1. Study of Characteristics of phototransistors.
2. Study of Characteristics of laser diode.
3. Study of Characteristics of photodiodes.
4. Study of Characteristics of LDR.
5. Study of Characteristics of opto-couplers.
6. Study of Measurement of beam characteristics of lasers.
7. Measurement of losses- attenuation, bending in optical fibers.
8. Measurement of power gain in an optical amplifier.

Essential/recommended readings

1. Ajoy Ghatak, Optics, **8th Edition**, published in **August 2024** by McGraw Hill Education
2. S. O. Kasap, *Optoelectronics and Photonics: Principles and Practices*, Prentice Hall, 2012.
3. P. N. Prasad, *Nanophotonics*, John Wiley & Sons, 2004.
4. J. Singh, *Optoelectronics: An introduction to materials and devices*, McGraw-Hill, 1996.
5. Fiber Optic Sensors, An introduction for Engineers and Scientists, Eric Udd and W. B. Spillman, 2nd Ed, Wiley,2012, New Jersy, USA.
6. Kathryn M. Booth, The Essence of Optoelectronics, Prentice Hall, 2007

Suggestive readings

1. Optical Fiber Sensors: Systems and Applications, Ed. B. Culshaw and John Dakin, Artech House, Inc., 1989, Noewood, USA.
2. Fundamentals of Optical Fiber Sensors, Z. Fang, K.K.Chin, R. Qu, H. Cai, Wiley,2012, New ersy, USA.
3. G. P. Agrawal, *Fiber optics communication system*, John Wiley & Sons, 2011.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time

DISCIPLINE SPECIFIC ELECTIVE COURSE –: Advanced Process Control (INDSE8E)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Advanced	04	03	-	01	Course	Basics of

Process Control (INDSE8E)					**admission eligibility**	**Process Control**

Learning Objectives

The Learning Objectives of this course are as follows:

- To understand the fundamentals of process control and its role in industrial systems.
- To comprehend the dynamic behavior of various processes like flow, temperature, pressure, and level control systems.
- To explore different control strategies, such as feedback, feedforward, and cascade control.
- To familiarize students with essential control hardware (sensors, transmitters, controllers, and actuators).

Learning Outcomes

After successful completion of the course, students will be able to:

- Understand and analyze the dynamic behavior of first-order, second-order, and higher-order processes, focusing on key parameters like time constant, transient response, and steady-state error.
- Develop mathematical models for open-loop and closed-loop control systems and classify their structure and functionality.
- Implement and evaluate control strategies, including feedback, feedforward, and cascade control, to mitigate process disturbances.
- Identify and understand the roles of sensors, actuators, controllers in industrial automation.
- Use tools like MATLAB/Simulink to model, simulate, and analyze process control systems, and apply these concepts to real-world industrial processes.

SYLLABUS OF DSE

UNIT – I **(12 hours)**

Basics of Process Control, Process Dynamics, Types of processes, Control Strategies: Feedback control, Feedforward control, Cascade control. Introduction to Control Hardware and Software: Overview of sensors, transmitters, controllers, and actuators

UNIT – II **(11 hours)**

PID Control forms and closed loop tuning and direct synthesis method, Internal Model Control, IMC based PID procedure, control actions, Tuning methods, Controller Design, Controller Implementation

UNIT – III **(11 hours)**

Advanced Control Strategies: Ratio control, Adaptive control, and Inferential control, Concept of Model Predictive Control (MPC) and its applications, Multivariable Process Control, Nonlinear and Optimal Control: Concept of nonlinear systems and need for nonlinear control.

UNIT – IV **(11 hours)**

Industrial Process Control Applications, Case Studies and Simulation Projects, Current Trends in Process Control: Introduction to Industry 4.0 and Smart Process Control, Role of IoT, AI, and ML in predictive and self-tuning controllers, Emerging trends in sustainable and green process control systems.

Practical component: **(30 hours)**

1. Analysis of First-Order Dynamic Systems: Response to Step, Impulse, and Ramp Inputs.
2. Analysis of Second-Order Dynamic Systems: Response to Step, Impulse, and Ramp Inputs.
3. Design, Implementation, and Performance Analysis of P Controller for Process Control Systems.
4. Design, Implementation, and Performance Analysis of PI Controller for Process Control Systems.
5. Design, Implementation, and Performance Analysis of PD Controller for Process Control Systems.
6. Design, Implementation, and Performance Analysis of PID Controller for Process Control Systems.
7. Design and Implementation of a Cascade Control System.
8. Analysis of Multivariable Control Systems Using Relative Gain Array Method.
9. Design, Simulation, and Performance Evaluation of a Model Predictive Controller.

Essential/recommended readings

1. Chemical Process Control: George Stephanopoulos, Prentice Hall India Pvt. Ltd. January 2015
2. Process Systems Analysis and Control: Donald Coughanowr, McGrawHill, Inc.3rd edition, 2017
3. Process Control and Instrumentation: Prof. R. P. Vyas, Central Techno Publications, 8th Edition, Jan 2015

Suggestive readings

1. Process Dynamics and Control: D. E. Seborg, T. F. Edgar, D. A. Mellichamp,4th Edition, published in 2016 by Wiley.

2. Control System Design: Graham C. Goodwin, Stefan F. Graebe, Mario E. Salgado, Prentice Hall,1st Edition, published in 2015 by Pearson Education India.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time

DISCIPLINE SPECIFIC ELECTIVE COURSE: Pneumatic and Hydraulic Systems (INDSE8F)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Pneumatic and Hydraulic Systems (INDSE8F)	04	03	-	01	Course admission eligibility	Basics of Electric Circuits

Learning Objectives

The Learning Objectives of this course are as follows:

- Understand the concept, importance, and real-world applications of pneumatic and hydraulic systems.
- Identify and describe the components of a fluid power system, including actuators, valves, pumps, compressors, and reservoirs.
- Develop foundational knowledge of the working principles of hydraulic and pneumatic systems.
- Differentiate between hydraulic and pneumatic systems based on their operational principles, advantages, and limitations.

Learning Outcomes

After successful completion of the course, students will be able to:

- Define the concept of fluid power and explain its role in industrial applications.
- List and describe the key components of a fluid power system and their respective functions.
- Differentiate between hydraulic and pneumatic systems, citing examples of where each is used.