

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: ROBOTICS & AUTOTRONICS
(Code: 3361108)

Diploma Programme in which this course is offered	Semester in which offered
Electronics and Communication Engineering	Sixth

1. RATIONALE

Today's industrial assembly line is equipped with robots and man vs. machine interface has been replaced by automation. Most of the machines including our automobiles are available with variety of models and controls. We see luxury cars around us and simply dream of having one. These luxury cars offer varied and many features including safety (central lock, parking assistance, air bags etc.), economy (at times) and comfort as per buyer's criteria. It is therefore need of the day for students to learn Robotics and Auto- electronics shortened as autotronics for working in industry. This course therefore attempt to build required skills of this field in students. Further in order to tune up with growth engine of Gujarat i.e. automobile sector this course has become inevitable.

2. COMPETENCY

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

- **Maintain various Robotic controls and Autotronics features**

3. COURSE OUTCOMES

The theory should be taught and practical should be undertaken in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domains to demonstrate the following course outcomes:

- Identify a Robot for a specific application.
- Interface various Servo and hardware components with Controller based projects.
- Identify parameters required to be controlled in a Robot.
- Develop small automatic / autotronics applications with the help of Robotics.
- Test the robotics circuit.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
4	0	2	6	70	30	20	30	150

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment.

5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (Outcomes in Cognitive Domain)	Topics and Sub-topics
UNIT-I Basic Components of Robotics Systems	1a. Define the terms used in robotics. 1b. Identify components used in robots. 1c. Explain structure of the robot. 1d. Explain various types of movements. 1e. Describe the advantages and limitations of robots 1f. Troubleshoot robot systems	1.1 Definition, need, brief history, social justification 1.2 Basic Robot terminology configuration and its working 1.3 Robot components (Anatomy)– manipulator, end effects, drive system, controller, sensors (Optical, Proximity, LVDT, Thermocouple-RTD-Thermistor, Force sensing – strain gauge-piezoelectric, Acoustic) 1.4 Basic structure of a Robot and Classification – Cartesian, cylindrical, spherical, horizontal articulated(SCARA), Mechanical arm, Degree of freedom, Links and joints, Wrist rotation, Mechanical transmission-pulleys, belts, gears, harmonic drive
	1g. Specify the methods of linear motion into rotary motion and vice-verse. 1h. Describe robot configuration. 1i. Select of robot for specific application.	1.5 Linear and rotary motion and its devices 1.6 Robot configurations: (1) stand above (2) in line (3) cycle independent, 1.7 Selection criteria for robot 1.8 Robot machine vision
Unit– II Servo Mechanism and Motion Systems	2a. Explain robotic controls. 2b. Explain block diagrams of control systems. 2c. Apply various controls as per requirement. 2d. Differentiate the various controls.	2.1 ROBOTIC CONTROLS-Purpose and Levels- Device controller, Work cell controller, Area controller, Plant host 2.2 Servo and non servo control systems – Types, basic principles and block diagram 2.3 Types, working (with diagrams), and applications of various controls- Computed torque technique, New minimum time control , Variable structure control Non linear decoupled feedback control, Resolved motion control , Adaptive control

Unit	Major Learning Outcomes (Outcomes in Cognitive Domain)	Topics and Sub-topics
	2e. Identify programming languages. 2f. Describe robot as work cell controller. 2g. Explain robot path control. 2h. Distinguish different types of motors and their drives. 2i. Explain microprocessor based control system. 2j. Describe the working of microprocessor based control system components.	2.4 Types, electrical hardware, programming languages used, advantages, limitations and specific examples of control systems. 2.5 Robot as work cell controller-PLC 2.6 Work cell control with local area networking, Multiple network level 2.7 Level of Robot controller 2.8 Robot path control (Point to point, Continuous path, Sensor based path) 2.9 Controller programming 2.10 Actuators: DC servo motors, Stepper motor, Hydraulic and pneumatic drives 2.11 Feedback devices 2.12 Microprocessor based control system
Unit- III Sensors and Actuators	3a. Distinguish the mechanical and electrical measurement. 3b. Interpret the various physical quantities used in automobile engines. 3c. Select appropriate sensors for automobile applications. 3d. Maintain the electronic circuits using sensors for physical parameter measurement in vehicles. 3e. Interpret the sequence tasks in robotic control. 3f. Describe the functions of PLCs	3.1 Concept of general measurement system and difference between Mechanical and electrical/electronics instruments; 3.2 Measurement of Pressure : Working of Thermocouple vacuum gauge And Pirani vacuum gauge; 3.3 Measurement of Flow: Hot wire Anemometer, Ultrasonic flow meter; 3.4 Measurement of Speed: Contact less electrical tachometer, Inductive, Capacitive type tachometer, Stroboscope; 3.5 Electrical method for moisture measurement; 3.6 Basic requirement of Sensors, Functions, 3.7 Applications and Circuitry arrangement of various Sensors such as Mass Air flow rate sensor, Exhaust gas Oxygen concentration, Throttle plate angular position, Crankshaft angular position, Coolant temperature, Intake air

