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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- DECEMBER 2018

B. TECH VIIth SEMESTER

COURSE CODE: 17B1WEC733 **MAX. MARKS: 35**

COURSE NAME: ROBOTIC SYSTEMS AND CONTROL

COURSE CREDITS: 3 **MAX. TIME: 2hrs**

Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means. Make valid assumptions wherever required.

1. **[6 marks] Differentiate hard automation, soft automation and autonomous systems. What are the components required to design the autonomous robots?**

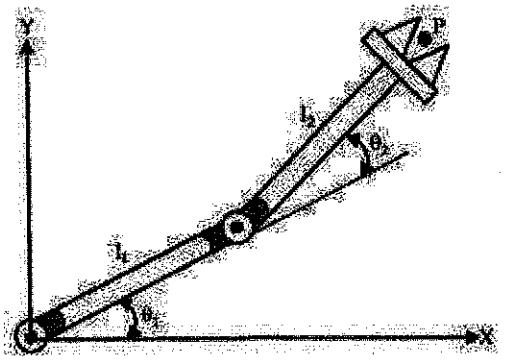
2. **[7 marks] Explain computed torque control method. Draw the block diagram of trajectory tracking control of manipulator using PD+ computed torque control and perform the stability analysis.**

3. **[10 marks] State and explain controllability and observability tests. Check whether the given state-space model is controllable or not. Design a linear state-feedback controller such that the closed-loop poles will be placed at s= -2, -2.**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & -3 \\ 1 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ -2 \end{bmatrix} u$$

4. **[4 marks] Explain the working principle of potentiometer with the help of schematic diagram. Is potentiometer a sensor or a transducer? Justify your answer.**

5. **[8 marks] How does the change in the position and orientation of rigid body take place? Suppose that a planar manipulator shown in fig. with the link lengths $l_1 = 10$ & $l_2 = 5$ in some units employs inverse kinematic analysis to bring the end-effector at the following position $(p_x, p_y) = (12.99, 2.5)$. Find the joint angles to solve this inverse kinematic problem. Draw the appropriate diagrams indicating the planar manipulator kinematic solutions.**



JUIT TEST EXAMINATION DEC-2018