

ANNEXURE - A

CURRICULUM

BOSCH-REXROTH

(CENTRE OF EXCELLENCE)

Host Institute:

GANPAT UNIVERSITY

Contents of Basic Industrial Pneumatics

- Fundamentals of Pneumatics covering: Basic Laws say Boyle – Mariotte's Law etc.
- Advantages & Limitations
- Elements of Pneumatic system, .Hierarchy, Comparison between Pneumatics & Hydraulics.
- Properties of different Energy Media.
- Air Preparation & Distribution,
- Air regulator, Filter, Lubricator ,
- Service units.
- Air Leakage & its effects
- Different types of Dryers & Filters
- Directional Control Valves,
- Valve Port numbering & Lettering system.
- Cylinder and its types.
- Control of Single Acting & Double Acting Cylinder.
- Flow control valves.
- Simple Throttle & One way Flow Control valve, its operation..
- Meter-in & Meter – out .Understanding various mounting possibilities
- Drawing Basic Pneumatic Circuit .
- Using Different components in circuit.
- Special Purpose valves , say Dual Pressure valve, Shuttle valve, Quick Exhaust Valve etc.
- Logical Building Block.
- Functional Block Diagram.
- Safety Consideration & Troubleshooting.
- Latching Circuits.

Tutorial

Contents of Advanced Industrial Pneumatics

- Fundamentals of Pneumatics covering: Basic Laws say Boyle – Mariotte's Law etc.
- Advantages & Limitations
- Elements of Pneumatic system, .Hierarchy, Comparison between Pneumatics & Hydraulics.
- Properties of different Energy Media.
- Air Preparation & Distribution,
- Air regulator, Filter, Lubricator ,
- Service units.
- Air Leakage & its effects
- Different types of Dryers & Filters
- Directional Control Valves,
- Valve Port numbering & Lettering system.
- Cylinder and its types.
- Control of Single Acting & Double Acting Cylinder.
- Flow control valves.
- Simple Throttle & One way Flow Control valve, its operation..
- Meter-in & Meter – out .Understanding various mounting possibilities
- Drawing Basic Pneumatic Circuit .
- Using Different components in circuit.
- Special Purpose valves , say Dual Pressure valve, Shuttle valve, Quick Exhaust Valve etc.
- Logical Building Block.
- Functional Block Diagram.
- Safety Consideration & Troubleshooting.
- Latching Circuits.

- Properties of Electro – Pneumatics .
- Principal & Operation of Solenoid Valve. .
- Various Types of Electrical Contacts .
- Switching Symbols .
- Relay & Its Operation
- Logical Building Block (Electrical).
- Basic Circuit Diagram.
- Electrical Latching Circuits.
- Electrical Memory Circuits.
- Stroke Dependent Control.
- Pressure Dependent Control.
- Exercises to related topics.
- Piston Diameter & Air consumption calculations.

Contents of Basic Industrial Hydraulic

- Fundamentals of Hydraulics covering: Basic Laws say Pascal's Law, Brahma's Principle, Reynold's number etc.
- Elements of Hydraulic system, .Hierarchy, Comparison between Pneumatics & Hydraulics.
- Properties of different Energy Media.
- Function, Construction, Working Principles and Characteristics of Hydraulic Pumps like Gear, Vane and Piston Pumps.
- Installation of Pump.
- Construction of Power pack unit.
- Directional Control Valves,
- Poppet design concept, Spool design concept.
- Various switch overlaps & its effect on function of Directional Control Valves.
- Pressure Control Valves.
- Pressure Relief, Pressure sequence etc.
- Concept of Multifunctional valves.
- Flow Control Valves.
- Construction of Simple Throttle and Temperature compensated throttle valve.
- Meter-in & Meter – out .Understanding various mounting possibilities
- Check Valves.
- Various types of Check Valve like direct & Pilot operated etc.
- Cylinder and its types.
- Control of Double Acting Cylinder.
- Drawing Basic Hydraulic Circuit .
- Using Different components in circuit.
- Logical Building Block.
- Hydraulic accessories.
- Accumulator, Pressure switch, Filters & Gauges.
- Importance of Oil cleanliness/ Contamination control in Hydraulics.
- Safety Consideration & Troubleshooting.
- Latching Circuits.
- Tutorials

