

1. National Institute of Electronics and Information Technology

1.1 Consumer Electronics

ESDM Courses

Level Code: **Vertical Name:**

Course ID: **Course Name:**

Objective of the Course:

Objective of this course is to give knowledge and competencies regarding Installation, Servicing, Repair, Fault Diagnosis and Error Remover for Consumer Electronics Product like LCD-LED TV and Monitor, Cable TV and DTH Services, Induction Stove etc.

Learning Outcomes:

After successful completion of this course, participant will be acquainted with the necessary Hardware and Software skills for Installation, Repair, Maintenance and Trouble shooting of Consumer Electronics Product. Participants will be a "Ready to Observe" product for Consumer Electronics Product manufacturing sector or may be self-employed.

Expected Job Roles:

Participants Job Role includes

- Support Technician for Multi-National and National Desktop PCs Manufacturers
- Can Work In Call Centre for After Sale Support
- can be also absorbed in Local Markets
- Can start their own Small Scale business and can be self employed

Duration of the Course (in hours)

Minimum Eligibility Criteria and pre-requisites, if any

Professional Knowledge:

The individual on the job needs to know and understand:

- PK1. Knowledge of spare management and repair & return process for faulty components
- PK2. Protection equipment (anti-static wrist bands, shoes, dress, packaging, and other appropriate insulations) that are required to be used
- PK3. First aid requirements in case of electrical shocks, cuts and other common injuries
- PK4. Functionality and features/working of Consumer Electronics Products
- PK5. Consumer Electronics Products specific Console Control and user interface
- PK5. Functionality of hardware components of Consumer Electronics Products
- PK6. Procedure to dismantle and assemble Consumer Electronics Products
- PK7. Range of tools and testing equipment (multi meters, frequency generators etc) available and their functionality
- PK8. ESD hazards and their effect on electronic components
- PK9. Standard fault-finding (troubleshooting) techniques
- PK10. Basic computer knowledge to be able to run diagnostic tools
- PK11. Functionality of hardware components, software applications, screen, touchpad etc.
- PK12. Consumer Electronics Products software related problems and their possible solutions
- PK13. Standard repairing process

Professional Skill:

The individual on the job needs to know and understand:

- Consumer Electronics Product Equipment operating Skills**
- PS1. Use and access all features and applications Consumer Electronics Product
- PS2. Operate Consumer Electronics Product testing equipment's
- PS3. Connect Consumer Electronics Product's PCB to PC/test equipment for diagnostics
- Consumer Electronics Product repairing skills**
- PS4. Undertake fault diagnostic
- PS5. Interpret test results to identify and localize faults
- PS6. Utilize appropriate mechanisms and tools to rectify the faults
- PS7. Utilize appropriate communication channels to escalate unresolved problems
- PS8. Test Consumer Electronics Product to confirm and resolve of the reported fault
- PS9. Undertake corrective repairs by software porting/updates
- PS10. Undertake checks to confirm that the problem is resolved
- Consumer Electronics Product Component Handling skills**
- PS11. Safely dismantle/assemble Consumer Electronics Product using the right tools
- PS12. Safe remove/replace components using right tools
- PS13. Compliance to ESD protection measures
- Consumer Electronics Product Software Skills**
- PS14. Identifying correct software version/modules
- PS15. Ascertain correct and complete porting/update of software in the Consumer Electronics Product
- Consumer Electronics Product Troubleshooting Skills**
- PS16. How to approach a defect
- PS17. Make use of standard OEM specified troubleshooting steps
- PS18. Interpret intermediate results and progress fault rectification accordingly

Core Skill:

The individual on the job needs to know and understand how to:

	<p>Reading skills</p> <p>CS1. Read and understand technical manuals, work orders and reports</p> <p>CS2. Read and understand Consumer Electronics Product safety instructions</p> <p>Writing Skills</p> <p>CS3. Fill up record sheets clearly, concisely and accurately as per company procedures</p> <p>Communication Skills</p> <p>CS4. Clearly communicate relevant information to supervisors</p> <p>CS5. Respond appropriately to queries</p> <p>CS6. Time Management Skills</p> <p>CS7. Prioritize and execute tasks in a high-pressure environment</p> <p>CS8. Use and maintain resources efficiently and effectively</p> <p>Analytical Skills</p> <p>CS9. Analyse (and understand) Manufacturing Process based on Company need</p> <p>CS10. Interpret reports, readings and numerical data</p> <p>CS11. Keep up to date with new technology and performance issues</p> <p>Other Skills</p> <p>CS12. Create and maintain effective working relationships and team environment through collaboration</p> <p>CS13. Take initiatives and progressively assume increased responsibilities</p> <p>CS14. Share knowledge with other team members and colleagues</p>
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Detailed Syllabus of Course

Module. No	Modules	Minimum No. of Hours (Theory/Practical)
1.	LCD-LED TV and Monitor: - Basic Principle, Working and Operation of LCD-LED TV and Monitor, Installation, Repair Maintenance and Servicing and Practice, Fault Diagnosis and Error Remover Techniques and Practices	25/80
2.	Cable TV and DTH Services: - Basic Principle, Working and Operation of Cable TV and DTH Services, Installation and Checking, Repair Maintenance, Servicing and Practice, Fault Diagnosis and Error Remover Techniques and Practices.	25/70
3.	VCD-DVD Player and Home Theatre System: - Basic Principle, Working and Operation of VCD-DVD Player and Home Theatre System, Installation, Repair, Maintenance, Servicing and Practice, Fault Diagnosis and Error Remover Techniques and Practices.	25/50
4.	FM Radio- Cordless Phone-Hair Dryer: - Basic Principle, Working and Operation of FM Radio- Cordless Phone-Hair Dryer, Installation, Repair, Maintenance, Servicing and Practice, Fault Diagnosis and Error Remover Techniques and Practices.	10/25
5.	Induction Stove and Microwave Oven: - Basic Principle, Working and Operation of Induction Stove and Microwave Oven, Installation, Repair, Maintenance, Servicing and Practice, Fault Diagnosis and Error Remover Techniques and Practices.	15/25
Total Theory / Lecture Hours:		100
Total Practical / Tutorial Hours:		250
Total Hours:		350

Recommended Hardware:

- | |
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| <p>For a Batch of 50 No's</p> <ul style="list-style-type: none"> • Trainer Kits of all Consumer Product as mentioned in Detail Syllabus of Course Content: 10 No's Each • For those Consumer Electronics Product whose Trainer Kits are not Available product |
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will be purchased and dismantle by Trainer for individual Practice: 10 No's each.
• Complete Electronics-Electrical Tool Kit: 10 No's Each

**Recommended
Software:**

As prescribed and provided by Consumer Electronics Product Manufacturer. No need to purchase externally and can be downloaded from respective manufacturer web sites

Text Books:

BPB Publication Books on Installation Repair, Maintenance and Servicing of Consumer Electronic Products in Hindi

Reference Books:

User Manual as provided by Consumer Electronics Product Manufacturer.

ESDM Courses

Level Code: L4 **Vertical Name:** Consumer Electronics (Home Appliances)

Course Code: NL/S/L4/C021 **Course Name:** 1.1.2 Installation, Repair and Maintenance of Home Appliances

Objective of the Course:

The module has been designed to provide an understanding of the basics of Electrical and Electronic with an introduction to various electronic active & passive components and test equipments. The participants would be acquainted with the Electrical Hazards along with work place safety instructions and precautions that need to be taken while handling the Electrical and Electronic equipment and appliances. It covers the basic know how required for Installation, Repair and Maintenance of Washing Machine, Microwave Oven, Juicer-Mixer-Grinder & Water purifier. In addition, the participants would get the knowledge about Soldering & De-soldering technique.

Learning Outcomes:

Students shall be able to

- Install the washing machine, Microwave Oven, Juicer-Mixer-Grinder and Water Purifier
- Diagnose faults in the Washing Machine, Microwave Oven, Juicer-Mixer-Grinder & Water purifier.
- Carry out fault rectification
- Interact with the customer, management effectively
- Be able to log call reporting

Expected Job Roles:

The pass out would be competent to:

- Understand the basic terminology and handling of tools and instruments.
- Learn to have effective interaction with customer for Servicing, Installation and Troubleshooting of Washing Machine, Microwave Oven, Juicer-Mixer-Grinder & Water purifier in addition to the product operating guidelines for customer.
- Able to take decision to go for repair work by different case analysis and discussion with colleague.
- Understand the type, model, rating and accessories of Washing Machines, Microwave Oven, Juicer-Mixer-Grinder & Water purifier.
- Installation, fault identification and servicing of Washing Machines, Microwave Oven, Juicer-Mixer-Grinder & Water purifier

Duration of the Course (in hours) 350 Hours

**Minimum Eligibility
Criteria and pre-
requisites, if any**

10th + ITI, 12th pass, non-science graduates.

Professional Knowledge:

The individual on the job needs to know and understand:

- PK1. Knowledge of Electronic and Electrical Components
- PK2. Resistors, Capacitors and Inductors, their identification, types and application
- PK3. Protection equipment (anti-static wrist bands, shoes, dress, packaging, and other appropriate insulations) that are required to be used
- PK4. First aid requirements in case of electrical shocks, cuts and other common injuries
- PK5. Soldering and De-Soldering Techniques
- PK5. Basic functionality/working of washing machine/ microwave oven/juicer-mixer-grinder, water purifier.
- PK6. Installation/Handling instruction of these devices.
- PK7. Fault identification, repair and maintenance of washing machine/ microwave oven/juicer-mixer-grinder, water purifier.
- PK8. Component testing methods
- PK9. Troubleshooting through circuit diagram
- PK10. Removal and Replacement of faulty Component

Professional Skill:

The individual on the job needs to know and understand:

Electrical and Electronic Component Identification and Use Skills

- PS1. Understand use of Electrical Component such as cable, switches, transformers, etc.
Understand use of Electronics Component such as Diodes, Transistors, ICs etc.
- PS2. Use of Test and Measurement Equipment
- PS3. **Soldering skills**
Understand Soldering Requirements
- PS4. Operation of Equipment required for Soldering
- PS5. Use of Desoldering Pump
- PS6. **Basic functionality and Installation**
washing machine, Microwave oven, Juicer-Mixer-Grinder, Water Purifier
- PS7. **Fault identification, Repair and Maintenance**
washing machine, Microwave oven, Juicer-Mixer-Grinder, Water Purifier
- PS8. **Troubleshooting Skills**
How to approach a defect
- PS9. Make use of standard OEM specified troubleshooting steps
- PS10. Interpret intermediate results and progress fault rectification accordingly
- PS11. Utilize appropriate tools to rectify faults
- PS12.

Core Skill:

The individual on the job needs to know and understand how to:

	Reading skills
CS1.	Read and understand technical manuals, work orders and reports
CS2.	Read and understand organizational health and safety instructions
	Writing Skills
CS3.	Fill up record sheets clearly, concisely and accurately as per company procedures
	Communication Skills
CS4.	Clearly communicate relevant information to supervisors
CS5.	Respond appropriately to queries
CS6.	Communicate with customer/customer facing teams to understand handset performance issues
CS7.	Communicate in the local language
CS8.	Convey proposed solution to the customers
	Time Management Skills
CS9.	Prioritize and execute tasks in a high-pressure environment
CS10.	Use and maintain resources efficiently and effectively
	Analytical Skills
CS11.	Analyse (and understand) customer complaints
CS12.	Interpret reports, readings and numerical data
CS13.	Keep up to date with new technology and performance issues
	Other Skills
CS14.	Create and maintain effective working relationships and team environment through collaboration
CS15.	Take initiatives and progressively assume increased responsibilities
CS16.	Share knowledge with other team members and colleagues

Detailed Syllabus of Course

Sl. No.	Modules	Min: No. of Hours
		Theory/ Practical
1.	Introduction to Electricity <ul style="list-style-type: none"> • Electric Charge, Voltage, Electric Current • Ohm's Law, Electric Potential, Cell • Serial and Parallel Circuit, their effect on Voltage and Current • Transformer, Use and Operation 	5 / 5
2.	Electronic and Electrical components <ul style="list-style-type: none"> • Active and Passive Components • Resistors, Capacitors and Inductors, their identification, types and application • Semiconducting Devices: Diodes, its type, characteristics and applications • Transistors, Integrated Circuits • Study of a transistor, use of a transistor as an amplifier and as a switch. • Analog ICs, 555 timer, IC741, characteristics of 741 • Digital ICs, ICs for logic gates, Truth table verification of logic gates • Connectors • Fuse, types, Use of Fuses and its rating 	15 / 15

	<ul style="list-style-type: none"> • Relays and Switches • Panel Components • Digital electronics – gates and its application, multiplexers, de-multiplexers, counter 	
3.	Soldering/ de- soldering techniques <ul style="list-style-type: none"> • Soldering Iron, Soldering wire, Soldering Flux, Soldering method, Zero defect soldering • Desoldering pump, Temperature controlled soldering station, • Hands-on-practices of Soldering 	10 / 10
4.	Tools and equipment use for Repairing and maintenance of Electrical Equipment <ul style="list-style-type: none"> • Screw Driver Set • Tweezers, Different Types of Tweezers, Nose Pliers, Wire Cutter • Hot air gun • Liquid solder pest, Magnifying Lamp and Measuring Tools • Brush, CRO, Nipper • Test and Measurement Equipment, Multimeter Operation etc. 	10 / 10
5.	Basic functionality and Installation of washing machine <ul style="list-style-type: none"> • Different type of washing machines & working principle, • Basic hand wash process, Different types of technologies being used in Washing machines – Pulsator, Agitator, Agipellar, Tumble wash, • Main parts of washing machines and their functionalities etc. • Opening the packed Washing machine, Selection of the suitable place for washing machine, • Installation of washing machine, • Demonstration of various functionality of washing machine 	15/20
6.	Fault identification, Repair and Maintenance of Washing machine <ul style="list-style-type: none"> • Testing & identification of the faulty block on the basis of symptom, rectifying common faults by replacing the damage components, • Testing of the damage block after repair, • Step by step re-assembly of the washing machine panel. 	15/20
7.	Basic functionality and Installation of Microwave oven <ul style="list-style-type: none"> • Basic working principle of circuit and block description of Microwave Oven • identification of parts and their working • MWO heating/cooking, MWO safe utensils, Tips & Safety precautions for MW • Opening the packaged Microwave Oven • Selection of the electric power socket • switch rating and place for microwave oven installation • Install the microwave oven with the help of step by step instruction. • Demonstration of various functionality of Microwave Oven. 	10/15
8.	Fault identification, Repair and Maintenance of Microwave oven <ul style="list-style-type: none"> • Identify the problem based on customer's information, possible solutions and repair costs involved, • Common occurring faults with the Microwave Oven their identification and 	10/20

	<ul style="list-style-type: none"> repair. Maintenance of Microwave Oven. 	
9.	Basic functionality and Installation of Mixer/Juicer/Grinder <ul style="list-style-type: none"> Working principle of mixer/juicer/grinder, Identification of various parts and their functionalities. functioning of motor and circuit breaker, Opening the packaged Mixer/Juicer/Grinder, assembly of component, Selection of the power socket, switch rating and place for installation, Steps to Install the Mixer/Juicer/Grinder. Demonstration of various functionalities of Mixer/Juicer/Grinder 	10/15
10.	Fault identification, Repair and Maintenance of Mixer/Juicer/Grinder <ul style="list-style-type: none"> Common occurring faults, identification and repair, maintenance of Mixer/Juicer/Grinder 	10/20
11.	Basic functionality and Installation of Water purifier <ul style="list-style-type: none"> Working principle /functionality of different types of water purifiers, part identification and their working, unpacking of Water purifier, Selection of the place for installation, Steps to Install the water purifier. 	10/15
12.	Fault identification, Repair and Maintenance of Water purifier <ul style="list-style-type: none"> Identification of problem, possible causes and solution Replacement of parts Water Filter Maintenance 	10/15
13.	Safety and Security Procedures <ul style="list-style-type: none"> Reporting incidents, system failures, power failures etc., protection equipment First aid requirement in case of electrical shocks and other injuries 	5 / 5
14.	Reading, Writing and Communication Skills <ul style="list-style-type: none"> Understanding Technical Manuals, Reports, Work orders etc. Understanding Organizational health and safety instructions Types of documentation in organization, their importance, Company guidelines and norms, activities after maintenance process Spare management, Service Level Agreements (SLAs) Fill-up forms, record sheets, log book etc. as per company procedures Customer Communication, Convey proposed solution to the customer, responding queries Communication with supervisor, Report for unresolved problems Time Management and Team Skills 	15 /15
Total Theory / Lecture Hours:		150 hrs
Total Practical / Tutorial Hours:		200 hrs
Total Hours:		350 hrs

Recommended Hardware:

- Semi-Automatic Washing Machine
- Microwave Oven
- Juicer-Mixer-Grinder& Water Purifier
- Multimeter, Soldering Iron, screw driver set, Wire cutter & plier etc

Recommended Software:

NIL

Text Books:

Course Material Prepared by NIELIT, Chandigarh

Reference Books:

Modern Washing Machine Servicing by Lotia(Author) BPB (Publisher)

ESDM Courses

Level Code: **Vertical Name:**

Course ID: **Course Name:**

Objective of the Course:

This course has been designed to provide the knowledge and expertise of Systematic Testing of selected Electronics Products along with Communicative English and soft Skills and Basic IT skills required for good performance in any job in the modern world.

Learning Outcomes:

To systematically test electronic equipments using appropriate tools and equipments.
Have good Communicative English skills, soft Skills & Basic IT Skills

Expected Job Roles:

Technician-In Electronic Products Testing / QA Areas

Duration of the Course (in hours)

Minimum Eligibility Criteria and pre-requisites, if any

Professional Knowledge:

1. Fundamentals of electricity & Electronics
2. Use of Tools and Test and Measuring equipments such as CRO, Multimeter, Signal Generator, LCR meter etc
3. Handling of Different electronics Components and Electrostatic discharge
4. Awareness of Types of Product testing, Safety Standards & Certificates
5. Awareness of Quality standards, Calibration of Equipments etc
6. Specifications of Products and their testing Procedures
7. Basic knowledge of working principle of Different Electronic Products
8. Understanding of internal modules and major components used in the Product
9. Testing of Electronic Components
9. Safety rules, policies and procedures

Professional Skill:

1. Systematic Approach to Testing of Products
2. Use of Tools and Test and Measuring equipments such as CRO, Multimeter, Signal Generator, LCR meter etc
3. Fault Diagnosing skills- Detect basic electrical faults such as improper earthing, defective power chord, connector or wiring defects, loose connections etc.,
4. Good Soldering & de-soldering Skills
5. Use oscilloscope for diagnosing faults
6. Sound Judgement based on quality Standards and Company Policy

Core Skill:

1. Reading and writing skills
2. To record the details of tests & Measurements and Observations
3. to know and understand: how to read product and module serial numbers and interpret details such as make, date, availability , how to note problems on job sheet and details of work done.
4. To read and understand Product manuals
5. to read and understand warnings, instructions and other text material on product labels, and components
6. Safety Habits

Detailed Syllabus of Course

Communication and Soft skills

Module. No	Module Name	Minimum No. of Hours
Module 1.	Personal Skills Knowing Oneself, Confidence Building, Defining Strengths, Thinking Creatively, Personal Values, Time and Stress Management	10 hrs
Module 2.	Social Skills Appropriate and Contextual Use of Language, Nonverbal Communication, Interpersonal Skills, Problem Solving, Understanding Media, Public Speaking	30 hrs
Module 3.	Professional Skills Organizational Skills, Team Work, Business/Technical Communication, Job Oriented Skills, Professional Etiquette	30 hrs
Module 4.	Training for Language Proficiency Tests Integrated Skills, Integrated Skills, Integrated Skills, Practice Exercises, Practice Tests	20 hrs

	Module. Name	Minimum No. of Hours
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Module 5.	Preparing and Presenting a Project Brainstorming, Gathering, Selecting, Processing, Cohesive and Coherent Organization, Drafting and Revising, Presentation of the Project	10 hrs
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Theory / Lecture Hours: 100

IT Skills

Module. No	Module Name	Minimum No. of Hours
Module 1.	Introduction to internet, Office Writer, Emails Module Project and Evaluation	16 hrs
Module 2.	Operating Systems , Edit Images, Presentations, Internet Security, Chat and Social Networking ,Malayalam in Computer, Module Project and Evaluation	24 hrs
Module 3.	Computer Networks, Spreadsheet, Online Services, Interoperability, Module Project and Evaluation	24 hrs
Module 4.	Final Project and Evaluation	16 hrs

Practical / Tutorial Hours: 80

Module 1.	<p>Fundamentals of Electricity and Electronics</p> <ol style="list-style-type: none"> 1. Identification of basic electronic components, ICs, PCBs, Battery & Sensors. 2. Basics of electricity, wave form , frequency value, peak value, average value of voltage and current 3. Awareness of tools, testing and measuring instruments – CROs, Multimeter, Power supplies, LCRs, Signal Generator and Power Analyzer. 	25
Module 2.	<p>Soldering Practices</p> <ol style="list-style-type: none"> 1. Handling of components, Instruments etc. ESD – (Electrostatic discharge). 2. Basics of SMD, its soldering and desoldering 3. Basics of Transformer , ICs ,thyristors and IGBT testing Pin configuration of some important ICs used in SMPS,UPS and Inverters, testing of Induction cookers 	15
Module 3.	<p>Types of Product Testing</p> <p>Acceptance Testing, Type Testing , Safety Testing, Identification of legends, symbols, colour codes, Safety, safety standards, safety certificates (CE, UL and VDE) Effect of environmental testing(refer to IEC 60068-1 for guidance), General awareness of quality standards, quality management systems & documentation, Awareness on ISO 17025, ISO 9001, Calibration and Uncertainty of measurements, Awareness on disposal of Electronic waste</p>	20
Module 4.	<p>Testing Procedures(Practical)</p> <p>Testing of Basic Electronic Components</p> <p>Resistor (Parameter to be measured: Resistance Value), Capacitor(Parameter to be measured: Capacitance Value, IR at rated Voltage), Inductor(Parameter to be measured: Inductance Value, DC Resistance), Diode(Parameter to be measured: Resistance in forward direction and reverse direction), Transistors-PNP and NPN (Parameter to be measured: Each PN Junction shall be tested as in diode testing), Transformer basics, ICs, Thyristors and IGBT testing, Pin configuration of some important ICs used in SMPS,UPS and Inverters, testing of Induction cookers</p> <p>2. Switch Mode Power Supply (Applicable Standard : IS 14886)</p>	90

	<p>Safety Testing(Earth Leakage current Test, Dielectric Test, Short Circuit Protection), Performance Testing (Line Regulation, Load Regulation for a variation of Load Min to Max load and vice versa, Efficiency at nominal input and rated load)</p> <p>3. Tubular Batteries (Applicable standard : IS 1651) Test for Capacity, Test for voltage during discharge</p> <p>4. Personal Computer (Applicable Standard : IS 14896) Safety Testing (Earth Leakage current Test, Dielectric Test) Performance Testing (Microprocessor used, RAM expansion Capacity, Clock Rate and RAM Capacity, Effect of Power Supply variations)</p> <p>5. Invertor (Applicable Standard : IS 13314) Visual Inspection, High Voltage Test, Insulation Resistance Test, No –Load Test, Output Test</p> <p>6. UPS (Applicable Standard : IEC 62040-3) Steady State Input Voltage Tolerance, Output-Normal Mode – No Load, Output-Normal Mode – Full Load, Output-Stored Energy Mode – No Load, Output- Stored Energy Mode – Full Load, Output-Normal Mode – Over Load, Output- Stored Energy Mode – Over Load Output-Normal Mode – Short Circuit, Output- Stored Energy Mode – Short Circuit, Efficiency and Input Power factor</p> <p>7. Electronic Ballast (Applicable Standard : IS 13021) Operating Supply Voltage, Total Circuit Power, Circuit Power factor, Supply Current</p> <p>8. Safety Testing of Household Appliances (Applicable Standard : IS 302-1) Definitions and Terminology, Protection against Shock, Power Input and Current, Leakage Current and Electric Strength at Operating Temperature, Earthlings</p> <p>9. Testing of Electric Iron/Electric Kettle (Applicable Standard : IS 302-2) Ground bond resistance, Touch Current, Temperature (Thermostatic Cut off) Power Consumption.</p> <p>10. Audio Amplifier (Applicable Standard : IEC 60065) Audio frequency response at various power levels,</p>	
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	Response to various inputs sources like DVD player, IPOD, CD player, etc., audio output power, Power Consumption, Voltage range test, Touch Current	
	Intership/ Practical training	30

Total Course Theory / Lecture Hours: 160

Total Course Practical / Tutorial Hours: 200

Total Course Hours: 360

Recommended Hardware:

Electronics lab in Polytechnic Colleges

Recommended Software:

Nil

Text Books:

Reference Books:

Evaluation criteria:

National Institute of Electronics and Information Technology

ESDM Courses

Level Code: Vertical Name:

Course ID: Course Name:

Objective of the Course:

To train students in the area of Electronic Product Design

Learning Outcomes:

After completion of the training, participants would be able to:

- Prepare working Drawing of Electronics products
- Do the work on 2D Engineering drafting
- To apply this knowledge to understand the engineering design work flow Process in the Industry
- Acquire knowledge of basic 3D modeling concepts.

