1. **National Institute of Electronics and Information Technology**

1.1 Consumer Electronics

**ESDM Courses**

<table>
<thead>
<tr>
<th>Level Code:</th>
<th>Vertical Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>L4</td>
<td>3.1 Consumer Electronics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course ID:</th>
<th>Course Name:</th>
</tr>
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<tbody>
<tr>
<td>NL/S/L4/C007</td>
<td>1.1.1 Diploma in Installation &amp; Repair of Consumer Electronics Products</td>
</tr>
</tbody>
</table>

**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 competition 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)**

350 Hours

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

ITI or 12th pass
### 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
- **PK6.** Functionality of hardware components of Consumer Electronics Products
- **PK7.** Procedure to dismantle and assemble Consumer Electronics Products
- **PK8.** Range of tools and testing equipment (multi meters, frequency generators etc) available and their functionality
- **PK9.** ESD hazards and their effect on electronic components
- **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:

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

### 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 Consumer Electronics Product 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

### Time Management Skills
CS6. Prioritize and execute tasks in a high-pressure environment
CS7. Use and maintain resources efficiently and effectively

### Analytical Skills
CS8. Analyse (and understand) Manufacturing Process based on Company need
CS9. Interpret reports, readings and numerical data
CS10. Keep up to date with new technology and performance issues

### Other Skills
CS11. Create and maintain effective working relationships and team environment through collaboration
CS12. Take initiatives and progressively assume increased responsibilities
CS13. Share knowledge with other team members and colleagues

### Detailed Syllabus of Course

<table>
<thead>
<tr>
<th>Module No</th>
<th>Modules</th>
<th>Minimum No. of Hours (Theory/Practical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Cable TV and DTH Services: Basic Principle, Working and Operation of Cable TV and DTH Services, Installation and Checking, Repair Maintenance, Serving and Practice, Fault Diagnosis and Error Remover Techniques and Practices</td>
<td>25/70</td>
</tr>
<tr>
<td>5.</td>
<td>Induction Stove and Microwave Oven: Basic Principle, Working and Operation of Induction Stove and Microwave Oven, Installation, Repair, Maintenance, Serving and Practice, Fault Diagnosis and Error Remover Techniques and Practices</td>
<td>15/25</td>
</tr>
</tbody>
</table>

**Total Theory / Lecture Hours:** 100  
**Total Practical / Tutorial Hours:** 250  
**Total Hours:** 350

### Recommended Hardware:

- For a Batch of 50 No’s
  - 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
- will be purchased and dismantle by Trainer for individual Practice: 10 No’s each.
- Complete Electronics-Electrical Tool Kit: 10 No’s Each

<table>
<thead>
<tr>
<th>Recommended Software:</th>
<th>As prescribed and provided by Consumer Electronics Product Manufacturer. No need to purchase externally and can be downloaded from respective manufacturer web sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text Books:</td>
<td>BPB Publication Books on Installation Repair, Maintenance and Servicing of Consumer Electronic Products in Hindi</td>
</tr>
<tr>
<td>Reference Books:</td>
<td>User Manual as provided by Consumer Electronics Product Manufacturer.</td>
</tr>
</tbody>
</table>
**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 workplace 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**

<table>
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<th>(in hours)</th>
<th>350 Hours</th>
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**Course Code:** NL/S/L4/C021  
**Course Name:** 1.1.2 Installation, Repair and Maintenance of Home Appliances  
**Level Code:** L4  
**Vertical Name:** Consumer Electronics (Home Appliances)
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
PK7. Installation/Handling instruction of these devices.
PK9. Component testing methods
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.
PS2. Understand use of Electronics Component such as Diodes, Transistors, ICs etc.
PS3. Soldering skills
PS4. Operation of Equipment required for Soldering
PS5. Use of Desoldering Pump
PS6. Basic functionality and Installation
PS7. Fault identification, Repair and Maintenance
PS8. Troubleshooting Skills
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
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

