

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT
COURSE CURRICULUM

COURSE TITLE: CONTROL DEVICES
(Code: 3342001)

Diploma Programme in which this course is offered	Semester in which offered
Mechatronics	4 th semester

1. RATIONALE

Due to labour crisis and high quality products in demand, now a day company move towards Automation. In automation there are lots of components are used. This course is intended to learn basic concept of automation and working of common components. Knowledge of this subject will lead to understanding working of sensors and actuators used in Mechatronics systems.

2. COMPETENCY

The course content should be taught with the aim to develop different types of skills so that students are able to acquire following competency.

- Select and operate Mechatronics system as per requirements.

3. COURSE OUTCOMES

- Differentiate open loop and closed loop system
- Convert signals
- Identify components in automation systems.
- Understand specification of different types of sensors and actuators
- Recognize role of various control devices in Mechatronics system

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	200
3	0	4	7	70	30	40	60	

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

5. DETAILED COURSE CONTENTS

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I INTRODUCTION	1a. Compare open loop and close loop system. 1b. Identify sinking and sourcing device.	1.1. Control devices-Meaning, need and application. 1.2. Open loop control 1.3. Closed loop control 1.4. Sinking and sourcing concept.
Unit –II SIGNAL PROCESSING	2a. Explain Signal processing and filtration and Differentiate between Analog and digital Signal. 2b. Convert signals	2.1. Signal processing- Need and meaning 2.2. Data acquisition 2.3. Sampling 2.4. Digitized signal 2.5. Sampling rate 2.6. Nyquist frequency 2.7. Aliasing 2.8. Analog to digital signal conversion 2.9. Digital to analog signal conversion
Unit-III SENSORS	3a. Identify and select the different type of sensors based on given criteria. 3b. Make the connection of sensors. 3c. Explain working of different type of sensors.	3.1. Sensors- Need and classification. 3.2. Important parameters (such as sensitivity, linearity, range, response time, accuracy, repeatability, Resolution, threshold value etc.) Its definitions and Importance in sensor Selection. 3.3. Working and application of sensing technique for following parameter. i. Position and speed. ii. Stress, strain. iii. Temperature. iv. Pressure. v. Flow and level. vi. Vibration vii. Acoustic viii. Optical ix. Object detection 3.4. Selection criteria for sensors 3.5. Common troubles and remedies in sensor operations.
Unit-IV ACTUATORS	4a. Identify different types of actuator. 4b. Make the connections with actuators. 4c. Describe different types of electrical motors used in	4.1. Definition, need, working, applications. 4.2. Electrical actuator (working and application). i. DC motors – series, shunt and compound. ii. Ac Single-phase motor.

Unit	Major Learning Outcomes	Topics and Sub-topics
	mechatronics system. 4d. Describe the working of different types of hydraulic and pneumatic cylinder. 4d. Identify and interpret different hydraulic and pneumatic symbols.	iii. AC poly phase motor. iv. Servo Motor v. Stepper motors. 4.3 Hydraulic & Pneumatic actuators (working and application) i. Types of Cylinder. ii. Direction control valve. 4.4. Precautions in handling / operating actuators. 4.5. Selection criteria. 4.6. Common troubles and remedies.
Unit- 5 MECHATRONIC SYSTEMS	5a. explain working and function of elements used in Mechatronics systems.	5.1. Introduction. 5.2. Design steps and considerations 5.3. Various mechatronics systems. i. Being used in day-to-day life. ii. Expected use in future. 5.4. Working elements ,its functions and applications of following system. i. Hydraulic robot arm. ii. DC motor based bottle filling. iii. Temperature sensing system. 5.5. Mechatronics systems, which are in recent trend

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	Introduction	3	3	4	0	7
II	Signal processing.	3	2	3	2	7
III	Sensor	16	8	6	7	21
IV	Actuators	16	8	6	7	21
V	Mechatronics systems	4	1	5	8	14
Total		42	22	24	24	70

Legends: R = Remember; U= Understand; A= Apply and above levels

Notes:

- This specification table shall be treated as only general guideline for students and teachers. The actual distribution of marks in the question paper may vary from above table.
- It is preferable to conduct unit tests and mid semester examination. In mid semester examination Units I,II and III should be considered.

- c. Ask the questions from each topic as per marks weightage. Numerical questions are to be asked only if it is specified. Optional questions must be asked from the same topic.
- d. This subject is to be taught by Mechatronics Engineering faculty.

