



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2021/2021 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE

OF

**BACHELOR OF SCIENCE IN ELECTRICAL AND
COMMUNICATIONS ENGINEERING**

COURSE CODE: ECE 221

COURSE TITLE: BASIC ELECTRONICS

DATE: TUESDAY, APRIL, 26TH, 2022

TIME: 8:00 – 10:00 AM

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.
QUESTION ONE CARRIES 30 MARKS AND ALL OTHERS 20 MARKS EACH.

MMUST observes ZERO tolerance to examination cheating

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

Constants

k	-	1.38 x 10⁻²³ J/K⁰	Boltzmann's Constant
e	-	1.6 x 10⁻¹⁹C	electronic charge
ε	-	8.85 x 10⁻¹² F/m	Relative permittivity
μ	-	4π x 10⁻⁷ H/m	Relative permeability
h	-	6.67 x 10⁻³⁴	Plancks Constant
m	-	9.1 x 10⁻³¹ Kg	Electron mass at rest

QUESTION ONE

- a. Explain with the suitable illustrations how the n-type semiconductor material is formed. 3 marks
- b. State Two main advantages the transformer coupled amplifier has over the R-C coupled amplifier. 4 marks
- c. Show that the change in emitter current ΔI_E to the change in base current ΔI_B may be expressed as $\frac{\Delta I_E}{\Delta I_B} = \frac{1}{1-\alpha}$
- Where α is the current gain in CB configuration 5 marks
- d. Explain the operation of a half-wave rectifier using suitable drawings and expressions. 7 marks
- e. With aid of suitable illustrations and expressions, explain the principle operation of a varactor diode. 5 marks
- f. Determine the value of a series resistor required to limit the current through an LED to 20mA with a forward voltage drop of 1.6 v when connected to a 10 v supply. 5 marks

QUESTION TWO

- a. Illustrate how the positive half-cycle of applied input signal becomes negative at the output of the amplifier. 6 marks

- b. A transistor operating in the C_E mode draws a constant base current $I_B=30\mu A$. The collector current is found to change from 3.5mA to 3.7mA when the collector –emitter voltage changes from 7.5 v to 12.5 v. Calculate
- Current gain in CE 3 marks
 - Output resistance 3 marks
 - Current gain CB 3 marks
- c. Draw the three transistor modes and indicate the respective polarities of each terminal. 5 marks

QUESTION THREE

- a. Define the following terms:
- Dopant 1 mark
 - Electron-volt 1 mark
 - Mobility 1 mark
 - Resistivity 1 mark
- b. Describe the graphical representation of an amplifier operating using suitable illustration 7 marks
- c. Derive that the ripple factor for a rectifier may be expressed as:-

$$\gamma = \frac{\sqrt{v^2_{r.m.s} - v^2_{dc}}}{V_{dc}} \quad \text{9 marks}$$

QUESTION FOUR

- a. Describe the operation of an n-channel field effect transistor 11 marks

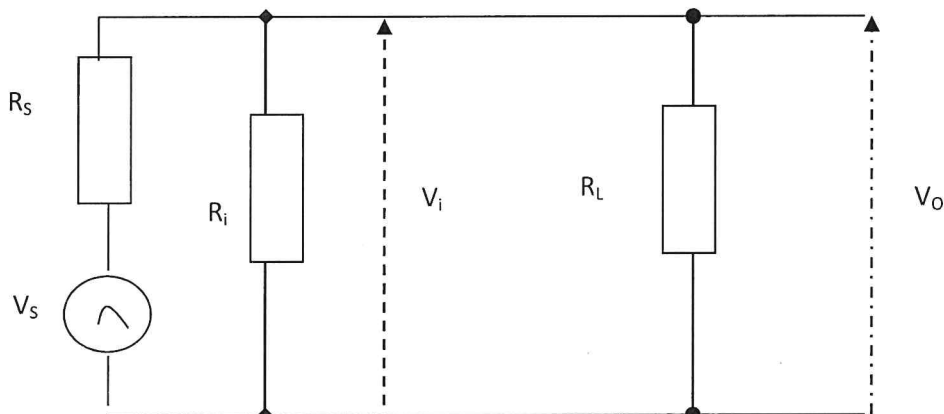


Figure 1

The circuit of figure 1 is an equivalent of a single stage amplifier

Derive that:- $G_p = G_v \times G_i$

Where: G_p - Power gain
 G_v - voltage gain
 G_i - current gain

9 marks

QUESTION FIVE

a. Derive to show that in JUFET $\mu = r_d \times g_m$ Type equation here.

Where μ - multiplication factor

r_d - drain resistor

g_m - mutual conductance

3 marks

b. Briefly explain the operation of an LED device

5 marks

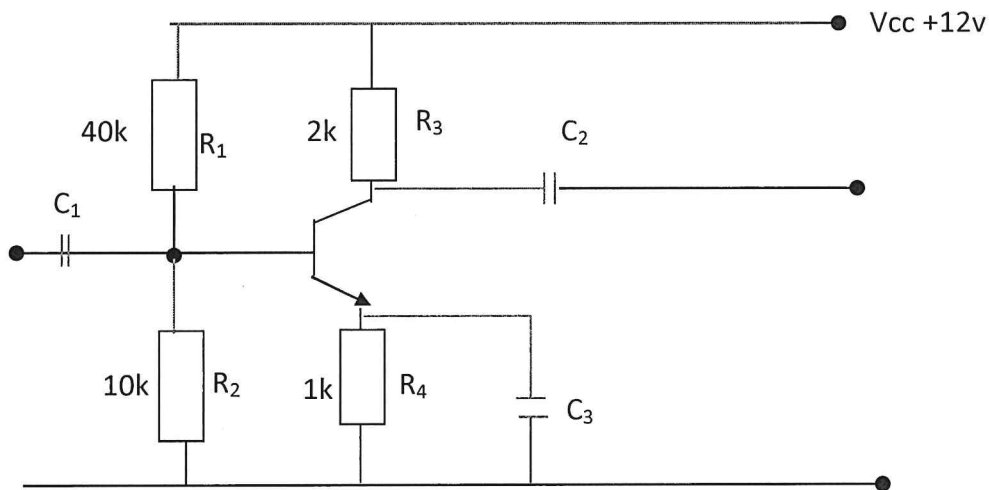


Figure 2

Using the given values in figure 2; $\beta = 100$. Calculate the following biasing levels.

- (i) V_B (ii) V_E (iii) I_E (iv) I_C (v) V_{ce} (vi) I_B 12 marks