**Communication 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

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**Detailed Syllabus of Course**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Modules</th>
<th>Min: No. of Hours</th>
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<tbody>
<tr>
<td></td>
<td><strong>Introduction to Electricity</strong></td>
<td>Theory/Practical</td>
</tr>
<tr>
<td>1.</td>
<td>Electric Charge, Voltage, Electric Current</td>
<td>5 / 5</td>
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<td></td>
<td>Ohm's Law, Electric Potential, Cell</td>
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<tr>
<td></td>
<td>Serial and Parallel Circuit, their effect on Voltage and Current</td>
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<td></td>
<td>Transformer, Use and Operation</td>
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<tr>
<td>2.</td>
<td>Electronic and Electrical components</td>
<td>15 / 15</td>
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<tr>
<td></td>
<td>Active and Passive Components</td>
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<tr>
<td></td>
<td>Resistors, Capacitors and Inductors, their identification, types and application</td>
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<tr>
<td></td>
<td>Semiconducting Devices: Diodes, its type, characteristics and applications</td>
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<td></td>
<td>Transistors, Integrated Circuits</td>
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<tr>
<td></td>
<td>Study of a transistor, use of a transistor as an amplifier and as a switch.</td>
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<td>Analog ICs, 555 timer, IC741, characteristics of 741</td>
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<td>Digital ICs, ICs for logic gates, Truth table verification of logic gates</td>
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<td>Connectors</td>
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<td></td>
<td>Fuse, types, Use of Fuses and its rating</td>
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<tr>
<td><strong>· Relays and Switches</strong>&lt;br&gt;<strong>· Panel Components</strong>&lt;br&gt;<strong>· Digital electronics – gates and its application, multiplexers, de-multiplexers, counter</strong>&lt;br&gt;<strong>· Soldering/ de-soldering techniques</strong>&lt;br&gt;<strong>· Soldering Iron, Soldering wire, Soldering Flux, Soldering method, Zero defect soldering</strong>&lt;br&gt;<strong>· Desoldering pump, Temperature controlled soldering station,</strong>&lt;br&gt;<strong>· Hands-on-practices of Soldering</strong></td>
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<td><strong>3.</strong></td>
<td>10 / 10</td>
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<td><strong>Tools and equipment use for Repairing and maintenance of Electrical Equipment</strong>&lt;br&gt;<strong>· Screw Driver Set</strong>&lt;br&gt;<strong>· Tweezers, Different Types of Tweezers, Nose Pliers, Wire Cutter</strong>&lt;br&gt;<strong>· Hot air gun</strong>&lt;br&gt;<strong>· Liquid solder pest, Magnifying Lamp and Measuring Tools</strong>&lt;br&gt;<strong>· Brush, CRO, Nipper</strong>&lt;br&gt;<strong>· Test and Measurement Equipment, Multimeter Operation etc.</strong></td>
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<td><strong>4.</strong></td>
<td>10 / 10</td>
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<td><strong>5.</strong></td>
<td>15/20</td>
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<tr>
<td><strong>Basic functionality and Installation of washing machine</strong>&lt;br&gt;<strong>· Different type of washing machines &amp; working principle,</strong>&lt;br&gt;<strong>· Basic hand wash process, Different types of technologies being used in Washing machines – Pulsator, Agitator, Agipellar, Tumble wash,</strong>&lt;br&gt;<strong>· Main parts of washing machines and their functionalities etc.</strong>&lt;br&gt;<strong>· Opening the packed Washing machine, Selection of the suitable place for washing machine,</strong>&lt;br&gt;<strong>· Installation of washing machine,</strong>&lt;br&gt;<strong>· Demonstration of various functionality of washing machine</strong></td>
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<td><strong>6.</strong></td>
<td>15/20</td>
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<td><strong>7.</strong></td>
<td>10/15</td>
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<tr>
<td><strong>Basic functionality and Installation of Microwave oven</strong>&lt;br&gt;<strong>· Basic working principle of circuit and block description of Microwave Oven</strong>&lt;br&gt;<strong>· identification of parts and their working</strong>&lt;br&gt;<strong>· MWO heating/cooking, MWO safe utensils, Tips &amp; Safety precautions for MW</strong>&lt;br&gt;<strong>· Opening the packaged Microwave Oven</strong>&lt;br&gt;<strong>· Selection of the electric power socket</strong>&lt;br&gt;<strong>· switch rating and place for microwave oven installation</strong>&lt;br&gt;<strong>· Install the microwave oven with the help of step by step instruction.</strong>&lt;br&gt;<strong>· Demonstration of various functionality of Microwave Oven.</strong></td>
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<td><strong>8.</strong></td>
<td>10/20</td>
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<tr>
<td><strong>Fault identification, Repair and Maintenance of Washing machine</strong>&lt;br&gt;<strong>· Testing &amp; identification of the faulty block on the basis of symptom, rectifying common faults by replacing the damage components,</strong>&lt;br&gt;<strong>· Testing of the damage block after repair,</strong>&lt;br&gt;<strong>· Step by step re-assembly of the washing machine panel.</strong></td>
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<tr>
<td><strong>6.</strong></td>
<td>15/20</td>
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<tr>
<td><strong>Basic functionality and Installation of Microwave oven</strong>&lt;br&gt;<strong>· Basic working principle of circuit and block description of Microwave Oven</strong>&lt;br&gt;<strong>· identification of parts and their working</strong>&lt;br&gt;<strong>· MWO heating/cooking, MWO safe utensils, Tips &amp; Safety precautions for MW</strong>&lt;br&gt;<strong>· Opening the packaged Microwave Oven</strong>&lt;br&gt;<strong>· Selection of the electric power socket</strong>&lt;br&gt;<strong>· switch rating and place for microwave oven installation</strong>&lt;br&gt;<strong>· Install the microwave oven with the help of step by step instruction.</strong>&lt;br&gt;<strong>· Demonstration of various functionality of Microwave Oven.</strong></td>
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<td><strong>8.</strong></td>
<td>10/20</td>
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<tr>
<td><strong>Fault identification, Repair and Maintenance of Microwave oven</strong>&lt;br&gt;<strong>· Identify the problem based on customer’s information, possible solutions and repair costs involved,</strong>&lt;br&gt;<strong>· Common occurring faults with the Microwave Oven their identification and</strong></td>
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<td><strong>8.</strong></td>
<td>10/20</td>
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<tr>
<td>Module</td>
<td>Description</td>
<td>Hours</td>
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<tr>
<td>--------</td>
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<tr>
<td>1.</td>
<td>Repair of common small appliances</td>
<td>10/15</td>
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<tr>
<td>2.</td>
<td>Maintenance of Microwave Oven</td>
<td>10/15</td>
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<tr>
<td>9.</td>
<td>Basic functionality and Installation of Mixer/Juicer/Grinder</td>
<td>10/15</td>
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<tr>
<td></td>
<td>- Working principle of mixer/juicer/grinder,</td>
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<td></td>
<td>- Identification of various parts and their functionalities.</td>
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<td></td>
<td>- Functioning of motor and circuit breaker,</td>
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<td></td>
<td>- Opening the packaged Mixer/Juicer/Grinder, assembly of component,</td>
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<td></td>
<td>- Selection of the power socket, switch rating and place for installation,</td>
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<td></td>
<td>- Steps to Install the Mixer/Juicer/Grinder. Demonstration of various functionalities of Mixer/Juicer/Grinder</td>
<td>10/15</td>
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<td>10.</td>
<td>Fault identification, Repair and Maintenance of Mixer/Juicer/Grinder</td>
<td>10/20</td>
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<tr>
<td></td>
<td>- Common occurring faults, identification and repair,</td>
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<td></td>
<td>- Maintenance of Mixer/Juicer/Grinder</td>
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<td>11.</td>
<td>Basic functionality and Installation of Water purifier</td>
<td>10/15</td>
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<tr>
<td></td>
<td>- Working principle /functionality of different types of water purifiers, part identification and their working,</td>
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<td></td>
<td>- Unpacking of Water purifier, Selection of the place for installation,</td>
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<td>- Steps to Install the water purifier.</td>
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<tr>
<td>12.</td>
<td>Fault identification, Repair and Maintenance of Water purifier</td>
<td>10/15</td>
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<tr>
<td></td>
<td>- Identification of problem, possible causes and solution</td>
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<td></td>
<td>- Replacement of parts</td>
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<td>- Water Filter Maintenance</td>
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<td>13.</td>
<td>Safety and Security Procedures</td>
<td>5/5</td>
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<tr>
<td></td>
<td>- Reporting incidents, system failures, power failures etc., protection equipment</td>
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<td></td>
<td>- First aid requirement in case of electrical shocks and other injuries</td>
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<td>14.</td>
<td>Reading, Writing and Communication Skills</td>
<td>15/15</td>
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<tr>
<td></td>
<td>- Understanding Technical Manuals, Reports, Work orders etc.</td>
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<td></td>
<td>- Understanding Organizational health and safety instructions</td>
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<td></td>
<td>- Types of documentation in organization, their importance, Company guidelines and norms, activities after maintenance process</td>
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<td></td>
<td>- Spare management, Service Level Agreements (SLAs)</td>
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<td>- Fill-up forms, record sheets, log book etc. as per company procedures</td>
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<td>- Customer Communication, Convey proposed solution to the customer, responding queries</td>
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<td>- Communication with supervisor, Report for unresolved problems</td>
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<td></td>
<td>- Time Management and Team Skills</td>
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</table>

Total Theory / Lecture Hours: 150 hrs
Total Practical / Tutorial Hours: 200 hrs
Total Hours: 350 hrs
<table>
<thead>
<tr>
<th><strong>Recommended Hardware:</strong></th>
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</thead>
<tbody>
<tr>
<td>- Semi-Automatic Washing Machine</td>
</tr>
<tr>
<td>- Microwave Oven</td>
</tr>
<tr>
<td>- Juicer-Mixer-Grinder &amp; Water Purifier</td>
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<tr>
<td>- Multimeter, Soldering Iron, screw driver set, Wire cutter &amp; plier etc</td>
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<table>
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<tr>
<th><strong>Recommended Software:</strong></th>
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<tbody>
<tr>
<td>NIL</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Text Books:</strong></th>
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</thead>
<tbody>
<tr>
<td>Course Material Prepared by NIELIT, Chandigarh</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Reference Books:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Modern Washing Machine Servicing by Lotia (Author) BPB (Publisher)</td>
</tr>
</tbody>
</table>
1.2 Electronic Product Design

**ESDM Courses**

<table>
<thead>
<tr>
<th>Level Code:</th>
<th>L3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Name:</td>
<td>Electronic Product Design</td>
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<thead>
<tr>
<th>Course ID:</th>
<th>NL/S/L3/C002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Name:</td>
<td>1.2.1 Certificate Course in Electronic Product Testing</td>
</tr>
</tbody>
</table>

**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):** 360 Hrs

**Minimum Eligibility Criteria and pre-requisites, if any:** 10th / 12th Pass with Science background

**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
10. 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

<table>
<thead>
<tr>
<th>Module. No</th>
<th>Module Name</th>
<th>Minimum No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1.</td>
<td>Personal Skills</td>
<td>10 hrs</td>
</tr>
<tr>
<td></td>
<td>Knowing Oneself, Confidence Building, Defining Strengths,</td>
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<tr>
<td></td>
<td>Thinking Creatively, Personal Values, Time and Stress</td>
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<tr>
<td></td>
<td>Management</td>
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<tr>
<td>Module 2.</td>
<td>Social Skills</td>
<td>30 hrs</td>
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<tr>
<td></td>
<td>Appropriate and Contextual Use of Language, Nonverbal</td>
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<tr>
<td></td>
<td>Communication, Interpersonal Skills, Problem Solving,</td>
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<tr>
<td></td>
<td>Understanding Media, Public Speaking</td>
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</tr>
<tr>
<td>Module 3.</td>
<td>Professional Skills</td>
<td>30 hrs</td>
</tr>
<tr>
<td></td>
<td>Organizational Skills, Team Work, Business/Technical</td>
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</tr>
<tr>
<td></td>
<td>Communication, Job Oriented Skills, Professional Etiquette</td>
<td></td>
</tr>
<tr>
<td>Module 4.</td>
<td>Training for Language Proficiency Tests</td>
<td>20 hrs</td>
</tr>
<tr>
<td></td>
<td>Integrated Skills, Integrated Skills, Integrated Skills,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practice Exercises, Practice Tests</td>
<td></td>
</tr>
</tbody>
</table>
## Module 5: Preparing and Presenting a Project

| Brainstorming, Gathering, Selecting, Processing, Cohesive and Coherent Organization, Drafting and Revising, Presentation of the Project | 10 hrs |