Contents of Advanced Industrial Hydraulic

- Fundamentals of Hydraulics covering: Basic Laws say Pascal's Law, Brahma's Principle, Reynold's number etc.
 - Elements of Hydraulic system, .Hierarchy, Comparison between Pneumatics & Hydraulics.
 - Properties of different Energy Media.
 - Function, Construction, Working Principles and Characteristics of Hydraulic Pumps like Gear, Vane and Piston Pumps.
 - Installation of Pump.
 - Construction of Power pack unit.
 - Directional Control Valves,
 - Poppet design concept, Spool design concept.
 - Various switch overlaps & its effect on function of Directional Control Valves.
 - Pressure Control Valves.
 - Pressure Relief, Pressure sequence etc.
 - Concept of Multifunctional valves.
 - Flow Control Valves.
 - Construction of Simple Throttle and Temperature compensated throttle valve.
 - Meter-in & Meter – out .Understanding various mounting possibilities
 - Check Valves.
 - Various types of Check Valve like direct & Pilot operated etc.
 - Cylinder and its types.
 - Control of Double Acting Cylinder.
 - Drawing Basic Hydraulic Circuit .
 - Using Different components in circuit.
 - Logical Building Block.
 - Hydraulic accessories.
 - Accumulator, Pressure switch, Filters & Gauges.
 - Importance of Oil cleanliness/ Contamination control in Hydraulics.
 - Safety Consideration & Troubleshooting.
 - Latching Circuits.
-
- Properties of Electro – Hydraulics .
 - Principal & Operation of Solenoid Valve. .
 - Various Types of Electrical Contacts .
 - Switching Symbols .
 - Relay & Its Operation
 - Logical Building Block (Electrical).
 - Basic Electro – Hydraulic Circuit Diagram.
 - Electrical Latching Circuits.
 - Electrical Circuits using Latch.
 - Stroke/Pressure Dependent Control.
 - Exercises to related topics.
 - Hydraulic Calculations.

Contents of Advanced PLC

- PLC Structure
- Difference between Hardwire & PLC.
- Advantages of a PLC Compared to Conventional Controls such as Electrical, Electro – Pneumatic Controls.
- Function of the system Components of a PLC.
- Commissioning of a PLC.
- Circuit development and diagram design.
- Communication between Personal Computers and PLCs.
- Types of Programming.
- Programming in Ladder Diagram.
- Development of sequence and logic control systems.
- Defining appropriate control systems for a given control task.
- Modification of programs by inserting or deleting control commands.
- Documentation and software management.
- How to convert Electro – Pneumatic Circuit to PLC.

Tutorial

Contents of Sensors

Sensors

- Introduction to Proximity Sensor.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
 - ✓ Application

- Introduction to Magnetic Sensor.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
 - ✓ Application

- Introduction to Inductive Sensor.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
 - ✓ Application

- Introduction to Capacitive Sensor.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
 - ✓ Application

- Introduction to Strain Guage Sensor.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
 - ✓ Application

- Introduction to Ultrasonic Sensor.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
 - ✓ Application

- Introduction to Photo Electric Sensor.
 - ✓ Types.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
- ✓ Application

Contents of Industrial hydraulic and pneumatic

- Fundamentals of Pneumatics covering: Basic Laws say Boyle – Mariotte’s Law etc.
 - Advantages & Limitations
 - Elements of Pneumatic system, .Hierarchy, Comparison between Pneumatics & Hydraulics.
 - Properties of different Energy Media.
 - Air Preparation & Distribution,
 - Air regulator, Filter, Lubricator ,
 - Service units.
 - Air Leakage & its effects
 - Different types of Dryers & Filters
 - Directional Control Valves,
 - Valve Port numbering & Lettering system.
 - Cylinder and its types.
 - Control of Single Acting & Double Acting Cylinder.
 - Flow control valves.
 - Simple Throttle & One way Flow Control valve, its operation..
 - Meter-in & Meter – out .Understanding various mounting possibilities
 - Drawing Basic Pneumatic Circuit .
 - Using Different components in circuit.
 - Special Purpose valves , say Dual Pressure valve, Shuttle valve, Quick Exhaust Valve etc.
 - Logical Building Block.
 - Functional Block Diagram.
 - Safety Consideration & Troubleshooting.
 - Latching Circuits.

