FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Mechanical Engineering)**

Semester: **V**

Course Code: **202090506**

Course Title: **Automation and Control Engineering**

Course Group: **Professional Elective Course-I**

Course Objectives: To develop comprehensive knowledge and understanding of classical and modern control theory, industrial automation, and systems analysis. Control engineering is a diverse and rapidly expanding discipline which has become increasingly important in a wide range of industries.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50 / 18	50 / 17	25 / 9	25 / 9	150/53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
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.	03
2	**Mathematical modelling of systems:** Translational and rotational mechanical, electrical, thermal, hydraulic, and pneumatic systems, Force voltage and force current analogy, Block diagram and signal flow graph representation of physical systems along with rules, properties, comparison and limitation, Mason's gain formula.	12
3	**Time response analysis:** Standard test signals along with examples of their usage, steady state errors for step, ramp and parabolic inputs, analysis of first and second order systems, Transient response specifications with numerical examples.	06

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4	**Controllers:** Two position controllers, proportional controllers, proportional + integral (PI) controllers, proportional + derivative (PD) controllers, PID controllers, effect of controllers on time response of the system.	**04**
5	**Stability:** Concept of stability, types of stability, Routh's stability criterion, special cases with numerical examples, stability of closed loop system, concept of root locus, open loop, and closed loop transfer poles, step by step procedure for root loci, numerical examples.	**06**
6	**Hydraulic control system:** Basic elements of hydraulic circuit, Principle used in hydraulic circuit, Sources of hydraulic power, Integral, Derivative, PD & PID controller with its transfer function, Comparison between hydraulic and electrical control system.	**05**
7	**Pneumatic control system:** Basic elements of pneumatic circuit, Difference between pneumatic and hydraulic control systems, Force balance and force distance type controllers, Nozzle-flapper amplifier, PD, PI and PID control system along with its transfer function.	**05**
8	**Control Technologies in Automation:** Industrial Control Systems, Process Industries Verses Discrete- Manufacturing Industries, Computer Process Control, and its Forms. Computer Based Industrial Control: Introduction & Automatic Process Control	**04**
	Total	**45**

List of Practicals / Tutorials:

1	Development of block diagram of various physical systems.
2	Introduction to simulation software like MATLAB/LABVIEW, modelling of physical system using simulation software.
3	Given a system transfer function, plot the location of the system zeros and poles using simulation software.
4	To reduce linear systems, block diagram using series, parallel and feedback configuration.
5	Simulation of linear system to different inputs.
6	Performance measurement of first and second order system using simulation system as given by instructor.
7	Simulation of root locus plot using simulation software.
8	Study of hydraulic trainer system/software & Development & performance of given hydraulic circuit.
9	Study of pneumatic trainer system/software and Development & performance of given pneumatic circuit.
10	Open Ended Problem: Solve any industrial control system problem.

Reference Books:

1	"Computer Based Industrial Control" – Krishna Kant, EEE-PHI.
2	Principles and Applications of PLC – Webb John, Mcmillan 1992.
3	"An Introduction to Automated Process Planning Systems" – Tiess Chiu Chang & Richard A. Wysk.

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4	"Anatomy of Automation" – Amber G.H & P.S. Amber, Prentice Hall.
5	Modern control theory, Katsuhiko Ogata, Pearson Education International, Fifth edition.
6	Control system engineering, Norman S Nise, John Wiley & Sons, Inc., Sixth edition.
7	Modern control systems, Richard C. Dorf, Robert H Bishop, Pearson Education International, Twelfth edition.
8	Automatic control systems, Farid Golnaraghi, Benjamin C Kuo, John Wiley & Sons, Inc., Nineth edition.
9	J. Nagrath and M. Gopal," Control System Engineering", New Age International Publishers, 5th Edition, 2007.

Supplementary learning Material:	
1	NPTEL Resources

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods

Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
25	20	20	15	10	10	

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.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the basic components of control systems with modelling of mechanical, hydraulic, and pneumatic systems.	**35**
CO-2	Analyze time domain responses of Linear Time Invariant (LTI) systems and its stability.	**30**
CO-3	Understanding the use of Hydraulic and Pneumatic controllers for control of physical systems.	**25**
CO-4	Understand the application of control technologies in automation.	**10**

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Curriculum Revision:	
Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	--
Next Review on (Month-Year):	June-2025

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