



Name: ..... Roll No.: .....

Branch: ..... Signature of Invigilator: .....

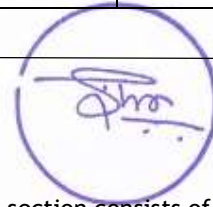
Semester: VIth

Date: 06/05/2022 (MORNING)

Subject with Code: EE425 ROBOTICS

Marks Obtained	Section A (30)	Section B (20)	Total Marks (50)

INSTRUCTION TO CANDIDATE



1. The booklet (question paper cum answer sheet) consists of two sections. First section consists of MCQs of 30 marks. Candidates may mark the correct answer in the space provided / may also write answers in the answer sheet provided. The Second section of question paper consists of subjective questions of 20 marks. The candidates may write the answers for these questions in the answer sheets provided with the question booklet.
2. The booklet will be distributed to the candidates before 05 minutes of the examination. Candidates should write their roll no. in each page of the booklet.
3. Place the Student ID card, Registration Slip and No Dues Clearance (if applicable) on your desk. All the entries on the cover page must be filled at the specified space.
4. Carrying or using of mobile phone / any electronic gadgets (except regular scientific calculator)/chits are strictly prohibited inside the examination hall as it comes under the category of unfair means.
5. No candidate should be allowed to enter the examination hall later than 10 minutes after the commencement of examination. Candidates are not allowed to go out of the examination hall/room during the first 30 minutes and last 10 minutes of the examination.
6. Write on both side of the leaf and use pens with same ink.
7. The medium of examination is English. Answer book written in language other than English is liable to be rejected.
8. All attached sheets such as graph papers, drawing sheets etc. should be properly folded to the size of the answer book and tagged with the answer book by the candidate at least 05 minutes before the end of examination.
9. The door of examination hall will be closed 10 minutes before the end of examination. Do not leave the examination hall until the invigilators instruct you to do so.
10. Always maintain the highest level of integrity. Remember you are a BITian.
11. Candidates need to submit the question paper cum answer sheets before leaving the examination hall.

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

**CLASS: B. Tech.  
BRANCH: All**

**SEMESTER : VI  
SESSION : SP/22**

**SUBJECT: EE425 Robotics**

**TIME: 2 Hrs.**

**FULL MARKS: 50**

**INSTRUCTIONS:**

1. The question paper contains two Sections. Section A (MCQ) is of 30 Marks and Section B (Short Answer Type) of 20 marks and total 50 Marks.
  2. Candidates may attempt all questions maximum of 50 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.
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**Section A: MCQ**

**Marks: 15x2=30**

1. Which of the terms is not one of the basic parts of robots?
  - a. End effector
  - b. Peripheral tools
  - c. Controller
  - d. Drive
2. What is the name of the space in which the robot operates?
  - a. Environment
  - b. Spatial base
  - c. Work envelope
  - d. Exclusion zone
3. What is the name of information sent from the robot sensors to the robot controller?
  - a. Feedback
  - b. Signal
  - c. Pressure
  - d. Temperature
4. The number of movable joints in the base, arm and end effector is known as
  - a. Degrees of freedom
  - b. Flexibility
  - c. Payload capacity
  - d. Operational limits
5. Which of these basic parts of robot contains computer circuitry that could be programmed to determine what the robot would do?
  - a. Sensor
  - b. Controller
  - c. Arm
  - d. End effector

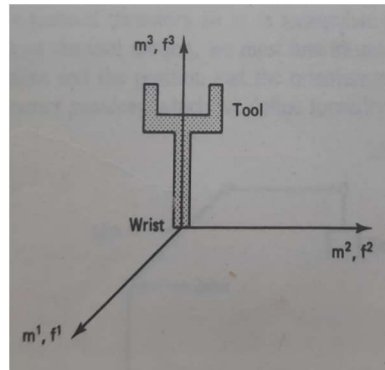
6. How many degrees of freedom are required for a robot to be called as a functional industrial robot?
  - a. Three
  - b. Four
  - c. Six
  - d. Eight
7. In which of the following applications, continuous path system can be used?
  - a. Loading and unloading
  - b. Spray painting
  - c. Pick and place operation
  - d. All of the above
8. Internal state sensors are used for measuring .....of the end effector.
  - a. Position
  - b. Position and Velocity
  - c. Velocity and Acceleration
  - d. Position, Velocity and Acceleration
9. 'Robot' word is derived from the Czech word:
  - a. Robota
  - b. Reбота
  - c. Ribota
  - d. Rabota
10. A robot is a ....
  - a. Programmable device
  - b. Multifunctional manipulator
  - c. Both a and b
  - d. None of the above
11. Robot is designed with Cartesian coordinate system has
  - a. Three linear movements
  - b. Three rotational movements
  - c. Two linear and one rotational movements
  - d. One linear and two rotational movements
12. Radial movement (In and Out) to the manipulator arm is provided by
  - a. Elbow extension
  - b. Wrist bend
  - c. Wrist yaw
  - d. Wrist swivel
13. The main objective of industrial robot is to
  - a. To minimize the labour requirement
  - b. To increase productivity
  - c. To increase the life of production machines
  - d. All of the above
14. Robot is designed with Cylindrical coordinate system has

- a. Three linear movements
  - b. Three rotational movements
  - c. Two linear and one rotational movements
  - d. One linear and two rotational movements
15. Industrial robots are designed generally to have which type of coordinate system?
- a. Cartesian coordinate system
  - b. Cylindrical coordinate system
  - c. Polar coordinate system
  - d. All of the above

**Section B: Short Answer Type**

**Marks: 20**

1. What are the laws of robotics? State them. [2]
2. Consider the robotics tool shown in Figure below. Sketch the tool position after each intermediate position of the following YPR operation: pitch of  $-\pi/2$ , roll of  $\pi/2$ , yaw of  $\pi/2$ . [2]



3. What is a rotation matrix? What is its use in robotics? [2]
4. The kinematic parameters of the Yasukawa L-3 manipulator are given in the table below. Find the arm matrix. [4]

i	$\alpha_{i-1}$	$a_{i-1}$	$d_i$	$\theta_i$
1	0	0	0	$\theta_1$
2	$-90^\circ$	0	0	$\theta_2$
3	0	$a_2$	0	$\theta_3$
4	0	$a_3$	0	$\theta_4$
5	$90^\circ$	0	0	$\theta_5$

5. What is a tool configuration vector? What is reduced tool configuration vector? [2]
6. Suppose a 6-axis articulated robot has the following limits on the range of travel of its joint variables. [2]
- $3\pi/4 < q_1 < 3\pi/4$
  - $\pi/4 < q_2 < 3\pi/4$
  - $\pi/2 < q_2 + q_3 < \pi/2$
  - $\pi/2 < q_4 < \pi/2$
  - $\pi/2 < q_2 + q_3 + q_4 < \pi/2$
  - $\pi < q_6 < \pi$
- Find the joint limit vectors ( $q_{min}, q_{max}$ ) and the joint coupling matrix C that characterize the joint space work envelope Q of this robot.
7. What are the different types of sensors? Classify them. Explain briefly. [4]
8. Mention the characteristics of AL and AML. [2]

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