

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: ROBOTICS
(COURSE CODE: 3362004)**

Diploma Programme in which this course is offered	Semester in which offered
Mechatronics	Sixth

1. RATIONALE

Nowadays industries demand continuous and fine quality work in different processes of industries. All process is generally done by humans and as we know humans are not able to give same quantity and quality of work with respect to time, environment and complexity of the work. To get quality and quantity of work in toughest environment or the environment which is not suitable for the humans to work, industries demand for robots and its operator. Operators which operate this robot need some basic knowledge of robotics. To fulfil the demand of industries and advancement in technology it is necessary for the mechatronics engineers to have knowledge and skill in robotics.

2. COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop required skills in the students so that they are able to acquire the following competency:

- **Operate and maintain different types of robots.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes:

- Evaluate degree of freedom and able to select right parameter for robot.
- Maintain the different types of robot sensors
- Distinguish servo and non-servo control.
- Operate robot through software.
- Troubleshoot minor problems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
L	T	P		Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	0	2	5	70	30	20	30	150

Legends: L -Lecture; T -Tutorial/Teacher Guided Student Activity; P -Practical; C - Credit; ESE-End Semester Examination; PA -Progressive Assessment

5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Elements of Robot	1a. Explain the basic concept of robot. 1b. Explain the structure of manipulator. 1c. Classify different robotic systems. 1d. Evaluate degrees of freedom.	1.1 Robot-definition, need, brief history, social justification 1.2 Robot terminology, basic concepts, and key features 1.3 Robot anatomy. 1.4 Classification of robot according to: types of system, control loop, structure of manipulator (Cartesian, cylindrical, spherical, articulated) 1.5 Degree of freedom: concept measuring and importance.
Unit -II Robot Sensors	2a. Describe the end effector's types. 2b. Explain working of sensors used in robot. 2c. Differentiate between open loop and closed loop. 2d. Explain different robot configuration. 2e. Select robot for suitable application.	2.1 End effectors: types, sketches, working and applications 2.2 Drives: types and applications. 2.3 Sensing devices: Optical sensors, Proximity sensors, LVDT, Thermocouple, RTD, Thermistor, Force sensing – strain gauge, piezoelectric, Acoustic sensing 2.4 Control systems : Open loop and close loop with applications and its elements 2.5 Robot configurations : 2.6 Stand above, In-line, Cycle independent. 2.7 Selection criteria for robot 2.8 Robot machine vision
Unit-III Robotic Controls	3a. Explain the different level of control. 3b. Differentiate between servo and non-servo control. 3c. Explain various control techniques. 3d. Explain hardware which uses to control robot.	3.1 Need and scope of robot control 3.2 Levels of controls: Device controller, Work cell controller, Area controller, Plant host 3.3 Servo and non-servo control systems: Types, basic principles and block diagram 3.4 Controlling methods: Types, Computed torque technique, New minimum time control, Variable structure control, Non-linear decoupled feedback control, Resolved motion control, Adaptive control 3.5 electrical hardware, 3.6 programming languages 3.7 Controllers: Robot as work cell controller, Programmable logic controller, work cell control with local

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		area networking, multiple network levels.
Unit-IV Introduction to Robot Programming	4a. Explain various robot programming languages. 4b. Simulate robot via software.	4.1 Need and functions of programming 4.2 Methods of robot programming: Manual Teaching, Lead through, Programming languages. Programming with graphics. 4.3 Programming languages: Types, features and applications 4.4 Simulation for robot movements
Unit- V Robotics Applications, Maintenance and Safety	5a. Explain general trouble shooting procedure. 5b. Explain safety norms. 5c. Describe maintenance procedure for robot	5.1 Applications of robots (including special types) 5.2 Robot maintenance: Need and types. 5.3 Common troubles and remedies in robot operation. 5.4 General safety norms, aspects and precautions in robot handling

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Elements of Robot	6	3	4	3	10
II	Robot Sensors	8	4	4	4	12
III	Robotic Controls	12	4	8	8	20
IV	Introduction to Robot Programming	10	3	3	12	18
V	Robotics Applications, Maintenance & Safety	6	3	3	4	10
Total		42	17	22	31	70

Legends: R = Remember, U = Understand, A= Apply and above Level (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7. SUGGESTED EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (outcomes in psychomotor and affective domain) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of Course Outcomes related to affective domain. Thus over all development of Programme Outcomes

(as given in a common list at the beginning of curriculum document for this programme) would be assured.