 - Properties of Electro – Pneumatics .
 - Principal & Operation of Solenoid Valve. .
 - Various Types of Electrical Contacts .
 - Switching Symbols .
 - Relay & Its Operation
 - Logical Building Block (Electrical).
 - Basic Circuit Diagram.
 - Electrical Latching Circuits.
 - Electrical Memory Circuits.
 - Stroke Dependent Control.
 - Pressure Dependent Control.
 - Exercises to related topics.
- Piston Diameter & Air consumption calculations

- Fundamentals of Hydraulics covering: Basic Laws say Pascal's Law, Brahma's Principle, Reynold's number etc.
 - Elements of Hydraulic system, .Hierarchy, Comparison between Pneumatics & Hydraulics.
 - Properties of different Energy Media.
 - Function, Construction, Working Principles and Characteristics of Hydraulic Pumps like Gear, Vane and Piston Pumps.
 - Installation of Pump.
 - Construction of Power pack unit.
 - Directional Control Valves,
 - Poppet design concept, Spool design concept.
 - Various switch overlaps & its effect on function of Directional Control Valves.
 - Pressure Control Valves.
 - Pressure Relief, Pressure sequence etc.
 - Concept of Multifunctional valves.
 - Flow Control Valves.
 - Construction of Simple Throttle and Temperature compensated throttle valve.
 - Meter-in & Meter – out .Understanding various mounting possibilities
 - Check Valves.
 - Various types of Check Valve like direct & Pilot operated etc.
 - Cylinder and its types.
 - Control of Double Acting Cylinder.
 - Drawing Basic Hydraulic Circuit .
 - Using Different components in circuit.
 - Logical Building Block.
 - Hydraulic accessories.
 - Accumulator, Pressure switch, Filters & Gauges.
 - Importance of Oil cleanliness/ Contamination control in Hydraulics.
 - Safety Consideration & Troubleshooting.
 - Latching Circuits.
-
- Properties of Electro – Hydraulics .
 - Principal & Operation of Solenoid Valve. .
 - Various Types of Electrical Contacts .
 - Switching Symbols .
 - Relay & Its Operation
 - Logical Building Block (Electrical).
 - Basic Electro – Hydraulic Circuit Diagram.
 - Electrical Latching Circuits.
 - Electrical Circuits using Latch.
 - Stroke/Pressure Dependent Control.
 - Exercises to related topics.
 - Hydraulic Calculations.

Contents of Industrial Automation

- Fundamentals of Pneumatics covering: Basic Laws say Boyle – Mariotte's Law etc.
 - Advantages & Limitations
 - Elements of Pneumatic system, .Hierarchy, Comparison between Pneumatics & Hydraulics.
 - Properties of different Energy Media.
 - Air Preparation & Distribution,
 - Air regulator, Filter, Lubricator ,
 - Service units.
 - Air Leakage & its effects
 - Different types of Dryers & Filters
 - Directional Control Valves,
 - Valve Port numbering & Lettering system.
 - Cylinder and its types.
 - Control of Single Acting & Double Acting Cylinder.
 - Flow control valves.
 - Simple Throttle & One way Flow Control valve, its operation..
 - Meter-in & Meter – out .Understanding various mounting possibilities
 - Drawing Basic Pneumatic Circuit .
 - Using Different components in circuit.
 - Special Purpose valves , say Dual Pressure valve, Shuttle valve, Quick Exhaust Valve etc.
 - Logical Building Block.
 - Functional Block Diagram.
 - Safety Consideration & Troubleshooting.
 - Latching Circuits.
 - Properties of Electro – Pneumatics .
 - Principal & Operation of Solenoid Valve. .
 - Various Types of Electrical Contacts .
 - Switching Symbols .
 - Relay & Its Operation
 - Logical Building Block (Electrical).
 - Basic Circuit Diagram.
 - Electrical Latching Circuits.
 - Electrical Memory Circuits.
 - Stroke Dependent Control.
 - Pressure Dependent Control.
 - Exercises to related topics.
- Piston Diameter & Air consumption calculations

