NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	2ME701
Course Title:	Automation and Control
Course Type:	Core
Year of introduction:	2023-24

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Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1	develop a mathematical model and analyse the control system,	(BL3)
2	select and integrate the suitable sensors and actuators with controller,	(BL3)
3	infer the concept of automation system,	(BL2)
4	make use of various simulation software for analysis of control system.	(BL3)

Syllabus: **Total Teaching Hours: 30**

Unit	Syllabus	Teaching Hours
Unit I	**System modeling** Classification of control systems, Transfer function, Nodal diagram, analogous systems, block diagram modeling and reduction, signal flow graph,	**06**
Unit II	**Analysis of control system** Standard test signals, Response analysis of first order and second order system, transient response specification, steady state error constant, stability analysis using Hurwitz criteria, Routh criteria, Root locus, Bode plot and its interpretation.	**10**
Unit III	**Sensors, Actuators and Controllers** Types of sensors: Position, distance, velocity, acceleration, vision, angle sensors, force torque sensors. Types of actuators: Hydraulic, pneumatic, electrical	**08**

Various control actions (PID), pneumatic controllers, hydraulic controllers, introduction of Microcontrollers, programming of microcontroller, introduction of PLC, Ladder logic diagram, fuzzy logic control, use of simulation software.

Unit IV   **Automation systems**   **06**

Introduction to automation system, automation principles and strategies, Basic elements of automated systems, levels of automation, automated storage and retrieval system, automated production lines, automated assembly systems, Industry 4.0.

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:
1. Katsuhiko Ogata, Modern Control Engineering, Prentice Hall
2. Groover, M. P. Automation, production systems, and computer-integrated manufacturing. Pearson Education India.
3. Kant, K. Computer-based Industrial Control. PHI.
4. Webb, J. W., & Reis, R. A. Programmable logic controllers: principles and applications. Prentice Hall.
5. Chang, T. C., & Wysk, R. A. An introduction to automated process planning systems. Prentice Hall.
6. Amber, G. H., & Amber, P. S. Anatomy of automation. Prentice-Hall.
7. Nagrath and Gopal, Control Systems engineering, New Age

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	Mathematical modelling of the system – Block diagram method	2
2.	Mathematical modelling of the system – signal flow diagram method	2
3.	Response analysis of first order system (using Matlab Simulink)	2
4.	Response analysis of second order system (using Matlab Simulink)	2
5.	Stability analysis of the system using root locus	2
6.	Stability analysis of the system using Bode plot	2
7.	Programming of microcontroller	2
8.	Programming of PLC	2
9.	Interfacing of sensors and actuator with microcontrollers	2
10.	Simulation of automation system using Automation Studio software	2
11.	Preparing the hydraulic circuit using hydraulic trainer kit	2
12.	Preparing the pneumatic circuit using pneumatic trainer kit	2