

ELI- 802: Process Control Dynamics

48 Periods

UNIT 1

Dynamics of Processes, Dead time processes. Inverse response behavior of processes. Dynamic behavior of first and second order systems. Interacting and non-interacting systems. Batch & Continuous Process, concept of self-regulation, Controller Principle, discontinuous, continuous and composite controller modes/actions (P, I, D, PI, PD and PID). Pneumatic, Hydraulic, Electronic controllers. Need for controller tuning, Evaluation criteria, Types of controller tuning 14 Periods

UNIT 2

Cascade control, Selective control, Ratio Control, split range control, feed forward control, feed forward combined with feedback control, inferential control, dead time and inverse response compensators, selective control, Adaptive control. Examples from Distillation columns, Chemical Reactors, Heat Exchangers and Boiler. Multivariable Control, Interaction, Tuning of Multivariable systems, relative gain analysis, Decoupler design. 15 Periods

UNIT 3

Discrete-State process control: Variables, process specification and event sequence description, Sampling and reconstruction, Transform analysis of sampled-data systems: z transform and its evaluation, inverse z transform, pulse transfer function, stability analysis in z-plane, implementation of digital controller. PLC Block Diagram, Scan cycle, memory organization, addressing, programming. Introduction to distributed control systems (DCS) 10 Periods

UNIT 4

I/P, P/I converters, Final control elements, Pneumatic and electric actuators. Types of control valves, Valve positioner and its importance, Inherent and Installed characteristics of control valves 9 Periods

UNIT 1

Chapter 1, 9, 10, 12 - Johnson C.D., Process Control Instrument Technology, Prentice Hall Inc. 1988, 7th Edition

Chapter 1, 2, 3, 5, 6, 8 – Bequette B. W., Process Control Modelling, Design and Simulation, PHI Learning, Original Edition

UNIT 2

Chapter 8, 10, 12, 13, 14 – Bequette B. W., Process Control Modelling, Design and Simulation, PHI Learning, Original Edition

UNIT 3

Chapter 8, 11 - Johnson C.D., Process Control Instrument Technology, Prentice Hall Inc. 1988, 7th Edition

Chapter 2, 3, 4 – Ogata K., Discrete Time Control Systems, Pearson Education, 2nd Edition

Chapter 11- Kuo B. C. , “Automatic control system”, Prentice Hall of India, 2000, 7th Edition

Chapter 11- Nagrath I. J. and Gopal M., Control System Engineering, New Age International, 2000, 2nd Edition

UNIT4

Chapter 7 – Johnson C.D., Process Control Instrument Technology, Prentice Hall Inc. 1988, 7th Edition

Essential Books:

1. Eckman. D.P, Automatic Process Control, Wiley Eastern Ltd., New Delhi, 1993, Original Edition
2. Johnson C.D., Process Control Instrument Technology, Prentice Hall Inc. 1988, 7th Edition
3. Bequette B. W. , Process Control Modelling, Design and Simulation, PHI Learning, Original Edition
4. Ogata K., Discrete Time Control Systems, Pearson Education, 2nd Edition
5. Kuo B. C. , “Automatic control system”, Prentice Hall of India, 2000, 7th Edition
6. Nagrath I. J. and Gopal M., Control System Engineering, New Age International,2000, 2nd Edition

Suggested Books:

1. Stephanopoulos G., Chemical Process Control, Prentice Hall of India, New Delhi, 1990, Original Edition
2. Liptak B.G., Instrument Engineers Handbook, Process Control, Chilton Book Company, 3rd Edition
3. Harriott P., Process Control, Tata McGraw Hill, Edition 1972.
4. Anderson N.A., Instrumentation for Process Measurement and Control, Chilton company 1980, 3rd Edition
5. Pollard A., Process Control, Heinemann educational books, London, 1971, Original Edition
6. Smith C.L. and Corripio A. B., Principles and Practice of Automatic Process Control, , John Wiley and Sons, New York, 2nd Edition
7. Shinskey, Process Control Systems, McGraw Hill, Singapore, 1996, 4th Edition.

Practicals (based on ELI-DC-I-702)

(Any eight)

1. Study of PID controller response and it's tuning
2. Study of ON-OFF and Proportional controller responses on temperature loop.
3. Analysis of Flow loop/Level loop/Temperature loop/Pressure loop.
4. Tuning of controllers on a pressure loop.
5. Control valve characteristics with and without positioner.
6. Study of cascade control
7. Study of ratio control/selective control
8. Study of feedforward control

9. Study of pneumatic/ hydraulic controllers
10. Problem solving/Ladder Programming in PLC.
11. Mathematical modeling and simulation of CSTR & STH systems