Code No: RT32034 **R13** SET - 1

III B. Tech II Semester Regular/Supplementary Examinations, April -2018

ROBOTICS

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1	a)	Define a robot and give its applications.	[3M]
	b)	What are the common types of arms of a robot?	[4M]
	c)	What is meant by position and orientation of robot?	[4M]
	d)	What is dynamic modeling?	[3M]
	e)	What are the advantages of offline programming?	[4M]
	f)	What are the merits and demerits of moving coil dc motors?	[4M]

PART -B

2	a)	Name and discuss the four basic arm configurations that are used in robotic manipulators.	[8M]
	b)	Discuss the advantages and disadvantages of using robots in industry.	[8M]
3	a)	Explain the functions of basic components of a robot with a neat sketch.	[8M]
	b)	Sketch the following robots indicating the joints and degree of freedom. i) SCARA robot. ii) Gantry robot. Write their applications.	[8M]
4	a)	Compute the homogeneous transformation representing a translation of 3 units along the x-axis and followed by rotation of 90^0 about the current z-axis followed by a translation of 1 unit along the fixed y-axis.	[8M]
	b)	Discuss about direct and inverse kinematics.	[8M]
5		Determine the dynamic equations for the two-link manipulator shown in Figure 1, using Lagrange-Euler formulation. Assume that the whole mass of the link can be considered as a point mass located at the outermost end of each link. The masses are m1 and m2 and the link lengths are a1 and a2.	[16M]

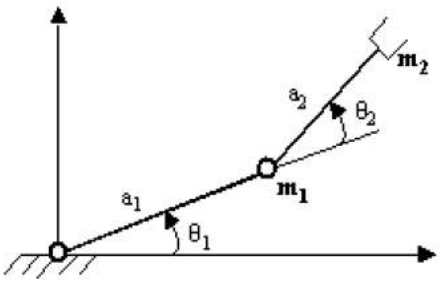

Figure1

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6 a) Differentiate between path planning and trajectory planning. [8M]
b) Discuss the software elements of robot and different teaching methods of robot. [8M]

7 a) Compare stepper motor and D.C. motor drives for a robot. [8M]
b) What are the desirable features of a robot for successful machine tool load/unload applications? [8M]

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Code No: RT32034 **R13** SET - 2

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ROBOTICS

(Mechanical Engineering)

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1	a)	With help of sketch describe pitch, yaw and roll motion of a robot wrist.	[4M]
	b)	What are the basic components of a robotic system?	[4M]
	c)	Explain the importance of homogeneous transformations.	[4M]
	d)	What are the advantages of Euler-Lagrange formulation?	[4M]
	e)	Write short notes on joint integrated motion.	[3M]
	f)	Discuss robot application for assembly and inspection.	[3M]

PART -B

2	a)	Enlist the applications and characteristics of future robots.	[8M]
	b)	Sketch and explain two views to indicate the work envelope of a i) Cartesian robot. ii) Polar robot.	[8M]
3	a)	What is the function of a manipulator? Discuss the working of a robotic manipulator arm with a sketch.	[8M]
	b)	What are the various factors in selection and design of end effectors? Explain**.**	[8M]
4	a)	Explain and derive inverse kinematic solution for the variables of a cylindrical robot.	[8M]
	b)	State the important steps in Denavit-Hartenberg (D-H) convention.	[8M]
5		Consider a two-degree of freedom manipulator shown in Figure 1. Assuming that the inertia of the first moving link is negligible and that the second moving link is a slender homogeneous rod of mass m, determine the dynamic equations of motion by the Lagrangian method using θ1 and θ2 as the generalized coordinates.	[16M]

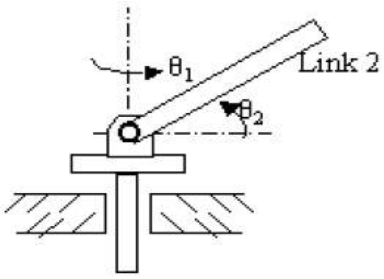

Figure1

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6	a)	Explain the following i) Skew motion ii) Joint integrated motion iii) Straight line motion	[8M]
	b)	What is robot software and explain common software elements of a robot.	[8M]
7	a)	Sketch and explain a hydraulic drive system used for robots.	[8M]
	b)	State characteristics of work which promote application of robots. Discuss robot application for assembly and inspection.	[8M]