**IT Skills**

<table>
<thead>
<tr>
<th>Module No</th>
<th>Module Name</th>
<th>Minimum No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1.</td>
<td>Introduction to internet, Office Writer, Emails Module Project and Evaluation</td>
<td>16 hrs</td>
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<tr>
<td>Module 3.</td>
<td>Computer Networks, Spreadsheet, Online Services, Interoperability, Module Project and Evaluation</td>
<td>24 hrs</td>
</tr>
<tr>
<td>Module 4.</td>
<td>Final Project and Evaluation</td>
<td>16 hrs</td>
</tr>
<tr>
<td>Module 1</td>
<td>Fundamentals of Electricity and Electronics</td>
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</tr>
<tr>
<td></td>
<td>1. Identification of basic electronic components, ICs, PCBs, Battery &amp; Sensors.</td>
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<tr>
<td></td>
<td>2. Basics of electricity, wave form, frequency value, peak value, average value of voltage and current</td>
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<tr>
<td></td>
<td>3. Awareness of tools, testing and measuring instruments – CROs, Multimeter, Power supplies, LCRs, Signal Generator and Power Analyzer.</td>
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</tbody>
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<thead>
<tr>
<th>Module 2</th>
<th>Soldering Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Handling of components, Instruments etc. ESD – (Electrostatic discharge).</td>
</tr>
<tr>
<td></td>
<td>2. Basics of SMD, its soldering and desoldering</td>
</tr>
<tr>
<td></td>
<td>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</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 3</th>
<th>Types of Product Testing</th>
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<tbody>
<tr>
<td></td>
<td>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 &amp; documentation, Awareness on ISO 17025, ISO 9001, Calibration and Uncertainty of measurements, Awareness on disposal of Electronic waste</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Module 4</th>
<th>Testing Procedures (Practical)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Testing of Basic Electronic Components</td>
</tr>
<tr>
<td></td>
<td>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</td>
</tr>
</tbody>
</table>

2. Switch Mode Power Supply (Applicable Standard: IS 14886)
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<tbody>
<tr>
<td>3.</td>
<td>Tubular Batteries (Applicable standard : IS 1651) Test for Capacity, Test for voltage during discharge</td>
</tr>
<tr>
<td>10.</td>
<td>Audio Amplifier (Applicable Standard : IEC 60065) Audio frequency response at various power levels,</td>
</tr>
<tr>
<td>Evaluation criteria</td>
<td>Hours</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------</td>
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<tr>
<td>Response to various inputs sources like DVD player, iPod, CD player, etc., audio output power, Power Consumption, Voltage range test, Touch Current</td>
<td>30</td>
</tr>
<tr>
<td>Intership/ Practical training</td>
<td></td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Level Code:</th>
<th>Vertical Name:</th>
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<tbody>
<tr>
<td>L4</td>
<td>Electronics Product Design</td>
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<table>
<thead>
<tr>
<th>Course ID:</th>
<th>Course Name:</th>
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</thead>
<tbody>
<tr>
<td>NL/M/L4/C015</td>
<td>1.2.2 Computer Aided Product Design</td>
</tr>
</tbody>
</table>

## 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 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)
360 Hrs

### Minimum Eligibility Criteria and pre-requisites, if any
Polytechnic Diploma/Graduation/ ITI/12th/10th

### 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.
- 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**

**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
<table>
<thead>
<tr>
<th>Module. No</th>
<th>Module. Name with detailed syllabus</th>
<th>Minimum No. of Hours (Theory/Practical)</th>
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<tbody>
<tr>
<td></td>
<td><strong>Module-I</strong></td>
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<tr>
<td></td>
<td>Creating a Simple Drawing</td>
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<tr>
<td></td>
<td>• Getting Started with AutoCAD</td>
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<tr>
<td></td>
<td>o Starting AutoCAD</td>
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<td></td>
<td>o AutoCAD’s Screen Layout</td>
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<td></td>
<td>o Working with Commands</td>
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<td></td>
<td>o Opening an Existing Drawing File</td>
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<td>o Saving Your Work</td>
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<td>o AutoCAD’s Cartesian Workspace</td>
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<td>• Drawing &amp; Editing Commands</td>
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<td></td>
<td>o Drawing Lines</td>
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<td>o Erasing Objects</td>
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<td>o Drawing Lines with Polar Tracking</td>
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<td>o Drawing Rectangles</td>
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<td>o Drawing Circles</td>
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<td>o Viewing Your Drawing</td>
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<td>o Undoing and Redoing Actions</td>
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<tr>
<td></td>
<td><strong>Module-II</strong></td>
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<tr>
<td></td>
<td>• Drawing Precision in AutoCAD</td>
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<td></td>
<td>o Using Object Snap</td>
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<td>o Object Snap Overrides</td>
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<td>• Polar Tracking Settings</td>
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<td>o Object Snap Tracking</td>
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<td>o Drawing with SNAP and GRID</td>
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<td>• Making Changes in Your Drawing</td>
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<tr>
<td></td>
<td>o Selecting Objects for Editing</td>
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<td>o Moving Objects</td>
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<td>o Copying Objects</td>
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<td>o Rotating Objects</td>
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<td>o Scaling Objects</td>
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<td>o Mirroring Objects</td>
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<td>o Editing Objects with Grips</td>
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<td><strong>Module-III</strong></td>
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<tr>
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<td>Drawing Organization and Information</td>
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<td>• Layers</td>
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<td></td>
<td>o Creating New Drawings With Templates</td>
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<td></td>
<td>o What are Layers?</td>
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<td></td>
<td>o Layer State</td>
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<td>Module-IV</td>
<td>Advanced Editing Commands</td>
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<td>o Changing an Object's Layer</td>
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<td>o Advanced Object Types</td>
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<td>o Drawing Arcs</td>
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<td>o Drawing Polylines</td>
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<td>o Editing Polylines</td>
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<td>o Drawing Polygons</td>
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<td>o Drawing Ellipses</td>
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<td>o Getting Information From Your Drawing</td>
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<td>o Measuring Objects</td>
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<td>o Working with Properties</td>
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<td>o Trimming and Extending</td>
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<td>o Stretching Objects</td>
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<td>o Creating Fillets and Chamfers</td>
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<td>o Offsetting Objects</td>
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<td>o Creating Arrays of Objects</td>
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<td>o Blocks</td>
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<td>o What are Blocks?</td>
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<td>o Inserting Blocks from Tool Palettes</td>
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<td>o Inserting Blocks using Insert</td>
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<td>o Inserting Blocks with Design Center</td>
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<thead>
<tr>
<th>Module-V</th>
<th>Annotating Your Drawing Text</th>
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<tr>
<td></td>
<td>o Working with Annotations</td>
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<td>o Adding Text in a Drawing</td>
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<td>o Modifying Multiline Text</td>
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<td>o Formatting Multiline Text</td>
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<td>o Hatching</td>
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<td>o Adding Dimensions</td>
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<td>o Dimensioning Concepts</td>
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<td>o Adding Linear Dimensions</td>
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<td>o Adding Radial and Angular Dimensions</td>
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<td>o Editing Dimensions</td>
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<td>o Adding Notes to Your Drawing</td>
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<td>o Preparing to Print</td>
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<td>o Setting Up a Layout</td>
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<thead>
<tr>
<th>Module-VI</th>
<th>3D Foundations</th>
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<tbody>
<tr>
<td></td>
<td>o Why use 3D?</td>
</tr>
<tr>
<td></td>
<td>o Introduction to the 3D Modeling Workspace</td>
</tr>
<tr>
<td></td>
<td>o Basic 3D Viewing Tools</td>
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<td>o 3D Navigation Tools</td>
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<tr>
<td></td>
<td>o Introduction to the User Coordinate System</td>
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<td>o Simple Solids</td>
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<td>o Working with Solid Primitives</td>
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<td>o Solid Primitive Types</td>
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<td>o Working with Composite Solids</td>
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<td>o Working with Mesh Models</td>
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</table>
| | o Creating Solids &
<table>
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<tr>
<th>Surfaces from 2D Objects</th>
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</thead>
<tbody>
<tr>
<td>o Complex 3D Geometry</td>
</tr>
<tr>
<td>o Extruded Solids and Surfaces</td>
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<tr>
<td>o Swept Solids and Surfaces</td>
</tr>
<tr>
<td>o Revolved Solids and Surfaces</td>
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<tr>
<td>o Lofted Solids and Surfaces</td>
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</table>

