NIELIT

Courses

Level Code: Vertical Name:

L4

Industrial Automation

Course Code: Course Name:

3.3.2 Automation Technology – Basic Level –L4

Objective of the Course:

Student will be exposed to cutting edge technologies in automation, knowledge new developments in automation.

Student will be industry ready for Automation technology hydraulic pneumatic and electric automation.

The students are also equipped with good Communicative English Skills, soft Skills and Basic IT skills required for good performance in any job in the modern world .

Learning Outcomes:

Students will be able to read and understand the circuit and process in any of the trained areas. They will be able to perfom the specification reading and suggest sensors as per requirement. They can also do troubleshooting to a certain extend.

Have Good Communicative English Skills, Soft Skills and Basic IT Skills

Expected Job Roles:

Helper and assistants in regular production areas, quality, logistics and maintenance areas

Duration of the Course (in hours)

For Technical Students : 180 Hrs Non Technical Students : 240 Hrs

Minimum Eligibility Criteria

and pre-requisites, if any Diploma in /Electronics/Instrumentation/ Mechanical/Electrical – for Technical students.

Non Technical Students: 12th pass with science background and affinity

towards technical studies.

To be competent, the user/ individual must be able to:

PK1. Understand the overview of automation PK2 Different devices used in Automation,

PK3. interact with the technical lead engineer in order to understand the work schedules,

PK4. understand the roles and responsibilities of the work

PK5. understand broad level activities involved in the Industrial automation PK6. list the various department to interact with for completing the work PK7. interact with higher officials to understand the specifics of work

PK8. understand the different Communication Protocols/Field Buses PK9. establish module requirement and constraints

PK10. understand Network Settings/Communication Settings PK11. understand the PLC Software

PK12. understand the basics of electro hydraulics PK13. define the design flow for the specific system

PK14. use agreed language and application as per standards

PK15. define the requirement specification of the electro pneumatics

PK16. get approval from superior and relevant department on the electro pneumatics PK17. Understand different types of pumps

PK18. Understand different types of valves

PK19. understand the functionality of the electro pneumatics PK20. assist in system testing, product verification and validation

Professional Skill:

Core Skill:

PS 1: Overview of Automation System PS 2: Overview of Switchgears.

PS 3: Different Communication Protocols/Field Buses PS 4: Introduction to PLC

PS 5: Network Settings/Communication Settings PS 6: Digital Signals/IO’s, Relay Logic PS 7: Timer/Counters/Triggers/FlipFlops,

PS 8: Trouble Shooting the PLC programming errors PS 9: Basic and electrohydraulics

PS 10: Force pressure and weight PS 11: Laminar and turbulent flow PS 12: Selection of Hydraulic fluid PS 13: Hydraulic Pumps

PS 14: External and internal gear pumps PS 15: Pressure Control Valves

PS 16: Types of directional control valves, Spool design, Poppet design PS 17: Directional control valves

PS 18: Basic & Electro Pneumatics PS 19: Pneumatics Vs Hydraulics PS 20: Air compressors

PS 21: Pneumatic Valves and Control Circuits PS 22: Pressure Control Valves

The individual on the job needs to know and understand:

CS1. specifications and use of automation system used by the organisation CS2. licensed software and application tools used for design, their performance CS3. PLC Programming using Ladder Logic

CS4. Efficient in working with any kind of Hydraulics & Pneumatic Systems

*Interpersonal skills*

CS5. how to interact with higher officials to understand the work requirement CS6. how to interact with co employees in order to co-ordinate work processes *Reflective thinking*

CS7. to improve work processes CS8. to reduce repetition of errors

Detailed Syllabus of Course Module 1 PLC

*Overview of Automation System*: What is Automation? Different devices used in Automation, Role of PLC in automation system., Scope of Automation field in present and future, Comparison between Automated and Manual Operated Systems.

Overview of Switchgears: What is a Relay and its applications? Introduction to Switching devices like Contactors, Solenoids, MCB’s etc., Symbolic representation of different electrical & electronic components in wiring diagram.

