JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

MOOC End Term Examination- 2026

B.Tech-VII Semester (CSE/IT/ECE/CE/BT/BI)

COURSE CODE(CREDITS): 25B2WEC604 (3) MAX. MARKS: 70

COURSE NAME: INDUSTRIAL ROBOTICS THEORIES FOR IMPLEMENTATION

COURSE INSTRUCTORS: Dr Emjee Puthooran MAX. TIME: 3 Hours

***Note: (a)** All questions are compulsory.*
(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems
(c) Use of non-programmable scientific calculators are allowed in the exam.
(d) Assume standard industrial 6-DOF articulated robot wherever required unless specified.
(e) Draw neat sketches wherever necessary.

Q.No	Question	Marks
Q1	Define Degrees of Freedom (DOF) of a robot. How does DOF affect robot workspace?	2
Q2	Differentiate between point-to-point (PTP) control and continuous path (CP) control with one industrial application each.	3
Q3	Explain the concept of robot payload capacity and reach. Why are these two parameters interdependent?	3
Q4	Write the Denavit-Hartenberg (DH) parameter table format and explain the physical meaning of each parameter.	3
Q5	Explain workspace types of industrial robots. Compare Cartesian, Cylindrical, and Articulated robot workspaces with neat sketches.	4
Q6	(a) A servo motor has: Torque = 5 Nm, Rotor inertia = 5×10^{-4} kg.m^2 Calculate the angular acceleration. (4) (b) Explain PID control in robot joint control systems. (3) (c) Why are harmonic drives preferred in robot joints? Give three reasons. (3)	10
Q7	(a) Explain working principle of optical encoders (incremental & absolute). (5) (b) Compare vision sensors vs proximity sensors in industrial robotics. (5)	10
Q8	(a) Explain robot programming methods: (i)Teach pendant programming, (ii) Lead-through programming (iii) Offline programming (6) (b) What is Tool Center Point (TCP)? Explain TCP calibration using 3-point method. (6)	12

Q9	A 2-DOF planar manipulator has link lengths: $a_1 = 500$ m, $a_2 = 300$ mm (a) Derive forward kinematics equations for end-effector position (x, y). (5) (b) Derive Jacobian matrix. (4) (c) Determine singularity condition. (3)	12
Q10	(a) Explain Inverse Kinematics problem and discuss multiple solutions with an example. (6) (b) Describe robot safety systems:(i) Emergency stop, (ii) Light curtains (iii) Safety PLC (iv) Interlocks (6) (c) Explain Industrial applications of robots in welding and assembly with advantages. (4)	16