Advanced Solid Editing
- o Editing Components of Solids
- o Editing Faces of Solids
- o Fillets and Chamfers on Solids

Working Drawings from 3D Models
- o Creating Multiple Viewports
- o 2D Views from 3D Solids

<table>
<thead>
<tr>
<th>Module-VII</th>
<th>10. Advanced Layouts and Printing</th>
<th>40 Hrs</th>
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</thead>
<tbody>
<tr>
<td>Advanced Layouts</td>
<td>o Creating and Using Named Views</td>
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<tr>
<td></td>
<td>o Creating Additional Viewports</td>
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<td></td>
<td>o Layer Overrides in Viewports</td>
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<tr>
<td></td>
<td>o Additional Annotative Scale Features</td>
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<tr>
<td>DWF Printing and Publishing</td>
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<tr>
<td>o DWF Plotting and Viewing</td>
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<tr>
<td>o Publishing Drawing Sets</td>
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<thead>
<tr>
<th>Practical Project</th>
<th>60 Hrs</th>
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</thead>
<tbody>
<tr>
<td>Total Theory / Lecture Hours:</td>
<td>120</td>
</tr>
<tr>
<td>Total Practical / Tutorial Hours:</td>
<td>240</td>
</tr>
<tr>
<td>Total Hours:</td>
<td>360</td>
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</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>The individual on the job needs to know and understand:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PK1. Protection equipment that are required to be used</td>
</tr>
<tr>
<td>PK2. First aid requirements in case of electrical shocks, cuts and other common injuries</td>
</tr>
<tr>
<td>PK3. Have basic knowledge of electrical and electronic components</td>
</tr>
<tr>
<td>PK4. Standard fault-finding techniques</td>
</tr>
<tr>
<td>PK5. Standard repairing process</td>
</tr>
<tr>
<td>PK6. Principle of operation and features/working of instruments</td>
</tr>
<tr>
<td>PK7. Knowledge to dismantle and assemble the faulty instrument</td>
</tr>
<tr>
<td>PK8. Range of tools and testing equipments available and their functionality</td>
</tr>
<tr>
<td>PK9. Basic computer knowledge to be able to run diagnostic tools in case of smart instruments</td>
</tr>
<tr>
<td>PK10. Range of instrument related problems and their possible solutions</td>
</tr>
<tr>
<td>PK11. Knowledge of spare management and repair</td>
</tr>
<tr>
<td>PK12. Vendor specific configuration and user interfaces</td>
</tr>
<tr>
<td>PK13. Functionality of hardware components and software applications.</td>
</tr>
</tbody>
</table>

### Professional Skill:

<p>| The individual on the job needs to know and understand: |</p>
<table>
<thead>
<tr>
<th><strong>Instrument operating Skills</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>PS1. Use and access all instrument features and applications</td>
</tr>
<tr>
<td>PS2. Operate instrument calibration equipments and testing equipments</td>
</tr>
<tr>
<td>PS3. Connect instrument to PC for diagnostics for smart instruments</td>
</tr>
<tr>
<td>PS4. Initialize PC based diagnostic tools</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th><strong>Instrument Handling skills</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>PS14. Safely dismantle/assemble instrument using the right tools</td>
</tr>
<tr>
<td>PS15. Safe remove and replace components using right tools</td>
</tr>
<tr>
<td>PS16. Compliance to ESD protection measures</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Software Skills</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>PS17. Identifying correct software version for the modules for smart instruments</td>
</tr>
<tr>
<td>PS18. Execute basic software commands for calibration and use diagnostic tools</td>
</tr>
<tr>
<td>PS19. Use vendor specific software by navigating through it based on screen commands.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Troubleshooting Skills</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>PS20. Make use of standard OEM specified troubleshooting steps</td>
</tr>
<tr>
<td>PS21. Interpret intermediate results and progress fault rectification accordingly</td>
</tr>
<tr>
<td>PS22. Utilize appropriate tools to rectify faults</td>
</tr>
</tbody>
</table>

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. Respond appropriately to queries
  - CS5. Communicate with other team members to understand instrument performance issues
  - CS6. Communicate in the local language
  - CS7. Convey proposed solution to the customers and higher officials if necessary

- **Time Management Skills**
  - CS8. Prioritize and execute tasks in a high-pressure environment
  - CS9. Use and maintain resources efficiently and effectively

- **Analytical Skills**
  - CS10. Analyse (and understand) performance issues of the instrument
  - CS11. Interpret reports, readings and numerical data

- **Other Skills**
  - CS12. Keep up to date with new technology and performance issues
  - CS13. Create and maintain effective working relationships and team environment through collaboration
  - CS14. Take initiatives and progressively assume increased responsibilities
  - CS15. Share knowledge with other team members and colleagues

CS16.
## Detailed Syllabus of Course

<table>
<thead>
<tr>
<th>Module. No</th>
<th>Modules</th>
<th>Min. No. of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fundamentals</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Plan and perform routine trade activities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Examine types of trade related personal protective equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Head protection - hard hat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Eye protection - goggles and face shield</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Hearing protection - Ear plugs &amp; Ear muffs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Hand protection - Types of gloves and mitts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Clothing - Types of materials suitable to work environment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Foot protection - safety boots with suitable soles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Personal Breathing Apparatus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Maintain safe work environment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Safe housekeeping practices</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Appropriate recycling and disposal procedures</td>
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</tr>
<tr>
<td></td>
<td>• Use and maintain hand and power tools</td>
<td></td>
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<tr>
<td></td>
<td>o Trade specific hand and power tools</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Examine mounting and installation hardware and practices</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Manufacturer instructions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Types of mounting hardware (uni-strut, clamps, u-bolts...)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Location for installation of mounting hardware</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scope of Instrumentation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Scope and necessity of Instrumentation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• functional block diagram of measurement system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• calibration and calibration standards</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o basic, secondary and working standards</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• the metric system</td>
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<tr>
<td></td>
<td>o base and supplementary units</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o derived units</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Multiplying factors (milli,micro, nano......Mega,Giga...)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Instrument Characteristics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Instrument performance terminology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Repeatability and Accuracy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Zero, span and Linearity errors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Types of errors</td>
<td></td>
</tr>
</tbody>
</table>
- Standard Signals
- Different number bases
  - Binary
  - Octal
  - Hex

**Explain codes, standards and regulations**
- Examine work-related safety regulations and publications
  - 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

**Identify electrical hazards and apply safe work practices**
Packaging & Enclosures of Instrumentation System
- Safety Measures
  - Measurement Categories
- Nature of Environment & Safety Measures
  - Enclosures of electric equipment for Non-Hazardous location
    - International standards
  - Enclosures of electric equipment for Hazardous location
    - International standards
- Intrinsically Safe Equipment
- Design Consideration of Enclosures for Different Market Segments

- Examine regulations
  - Sizing of wire, fuses and circuit breakers
  - Overloads and Inrush current
  - Proper installation and grounding of electrical equipment

**Use trade related schematics and drawings**
- Examine types of schematics and drawings
  - P&ID and Loop wiring diagrams
- Examine symbols and conventions
  - ISA and SAMA symbols
- Use basic schematics and drawings
### 2. Installation and Maintenance of Measuring and Indicating Devices

**Calibrate and service indicating and recording instruments**

- Types of recording devices
  - Chart recorders
  - Electronic
- Indicating devices
  - Digital displays
  - Analog displays
  - Configurable
    - LCD
- Calibrate and service indicating devices
  - Gauges
  - Bourdon tube
    - Helical
    - Spiral
  - Bellows
    - Diaphragm capsule
  - Accessories
    - 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)
  - Identification of measuring element and input measurement scale
  - Power supply
  - Troubleshooting procedures (instrument specific - according to manuals)