Introduction to Different Communication Protocols/Field Buses: Ethernet, RS232, Profibus DP, Canopen, Devicenet, Sercos II & III, Modbus, Profinet, Ethercat, Different types of Signals, Digital Signal, Analog Signal, Overview of Limit Switches, Proximity Switches & Reed switches, Introduction to PLC, Comparison of PLC & PC, What is a PLC?, How does a PLC work? Applications of PLC, Block Diagram of PLC, Processing cycle of PLC, Different types of PLC’s available in the market, Programmable Logic Controller, Specifications of PLC, Onboard/Inline/Remote IO’s, Memory Allocation in PLC, What is Scan time of PLC? IO handling capacity of different PLC, Remote connectivity in PLC, Internal Structure of PLC, Hardware Details of the PLC, Wiring and Connection Techniques, Safety Measures for handling the PLC, Diagnosis of PLC Status and other hardware connected to PLC.

Network Settings/Communication Settings: Introduction to PLC Software, Overview of Software/Software at a glance, Hardware Configuration Communication Settings for PLC, PLC Programming, Building simple logic in PLC (AND/OR/NOT), Online & Offline Change, Overview of different types of Data types in PLC programming, Standard format for addressing the variables, Standard Time formats, Rules for Declaration of Variable names, Working with Digital Signals/IO’s, Relay Logic, Difference between Function & Function Blocks, Introduction to Timer/Counters/Triggers/FlipFlops, Exercises based on Timers, Counters, Flip Flops & Triggers, Usage of Mathematical Operators, Comparators, Conversion Operators, Multiplexers & Logical Gates in the PLC Program, Exercises based on the above operators, Compilation & Downloading the program to PLC, Trouble Shooting the PLC programming errors, Local & Global Variables, Working with Analog Signals/IO’s, Developing a program for process control, Declaration in Tabular Format, Display of Address and Comments in Logic, Jump & Return Command, Commands like Run, Stop, Reset, Reset Original, Breakpoint etc, Developing User Defined Function Blocks & Functions in the PLC program, Conditional & Unconditional Calling in PLC Program, Task, Configuration, Visualization, Developing user defined Data Types in PLC program, Password Management, Different Methods to take the PLC Program Backup (Source Code Download/Upload, Archive/Restore &

Export/Import), Library Management, Target Settings, Running the PLC program in Simulation Mode, Master/Slave Configuration, Data Exchange between the Master & Slave PLC

*PROJECT*: Tank Filling Device Simulator, Supervise Equipment, Pump Control 1, Selective Band Switch, Gate Control System, Star Delta Starting Up, Starter Control, Dahlander Pole Changing, Furnace Door Control, Reaction Vessel, Pump Control 2, Roadworks Traffic Lights, Cleaning System, Buffer Store Simulation, Automatic Tablet Filler, Changing Floor.

Practical / Tutorial Hours: 48

Module II

*Basic and electrohydraulics*

What is Fluid power: Advantages of Fluid power, What is Hydraulics? Definition of industrial Hydraulics, Hydrostatics and Hydrodynamics, Applications of Hydrostatics and Hydrodynamics, Characteristics of Industrial Hydraulics like advantages and its limitations, Comparisons of Drives (Hydraulics Vs Pneumatics, Electrical/Electronics & Mechanical, Applications of Hydraulics.

