BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: ME **SEMESTER : II**
BRANCH: AMS **SESSION : SP/17**

SUBJECT: MPE2001 ROBOTICS & ROBOT APPLICATIONS

TIME: **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
6. Nothing should be written on front or back of the question paper except tick marking.

Q.1(a) Define industrial robot and robotics? How can you specify an industrial robot? A cylindrical robot has a wrist axis that can be rotated a total of three rotations of 360^0 each. It is desired to be able to position the wrist with a control resolution of 0.1^0 between the adjacent addressable points. Determine the number of bits required in the binary register in that axis in the robot's control memory. [6]

Q.1(b) What are various physical configurations of industrial robot? Explain with the helep of neat sketches stating their application possibilities. [6]

Q.2(a) What should be the characteristics of a good robot - wrist - gripper interface? Explain a robot - wrist - gripper interface with the help of a neat sketch. [6]

Q.2(b) What are advantages and disadvantages of mechanical gripper? A 10 kg rectangular block is gripped in the middle and lifted vertically at a velocity of 1.5 m/s. If it accelerates to this velocity at 35 m/s^2 and the coefficient of friction between the gripping pads and the block is 0.25, calculate the minimum force that would prevent slippage. If the factor of safety is 1.5, then what will be the force requirement? [6]

Q.3(a) What do you mean by inverse kinematics of robot? A three - jointed R-P-R robot has the following D-H parameters: [6]

I	A	α	d	Θ
1	0	π/2	0.5	θ1
2	1	0	d2	0
3	0.2	π/2	0	θ3

Solve the position kinematic equations for the robot to achieve the end effector position vector given by $[P] = [10 \quad 20 \quad 40]^T$

Q.3(b) What do you mean by path and trajectory? A single link robot with a rotary joint has no motion at the position 15^0. It is desired to move the joint in smooth manner to the position 75^0 in 5 seconds. Find the coefficients of a cubic which accomplishes this motion and brings the manipulator to rest at the goal. What is maximum velocity and acceleration of the trajectory? [6]

Q.4(a) Why sensors are required for industrial robot? What should be the characteristics of an ideal tactile sensor? Explain the working principle of ultrasonic touch sensor with the help of a neat sketch. What are its application possibilities? [6]

Q.4(b) Explain the working principle of a robotic vision system with the help neat sketch. What are its advantages and limitations. [6]

Q.5(a) What are different levels of robot programming? Explain the meaning of the following symbols used in VAL: [6]

(i) WSTART 1,2 (ii) DMOVE (iii) APPRO 10.00

(iv) CRATERFILL 0.5 (v) CLOSEI 5 lb (vi) OPENI 20.00

(vii) MOVES 20.00 (viii) WSET 10,20,80

PTO

Q.5(b) What do you mean by task level programming? Write a robot programme in VAL to pick up parts from a fixed position on a conveyor and insert them in to a cardboard carton, which is 127 mm tall. Each carton holds two parts. Open cartons are presented to the robot on a start and stop conveyor. [6]

Q.6(a) State and explain the following factors for qualifying an industrial task for robotisation: (i) Complexity of the task [6]

(ii) Production volume

(iii) Feasibility of robot

(iv) Cycle time of production

Q.6(b) Explain the procedure for design of industrial robotic work station. [6]

Q.7(a) What are the conditions under which you can recommend to have an artificial robotic expert system? [2]

Q.7(b) How can you deploy a robot for drilling operation? What are its advantages and limitations for this operation? [4]

Q.7(c) How can you recommend and implement an industrial robot for resistance spot welding operation? What are its advantages and limitation for this task? [6]

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