Expected Job Roles:

Act as a Product Designer of Electronics Products

Duration of the Course (in hours)

Minimum Eligibility Criteria and pre-requisites, if any

Professional Knowledge:

- Making plan of Projection.
- • Creation Multi-view Orthographic projection.
- • Drafting views in First angle & Third angle Projection.
- • Creating Auxiliary views & Sections.
- • Freehand Sketching.
- • Representing Standard base 2D drafting.
- Modeling
 - Solid Modeling –Extrude sketch geometry,
 - Sweep geometry along a path, revolve
 - sketch geometry, Coil feature, Rib & Web feature.
 - Create hole feature on part, Create a shell feature with varying thickness.
 - • Add chamfer & edge fillet feature to a part.
- • Surface Modeling – Create a curved surface, Revolved surface, Ruled Surface, Edge Surface.
- Creating 3D Solid drawing with template, using Title block, Detailing & Section view

Professional Skill:

- Practise on Drawing basics
- Geometrical Drawing Practise
- Making Projection.
- Creation Multi-view Orthographic projection.
- Drafting views in First angle & Third angle Projection.
- Creating Auxiliary views & Sections.
- Freehand Sketching.
- Representing Standard base 2D drafting.
- Drawing with Elementary CADD command –Line, Polyline, Polygon, Circle, Polyline, arc, ellipse, Text- Single Text, Multitext, Dtext.
- Modifying Elementary Commands – Erase, Move, Copy, Mirror, Offset, Scale, Stretch, Chamfer, fillet & explode.
- Making layers, line type & Lineweight.
- Different menus of Auto-Cad, Function keys, Shortcut keys, Paper size.
- Making Title Block, Writing it & inserting it in any drawing file with scale, angle & explode options.
- Creating a new template file (.Dwt file) & applying it to every drawing file.
- Drafting of building plan, Elevation, Section Views.
- Applying dimensions to various views by using dimension style.
- Creating Revolved, Ruled, and Tabulated & Edge surfaces.
- Creating Isometric drawing with the Isoplane (Left, Top & Right Plane)
- Making Solid Model – Box, Polysolid,
 - Building Model.
 - Modeling
 - Solid Modeling –Extrude sketch geometry,
 - Sweep geometry along a path, revolve
 - sketch geometry, Coil feature, Rib & Web feature.
 - Create hole feature on part, Create a shell feature with varying thickness.
 - Add chamfer & edge fillet feature to a part.
- Surface Modeling – Create a curved surface, Revolved surface, Ruled Surface,
 - Edge Surface.
- Creating 3D Solid drawing with template, using Title block, Detailing & Section view.
- Apply material, background, light – Point, Distance, Spot light, landscaping.
- Making slide & running run script file.
- Creating view ports & views & plotting it.
- Creating a flat & flange wall in sheet metal modeling.
- Constraining component by mating plane faces.
- Creating assembly components in place.
- Creating component pattern.
- Copying & mirroring assembly.
- Making exploded assemblies - Making detailed drawing of Machine drawing, dismantling machine component. Adaptive Assemblies.
- Project-

Core Skill:

Introduction

- Principle of drafting, Terminology, & fundamentals.
- Size & shape descriptions.
- Geometric Construction.

Views

- Plan views, Auxiliary views, Section Views.

Projection

- Method of Projection.
- Multi-view Orthographic Projection.
- Projection Techniques.

Modeling

- Modeling Fundamental for Engineering design
- Shape Modeling and it's application.

CADD

- Introduction of CADD (Computer Aided

Drafting & Designing).

- Function keys, Shortcut keys,
- Different sizes of paper.
- Application of CADD – Automatic Drafting ,

Geometric Modeling

- Geometric Modeling – Wire frame Modeling, Surface Modeling, and Solid Modeling.

CADD Application & it's feature

- Introduction to Standard based 2D drafting

3D Design

- Concept of 3D Design.
- X, Y, Z Co-ordination System.

Documentation

- Manufacturing Process & Material

Detailed Syllabus of Course

Module. No	Module. Name with detailed syllabus	Minimum No. of Hours (Theory/Practical)
➤ Module-I	Creating a Simple Drawing <ul style="list-style-type: none"> ☑ Getting Started with AutoCAD <ul style="list-style-type: none"> o Starting AutoCAD o AutoCAD's Screen Layout o Working with Commands o Opening an Existing Drawing File o Saving Your Work o AutoCAD's Cartesian Workspace ☑ Drawing & Editing Commands <ul style="list-style-type: none"> o Drawing Lines o Erasing Objects o Drawing Lines with Polar Tracking o Drawing Rectangles o Drawing Circles o Viewing Your Drawing o Undoing and Redoing Actions 	40Hrs
➤ Module-II	<ul style="list-style-type: none"> ☑ Drawing Precision in AutoCAD <ul style="list-style-type: none"> o Using Object Snap o Object Snap Overrides ☑ Polar Tracking Settings <ul style="list-style-type: none"> o Object Snap Tracking o Drawing with SNAP and GRID ☑ Making Changes in Your Drawing <ul style="list-style-type: none"> o Selecting Objects for Editing o Moving Objects o Copying Objects o Rotating Objects o Scaling Objects o Mirroring Objects o Editing Objects with Grips 	60 Hrs
➤ Module-III	Drawing Organization and Information <ul style="list-style-type: none"> ☑ Layers <ul style="list-style-type: none"> o Creating New Drawings With Templates o What are Layers? o Layer State 	40 Hrs

	<ul style="list-style-type: none"> o Changing an Object's Layer ☑ Advanced Object Types <ul style="list-style-type: none"> o Drawing Arcs o Drawing Polylines o Editing Polylines o Drawing Polygons o Drawing Ellipses ☑ Getting Information From Your Drawing <ul style="list-style-type: none"> o Measuring Objects o Working with Properties 	
➤ Module-IV	<ul style="list-style-type: none"> ☑ Advanced Editing Commands <ul style="list-style-type: none"> o Trimming and Extending o Stretching Objects o Creating Fillets and Chamfers o Offsetting Objects o Creating Arrays of Objects ☑ Blocks <ul style="list-style-type: none"> o What are Blocks? o Inserting Blocks from Tool Palettes o Inserting Blocks using Insert o Inserting Blocks with Design Center 	40 Hrs
➤ Module-V	<ul style="list-style-type: none"> ☑ Annotating Your Drawing Text <ul style="list-style-type: none"> o Working with Annotations o Adding Text in a Drawing o Modifying Multiline Text o Formatting Multiline Text ☑ Hatching <ul style="list-style-type: none"> o Hatching ☑ Adding Dimensions <ul style="list-style-type: none"> o Dimensioning Concepts o Adding Linear Dimensions o Adding Radial and Angular Dimensions o Editing Dimensions o Adding Notes to Your Drawing ☑ Preparing to Print <ul style="list-style-type: none"> o Setting Up a Layout 	40 Hrs
➤ Module-VI	<ul style="list-style-type: none"> ☑ 3D Foundations <ul style="list-style-type: none"> o Why use 3D? o Introduction to the 3D Modeling Workspace o Basic 3D Viewing Tools o 3D Navigation Tools o Introduction to the User Coordinate System Simple Solids <ul style="list-style-type: none"> o Working with Solid Primitives o Solid Primitive Types o Working with Composite Solids ☑ Working with Mesh Models Creating Solids & 	80 Hrs

	Surfaces from 2D Objects <ul style="list-style-type: none"> o Complex 3D Geometry o Extruded Solids and Surfaces o Swept Solids and Surfaces o Revolved Solids and Surfaces o Lofted Solids and Surfaces ☒Advanced Solid Editing <ul style="list-style-type: none"> o Editing Components of Solids o Editing Faces of Solids o Fillets and Chamfers on Solids ☒Working Drawings from 3D Models <ul style="list-style-type: none"> o Creating Multiple Viewports o 2D Views from 3D Solids 	
➤ Module-VII	10. Advanced Layouts and Printing <ul style="list-style-type: none"> ☒ Advanced Layouts <ul style="list-style-type: none"> o Creating and Using Named Views o Creating Additional Viewports o Layer Overrides in Viewports o Additional Annotative Scale Features ☒ DWF Printing and Publishing <ul style="list-style-type: none"> o DWF Plotting and Viewing o Publishing Drawing Sets 	40 Hrs
➤	Practical Project	60 Hrs
Total Theory / Lecture Hours:		120
Total Practical / Tutorial Hours:		240
Total Hours:		360

Recommended Hardware(minimum batch size 10):

20 Workstations of suitable configuration

Recommended Software:

20 licenses AutoCAD software

Text Books:

Illustrated Auto Cad (BPB Publications)
Thinking in Auto Cad (Wheeler Publication)
AutoCAD 2015 Instant Reference (BPB Publications)
Beginning AutoCad 2011 (BPB Publications)
Introduction to AutoCAD 2002 (BPB Publications)

Reference Books:

DRAUGHTSMAN - CIVIL – PRACTICAL – ENGLISH (NIMI)
P&M - Draughtsman Mechanical -Trade Practical - First Semester-NCVT (NIMI)
Mastering Auto Cad (Tech Publication)
Auto Cad 3D Book (Venlana Publication)

ESDM Courses

Level Code:

L5

Vertical Name:

Industrial Automation

Course ID:

NL/S/L5/C009

Course Name:

3.3.1 Diploma in Repair & Maintenance of Industrial Instrumentation & Automation System

Objective of the Course:

To develop the competency to install, operate & maintain industrial instruments and automation systems.

Learning Outcomes :

On completion of the course the participants will be able to:-

1. Understand P & ID and other trade related codes and standards
2. Identify a particular instrument in plant from P&ID.
3. Demonstrate the working of different field instruments/sensor.
4. Install, calibrate, operate and maintain all control loop elements.
5. Develop and test PLC programs.
6. Identify the requirements of open loop and closed loop stability.

Expected Job Roles:

As Technician in Process Industries.

Duration of the Course (in hours)

400

Minimum Eligibility Criteria and pre-requisites, if any

ITI / Diploma / BSc

Professional Knowledge:

The individual on the job needs to know and understand:

- PK1. Protection equipment that are required to be used
- PK2. First aid requirements in case of electrical shocks, cuts and other common injuries
Have basic knowledge of electrical and electronic components
- PK3. Standard fault-finding techniques
- PK4. Standard repairing process
- PK5. Range of tools and testing equipments available and their functionality
- PK5. Principle of operation and features/working of instruments
- PK6. Knowledge to dismantle and assemble the faulty instrument
- PK7. Basic computer knowledge to be able to run diagnostic tools in case of smart instruments
- PK8. Range of instrument related problems and their possible solutions
Knowledge of spare management and repair
- PK9. Vendor specific configuration and user interfaces
- PK10. Functionality of hardware components and software applications.
- PK11.
- PK12.

Professional Skill:

The individual on the job needs to know and understand:

Instrument operating Skills

- PS1. Use and access all instrument features and applications
- PS2. Operate instrument calibration equipments and testing equipments
- PS3. Connect instrument to PC for diagnostics for smart instruments
- PS4. Initialize PC based diagnostic tools

Instrument repairing skills

- PS5. Undertake fault diagnostic
- PS6. Interpret test results to identify and localize faults
- PS7. Utilize appropriate mechanisms and tools to rectify the faults
- PS8. Utilize appropriate communication channels to rectify unresolved problems
- PS9. Test instruments to confirm the rectification of the reported fault
- PS10. Interpret diagnostic test results to identify and localize faults
- PS11. Connect instrument to PC using connectors/cables
- PS12. Undertake corrective repairs by software if any.
- PS13. Undertake checks to confirm that the problem is resolved

Instrument Handling skills

- PS14. Safely dismantle/assemble instrument using the right tools
- PS15. Safe remove and replace components using right tools
- PS16. Compliance to ESD protection measures

Software Skills

- PS17. Identifying correct software version for the modules for smart instruments
- PS18. Execute basic software commands for calibration and use diagnostic tools
- PS19. Use vendor specific software by navigating through it based on screen commands.

Troubleshooting Skills

- How to approach a defect
- PS20. Make use of standard OEM specified troubleshooting steps
- PS21. Interpret intermediate results and progress fault rectification accordingly
- PS22. Utilize appropriate tools to rectify faults
- PS23

Core Skill:

The individual on the job needs to know and understand how to:

Reading skills

CS1. Read and understand technical manuals, work orders and reports

CS2. Read and understand organizational health and safety instructions

Writing Skills

CS3. Fill up record sheets clearly, concisely and accurately as per company procedures

Communication Skills

Clearly communicate relevant information to higher officials

CS4. Respond appropriately to queries

CS5. Communicate with other team members to understand instrument performance issues

CS6. Communicate in the local language

Convey proposed solution to the customers and higher officials if necessary

CS7. Time Management Skills

CS8. Prioritize and execute tasks in a high-pressure environment

Use and maintain resources efficiently and effectively

CS9. Analytical Skills

CS10. Analyse (and understand) performance issues of the instrument

Interpret reports, readings and numerical data

CS11. Keep up to date with new technology and performance issues

CS12. Other Skills

CS13. Create and maintain effective working relationships and team environment through collaboration

Take initiatives and progressively assume increased responsibilities

CS14. Share knowledge with other team members and colleagues

CS15.

CS16.

Detailed Syllabus of Course

Module. No	Modules	Min. No. of hours
1.	<p>Fundamentals</p> <p>Plan and perform routine trade activities</p> <ul style="list-style-type: none"> • Examine types of trade related personal protective equipment <ul style="list-style-type: none"> ○ Head protection - hard hat ○ Eye protection - goggles and face shield ○ Hearing protection - Ear plugs & Ear muffs ○ Hand protection - Types of gloves and mitts ○ Clothing - Types of materials suitable to work environment ○ Foot protection - safety boots with suitable soles ○ Personal Breathing Apparatus • Maintain safe work environment <ul style="list-style-type: none"> ○ Safe housekeeping practices ○ Appropriate recycling and disposal procedures • Use and maintain hand and power tools <ul style="list-style-type: none"> ○ Trade specific hand and power tools • Examine mounting and installation hardware and practices <ul style="list-style-type: none"> ○ Manufacturer instructions ○ Types of mounting hardware (uni-strut, clamps, u-bolts...) ○ Location for installation of mounting hardware <p>Scope of Instrumentation</p> <ul style="list-style-type: none"> • Scope and necessity of Instrumentation • functional block diagram of measurement system • calibration and calibration standards <ul style="list-style-type: none"> ○ basic, secondary and working standards • the metric system <ul style="list-style-type: none"> ○ base and supplementary units ○ derived units ○ Multiplying factors (milli,micro, nano.....Mega,Giga...). • Instrument Characteristics • Instrument performance terminology <ul style="list-style-type: none"> ○ Repeatability and Accuracy ○ Zero, span and Linearity errors • Types of errors. 	12

	<ul style="list-style-type: none"> • Standard Signals • Different number bases <ul style="list-style-type: none"> ○ Binary ○ Octal ○ Hex <p>Explain codes, standards and regulations</p> <ul style="list-style-type: none"> • Examine work-related safety regulations and publications <ul style="list-style-type: none"> ○ OHS Regulation ○ General Requirements of OHS ○ Chemical and biological agents ○ Noise, vibration, radiation and temperature ○ Tools machinery and equipment safety ○ Ladders, scaffolds and temporary work platforms ○ Rigging, cranes and hoists ○ Mobile equipment ○ Electrical safety ○ Oil and gas industries <p>Identify electrical hazards and apply safe work practices Packaging & Enclosures of Instrumentation System</p> <ul style="list-style-type: none"> ○ Safety Measures <ul style="list-style-type: none"> ▪ Measurement Categories ○ Nature of Environment & Safety Measures <ul style="list-style-type: none"> ▪ Enclosures of electric equipment for Non-Hazardous location <ul style="list-style-type: none"> • International standards ▪ Enclosures of electric equipment for Hazardous location <ul style="list-style-type: none"> • International standards ○ Intrinsically Safe Equipment ○ Design Consideration of Enclosures for Different Market Segments <ul style="list-style-type: none"> • Examine regulations <ul style="list-style-type: none"> ○ Sizing of wire, fuses and circuit breakers ○ Overloads and Inrush current ○ Proper installation and grounding of electrical equipment <p>Use trade related schematics and drawings</p> <ul style="list-style-type: none"> • Examine types of schematics and drawings <ul style="list-style-type: none"> ○ P&ID and Loop wiring diagrams • Examine symbols and conventions <ul style="list-style-type: none"> ○ ISA and SAMA symbols • Use basic schematics and drawings 	
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	<ul style="list-style-type: none"> ○ P&ID, Loop drawings 	
2.	<p>Installation and Maintenance of Measuring and Indicating Devices</p> <p>Calibrate and service indicating and recording instruments</p> <ul style="list-style-type: none"> • Types of recording devices <ul style="list-style-type: none"> ○ Chart recorders <ul style="list-style-type: none"> ▪ Electronic • Indicating devices <ul style="list-style-type: none"> ○ Digital displays ○ Analog displays ○ Configurable <ul style="list-style-type: none"> ▪ LCD • Calibrate and service indicating devices <ul style="list-style-type: none"> ○ Gauges ○ Bourdon tube <ul style="list-style-type: none"> ▪ Helical ▪ Spiral ○ Bellows <ul style="list-style-type: none"> ▪ Diaphragm capsule ○ Accessories <ul style="list-style-type: none"> ▪ Pigtail siphons ▪ Damping mechanisms ▪ Chemical seals ○ Measuring element and range ○ Fill fluid specifications ○ Differential measuring devices ○ Device calibration using principles of zero, span and angularity adjustments as they relate to links and levers • Service recording devices (Electronic) <ul style="list-style-type: none"> ○ Identification of measuring element and input measurement scale ○ Power supply ○ Troubleshooting procedures (instrument specific - according to manuals) <p>Introduction to pressure measurement</p> <ul style="list-style-type: none"> • Types of pressure <ul style="list-style-type: none"> ○ Absolute, Differential, Gage, Vacuum ○ Conversion tables 	140

	<ul style="list-style-type: none"> ○ Pressure conversion formulas ○ Steam tables (relationship between temperature and pressure) ○ Head correction calculation ● Types of pressure measuring devices and transmitters <ul style="list-style-type: none"> ○ Pneumatic ○ Electronic <ul style="list-style-type: none"> ▪ Analog ▪ Digital ○ Pressure Transmitters ● Installation of pressure measuring devices <ul style="list-style-type: none"> ○ Manufacturers' specifications ○ Selection of device ○ Air / power supply requirements ○ Location of device ○ Isolation of device ○ Connection of device to process ○ Connection of device to control system ○ Sealants and gaskets ● Configure / calibrate pressure measuring devices <ul style="list-style-type: none"> ○ Device Operation ○ Primary Calibration Standards ○ Differential Pressure Measurement ○ Pascal's Law ○ Absolute and Atmospheric Pressure ○ Relationship between Pressure and Column of Liquid ○ Hydrostatic Head Pressure ○ U-Tube and Well Manometers ○ Bourdon Pressure Gage <ul style="list-style-type: none"> ▪ Spiral and Helical Elements ○ Bellows and Diaphragm Elements ○ Calibration / configuration parameters ○ Interpretation of results ○ Identification of cause/effect of calibration errors ○ Adjustments to bring device within calibration parameters ○ Document calibration results ● Maintain device <ul style="list-style-type: none"> ○ Manufacturers' recommended maintenance procedures 	
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Introduction to temperature measurement

- Define Temperature, Heat and Energy
- Temperature scales
 - Fahrenheit
 - Celsius
 - Kelvin
 - Conversions between scales
- Temperature measuring devices, their operation and Transmitters
 - Thermometer
 - Thermocouple
 - Thermocouple tables
 - Resistance Temperature Detectors (RTD)
 - RTD tables
 - Thermistor
 - Liquid in Glass and Filled bulb systems
 - Pyrometer
 - Semi-conductor mechanical thermal system
 - Infrared radiation
 - Fibre Optic
 - Thermal Expansion Thermometers
 - Temperature Transmitters
- Temperature calibrating instruments
 - Thermometers
 - Multimeters
 - Millivolt source
 - Resistance source
 - Temperature baths
 - Dry block calibrators
 - Thermocouple simulators
 - Decade box
- Installs, calibrates and services temperature measuring devices
 - Manufacturers' specifications
 - Best Practices for selection /location of measuring device
 - Response time
 - Temperature ranges
 - Resolution
 - Thermo well selection and installation

