EC4.404 Mechatronics System Design

Assignment 3

Robotics Research Center

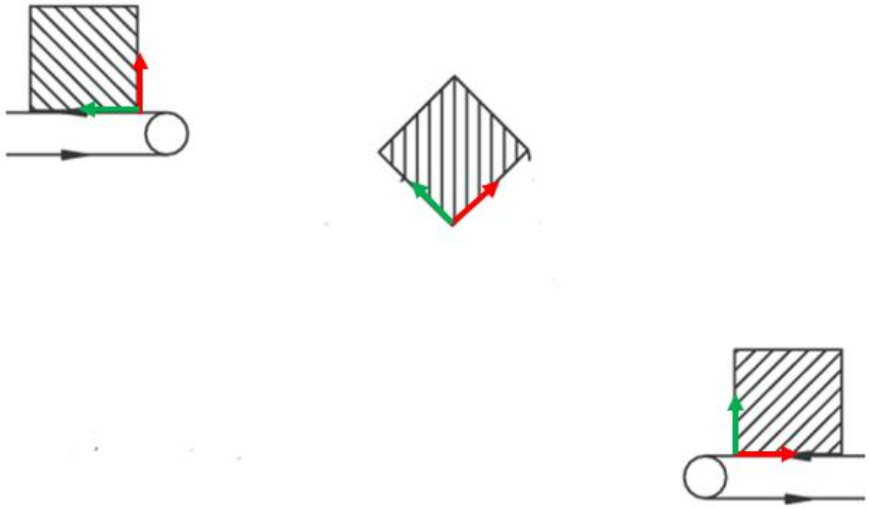
International Institute of Information Technology Hyderabad

18-03-2023

Total Marks : (100)
Due Date : 07-04-2022
Late Submission : Not allowed

Section B:

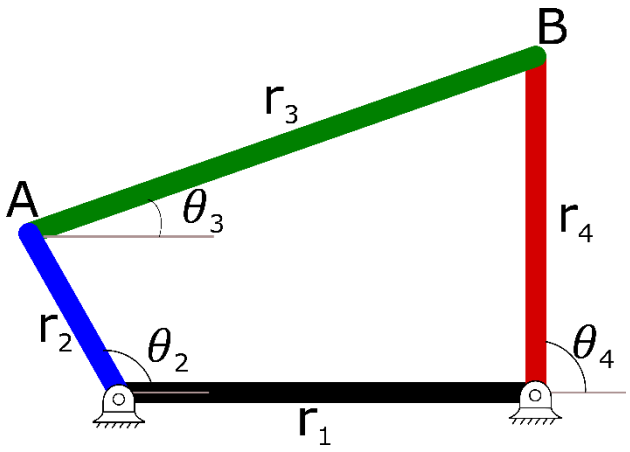
1. *Take a print of the below figure and use the geometry tools to graphically synthesize a mechanism to transport an object through the given poses* ***(15)***



2. *Assume the crank is rotating at a constant speed.* ***(20)***

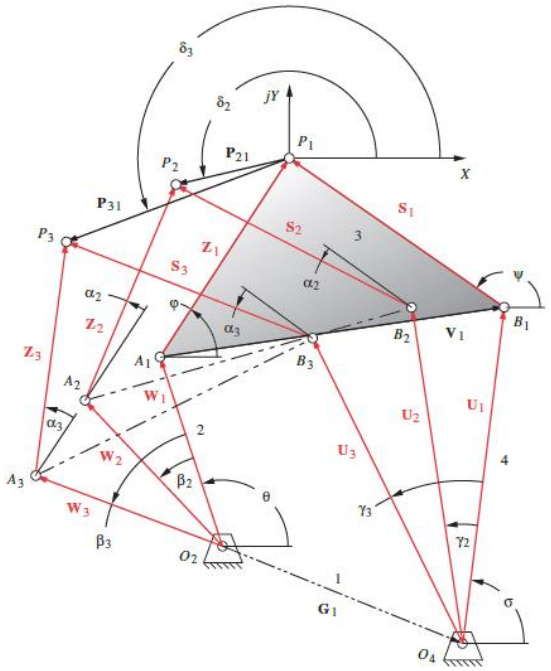
a. Derive the kinematic equations using loop closure and solve for joint angles θ_3 and θ_4.

b. Write a program to simulate the four-bar motion using the equations obtained from 2a for both assembly modes. - (Preferred tool: MATLAB)



3a. Write a program to design a four-bar linkage which will move a line on its coupler link such that a point P on that line will be first at P_1, later at P_2, and still later at P_3, and also will rotate the line through an angle α_2 between the first two precision positions and through an angle α_3 between the first and third precision positions. Find the lengths and angles of the four links and the coupler link dimensions A_1P_1 and B_1P_1 as shown in the figure. **(20)**

3b. Use the program (written for 2b Question) to simulate the synthesized four-bar mechanism. **(5)**



4. Derive the kinematic equations of all the closed loops of the animatronic eye and write a program to simulate them. (Preferred tool: MATLAB) **(30)**

5. Plot the response $(Y_m(s))$ of the following system for the following inputs $(U(s))$ when measured using a sensor $(S(s))$ with the following transfer function? Plot as a function of time using MATLAB or PYTHON. **(10)**

System Response:

$$Y(s) = G(s)U(s)$$

Measured Response:

$$Y_m(s) = S(s)Y(s)$$

System Transfer Function:

$$G(s) = \frac{2}{S+2}$$

$$S(s) = \frac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$$

Inputs:

a) $U(s) = \frac{1}{s}$

b) $U(s) = \frac{1}{s^2+4}$

Two different sensors with the following parameters:

$\zeta = 0.5, \omega_n = 4\ rad/s$

$\zeta = 0.9, \omega_n = 2\ rad/s$