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Course Code: EIE329M
Semester: VI

CONTROL AND AUTOMATION

Course objectives:
This course enables the learners to

1. Analyse the transient and steady state responses of the systems in time domain and stability analysis in frequency domain.
2. Develop the state space model, controller and observer design and understand the concept of PID controllers
3. Expose on the concept of Programmable logic controllers (PLC) and impart conceptual knowledge of Distributed Control System (DCS)

UNIT – I **12 Periods**

Transfer function-based Modelling and Time response Analysis

Definition - Control system - Open loop and closed loop systems with examples - Block diagram representation and its reduction - Mathematical model for electrical systems: Mechanical systems, Electromechanical Systems-Transfer function of DC servo systems.
Time response analysis: Response of First and second order system to test signals (Unit step input, ramp and parabolic)-Transient and steady state response analysis

UNIT – II **12 Periods**

Frequency response Analysis and stability analysis

Frequency response analysis of second order system- Frequency domain specifications - BIBO stability - Characteristics equation - Location of roots in the s - plane for stability - Routh stability criterion - Root locus technique – Bode plot (only first and second order systems)

UNIT – III **12 Periods**

State Space modelling, controller and observer design

State space model of Linear system - state space representation for electrical, mechanical and electromechanical systems.
Concept of controllability and Observability - State feedback - Pole placement controller design (Direct method) - Full order Observer
Introduction to P, PI and PID controllers.

UNIT – IV **9 Periods**

Automation

PLC - Basics, overview of PLC systems, PLC Architecture, latching and interlocking concept, Evolution: DAS, SCADA, Introduction to DCS and its architecture, example of continuous control and logic control.

TEXTBOOKS

1. Gopal M, Control *Systems*: *Principles and Design*, McGraw Hill, 4th Edition, 2014.
2. Ogata K, *Modern control Engineering*, Prentice Hall of India, 5th Edition, 2010.
3. Donald Coughanowr and Steven Leblanc, *Process Systems: Analysis and Control*, McGraw Hill Publications, 3rd Edition, 2009.
4. Frank D. Petruzella, *Programmable Logic Controllers*, 3rd edition, Tata McGraw-Hill, Edition, 2010
5. Practical Distributed Control Systems (DCS) for Engineers and Technicians, Revision 6.1 IDC Technologies Pvt. Ltd, 2012

REFERENCES

1. Nagrath I J and Gopal M, *Control System Engineering*. New Age International (P) Ltd., 6th Edition, 2017.
2. Richard C. Dorf and Robert H. Bishop, *Modern control systems*, Prentice Hall, 12th Edition, 2010
3. Palani S, *Control Systems Engineering*, McGraw Hill, 2nd Edition, 2010.

ONLINE MATERIAL

1. NPTEL – https://nptel.ac.in/courses/108102043/

UNIT - WISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	• Develop transfer function models of electrical, mechanical and electromechanical systems • Analyse time domain behaviour of first and second order systems
Unit II	• Analyse the behaviour of closed loop system using frequency response plots • Analyse the stability of the system using root loci plots and bode plots
Unit III	• Develop state space models for electrical, mechanical and electromechanical systems • Design state feedback controller and state observers • Introduce the basics of P, PI and PID controllers
Unit IV	• Explain PLC and architecture of DCS, SCADA