- Thermocouples
 - Grounding
 - Cold junction compensation
 - Types (J, K...T)
 - Extension wires
 - Colour codes (North American and European colour codes)
- RTDs
 - Alpha value and Different standards (IEC, DIN etc..)
 - 2, 3 and 4 wire
 - 100, 200...1000 ohm
- Device check / calibration
- Wheatstone bridge
- Simulators
 - Decade box
- Interpretation of calibration results
- Cause / effect of calibration error
- Device adjustments
- Repairing/replacing device components
- Verification of operation
- Documenting calibration

Introduction to level measurement

- Level measuring devices, their operation and Transmitters
 - Dip Stick Level Measurement
 - Basic Sight Glasses
 - Float and Cable Arrangements
 - Ultrasonic
 - Capacitance Probe
 - Rotating Paddle
 - Radar Level System
 - Laser Level System
 - Interface Measurement
 - Hydrostatic Pressure
 - Open Tank Level
 - Air Bubbler System
 - Level Transmitters
- Calibration instruments used on level measuring devices
 - Pressure calibrator

	<ul style="list-style-type: none"> ○ Laptop / software ○ Handheld programmer ● Install, calibrate and service level measuring devices <ul style="list-style-type: none"> ○ Manufacturers' specifications ○ Selection /Location of measuring device ○ Process application ○ Zero Suppression/Elevation ○ Process medium ○ Best practices ○ Device check / calibration ○ Interpretation of calibration results ○ Cause / effect of calibration error ○ Device adjustments ○ Repairing/replacing device components ○ Verification of operation ○ Documenting calibration <p>Introduction to density measurement</p> <ul style="list-style-type: none"> ● Density measuring devices and their operation <ul style="list-style-type: none"> ○ Applications and Selection ○ Hydrometer ○ Hydrostatic head ○ Displacers ○ Radiation Densitometers ○ Oscillating Coriolis Densitometer ○ Ultrasonic Sludge and Slurry Densitometers ○ Gas Densitometers ○ Effect of temperature on density ● Calibration instruments used on density measuring devices <ul style="list-style-type: none"> ○ Pressure calibrator ○ Laptop / software ○ Handheld programmer ● Install, calibrate and service density measuring devices <ul style="list-style-type: none"> ○ Manufacturers' specifications ○ Selection /Location of measuring device ○ Process application ○ Process medium ○ Best practices 	
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- Verify operation
- Device check / calibration
- Interpretation of calibration results
- Cause / effect of calibration error
- Device adjustments
- Repair/replace device components
- Documenting calibration

Introduction to weight measurement

- Weight measuring devices and their operation
 - Load cells
 - Scales
 - Strain gauges
- Calibration instruments used on weight measuring devices
 - Test weights
 - Wheatstone bridge
 - Laptop / software
 - Handheld programmer (configurator)
- Install, calibrate and service weight measuring devices
 - Manufacturers' specifications
 - Selection /Location of measuring device
 - Process application
 - Best practices
 - Verify operation
 - Device check / calibration
 - Interpretation of calibration results
 - Cause / effect of calibration error
 - Device adjustments
 - Repair/replace device components
 - Documenting calibration

Introduction to flow measurement (volumetric, mass flow)

- Flow measuring devices and their operation
 - Types of Flow
 - Reynolds Number
 - Types of flow meters
 - head type
 - variable area type
 - quantitative flow meters

	<ul style="list-style-type: none"> <ul style="list-style-type: none"> ▪ mass flow meters ○ Differential Pressure Flowmeters <ul style="list-style-type: none"> ▪ Concentric and Eccentric Orifices ▪ Flow Nozzle ▪ Venturi and Pitot Tubes ○ Target Flowmeter ○ Rotameter or Variable Area Meter ○ Magnetic, Vortex, Turbine, and Ultrasonic Flowmeters ○ Doppler Effect ○ Flow Tube Vibration and Twist ○ Coriolis ○ Thermal Mass Flowmeters ○ Positive Displacement Flowmeters <ul style="list-style-type: none"> ▪ Rotary Vane, Oval Gear, and Nutating Disc Designs ○ Open Channel Flow Measurement <ul style="list-style-type: none"> ▪ Weirs ○ Parshall Flume ○ Solid flow meters • Calibration instruments used on flow measuring devices <ul style="list-style-type: none"> ○ Pressure calibrators ○ Temperature calibrator ○ Frequency generator ○ Laptop / software ○ Handheld programmer • Install, calibrate and service flow measuring devices <ul style="list-style-type: none"> ○ Manufacturers' specifications ○ Selection /Location factors ○ Pressure taps ○ Straight pipe requirements ○ Accuracy requirements ○ Process application ○ Process medium ○ Best practices ○ Verify operation ○ Device check / calibration ○ Interpretation of calibration results ○ Cause / effect of calibration error ○ Device adjustments 	
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	<ul style="list-style-type: none"> ○ Repair/replace device components ○ Documenting calibration 	
3.	<p>Installs & Maintains Safety and Process Monitoring Systems</p> <p>Service ESD (emergency shutdown devices)</p> <ul style="list-style-type: none"> • Types of ESD control systems <ul style="list-style-type: none"> ○ Levels of Shutdown <ul style="list-style-type: none"> ▪ Unit Shutdown ▪ Process Shutdown ▪ Emergency Shutdown ▪ Emergency Depressurize Shutdown ○ Types of ESD <ul style="list-style-type: none"> ▪ Electric ▪ Pneumatic ▪ Hydraulic ▪ Mechanical • Purposes of different types of ESD <ul style="list-style-type: none"> ○ Personnel protection ○ Environmental protection ○ Equipment protection • ESD testing procedures <ul style="list-style-type: none"> ○ Partial Stroke Test ○ Time test ○ Valve integrity ○ Interlock checks (system shut down check) <p>Service and calibrate personal safety systems</p> <ul style="list-style-type: none"> • Personal gas monitors and standard calibration routines <ul style="list-style-type: none"> ○ Portable personal gas monitor (Cl, SO₂, H₂S, O₂ , CO) ○ Pull tube (Draeger) • Radiation safety devices <ul style="list-style-type: none"> ○ Radiation (gamma) survey meter ○ Personal dosimeter 	10
4.	<p>Installs and Maintains Pneumatic Systems</p> <p>Air supply systems</p> <ul style="list-style-type: none"> • Instrument air systems and equipment <ul style="list-style-type: none"> ○ Need for clean, dry air 	20

	<ul style="list-style-type: none">○ Air compressors○ Air dryers○ Air receivers○ Air filters● Air distribution systems● Use of relative humidity to infer dew point<ul style="list-style-type: none">○ Hygrometers○ Sling psychrometer○ Digital psychrometer○ Bulk polymer resistance sensor● Servicing procedures for air supply systems<ul style="list-style-type: none">○ Servicing requirements○ Traps○ Dessicant○ Pre and post filters <p>Tubing and fittings</p> <ul style="list-style-type: none">● Types of tubing and installation procedures<ul style="list-style-type: none">○ Plastic○ Stainless steel○ Copper○ Rubber○ Process and pressure requirements○ Sizes○ Pressure and Temperature Ratings● Tube bending techniques<ul style="list-style-type: none">○ Calculating dimensions○ Manual tube benders○ Hydraulic tube benders● Install tubing and fittings<ul style="list-style-type: none">○ Ferrule fitting○ Tightening fittings○ Follow P&ID drawings○ Select appropriate tubing and fittings <p>Install and service pneumatic instruments</p> <ul style="list-style-type: none">● Specifications and hazards of pneumatic equipment<ul style="list-style-type: none">○ Compressed air safety	
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	<ul style="list-style-type: none"> ○ Pneumatic signal ranges ● Types of pneumatic equipment <ul style="list-style-type: none"> ○ Transmitters ○ Converters (I/P) ○ Positioners ○ Controllers ○ Relays ● Operating principles of pneumatic equipment <ul style="list-style-type: none"> ○ Force balance ○ Motion balance ● Calibrate pneumatic transmitters <ul style="list-style-type: none"> ○ Calibration block diagram ○ Five point calibration check ○ Shop or field calibration ○ Force balance calibration procedure ○ Motion balance calibration procedure ○ Documentation of calibration results ○ Manufacturers' specifications for installation 	
5.	<p>Installs and Maintains Electrical and Electronic Systems</p> <p>Identification of various Electrical and Electronic components</p> <ul style="list-style-type: none"> ● Active components ● Passive Components ● Switches ● Plugs ● Sockets ● Relays/Solenoids/Contactors ● Inductive proximity switch ● Symbols of electrical components <ul style="list-style-type: none"> ○ Switch ○ Contacts ○ Solenoids ○ Relay ○ LED ● Electrical Ladder Diagram ● Panel controls ● Integrated Circuits <ul style="list-style-type: none"> ○ Pin identification and numbering convention 	60

	<ul style="list-style-type: none">○ IC handling and installation● Safety<ul style="list-style-type: none">○ Need for Electrostatic Discharge Protection <p>Apply basic principles of DC electricity</p> <ul style="list-style-type: none">● operation and applications of various batteries<ul style="list-style-type: none">○ Lead acid○ NiCad○ NiMh● Measure electrical current, voltage and resistance<ul style="list-style-type: none">○ Analog multimeters○ Digital Multimeters● Calculate currents, voltages and resistance using Ohm's law<ul style="list-style-type: none">○ Series circuits○ Parallel and combination circuits○ Formula $E = I \times R$● Define and reference voltage measurement to circuit common<ul style="list-style-type: none">○ Difference between ground and circuit common○ Multimeter○ Oscilloscope and scope meter○ Frequency generator○ Circuit schematic● Calculate electrical power in watts<ul style="list-style-type: none">○ Apply Watt's Law to define power rating of appliances○ $Watts = E \times I$● Examine resistors, potentiometers and rheostats<ul style="list-style-type: none">○ Differences○ Power ratings○ Applications○ Colour codes <p>Apply basic principles of AC electricity</p> <ul style="list-style-type: none">● Define AC electricity<ul style="list-style-type: none">○ Generation○ Polarity and waveform analysis<ul style="list-style-type: none">▪ Peak/RMS voltages● various types of transformers<ul style="list-style-type: none">○ Step up○ Step down	
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- Autotransformer
- Isolation
- Three phase transformer
- Examine the use of capacitors and inductors in AC circuits
 - Applications
 - Filtering
 - Regulating voltage
 - Power factor correction
- Size electrical components for various circuits
 - Capacitors
 - Inductors
 - Resistors
 - Wire
 - Fuses
- Build and test circuits
 - Understand various components in circuits
 - Electromagnetism
 - Lenz's Law
 - Inductive Reactance
 - Inductive Kick
 - Capacitive Reactance
 - Capacitor Types
 - Time Constants and Their Application
 - Filters and Resonance
 - Effect of frequency on a circuit
 - Measuring techniques and equipments
- Types of AC circuits
 - Different classes (based on different standards)
- installation procedures for AC equipment
 - Wiring methods
 - Support
 - Grounding
 - Shielding
- Apply proper circuit connection techniques
 - Soldering
 - Crimping

Introduction to Power Electronics (Only Block diagrams)

	<ul style="list-style-type: none"> • SMPS • Convertor • Inverter • UPS • DC and AC Drives 	
6.	<p>Installs and Maintains Final Control Elements</p> <p>Service regulators and examine relief valves</p> <ul style="list-style-type: none"> • Examine regulators <ul style="list-style-type: none"> ○ Purpose ○ Pressure drops ○ Types <ul style="list-style-type: none"> ▪ Relieving ▪ Non- Relieving ▪ Pilot operated ○ Definitions <ul style="list-style-type: none"> ▪ Droop ▪ Turndown ○ Applications <ul style="list-style-type: none"> ▪ Pressure reducing ▪ Pressure relieving • Examine operation and applications of regulators <ul style="list-style-type: none"> ○ Air ○ Water ○ Steam ○ Oil ○ Gas ○ Differential • Service and maintain regulators <ul style="list-style-type: none"> ○ Components <ul style="list-style-type: none"> ▪ Diaphragms ▪ Bolts ▪ Springs ▪ Seats ▪ Gaskets ○ Disassembling <ul style="list-style-type: none"> ▪ Spring compression 	50

	<ul style="list-style-type: none">○ Reassemble○ Test● Examine relief valves<ul style="list-style-type: none">○ Applications○ Safety Device○ Reset Differential○ Certification and testing <p>Service, size and install control valves and actuators</p> <ul style="list-style-type: none">● Examine actuators<ul style="list-style-type: none">○ Types<ul style="list-style-type: none">▪ Pneumatic▪ Hydraulic▪ Electric○ Applications<ul style="list-style-type: none">▪ Fail open▪ Fail close▪ Fail last○ Actions<ul style="list-style-type: none">▪ Spring return▪ Double-acting○ Components<ul style="list-style-type: none">▪ Diaphragms▪ Plates▪ Stem connector (coupling)▪ Bushings▪ O-rings▪ Pistons▪ Motors▪ Springs○ Required Operating Environment● Examine control valves<ul style="list-style-type: none">○ Process applications○ Seal / shut off requirements○ Flow Characteristics<ul style="list-style-type: none">▪ Quick opening▪ Linear▪ Equal percentage	
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	<ul style="list-style-type: none">○ Body Types○ Valve sizing○ Sliding stem<ul style="list-style-type: none">▪ Globe▪ Bar stock▪ Pinch valve○ Rotary<ul style="list-style-type: none">▪ Butterfly▪ E-Disc▪ Segmented ball▪ Through-bore ball▪ Restricted trim○ Components<ul style="list-style-type: none">▪ Cages▪ Plugs▪ Seats▪ Stems▪ Packing<ul style="list-style-type: none">● Types and applications of valve packing<ul style="list-style-type: none">○ Teflon○ Graphite○ Rope● Install and service control valves<ul style="list-style-type: none">○ Gaskets○ Sealants○ Positioning valve in process○ Securing valve using appropriate process<ul style="list-style-type: none">▪ Flanged▪ Screwed▪ Wafered / Flangeless○ Isolation of valve from process○ Testing procedures○ Stroke to ensure proper operation○ Leak testing○ Possible faults<ul style="list-style-type: none">▪ Leaking packing▪ Valve passing	
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	<ul style="list-style-type: none">▪ Damaged parts▪ Incorrect travel○ Cleaning / lubricating○ Repairing / Rebuilding• Install and service actuators<ul style="list-style-type: none">○ Matching to valve○ Connecting to valve○ Valve travel○ Bench set○ Verifying operation○ Correct air supply pressure○ Function testing○ Possible faults<ul style="list-style-type: none">▪ Leaking diaphragms▪ Broken springs▪ Damaged/worn O-rings○ Removing /replacing components○ Cleaning/lubricating components○ Assembling/disassembling<ul style="list-style-type: none">▪ Spring compression○ Loading on stem connector <p>Install and service valve positioners</p> <ul style="list-style-type: none">• Valve positioners<ul style="list-style-type: none">○ Types<ul style="list-style-type: none">▪ Pneumatic▪ Electronic▪ Digital▪ Electro hydraulic▪ Electro mechanical○ Applications○ Single Acting○ Double Acting○ Components<ul style="list-style-type: none">▪ Levers▪ Nozzles▪ Flappers▪ Relays	
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	<ul style="list-style-type: none"> ▪ Auxiliaries ▪ Locks ▪ Boosters ▪ Speed controls ○ Relation to actuator type / application • Install and service valve positioners <ul style="list-style-type: none"> ○ Mounting ○ Connecting to actuator ○ Connecting to process control system ○ Configuring ○ Set stroke ○ Set pressures ○ Match to actuator ○ Auto tune ○ Calibrating ○ Connecting calibration instruments ○ Calibration parameters ○ Interpretation of calibration results ○ Cause/effect of calibration errors ○ Component maintenance 	
7.	<p>Installs and Maintains Communications, Networking and Signal Transmission Systems</p> <p>Install wiring in accordance with different standards</p> <ul style="list-style-type: none"> • Examine wiring requirements <ul style="list-style-type: none"> ○ Materials ○ Connections <ul style="list-style-type: none"> ▪ Crimping ▪ Terminal blocks ▪ Marrettes ▪ Soldering ▪ Protection (heat shrink, taping etc.) ○ Shielding ○ Grounding ○ Grounding loops • Install wiring <ul style="list-style-type: none"> ○ Sizing wire ○ Routing of wiring runs 	28

- Stripping wire
- Labeling / colour-coding wire
- Connecting wire

Trends in control technologies

- Smart Components
 - Typical smart DP Transmitter
 - Smart temperature transmitter
 - Benefits

Service supervisory control and data acquisition (SCADA) systems

- types of SCADA protocols and configurations
 - Applications
 - Online history
 - Remote equipment operation
 - Network layout
 - Protocols
 - Host
 - Field
 - Addressing methods
- types of SCADA equipment and servers for data acquisition and storage
 - Radio Telemetry Units (RTU)
 - Wireless Communications systems
 - Cellular
 - Satellite

communication systems

- types of signal transmission systems
 - Fibre optics
 - Armoured cable
 - Non armoured cable
 - Multimode / single mode transmission
 - Wired
 - Coax
 - UTP
 - Wireless
 - Satellite
 - Blue tooth
 - RF
 - IR

	<ul style="list-style-type: none"> ○ IEEE standards ● features and limitations of communication protocols <ul style="list-style-type: none"> ○ Types of protocols ○ RS232 ○ RS422/485 ○ MODBUS ○ ASi BUS ○ Device Net ○ Profibus ○ Highway Addressable Remote Transducer(HART) ○ Foundation Fieldbus H1 & H2 ○ Ethernet TCP/IP ○ Addressing methods and components ○ Potential sources of interference ○ Related standards, codes, licenses 	
8.	<p>Installs and Maintains Control Systems</p> <p>Stand alone Controllers</p> <ul style="list-style-type: none"> ● Electronic Controllers ● Single loop controllers <p>Programmable Logic Controllers (PLCs)</p> <ul style="list-style-type: none"> ● Examine types of PLCs <ul style="list-style-type: none"> ○ Hardware Architecture ○ Control Capabilities <ul style="list-style-type: none"> ▪ Discrete control ▪ Analog control ○ Compatibility with other process systems ○ Networks ○ Protocols ● PLC languages and symbols <ul style="list-style-type: none"> ○ Structured Text ○ Instruction list ○ Ladder Logic ○ Function block ○ Sequential function chart ● PLC components <ul style="list-style-type: none"> ○ CPU 	80

- Memory organization
- Input interface
- Output interface
- Power supply
- Programming/Monitoring interface
- Data Table
- User Program

fundamental theories of process operation and equipment

- Common industrial processes
 - Continuous Process
 - Batch process

Introduction to control theory

- Basic control theory
 - Set point / process variable / manipulated variable
 - Relation of output to input
 - Steady state value and dynamic component
 - Control loop gains / loop stability
- Control modes
 - On / Off control
 - Differential Gap
 - Proportional only
 - Integral only
 - Proportional plus Integral
 - PID -Proportional, Integral, Derivative
 - Reset rate / Reset time
 - Series / parallel
 - Interactive / non-interactive / rate on PV
- Controller action
 - Direct acting
 - Reverse acting
- Controller operating modes
 - Automatic
 - Manual
 - Remote
 - Local
 - Supervisory

Introduction to process control techniques and strategies

	<ul style="list-style-type: none"> • Control techniques <ul style="list-style-type: none"> ○ Loop tuning ○ Zeigler Nicholls ○ Lambda ○ Tuning from manual output changes • Basic control strategies <ul style="list-style-type: none"> ○ Feedback control <ul style="list-style-type: none"> ▪ Process Dynamics <ul style="list-style-type: none"> • Lags • Dead Time ○ Feed forward control ○ Cascade control ○ Ratio Control ○ Gap action control ○ Multi variable control <p>Implement process control strategies</p> <ul style="list-style-type: none"> • Implement process control strategies <ul style="list-style-type: none"> ○ Determining required controller action based on process and valve action ○ Consulting loop diagrams ○ Override ○ Interlocks ○ Limits ○ Select relays ○ Loop impact on overall process ○ Alarming ○ control strategy design ○ Implementation on live processes ○ Upset recovery 	
Total Theory / Lecture Hours:		150
Total Practical / Tutorial Hours:		250
Total Hours:		400

Recommended Hardware:

- Personal Protective equipments for demonstration
- Electronic Chart recorder

- Indicating devices- Digital, Analog and LCD
- Bourdon tube and bellows
- Pressure transmitter (conventional 4 - 20 mA)
- Pressure calibrator
- Multimeter
- Thermometer
- Thermocouple simulator
- Resistance source
- Temperature bath
- Thermocouple (J)
- RTD (Pt 100)
- Capacitance probe for level measurement
- Ultrasonic Levelsensor
- Level transmitter
- Hydrometer
- Load cell
- Orifice plate
- Magnetic flow meter
- Portable gas monitor
- Hygrometer
- I to P converter
- Positioner
- Pneumatic relay
- Compressor
- Electro mechanical relay
- Contactor
- Solenoid
- Electric actuator
- Pneumatic control valve
- Pressure regulator
- Soldering Kit
- Crimping tool
- Marretes, wire terminator
- Standard tool box (Mechanical and Electrical)
- SCADA
- PLC

- Fieldbus cable
- Function generators
- Computers/ Laptop with associated softwares

Recommended

Software:

Software compatible for different types of instruments

Text Books:

- Instrument Engineers Handbook: Process Measurement and Analysis, Liptak, Bela G, CRC Press
- Instrument Engineers Handbook: Process Control and Optimization,, Liptak, Bela G, CRC Press
- Instrument Engineers Handbook. Process Software and Digital Networks, Liptak, Bela G, CRC Press
- Advanced temperature measurement and control, McMillan, Gregory K.
- Control instrument mechanisms, Warren, John E
- Fundamentals of industrial control, Coggan, Donald A
- Hydraulics and Pneumatics, Parr, E.A
- Digital Fundamentals, Floyd, Thomas L.
- Industrial Flow Measurement, Spitzer, David W.
- A Guide to the Automation Body of Knowledge, Trevathan, Vernon L., Ed.
- Wireless communication systems/ Design and construction, Eren, Halit.
- Practical Industrial Safety, Risk Assessment and Shutdown Systems, Macdonald, Dave.
- Linear Position Sensors, Nyce, David S
- Practical Data Communication for Instrumentation and Control, Park, John
- Practical Industrial Data Networks, Mackay, Steve
- Fundamentals of Electronics DC/AC Circuits, Terrel, David L
- Basic Math for Electronics, Cooke and Adams
- Instrumentation, PTEC
- Fundamentals of Process Control Theory, Murrill, Paul W
- Experiments of Digital Fundamentals, Buchla, David
- Principals of Electric Circuits, Floyd
- Instrumentation and Process Control, Bartlet, Terry
- Pneumatic Instrumentation, Patrick, Dale R & Steven R
- Industrial Instrumentation, Faulk, Sutko
- Fundamentals of Instrumentation, Thomson, Delmar Learning

- Elements of Data Processing Math, Price, Winston T & Miller, Merlin
- Electricity 3, Alerich, Walter N & Keljik, Jeff
- Process Industrial Instrumentation and Control Hand Book, Considine, Douglas M
- Instruments for Process Measurement and Control, Anderson, Norman A
- Fundamentals of Electric Circuits, Bell, David A
- Basic Fluid Power, Rease, Dudley A
- Fundamentals of Analytical Chemistry, Skoog, Douglas A & West, Donald M
- Elements of Physics, Shortley and Williams
- Electrical Machines, Drives and Power Systems, Wildi, Theodore
- Process Control Instrument Technologies, Johnson, Curtis D
- Low Pressure Boilers, Steingress, Frederick M
- Fundamentals of Physics Heath, Macnaughton and Martindale

Reference :

- ANSI/ISA5.1-2009 – Instrumentation Symbols and Identification
- ANSI/ISA5.4-1991 – Instrument loop Diagrams
- ANSI/ISA5.06.01-2007- Functional Requirements Documentation for Control Software Applications
- ANSI/ISA20-1981 – Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves
- ISA-TR20.00.01-2007 – Specification Forms for Process Measurement and Control Instruments Part1: General Considerations Updated with 27 New Specification forms in 2004-2005
- Canadian Electrical Code, Part 1, 20th Edition. CSA, January 2006
- Industrial Hydraulics manual, Eaton Corporation
- Closed loop electro hydraulic systems manual, Vickers, Incorporated Training Center
- www.abb.com
- www.boschrexroth.com
- www.control.com
- www.controlglobal.com/whitepapers
- www.controlsweekly.com
- www.cpecn.com
- www.cvs-controls.com
- www.cyberlaboratory.com

- www.documentation.emersonprocess.com
- www.emersonprocess.com
- www.enmet.com
- www.fisherregulators.com
- www.flowcontrolnetwork.com
- www.foxboro.com
- www.galvanic.com
- www.gongol.net
- www.graceindustries.com
- www.honeywell.com
- www.iceweb.com.au/Technical/LevelTechnologies.html
- www.invensys.com
- www.isa.org
- www.joliettech.com
- www.metsoautomation.com
- www.modelingandcontrol.com
- www.multimediahrd.com
- www.omega.com
- www.ohsonline.com
- <http://source.theengineer.co.uk/>
- www.raesystems.com
- www.scadalink.com
- www.smar.com/PDFs/Catalogues/FBTUTCE.pdf
- www.smar.com/PDFs/Catalogues/HARTTUTCE.PDF
- www.spitzerandboyes.com
- www.vegacontrols.co.uk
- www.worksafebc.com
- www.yokogawa.com
- www.zoneni.com
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ESDM Courses

Level Code: L4 **Vertical Name:** Industrial Automation

Course Code: NL/M/L4/C012 **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 perform 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.

