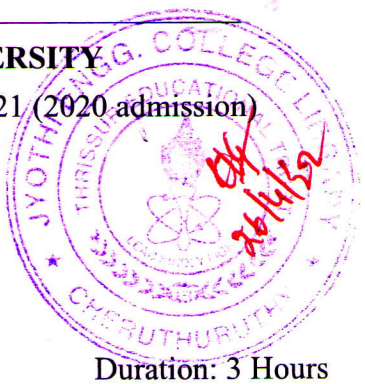
Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester B.Tech (Minor) Degree Examination December 2021 (2020 admission)



Course Code: RAT281

Course Name: BASICS OF ROBOTICS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks Marks

1	Explain reach and stroke of a robotic manipulator with necessary diagrams.	(3)
2	Compare Point-To-Point with Continuous Path Planning.	(3)
3	"Actuators are like the muscles in the human body". Justify this statement.	(3)
4	A strain gauge of gauge factor 2 and resistance of the unreformed wire 100 Ω is used to measure the acceleration of an object of mass 3 kg. If the strain is 10^{-6}, cross sectional area = 10 mm^2 and Young's modulus = 6.9×10^{10} N/m^2, compute the acceleration of the object.	(3)
5	Differentiate between active and passive grippers.	(3)
6	Identify the features of a SCARA robot that make it suitable for assembly.	(3)
7	Describe the Kinematic Parameters related to robotic arms.	(3)
8	Distinguish between motion planning in joint space and cartesian space.	(3)
9	Compare linear and non-linear control.	(3)
10	Apply Lagrangian Mechanics to dynamic modelling of robots.	(3)

PART B

Answer any one full question from each module. Each question carries 14 marks

Module 1

11		Explain with necessary diagrams the considerations in the choice of a robotic manipulator for an application.	(14)
12	a)	Explain with a neat diagram, the typical anatomy of a robotic manipulator,	(8)
	b)	Justify the use of robots in any three industrial applications.	(6)

Module 2

13	a)	Compare electric, hydraulic and pneumatic actuators.	(7)
	b)	Explain the working of typical hydraulic actuator with necessary diagrams.	(7)

14 a) Explain how we can apply Pulse Width Modulation PWM to control the speed of a dc motor. (7)

b) Choose a non-contact sensor for sensing the presence of both metallic and non-metallic objects with justification for the choice and necessary diagrams. (7)

Module 3

15 a) Select a robot configuration suitable for the task of reaching into small openings or working on cylindrical surfaces, e.g., welding pipes with explanation of the choice and necessary diagrams. (7)

b) Compare the four basic robotic arm configurations. (7)

16 Explain the various types of grippers with necessary diagrams. (14)

Module 4

17 a) Suppose the mobile coordinate frame M is rotated about the fixed coordinate frame F by an angle 180^0 about the y (f^2) axis, followed by a rotation by an angle 90^0 about the x (f^1) axis, followed by a rotation of -90^0 about the y (f^2) axis. If p is a point whose coordinates in the mobile M frame are $[1, 1, 0]^T$. Obtain the composite rotation matrix R and the coordinates of p with respect to the fixed frame F. (7)

b) Obtain the forward kinematic model of a two link RP planar robot with intersecting joint axes. (7)

18 a) It is desired to have the third joint of a 6-axis robot go from initial angle of 15^0 to a final angle of 45^0 in 6 seconds. Plan a third-order (cubic) polynomial for this requirement (7)

b) Justify why the LSPB method is preferable to the Straight-Line Trajectory method of Trajectory Planning. (7)

Module 5

19 a) Derive the closed loop transfer function of a PID controlled robotic manipulator with explanation and necessary diagrams. (10)

b) Examine the stability of the above controller, (4)

20 a) Develop the performance and stability considerations of feedback-controlled robots. (7)

b) Derive the equations of motion for a 2-DOF 2R planar manipulator robot arm, (7)

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