



# GUJARAT TECHNOLOGICAL UNIVERSITY

## BACHELOR OF ENGINEERING SYLLABUS

Subject Code : 3164208

Subject Name : Introduction to Robotics

|                          |                   |
|--------------------------|-------------------|
| WEF Academic Year :      | 2020-21           |
| Semester :               | 6                 |
| Category of the Course : | Open Elective - I |

**Prerequisite :** This course aims to familiarize students with basic concepts and terminologies of the robotics. Devising robotics architecture to solve problems with sensors and controllers. Developing AI based robots for industrial and real time applications.

**Rationale :** This course introduces students to the fundamentals of robotics through an application-based curriculum. The students learn fundamental design considerations for robotics. The course highlights various sensors, actuators to design trajectory planning, obstacle avoidance, and the kinematics of robotics. The course also includes a discussion of mobile robots and robotic manipulators to provide a comprehensive understanding of robotics. The course finally enables understanding research and industrial usages of robots.

### Course Scheme :

| Teaching Scheme |   |   | Total Credits | Assessment Pattern and Marks |                             |                                     |   | Total Marks |
|-----------------|---|---|---------------|------------------------------|-----------------------------|-------------------------------------|---|-------------|
| L               | T | P | C             | Theory                       |                             | Tutorial/ Practical                 |   |             |
|                 |   |   |               | University exams (ESE)       | Progressive Assessment (PA) | External Practical /viva Exam (ESE) | Internal evaluation Practical /viva Exam (PA) |             |
| 3               | 0 | 2 | 4             | 70                           | 30                          | 50                                  | 50  | 150         |

### Course Content :

| Unit No. | Content   | No. of Hours | Weightage (%) |
|----------|---|--------------|---------------|
| 1        | Introduction to Robotics - Brief History, Basic Concepts of robotics, Elements of robotic Systems i.e. robot anatomy, Classification of robotic systems on the basis of various parameters, Applications of robotics, Need of automation, Industrial applications of robot. | 6            | 20%           |
| 2        | Actuators, Grippers, and Sensors for Robotics - Actuators and its types, Grippers for Robotics - Types of Grippers, Design Considerations, resolution, accuracy and repeatability of robot, Force analysis for various basic gripper system.                                | 6            | 20%           |



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| 3                    | Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Need for sensors and vision system in the working and control of a robot.   | 8         | 15% |
| 4                    | Mobile Robots, Kinematics and Dynamics, Drives and Control for Robotics – Drive, Types of Drives, Types of transmission systems, Control Systems: Types of Controllers, Motion Controls.   | 8         | 15% |
| 5                    | Programming and Languages for Robotics - Robot Programming: Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, Python, ROS etc., Development of languages since WAVE till ROS. | 8         | 15% |
| 6                    | AI in Robotics - Need of AI in robotics, Problem solving, Searching, Learning Methods, Reasoning, Role of Genetic Algorithms and Artificial Neural Networks (ANN), Trends and applications of AI in robotics.  | 6         | 15% |
| <b>Total Hours :</b> |  | <b>42</b> |     |

### Textbook :

1. S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014)
2. Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006)
3. Dilip Kumar Pratihari, Fundamentals of Robotics, Narosa Publishing House, (2019)

### Reference Books :

1. R. K. Mittal, I. J. Nagrath, Robotics and Control, TATA McGraw Hill Publishing Co Ltd, Delhi (2003)
2. S. B. Niku, Introduction to Robotics – Analysis, Control, Applications, 3rd edition, John Wiley & Sons Ltd., (2020)
3. J. Angeles, Fundamentals of Robotic Mechanical Systems Theory Methods and Algorithms, Springer (1997)
4. Mikell Groover, Mitchell Weiss, Roger N. Nagel, Nicholas Odrey, Ashish Dutta, Industrial Robotics 2nd edition, SIE, McGraw Hill Education (India) Pvt Ltd (2012)
5. R. D. Klafter, Thomas A. Chmielewski, and Michael Negin, Robotic Engineering – An Integrated Approach, EEE, Prentice Hall India, Pearson Education Inc. (2009)



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### Course Outcomes :

| No. | Course Outcomes   | RBT Level* |
|-----|---|------------|
| 1   | To develop knowledge and relate terminologies in Robotics technology. | RM, UN     |
| 2   | To understand selection of robotic features, sensors, and operations. | RM, UN     |
| 3   | To illustrate logic for robot system integration.                     | UN, AP     |
| 4   | To apply robotics in field of AI and automation.                      | UN, AP, AN |

\*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

### Suggested Course Practical List :

1. Study the major equipment/Software/Components in Robotics Lab, e.g. Robotic Arm components, Arena etc.
2. Study components of a real robot and its DH parameters.
3. Study integration of assorted sensors (IR, Potentiometer, strain gages etc.), micro controllers and ROS (Robot Operating System) in a robotic system.
4. Study Forward and Inverse kinematics and validation.
5. To identify the geometric relationship between input and output motion parameters of Movemaster RM-501 robotic arm.
6. Study of Industrial Robot KGP 50.
7. Study of Oldham coupling mechanism.
8. Study of Quick return mechanism.
9. Study of CAM follower mechanism.
10. Study of NI LabVIEW Robotics, Lego ® Mindstorm NXT and Lego ® Mindstorm RCX.

### List of Laboratory/Learning Resources Required :

1. <http://vlabs.iitkgp.ernet.in/mr/exp2/index.html>
2. <http://vlabs.iitkgp.ac.in/mvl1/index.html>
3. <https://www.iitg.ac.in/cse/robotics/>

### Other Resources/MOOCs : NPTEL Courses

1. Introduction to robotics, Dr. Krishna Vasudevan, Dr. Balaraman, Ravindran, Dr. T Asokan IIT Madras
2. Sensors and Actuators Prof. Hardik Jeetendra Pandya IISc Bangalore

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