

Branch Name:	Mechanical Engineering
Semester/Year:	Semester V / Third Year
Subject Title:	Instrumentation & Control
Subject Code:	1ET1010505
Pre-requisite:	Fundamental of Engineering Science and Mathematics

Course Objectives:

1. To provide a basic knowledge about measurement systems and their components
2. To learn about various sensors used for measurement of mechanical quantities
3. To learn about system stability and control
4. To integrate the measurement systems with the process for process monitoring and control.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03	01	00	04	70	30	00	20	120

Subject Contents			
Sr. No	Topic	Total Hours	Weightage (%)
1	Basic concepts of control system: Terminology - plant, process, system, disturbances, controlled variable, manipulated variable etc., Block diagram of basic control system, application areas with examples. Classifications of control systems, Concept of superposition for linear systems with examples.	05	15
2	Mathematical modelling of systems: Translational and rotational mechanical, electrical, thermal, hydraulic and pneumatic systems, Force voltage and force current analogy, Position servo mechanism. Block diagram and signal flow graph representation of physical systems along with rules, properties, comparison and limitation, Mason's gain formula.	10	20
3	Measurement systems and performance: Accuracy, range, resolution, error sources; Instrumentation system elements: Sensors for common engineering measurements	05	15
4	Signal processing and conditioning; correction elements- actuators: pneumatic, hydraulic, electric;	04	10
5	Control method – P, PI, PID, when to choose what, tuning of controllers;	08	20
6	System models, transfer function and system response, frequency response; Nyquist diagrams and their use.	08	20
	Practical group based project utilizing above concepts.		

Course Outcomes:**The student will be able to**

Upon completion of this course, the students will be able to understand the measurement of various quantities using instruments, their accuracy & range, and the techniques for controlling devices automatically.

List of Reference Books:

1. Ogata, Katsuhiko. Modern control engineering. Vol. 4. India: Prentice hall, 2002.
2. Nagrath, I. J. "M. gopal. control system engineering 5 th edition." New age international publishing company Ltd(2007).
3. Bolton, William. Instrumentation and control systems. Newnes, 2015.
4. Beckwith, Thomas G., Roy D. Marangoni, and John HV Lienhard. Mechanical measurements. Pearson, 2009.
5. McMillan, Gregory K., and Douglas M. Considine. Process/industrial instruments and controls handbook. Vol. 7. McGraw Hill, 1999.

List of Tutorials:**Design of Problems and Preparation of Report:**

1. Exercise on Block-diagram algebra.
2. Exercise on Mason's gain formula
3. Simulation Practice on MATLAB/LABVIEW
4. Simulation of linear system to different inputs
5. Given a system transfer function, plot the location of the system zeros and poles using simulation software
6. Simulation of root locus plot using simulation software
7. Performance measurement of first and second order system
8. Introduction of programmable logic controller and ladder diagram

E-Resources:

1. <https://www.scilab.org>
2. www.simscale.com