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020401

May 2023
B.Tech. (RAI) IVth Semester
Kinematics of Robots
(PCC-RAI-401/21)

Time : 3 Hours]

[Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART–A

1. (a) Define kinematics chain.

(b) How are the kinematic pairs classified?

(c) Define differential degree of freedom.

(d) Write the rotation matrix for 2-D with respect to Y-Z plane.

(e) What is a multiple robot?

(f) What do you mean by Jacobian matrix?

(g) What do you mean by manipulator Jacobian?

(h) Differentiate between Lagrange Euler and Newton Euler formulation.

(i) Explain the pressure angle, circular pitch and diametral pitch.

(j) Define trace point, cam angle and pitch curve terms used in cam. (10×1.5=15)

PART–B

2. (a) Describe various inversions of slider-crank mechanism giving examples. (10)

(b) What are the future applications of robot? (5)

3. (a) What are the singularities of a manipulator? (5)

(b) Difference between velocity Jacobian and the static force Jacobian for a given manipulator. (10)

4. A pair of spur gears has 16 teeth and 18 teeth, a module 12.5 mm, an addendum 12.5 mm and a pressure angle 14.5 degree. Prove that the gears have interference. Determine the minimum number of teeth and the velocity ratio to avoid interference. (15)

5. (a) Explain inverse kinematics. (5)

(b) Define Gear Train and its types. (10)

6. (a) What is homogeneous transformation matrix? Explain *four* sub-matrices. (10)

(b) What do you mean by arc of contact? Explain. (5)

7. Derive dynamic equations for multiple degree of freedom robots using concept of Lagrangian mechanism. (15)