Unit	Major Learning Outcomes (Outcomes in Cognitive Domain)	Topics and Sub-topics
		temperature, Manifold absolute pressure (MAP), Vehicle speed Sensor. Transmission gear selector position, Methanol sensor, Rain Sensor; Sensor Calibration, 3.8 Task oriented controls and sequencing, Robotic conventions 3.9 PLC basics
Unit-IV Programm ing and Application in Manufactur ing	4a. Explain robot programming methods. 4b. Develop simple programmes to simulate robot movements. 4c. Describe the procedure to test and troubleshoot robots. 4d. Describe the procedure to common troubles and remedies in robot operation 4e. Describe the safety rules in robot handling.	4.1 Methods of robot programming : Manual Teaching, Lead through 4.2 Programming languages, Programming with graphics. 4.3 Types, features and applications of various programming languages. 4.4 Simulation for robot movements 4.5 Applications of robots (including special types) 4.6 Robot maintenance: Need and types. 4.7 Common troubles and remedies in robot operation. 4.8 General safety norms, aspects and precautions in robot handling
Unit-V Applications in Auto Electronics	5a. Select the electronics for automation in vehicles. 5b. Describe the working of the various automated controls in automobiles.	5.1 Automobile Battery 5.2 Hybrid Synergy Vehicles 5.3 Automation in Automobiles: MPFI, ABS, SRS, Stability and Cruise Control, Electronic Power Steering, Parking Assistant System, Central lock system, Immobilizer system

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

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basic Components of Robotics Systems	10	06	04	02	12
II	Servo Mechanism and Motion Systems	12	04	04	08	16
III	Sensors and Actuators	12	04	04	06	14
IV	Programming and Application in	12	04	06	06	16

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
	Manufacturing					
V	Applications in Auto Electronics	10	02	04	06	12
	Total	56	20	22	28	70

Legends: R = Remember; U = Understand; A = Apply and above levels (Revised Bloom's 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 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. However, if these practical 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. Hour. required
1	I	Configure the working of robots	2
2	I	Use the robot end effecters	2
3	II	Control servo and non-servo system	2
4	III	Use the different types of sensor in robotics.	2
5	III	Interface sensors using μ P or μ C	4
6	III	Measure various parameters of Electro-Mechanical Instruments- Pressure, Flow, Speed and Moisture	6
7	III	Interface Actuators using μ P or μ C	2
8	III	Interface Drives using μ P or μ C	2
9	III	Interface Stepper Motor using μ P or μ C	2
10	IV	Interface PLC and prepare Ladder Diagram	2
11	IV	Use robot trainer to perform different tasks	2
12	IV	Develop a Program for Line Follower Configuration.	2
13	IV	Develop a Program for golfer /thrower configuration	2
14	IV	Develop a Program for coffee maker configuration	2
15	IV	Develop a Program for draw robot configuration	2
16	IV	Develop a Program for strider configuration	2
17	IV	Use Robot programming commands	2

S. No.	Unit No.	Practical Exercises (Outcomes' in Psychomotor Domain)	Approx. Hour. required
Total Hours (Depending upon the availability of resources, perform any of the practical exercises for a total of minimum 28 hours from above list so that skills matching with the most of the outcomes in the every units are included)			40

8. SUGGESTED STUDENT ACTIVITIES

Following is the list of proposed student activities :

