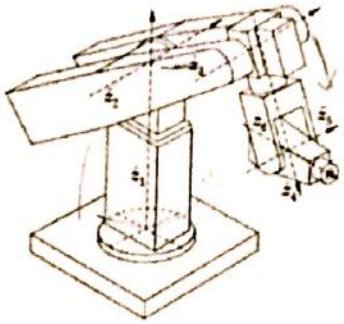
Mechanical Engineering Department, IIT Kharagpur
End Spring Semester Examination 2017-2018

Subject Code: ME60412 Subject: Mechanism and Robot Kinematics Date: 27/4/2018 (AN)
Specialization: ME3+DD(ME3) Number of students: 34 Time: 3 hrs Full Marks 60

Instructions: Answer all questions. If any additional information is required, the data may be assumed with adequate reasoning. Marks for each question or its parts are stated in brackets.

Q 1 Develop the DH parameter table and describe how the inverse kinematics solution of the robotic manipulator below can be obtained by a) geometric method and b) using the Paden-Kahan sub-problems. Assume generic link lengths. There are no offsets. (6+6)



Q 2. Show how the forward kinematics of a closed chain slider crank mechanism is derived using the exponential matrix method of representation. (10)

Q 3. Describe the polynomial based joint motion planning and trajectory generation procedure for a manipulator with 6 DOF. How many constraints are required for the polynomials of 3rd order and 5th order used in these applications? (10)

Q 4. Write the equations of motion representing the kinematics of a rear wheel drive vehicle as shown. Comment on the degree of non-holonomy of this system. (10)

Q 5. How is the Jacobian in differential kinematics useful ascertaining the following aspects of a manipulator?

a) Force transmission capability (4),
b) Conditions of singularities. (4)

Q 6. Write in brief on any two of below: (5x2)

a) Methods needed to solve the kinematics of redundant manipulators.
b) Representation of joints in flexure mechanisms.
c) Methods to determine holonomic and non-holonomic constraints in a mechanical system