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Code No: RT32034 **R13** SET - 3

III B. Tech II Semester Regular/Supplementary Examinations, April -2018

ROBOTICS

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1	a)	Define payload and work volume of a robot.	[4M]
	b)	List the advantages of Pneumatic manipulators.	[3M]
	c)	Write short notes on inverse kinematics.	[4M]
	d)	Distinguish between Euler-Lagrange and Newton-Euler formulation.	[4M]
	e)	Define path and trajectory of a robot.	[3M]
	f)	Discuss robot application for welding and machine loading.	[4M]

PART –B

2	a)	Explain the relationship of robotics with industrial automation and illustrate the same with a suitable example.	[8M]
	b)	Give the applications of robot with respect to Cartesian, cylindrical and polar arm configuration.	[8M]
3	a)	Compare the features of most commonly used electric actuators in robotics.	[8M]
	b)	List the advantages and disadvantages of Pneumatic manipulators.	[8M]
4	a)	The end effector position of a robot is translated in the x-y-z- directions by distances of 5, 10 and 15 respectively. Write the transformation matrix if the initial point position of the end effector is (2, 1, 2). What is the final position on of the end effector?	[8M]
	b)	Derive the forward kinematics matrix for an articulated robot arm (3-axis) using D-H convention?	[8M]
5		Using Lagrangian mechanics, Derive the equations of motion for the two-degree-of-freedom system shown in figure 1.	[16M]

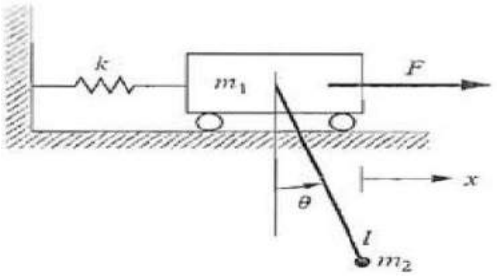

Figure 1

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6 a) A point to point robot with a revolute joint moving with velocity of 15 deg/sec, traverses from an initial position of 12^0 to a final position of 60 deg/sec. Determine the position and velocity at the end of 1,2 and 3 seconds. The range of initial and final position is covered in 6 seconds with a finite acceleration of 8 deg/sec^2. [8M]

b) Discuss the relative merits and demerits of different textual robot languages. Explain different program instructions. [8M]

7 a) Discuss different types of actuators used for robots? [8M]

b) Describe briefly the operations involved in robotic spot welding. What are the advantages of robotic welding over manual welding? [8M]

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Code No: RT32034 **R13** SET - 4

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ROBOTICS

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1	a)	What are the advantages of cylindrical arm configuration over a polar arm configuration?	[4M]
	b)	What are the various types of joints used in robots?	[4M]
	c)	Write short notes on DH convention.	[4M]
	d)	What is Manipulator Jacobian?	[3M]
	e)	What are the functions of robot software?	[3M]
	f)	Explain the working of position sensors.	[4M]

PART –B

2	a)	Discuss the following types of automation i) Fixed automation ii) Flexible automation	[8M]
	b)	What are the advanced technological features of modern robots?	[8M]
3	a)	What is the range of number of axes that may be found in industrial manipulators? Compare Electrical and Pneumatic manipulators.	[8M]
	b)	How many degrees of freedom are normally provided in the arm of a manipulator? Explain why.	[8M]
4	a)	Explain the homogeneous transformation as applicable to rotation?	[8M]
	b)	What is forward kinematics problem? Find the D-H matrix for cylindrical robot.	[8M]
5	a)	Explain the steps involved in the formulation of Lagrange-Euler dynamic model.	[8M]
	b)	Distinguish the advantages and disadvantages between Lagrange-Euler and Newton-Euler formulation.	[8M]
6	a)	A single cubic trajectory is given by $\theta(t) = 8+10t+45t^2+35t^3$ and is used over the time interval from t =1 to t = 2. What are the initial and final velocities and accelerations?	[8M]
	b)	Explain the different types of Robot languages.	[8M]
7	a)	What are the functions of sensors? How do you sense the positional accuracy of a robot? Describe the suitable type of sensor used to measure the position.	[8M]
	b)	Discuss robot application for welding and machine loading.	[8M]

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