MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING TECHNOLOGY

DEPARTMENT OF _____

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

FOURTH YEAR **SECOND** SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING/BACHELOR OF TECHNOLOGY IN ELECTRICAL

EMT410: ROBOTICS TECHNOLOGY

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)

a) What is a robot? (2marks)

b) Explain the following types of robots
   i. Android robot
   ii. NC robot
   iii. Intelligent robot
   iv. Fixed sequence robot (4marks)

c) Describe the classification of robot vision systems based on dimensional model of scenes and light intensity level. (4marks)

d) Find the equation of motion of the spring-mass system shown below using Newtorian approach and Langragian approach. (2marks)

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e) Explain the following common robot terminologies
   i. Limited sequence
   ii. Accuracy
   iii. Payload
   iv. Yaw (4marks)

f) Robots are structured in four coordinate systems. Name and describe two of them. (4marks)

g) Describe the following sensors used in robotics (4marks)

i. Force sensor

ii. Proximity sensor

iii. Tactile sensor

iv. Limit switches

h) Mention any two uses of sensors in robotics (4marks)

SECTION TWO: ANSWER ANY TWO QUESTIONS

QUESTION TWO (20 MARKS)

a) Differentiate between power and manual lead through programming (4marks)

b) Explain the five generators of robots controllers (5marks)

c) What is a controller? Mention the basic types of controllers and their purpose. (4marks)

d) Consider the following electrical system shown in the figure below (7marks)

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Find the transfer function model and draw its function model.

QUESTION THREE (20 MARKS)

a) Explain the following terms used in robot vision (4marks)

   i.   Thresholding

   ii.   Object recognition

   iii.   Feature extraction

   iv.   Windowing

b) Find the transfer function of PiD controller and draw its block diagram (4marks)

c) Show that the equation f a pendulum is given by $\theta + {}^{g}/_{l}\sin\theta = 0$ (8marks)

d) With the help of a diagram explain the operation of the vidicon tube. (4marks)

QUESTION FOUR (20 MARKS)

a) Differentiate between robot-oriented and object-oriented programming. (4marks)

b) The position of an end effector P(5,8,10) is rotated at 60° about the 2-axis, followed by 30o about x-axis and then 45o about the y-axis. Find the final position of the end effector. (6marks)

c) The figure below shows a 2-DOF link manipulator whose joints are both revolute and link lengths 11 and 12 as shown. Given the exact position and orientation, find the possible joint angles. (10marks)