Force pressure and weight, Pascal’s Law, Calculations : Pascal’s Law, Application of Pascal’s Law, Force Multiplication, Pressure Multiplication, Displacement transmission, Calculations, Units of pressure., What does 1bar mean? Absolute and relative pressure, What is flow rate? Flow law, Calculation, Open, Types of flow : Laminar and turbulent flow, Reynolds’s number, Throttling, Graphical Symbols and Circuit Diagrams ISO 1219, Purpose of graphical symbols, Function of symbols, Basic elements, Circuit diagram Commonly used symbols, Circuit symbols., Symbols for energy supply and processing unit ( Power Pack ), Symbols for Hydraulics energy control units (Pressure, Flow and Direction ), Symbols for Energy conversion units (Actuators), Symbols for accessories, Demonstration of Hydraulics circuits, Hydraulic circuit with manual DCV and a cylinder, Hydraulic circuit with manual DCV and a Hydraulic motor, Hydraulic circuit with solenoid DCV and cylinder and a motor, Demonstration of speed and direction changes in Hydraulic circuit, Hydraulic Fluids, Main functions of Hydraulic fluids, Functions, Capacity and Constructions of Tanks, Calculation, Requirements of Hydraulic fluids, Types of Hydraulic Fluids, Viscosity of Hydraulic fluid, Relation between temperature and viscosity, Selection of Hydraulic fluid for an applications, Compressibility of Hydraulic fluids, Thermal expansion of Hydraulic fluids, Fluid Analysis, Hydraulic Pumps, Functions and Operating principle Hydraulic pumps, Differentiate b/w positive and non – positive displacement pumps, Characteristics of standard Hydraulic pumps, Construction and Operating principle following pumps, i. External and internal gear pumps, ii. Vane pumps, iii. Axial piston pumps, iv. Radial piston pumps, Selection criteria of pumps, Flow rate and pump power, Efficiency, Hydraulic Cylinder, Operating Principle, Components of a Hydraulic cylinder, Functions of Hydraulic cylinder, Design and operation, Types of cylinder, Types of design, i. Tie rod cylinders, ii. Mill type cylinders, Technical specification, End positioning cushioning, Cylinder mounting, Hydraulic Motors, Functions of Hydraulic Motors, Characteristics of standard Hydraulic Motors, Selection of Hydraulic motors, Calculations, Efficiency, Pressure Control Valves, Introduction, Function and operating principle of pressure relief valve, direct operated, Pressure relief valve in series and parallel, Pressure relief valve, pilot operated, Function and operating principle of pressure reducing valve, Pressure sequence valve, direct operated, Directional Control Valve, Operation and Function, Special characteristics, Types of directional control valves, Spool design, Poppet design, Types of actuation of spools with symbols, Directional spool valves, direct operated, Directional spool valves, pilot operated, Designation of Directional control valves, Operation of solenoid, Solenoid operated valves and its symbols, Standard spool valve : G spool, E spool, J spool and H spool, Comparison of spool Vs poppet valves, Flow Control Valves, Functions, Throttle valves, Viscosity dependent throttle valves, Types of

mounting, Throttle valve independent of viscosity, Flow control valves, 2-way flow control valves, Upstream pressure compensator, Downstream pressure compensator, Applications of 2-way flow control valve, Meter-in flow control, Meter-out flow control, Check Valves, Operation and function of a simple check valve, Check valve, pilot operated, Double pilot operated check valve, Applications of check valves,

*Project*: Hydraulic pump, characteristic Curve, Single-rod cylinder, pressure intensification, Single-rod cylinder, flow, Hydraulic motor, 4/3 directional valve, Check valve, Check valve, pilot operated, Throttle valve, adjustable, Throttle check valve, Flow control valve, Pressure relief valve, direct operated, controls, Pressure reducing valve:

Theory / Lecture Hours: 32 Practical / Tutorial Hours: 48

Module III

*Basic & Electro Pneumatics*

Fluid power, Advantages, Pneumatics, Definition, Characteristics of Industrial Pneumatics, advantages and its limitations, Comparisons of Drives - Pneumatics Vs Hydraulics, Electrical/Electronics & Mechanical, Applications of Pneumatics, Compressed Air Generation and Contamination Control, Compressed Air for transmitting power, Composition of Atmospheric Air, force, weight, pressure, Pascal’s Law, Application of Pascal’s Law, Force Multiplication, Pressure Multiplication, Displacement transmission, Calculations, Gas Laws, Air compression process, Absolute and relative pressure. Flow rate, Characteristics of compressed air, Graphical Symbols and Circuit Diagrams ISO 1219, Purpose of graphical symbols, Function of symbols, Basic elements, Circuit diagram, Commonly used symbols, Circuit symbols., Symbols for Maintenance unit, Symbols for Pneumatic energy control units (Pressure, Flow and Direction ), Symbols for Energy conversion units (Actuators), Symbols for accessories, Demonstration of Pneumatic circuits, Pneumatic circuit with manual DCV and a cylinder, Pneumatic circuit with solenoid DCV and cylinder and a motor, Demonstration of speed and direction changes in Pneumatic circuit, Compressed Air Generation and Contamination Control, A typical Pneumatic system, Air compressors, Classification of Compressors, Terms and Definition : Delivery volume, Pressure, Drive , Cooling and Regulation, Piston Compressor, Screw Compressor, Vane Compressor, Compressor unit, Preparation of compressed Air, Stages of Preparation, Drying of Compressed Air, Distribution of Compressed Air, Pneumatic Actuators, Introduction, Basic Actuator Functioning, Thrust, Cylinder Air Consumption, Cylinder speed and its relation to flow rate, Stroke Length, Piston –rod buckling, Classification of Pneumatic Actuators, Linear Actuators, Single-Acting cylinder, Double-Acting cylinder, Cylinder cushioning, Classification of cylinders According to Duty, Cylinder with Magnetic Piston, Cylinder with Non-Rotational Guiding, Rodless Cylinder, Tandem Cylinder, Rotary Actuator, Semi-Rotary Actuators, Pneumatic Valves and Control Circuits, Introduction, Classification of valves, Functional Classification of Valves, i. Directional control valves, ii. Pressure control valves, iii. Flow control valves, iv. Non return valves, Graphical Representation, Port Markings, Ports and Positions, Graphical symbols for DC valves, Methods of DC Valve Actuations, 3/2- Directional Control valve, i. NC-type 3/2-DC valves, ii. NO-type 3/2-DC valves, Non-Return Valves, Flow control valves, Throttle valve and Throttle check valves, Pneumatically Actuated 3/2-DC valve, Manually actuated 5/2- DC valve, Pneumatically actuated 5/2-DC valve, Speed control of Double-Acting Cylinder, 5/2-DC Double-Pilot valve, Login Controls, Pneumatic, i. Shuttle valve, ii. Twin pressure valve, iii. Applications of Logic valves, Structure of Pneumatic Circuits, Automatic Control, Roller valve, Quick-Exhaust vavle, Time-Delay valves,