**Introduction to pressure measurement**

- Types of pressure
  - Absolute, Differential, Gage, Vacuum
  - Conversion tables
<table>
<thead>
<tr>
<th>Pressure conversion formulas</th>
<th>Steam tables (relationship between temperature and pressure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head correction calculation</td>
<td></td>
</tr>
</tbody>
</table>

- Types of pressure measuring devices and transmitters
  - Pneumatic
  - Electronic
    - Analog
    - Digital
  - Pressure Transmitters

- Installation of pressure measuring devices
  - 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
  - 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
    - 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
  - Manufacturers’ recommended maintenance procedures
<table>
<thead>
<tr>
<th>Introduction to temperature measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Define Temperature, Heat and Energy</td>
</tr>
<tr>
<td>• Temperature scales</td>
</tr>
<tr>
<td>o Fahrenheit</td>
</tr>
<tr>
<td>o Celsius</td>
</tr>
<tr>
<td>o Kelvin</td>
</tr>
<tr>
<td>o Conversions between scales</td>
</tr>
<tr>
<td>• Temperature measuring devices, their operation and Transmitters</td>
</tr>
<tr>
<td>o Thermometer</td>
</tr>
<tr>
<td>o Thermocouple</td>
</tr>
<tr>
<td>o Thermocouple tables</td>
</tr>
<tr>
<td>o Resistance Temperature Detectors (RTD)</td>
</tr>
<tr>
<td>• RTD tables</td>
</tr>
<tr>
<td>o Thermistor</td>
</tr>
<tr>
<td>o Liquid in Glass and Filled bulb systems</td>
</tr>
<tr>
<td>o Pyrometer</td>
</tr>
<tr>
<td>o Semi-conductor mechanical thermal system</td>
</tr>
<tr>
<td>o Infrared radiation</td>
</tr>
<tr>
<td>o Fibre Optic</td>
</tr>
<tr>
<td>o Thermal Expansion Thermometers</td>
</tr>
<tr>
<td>o Temperature Transmitters</td>
</tr>
<tr>
<td>• Temperature calibrating instruments</td>
</tr>
<tr>
<td>o Thermometers</td>
</tr>
<tr>
<td>o Multimeters</td>
</tr>
<tr>
<td>o Millivolt source</td>
</tr>
<tr>
<td>o Resistance source</td>
</tr>
<tr>
<td>o Temperature baths</td>
</tr>
<tr>
<td>o Dry block calibrators</td>
</tr>
<tr>
<td>o Thermocouple simulators</td>
</tr>
<tr>
<td>o Decade box</td>
</tr>
<tr>
<td>• Installs, calibrates and services temperature measuring devices</td>
</tr>
<tr>
<td>o Manufacturers’ specifications</td>
</tr>
<tr>
<td>o Best Practices for selection/location of measuring device</td>
</tr>
<tr>
<td>o Response time</td>
</tr>
<tr>
<td>o Temperature ranges</td>
</tr>
<tr>
<td>o Resolution</td>
</tr>
<tr>
<td>o Thermo well selection and installation</td>
</tr>
<tr>
<td>Thermocouples</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>• Grounding</td>
</tr>
<tr>
<td>• Cold junction compensation</td>
</tr>
<tr>
<td>• Types (J, K...T)</td>
</tr>
</tbody>
</table>
| • Extension wires | |}

| Device check / calibration | |}
| 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
<table>
<thead>
<tr>
<th>Laptop / software</th>
<th>Handheld programmer</th>
</tr>
</thead>
</table>

- Install, calibrate and service level measuring devices
  - 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

**Introduction to density measurement**

- Density measuring devices and their operation
  - 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
  - Pressure calibrator
  - Laptop / software
  - Handheld programmer

- Install, calibrate and service density measuring devices
  - Manufacturers’ specifications
  - Selection / Location of measuring device
  - Process application
  - Process medium
  - Best practices
<table>
<thead>
<tr>
<th>Introduction to weight measurement</th>
<th>Introduction to flow measurement (volumetric, mass flow)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Weight measuring devices and their operation</td>
<td>• Flow measuring devices and their operation</td>
</tr>
<tr>
<td>o Load cells</td>
<td>o Types of Flow</td>
</tr>
<tr>
<td>o Scales</td>
<td>• Reynolds Number</td>
</tr>
<tr>
<td>o Strain gauges</td>
<td>o Types of flow meters</td>
</tr>
<tr>
<td>• Calibration instruments used on weight measuring devices</td>
<td>• head type</td>
</tr>
<tr>
<td>o Test weights</td>
<td>• variable area type</td>
</tr>
<tr>
<td>o Wheatstone bridge</td>
<td>• quantitative flow meters</td>
</tr>
<tr>
<td>o Laptop / software</td>
<td></td>
</tr>
<tr>
<td>o Handheld programmer (configurator)</td>
<td></td>
</tr>
<tr>
<td>• Install, calibrate and service weight measuring devices</td>
<td></td>
</tr>
<tr>
<td>o Manufacturers’ specifications</td>
<td></td>
</tr>
<tr>
<td>o Selection /Location of measuring device</td>
<td></td>
</tr>
<tr>
<td>o Process application</td>
<td></td>
</tr>
<tr>
<td>o Best practices</td>
<td></td>
</tr>
<tr>
<td>o Verify operation</td>
<td></td>
</tr>
<tr>
<td>o Device check / calibration</td>
<td></td>
</tr>
<tr>
<td>o Interpretation of calibration results</td>
<td></td>
</tr>
<tr>
<td>o Cause / effect of calibration error</td>
<td></td>
</tr>
<tr>
<td>o Device adjustments</td>
<td></td>
</tr>
<tr>
<td>o Repair/replace device components</td>
<td></td>
</tr>
<tr>
<td>o Documenting calibration</td>
<td></td>
</tr>
</tbody>
</table>
- mass flow meters
  - Differential Pressure Flowmeters
    - 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
    - Rotary Vane, Oval Gear, and Nutating Disc Designs
  - Open Channel Flow Measurement
    - Weirs
  - Parshall Flume
  - Solid flow meters

- Calibration instruments used on flow measuring devices
  - Pressure calibrators
  - Temperature calibrator
  - Frequency generator
  - Laptop / software
  - Handheld programmer

- Install, calibrate and service flow measuring devices
  - 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
3. Installs & Maintains Safety and Process Monitoring Systems

Service ESD (emergency shutdown devices)

- Types of ESD control systems
  - Levels of Shutdown
    - Unit Shutdown
    - Process Shutdown
    - Emergency Shutdown
    - Emergency Depressurize Shutdown
  - Types of ESD
    - Electric
    - Pneumatic
    - Hydraulic
    - Mechanical
- Purposes of different types of ESD
  - Personnel protection
  - Environmental protection
  - Equipment protection
- ESD testing procedures
  - Partial Stroke Test
  - Time test
  - Valve integrity
  - Interlock checks (system shut down check)

Service and calibrate personal safety systems

- Personal gas monitors and standard calibration routines
  - Portable personal gas monitor (Cl, SO2, H2S, O2, CO)
  - Pull tube (Draeger)
- Radiation safety devices
  - Radiation (gamma) survey meter
  - Personal dosimeter

4. Installs and Maintains Pneumatic Systems

Air supply systems

- Instrument air systems and equipment
  - Need for clean, dry air
- Air compressors
- Air dryers
- Air receivers
- Air filters
- Air distribution systems
- Use of relative humidity to infer dew point
  - Hygrometers
  - Sling psychrometer
  - Digital psychrometer
  - Bulk polymer resistance sensor
- Servicing procedures for air supply systems
  - Servicing requirements
  - Traps
  - Dessicant
  - Pre and post filters

**Tubing and fittings**
- Types of tubing and installation procedures
  - Plastic
  - Stainless steel
  - Copper
  - Rubber
  - Process and pressure requirements
  - Sizes
  - Pressure and Temperature Ratings
- Tube bending techniques
  - Calculating dimensions
  - Manual tube benders
  - Hydraulic tube benders
- Install tubing and fittings
  - Ferrule fitting
  - Tightening fittings
  - Follow P&ID drawings
  - Select appropriate tubing and fittings

