MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

UNIVERSITY ORDINARY EXAMINATION

2021/2022 ACADEMIC YEAR

FOURTH YEAR **SECOND** SEMESTER EXAMINATION FOR BACHELOR OF TECHNOLOGY EDUCATION

EMT 410: ROBOTICS TECHNOLOGY

DURATION: 2 HOURS

Instructions to candidates:

1. Question One is compulsory
2. Attempt any other Two questions in section B
3. Mobile phones are not allowed in the examination room
4. You are not allowed to write on this examination question paper

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

a) Explain the following terms:
   i. Robotics
   ii. Forward kinematics
   iii. Inverse kinematics   (6marks)

b) Explain the following divisions of link in robots:
   i. Rigid link
   ii. Flexible link
   iii. Fluid link.   (6marks)

c) Explain any three types of robot manipulator.   (6marks)

d) Determine the missing elements of the following frame representation:

$$F = \begin{bmatrix} ? & 0 & ? & 3 \\ 0.5 & ? & ? & 9 \\ 0 & ? & ? & 7 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$ (6marks)

e) For the mechanism shown in figure 1.e, determine the number of degrees of freedom. (6marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

a) With the help of sketches describe the main components of a robot.   (10marks)

b) A point P $(2, 3, 4)^T$ is attached to a rotating frame. The frame rotates at 90^0 about x-axis of the reference frame after the rotation and verify the results graphically.   (10marks)

QUESTION THREE (20 MARKS)

a) Using suitable diagrams describe two types of joints in a robot.   (8marks)

b) Briefly discuss four robot applications in our lives.   (12marks)

QUESTION FOUR (20 MARKS)

a) Explain any three programming modes of a robot.   (6marks)

b) Using Lagrangian method, derive the equations of motion for the 2-DoF robot arm, as shown in Figure Q2b.the centre of mass for each link is at the centre of mass for each link is at the centre of the link. The moments of inertia are I_1 and I_2.   (14marks)