Pressure Control Valves, Introduction, Function and operating principle of pressure relief valve, direct operated Pressure regulator

Project: Direct control of a single-acting cylinder, extending, Direct control of a single-acting cylinder, retracting, Indirect control of a single-acting cylinder, Regulating the speed of a single-acting cylinder, Slow- speed extension, rapid retraction of a single-acting cylinder, Direct control of a double-acting cylinder with push-button, Indirect control of a double-acting cylinder, Speed regulation of a double-acting cylinder, Controlling a double-acting cylinder, impulse valve, 2 push-buttons, Displacement-dependent control of a double-acting cylinder, impulse, Controlling a double-acting cylinder, impulse valve, 2 reflex nozzles, Stop control, double-acting cylinder, 5/3 directional control valve, tensile load, Pressure-dependent control of 1 double-acting cylinder, Time-dependent control of 1 double-acting cylinder, Logical control with shuttle and twin-pressure valves, Sequential control 2 double-acting cylinders w/o overlapping signals, Seq. control 2 double-act. cylinders, signal overlapping, idle return rollers, Pilot control of a single-acting cylinder with spring return valve, Pilot control of a double-acting cylinder with spring return valve, Holding-element control of a double-acting cylinder with impulse valve, directly controlled, Holding-element control of a double-acting cylinder with impulse valve, relay, Basic circuit with AND Function, Basic circuit with OR Function

Theory / Lecture Hours: 32 Practical / Tutorial Hours: 48

Total Course Theory / Lecture Hours: 96 Total Course Practical / Tutorial Hours: 144 Total Course Hours: 240

(Training in 100 hrs of Communicative English and 80 hrs of Basic IT Skills also provided, as required)

Recommended Hardware:

State of the art Training system for Hydraulics, Pneumatics, Sensoric and PLC

Recommended Software:

Automation studio, web trainers, Indraworks and indralogic

Text Books:

* Hydraulics. Basic Principles and Components (Bosch Rexroth AG) Volume 1
* The Pneumatic Trainer – Basic Pneumatics Volume 1 (Bosch Rexroth AG)
* The Pneumatic Trainer – Volume 2 (Bosch Rexroth AG)
* Sensors in Theory and Practice – Textbook (Bosch Rexroth AG)
* Basics of Indraworks and Indralogic (Bosch Rexroth AG)

- Herbert R. Merritt, Hydraulic control systems, John Wiley & Sons, Newyork,

Reference Books:

1967

* Dudbey.A.Peace, Basic Fluid Power, Prentice Hall Inc, 1967
* R.Srinivasan Hydraulic and Pneumatic Control published by Vijay Nicole Imprints Private Ltd.
* Programmable Logic Controllers by W.Bolton
* Dudbey.A.Peace, Basic Fluid Power, Prentice Hall Inc, 1967
* Introduction to Programmable Logic Controllers by Garry Dunning, 2nd edition, Thomson, ISBN:981-240-625-5
* Programmable Logic Controllers by Hugh Jack

Evaluation criteria:

The training is conducted with the industrial support of Bosch Rexroth,Germany. MOU

Signed with them .

Bosch has supplied all equipments and set up the state of the art lab facilities in two engineering colleges in the state.. They have trained our faculty.

Evaluation & Certification by Bosch Rexroth

ESSCI has also agreed to do Assessment and Certification