Professional Knowledge:

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:

- 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

Core Skill:

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, Logic Controls, Pneumatic, i. Shuttle valve, ii. Twin pressure valve, iii. Applications of Logic valves, Structure of Pneumatic Circuits, Automatic Control, Roller valve, Quick-Exhaust valve, 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:	<ul style="list-style-type: none"> - 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)
Reference Books:	<ul style="list-style-type: none"> - Herbert R. Merritt, Hydraulic control systems, John Wiley & Sons, Newyork, 1967 - Durbey.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 - Durbey.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:

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ESDM Courses

Level Code: L5 **Vertical Name:** Industrial Automation

Course Code: NL/M/L5/C0018 **Course Name:** 3.3.3 Automation Technology – Intermediate Level

Objective of the Course:

To get an overview of automation technology. With hands on and theoretical knowledge on basics of Hydraulics, Pneumatics, Sensors and PLC

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:

At the end of the level one the student will be able to identify basic components of automation technology, gets an idea on the overall working of the system and shall be able to troubleshoot on an intermediate level.
Have Good Communicative English skills, Soft skills & Basic IT Skills

Expected Job Roles:

Assistants in regular production areas, quality, logistics and maintenance areas

Duration of the Course (in hours) Technical Students –350 Hrs
Non-Technical Students –450 Hrs

Minimum Eligibility Criteria and pre-requisites, if any

Diploma in /Electronics/Instrumentation/ Mechanical/Electrical – for Technical students.
Non Technical Students: Students with 12+ with science background and affinity towards technical studies.

Professional Knowledge:

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
- PK 21. understand the functionality of the electro hydraulics
- PK22. understand the functionality of the HMI

Professional 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
- PS 23: HMI
- PS 24: Programming of HMI
- PS 25: Downloading and Uploading the program to or from the HMI
- PS 26: Hydraulic Accumulator and its Applications
- PS 27: Classifications of filters

PS 28: Principles of Electro-Hydraulics, Basics
PS 29: Electro-hydraulic valves
PS 30: Design of Pneumatics systems
PS 31: Maintenance Activities
PS 32: System Malfunctions

Core Skill:

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.

HMI : Introduction, Applications, Role of HMI in Automation, Interfacing HMI with different devices, Hardware Details of HMI, Technical Specifications of HMI, Wiring and Connection Techniques, Various models of HMI available in market, Editing various display options using the keys, Programming of HMI, Overview of HMI software, Hardware Configuration, Network Settings or Communication Settings, Developing Different Screens on HMI, Writing Plain Text on the screen, Developing Headers & Footers for the Screen, Configuring the function keys of HMI for screen change or for giving inputs, Linking the variables directly on the screen, Password Management (for screen change & for editing the values), Developing user defined text list, Screen Change using PLC variables, Displaying Alarm Messages on the Screen during fault, Configuring Help Screen for Troubleshooting the errors or faults, Downloading and Uploading the program to or from the HMI respectively using bus interface or USB drive.

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, Embossing Machine, Bending Tool, Drilling Tool, Pipe Bending Machine, Two Door Access Control System, Mix Equipment, Level Control, Compressed Air Network, Water Level Controlling, A Low-Cost PLC Based Automatic Liquid Filling and Sorting System, Modular Automated Testing Unit Sequencing and Controlling, Low Cost PLC Based Automated Sorting And Pressing By Servo-Pneumatic Pressure Control, Automated Multistorey Car Parking System

There are 3 mixing devices on a processing line A,B,C. After the process begin mixer-A is to start after 7 seconds elapse, next mixer-B is to start 3.6 second after A. Mixer-C is to start 5 seconds after B. All then remain ON until a master enable switch is turned off. Write PLC ladder diagram, timing diagram and realize the same

An indicating light is to go ON when a count reaches 23.The light is then go off when a count of 31 is reached. Design, construct, and test PLC circuits for this process

In certain process control application when the count reaches 25, a paint spray is to run for 40 seconds. Design, construct and test PLC circuits for this process

Three conveyors feed a main conveyor. The count from each feeder conveyor is fed into an input register in the PLC. Construct a PLC program to obtain the total count of parts on the main conveyor. Use a time to update the total every 15 seconds. Design, construct, and test PLC circuits for this process

In certain process control application o/p is ON if the count is less than 34 or more than 41. Implement the same using PLC ladder diagram

A conveyor is supposed to have exactly 45 parts on it. You have three indicating lights to indicate the conveyor count status: less than 45, yellow: exactly 45, green: and more than 45, red. The count of parts on the conveyor is set at 45 each morning by an actual count of parts. There are two sensors on the conveyor, one is actuated by parts entering the conveyor, and the other is actuated by parts leaving. Design a PLC program to carry out this process.

Theory / Lecture Hours: 60

Practical / Tutorial Hours: 90

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,

Hydraulic Accumulator and its Applications, Functions, Energy storage, Types of Accumulator, Safety regulations, Application of accumulators, Filtration and Filtration Technology, Causes of contamination, Classifications of filters, Suction filter, Pressure line filter, Return line filter, Bypass filter, Filter with clogging indicator, Basic Principles of Electro-Hydraulics, Basics : Electric current, voltage, resistance and power, Basic electric circuits : series and parallel, Measurement of current and voltage, Electro-hydraulic valves, Solenoids, Classifications of solenoids, Function and operating principle of a relay, Relay as a logical switch, Relay Logic Diagram : control and main circuit, Symbols of most important switching elements (NO and NC), Signal storage concept, Electrical interlocking concept, Momentary-contact limit switches, Categories of limit switches, Pressure switches, Graphical symbols to DIN electrical engineering and electronics.

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, Pressure switch, hydraulic accumulator, Regenerative circuit, Rapid speed/creep speed control, Extending a cylinder by operating a push button, Signal storage by electrical self-locking, setting and resetting using a momentary-contact switch, Mechanical locking by means of momentary-contact switch contacts, Electrical locking by means of contactor contacts, Signal storage by means of contactor contacts, Rapid advance circuit, Pressure-dependent reversing, Pressure switches and proximity switches, Advance control with time-dependent intermediate stop, Pressure-dependent sequence control, Sequencing Hydraulic actuators

Theory / Lecture Hours: 60

Practical / Tutorial Hours: 90

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, Logic Controls, Pneumatic, i. Shuttle valve, ii. Twin pressure valve, iii. Applications of Logic valves, Structure of Pneumatic Circuits, Automatic Control, Roller valve, Quick-Exhaust valve, Time-Delay valves, Pressure Control Valves, Introduction, Function and operating principle of pressure relief valve, direct operated Pressure regulator.

Multiple-Actuator Circuits, Introduction, Representation of a Control Task, i. Text form, ii. Positional Layout, iii. Notational form, iv. Displacement –step diagram, v. Displacement-time diagram, Sequence Control, Circuit design for the sequence of two cylinder and three cylinders, Elimination of signal overlaps, Electro-Pneumatics, Introduction, Integration of Technologies, Solenoid valves, DC solenoids Vs AC Solenoids, 3/2-Way single solenoid valve, Spring return, 5/2-Way single solenoid valve, Spring return, 5/2-Way double solenoid valve, Control devices, Switch and Push button, Terminal Markings, Relay, Logic Controls, Electric, Memory function, Operation of the ‘Dominant OFF’ Circuit, Operation of the ‘Dominant ON’ Circuit, Electronic sensors, Limit switch, Reed switch, Proximity Sensors, Time-Delay Relays, Two-hand safety operation, Pressure switch, Electro-Pneumatic Multiple-Actuator Circuits, Pneumatic Application Concepts, Introduction, Selection and Optimization Criteria, i. Type of motion, ii. Stroke and stroke control, iii. Force, iv. Speed and speed control,

Design of Pneumatics systems, Selection of Pneumatic Actuators, Selection of Pneumatic Valves, Maintenance, Troubleshooting, and Safety, Introduction, Requirements of Preventive Maintenance, Definitions of Maintenance Activities, Preventive Maintenance of Pneumatic Systems (General Procedure), System Malfunctions, i. Malfunctions due to contaminants, ii. Malfunctions due to improper mountings, iii. Malfunctions due to inadequate air supply, iv. Malfunctions due to under-lubrication/over lubrication, Maintenance Tips, i. Maintenance of compressor, ii. Maintenance of air receivers, iii. Maintenance of air-mains, iv. Maintenance of air service units (FRL), v. Maintenance of Pneumatic cylinder, vi. Maintenance of Pneumatic valves, Troubleshooting, i. General troubleshooting procedure, ii. Faults in Pneumatic systems, General Malfunctions, i. Malfunction in pneumatic cylinder, ii. Malfunction in Pneumatic valves, iii. Malfunctions in limit switches and reed switches, Safety in Pneumatic Systems, i. Safety hazards, ii. General safety measures.

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. Basic circuit with electric latching circuits, Displacement-dependent control of a double-acting cylinder with 1 electric limit switch, Displacement-dependent control of a double acting cylinder, impulse valve, cylinder switch, Displacement-dependent control of a double-acting cylinder with spring return valve, cylinder switch, Stop control of a double-acting cylinder with a 5/3 directional control valve in closed mid-position, Time-dependent control of a double-acting cylinder with switch-on time delay, Time-dependent control of a double-acting cylinder with switch-off time delay, Pressure-dependent control of a double-acting cylinder, Two-hand safety control, electric, Sequential control of 2 double-acting cylinders with impulse valve, Sequential control of 2 double-acting cylinders with impulse valves and signal overlapping, Sequential control of 2 double-acting cylinders with spring return valves and step sequence, Sequential control of 3 double-acting cylinders with impulse valves and step sequence, Sequential control of 3 double-acting cylinders with spring return valves and step sequence, Multiple actuator sequence, Two cylinder sequence, Three cylinder sequence.

Theory / Lecture Hours: 60

Practical / Tutorial Hours: 90

Total Course Theory / Lecture Hours: 180

Total course Practical / Tutorial Hours: 270

Total course Hours: 450

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)

Reference Books:

- Herbert R. Merritt, Hydraulic control systems, John Wiley & Sons, Newyork, 1967
- Durbey.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
- Durbey.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.

ESDM Courses

Level Code: L5 **Vertical Name:** Industrial Automation

Course Code: NL/M/L5/C019 **Course Name:** 3.3.4 Automation Technology – Advanced level

Objective of the Course:

To get an overview of automation technology. With hands on and theoretical knowledge on advanced of Hydraulics, Pneumatics, Sensors, PLC, Electric drives and Mechatronics (Optional Robotics).
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:

At the end of the level one the student will be able to identify components of automation technology, gets complete knowledge on understanding the automated systems and design circuits and develop programs for given automation tasks.
Have Good Communicative English Skills, Soft Skills and Basic IT Skills

Expected Job Roles:

Assistants in regular production areas, quality, logistics, maintenance areas, design, Application, Service and R&D

Duration of the Course (in hours) 520 Hrs

Minimum Eligibility Criteria and pre-requisites, if any Diploma in Electronics/Instrumentation/ Mechanical/Electrical / Graduates, with science background and affinity towards technical studies

Professional Knowledge:

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
- PK 21. understand the functionality of the electro hydraulics
- PK22. understand the functionality of the HMI
- PK23. understand Proportional Hydraulics
- PK24. definition of Proportional valve
- PK25. understand LVDT
- PK26. understand different types of amplifiers
- PK27. understand proportional direction control valves
- PK28. Introduction to control system
- PK23. understand Proportional & Closed loop

Professional 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
PS 23: HMI
PS 24: Programming of HMI
PS 25: Downloading and Uploading the program to or from the HMI
PS 26: Hydraulic Accumulator and its Applications
PS 27: Classifications of filters
PS 28: Principles of Electro-Hydraulics, Basics
PS 29: Electro-hydraulic valves
PS 30: Design of Pneumatics systems
PS 31: Maintenance Activities
PS 32: System Malfunctions
PS 33: Proportional Hydraulics
PS 34: Definition of Proportional valve
PS 35: LVDT
PS 36: Types of amplifiers
PS 37: Proportional direction control valves
PS 38: Introduction to control system
PS 39: Proportional & Closed loop

Core Skill:

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.

HMI : Introduction, Applications, Role of HMI in Automation, Interfacing HMI with different devices, Hardware Details of HMI, Technical Specifications of HMI, Wiring and Connection Techniques, Various models of HMI available in market, Editing various display options using the keys, Programming of HMI, Overview of HMI software, Hardware Configuration, Network Settings or Communication Settings, Developing Different Screens on HMI, Writing Plain Text on the screen, Developing Headers & Footers for the Screen, Configuring the function keys of HMI for screen change or for giving inputs, Linking the variables directly on the screen, Password Management (for screen change & for editing the values), Developing user defined text list, Screen Change using PLC variables, Displaying Alarm Messages on the Screen during fault, Configuring Help Screen for Troubleshooting the errors or faults, Downloading and Uploading the program to or from the HMI respectively using bus interface or USB drive.

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, Embossing Machine, Bending Tool, Drilling Tool, Pipe Bending Machine, Two Door Access Control System, Mix Equipment, Level Control, Compressed Air Network, Water Level Controlling, A Low-Cost PLC Based Automatic Liquid Filling and Sorting System, Modular Automated Testing Unit Sequencing and Controlling, Low Cost PLC Based Automated Sorting And Pressing By Servo-Pneumatic Pressure Control, Automated Multistorey Car Parking System

There are 3 mixing devices on a processing line A,B,C. After the process begin mixer-A is to start after 7 seconds elapse, next mixer-B is to start 3.6 second after A. Mixer-C is to start 5 seconds after B. All then remain ON until a master enable switch is turned off. Write PLC ladder diagram, timing diagram and realize the same

An indicating light is to go ON when a count reaches 23.The light is then go off when a count of 31 is reached. Design, construct, and test PLC circuits for this process

In certain process control application when the count reaches 25, a paint spray is to run for 40 seconds. Design, construct and test PLC circuits for this process

Three conveyors feed a main conveyor. The count from each feeder conveyor is fed into an input register in the PLC. Construct a PLC program to obtain the total count of parts on the main conveyor. Use a time to update the total every 15 seconds. Design, construct, and test PLC circuits for this process

In certain process control application o/p is ON if the count is less than 34 or more than 41. Implement the same using PLC ladder diagram

A conveyor is supposed to have exactly 45 parts on it. You have three indicating lights to indicate the conveyor count status: less than 45, yellow: exactly 45, green: and more than 45, red. The count of parts on the conveyor is set at 45 each morning by an actual count of parts. There are two sensors on the conveyor, one is actuated by parts entering the conveyor, and the other is actuated by parts leaving. Design a PLC program to carry out this process.

Theory / Lecture Hours: 65

Practical / Tutorial Hours: 105

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,

Hydraulic Accumulator and its Applications, Functions, Energy storage, Types of Accumulator, Safety regulations, Application of accumulators, Filtration and Filtration Technology, Causes of contamination, Classifications of filters, Suction filter, Pressure line filter, Return line filter, Bypass filter, Filter with clogging indicator, Basic Principles of Electro-Hydraulics, Basics : Electric current, voltage, resistance and power, Basic electric circuits : series and parallel, Measurement of current and voltage, Electro-hydraulic valves, Solenoids, Classifications of solenoids, Function and operating principle of a relay, Relay as a logical switch, Relay Logic Diagram : control and main circuit, Symbols of most important switching elements (NO and NC), Signal storage concept, Electrical interlocking concept, Momentary-contact limit switches, Categories of limit switches, Pressure switches, Graphical symbols to DIN electrical engineering and electronics.

Proportional Hydraulics: Control Engineering, Open loop control, Closed loop control, Ohms Law, Introduction to Proportional Technology, Why proportional valves, Definition of Proportional valve, Components of proportional technology, Possible functions of proportional valve, Solenoids, Construction, Characteristics, Difference between conventional and proportional solenoid, Types of proportional solenoid, Force controlled solenoid, Stroke controlled solenoid.

LVDT, Construction, Working principle, Proportional Terminology, Hysteresis, Pressure Differential, Reversal Error, Response Sensitivity, Reliability, Control range / Resolution, Control Spool, Construction, Geometry of metering notches, Spool overlap, Positive overlap, Negative overlap, Zero overlap, Amplifiers, Types of amplifiers, Functions of amplifiers, Enable, Internal command value, Zero adjustment, Gain adjustment, Biasing current, Dither current, Differential input, cable break detection, Ramp generator, Pulsed output stage, Step generator, Inverter, Summator, Call up command, 4 Quadrant Ramps, Overview of industrial hydraulics, Flow curve characteristics, Pressure curve characteristics, Time spool characteristics, Frequency response, Amplitude response, Bode plot, Proportional direction control valves, Direct operated proportional direction control valve, Construction, Working principle, Characteristics, Pilot operated direction control valve, Construction, Working principle, Characteristics, Proportional pressure control valves, Direct operated proportional pressure relief valve, Construction, Working principle, Characteristics, Pilot operated proportional pressure relief valve, Construction, Working principle, Characteristics, Direct operated proportional pressure reducing valve, Construction, Working principle, Characteristics, Pilot operated proportional pressure reducing

valve, Construction, Working principle, Characteristics, Proportional Flow control valve, Direct operated proportional flow control valve, Construction, Working principle, Characteristics, Pilot operated proportional flow control valve, Construction, Working principle, Characteristics, Application of Proportional valves, Introduction to control system, Advantages of Open loop and Closed loop control System, Terminologies, Control response, Non-continuous action controllers, continuous action controllers, Control range / Resolution, Practical Implementation, Static data, Dynamic data, Components of closed loop technology,

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, Pressure switch, hydraulic accumulator, Regenerative circuit, Rapid speed/creep speed control, Extending a cylinder by operating a push button, Signal storage by electrical self-locking, setting and resetting using a momentary-contact switch, Mechanical locking by means of momentary-contact switch contacts, Electrical locking by means of contactor contacts, Signal storage by means of contactor contacts, Rapid advance circuit, Pressure-dependent reversing, Pressure switches and proximity switches, Advance control with time-dependent intermediate stop, Pressure-dependent sequence control, Sequencing Hydraulic actuators. Moving a cylinder with the help of an external potentiometer for the provision of a command value. Traversing a cylinder with command value module SWMA1 as command value source. Adjusting command value module SWMA1 with 4 command values. Adjusting command value module SWMA1 with 4 command values and ramps, Adjusting a braking distance following a proximity switch signal. Pressures of the proportional valve and their influence on velocity and braking distance. Adjusting a motion sequence with 4-quadrant ramps, Adjusting a sequence with 2 proximity switches, Three different speeds in single stroke using proximity switches. Adjustment of an automatic sequence with 3 proximity switches. Setting position with 4/3 directional valve. Setting position with proportional servo valve. Position control

Theory / Lecture Hours: 65

Practical / Tutorial Hours: 105

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, Logic Controls, Pneumatic, i. Shuttle valve, ii. Twin pressure valve, iii. Applications of Logic valves, Structure of Pneumatic Circuits, Automatic Control, Roller valve, Quick-Exhaust valve, Time-Delay valves, Pressure Control Valves, Introduction, Function and operating principle of pressure relief valve, direct operated Pressure regulator.