- Fundamentals of Hydraulics covering: Basic Laws say Pascal's Law, Brahma's Principle, Reynold's number etc.
 - Elements of Hydraulic system, .Hierarchy, Comparison between Pneumatics & Hydraulics.
 - Properties of different Energy Media.
 - Function, Construction, Working Principles and Characteristics of Hydraulic Pumps like Gear, Vane and Piston Pumps.
 - Installation of Pump.
 - Construction of Power pack unit.
 - Directional Control Valves,
 - Poppet design concept, Spool design concept.
 - Various switch overlaps & its effect on function of Directional Control Valves.
 - Pressure Control Valves.
 - Pressure Relief, Pressure sequence etc.
 - Concept of Multifunctional valves.
 - Flow Control Valves.
 - Construction of Simple Throttle and Temperature compensated throttle valve.
 - Meter-in & Meter – out .Understanding various mounting possibilities
 - Check Valves.
 - Various types of Check Valve like direct & Pilot operated etc.
 - Cylinder and its types.
 - Control of Double Acting Cylinder.
 - Drawing Basic Hydraulic Circuit .
 - Using Different components in circuit.
 - Logical Building Block.
 - Hydraulic accessories.
 - Accumulator, Pressure switch, Filters & Gauges.
 - Importance of Oil cleanliness/ Contamination control in Hydraulics.
 - Safety Consideration & Troubleshooting.
 - Latching Circuits.
-
- Properties of Electro – Hydraulics .
 - Principal & Operation of Solenoid Valve. .
 - Various Types of Electrical Contacts .
 - Switching Symbols .
 - Relay & Its Operation
 - Logical Building Block (Electrical).
 - Basic Electro – Hydraulic Circuit Diagram.
 - Electrical Latching Circuits.
 - Electrical Circuits using Latch.
 - Stroke/Pressure Dependent Control.
 - Exercises to related topics.
 - Hydraulic Calculations.

- PLC Structure
- Difference between Hardwire & PLC.
- Advantages of a PLC Compared to Conventional Controls such as Electrical, Electro – Pneumatic Controls.
- Function of the system Components of a PLC.
- Commissioning of a PLC.
- Circuit development and diagram design.
- Communication between Personal Computers and PLCs.
- Types of Programming.
- Programming in Ladder Diagram.
- Development of sequence and logic control systems.
- Defining appropriate control systems for a given control task.
- Modification of programs by inserting or deleting control commands.
- Documentation and software management.
- How to convert Electro – Pneumatic Circuit to PLC.
 - Introduction to Proximity Sensor.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
 - ✓ Application
 - Introduction to Magnetic Sensor.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
 - ✓ Application
 - Introduction to Inductive Sensor.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
 - ✓ Application
 - Introduction to Capacitive Sensor.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
 - ✓ Application
 - Introduction to Strain Gauge Sensor.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
 - ✓ Application
 - Introduction to Ultrasonic Sensor.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
 - ✓ Application
 - Introduction to Photo Electric Sensor.
 - ✓ Types.
 - ✓ Characteristics
 - ✓ Advantages & Disadvantages
 - ✓ Application

Content of Web based Interaction of Automotive Program

SUBJECTS / MODULES:

- (1) Anti-lock braking Systems (ABS) in motor vehicles
- (2) Basic principles of Gasoline Injection
- (3) Basic principles of Diesel Injection
- (4) Basic principles of Motor vehicle Electrics
- (5) Basic principles of Motor vehicle Electrics (BATTERY)
- (6) Basic principles of Motor vehicle Electrics (STARTER)
- (7) Basic principles of Motor vehicle Electrics (GENERATOR)
- (8) Basic principles of Motor vehicle Electrics (IGNITION SYSTEMS)
- (9) Measurement & testing of Sensors in Motor vehicles

1. Anti-lock braking systems (ABS) in motor vehicles

Content : ▶ Basic principles of physics relating to braking force and slippage ▶ Function and system design of anti-lock braking system in motor vehicles ▶ System design and function of hydro units ▶ Characteristics of sensors ▶ Change of brake fluid, characteristics ▶ Testing of the whole system with various test systems with self-diagnoses ▶ Knowledge test Learning Outcome : The participants (apprentices, car mechanics, car electricians, automotive Mechatronics) learn basic principles of physics relating to braking force and slippage. Furthermore they get to know various anti-lock braking systems and their control concepts and learn how to test these systems.