**Install and service pneumatic instruments**
- Specifications and hazards of pneumatic equipment
  - Compressed air safety
### Types of pneumatic equipment
- Transmitters
- Converters (I/P)
- Positioners
- Controllers
- Relays

### Operating principles of pneumatic equipment
- Force balance
- Motion balance

### Calibrate pneumatic transmitters
- 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

### Identifies various Electrical and Electronic components
- Active components
- Passive Components
- Switches
- Plugs
- Sockets
- Relays/Solenoids/Contactors
- Inductive proximity switch
- Symbols of electrical components
  - Switch
  - Contacts
  - Solenoids
  - Relay
  - LED
- Electrical Ladder Diagram
- Panel controls
- Integrated Circuits
  - Pin identification and numbering convention
- IC handling and installation

- Safety
  - Need for Electrostatic Discharge Protection

**Apply basic principles of DC electricity**

- operation and applications of various batteries
  - Lead acid
  - NiCad
  - NiMh

- Measure electrical current, voltage and resistance
  - Analog multimeters
  - Digital Multimeters

- Calculate currents, voltages and resistance using Ohm’s law
  - Series circuits
  - Parallel and combination circuits
  - Formula \( E = I \times R \)

- Define and reference voltage measurement to circuit common
  - Difference between ground and circuit common
  - Multimeter
  - Oscilloscope and scope meter
  - Frequency generator
  - Circuit schematic

- Calculate electrical power in watts
  - Apply Watt’s Law to define power rating of appliances
  - Watts = \( E \times I \)

- Examine resistors, potentiometers and rheostats
  - Differences
  - Power ratings
  - Applications
  - Colour codes

**Apply basic principles of AC electricity**

- Define AC electricity
  - Generation
  - Polarity and waveform analysis
    - Peak/RMS voltages

- various types of transformers
  - Step up
  - Step down
- 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)**
6. Installs and Maintains Final Control Elements

Service regulators and examine relief valves

- Examine regulators
  - Purpose
  - Pressure drops
  - Types
    - Relieving
    - Non-Relieving
    - Pilot operated
  - Definitions
    - Droop
    - Turndown
  - Applications
    - Pressure reducing
    - Pressure relieving

- Examine operation and applications of regulators
  - Air
  - Water
  - Steam
  - Oil
  - Gas
  - Differential

- Service and maintain regulators
  - Components
    - Diaphragms
    - Bolts
    - Springs
    - Seats
    - Gaskets
  - Disassembling
    - Spring compression
Service, size and install control valves and actuators

- Examine relief valves
  - Applications
  - Safety Device
  - Reset Differential
  - Certification and testing

- Examine actuators
  - Types
    - Pneumatic
    - Hydraulic
    - Electric
  - Applications
    - Fail open
    - Fail close
    - Fail last
  - Actions
    - Spring return
    - Double-acting
  - Components
    - Diaphragms
    - Plates
    - Stem connector (coupling)
    - Bushings
    - O-rings
    - Pistons
    - Motors
    - Springs
  - Required Operating Environment

- Examine control valves
  - Process applications
  - Seal / shut off requirements
  - Flow Characteristics
    - Quick opening
    - Linear
    - Equal percentage
Body Types
- Valve sizing
  - Sliding stem
    - Globe
    - Bar stock
    - Pinch valve
  - Rotary
    - Butterfly
    - E-Disc
    - Segmented ball
    - Through-bore ball
    - Restricted trim
- Components
  - Cages
  - Plugs
  - Seats
  - Stems
  - Packing
    - Types and applications of valve packing
      - Teflon
      - Graphite
      - Rope

Install and service control valves
- Gaskets
- Seals
- Positioning valve in process
- Securing valve using appropriate process
  - Flanged
  - Screwed
  - Wafered / Flangeless
- Isolation of valve from process
- Testing procedures
- Stroke to ensure proper operation
- Leak testing
- Possible faults
  - Leaking packing
  - Valve passing
<table>
<thead>
<tr>
<th>Install and service actuators</th>
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<tbody>
<tr>
<td>Damaged parts</td>
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<tr>
<td>Incorrect travel</td>
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<tr>
<td>Cleaning / lubricating</td>
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<tr>
<td>Repairing / Rebuilding</td>
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- Install and service actuators
  - Matching to valve
  - Connecting to valve
  - Valve travel
  - Bench set
  - Verifying operation
  - Correct air supply pressure
  - Function testing
  - Possible faults
    - Leaking diaphragms
    - Broken springs
    - Damaged/worn O-rings
  - Removing / replacing components
  - Cleaning/lubricating components
  - Assembling/disassembling
    - Spring compression
  - Loading on stem connector

**Install and service valve positioners**

- Valve positioners
  - Types
    - Pneumatic
    - Electronic
    - Digital
    - Electro hydraulic
    - Electro mechanical
  - Applications
  - Single Acting
  - Double Acting
  - Components
    - Levers
    - Nozzles
    - Flappers
    - Relays
- Auxiliaries
- Locks
- Boosters
- Speed controls
  - Relation to actuator type / application
- Install and service valve positioners
  - 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

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<thead>
<tr>
<th>7.</th>
<th>Installs and Maintains Communications, Networking and Signal Transmission Systems</th>
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<tr>
<td></td>
<td>Install wiring in accordance with different standards</td>
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<td></td>
<td>- Examine wiring requirements</td>
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<tr>
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<td>- Materials</td>
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<td>- Connections</td>
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<td>- Crimping</td>
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<td>- Terminal blocks</td>
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<td>- Marrettes</td>
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<td></td>
<td>- Soldering</td>
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<td>- Protection (heat shrink, taping etc.)</td>
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<td>- Shielding</td>
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<td>- Grounding</td>
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<td>- Grounding loops</td>
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<td></td>
<td>- Install wiring</td>
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<td>- Sizing wire</td>
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<td>- Routing of wiring runs</td>
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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
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<td>o IEEE standards</td>
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<td>features and limitations of communication protocols</td>
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<td>o Types of protocols</td>
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<td>o RS232</td>
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<td>o Highway Addressable Remote Transducer (HART)</td>
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<td>o Foundation Fieldbus H1 &amp; H2</td>
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<td>o Ethernet TCP/IP</td>
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<tr>
<td>o Addressing methods and components</td>
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<td>o Potential sources of interference</td>
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<tr>
<td>o Related standards, codes, licenses</td>
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8. Installs and Maintains Control Systems

Stand alone Controllers

- Electronic Controllers
- Single loop controllers

Programmable Logic Controllers (PLCs)

- Examine types of PLCs
  o Hardware Architecture
  o Control Capabilities
    - Discrete control
    - Analog control
  o Compatibility with other process systems
  o Networks
  o Protocols

- PLC languages and symbols
  o Structured Text
  o Instruction list
  o Ladder Logic
  o Function block
  o Sequential function chart

- PLC components
  o CPU
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
• Control techniques
  o Loop tuning
  o Zeigler Nicholls
  o Lambda
  o Tuning from manual output changes

• Basic control strategies
  o Feedback control
    • Process Dynamics
      • Lags
      • Dead Time
  o Feed forward control
  o Cascade control
  o Ratio Control
  o Gap action control
  o Multi variable control

Implement process control strategies
• Implement process control strategies
  o Determining required controller action based on process and valve action
  o Consulting loop diagrams
  o Override
  o Interlocks
  o Limits
  o Select relays
  o Loop impact on overall process
  o Alarming
  o Control strategy design
  o Implementation on live processes
  o 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:**
- 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.
- 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
- Industrial Hydraulics manual, Eaton Corporation
- Closed loop electro hydraulic systems manual, Vickers, Incorporated Training Center
- www.abb.com
- www.boschrexroth.
- 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.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
-
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 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, Serco 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**


Force pressure and weight, Pascal’s Law, Calculations : Pascal’s Law, Application of Pascal’s Law, Force Multiplication, Pressure Multiplication, Displacement transmission, Calculations, Units of pressure., What does 1bar mean? Absolute and relative pressure, What is flow rate? Flow law, Calculation, Open, Types of flow : Laminar and turbulent flow, Reynolds’s number, Throttling, Graphical Symbols and Circuit Diagrams ISO 1219,