Multiple-Actuator Circuits, Introduction, Representation of a Control Task, i. Text form, ii. Positional Layout, iii. Notational form, iv. Displacement –step diagram, v. Displacement-time diagram, Sequence Control, Circuit design for the sequence of two cylinder and three cylinders, Elimination of signal overlaps, Electro-Pneumatics, Introduction, Integration of Technologies, Solenoid valves, DC solenoids Vs AC Solenoids, 3/2-Way single solenoid valve, Spring return, 5/2-Way single solenoid valve, Spring return, 5/2-Way double solenoid valve, Control devices, Switch and Push button, Terminal Markings, Relay, Logic Controls, Electric, Memory function, Operation of the ‘Dominant OFF’ Circuit, Operation of the ‘Dominant ON’ Circuit, Electronic sensors, Limit switch, Reed switch, Proximity Sensors, Time-Delay Relays, Two-hand safety operation, Pressure switch, Electro-Pneumatic Multiple-Actuator Circuits, Pneumatic Application Concepts, Introduction, Selection and Optimization Criteria, i. Type of motion, ii. Stroke and stroke control, iii. Force, iv. Speed and speed control,

Design of Pneumatics systems, Selection of Pneumatic Actuators, Selection of Pneumatic Valves, Maintenance, Troubleshooting, and Safety, Introduction, Requirements of Preventive Maintenance, Definitions of Maintenance Activities, Preventive Maintenance of Pneumatic Systems (General Procedure), System Malfunctions, i. Malfunctions due to contaminants, ii. Malfunctions due to improper mountings, iii. Malfunctions due to inadequate air supply, iv. Malfunctions due to under-lubrication/over lubrication, Maintenance Tips, i. Maintenance of compressor, ii. Maintenance of air receivers, iii. Maintenance of air-mains, iv. Maintenance of air service units (FRL), v. Maintenance of Pneumatic cylinder, vi. Maintenance of Pneumatic valves, Troubleshooting, i. General troubleshooting procedure, ii. Faults in Pneumatic systems, General Malfunctions, i. Malfunction in pneumatic cylinder, ii. Malfunction in Pneumatic valves, iii. Malfunctions in limit switches and reed switches, Safety in Pneumatic Systems, i. Safety hazards, ii. General safety measures.

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. Basic circuit with electric latching circuits, Displacement-dependent control of a double-acting cylinder with 1 electric limit switch, Displacement-dependent control of a double acting cylinder, impulse valve, cylinder switch, Displacement-dependent control of a double-acting cylinder with spring return valve, cylinder switch, Stop control of a double-acting cylinder with a 5/3 directional control valve in closed mid-position, Time-dependent control of a double-acting cylinder with switch-on time delay, Time-dependent control of a double-acting cylinder with switch-off time delay, Pressure-dependent control of a double-acting cylinder, Two-hand safety control, electric, Sequential control of 2 double-acting cylinders with impulse valve, Sequential control of 2 double-acting cylinders with impulse valves and signal overlapping, Sequential control of 2 double-acting cylinders with spring return valves and step sequence, Sequential control of 3 double-acting cylinders with impulse valves and step sequence, Sequential control of 3 double-acting cylinders with spring return valves and step sequence, Multiple actuator sequence, Two cylinder sequence, Three cylinder sequence.

Proportional & Closed loop: Introduction to closed loop technology in Pneumatics, Applications, Electropneumatic

Theory / Lecture Hours: 70

Practical / Tutorial Hours: 105

Total Course Theory / Lecture Hours: 205

Total Course Practical / Tutorial Hours: 315

Total Hours: 520

Recommended Hardware:

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

Recommended Software:

Automation studio, web trainers, Indraworks and indralogic

Text Books:

- Proportional and Servo Valve Technology (Bosch Rexroth AG) Volume 2
- The Pneumatic Trainer – Basic Pneumatics Volume 1 & 2 (Bosch Rexroth AG)
- Sensors in Theory and Practice – Textbook (Bosch Rexroth AG)
- Basics of Indraworks and Indralogic (Bosch Rexroth AG)
- Mechatronics Theory (Bosch Rexroth AG)

- Andrew Parr, Hydraulics and Pneumatics, Butterworth – Heineamann

Reference Books:

- Andrew Parr, Industrial drives, Butterworth – Heineamann
- S.R. Majumdar - Pnematic Systems, TMH.1995
- G.K.Dubey.Fundamentals of electrical drives
- Programmable Logic Controllers by W.Bolton
- Mechatronics - W. Bolton, Pearson Edition
- Herbert R. Merritt, Hydraulic control systems, John Wiley & Sons, Newyork, 1967
- Dodbey.A.Peace, Basic Fluid Power, Prentice Hall Inc, 1967
- R.Srinivasan Hydraulic and Pneumatic Control published by Vijay Nicole Imprints Private Ltd.
- Servo Pneumatics D.Scholz.A.Zimmermann
- Peter Rohner, Fluid Power logic circuit design. The Macmillan Press Ltd., London, 1979
- Peter Rohner, Fluid Power Logic Circuit Design, Mcmelan Prem, 1994
- Introduction to Programmable Logic Controllers by Garry Dunning, 2ndedition, Thomson, ISBN:981-240-625-5
- Instrumentation Engineers Hand Book - Process Control, Bela G Liptak, Chilton book company, Pennsylvania
- A.E. Fitzerald ,C.Kingsley and S.D Umans, Electric Machinery - Mc Graw Hill Int. Student edition
- S.K.Pillai. A First course on electric drives –Wiley Eastern 1990
- Programmable Logic Controllers by Hugh Jack
- Mechatronics - Mahalik, TMH
- Mechatronics - HMT, TMH

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

ESDM Courses

Level Code: L4 **Vertical Name:** Industrial Automation

Course Code: NL/M/L4/C013 **Course Name:** 3.3.5 Certificate in robotic programming and maintenance

Objective of the Course:

- Use the safety devices
- Familiar with necessary safety precautions for working with Industrial Robot.
- Familiarization to industrial robot and its application.
- Skill to programme an Industrial robot.
- Skill to operate an Industrial Robot.
- Familiarization to Robot Maintenance & Safety

Learning Outcomes:

Understanding about Robots ,and to get basic training an industrial Robot (operation, maintenance, safety)

Expected Job Roles:

Industrial robot programmer, Robot operator, Maintenance technician etc, in robotic companies

Duration of the Course (in hours) 325HRS

Minimum Eligibility Criteria and pre-requisites, if any 10th with aptitude in the subject/12th pass

Professional Knowledge:

- Understanding safety measures in Robotic field
- Robotic components recognition
- Manipulating the robot.
- Identifying the movements of a robotic arm
- Robot programming

Professional Skill:

- Programming of an Industrial Robot
- Operating of an Industrial robot.
- Safety measures and maintenance of an Industrial robot.

Core Skill:

1. To be able to understand an Industrial production cycle.
2. To be able to understand about the basics of robot.
3. To be able to work with the robot operating and maintenance with greatest safety.
4. To be able to work in robotic industry either in assembly units or in manufacturing.
5. To be able to handle the industrial robot.

Detailed Syllabus of Course

Theory:

Sl.No	TOPICS	Hr
UNIT -1		
1.0	Introduction to Robotics-	4
1.1	Evolution of Robots & Robotics, Laws of Robotics,	1
1.2	Progressive advancement in robotics,	1
1.3	Types of Robot, Selection of Robot- Payload, speed, Reach	1
1.4	Major parts of Industrial robot. -	1
UNIT 2		
2.0	Robot Anatomy	8
2.1	Links, Joints and Joints Notation Scheme.	1
2.2	Links, Joints and Joints Notation Scheme.	1
2.3	Degrees Of Freedom, Required DOF in a Manipulator	1
2.4	Arm Configuration, Wrist Configuration,	1

2.5	Work Cell, Work Envelope, and Work Volume	1
2.6	Robot End Effectors – Definition, Classification of End Effectors,	1
2.7	Types of Grippers.	1
2.8	General structure of Robot and Specifications of Robots	1
UNIT 3		
3.0	Robot motion analysis	6
3.1	Introduction, link description,	1
3.2	Joint link connection description,	1
3.3	Kinematic modeling of manipulator	1
3.4	Direct and Inverse manipulator Kinematics - Basics	1
3.5	Manipulator dynamics- Basics	1
3.6	Trajectory planning – Basics	1
UNIT 4		
4.0	Robotic Vision System	4
4.1	Robot Sensors, Function & use of sensors in robotics.	1
4.2	Definition & Concept-Robotic vision system	1
4.3	Aspects of vision systems.	1
4.4	Robot welding with vision system	1
UNIT 5		
5.0	Robot Software and Programming	4

5.1	Introduction, Robot software features	1
5.2	Concept of programmability and related languages,	1
5.3	Robot programming languages and Robotic Functions,	1
5.4	Control functions of a Teach box, Jogging of a Robot	1
UNIT 6		
6.0	Robotic System Design Aspects	2
6.1	Introduction, Informational requirements	1
6.2	Overall Design, Mechanical design considerations	1
UNIT 7		
7.0	Robotic Applications	8
7.1	Introduction	1
7.2	Adapting robots to industrial workstation- Why?	1
7.3	General Conditions for usage of industrial Robot	1
7.4	Robot capabilities	1
7.5	Non- Industrial applications, Industrial applications	1
7.6	Process wise Applications- Material handling, process operation and product inspection,	1
7.7	Machine loading and Unloading.	1
7.8	Spot & Arc welding	1
UNIT 8		
8.0	Robot Maintenance & Safety	5
8.2	Robot Maintenance	1
8.3	Robot Maintenance	1
8.4	Robot Safety systems	1
8.5	Present state of safety technology	1

9.0	Assignment	4
10	Theory Test	4

Practical Syllabus:

SL. No	3.3.5.1.1.1.1.1.1 Major topics	Time allotted
1.	Robot component recognition.	8h
2.	Manipulating the robot.	8h
3.	Recording the position	12h
4.	Writing and running robot programs	16h
5.	Joint & XYZ co-ordinate system.	8h
6.	Point-to-Point control	8h
7.	Linear and Circular Interpolation	4h
8	Writing the programs using Loops.	4h
9.	Writing the programs using Delay.	4h
10	Test & Exam	4h
11	Internship	200 h
	Total	276 Hrs.

Total Course Theory / Lecture Hours: 49

Total Course Practical / Tutorial Hours: 276

Total Course Hours:325

(Training in 100 hrs of Communicative English and

80 hrs of Basic IT Skills also provided, as required)

Recommended Hardware:

- Industrial Robot
- End effector
- Relevant components for a specific job.

We are providing Robot,
 1) Fanuc LR mate200iC
 2) Fanuc LR mate200iD
 3) Pneumatic Gripper

Recommended Software:

Robot simulator(robo sim)

Text Books:

Robotics and Control- RK Mittal, I J Nagrath

Trainees handbook by NTTF,
Robotics trainers manual by NTTF.**Reference Books:**Industrial Robotics By Michel P Groover, Robotic Engineering By Dr. Surender
Kumar, Dr. S K Mukherjee, Robotics and Control – RK Mittal, I.J. Nagrath.

1.4 Industrial Electronics

ESDM Courses**Course ID:**

NL/S/L3/C003

Course Name:3.4.1 Repair & Maintenance of Power Supply, Inverter &
UPS**Objective of the Course:**This course has been designed to provide knowledge of repair and maintenance of Power Supply, Inverter and UPS.
The participant will be able to troubleshoot problems of CVT, Inverter and UPS**Learning Outcomes:**

At the end of the course the participants will be having knowledge of:-

- Electrical and Electronics Component
- UPS parts and repair
- Inverter, CVT and its operation, parts and installation
- Tools and Equipment used in Repair and Maintenance of Inverter, UPS etc.
- Troubleshooting Techniques

Expected Job Roles:

Inverter Repair Technician, UPS Repair Technician, Power Supplies Repair Technician

Duration of the Course (in hours)

350

Minimum Eligibility Criteria and pre-requisites, if any10th Pass/ITI

Professional Knowledge:

The individual on the job needs to know and understand:

- PK1. Knowledge of Electronic and Electrical Components
- PK2. Resistors, Capacitors and Inductors, their identification, types and application
- PK3. Protection equipment (anti-static wrist bands, shoes, dress, packaging, and other appropriate insulations) that are required to be used
- PK4. First aid requirements in case of electrical shocks, cuts and other common injuries
- PK5. Soldering and De-Soldering Techniques
- PK5. Need of stabilizer, working principle, types of stabilizer
- PK6. Constant Voltage transformer, General Circuit diagram of CVT, Working principle of CVT
- PK7. EMI/RFI filter, Surge Suppressor, Repairing of CVT
- PK8. Introduction to Inverter, Block diagram of Inverter
- PK9. UPS, Working principle, specifications, explanation with the help of block diagram
- PK10. Find the total Load and Select suitable Inverter/UPS
- PK11. Range of tools and testing equipment available and their functionality
- PK12. Construction of Battery, Case Cover plates, Separator, Cells, Electrolyte, etc
- PK13. Factor affecting charging, Cause of battery failure, diagnosis and testing, visual inspection, Heavy load test
Standard fault-finding (troubleshooting) techniques
- PK14. Component testing methods
- PK15. Troubleshooting through circuit diagram
- PK16. Removal and Replacement of faulty Component
- PK17.

Professional Skill:

The individual on the job needs to know and understand:

Electrical and Electronic Component Identification and Use Skills

- PS1. Understand use of Electrical Component such as cable, switches, transformers etc.
- PS2. Understand use of Electronics Component such as Diodes, Transistors, ICs etc.
- PS3. Use of Test and Measurement Equipment

Soldering skills

- PS4. Understand Soldering Requirements
- PS5. Operation of Equipment required for Soldering
- PS6. Use of Desoldering Pump

Stabilizer and CVT Repairing Skill

- PS7. Working principle, types of stabilizer
- PS8. Transformer employed in stabilizer, multiwinding/multitaped transformer
- PS9. Understanding General Circuit diagram of CVT, Working principle of CVT
- PS10. Finding fault in Stabilizer and CVT
- PS11. Replace faulty components in Stabilizer and CVT

Inverter and UPS Repairing Skill

- PS12. Working principle of Inverter and UPS
- PS13. Working Principle of Rectifier
- PS14. Finding fault in Inverter and UPS
- Replace faulty components in Inverter and UPS

Troubleshooting Skills

- PS15. How to approach a defect
- PS16. Make use of standard OEM specified troubleshooting steps
- PS17. Interpret intermediate results and progress fault rectification accordingly
- PS18. Utilize appropriate tools to rectify faults

Core Skill:

The individual on the job needs to know and understand how to:

Reading skills

- CS1. Read and understand technical manuals, work orders and reports
 CS2. Read and understand organizational health and safety instructions

Writing Skills

- CS3. Fill up record sheets clearly, concisely and accurately as per company procedures

Communication Skills

- CS4. Clearly communicate relevant information to supervisors
 CS5. Respond appropriately to queries
 CS6. Communicate with customer/customer facing teams to understand handset performance issues
 CS7. Communicate in the local language
 CS8. Convey proposed solution to the customers

Time Management Skills

- CS9. Prioritize and execute tasks in a high-pressure environment
 CS10. Use and maintain resources efficiently and effectively

Analytical Skills

- CS11. Analyse (and understand) customer complaints
 CS12. Interpret reports, readings and numerical data
 CS13. Keep up to date with new technology and performance issues

Other Skills

- CS14. Create and maintain effective working relationships and team environment through collaboration
 CS15. Take initiatives and progressively assume increased responsibilities
 CS16. Share knowledge with other team members and colleagues

Detailed Syllabus of Course

Sl. No.	Modules	Min: No. of Hours
		Theory/ Practical
1.	Introduction to Electricity Electric Charge, Voltage, Electric Current Ohm's Law, Electric Potential, Cell Serial and Parallel Circuit, their effect on Voltage and Current Transformer, Use and Operation	5 / 5
2.	Electronic and Electrical components Active and Passive Components Resistors, Capacitors and Inductors, their identification, types and application Semiconducting Devices: Diodes, its type, characteristics and applications Transistors, Integrated Circuits Study of a transistor, use of a transistor as an amplifier and as a switch. Analog ICs, 555 timer, IC741, characteristics of 741 Digital ICs, ICs for logic gates, Truth table verification of logic gates Connectors Fuse, types, Use of Fuses and its rating Relays and Switches Panel Components Digital electronics – gates and its application, multiplexers, de-multiplexers, counter	15 / 15

3.	Soldering/ de- soldering techniques Soldering Iron, Soldering wire, Soldering Flux, Soldering method, Zero defect soldering Desoldering pump, Temperature controlled soldering station, Hands-on-practices of Soldering)	10 / 10
4.	Tools and equipment use for Repairing and maintenance of Electrical Equipment Screw Driver Set Tweezers, Different Types of Tweezers, Nose Pliers, Wire Cutter Hot air gun Liquid solder pest, Magnifying Lamp and Measuring Tools Brush, CRO, Nipper Test and Measurement Equipment, Multimeter Operation etc.	10 / 10
5.	Stabilizer and CVT Need of stabilizer, working principle, types of stabilizer Autocut and automatic stabilizer, Servo Stabilizer, Study of Control Circuit of Stabilizer Transformer employed in stabilizer, multiwinding/multitaped transformer Introduction to Constant Voltage transformer, General Circuit diagram of CVT, Working principle of CVT EMI/RFI filter, Surge Suppressor, Repairing of CVT	20 / 30
6.	Inverter and UPS Introduction to Inverter, Block diagram of Inverter Rectifier, its type and working principle, PIV of Diode, Filter employed in rectifier Battery charger circuit, working of Inverter Oscillator, type of Oscillator, Square wave Generator PWM, DC to AC Convertor/Invertor, Designing an investor, Circuit using PWM UPS, Working principle, specifications, explanation with the help of block diagram UPS Installation Find the total Load and Select suitable Inverter/UPS	20 / 30
7.	Battery Battery types, Primary Cell, Secondary Cell, Wet- charged, Dry-charged, Low maintenance Construction of Battery, Case Cover plates, Separator, Cells, Electrolyte, etc Lead Acid battery, Electrochemical reaction, N1-CD battery, Capacity rating, CCA, RC, AH & Power(watt) Factor affecting charging, Cause of battery failure, diagnosis and testing, visual inspection, Heavy load test	10 / 20
8.	Troubleshooting techniques Basic troubleshooting method, Getting into troubleshooting, selected instruments for troubleshooting Component testing methods, Testing of components in circuits , Logical steps of fault finding, Troubleshooting through circuit diagram Removal and Replacement of faulty component	40 / 60

9.	Safety and Security Procedures Reporting incidents, system failures, power failures etc., protection equipment First aid requirement in case of electrical shocks and other injuries	5 / 5
10.	Reading, Writing and Communication Skills Understanding Technical Manuals, Reports, Work orders etc. Understanding Organizational health and safety instructions Types of documentation in organization, their importance, Company guidelines and norms, activities after maintenance process Spare management, Service Level Agreements (SLAs) Fill-up forms, record sheets, log book etc. as per company procedures Customer Communication, Convey proposed solution to the customer, responding queries Communication with supervisor, Report for unresolved problems Time Management and Team Skills	15 / 15
Total Theory / Lecture Hours:		150 hrs
Total Practical / Tutorial Hours:		200 hr
Total Hours:		350 hrs

Recommended Hardware:

For a batch size of 50Nos		
1.	Resistance of different value and Wattage ratings	20 nos. each
2.	Capacitor of different types	20 nos. each
3.	Transistors – BC 546, BC 547, SL 100, 2N3055	10 nos. each
4.	Rectifier Diode	20 Nos.
5.	Zener Diode of different values	10 nos. each
6.	Step down Transformers of different ratings	04 nos. each
7.	LED of different colours	20 nos. each
8.	3 Pin Voltage Regulators	05 nos. each
9.	Logic GATE ICs	10 nos. each
10.	Tool Kit	05 sets
11.	Digital Multimeter	05 nos.
12.	CRO	02 nos.
13.	Soldering Iron	05 nos.
14.	Solder Wire	250 gms
15.	Soldering Flux	100 gms.
16.	Microwatt Soldering Iron	02 nos
17.	Desoldering Station	02 nos.
18.	Desoldering Pump	05 nos.
19.	Inverter	2 set
20.	UPS	2 set
21.	Stabilizer/CVT	5 nos
22.	Battery Charger	1 No.

Recommended Software:

NA

Text Books:

1. Basic Electronics - Repair & Maintenance of Power supply, Invertor & UPS – NIMI Published by National Instructional Media Institute, Chennai
2. Switching Power Supply Design, 3rd Ed. by Abraham Pressman (Author),
3. Uninterruptible Power Supplies Alexander King, William Knight McGraw Hill Professional

Reference Books:

- user/service manuals

National Institute of Electronics and Information Technology

ESDM Courses

Level Code: L3 **Vertical Name:** Medical Electronics

Course ID: NL/S/L3/C004 **Course Name:** 3.5.1 Repair & Maintenance of Dental equipment

Objective of the Course:

Have knowledge about the various devices used in medical field.
Have an awareness of the safety aspects of medical instruments.
Understand the basics of how the signals are obtained from the body that is to be measured by various machines.

Learning Outcomes:

Have knowledge about various devices used in medical field
Have the basic understanding of how the signals are obtained from the body
Be aware of the safety aspects in this field.

Expected Job Roles:

Operation and Maintenance of Dental Equipment

Duration of the Course (in hours) 350 Hours

Minimum Eligibility Criteria and pre-requisites, if any 10TH Pass

Professional Knowledge:

- a) Basics of Mechanical Foundry Equipments
- b) Working of Motor, Drilling.
- c) Basic concept of suction apparatus.
- d) Have understanding related to medical Lights, Shadow less lights.
- e) Basics of X-rays.
- f) Understanding of basics of dental machines.
- g) Basic Knowledge of Dental tools.
- h) Basic Of active and passive components
- i) Types of components with its working.
- j) Working and usage of OP AMP 741.
- k) Basics of ultrasonic s waves ,concepts and Units

Professional Skill:

- a) Knowledge and hands on experience with designing of circuits
- b) Working and designing of PCB's
- c) Basics of dental chairs usage
- d) Concepts of hydraulics and Suction system,
- e) Working and Concept Of TTL .
- f) Understanding and theory related to ultrasonics, Internal circuitry.

Core Skill:

- a) Basic understanding and co-ordinating skills.
- b) Basic Numeracy and co-ordination.
- c) Should have a strong determination and curiosity to learn new things
- d) Adaptable with the environment.
- e) Should have understanding and adaptability with new concepts.
- f) Blending with the technical aspects.

Detailed Syllabus of Course

Module. No	Modules	Minimum No. of Hours
1.	Basics understanding of Dental Chair	50
2.	Tools & Aids for servicing & maintenance, Hard & soft tools	200
3.	Soft Skills	100
Total Theory / Lecture Hours:		250
Total Practical / Tutorial Hours:		100
Total Hours:		350

Recommended Hardware:

**Recommended
Software:**

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Text Books:

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Reference Books:

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ESDM Courses

Level Code: L3 **Vertical Name:** Medical Electronics

Course ID: NL/S/L3/C006 **Course Name:** 3.5.2 Repair & Maintenance of ECG and ICCU Equipment

Objective of the Course:

Have knowledge about the various devices used in medical field.
Have an awareness of the safety aspects of medical instruments.
Understand the basics of how the signals are obtained from the body that is to be measured by various machines.

