



- Singh S and Verma SR. *Farm Machinery Maintenance and Management*. DIPA, ICAR, KAB-I, New Delhi.

- I. Course Title : Principles of Automation and Control**
II. Course Code : FMPE 511
III. Credit Hours : 2+1
IV. Aim of the course

To learn the principles behind systems for industrial automation and control especially with respect to electronically implemented systems.

V. Theory

Unit I

Introduction to industrial automation and control: Architecture of industrial automation systems, review of sensors and measurement systems. Introduction to process control: PID control, controller tuning, implementation of PID controllers, special control structures, feed forward and ratio control, predictive control, control of systems with inverse response, cascade control, overriding control, selective control and split range control.

Unit II

Introduction to sequence control: PLCs and relay ladder logic, sequence control, scan cycle, RLL syntax, sequence control structured design approach, advanced RLL programming, the hardware environment, Introduction to CNC machines.

Unit III

Control of machine tools: Analysis of a control loop, introduction to actuators. Flow control valves, hydraulic actuator systems, principles, components and symbols, pumps and motors. Proportional and servo valves. Pneumatic control systems, system components, controllers and integrated control.

Unit IV

Control systems: Electric drives, introduction, energy saving with adjustable speed drives stepper motors, principles, construction and drives. DC motor drives: Introduction to DC-DC converters, adjustable speed drives. Induction motor drives: Introduction, characteristics, adjustable speed drives. Synchronous motor drive-motor principles, adjustable speed and servo drives.

Unit V

Networking of sensors, actuators and controllers, the fieldbus, the fieldbus communication protocol, introduction to production control systems.

VI. Practical

Control system practical: Characteristics of DC servomotor, AC/DC position control system. ON/OFF temperature control system. Step response of second order system, temperature control system using PID level control system. Automation: Introduction to ladder logic, writing logic and implementation in ladder. PLC programming, water level controller using programmable logic controller. Batch process reactor using programmable logic controller. Speed control of AC servo motor using programmable logic controller.



VII. Learning outcome

Understanding of the principles behind implementation of systems for automation and control.

VIII. Lecture Schedule

| S.No. | Topic | No of Lectures |
|-------|---|----------------|
| 1. | Introduction to industrial automation and control | 1 |
| 2. | Architecture of industrial automation systems | 1 |
| 3. | Review of sensors and measurement systems-I | 1 |
| 4. | Review of sensors and measurement systems-II | 1 |
| 5. | Introduction to process control | 1 |
| 6. | PID control, controller tuning and implementation of PID controllers, | 1 |
| 7. | Special control structures, feed forward and ratio control | 1 |
| 8. | Predictive control and control of systems with inverse response | 1 |
| 9. | Cascade control, overriding control | 1 |
| 10. | Selective control and split range control. | 1 |
| 11. | Introduction to sequence control | 1 |
| 12. | PLCs and relay ladder logic, sequence control and scan cycle, | 1 |
| 13. | RLL syntax, sequence control structured design approach, | 1 |
| 14. | Advanced RLL programming and the hardware environment, | 1 |
| 15. | Introduction to CNC machines. | 1 |
| 16. | Control of machine tools | 1 |
| 17. | Analysis of a control loop | 1 |
| 18. | Introduction to actuators. | 1 |
| 19. | Introduction to flow control valves, | 1 |
| 20. | Hydraulic actuator systems, principles, components and symbols | 1 |
| 21. | Introduction to hydraulic pumps and motors | 1 |
| 22. | Introduction about proportional and servo valves. | 1 |
| 23. | Pneumatic control systems, system components and controllers and integrated control. | 1 |
| 24. | Introduction about electric control systems | 1 |
| 25. | Electric drives, energy saving with adjustable speed drives | 1 |
| 26. | Stepper motors, principles, construction and drives. | 1 |
| 27. | DC motor drives: Introduction to DC-DC converters, adjustable speed drives. | 1 |
| 28. | Induction motor drives: Introduction, characteristics, adjustable speed drives | 1 |
| 29. | Synchronous motor drive-motor principles, adjustable speed and servo drives. | 1 |
| 30. | Networking of sensors, actuators and controllers, | 1 |
| 31. | The field bus, the field bus communication protocol, | 1 |
| 32. | Introduction to production control systems. | 1 |
| | Total | 32 |

IX. List of Practicals

| S.No. | Topic | No of Practicals |
|-------|---|------------------|
| 1. | Control system including characteristics of DC servomotor. | 2 |
| 2. | AC/DC position control system | 1 |
| 3. | Temperature control system | 1 |
| 4. | Step response of second order system | 2 |
| 5. | Temperature control system using PID level control system | 1 |
| 6. | Introduction to ladder logic, writing logic and implementation in ladder. | 2 |



| S.No. | Topic | No of Practicals |
|-------|---|------------------|
| 7. | PLC programming | 2 |
| 8. | Water level controller using programmable logic controller | 1 |
| 9. | Batch process reactor using programmable logic controller | 1 |
| 10. | Speed control of AC servo motor using programmable logic controller | 1 |
| | Total | 14 |

X. Suggested Reading

- <https://nptel.ac.in/downloads/108105063/>
- Manesis S and Nikolakopoulos G. 2018. *Introduction to Industrial Automation. 1st Edition*, CRC Press. Textbook-ISBN 9781498705400-CAT#K24766

I. Course Title : Principles of Hydraulic and Pneumatic Systems

II. Course Code : FMPE 512

III. Credit Hours : 2+1

IV. Aim of the course

To understand the principles behind operation of hydraulic and pneumatic systems and their components and design simple hydraulic and pneumatic circuits and select components for the same.

V. Theory

Unit I

Hydraulic power, its advantages, applications, properties of hydraulic fluids, viscosity, bulk modulus, density. Concepts of energy of hydraulic systems, laws of fluid flow.

Unit II

Hydraulic pump and motors, principle, capacity, classifications, working, performance. Design of various types of pumps and motors.

Unit III

Actuators, types, design of linear actuator and rotary actuators. Hydraulic rams, gear motors, piston motors and their performance characteristics. Hose, filters, reservoirs, types of circuits, intensifier, accumulator, valves. Valve types: Direction control, deceleration, flow, pressure control, check valve and their working etc.

Unit IV

Hydraulic circuit design. Applications in farm power and machinery: Tractor, combine, farm machinery systems, hydrostatic system etc.

Unit V

Power pack, pneumatic circuits, properties of air. Compressors, types. Design of pneumatic circuits.

VI. Practical

Study of various hydraulic pumps, motors, valves, directional control valves, cylinder piston arrangements, engineering properties of hydraulic fluids, hydraulic system of tractor, power steering system.