



# **MURANG'A UNIVERSITY OF TECHNOLOGY**

## **SCHOOL OF ENGINEERING AND TECHNOLOGY**

### **DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING**

**UNIVERSITY ORDINARY EXAMINATION**

**2023/2024 ACADEMIC YEAR**

**FOURTH YEAR SECOND SEMESTER EXAMINATION FOR BACHELOR  
OF TECHNOLOGY IN ELECTRIC AND ELECTRONIC ENGINEERING**

**EET216: ELECTRICAL MACHINES**

**DURATION: 2 HOURS**

#### **INSTRUCTIONS TO CANDIDATES:**

1. Answer Question one and any other two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

## SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

### QUESTION ONE (30 MARKS)

1. A. i. Explain in general terms an operational amplifier (2marks)  
ii) Outline any three characteristics of an ideal operational amplifiers. (3marks)
- B) i. With the aid of diagram, illustrate the features of an open-loop operational amplifier circuit (5marks)  
ii. Explain three limitations of open-loop operational amplifiers connection configurations (6marks)
- C) Distinguish the following terms with reference to variation of input voltage to operational amplifiers.  
i. Common mode gain and common mode rejection ratio  
ii. show rate and virtual ground (4marks)
- D) A current amplifier whose inputs is 20NA flows through 82ks<sup>2</sup> resistor in parallel with a 10ks<sup>2</sup> resistor.  
i. Calculate the current through a 33ks<sup>2</sup> load  
ii. Determine the amplifier current amplification (6marks)
- E) With the aid of circuit diagram illustrate the design of an RC high band pass frequency filter. (4marks)

## SECTION TWO: ANSWER ANY TWO QUESTIONS

### QUESTION TWO (20 MARKS)

- a) Explain the following parameters as applied to operational amplifiers
  - i)  $I_{B1}$  current
  - ii) Input offset current
  - iii) Input offset voltage (6marks)
- b) An operational amplifier circuit connected in open loop configuration operates with a d.c supply of \_\_\_\_\_ 15V and an  $R_L = 200$  \_\_\_\_\_ load resistance.  
Determine
  - i) Maximum peak – to – peak unclipped output signal  $V_o$ .

ii. Maximum peak –to-peak signal voltage  $V_s$  that can be applied without causing clipping of  $V_o$ . (6marks)

c) With the aid of a sketch, explain the operation of non-inverting amplifier using an amplifier that is supplied from a single power supply (8marks)

### QUESTION THREE (20 MARKS)

a) i. Explain any three basic circuits where operational amplifiers are applied. (3marks)

ii) With the aid of a sketch, derive the equations from the output of a two input non-inverting summer circuit. (4marks)

b) Sketch a design of a window detector circuit that connects a 9-volts battery to a charging system when the battery voltage is below 8V and disconnect the battery when the battery is 10V. Briefly explain how the circuit works. (7marks)

c) Figure 1 shows a three-terminal regulator connected to vary d.c. voltage output. If  $v_{in}$  varies from (15 to 20) with  $I_Q$  tuned to 3mA; the values of  $R_1$  and  $R_2$  set at 2ks $\Omega$  and 1ks $\Omega$  respectively determine the  $v_{out}$  when

i.  $R_1$  is 1ks $\Omega$

ii.  $R_2$  is 500s $\Omega$  (6marks)

### QUESTION FOUR (20 MARKS)

a) i. Explain a bandpass filter as applied to oscillators (2marks)

ii. With the aid of a circuit sketch, explain the operation of a wein bridge oscillator in cooperated to operational amplifiers. (6marks)

i) Construct a labelled operational amplifiers and resistors configuration circuit of a 10V light-column voltmeter that measures in steps of 0.5B (5marks)

ii) Design a +/-1.2V to +/-12V split voltage using a three terminal variable voltage regulated power supply ICs, LM317 (positive) and LM337(negative) the supply is operated from a 230V 50Hz socket outlet. The two ICs, have a possible output of +/- 1.2V to +/-57V when a 240s $\Omega$  resistor is used between the output and the variable terminal. From the labelled design determine the value of resistance from the variable resistor. (7marks)