KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Mechanical Engineering

B. Sc. Engineering 4th Year 1st Term Examination, 2015

ME 4083

(Robotics)

Time: 3 Hours | Total Marks: 210

N.B.: i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if any missing.

SECTION-A

1(a) What are the basic components of a robotic system? State the main function of each component. 12

1(b) Describe the application areas of modern Robots. 11

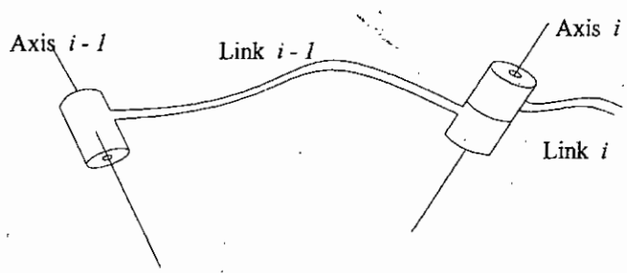
1(c) What are the different types of actuator used in Robot? What are the advantages and disadvantages of each of them? 12

2(a) What are the main components of a Robotic manipulator? Briefly explain each of them. 10

2(b) Draw the following Robotic manipulators and state the types of joints required for each of them. 16
(i) Cartesian Robot, (ii) Cylindrical Robot, (iii) Spherical Robot and (iv) SCARA Robot

2(c) What are the common characteristics (specification) of a Robotic manipulator? Describe briefly at least three of them. 09

3(a) Derive the homogeneous transformation matrix from {i – 1} to {i} frames by using Denavit–Hartenberg parameters. 15



3(b) By considering universal coordinate system, draw a 3 link manipulator with two revolute and one prismatic joint. Assume arbitrary link lengths and joint angles. Find the D-H parameters. Also compute the position and orientation of the end-effector with respect to base. 20

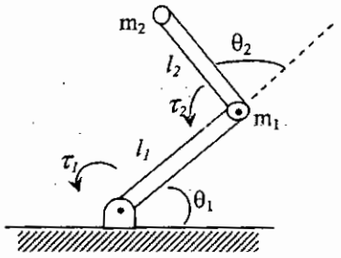
4(a) Define and differentiate forward and inverse kinematics. 08

4(b) *Find the joint angles of a two link manipulator by using a pre-defined end effector position.* 13

4(c) A two-link manipulator consists of two revolute joints. Calculate the velocity of the tip of the manipulator as a function of joint rates. Also calculate the Jacobian matrix. 14

SECTION-B

5(a)	What is sensor? Explain the major classification of sensors.	06
5(b)	Define actuators in Robot with its important properties.	07
5(c)	Explain the prime characteristics of different actuators commonly used in Robotics.	12
5(d)	Describe why we use sensors and actuators in Robotics.	10
6(a)	What is the difference between path and trajectory? In which cases we need to consider path generation with via points?	10
6(b)	Differentiate path generation in joint space and Cartesian space.	10
6(c)	Derive the joint space trajectory of a Robot with a suitable method for minimum jerk. Mention its benefits and drawbacks.	15
7(a)	Write short notes on Jacobians and Singularities.	10
7(b)	Calculate the joint torques of a 2–DOF planner manipulator as shown in figure. Take necessary assumptions if you required.	25



8(a)	How does encoder works?	07
8(b)	What are the different methods of robot programming? What are the requirements of a robot programming language?	13
8(c)	Design a Robot manipulator with available sensors and actuators which is preferable to you and how you will control your robot. Explain with necessary sketch.	15

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Department of Mechanical Engineering

B. Sc. Engineering 4th Year 1st Term Examination, 2015

ME 4059

(Engineering Tribology)

Time: 3 Hours | Total Marks: 210

N.B.: i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if any missing.

SECTION-A

1(a) What is tribology? Explain the industrial importance of tribology. 07

1(b) What are the methods of tribological solution in mechanical engineering? Explain them with neat sketch. 15

1(c) What is meant by atomic packing factor? Find out the APF of FCC structure metal. 08

1(d) Draw the structure of a metallic surface. 05

2(a) What are the different techniques to examine the surface? Describe the method of surface profilometry with necessary diagram. 15

2(b) Describe the thermal effects on metal surfaces between two solids contact. 08

2(c) Explain the simple adhesion theory at solid-solid contact. 12

3(a) What is friction? Describe the laws of friction. 10

3(b) Define rolling friction. What are the various types of rolling friction? Describe any one of them. 15

3(c) In a friction band loaded against a rotating shaft, prove that the friction coefficient $\mu = \frac{1}{\pi} log_e \left(\frac{T_1}{T_2}\right)$, where T_1 and T_2 are the tensions of both sides of the band. 10

4(a) Write short notes on: 12

(i) Wear, (ii) Fretting, (iii) Pitting and (iv) Delamination

4(b) What are the mechanisms of wear? Describe the laws of adhesive wear with necessary equation. 15

4(c) How wear can be measured? Describe the factors which affect the wear behavior. 08

SECTiON-B

5(a)	Describe the properties and functions of lubricant.	10
5(b)	Why additives are used in lubricant? Describe different types of additives.	10
5(c)	Describe the effects of temperature and pressure on viscosity of a lubricant.	10
5(d)	Explain film geometry of journal bearing.	05
6(a)	How viscosity can be measured? Describe the viscosity measurement using falling body viscosity meter.	12
6(b)	Draw Stribeck curve mentioning lubrication regimes.	05
6(c)	What is boundary lubrication? Explain in details with neat sketch.	08
6(d)	Describe the term viscosity rating and service rating of lubricating oil.	04
6(e)	What is meant by multigrade oil and multipurpose grease? Explain with the field of applications.	06
7(a)	What is meant by fluid film lubrication? What are the important characteristics of viscous flow?	06
7(b)	Derive the expression of Navier – Stokes equation in fluid film lubrication.	17
7(c)	What are the different types of bearing? Describe the working principle of journal bearing with neat sketch.	12
8(a)	What are the requirements of gear lubrication for open gears and enclosed gears?	06
8(b)	What are basic types of seal? Mention the factors which should consider in design of sealing systems.	14
8(c)	Briefly describe the following terms: (i) Engine tribology, (ii) Micro and Nano tribology and (iii) Bio tribology	15

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