Purpose of graphical symbols, Function of symbols, Basic elements, Circuit diagram Commonly used symbols, Circuit symbols., Symbols for energy supply and processing unit ( Power Pack ), Symbols for Hydraulics energy control units (Pressure, Flow and Direction ), Symbols for Energy conversion units (Actuators), Symbols for accessories, Demonstration of Hydraulics circuits, Hydraulic circuit with manual DCV and a cylinder, Hydraulic circuit with manual DCV and a Hydraulic motor, Hydraulic circuit with solenoid DCV and cylinder and a motor, Demonstration of speed and direction changes in Hydraulic circuit, Hydraulic Fluids, Main functions of

Hydraulic fluids, Functions, Capacity and Constructions of Tanks, Calculation, Requirements of Hydraulic fluids, Types of Hydraulic Fluids, Viscosity of Hydraulic fluid, Relation between temperature and viscosity, Selection of Hydraulic fluid for an applications, Compressibility of Hydraulic fluids, Thermal expansion of Hydraulic fluids, Fluid Analysis, Hydraulic Pumps, Functions and Operating principle Hydraulic pumps, Differentiate b/w positive and non – positive displacement pumps, Characteristics of standard Hydraulic pumps, Construction and Operating principle following pumps, i. External and internal gear pumps, ii. Vane pumps, iii. Axial piston pumps, iv. Radial piston pumps, Selection criteria of pumps, Flow rate and pump power, Efficiency, Hydraulic Cylinder, Operating Principle, Components of a Hydraulic cylinder, Functions of Hydraulic cylinder, Design and operation, Types of cylinder, Types of design, i. Tie rod cylinders, ii. Mill type cylinders, Technical specification, End positioning cushioning, Cylinder mounting, Hydraulic Motors, Functions of Hydraulic Motors, Characteristics of standard Hydraulic Motors, Selection of Hydraulic motors, Calculations, Efficiency, Pressure Control Valves, Introduction, Function and operating principle of pressure relief valve, direct operated, Pressure relief valve in series and parallel, Pressure relief valve, pilot operated, Function and operating principle of pressure reducing valve, Pressure sequence valve, direct operated, Directional Control Valve, Operation and Function, Special characteristics, Types of directional control valves, Spool design, Poppet design, Types of actuation of spools with symbols, Directional spool valves, direct operated, Directional spool valves, pilot operated, Designation of Directional control valves, Operation of solenoid, Solenoid operated valves and its symbols, Standard spool valve : G spool, E spool, J spool and H spool, Comparison of spool Vs poppet valves, Flow Control Valves, Functions, Throttle valves, Viscosity dependent throttle valves, Types of mounting, Throttle valve independent of viscosity, Flow control valves, 2-way flow control valves, Upstream pressure compensator, Downstream pressure compensator, Applications of 2-way flow control valve, Meter-in flow control, Meter-out flow control, Check Valves, Operation and function of a simple check valve, Check valve, pilot operated, Double pilot operated check valve, Applications of check valves,
Project: Hydraulic pump, characteristic Curve, Single-rod cylinder, pressure intensification, Single-rod cylinder, flow, Hydraulic motor, 4/3 directional valve, Check valve, Check valve, pilot operated, Throttle valve, adjustable, Throttle check valve, Flow control valve, Pressure relief valve, direct operated, controls, Pressure reducing valve:

Theory / Lecture Hours: 32

Practical / Tutorial Hours: 48

Module III

Basic & Electro Pneumatics

Fluid power, Advantages, Pneumatics, Definition, Characteristics of Industrial Pneumatics, advantages and its limitations, Comparisons of Drives - Pneumatics Vs Hydraulics, Electrical/Electronics & Mechanical, Applications of Pneumatics, Compressed Air Generation and Contamination Control, Compressed Air for transmitting power, Composition of Atmospheric Air, force, weight, pressure, Pascal's Law, Application of Pascal's Law, Force Multiplication, Pressure Multiplication, Displacement transmission, Calculations, Gas Laws, Air compression process, Absolute and relative pressure. Flow rate, Characteristics of compressed air, Graphical Symbols and Circuit Diagrams ISO 1219, Purpose of graphical symbols, Function of symbols, Basic elements, Circuit diagram, Commonly used symbols, Circuit symbols, Symbols for Maintenance unit, Symbols for Pneumatic energy control units (Pressure, Flow and Direction ), Symbols for Energy conversion units (Actuators), Symbols for accessories, Demonstration of Pneumatic circuits, Pneumatic circuit with manual DCV and a cylinder, Pneumatic circuit with solenoid DCV and cylinder and a motor, Demonstration of speed and direction changes in Pneumatic circuit, Compressed Air Generation and Contamination Control, A typical Pneumatic system, Air compressors, Classification of Compressors, Terms and Definition : Delivery volume, Pressure, Drive, Cooling and Regulation, Piston Compressor, Screw Compressor, Vane Compressor, Compressor unit, Preparation of compressed Air, Stages of Preparation, Drying of Compressed Air, Distribution of Compressed Air, Pneumatic Actuators, Introduction, Basic Actuator Functioning, Thrust, Cylinder Air Consumption, Cylinder speed and its relation to flow rate, Stroke Length, Piston—rod buckling, Classification of Pneumatic Actuators, Linear Actuators, Single-Acting cylinder, Double-Acting cylinder, Cylinder cushioning, Classification of cylinders According to Duty, Cylinder with Magnetic Piston, Cylinder with Non-Rotational Guiding, Rodless Cylinder, Tandem Cylinder, Rotary Actuator, Semi-Rotary Actuators, Pneumatic Valves and Control Circuits, Introduction, Classification of valves, Functional Classification of Valves, i. Directional control valves, ii. Pressure control valves, iii. Flow control valves, iv. Non return valves, Graphical Representation, Port Markings, Ports and Positions, Graphical symbols for DC valves, Methods of DC Valve Actuations, 3/2-Directional Control valve, i. NC-type 3/2-DC valves, ii. NO-type 3/2-DC valves, Non-Return Valves, Flow control valves, Throttle valve and Throttle check valves, Pneumatically Actuated 3/2-DC valve, Manually actuated 5/2-DC valve, Pneumatically actuated 5/2-DC valve, Speed control of Double-Acting Cylinder, 5/2-DC Double-Pilot valve, Login Controls, Pneumatic, i. Shuttle valve, ii. Twin pressure valve, iii. Applications of Logic valves, Structure of Pneumatic Circuits, Automatic Control, Roller valve, Quick-Exhaust 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:**
- 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:**
- R.Srinivasan Hydraulic and Pneumatic Control published by Vijay Nicole Imprints Private Ltd.
- Programmable Logic Controllers by W.Bolton
- Programmable Logic Controllers by Hugh Jack
Evaluation criteria:
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 hydraulic
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
PK21. understand the functionality of the electro hydraulic
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
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 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.


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


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 of 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 spoons 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 an NC), Signal storage concept, Electrical interlocking concept, Momentary-contact limit switches, Categories of limit switches,

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


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:

| - R.Srinivasan Hydraulic and Pneumatic Control published by Vijay Nicole Imprints Private Ltd. |
| - Programmable Logic Controllers by W.Bolton |
| - Introduction to Programmable Logic Controllers by Garry Dunning, 2nd edition, |
Evaluation criteria:

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<td>- Programmable Logic Controllers by Hugh Jack</td>
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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:

1. **PK1.** Understand the overview of automation
2. **PK2.** Different devices used in Automation,
3. **PK3.** Interact with the technical lead engineer in order to understand the work schedules,
4. **PK4.** Understand the roles and responsibilities of the work
5. **PK5.** Understand broad level activities involved in the Industrial automation
6. **PK6.** List the various department to interact with for completing the work
7. **PK7.** Interact with higher officials to understand the specifics of work
8. **PK8.** Understand the different Communication Protocols/Field Buses
9. **PK9.** Establish module requirement and constraints
10. **PK10.** Understand Network Settings/Communication Settings
11. **PK11.** Understand the PLC Software
12. **PK12.** Understand the basics of electro hydraulics
13. **PK13.** Define the design flow for the specific system
14. **PK14.** Use agreed language and application as per standards
15. **PK15.** Define the requirement specification of the electro pneumatics
16. **PK16.** Get approval from superior and relevant department on the electro pneumatics
17. **PK17.** Understand different types of pumps
18. **PK18.** Understand different types of valves
19. **PK19.** Understand the functionality of the electro pneumatics
20. **PK20.** Assist in system testing, product verification and validation
21. **PK21.** Understand the functionality of the electro hydraulics
22. **PK22.** Understand the functionality of the HMI
23. **PK23.** Understand Proportional Hydraulics
24. **PK24.** Definition of Proportional valve
25. **PK25.** Understand LVDT
26. **PK26.** Understand different types of amplifiers
27. **PK27.** Understand proportional direction control valves
28. **PK28.** Introduction to control system
29. **PK29.** 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 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 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.