Learning Outcomes:

Have knowledge about various devices used in medical field
Have the basic understanding of how the signals are obtained from the body
Be aware of the safety aspects in this field.

Expected Job Roles:

Operation and Maintenance of Clinical Equipment (ECG &ICCU)

Duration of the Course (in hours) 350 Hours

Minimum Eligibility Criteria and pre-requisites, if any 10th Pass

Professional Knowledge:

- a) Should have the understanding of Use of CRO, Multimeter, Measurement of voltage, current, resistance
- b) Testing of diodes, resistors
- c) Basic Knowledge about the waveforms.
- d) PCB repairing and locating the faults.
- e) Know basic medical terminologies like ECG, EEG, EMG
- f) Working of BP kit, measurement principle .
- g) Knowledge of transistors, types and working, usage.
- h) Knowledge of electromechanical components, relays, switches.

Professional Skill:

- a) Testing and working of resistors, capacitors, transistors, diodes, Inductors, OPAMP,
- b) Working Of ECG amplifiers, ECG instrumentation
- c) Knowledge about ECG, Defibrillators, pulse oximeters , ICU equipments.
- d) Basics of Non invasive blood pressure, Soldering, seven segment display.
- e) Identification of PCB fuses
- f) Performance evaluation of components

Core Skill:

- a) Analytical strong competency.
- b) Practical Evaluation and understanding of the basics.
- c) Strong approach towards the theoretical and practical applications.
- d) Eagerness and curiosity to learn more.

Detailed Syllabus of Course

Module No	Modules	Minimum No. of Hours
1.	Tools and servicing maintenance of Hard and soft.	75
2.	Familiarization and working with components, ECG , ICU equipments	175
3	Soft Skills	100
	Total Theory / Lecture Hours:	250
	Total Practical / Tutorial Hours:	100
	Total Hours:	350

Recommended Hardware:

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**Recommended
Software:**

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Text Books:

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Reference Books:

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ESDM Courses

Level Code: L3 **Vertical Name:** Medical Electronics

Course ID: NL/S/L3/C005 **Course Name:** 3.5.3 Repair & Maintenance of Imaging Equipment (X-Ray & Ultrasound machine)

Objective of the Course:

Have knowledge about the various devices used in medical field.
Have an awareness of the safety aspects of medical instruments.
Understand the basics of how the signals are obtained from the body that is to be measured by various machines.

Learning Outcomes:

Have knowledge about various devices used in medical field
Have the basic understanding of how the signals are obtained from the body
Be aware of the safety aspects in this field.

Expected Job Roles:

Operation and Maintenance of Imaging Equipment (X-Ray & Ultrasound machine)

Duration of the Course (in hours) 350 Hours

Minimum Eligibility Criteria and pre-requisites, if any 10th Pass

Professional Knowledge:

- a) Basics of Mechanical Foundry Equipments
- b) Working of Motor, Drilling.
- c) Basic concept of suction apparatus.
- d) Have understanding related to medical exposure of X-Rays.
- e) Basics of X-rays.
- f) Understanding of basics of dental machines.
- g) Basic Knowledge of Medical computer usage and applications in imaging field
- h) Basic Of active and passive components
- i) Types of components with its working.
- j) Working and usage of OP AMP 741.
- k) Basics of ultrasonic s waves ,concepts and Units

Professional Skill:

- a) Knowledge and hands on experience with designing of circuits
- b) Working and designing of PCB's
- c) Basics of XRay units,
- d) Concepts of hydraulics and Suction system,
- e) Working and Concept of xray Tubes, collimator.
- f) Understanding of basics of optics.
- g) Knowledge of Spectrum.
- h) Basics of Non Invasive Xrays.

Core Skill:

- a) Basic understanding and co-ordinating skills.
- b) Basic Numeracy and co-ordination.
- c) Should have a strong determination and curiosity to learn new things
- d) Adaptable with the environment.
- e) Should have understanding and adaptability with new concepts.
- f) Blending with the technical aspects.

Detailed Syllabus of Course

Module. No	Modules	Minimum No. of Hours
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1.	Basic Building Blocks of Bio-Medical Equipment	40
2.	Imaging Equipment	80
3.	Bio-Medical Instrumentation and Measurement	30
4.	On Job Training	100
5.	Soft Skills	100
Total Theory / Lecture Hours:		250
Total Practical / Tutorial Hours:		100
Total Hours:		350

Recommended Hardware:

Recommended Software:

Text Books:

Reference Books:

ESDM Courses

Level Code: L5 **Vertical Name:** Medical Electronics

Course ID: NL/S/L5/C009 **Course Name:** 3.5.4 Post Diploma in Repair & Maintenance of Hospital Equipment

Objective of the Course:

Have knowledge about the various devices used in medical field.
Have an awareness of the safety aspects of medical instruments.
Understand the basics of how the signals are obtained from the body that is to be measured by various machines.

Learning Outcomes:

Have knowledge about various devices used in medical field
Have the basic understanding of how the signals are obtained from the body
Be aware of the safety aspects in this field.

Expected Job Roles:

Operation & Maintenance of Hospital Equipment

Duration of the Course (in hours) 400 Hours

Minimum Eligibility Criteria and pre-requisites, if any ITI/Diploma/B.Sc

Professional Knowledge:

- a) Basic knowledge regarding ECG electrodes
- b) ECG working, Waveform generation.
- c) Calibration and testing Of ECG Equipment
- d) Working principles of Analytical Instrument.
- e) Working and analysis of pH meter
- f) Basics of diagnostic equipment.
- g) Diagnostics Technique and various physiology system

Professional Skill:

- a) Have knowledge of working of microscope, standard Procedure,
- b) Have understanding about the terms and definition like pH meter ,pH value, basics of chemistry
- c) Have basic understanding of human Physiology, and various human systems.
- d) Basics of bioelectric Potentials and measurements in human body

Core Skill:

- a) Basic understanding and co-ordinating skills.
- b) Basic Numeracy and co-ordination.
- c) Should have a strong determination and curiosity to learn new things
- d) Adaptable with the environment.
- e) Should have understanding and adaptability with new concepts.
- f) Blending with the technical aspects.

Detailed Syllabus of Course

Module. No	Modules	Minimum No. of Hours
1.	Basic Block of Biomedical Equipment	30
2.	ECG Machine and analytical	30
3.	Diagnostic Equipment	30
4.	Biomedical instrumentation	30
5.	Hands on Experience	200
6	Soft Skills	30
Total Hours:		350

Recommended Hardware:

Recommended Software:

Text Books:

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Reference Books:

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ESDM Courses

Level Code: **Vertical Name:**

Course ID: **Course Name:**

Objective of the Course:

This course has been designed to provide an introduction to installation and maintenance of Photocopiers and Printers. The participant will be able to troubleshoot problems of Photocopiers and Printers.

Learning Outcomes:

At the end of the course the participants will be having knowledge of:-

- Basic Electricity, Electrical and Electronic Components
- Soldering and De-soldering Techniques
- Tools and Equipment used
- Repair and maintain Photocopiers and Printers
- Troubleshooting Techniques

Expected Job Roles:

Photocopier and Printer Repair Technician

Duration of the Course (in hours)

Minimum Eligibility Criteria and pre-requisites, if any

Professional Knowledge:

The individual on the job needs to know and understand:

- PK1. Knowledge of Electronic and Electrical Components
- PK2. Resistors, Capacitors and Inductors, their identification, types and application
- PK3. Protection equipment (anti-static wrist bands, shoes, dress, packaging, and other appropriate insulations)
- PK4. that are required to be used
- PK5. First aid requirements in case of electrical shocks, cuts and other common injuries
- PK5. Soldering and De-Soldering Techniques
- PK6. Principle of Operation of Photocopier
- PK7. Dismantling and assembling of paper feed mechanism, paper tray, Thermal unit and Toner Unit.
- PK8. Identify the various sensors used in the copier and their fixtures.
- PK9. Paper trays, Paper feed mechanism and the sensors used for paper movement
- PK10. Periodic cleaning and servicing of copier machines
- PK11. Printers and their types
- PK12. Thermal Printers and Inkjet Printer, their Working Principle
- PK13. Laser Printers and its operation
- PK14. Different Parts of Printer
- PK15. Cartridges, toner, drum, their use and its replacement
- PK16. Overall fault finding and repair of Printer
- PK17. Standard fault-finding (troubleshooting) techniques
- PK18. Component testing methods
- PK19. Troubleshooting through circuit diagram
- PK20. Removal and Replacement of faulty Component

Professional Skill:

The individual on the job needs to know and understand:

Electrical and Electronic Component Identification and Use Skills

- PS1. Understand use of Electrical Component such as cable, switches, transformers etc.
- PS2. Understand use of Electronics Component such as Diodes, Transistors, ICs etc.
- PS3. Use of Test and Measurement Equipment

Soldering skills

- PS4. Understand Soldering Requirements
- PS5. Operation of Equipment required for Soldering
- PS6. Use of Desoldering Pump

Photocopier Repairing Skill

- PS7. Understand Operation of Photocopier
- PS8. Dismantling and assembling of paper feed mechanism, paper tray, Thermal unit and Toner Unit.
- PS9. Identify the various sensors used in the copier and their fixtures.
- PS10. Fault finding and repairing in electrostatic high voltage unit.
- PS11. Dismantling and fitting of drum unit- cleaning of drum unit
- PS12. Dismantling and refitting of Carriage unit , mirror unit and light unit
- PS13. Periodic cleaning and servicing of copier machines
- PS14. Overall fault finding and repair a photo copier machine.

Printer Repairing Skill

- PS15. Understand Working Principle of Thermal Printers and Inkjet Printer
- PS16. Understand Operation of Laser Printers
- PS17. Different Parts of Printer and their use
- PS18. Cartridges, toner, drum, their use and its replacement
- PS19. Overall fault finding and repair of Printers

Troubleshooting Skills

- PS20. How to approach a defect
- PS21. Make use of standard OEM specified troubleshooting steps
- PS22. Interpret intermediate results and progress fault rectification accordingly
- PS23. Utilize appropriate tools to rectify faults

Core Skill:

The individual on the job needs to know and understand how to:

Reading skills

- CS1. Read and understand technical manuals, work orders and reports
 CS2. Read and understand organizational health and safety instructions

Writing Skills

- CS3. Fill up record sheets clearly, concisely and accurately as per company procedures

Communication Skills

- CS4. Clearly communicate relevant information to supervisors
 CS5. Respond appropriately to queries
 CS6. Communicate with customer/customer facing teams to understand handset performance issues
 CS7. Communicate in the local language
 CS8. Convey proposed solution to the customers

Time Management Skills

- CS9. Prioritize and execute tasks in a high-pressure environment
 CS10. Use and maintain resources efficiently and effectively

Analytical Skills

- CS11. Analyse (and understand) customer complaints
 CS12. Interpret reports, readings and numerical data
 CS13. Keep up to date with new technology and performance issues

Other Skills

- CS14. Create and maintain effective working relationships and team environment through collaboration
 CS15. Take initiatives and progressively assume increased responsibilities
 CS16. Share knowledge with other team members and colleagues

Detailed Syllabus of Course

Sl. No.	Modules	Min: No. of Hours
		Theory/ Practical
1.	Introduction to Electricity Electric Charge, Voltage, Electric Current Ohm's Law, Electric Potential, Cell Serial and Parallel Circuit, their effect on Voltage and Current	5/ 5
2.	Electronic and Electrical components Active and Passive Components Resistors, Capacitors and Inductors, their identification, types and application Semiconducting Devices: Diodes, its type, characteristics and applications Transistors, Integrated Circuits Study of a transistor, use of a transistor as an amplifier and as a switch. Analog ICs, 555 timer, IC741, characteristics of 741 Digital ICs, ICs for logic gates, Truth table verification of logic gates Connectors Fuse, types, Use of Fuses and its rating Relays and Switches Panel Components Digital electronics – gates and its application, multiplexers, de-multiplexers, counter	10/ 10
3.	Soldering/ de- soldering techniques Soldering Iron, Soldering wire, Soldering Flux, Soldering method,	10 / 10

	Zero defect soldering Desoldering pump, Temperature controlled soldering station, Hands-on-practices of Soldering	
4.	Tools and equipment Screw Driver Set Tweezers, Different Types of Tweezers, Nose Pliers, Wire Cutter Hot air gun Liquid solder pest, Magnifying Lamp and Measuring Tools Brush, CRO, Nipper Test and Measurement Equipment, Multimeter Operation etc.	10 / 10
5.	Photocopiers Principle of Operation of Photocopier Dismantling and assembling of paper feed mechanism, paper tray, Thermal unit and Toner Unit. Identify the various sensors used in the copier and their fixtures. Fault finding and repairing in electrostatic high voltage unit. Dismantling and fitting of drum unit- cleaning of drum unit Dismantling and refitting of Carriage unit , mirror unit and light unit Paper trays, Paper feed mechanism and the sensors used for paper movement Periodic cleaning and servicing of copier machines Overall fault finding and repair a photo copier machine.	20 / 20
6.	Printers Printers and their types. Thermal Printers and Inkjet Printer, their Working Principle Laser Printers and its operation Different Parts of Printer Cartridges, toner, drum, their use and its replacement Overall fault finding and repair of Printers	25 / 25
7.	Safety and Security Procedures Reporting incidents, system failures, power failures etc., protection equipment First aid requirement in case of electrical shocks and other injuries	05 / 05
8.	Reading, Writing and Communication Skills Understanding Technical Manuals, Reports, Work orders etc. Understanding Organizational health and safety instructions Types of documentation in organization, their importance, Company guidelines and norms, activities after maintenance process Spare management, Service Level Agreements (SLAs) Fill-up forms, record sheets, log book etc. as per company procedures Customer Communication, Convey proposed solution to the customer, responding queries Communication with supervisor, Report for unresolved problems Time Management and Team Skills	15 / 15
Total Theory / Lecture Hours:		100 hrs
Total Practical / Tutorial Hours:		100 hrs
Total Hours:		200 hrs

Recommended Hardware:

For a batch size of 50Nos

1. Resistance of different value and Wattage ratings 20 nos. each
2. Capacitor of different types 20 nos. each
3. Transistors – BC 546, BC 547, SL 100, 2N3055 10 nos. each
4. Rectifier Diode 20 Nos.
5. Zener Diode of different values 10 nos. each
6. LED of different colours 20 nos. each
7. 3 Pin Voltage Regulators 05 nos. each
8. Logic GATE ICs 10 nos. each
9. Tool Kit 05 sets
10. Digital Multimeter 05 nos.
11. CRO 02 nos.
12. Soldering Iron 05 nos.
13. Solder Wire 250 gms
14. Soldering Flux 100 gms.
15. Microwatt Soldering Iron 02 nos
16. Desoldering Station 02 nos.
17. Desoldering Pump 05 nos.
18. Project Board 05 nos.
19. Multistand Connecting wire 01 Coil each
20. Single stand connecting wire 01 coil each
21. Photocopier (Mono) 01 nos.
22. Photocopier Color 01 nos.
23. Different types of Printers 01 no each

Recommended Software:

Printer Drivers etc.

Text Books:

1. MES - Electronics - Repair & Maintenance of Photocopier and Fax Machine (With DVD) - NIMI
2. Easy Laser Printer Maintenance and Repair Paperback - Stephen J. Bigelow

Reference Books:

user/service manuals

Level Code: L4 **Vertical Name:** Office Automation, IT & networking

Course Code: NL/S/L4/C014 **Course Name:** 1.6.2 Telecom Technician - PC Hardware and Networking

Objective of the Course:

To obtain proficiency in the different components of PC (processors, mother board, RAM, I/O Devices) and networking components (Simple Network Components, Networking Components like Switch, Router, Hub, NIC, PC/Laptop, Router) and the various processes of setting up different kinds of network. It also helps to gain proficiency in trouble shooting of networks, installation of software, setting up network security
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:

Acquire hands on training in assembling a PC using the scrap components. Also get a detailed knowledge on the basic networking concepts and complete hands on training in setting up different kinds of network. Efficient in managing, configuring, installing and troubleshooting different hardware and networking resources.
Have Good Communicative English Skills, Soft Skills & IT skills

Expected Job Roles:

1. Troubleshooting PC & it's Components
2. Maintenance of Computer Hardware
3. Network Administrators
4. Hardware Technicians
5. Entrepreneurs - Consultancy Services

Duration of the Course (in hours) 170 hrs

Minimum Eligibility Criteria and pre-requisites, if any 10th with strong aptitude in Science / 12th Pass

Professional Knowledge:

- KA1. Knowledge to assemble a PC using scrap components and standard methodologies to set up a system using various components of the system
- KA2. Understanding on designing the network and set up a network
- KA3. How to troubleshoot the various hardware resources like printer, scanner, hard disk, mouse, keyboard etc.
- KA4. How to troubleshoot the software resources (application troubleshooting)
- KA5. How to troubleshoot of networks and networking resources like routers, switches, hub, cable, modem etc.
- KA6. To interpret design requirements of different types of networks
- KA9. SMPS and Specifications- Form factors, Power Connectors
- KA10. Knowledge to prepare HDD- Configuring, Mounting, Partitioning, Formatting and loading OS
- KA11. Introduction to Computer Software- Application Software, Open Source Software, Proprietary Software, Functions of System Software
- KA12. Protocols and topologies to simulate, analyze and synthesize design options
- KA13. Number Conversion systems and IP addresses
- KA14. IP Addressing and sub-netting
- KA15. Broadband, Network Architecture & Wireless networks

Professional Skill:

- SA1. Assemble a PC using scrap components and standard methodologies to set up a system using various components of the system
- SA2. Designing the network topologies and setting up various types of networks
- SA3. Troubleshooting of hardware resources like printer, scanner, hard disk, mouse, keyboard etc., software resources (application troubleshooting) and the networks and networking resources like routers, switches, hub, cable, modem etc.
- SA4. Connecting SMPS and use of Form factors, Power Connectors
- SA5. Usage of number conversion systems, IP addresses and IPV6
- SA6. Setting up Broadband Network & Wireless networks

Core Skill:

SA1. Complete accurate well written work with attention to detail on the different components of PC (processors, mother board, RAM, I/O Devices)
SA2. Setting up networks and understanding of various network topologies
SA3. IP Addresses and IPV6
SA4. Number conversion systems and it's usage
SA5. Information on Broadband & Wireless Networks

Detailed Syllabus of Course

Module. No	Module. Name	Minimum No. of Hours
1	<p>PC Hardware</p> <ol style="list-style-type: none"> 1. Know your computer, PC case , SMPS 2. Motherboard of clients, Motherboard of Servers 3. Hard disks , CPUs-Intel/AMD , Keyboards , Mouse , USB Devices 4. Monitors – CRT / TFT / LCD / LED 5. I/O devices – Printers , Webcams, Scanners, Digital Camera, 6. USB Wifi, USB BT, USB Storages, UPS 7. Overhead/LCD/DLP/LED Projectors 8. Assembling of a PC, Servers and trouble shooting 	25
2	<p>PC Hardware Practical</p> <ol style="list-style-type: none"> 1. Loading and configuration procedure of Microsoft Client O/S – Win XP /Win 7 and Windows 8 2. Loading and configuration procedure of Microsoft Server O/S – Win 2003 server /Win 2008 Server 3. Loading and configuration procedure of Linux Clients and server OS 4. Firewall configuration, Antivirus/Internet security loading and configuration procedure 5. Installation and configuration of , I/O devices – Printers , Webcams , Scanners , Digital Camera , USB Wifi , USB BT, USB Storages , Projectors 6. Multiple OS loading and trouble shooting 	35

3	<p>Computer Networking</p> <ol style="list-style-type: none"> 1. Introduction to Networking, Types of Networks and Topologies available and its areas of use 2. Protocols used in networking- Its purpose, use and types 3. Introduction to ISO-OSI Layer Protocols 4. Different Networking elements used to build a network and its purpose-like NIC, Hubs, Switches, Routers 5. Addressing used in Networking-IP address 6. Basics of Internet protocol TCP/IP 7. Different types of cabling used in networking and their standards 8. UTP cable types and its purpose, UTP cable crimping using RJ 45 connectors- Straight through and Cross over Crimping 9. Introduction to Server- features, Hardware features and Software features, RAID etc. 10. Basics of routers- Difference from switches, uses, features 11. Configuration aspects, Basic concepts of Switching and Routing 12. Internet connection mechanisms-Dial up, Broadband etc 13. Overview of a Service Provider network to connect Internet 14. Wireless Networking- Wireless networking concepts, different wireless standards like Blue tooth, Wifi, WiMaX etc 	25
4	<p>Computer Networking Practical</p> <ol style="list-style-type: none"> 1. Familiarization of Internetworking elements like Hubs, switches, routers 2. Network Cable Crimping- Straight through and Cross over Crimping using UTP cables and testing 3. Installation of NIC in PCs and trouble shooting 4. Client configuration for networking, advanced client configuration for connecting multiple networks 5. Setting up of a simple LAN ,Checking the connectivity using DOS commands 6. Sharing files, Printers, CD drives 7. Sharing desktops, Remote desktop, Using Applications like Team Viewer for accessing a remote computer 8. Configuration of client PCs for connecting multiple networks etc 	35

	<p>9. Installation of Windows server, Configuration of server for Web Server and FTP server, Verification from a client</p> <p>10. Basic router configuration, Connecting through Hyper terminal, Configuring router connecting different networks</p> <p>11. Broadband Lab- Type 1 and Type 2 Modems, Modem configuration for internet connection</p> <p>12. Wireless modem configuration for Wi Fi connectivity, Internet connection sharing to multiple clients</p>	
5	<p>Internship</p> <p>Internship at various BSNL Units</p>	50

Total Course Theory / Lecture Hours: 50

Total Course Practical / Tutorial Hours: 120

Total Course Hours: 170

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

Recommended Hardware:

Scrap CPUs, Scrap PC Cabinet, SMPS and other basic components, Scrap Motherboard and Different Types of Processors, Scrap RAM, Desktop PC without loading OS, Scrap UPS, Laptop, Tablet, Smart Phones, Simple Network Components, Networking Components like Switch, Router, Hub, NIC, PC/Laptop, Router, Connectivity

Network lab of BSNL

Recommended Software:

Text Books:

Material prepared by BSNL.