- i. Prepare journals based on practical performed in laboratory.
- ii. Do assignments on modeling robotics.
- iii. List various Robot controlling parameters and find how they affect the performance of Robots
- iv. List two different types of Robots and their application.
- v. Download free simulation software and check program on it.
- vi. Visit Industries having robots and prepare specification list, understand operational and maintenance practices.
- vii. Download videos of robotic applications.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i. Show video/animation film to demonstrate the working principles, constructional features, testing and maintenance of different types of Robots Sensors and Actuators
- ii. Arrange a visit to IITRAM, IGTR, nearby Centre of Excellence setup by CTE, Gujarat (in Engg. College etc.) or any such laboratory. Arrange a visit to a plant/ manufacturer having automatic assembly line. Arrange at least one of the above visits.
- iii. Use Flash/Animations to explain the working of different Robots Sensors and Actuators devices.
- iv. Give Mini projects to students. Try to develop Robotics as Hobby.
- v. Arrange expert lectures by engineers working in the area of robotics/automation/autotronics.

10. SUGGESTED LEARNING RESOURCES

A) Books

S. No.	Title of Book	Author	Publication
1.	Robotics for Engineers	Koren Yoram	McGraw - Hill Education, New Delhi, 1 st Edition
2.	Textbook On Industrial Robotics	Hedge, G S	Laxmi Publications, New Delhi, ,1st Edition
3.	Industrial Robotics: Technology, Programming and Applications	Groover Mikell P.	McGraw - Hill Education, New Delhi 2 nd Edition
4.	Robotics	Fu K. S., Gonzalez R C., Lee C S G .	McGraw - Hill Education, New Delhi Pvt Ltd
5.	Robotic Engineering	Richard k lafter	PHI, New Delhi, 2012
6.	Robot applications design manual	Jon Hoshizaki, Emily Bopp	John Wiley and Sons, Ne Delhi

S. No.	Title of Book	Author	Publication
7.	Robot Reliability and safety	Dhillon, B.S.	Springer
8.	Automobile Electrical and Electronic systems	Denton, Tom	Arnold
9.	Understanding Automotive Electronics	William B. Ribbens Marcel Dekker.	Newnes, New York
10.	Automobile Electric equipments	Crouse WH	McGraw - Hill Education, New Delhi
11.	Understanding Automotive Electronics	William Ribbens	Newnes ; 6th Revised edition
12.	Automotive Electronics Handbook	Ronald K. Jurgen	McGraw-Hill Professional; 2 edition

B) Major Equipment /Instrument with Broad Specification

Programmable Robot trainer [Minimum 3 linkages, Minimum 4 degree of freedom, mechanical end effect or with servo control Interfacing card(RC servo output, sensors input)]

C) 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
- vii. http://www.autotronicsinc.com/pdf_files/design_notes.pdf
- viii. <http://www.yellowpages.com.au/content/if/extract/contentstore/2014/05/22/15/51/1079877236/1/automobileelectricalelectronicsystemsurgent.pdf>
- ix. http://ave.dee.isep.ipp.pt/~mjf/act_lect/SIAUT/Material%20Auxiliar/Automotive%20electrical%20systems.pdf
- x. http://www.iestcfa.org/presentations/wfcs04/keynote_leohold.pdf
- xi. <http://ebooksgo.org/>
- xii. <http://www.ignou.ac.in/upload/Unit-3-61.pdf>
- xiii. http://www.lucas-nuelle.com/index.php/fuseaction/download/lrn_file/automotive-engineering.pdf
- xiv. [http://www.oldfordcrewabs.com/public_pdf/Book%20-%20Understanding%20Automotive%20Electronics%20\(Newnes\).pdf](http://www.oldfordcrewabs.com/public_pdf/Book%20-%20Understanding%20Automotive%20Electronics%20(Newnes).pdf)

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. U V Buch**, Sr. Lecturer in EC, Govt. Poly for Girls, Surat
- **Prof. P P Gajjar**, Sr. Lecturer in EC, Govt. Poly for Girls, Surat

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. Sanjeet Kumar**, Assistant Professor, Department of Electrical and Electronics Engineering.
- **Dr. Anjali Potnis**, Assistant Professor, Department of Electrical and Electronics Engineering