



RM-7789

**B. E. IV (Instrumentation & Control) (Sem. VIII)**  
**Examination**  
**May / June – 2010**  
**Robotics Engineering**

Time : 3 Hours]

[Total Marks : 100

**Instructions :**

(1)

नीचे दृष्टावेक निशानीवाणी विगतो उत्तरवडी पर अवश्य लखवी.  
Fillup strictly the details of signs on your answer book.

Name of the Examination :  
B. E. 4 (I.C.) (Sem. 8)

Name of the Subject :  
Robotics Engineering

Subject Code No. : 7 7 8 9 Section No. (1, 2,.....): 1&2

Seat No. :

Student's Signature

- (2) Answer the two sections in separate answer books.  
(3) Use of non programmable calculators is allowed.  
(4) Assume suitable data if required.  
(5) Black figures to the right indicate full marks.  
(6) Draw neat diagrams and use mathematical expressions whenever required.

**SECTION-I**

- 1 (a) If R is the rotation matrix in OXYZ plane, the identity matrix  $I =$  \_\_\_\_\_ and its dimension is \_\_\_\_\_ 10
- (b) If a rotation matrix R is the rotation matrix representing angular displacement of  $\mu$  radians about OX axis then  $R=$ \_\_\_\_\_.
- (c) If T is a basic homogeneous translation matrix then  $T=$ \_\_\_\_\_.
- (d) State two basic methods for robot programming.
- (e) What is inverse kinematic problem ?

- 2 (a) Derive the rotation matrix for rotation about OY axis with  $\Omega$  angle. 15
- (b) A vector,  $b_{uvw}=[1,1,1]^T$  is to be rotated by angle  $\pi$  about OX axis. What will be position of the vector (i.e.  $b_{xyz}$ ) after rotation w.r.t. basic coordinate system ? 10

**OR**

- 2 (a) Give the detailed mathematical analysis for two degree of freedom robot arm. 15
- (b) A vector  $b_{uvw}=[1,1,1]^T$  is to be rotated by  $\beta=90$  degree angle about OX axis followed by a translation of  $c=2$  units along rotated OV axis. Find  $b_{xyz}$ . 10
- 3 Explain the following in detail : (any two) 15
- (1) Control systems for PUMA robot arm
- (2) Model reference adaptive control of robot arm
- (3) Robot programming methods.

## SECTION-II

- 4 (a) Define the following and give an example : 10
- (i) Accuracy
- (ii) Precision
- (iii) Operating range
- (iv) Speed of sensor
- (v) Calibration.
- (b) Discuss any three power and signal transmission methods. 8
- 5 (a) Describe three types of actuator mechanisms for mechanical grippers with examples. 10
- (b) Discuss Vacuum type grippers. 6

**OR**

- 5 (a) State the three basic functions of robot/end effector interface discuss the physical support of end effectors. 10
- (b) Discuss magnetic grippers. 6

- 6 (a) Write short notes : (any two) 8
- (i) Force sensing wrist
  - (ii) Joint sensing
  - (iii) Tactile array sensors.
- (b) A part weighing 15 lb is to be grasped by a 8  
mechanical gripper using friction between two opposing  
fingers. The coefficient to static friction is 0.35 and of  
dynamic friction is 0.20. The direction of the accelerat-  
ing force is parallel to the contacting surfaces of the  
gripper fingers. Which value of coefficient of friction is  
appropriate to use in the force calculations ? Why ?  
Compute the required gripper force assuming that a g  
factor of 2.0 is applicable.
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