Reference Books:

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Evaluation criteria:

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ESDM Courses

Level Code:	L4	Vertical Name:	Office Automation, IT & Networking
Course ID:	NL/S/L4/C020	Course Name:	1.6.3 CHM-O Level

Objective of the Course:

<p>The Objective of CHM-O Level course is to train candidates to acquire basic knowledge in:</p> <ul style="list-style-type: none">• Computer Hardware and Peripherals• Installation, troubleshooting and Maintenance• System Software
--

- Networking
- Data Backup and Recovery

Learning Outcomes:

On completion of the course the participants will be able to:-

- Assemble and Repair PC
- Trouble shoot H/W and S/W Components of PC
- Installation of System Software and other tools
- Install and maintain Networks
- Perform backup and recovery operation
- Interacting with customer effectively

Expected Job Roles:

Hardware Engineer, Network Engineer

Duration of the Course (in hours)

400

Minimum Eligibility Criteria and pre-requisites, if any

12th Pass/ITI/Diploma, graduation or more

Professional Knowledge:

The individual on the job needs to know and understand:

- PK1. Knowledge of components of PC
- PK2. Protection equipment (anti-static wrist bands, shoes, dress, packaging, and other appropriate insulations) that are required to be used
- PK3. First aid requirements in case of electrical shocks, cuts and other common injuries
- PK4. Functionality and features/working of PC Components
- PK5. PC operating system and user interface
- PK6. Functionality of hardware components like SMPS, Motherboard, processor, screen, Keyboard, Mouse etc.
- PK7. Have basic knowledge of electronic components on PC motherboard

- PK8. Procedure to assemble and dismantle PC and PC Components
- PK9. Range of tools and testing equipment (multimeters, soldering iron etc.) available and their functionality
- PK10. Knowledge of PC OS and related software installation (Windows, Linux, antivirus, MS office etc)
- PK11. Knowledge of networking components and its installation-switch, Hub, router
- PK12. Knowledge of setting wired and wireless LAN
- PK13. Basic knowledge to be able to run diagnostic tools
- PK14. Functionality of hardware components, software applications etc.
- PK15. Knowledge of networking problem and their possible solutions
- PK16. Knowledge of PC related problem and Standard fault-finding (troubleshooting) techniques
- PK17. Standard software testing techniques
- PK18. Standard backup and recovery operations

Professional Skill:

The individual on the job needs to know and understand:

PC operating Skills

- PS1. Use and access the features and applications
- PS2. Data backup and restoration
- PS3. Installation of Operating system and other related software
- PS4. Installation of peripheral specific software like printer, scanner, web cam etc
- PS5. Use the software diagnostic tools

PC Component maintenance skills

- PS6. Assemble and dis-assemble PC components
- PS7. Interpret diagnostic test results to identify and localize faults
- PS8. Utilize appropriate mechanisms and tools to rectify the faults
- PS9. Utilize appropriate communication channels to escalate unresolved problems
- PS10. Undertake corrective repairs or replacing component
- PS11. Undertake checks to confirm that the problem is resolved

Networking Skill

- PS12. Able to use networking basic equipment- cutter, crimping tools, cable tester etc
- PS13. Preparing UTP straight and cross patch cable
- PS14. Configuring IP –address on PC for LAN
- PS15. Configuring switch and router for LAN & WAN
- PS16. Configuring Shared resources on network like printer, storage device etc

Software Skills

- PS17. Identifying software version and its installation
- PS18. Configuring Windows and Linux Server
- PS19. Diagnosing peripheral software related problem

Troubleshooting Skills

- PS20. How to approach a defect
- PS21. Make use of standard OEM specified troubleshooting steps
- PS22. Interpret intermediate results and progress fault rectification accordingly
- PS23. Utilize appropriate tools to rectify faults

Core Skill:

The individual on the job needs to know and understand how to:
<p>Reading skills</p> <p>CS1. Read and understand technical manuals, work orders and reports</p> <p>CS2. Read and understand organizational health and safety instructions</p> <p>Writing Skills</p> <p>CS3. Fill up record sheets clearly, concisely and accurately as per company procedures</p> <p>Communication Skills</p> <p>CS4. Clearly communicate relevant information to supervisors</p> <p>CS5. Respond appropriately to queries</p> <p>CS6. Communicate with customer to understand handset performance issues</p> <p>CS7. Communicate in the local language</p> <p>CS8. Convey proposed solution to the customers</p> <p>Time Management Skills</p> <p>CS9. Prioritize and execute tasks in a high-pressure environment</p> <p>CS10. Use and maintain resources efficiently and effectively</p> <p>Analytical Skills</p> <p>CS11. Analyse (and understand) customer complaints</p> <p>CS12. Interpret reports, readings and numerical data</p> <p>CS13. Keep up to date with new technology and performance issues</p> <p>Other Skills</p> <p>CS14. Create & maintain effective working relationships environment & collaboration</p> <p>CS15. Take initiatives and progressively assume increased responsibilities</p> <p>CS16. Share knowledge with other team members and colleagues</p> <p>CS17. Improve social responsibilities and environmental understanding.</p>

Detailed Syllabus of Course

Sl. No.	Modules	Min: No. of Hours
		Theory/Practical
1.	PC Hardware & Components	30/30
2.	PC Architecture	30/20
3.	Advanced networks and networking peripherals	40/40
4.	Operating System, Software & Tools	40/40
5.	Personality Development	34/16

6,	Devices and Applications	40/40
Total Theory / Lecture Hours:		214 hrs
Total Practical / Tutorial Hours:		186 hrs
Total Hours:		400 hrs

Recommended Hardware:

For a batch size of 50Nos

A. Instruments :

1. Dual Traced CRO, 20 MHz - 2 Nos.
2. Signal generator, 1 GHz - 2 Nos.
3. Digital multimeter - 10 Nos.
4. Cable Tester, RJ-45 to Rj-45 - 2 Nos.
5. Soldering station 6V/10W - 10 Nos.
6. Printer (Laser, Ink-jet, Dot-Matrix)- 01 No. each
7. Scanner (flatbed Or handheld OR MFD) - 01 No.
- 8 . Latest mid-range servers with DUAL Processors.
9. Anti-Static PAD

B. Hardware :

1. Computers - 25 Nos.
2. Various Types of motherboards - 10 Nos.
3. Various types of Processors, RAM compatible with motherboards,
4. Blu-ray disc, DVD, CDROM and floppy Drive - 2Nos. each,
5. Hard Disk Drive like IDE, SATA, SCSCI - 2 Nos. each.
6. Cabinet with SMPS- 10 Nos.
7. Add-on cards Graphics Cards, sound Card, ethernet Cards Etc.
8. Monitors like CRT, LCD, LCD backlit LED various sizes.
9. 16, 24 port switches, UTP CAT-6 cable, Rj-45 Connectors,
10. CISCO 2800 Series or compatible Router

11. wireless AP, Wireless Router and Wireless ethernet Card.

Recommended

Software:

1. Linux and other popular OS, Office productivity tools.
2. Network Operating system Advanced Windows Server 2008/2012, RedHat Enterprise, Linux 6. - 01 Each.
3. Latest Anti-virus software,
4. Software compatible for different types of Handsets/Gadgets

Text Books:

A number of books are available in market, which can be referred. Efforts are being made to publish a standard text book.

Reference Books:

- user/service manuals

ESDM Courses

Level Code:	L5	Vertical Name:	Office Automation, IT & Networking
Course ID:	NL/S/L5/C023	Course Name:	1.6.4 CHM-A Level

Objective of the Course:

The Objective of CHM-A Level course is to train candidates to acquire basic knowledge in:

- Computer Networks, Hardware and Peripherals
- Installation, troubleshooting and Maintenance of Networks
- Operating Systems in Network Environment, Software and data security
- Network administration
- Entrepreneurship, financial planning and first aid.

Learning Outcomes:

On completion of the course the participants will be able to:-

- Assemble and manage Computer Networks
- Trouble shoot H/W and S/W Components of Computer Networks
- Installation of System Software and other tools
- Install and maintain Networks
- Perform backup and recovery operation.
- Plan a business venture with financial viability.
- Interacting with customer effectively

Expected Job Roles:

Hardware Engineer, Network Administration, Network Supervisor, Entrepreneur

Duration of the Course (in hours)

470

Minimum Eligibility Criteria and pre-requisites, if any

12th Pass/ITI/Diploma, graduation or more with CHM-O level

Professional Knowledge:

The individual on the job needs to know and understand:

- PK19. Knowledge of components of Computer Networks
- PK20. First aid requirements in case of electrical shocks, cuts and other common injuries
- PK21. Functionality and features/working of Computer Networks Components
- PK22. Knowledge of networking components and its installation-switch, Hub, router
- PK23. Knowledge of setting wired and wireless LAN
- PK24. Computer Networks operating system and user interface
- PK25. Have basic knowledge of electronic components on Computer Network switches
- PK26. Procedure to assemble and dismantle Computer Networks and Computer Networks Components
- PK27. Knowledge of Computer Networks OS and related software installation (Windows, Linux, antivirus, etc)
- PK28. Basic knowledge to be able to run diagnostic tools
- PK29. Functionality of hardware components & software in network environment.
- PK30. Knowledge of networking problem and their possible solutions
- PK31. Knowledge of Computer Networks related problem and Standard fault-finding (troubleshooting) techniques
- PK32. Standard software testing techniques in different Network topologies
- PK33. Standard backup and recovery operations in Networking environment.

Professional Skill:

The individual on the job needs to know and understand:

Computer Networks operating Skills

- PS24. Use and access the features and applications
- PS25. Data backup and restoration
- PS26. Installation of Operating system and other related software
- PS27. Installation of peripheral specific software like network printer, scanner, web cam etc.
- PS28. Use the software diagnostic tools

Computer Networks Component maintenance skills

- PS29. Assemble and dis-assemble Computer Networks components
- PS30. Interpret diagnostic test results to identify and localize faults
- PS31. Utilize appropriate mechanisms and tools to rectify the faults
- PS32. Utilize appropriate communication channels to escalate unresolved problems
- PS33. Undertake corrective repairs or replacing component
- PS34. Undertake checks to confirm that the problem is resolved

Networking Skill

- PS35. Able to use networking basic equipment- cutter, crimping tools, cable tester etc
- PS36. Preparing UTP straight and cross patch cable
- PS37. Configuring IP –address on Computer Networks for LAN
- PS38. Configuring switch and router for LAN & WAN
- PS39. Configuring Shared resources on network like printer, storage device etc

Software Skills

- PS40. Identifying software version and its installation
- PS41. Configuring Windows and Linux Servers
- PS42. Diagnosing peripheral software related problem

Troubleshooting Skills

- PS43. How to approach a defect
- PS44. Make use of standard OEM specified troubleshooting steps
- PS45. Interpret intermediate results and progress fault rectification accordingly
- PS46. Utilize appropriate tools to rectify faults

Core Skill:

The individual on the job needs to know and understand how to:
<p>Reading skills</p> <p>CS18. Read and understand technical manuals, work orders and reports</p> <p>CS19. Read and understand organizational health and safety instructions</p> <p>Writing Skills</p> <p>CS20. Fill up record sheets clearly, concisely and accurately as per company procedures</p> <p>CS21. Prepare a project report based on the objectives, literature survey, methodology, results and conclusion.</p> <p>Communication Skills</p> <p>CS22. Communicate relevant information to superiors, subordinates and colleagues</p> <p>CS23. Respond appropriately to queries</p> <p>CS24. Communicate with customer/customer facing teams & convey proposed solution</p> <p>CS25. Communicate through technical documentation.</p> <p>Time Management Skills</p> <p>CS26. Plan, procure and execute a project in a given time frame</p> <p>CS27. Prioritize and execute tasks in a high-pressure environment</p> <p>CS28. Use and maintain resources efficiently and effectively</p> <p>Analytical Skills</p> <p>CS29. Analyse (and understand) customer complaints</p> <p>CS30. Analyse and provide solution to the co-workers and subordinates.</p> <p>CS31. Interpret reports, readings and numerical data</p> <p>CS32. Keep up to date with new technology and performance issues</p> <p>Other Skills</p> <p>CS33. Create and maintain effective leadership and team environment</p> <p>CS34. Take initiatives and progressively assume increased responsibilities</p> <p>CS35. Share knowledge with other team members and colleagues</p> <p>CS36. Improve social responsibilities and environmental understanding.</p>

Detailed Syllabus of Course

Sl. No.	Modules	Practical	Theory	Total No. of Hours
1.	Advance PC Hardware & Networking Components	25	35	60
2.	Data Communication and Computer Networks	35	40	75
3.	Network Management and Administration	40	40	80
4.	Linux Administration	35	45	80
5.	Entrepreneurship Development	10	35	45
6.	Project	60	0	60

7,	(Elective) IT Security/ Networking with Advanced components	30	40	70
Total Practical / Tutorial Hours:		235		
Total Theory / Lecture Hours:			235	
Total Hours:				470

Recommended Hardware:

For a batch size of 50Nos

A. Instruments :

1. Dual Traced CRO, 20 MHz - 2 Nos.
2. Signal generator, 1 GHz - 2 Nos.
3. Digital multimeter - 10 Nos.
4. Cable Tester, RJ-45 to Rj-45 - 2 Nos.
5. Soldering station 6V/10W - 10 Nos.
6. Printer (Laser, Ink-jet, Dot-Matrix)- 01 No. each
7. Scanner (flatbed Or handheld OR MFD) - 01 No.
- 8 . Latest mid-range servers with DUAL Processors.
9. Anti-Static PAD

B. Hardware :

1. Computers - 25 Nos.
2. Various Types of motherboards - 10 Nos.
3. Various types of Processors, RAM compatible with motherboards,
4. Blu-ray disc, DVD, CDROM and floppy Drive - 2Nos. each,
5. Hard Disk Drive like IDE, SATA, SCSI - 2 Nos. each.
6. Cabinet with SMPS- 10 Nos.
7. Add-on cards Graphics Cards, sound Card, ethernet Cards Etc.
8. Monitors like CRT, LCD, LCD backlit LED various sizes.
9. 16, 24 port switches, UTP CAT-6 cable, Rj-45 Connectors,

10. CISCO 2800 Series or compatible Router
11. wireless AP, Wireless Router and Wireless ethernet Card.

Recommended Software:

1. Linux and other popular OS, Office productivity tools.
2. Network Operating system Advanced Windows Server 2008/2012, RedHat Enterprise, Linux 6. - 01 Each.
3. Latest Anti-virus software,
4. Software compatible for different types of Handsets/Gadgets

Text Books:

A number of books are available in market, which can be referred. Efforts are being made to publish a standard text book.

Reference Books:

- user/service manuals

1.7 Telecom Segment

ESDM Courses

Level Code:

L2

Vertical Name:

Telecom Segment

Course Code:

NL/S/L2/C011

Course Name:

1.7.1 Installation/Repair & Maintenance of EPABX System

Objective of the Course:

TO DEVELOP SKILLED PEOPLE IN THE FIELD OF INSTALLATION & MAINTENANCE OF EPABX SYSTEM

Learning Outcomes:

AT THE END OF PROGRAM TRAINEE WILL BE ABLE TO INSTALL AN EPABX SYSTEM .HE WILL BE ABLE TO REPAIR IT AND CAN WORK IN THE FIELD OF MAINTENANCE OF EPABX SYSTEM. HE CAN OPEN A SERVICE CENTRE.

Expected Job Roles:

The job potentials are as follows:

- Job as technician/operator in different telephone exchanges in Government/Private sector
- Job in telephone industries like BSNL, MTNL and others
- Job & Repairing Centre
- Self Employment

Duration of the Course (in hours)

200 Hrs.

Minimum Eligibility Criteria and pre-requisites, if any

9th Pass

Professional Knowledge:

The Learners must have the following professional knowledge as follows:

- Typical Telephone network
- Introduction to EPABX system
- Basic of Digital and data communication system
- Knowledge of Push button telephone system

Professional Skill:

The Learner will comprises the professional skills as :

- Installation and maintenance of EPABX system
- Principles of Space division switches and knowledge of digital exchange and its working

Core Skill:

- Basic Communication
- Analog and digital modulation technic
- Coding
- Data Transmission
- Modems

Detailed Syllabus of Course

Module. No	Module. Name	Minimum No. of Hours	
		Theory (Hrs.)	Practical (Hrs.)
1.	Basic Communication System	05	05
2.	Digital Modulation Technique	10	10
3.	Modems	05	10
4.	Push button Telephones	20	20
5.	Electronic Exchange	10	30
6.	EPABX systems	10	30
7.	Digital Exchange	10	25
Total Theory / Lecture Hours:		70	
Total Practical / Tutorial Hours:			130
Total Hours:		200	

MODULE 1 Basic Communication System (05 Periods)

Basic block diagram of digital and data communication systems. Their comparison with analog communication systems. Basic information theory.

MODULE 2 Digital Modulation Technique

- Basic block diagram and principle of working of the following:
- Amplitude shift keying (ASK): Interrupted continuous wave (ICW), two tone modulation
- Frequency Shift keying (FSK)
- Phase shift keying (PSK),
- Quadrature Amplitude modulation (QAM)

MODULE 3 Modems

Need and function of modems, Mode of modems operation (low speed, medium speed and high speed modems). Modem interconnection, Modem data transmission speed, Modem modulation method, Modem interfacing (RS 232 Interface, other interfaces).

MODULE 4 Push button Telephones

BASIC BLOCK DIAGRAM OF A TELEPHONE
FUNCTION OF EACH BLOCK
VARIOUS TONES USED IN THE PHONE CIRCUITS
USE OF MICROPHONE AND SPEAKER
PULSE DIALING AND TONE DIALING AND THEIR APPLICATIONS
FUNCTION OF DIALER CIRCUIT, SPEECH CIRCUIT, RINGER CIRCUIT, PROTECTION CIRCUIT,
FUNCTION & WORKING OF KEY PAD USED IN PUSHBUTTON TELEPHONE
TESTING METHODS OF PUSHBUTTON TELEPHONE FOR PROPER FUNCTIONS
USE OF VARIOUS ADAPTORS, CONNECTORS AND SOCKETS USED IN THE TELEPHONE CIRCUITS
FAMILIARISATION TO KEY TELEPHONE SYSTEM
Trouble shooting and corrective maintenance

MODULE 5 Electronic Exchange

- Typical telephone network. Various switching offices (Regional Centre, District Centre, Toll Centre, Local Office) and their hierarchy.
- Principles of space division switches. Basic block diagram of a electronic exchange and it's working.
- Basic idea of FAX system and its applications. Basic Principle of operation and block diagram of modern FAX system. Important features of modern FAX machines.
Trouble shooting and corrective maintenance

MODULE 6 EPABX systems

BASIC BLOCK DIAGRAM OF EPABX SYSTEM
 DIFFERENT TYPES OF EPABX SYSTEM
 METHODS TO CONNECT THE TRUNK LINE AND EXTENSION LINE IN A EPABX
 DIFFERENT FACILITIES AVAILABLE IN EPABX SYSTEM EG CALL WAITING, CALL TRANSFER,
 CONFERENCE FACILITY
 WIRING CIRCUITS AND UNDERSTAND THE WIRING OF EXTENSION CIRCUITS
 Trouble shooting and corrective maintenance

MODULE 7 Digital Exchange

Working Principle and operation of digital exchange, Trouble shooting and corrective maintenance

Detail of Practical Work

- 1 FAMILIARISATION OF TOOLS & INSTRUMENTS USED FOR WIRING AND TESTING OF EPABX SYSTEM
- 2 IDENTIFY & TEST THE COMPONENTS USED IN THE PUSHBUTTON TELEPHONE
- 3 IDENTIFY THE VARIOUS TONE SIGNALS USED IN THE PHONES
- 4 TESTING OF MICROPHONE AND SPEAKER
- 5 TESTING & REPLACING COMPONENTS IN THE PROTECTION CIRCUIT AND RINGER CIRCUIT
- 6 TESTING OF KEY PAD FOR PROPER FUNCTION AND REPAIR THE KEY PAD PROBLEMS
- 7 IDENTIFY THE FAULTY COMPONENT AND REPLACE IN THE DIALER CIRCUIT AND SPEECH CIRCUIT
- 8 TEST AND IDENTIFY THE FAULT IN A PUSHBUTTON TELEPHONE
- 9 IDENTIFY AND FIX THE VARIOUS ADAPTORS, CONNECTORS AND SOCKETS
- 10 IDENTIFY THE TERMINALS OF TRUNK LINE AND EXTENSION LINE AND CONNECT THE EXTENSIONS
- 11 SETTING THE CALL TRANSFER, CALL WAIT AND OTHER FACILITIES AVAILABLE ON EPABX
12. TRACE THE WIRING AND LOCATE THE FAULT IN THE EXTENSION WIRING CIRCUIT
13. TROUBLE SHOOTING AND MAINTENANCE PRACTICES OF EPABX, ELECTRONICS AND DIGITAL EXCHANGE

Recommended Hardware:

1. EPABX OF 2 TO 6 LINE - 1 NO
2. EPABX OF 2 TO 10 LINE - 1 NO
3. PUSHBUTTON TELEPHONES - 10 NOS
4. TELEPHONE ANALYZER - 1 NO.
5. CRIMPING TOOL - 1 NO.
6. MULTIMETER – 1 NO

Recommended Software:

NIL

Text Books:

2. Electronic Communication Systems By George Kennedy Tata McGraw Hill Education Pvt Ltd, New Delhi
3. Communication system By A.K. Gautam S.K. Kataria Sons, Delhi
4. Electronics communication by K.S. Jamwal, Dhanpat Rai and Sons, Delhi

Reference Books:

1. Manual of EPABX/ Digital Exchange

1.8 Computer Hardware

ESDM Courses

Level Code: Vertical Name:

Course ID: Course Name:

Objective of the Course:

To train students in the area of Assembling of Computer, Troubleshooting, Installation of Software and Peripherals.