2. Basic Principles of Gasoline Injection

Content : ▶ Various types of gasoline injection systems ▶ Functions and system design of gasoline injection systems in motor vehicles ▶ System design and function of the sensors ▶ System design, function and testing of exhaust gas treatment system ▶ Testing of the hydraulic system: Flow rate etc. ▶ Testing of the entire system in motor vehicles using various types of test devices, ▶ Knowledge test Learning Outcome: The participants (apprentices, car mechanics, car electricians, automotive mechatronics) get to know the various types of gasoline injection systems and their subsystems as well as their functions. Furthermore, they learn how to test them in the entire system.

3. Basic Principles of Diesel Injection

Content : ▶ Various types of Diesel injection systems ▶ Functions and system design of Diesel injection systems in motor vehicles ▶ System design and function of distributor injection pumps ▶ Removal and installation of injection pumps and nozzle holders with two springs ▶ Practical tips from the workshop ▶ EDC system overview, boost pressure control, exhaust gas recirculation (EGR) ▶ Common rail storage injection system ▶ Knowledge test Learning outcome: The participants (apprentices, car mechanics, car electricians, automotive mechatronics) get to know the basic principles of combustion processes and of the Diesel engine. Furthermore, they learn about the system design and working principle of distributor injection pumps and of the common rail injection system.

4. Basic Principles of Motor Vehicle Electric

Content : ▶ Basic introduction to Ohm's law ▶ Electrical resistance, electrical wiring ▶ Measurement of electrical quantities ▶ Series and parallel circuits ▶ Circuit symbols ▶ Basic principles of electronics (diodes, transistors ...) ▶ Knowledge test Learning outcome: The participants (apprentices, car mechanics, car electricians, automotive mechatronics) will learn how to deal with measurement technology safely and how to calculate the right cable diameters for car electronics.

5. Basic Principles of Motor Vehicle Electric – BATTERY

Content : ▶ Basic Principles of battery, safety instructions ▶ Functions and operating principles of the starter battery ▶ Battery technologies, wet cell battery, AGM battery, gel Battery ▶ Battery load, battery maintenance ▶ Battery faults, battery testing, battery charging ▶ Knowledge test Learning outcome: The participants (apprentices, car mechanics, car electricians, automotive mechatronics) learn to handle modern battery technology safely

6. Basic Principles of Motor Vehicle Electric – STARTER MOTOR

Content: ▶ Various types of starter motors ▶ Functions and operating principles of starter motors ▶ System design and function of the individual starter Motors ▶ Function of the freewheel mechanism ▶ Function test of the entire starter system in motor Vehicles ▶ Knowledge test Learning outcome: The participants (apprentices, car mechanics, car electricians, automotive mechatronics) get to know the operating principle, the system design and the function of starter motors. Furthermore, they learn how to test them.

7. Basic Principles of Motor Vehicle Electric – GENERATOR

Content: ▶ Various types of generators ▶ System design, functions and operating principles of generators ▶ Function of the voltage regulation and rectification ▶ Function test of the entire generator set in motor vehicles ▶ Knowledge test Learning outcome: The participants (apprentices, car mechanics, car electricians, automotive mechatronics) get to know the system design, function and operating principle of generators. Furthermore, the participants get to know the voltage regulation and the possibilities of testing..

8. Basic Principles of Motor Vehicle Electric – IGNITION SYSTEMS

Content : ▶ Various types of ignition systems ▶ Functions and operating principles of ignition systems ▶ System design, function and testing of encoder systems ▶ Different types of ignition coils ▶ Fully electronic ignition systems ▶ Testing of the individual ignition systems in motor Vehicles ▶ Knowledge test Learning outcome: The participants (apprentices, car mechanics, car electricians, automotive mechatronics) get to know the system design and function of electronic ignition systems, different encoder systems, ignition coils and fully electronic ignition systems. Furthermore, the participants learn how to test the respective systems.

9. Measurement and testing of sensors in motor vehicles

Content : ▶ Various types of sensors ▶ Functions and operating principles of sensors ▶ System design, function and testing of sensors ▶ Inductive sensors, hall sensors ▶ Temperature sensors, air mass meters, yaw sensors ,Magneto-resistive sensors, piezo sensors ▶ Co-operation of the sensors in the entire system ▶ Knowledge test Learning outcome: The participants (apprentices, car mechanics, car electricians, automotive mechatronics) get to know the system design and function of various sensors in motor vehicles and learn how to test them