Evening

Date:- 27/11/2014.

Student Exam No: _____

GANPAT UNIVERSITY

B.TECH SEM. VII - MECHATRONICS ENGINEERING

REGULAR EXAMINATION NOV/DEC - 2014

2MC-702 ROBOTICS

Time: 3 Hours **Total Marks: 70**

Instructions:

1). All questions are **compulsory.**
2). Figures to the **right** indicate full marks.
3). Answers to the two sections must be written in **separate** answer books.
4). Assume all necessary data.

Section – I

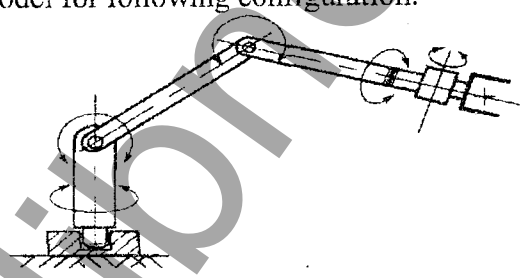
Que:-1 **Attempt All.**

(A) Find general Inverse kinematics solutions for the 3 DOF Cartesian Robotics Arm. **[12]**

OR

Que:-1 **Attempt All.**

(A) Draw frame assignment and obtain DH parameter for each joint link. Also find the forward kinematics model for following configuration. **[08]**



(B) Which are the different causes for existence of multiple solutions of joint variables? Explain in detail. **[04]**

Que:-2 **Attempt All.**

(A) Find Forward kinematics of Spherical Robotics Arm. **[06]**

(B) The homogeneous transformation matrices between frames {i}-{j} nad {i}-{k} are **[05]**

$$ {}^{i}T_{j} = \begin{bmatrix} 0.866 & -0.500 & 0 & 11 \\ 0.500 & 0.866 & 0 & -1 \\ 0 & 0 & 1 & 8 \\ 0 & 0 & 0 & 1 \end{bmatrix}; \quad {}^{k}T_{j} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0.866 & -0.500 & 10 \\ 0 & 0.500 & 0.866 & -20 \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

Determine ${}^{i}T^{k}$

OR

Que:-2 **Attempt All.**

(A) A vector P = 3i - 2j + 5k is first rotated by 90° about x-axis, then by 90° about z-axis. Finally, it is translated by -3i + 2j - 5k. Determine the new position of vector P. **[06]**

(B) Explain DH notation and derive equation of DH parameter. **[05]**

Que:-3 **Attempt Any three.** **[12]**

(A) What is mapping? State any one case of mapping.

(B) Write a short note on screw transformation.

(C) The end-effectors of a robot is rotated about fixed axes starting with a yaw of $-\pi/2$, followed by a pitch of $-\pi/2$. What is the resulting rotation matrix?

(D) Give Detail About Fundamental rotation Matrices.

Section - II

Que:-4 **Attempt All.** **[12]**

(A) List and explain in brief robot co-ordinate systems (Cartesian, Cylindrical, polar, spherical & Revolve system)

(B) Define degree of freedom. Explain degree of freedoms associated with a robot wrist with a neat sketch.

(C) Write down different desirable features of sensors in robotics.

OR

Que:-4 **Attempt All.** **[12]**

(A) Define stability, accuracy, repeatability and compliance of a robot.

(B) List and explain each object descriptor in machine vision system.

(C) Write short note on Touch sensors

Que:-5 **Attempt All.**

(A) Write a short note on CCD camera. **[06]**

(B) Explain a vacuum cup gripper. **[05]**

OR

Que:-5 **Attempt All.**

(A) List the application of robotics. Explain any one application with neat sketch. **[06]**

(B) Write a short note on optical encoders. **[05]**

Que:-6 **Attempt Any three.** **[12]**

(A) Architecture of Robotic vision system.

(B) Compare a robot manipulator with human hand for their capabilities.

(C) Explain components required for Robotics/Machine vision.

(D) Enlist Robotic applications in which end effecter is a tool.

END OF PAPER