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills (**Outcomes in cognitive, 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 **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain

S. No.	Unit Number	Description of Laboratory Experiment	Hours
1	I	Demonstrate different types of measuring instruments and its use.	02
2	II	To convert given Analog signal into Digital signal.	04
3	II	To convert given Digital signal into Analog signal.	04
4	III	To measure the different parameter like Accuracy, Repeatability and Resolution for Thermocouple.	04
5	III	To measure the different parameter like Accuracy, Repeatability and Resolution for Strain Gauge.	04
6	III	To measure the different parameter like Accuracy, Repeatability and Resolution for L.V.DT.	04
7	IV	To Plot various characteristic of Single Phase and Three Phase A.C. Motor.	04
8	IV	To control the speed of DC motor by PWM Method.	04
9	IV	Demonstrate Hydraulic actuator and its working.	06
10	IV	Demonstrate Pneumatic actuator and its working.	04
11	V	MINI PROJECT AND PRESENTATION on any one of the working of Mechatronics System used in: • Household applications • Packaging systems • Material handling/ transfer systems • Automobile systems • Security systems	16
		TOTAL	56

Notes:

- a. Term work report must not include any photocopy/i.e., printed manual/pages, litho, etc. It must be hand written / hand drawn by student only.
- b. Term work report content of each experience should also include following.
 - i. Experience description / data and objectives.
 - ii. Drawing of experience / setup with labels/nomenclature to carry out the experience.
 - iii. The specifications of machines / equipments / devices / tools /instruments /items/elements which is / are used to carry out and to check experience.
 - iv. Process parameters / setup settings' values applied to carry out experience.
 - v. Steps / Process description to execute experience.
- c. Mini project and presentation topic/area has to be assigned to the student in the beginning of the term by batch teacher. This may be assigned individually or in the group of maximum 2 to 3 students.
- d. For 40 marks ESE, students are to be assessed for competencies achieved. Students should be given following tasks(any two).
 - i. Identify sensors.
 - ii. Convert signals
 - iii. Measure parameters like accuracy, resolution and repeatability of thermocouple/ strain guage / LVDT
 - iv. Control speed of DC motor.
 - v. Explain role of control devices for given mechatronics system.

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Sr No	Activity
1	Prepare list of various mechatronics systems.
2	Study specifications and use of various sensors used in mechatronics system
3.	Study specifications and use of various actuators used in mechatronics system
4.	Identify alternative elements in mechatronics system
5.	Draw line diagram/ circuit of various mechatronics systems.
6.	Plot characteristics of motors.

9. SPECIAL INSTRUCTIONAL STREGEGY

Sr No.	Unit	Unit Title	Stretegies.
1	I	Introduction	Share experience, Videos
2	II	Signal processing.	Charts, Power point presentations

3	III	Sensor	Show actual elements and demonstrate, Videos
4	IV	Actuators	Show actual elements and demonstrate, Cross section of actual elements, Videos, Simulation
5	V	Mechatronic systems	Videos, Presentations, Simulation

10. SUGGESTED LEARNING RESOURCES

(A) List of Books:

Sr no.	Title of Books	Author	Publication
1.	Robotics-Control, Sensing, vision and intelligence	Ralph Gonzalez, C.S.G Lee, K.S. Fu	Tata Mc graw Hill Education
2.	Industrial Robotics	Roger N Nagel, M.P. Groover, N.G. Odrey, Michell Weiss	Tata Mc graw Hill Education
3.	Mechatronics- Electronics control systems in Mechanical and Electrical Engineering	W.Bolton Pearson	Tata Mc graw Hill Education
4.	Mechatronics	Ganesh Hegde	Jones & Bartlett

(B) List of Software/Learning Websites:

1. www.nationalinstruments.com
2. www.controldevices.com
3. www.youtube.com
4. www.sensors-research.com
5. www.sensormag.com
6. www.honeywell.com

(C) List of equipments:

- a. Proximity and Range sensor kit
- b. RTD, Thermocouple (Temperature Sensor Kit)
- c. Strain gauge
- d. L.V.D.T
- e. Stepper Motor control Kit
- f. AC Motor Cross sections
- g. DC Motor Cross sections
- h. Hydraulic Pneumatic trainer Kit

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics:

1. P.A.Solanki, B.S.Patel Polytechnic, Kherva.
2. V.K.Patel, B.S.Patel Polytechnic, Kherva.
3. B.D.Prajapati, B.S.Patel Polytechnic, Kherva.
4. K.P.Patel, B.S. Patel Polytechnic, Kherva.

Coordinator and Faculty Members from NITTTR Bhopal

1. Dr. K.K.Jain, Prof and Dean, Department of Mechanical Engineering
2. Dr. V.Somkuwar, Asso. Prof., Department of Mechanical Engineering