

Section - A (5 x 2 = 10 Marks)

S.No	Question
1	Describe a sensor which converts position information into a variable voltage.
2	Why sampling is required in analog to digital conversion?
3	Why closed loop control is required in control system?
4	How joint angles can be found using Jacobian?
5	Why PID controller is required in control system?

Section - B (4 x 10 = 40 Marks)

6	<p>(i) Derive the expression for Transformation matrix for two link planar manipulator.</p> <p>(ii) Find the Transformation matrix for two link planar manipulator for the following data. <math>l_1 = 1 \text{ m}</math>, <math>l_2 = 1 \text{ m}</math>, <math>\theta_1 = 10^\circ</math>, <math>\theta_2 = 20^\circ</math></p>
7	A single cubic trajectory is given by $\theta(t) = a_0 + a_1 t + a_2 t^2 + a_3 t^3$ and is used over the time interval from $t = 0$ to $t = 5$ sec. The initial angle and velocity are $0.5^\circ$ and $0^\circ/\text{sec}$ respectively. The final angle and velocity are $0.1^\circ$ and $0.02^\circ/\text{sec}$ respectively. Find the coefficients of the cubic polynomial trajectory.
8	A 0.5 Kg rectangular block is gripped in the middle and lifted vertically at a velocity $1 \text{ m/s}$ . If it accelerates to this velocity at $27.5 \text{ m/s}^2$ and the coefficient of friction between the gripping pads and the block is 0.48. Calculate the minimum force required to lift the block without slip.
9	A continuous video voltage signal is to be converted into a discrete signal. The range of the signal after amplification is 0 to 5 V. The A/D converter has an 8 bit capacity. Determine the number of quantization levels, the quantization level spacing, the resolution and the quantization error.



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