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes

S. No.	Unit No.	Practical Exercises (outcomes in Psychomotor Domain)	Approx. Hours Required
1	1	Demonstrate configurations and anatomy of robots	2
2	2	Demonstrate robot end effecters	2
3	2	Demonstrate different types of sensor in robotics.	2
4	3	Control servo and non-servo system	2
5	4	Demonstrate operation of robot trainer kit.	4
6	4	Program a robot for golfer configuration.	2
7	4	Program a robot for thrower configuration	2
8	4	Program a robot for coffee maker configuration	2
9	4	Program a robot for draw bot configuration.	2
10	4	Program a robot for strider configuration	2
11	4	Design a robot for a given application and simulate the movement using simulation software.	3
12	5	Identify a fault in a given robot and prepare trouble shooting chart.	3
TOTAL			28

8. SUGGESTED STUDENT ACTIVITIES.

Sr. No.	Activity
1	Form a robotic club in the polytechnic and make robotic models. (polytechnic may give some grant for purchasing robotic kits by this club)
2	Visit Industries having robots/websites of reputed suppliers of robots and prepare specification list, understand operational and maintenance practices.
3	Download videos of robotic applications.
4	Download free simulation software and check programme on it.

9. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

S. No.	Unit		Strategies
1	I	Introduction	Videos/animations/actual robots to explain different types of robots and their applications.
2	II	Elements of Robot	Show real picture of different types of robot elements./expert lectures
3	III	Robotic Controls	Show some video related to Robot control/expert lectures
4	IV	Introduction to Robot Programming	Operate at list one programme in real.
5	V	Robotics Applications, Maintenance and Safety	Visit workshop floor/industries using robots.

10. SUGGESTED LEARNING RESOURCES

A) Books

S. No.	Author	Title of Book	Publication
1.	Koren Yoram	Robotics for Engineers	Tata McGraw - Hill Education,, New Delhi, 1 st Edition
2.	Hedge G S	Textbook on Industrial Robotics	Laxmi Publications , New Delhi, 1st Edition
3.	Groover Mikell P.	Industrial Robotics: Technology, Programming, and Applications	McGraw Hill Education (India) Pvt Ltd, New Delhi, 2 nd Edition
4.	Fu K. S.	Robotics	McGraw Hill Education , New Delhi, 1st Edition
5.	Lafter, Richard K	Robotic Engineering	PHI Learning, New Delhi, 2012

B) Software/Learning Websites

- i. <http://www.mtabindia.com/>
- ii. <http://www.robotics.org/>
- iii. <http://pcbheaven.com>
- iv. <http://www.servodatabase.com>
- v. <https://www.youtube.com/watch?v=fH4VwTgfyrQ>
- vi. https://www.youtube.com/watch?v=aW_BM_S0z4k

C) Major Equipment/ Instrument with Broad Specifications

S.No.	Resource with brief specification.	
1	Programmable Robot trainer kit	Minimum 3 linkages, Minimum 4 degree of freedom, Mechanical end effector with servo control Interfacing card(RC servo output, sensors input)

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics:

- **Prof.V.K.Patel**, In-Charge H.O.D. In Mechatronics Engineering, B. S. Patel Polytechnic (1st Shift), Mahesana.
- **Prof. P. A. Solanki**, Sr. Lecturer in Mechatronics Engineering, B. S. Patel Polytechnic, Mahesana.
- **Prof. B. D.Prajapati**, In-Charge H.O.D. In Mechatronics Engineering, B. S. Patel Polytechnic (2nd Shift), Mahesana.

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. V. Somkuwar**, Associate Professor, Department of Mechanical Engineering.
- **Dr. Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering