a) Differentiate between common mode and differential mode signals (2 marks)
- b) Outline four important characteristics of an ideal operational amplifier (4 marks)
- c) Show that the voltage gain of a real inverting operational amplifier is given by

$$A = -\frac{R_2}{R_1} \frac{1}{1 + \frac{1}{A} \left(1 + \frac{R_2}{R_1}\right)}$$

where R_2 is the feedback resistor and R_1 is the input resistor of the Operational amplifier circuit. (10 marks)

- d) State the conditions under which the summing amplifier will act as an averaging amplifier. (4 marks)

QUESTION THREE (20 MARKS)

- a) Show that the effect of negative feedback on a voltage follower circuit is to increase the input impedance of the circuit by a factor $(1+A_o)$ where A_o is the open loop gain of the Operational amplifier. (4 marks)
- b) Two voltages of +0.6V and -1.4V are applied to the two input resistors of a summing amplifier. The respective input resistors are 400K Ω and 100K Ω and the feedback resistor is 200K Ω . Determine the output voltage of the amplifier. (4 marks)
- c) A three stage Op-amp circuit is required to provide voltage gains of +10, -18 and -27. If all the three stages use 270K Ω feedback resistors,
 - i) Draw the circuit of the amplifier clearly showing the connection of the input signal and the inter-stage connections. (4 marks)
 - ii) Compute the output voltage for an input voltage of 150 μ V. (8 marks)

QUESTION FOUR (20 MARKS)

- a) Compute the output voltage for a differentiator circuit whose input changes from 0 to 5V in 0.1ms if the input capacitance is 0.1 μ F and the feedback resistance is 1K Ω . (6 marks)
- b) Show that the voltage of an integrator circuit is given by

$$V_o = -\frac{1}{RC} \int_0^t V_i dt$$

where R is the input resistance and C is the feedback capacitor. (10 marks)

- c) State the Barkhausen criterion for sustained oscillations in electronic circuits **(2 marks)**
- d) Describe two important characteristics of comparator circuits **(2 marks)**

QUESTION FIVE (20 MARKS)

- a) Describe the operation of a comparator in performing the following functions
 - iii) zero crossing detection **(4 marks)**
 - iv) level detection **(4 marks)**
 - v) square wave generation **(4 marks)**
- b) A phase shift oscillator uses 5pF capacitors. Determine the value of resistance to produce an output frequency of 800KHz. **(2 marks)**
- c) Use a circuit diagram to describe the operation of a Wien-bridge Oscillator **(6 marks)**