Learning Outcomes:

After completing the course the person should be able to

- Assembled & Dissembled the computers installing the peripherals devices
- Repair of Computer up to Card label
- Install different software of computers
- Data recovery
- Maintenance & formatting the computers
- Password breaking
- Protect the computer from virus

Expected Job Roles:

Act as Computer Hardware Technician
Starting his own Computer Assembling and Maintenance Shop

Duration of the Course (in hours)

Minimum Eligibility Criteria and pre-requisites, if any

Professional Knowledge:

- Basic parts of Computer system
- Studies of Different types of Mother Board
- Power Supply
- Different types of Cards
- Different types of Monitors
- Different types of Printers and Scanners and their installation procedures

Professional Skill:

- Identification of Desktop Motherboard IC's and tracing of North Bridge Section
- Identification of Desktop Motherboard IC's and tracing of RAM/ROM/Clock Section
- Identification of Desktop Motherboard IC's and tracing of PS/2/Audio Section
- Practical on Diagnostics Card Error Code
- Fault finding of Desktop Computer Motherboard
- Card level Test along with error code
 - Mother Board Practical Test
 - Diagnostics Card Level Test
 - Fault Tracing through CRO Test
 - Different Drivers Loading Test
 - Soldering and De-soldering Test
 - BGA Chip Replacement and Reboling Test

Core Skill:

- Fault Diagnostic Skill
- Soldering and De-soldering Skill
- Motherboard Repair Skill
- Operation of BGA Machine Skill
- Software Installation Skill
- BIOS Programming Skill
- Partition making without Formatting Skill
- How to make Multi boot Pen Drive Skill
- How to Recover window by Command Prompt Skill

Detailed Syllabus of Course

Module. No	Module. Name with detailed syllabus	Minimum No. of Hours (Theory/Practical)
➤ Module-I	Introduction to Computer, Uses of Computer, Different between Hardware & Software, Different types of computers inside PC and its peripherals devices, Booting concept of computer in DOS and Windows environment, Different input and output devices/ cables, connectors identifications, Identifications of different types of motherboard, controller cards, display cards, sound card AGP cards FAX/Modem Cards, TV Tuner Cards, LAN Cards, Ethernet cards, Different types of RAM used in PC's.	40 Hrs
➤ Module-II	BIOS setting, Formatting of Hard Disk, Installation of Operating System i.e. DOS/Windows, Off-line drive installation / online drive installation / Driver backup / restore / partition formatting / Windows file repairing / BIOS password break / Administrative password break / Data recovery / Pen Driver bootable / Sound Problem / USB Problem / LAN problem etc.	30 Hrs
➤ Module-III	Application Software Installation/ Different types of Application Software/ Antivirus Software Installation/ different types of Antivirus Software/ Protect PC from Virus / Hard Disk utility Software / Dual Booting Installation etc	40 Hrs

➤ Module-IV	System integration of different types of computers, such as PC,PC-XT, PC –AT etc. upto Pentium-4 label, Trouble shooting of shooting of different types of faults, Different computer cards identifications and trouble shooting, Power supplies installation and trouble shooting, Different types of SMPS identifications, Hard Disk driver installation and configuration setting, Use of CD ROM and DVD Drivers, Using of FDD drives, Different types of keyboards, repairing and maintenance, different types of monitors, Monitors Repairing / Maintenance / Mouse repairing and Installation	50 Hrs
➤ Module-V	Different types of printers, working of printers, working / repairing of DMP printers, working / repairing of inkjet printer, working / repairing of LaserJet printer, Checking of printer interface cable and dip switch setting, self test and loading of printer drives, introduction to UPS, different types of UPS maintenance and servicing of UPS, battery replacement of UPS	30 Hrs
➤ Module-VI ➤	Assembly and dismantling of PCs front panel connection, preventing maintenance and Cleaning, servicing of computer, Type of Backup, Taking Backup files and fine tuning the system, running diagnostics tool, running of virus protection programme, FAQ and feedback.	50 Hrs
Total Theory / Lecture Hours:		
Total Practical / Tutorial Hours:		
Total Hours:		

Recommended Hardware(minimum batch size 10):

<p>Different types of Mother Board</p> <ul style="list-style-type: none"> • Desktop <p>Different types of Cards</p> <ul style="list-style-type: none"> • VGA • AGP • NIC • Audio <p>Different types of Tools and instrument</p> <ul style="list-style-type: none"> • BGA Machine • Soldering and Disordering Station • Oscilloscope 25-100 Mhz • Multi-meter • Digital IC Tester • Analog IC Tester • Function Generator • Power Supply 0-30 V • Small screw Driver kit • Different types of small Plair set

- De-soldering pump
- Soldering wire
- Twizer,
- Bond make liquid flux 0% some respective components etc.

Recommended Software:

Operating System
Diagnostic Card for Desktop and Laptop

Text Books:

Modern Computer Hardware Course
Computer Hardware Course

Reference Books:

Inside Module 13 Motherboard 14 GT Publishers Author S K Gupta
Tablet PC Servicing Manual GT Publishers Author S K Gupta
Circuit Diagram Books of different types of Mother Boards

1.9 Embedded systems & VLSI computer

ESDM Courses

Level Code:

L5

Vertical Name:

Embedded systems & VLSI

Course ID:

NL/M/L5/C017

Course Name:

1.9.1 Post Diploma in VLSI Design, Tools and Technology

Objective of the Course:

To develop skill of handling VLSI Tools for Designing mixed signal circuits, its verifications and to develop concept of VLSI Fabrication Technology, handling of EDA-VLSI Hardware-Software Tools, Custom-Semi Custom Design, FPGA Implementation etc.

Learning Outcomes:

Participants successfully completing this course will:

- Have the ability to design and specify Analog-Digital systems using the System Verilog and SPICE at the structural/RTL/MOS level.
- Have the ability to design and specify analog-digital systems using the CMOS
- Have the ability of Design Verification
- Have ability to design & simulate digital systems described with CMOS-VLSI Design Technology.
- Have the ability to design digital systems using Verilog and Xilinx FPGA.

Expected Job Roles:

To full-fill the need of Industry for skilled and trained manpower to design and verify Analog, Digital & Mixed VLSI Integrated circuits, as a policy of "Ready to Observe Man Power" for VLSI Manufacturing Industry.

Duration of the Course (in hours)

400 Hours (6 Months)

Minimum Eligibility Criteria and pre-requisites, if any

Diploma Holder or BSc. Graduate

Professional Knowledge:

An individual on the job needs to know and understand:

- Company's products product and its production
- To be able to understand designed functional Analog and digital system
- To perform synthesis, place, and route of a Mixed signal design into a target FPGA.
- To display knowledge of good digital design practices in the context of the target hardware.
- To learn advanced VLSI design using EDA Tools
- To introduce a bottom-up and top-down design approaches
- Relevant reference sheets, manuals and documents regarding e-waste

- Relevant tools, hardware's and peripherals required for recycling of e-waste
- Knowledge of Govt. rules and regulations regarding e-waste

Professional Skill:

An individual should have following Professional Skill

- Handling of EDA tools Hardware and Software for development of VLSI Circuitry.
- Handling of prototype and pre-production VLSI product for various electronic system and liaise with supplier for production implementations.
- Able to specify components and equipment required for product development.
- Creation of product specifications, Statement of Work, from customer requirements.
- Support for sales and technical staff.
- Support to areas such as post-design, production & QA.
- Quality standards required for designing good product.

Core Skill:

An individual on the job should have following Core Skill

- Providing support for VLSI Design Group
- Able to give support and advice whenever necessary to all stakeholders involved.
- Over the whole product life cycle, Ensure that the products meet the quality standards

Detailed Syllabus of Course

Module. No	Module. Name	Minimum No. of Hours
1	<p>INTRODUCTION</p> <p>VLSI Design Flow and Y-Chart, Front-Back End VLSI Design Example, Fully Custom and Semi-Custom VLSI Design Process, VLSI-EDA Hardware-Software tools available, comparisons and their applications, VLSI-EDA Hardware-Software tools used in Industries, Why Verilog, Its Types-Verilog, Verilog-A and System Verilog and Simple Logic Gates Coding, Compilation and Execution in System Verilog, High level Synthesis, RTL Design, Logic Optimization, Verification and Test Planning</p>	25
2	<p>Programmable Logic Devices (PLDs)</p> <p>Introduction, PLDs Types-Simple PLDs (SPLDs), Complex PLDs (CPLDs) and Field Programmable Gate Array (FPGA), their Architecture Details and Comparison w.r.t. Logic Blocks (CLBs), Logic Cells, System Gates, I/O Pins, Flip-Flops, Max Internal Frequency, Supply Voltage, Interconnects, Technology Used, SRAM Bits (Block RAM) etc.</p>	35
3	<p>System Verilog Code Structure and FPGA Implementation</p> <p>Module Declaration, Lexical Conventions, Data Types, Analog Block Statements, Mathematical Functions and Operators, Analog Operators, Filters and Events, System Verilog Pre-processor, Verilog-FPGA Interfacing and Simulation Techniques, System Task and Input Output Functions, Simple Analog and Mixed System Design Practices.</p>	100
4	<p>VLSI Technology</p> <p>Basic MOS Transistor Operations and Electrical Properties, Fabrication Process, Passive Component Fabrication Process, Gyration Circuit Fabrication for Inductor, Development in Technology and Equipment's for Oxidation, Diffusion, ION Implantation, Etching, Photo-Lithography etc. Moore's Law and Nano-Meter VLSI Technology Comparison,</p>	40
5	<p>VLSI Design- Part 1</p> <p>VLSI Design Style, Why CMOS, CMOS Fabrication and Electrical Properties, Dynamic, Clocked, Domino CMOS Logic VLSI Design Style, Pass Transistor Logic, Development in CMOS Design Style, Simple CMOS VLSI Design Examples, Comparison with respect to Speed, Area, Power Dissipation and Cost .</p>	40
6	<p>SPICE Modelling for VLSI Design-Part 2</p> <p>SPICE Tutorials and Commands, Sources and Passive Components, CMOS Inverter Transient Analysis, Level-1, Level-2 and Level-3 Models, BSIM Models, Diffusion Capacitance Models, SPICE Modelling for I-V Characteristics, Threshold Voltage, Gate Capacitance, Parasitic Capacitance, Effective Resistance, path Simulation, DC Transfer Characteristics, Logical efforts, Power and Energy Calculation, Monte Carlo Simulation, Simple Design Examples.</p>	100
7	<p>File Interchange Format for VLSI Design</p> <p>Need for File Inter Change, GDS2 Stream, Caltech Intermediate Format (CIF), Library Exchange Format (LEF), Design Exchange Format (DEF), Standard Delay Format (SDF), DSPF</p>	30

	and SPEF, Advance Library Format (ALE), Waves Waveform and Vector Exchange Specification, Physical Design Exchange Format, Open Access	
8	Design Verification Functional and Test Bench Verification using System, Verification Methodology-OVM, UVM, AVM and ABV Verilog, Coverage Driven Verification, RTL Design Verification of Industry Standard Interface IP and Protocols, Layout Vs Schematic Comparison.	30
Total Vocational/Practical / Tutorial / Lecture Hours		400hrs

Recommended Hardware:

- Xilinx Vertex Series FPGA Board 10 No's for a group of 20 Students
- 10 no's High End PCs

Recommended Software:

- Model Sim 6.6PE or advance Version. 10 User License
- Xilinx ISE Software. 25 User License
- Synopsis/Cadence/Tanner EDA Design ISE Software supporting FINFET at 45 nm Node Technology. 10 User License

Text Books:

1. "Verilog HDL: Digital Design and Modelling", Joseph Cavanagh, Publisher: CRC Press, Taylor and Francis Group
2. " Digital VLSI Design with Verilog-A text book from Silicon Polytechnic", John Michael Williams, Publisher: Springer
3. "Verilog HDL: A Guide to Digital Design and Synthesis", Samir Palnitkar, Publisher: Prentice Hall Professional
4. "Design through Verilog HDL", T. R. Padmanabhan, B. Bala, Tripura Sundari, Publisher: Willey India (P) Ltd.
5. CMOS VLSI DESIGN-A Circuit and Systems Perspective, Neil H. E. Weste, David Harris and Ayan Banerjee 3rd Edition, Pearson Education.
6. CMOS ANALOG CIRCUIT DESIGN, Philip E. Allen and Douglas R. Holberg International 2nd Edition 3rd Edition, Pearson Education.
7. "VLSI Technology" Wai-Kai Chen, Editor-in-Chief, CRC-Press, 2003

Reference Books:

1. **System Verilog for Design Second Edition: A Guide to Using System Verilog for Hardware Design and Modeling Paperback** –October 12, 2010 by [Stuart Sutherland](#) (Author), [Simon Davidmann](#) (Author), [Peter Flake](#) (Author), [P. Moorby](#) (Foreword)
2. **SystemVerilog For Verification: A Guide to Learning the Testbench Language Features** by Chris Spear
3. NPTEL Online Course Material
4. http://svovm.weebly.com/uploads/1/3/8/3/13830308/ovm_cookbook.pdf
UVM cookbook (Online reference)
5. Online Methodology Documentation from the Mentor Graphics Verification Methodology Team

6. <http://www.scribd.com/doc/193965916/Uvm-Cookbook-Complete-Verification-Academy>

ESDM Courses

Level Code: L5 **Vertical Name:** Embedded Systems & VLSI

Course ID: NL/M/L5/C016 **Course Name:** 1.9.2 Embedded system Design using 8-bit Microcontrollers

Objective of the Course:

To train students on programming of microcontroller, Interfacing of external peripherals to microcontroller and troubleshooting of microcontroller based Embedded electronic systems/products.

Learning Outcomes :

Participant shall learn

- Architecture of 8051 Microcontroller
- Programming of 8051 microcontroller
- Peripheral interfacing to 8051 microcontroller
- Trouble shooting 8051 microcontroller based systems
- Architecture of PIC Microcontroller
- Programming of PIC microcontroller
- Peripheral interfacing to PIC microcontroller
- Trouble shooting PIC microcontroller based systems

Expected Job Roles:

1. Microcontroller Technician - Trouble shooting of Microcontroller based electronic systems/products
2. Entrepreneur - Development of small electronic gadgets based on Microcontroller

Duration of the Course (in hours) 400 hrs

Minimum Eligibility Criteria and pre-requisites, if any Diploma or above Manufacturing

Professional Knowledge:

The participant shall know and understand

- Development of embedded systems with 8051 and PIC Microcontrollers
- Electronic System Design with 8051 Microcontrollers
- Electronic System Design with PIC Microcontrollers
- Embedded Coding with 8051 Microcontrollers
- Embedded Coding with PIC Microcontrollers

Professional Skill:

Reading and writing skills

- How to read and comprehend the data sheet of various 8051 and PIC based Microcontrollers
- To document the completed work
- To read the standard operating procedures for different types of Microcontroller based Electronic systems

Tool Usage

- To work with Embedded Systems Tools such as compiler, assembler, linker and debugger

Core Skill:

- Trouble shooting of Microcontroller based electronic systems/products
- Development of small electronic gadgets based on Microcontroller

Detailed Syllabus of Course

Module No	Module Name	No. of Hours
		Theory / Practical
1.	Embedded C with 8051 - Theory <ul style="list-style-type: none">• Introduction to 'C' programming• Embedded C Programming with KEIL	15 /25
2.	8051 Architecture - Theory <ul style="list-style-type: none">• Architecture of 8051 Family of Microcontrollers	10/0
3.	8051 Peripherals - Theory <ul style="list-style-type: none">• Timers• Interrupts• Serial Port	15/60
4.	Interfacing 8051 to peripheral devices –Theory <ul style="list-style-type: none">• LCD• Key board• Stepper Motor	15/60

5.	Embedded C with PIC – Theory <ul style="list-style-type: none"> • Embedded C Programming with MPLab 	15/25
6.	PIC Architecture – Theory <ul style="list-style-type: none"> • Architecture of PIC Microcontrollers 	10/0
7.	PIC Peripherals - Theory <ul style="list-style-type: none"> • Timers • Interrupts • ADC • Serial Port 	15/60
8.	Interfacing PIC to peripheral devices –Theory <ul style="list-style-type: none"> • LCD • Key board • Stepper Motor 	15/60
Theory / Lecture Hours:		110 hrs
Practical / Tutorial Hours:		290 hrs
Total Hours:		400 hrs

Recommended Hardware:

1. 8051 Microcontroller kits
2. PIC Development kit
3. PC
4. Interfacing boards
5. Electronic Components for Mini project as per requirement

Recommended Software:

1. Kiel 'C' or similar Embedded C Compiler for 8051
2. MP Lab with PIC –C Compiler/any other appropriate compiler

Text Books:

1. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems using Assembly and C", 2nd Edition, Prentice Hall
2. Design with PIC Microcontrollers, Peatman, John B , Pearson Education PTE. Ltd.

1. Programming and Customizing The 8051 Microcontroller, Predko, Myke, Tata

Reference Books:

- Mgh, New Delhi
2. Programming and Customizing the PIC Microcontroller, Predko, Myke, Tata Mgh, New Delhi

1.10 Solar Electronics

ESDM Courses

Level Code: **Vertical Name:**

Course Code: **Course Name:**

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and Manufacturing)

Objective of the Course:

The objective of this module is to provide the knowledge of basic characteristics of light sources. Basic parameters related with measurement of lights intensity, designing and assembling of LED based luminaries, etc. It familiarizes the participants with the basic terminology and various parts of Solar Panel, would cover manual assembly of LED light products. In addition, the participants would be familiarized with solar powered LED products.

Learning Outcomes:

- Participant will be able to
- Design & develop LED based Product
 - Solar panel installation
 - Solar powered LED products

Expected Job Roles:

Acquire the foundation level knowledge required to use LEDs as light source, Design of low cost LED products for common use like Lanterns, table lamps, etc. Assembly of LED based luminaries, Use of Solar panel for energy applications, Installation of Solar Panel, Assemble and Maintenance of Solar Panel

**Duration of the Course
(in hours)**

350 hrs

**Minimum Eligibility
Criteria and pre-
requisites, if any**

10 th + ITI, 12 th pass .

Professional Knowledge:

Pass out would be able to understand :

- PK 1.** The operation and significance of various electronic, electrical and mechanical components of LED luminary,
- PK 2.** Product design basics and significance of optics,
- PK 3.** To handle LED's and PCB's, IP rating , ESD precautions,
- PK 4.** Assembly of SPV chargeable Light sources as Marketable products,
- PK 5.** Testing of SPV – Voltage & Current measurement at various intensities.
- PK 6.** Testing and calculating peak power output of SPV and comparing with specified ratings,
- PK 7.** Calculation and practical measurement of power output from SPV for various exposed area of SPV,
- PK 8.** Install and maintain solar panels of different ratings

Professional Skill:

The individual on the job needs to know and understand:

- PS 1.** How to operate machine/meters like drilling machine, multi-meter, soldering iron, cathode ray oscilloscope, LUX meter , PCB design software etc.,
- PS 2.** The skill to interact with customer to understand the problem faced in case of service and to analyze and identify the fault relating to solar powered LED products.

Core Skill:

Pass out would be able to read warnings, instructions and other text material on product labels, components etc. and interact with customers and colleagues

Detailed Syllabus of Course

Module. No	Module. Name	Minimum No. of Hours Theory/Practical
1	Introduction of light sources and their characteristics <ul style="list-style-type: none"> • Light sources, characteristics of light sources, introduction to light units- candela, lux & nits 	15/15
2	Comparative study of LED and other light sources <ul style="list-style-type: none"> • Introduction of LEDs, principles of operation, Efficiency, lifetime and quality of LEDs, type of LEDs. • Electrical and Optical behaviour of LEDs with Temperature: Parallel circuit of LEDs, white light production from LEDs. • Calculation of current in the use of LEDs : Basic ideas for reliability • General principles of working of LED flash light, USB light, automobile taillight and replacement of Bulb and CFL by LED lights. • Ideas on quality of light, human visual function: receptors, retina, brain, warm white and daylight white colour spectrum and their effect on human being. 	15/15
3	Basic Principle , Design and Assembly of LED based products <ul style="list-style-type: none"> • General principles of working of LED luminaries. Design of constant current drive circuits. • Assembly and testing procedures for LED based products. • Significance of optics, riveting process, insulation tape and heat shrinkable tube, PCB cleaning, potting material and use of potting machine, press for making mechanical frame parts, tools required in process control like weighing machine, torque measurement meter, temperature meter & calibrator, magnifying glass, etc. • IP rating and CREE standards, 5S standards (sorting, setting, standardise, sustain, shining) • ESD and work safety precautions. • Handling and disposal of hazardous material. 	20/30
4	Introduction of Renewable Energy & Study of Characteristics of SPV Cells <ul style="list-style-type: none"> • Introduction to Solar Energy as Renewable source, Historical perspective of using Solar energy, Concept of Solar Photovoltaic Cells (SPV), Basic Principle & Working of SPV's. • Rating & Specifications of SPV, Peak Voltage and Voltage/ Current on load, Types of Solar Photovoltaic Cells (SPV), Area of SPV & Energy, SPV efficiency. • Charging of Battery & Operating life of SPV, Storage battery size & Autonomy of SPV system 	30/30
5	Installation and maintenance of solar panel <ul style="list-style-type: none"> • Tools involved in installation of system, occupational health and safety standards and waste management procedures, precautions to be taken while installation, voltage requirement of various 	20/30

	<p>equipment, site surveying methods and evaluation parameters,</p> <ul style="list-style-type: none"> • Sunlight and direction assessment, panel mounting and inclination and angle of tilt, assembly of solar panel mounting, placement of solar panel mounting, installation of solar plates on holding clamp, • wiring multiple PV modules, wiring of solar panel to inverter, Maintenance of solar panels. 	
6	<p>Project Work- PCB designing</p> <ul style="list-style-type: none"> • Introduction to PCB Designing and future scope <ul style="list-style-type: none"> ○ Different techniques to implement circuit ○ Advantages of PCB based products ○ Advantages of designing with CAD softwares • Designing circuits in schematic <ul style="list-style-type: none"> ○ To capture the circuit to make a PCB ○ Different techniques of modelling of design ○ Top down and Bottom up methodology for design ○ Creating Netlist of design and producing files for layout • Designing layout of circuits and generating output <ul style="list-style-type: none"> ○ Creating a layout of board using layout tool ○ Auto-routing and manual routing of a board ○ Making footprints of different components ○ Post processing and generating gerber files 	50/60
7	Project Work- Led luminaries design	0/20
Total Theory / Lecture Hours:		150
Total Practical / Tutorial Hours:		200
Total Hours:		350

Recommended Hardware:

Multimeter, Desktop PC, Oscilloscope, Soldering and De-soldering station, Electronic Work Bench, PCB designing and fabrication lab, basic circuit trainer boards, power circuit board trainers, linear and switching circuit board trainer, power meter

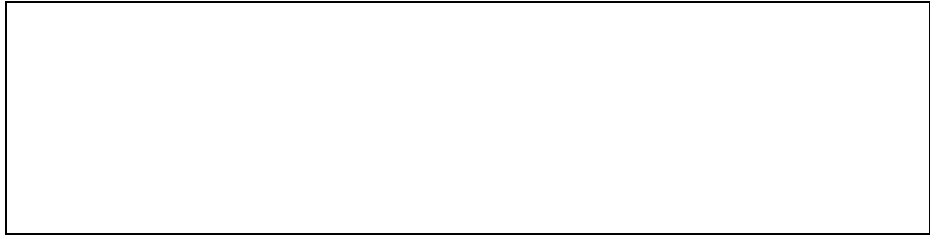
Recommended Software:

Circuit simulation Software, PCB design software

Text Books:

Course material by NIELIT, Chandigarh

Reference Books:

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