There are 3 mixing devices on a processing line A, B, C. After the process begins, mixer A is to start after 7 seconds elapse, next mixer B is to start 3.6 seconds 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


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 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,


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.


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


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 - Pneumatic Systems, TMH.1995
- G.K.Dubey.Fundamentals of electrical drives
- Programmable Logic Controllers by W. Bolton
- Mechatronics - W. Bolton, Pearson Edition
- 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, Mcmlan Prem, 1994
- Instrumentation Engineers Hand Book - Process Control, Bela G Liptak, Chilton book company, Pennsylvania
- Programmable Logic Controllers by Hugh Jack
- Mechatronics - Mahalik, TMH
- Mechatronics - HMT, TMH

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

Evaluation criteria:
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
## 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:**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>TOPICS</th>
<th>Hr</th>
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<tbody>
<tr>
<td></td>
<td><strong>UNIT -1</strong></td>
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<tr>
<td>1.0</td>
<td>Introduction to Robotics-</td>
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<tr>
<td>1.1</td>
<td>Evolution of Robots &amp; Robotics, Laws of Robotics,</td>
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<tr>
<td>1.2</td>
<td>Progressive advancement in robotics,</td>
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<tr>
<td>1.3</td>
<td>Types of Robot, Selection of Robot- Payload, speed, Reach</td>
<td>1</td>
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<tr>
<td>1.4</td>
<td>Major parts of Industrial robot.</td>
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<tr>
<td></td>
<td><strong>UNIT 2</strong></td>
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<tr>
<td>2.0</td>
<td>Robot Anatomy</td>
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<tr>
<td>2.1</td>
<td>Links, Joints and Joints Notation Scheme.</td>
<td>1</td>
</tr>
<tr>
<td>2.2</td>
<td>Links, Joints and Joints Notation Scheme.</td>
<td>1</td>
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<tr>
<td>2.3</td>
<td>Degrees Of Freedom, Required DOF in a Manipulator</td>
<td>1</td>
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<tr>
<td>2.4</td>
<td>Arm Configuration, Wrist Configuration,</td>
<td>1</td>
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<tr>
<td>2.5</td>
<td>Work Cell, Work Envelope, and Work Volume</td>
<td>1</td>
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<tr>
<td>2.6</td>
<td>Robot End Effectors – Definition, Classification of End Effectors,</td>
<td>1</td>
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<tr>
<td>2.7</td>
<td>Types of Grippers.</td>
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<tr>
<td>2.8</td>
<td>General structure of Robot and Specifications of Robots</td>
<td>1</td>
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</table>

**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 |
Practical Syllabus:

<table>
<thead>
<tr>
<th>SL. No</th>
<th>3.3.5.1.1.1.1.1 Major topics</th>
<th>Time allotted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Robot component recognition.</td>
<td>8h</td>
</tr>
<tr>
<td>2.</td>
<td>Manipulating the robot.</td>
<td>8h</td>
</tr>
<tr>
<td>3.</td>
<td>Recording the position</td>
<td>12h</td>
</tr>
<tr>
<td>4.</td>
<td>Writing and running robot programs</td>
<td>16h</td>
</tr>
<tr>
<td>5.</td>
<td>Joint &amp; XYZ co-ordinate system.</td>
<td>8h</td>
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<tr>
<td>6.</td>
<td>Point-to-Point control</td>
<td>8h</td>
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<tr>
<td>7.</td>
<td>Linear and Circular Interpolation</td>
<td>4h</td>
</tr>
<tr>
<td>8.</td>
<td>Writing the programs using Loops.</td>
<td>4h</td>
</tr>
<tr>
<td>9.</td>
<td>Writing the programs using Delay.</td>
<td>4h</td>
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<tr>
<td>10</td>
<td>Test &amp; Exam</td>
<td>4h</td>
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<tr>
<td>11</td>
<td>Internship</td>
<td>200h</td>
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<td><strong>Total</strong></td>
<td><strong>276 Hrs.</strong></td>
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</table>

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 any**
10th Pass/ITI
**Professional Knowledge:**

| 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 |
| PK6. | Need of stabilizer, working principle, types of stabilizer |
| PK7. | Constant Voltage transformer, General Circuit diagram of CVT, Working principle of CVT |
| PK8. | EMI/RFI filter, Surge Suppressor, Repairing of CVT |
| PK9. | Introduction to Inverter, Block diagram of Inverter |
| PK10. | UPS, Working principle, specifications, explanation with the help of block diagram |
| PK11. | Find the total Load and Select suitable Inverter/UPS |
| PK12. | Range of tools and testing equipment available and their functionality |
| PK13. | Construction of Battery, Case Cover plates, Separator, Cells, Electrolyte, etc |
| PK14. | Factor affecting charging, Cause of battery failure, diagnosis and testing, visual inspection, Heavy load test Standard fault-finding (troubleshooting) techniques |
| PK15. | Component testing methods |
| PK16. | Troubleshooting through circuit diagram |
| PK17. | 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

**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

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Modules</th>
<th>Min: No. of Hours</th>
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<td></td>
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<td>Theory/</td>
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<td>Practical</td>
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<tr>
<td>1.</td>
<td><strong>Introduction to Electricity</strong></td>
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<td>Electric Charge, Voltage, Electric Current</td>
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<td>Ohm’s Law, Electric Potential, Cell</td>
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<tr>
<td></td>
<td>Serial and Parallel Circuit, their effect on Voltage and Current</td>
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<td></td>
<td>Transformer, Use and Operation</td>
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<tr>
<td>2.</td>
<td><strong>Electronic and Electrical components</strong></td>
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<tr>
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<td>Active and Passive Components</td>
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<tr>
<td></td>
<td>Resistors, Capacitors and Inductors, their identification, types and application</td>
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<td></td>
<td>Semiconducting Devices: Diodes, its type, characteristics and applications</td>
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<tr>
<td></td>
<td>Transistors, Integrated Circuits</td>
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<tr>
<td></td>
<td>Study of a transistor, use of a transistor as an amplifier and as a switch.</td>
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<td>Analog ICs, 555 timer, IC741, characteristics of 741</td>
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<td>Digital ICs, ICs for logic gates, Truth table verification of logic gates</td>
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<td>Connectors</td>
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<td></td>
<td>Fuse, types, Use of Fuses and its rating</td>
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<td>Relays and Switches</td>
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<td>Panel Components</td>
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<td>Digital electronics – gates and its application, multiplexers, de-multiplexers, counter</td>
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<td>3.</td>
<td>Soldering/ de-soldering techniques</td>
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<tr>
<td>Soldering Iron, Soldering wire, Soldering Flux, Soldering method, Zero defect soldering Desoldering pump, Temperature controlled soldering station, Hands-on-practices of Soldering)</td>
<td>10 / 10</td>
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<thead>
<tr>
<th>4.</th>
<th>Tools and equipment use for Repairing and maintenance of Electrical Equipment</th>
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<tbody>
<tr>
<td>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.</td>
<td>10 / 10</td>
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<tr>
<th>5.</th>
<th>Stabilizer and CVT</th>
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<td>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</td>
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<tbody>
<tr>
<td>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</td>
<td>20 / 30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7.</th>
<th>Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>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 &amp; Power(watt) Factor affecting charging, Cause of battery failure, diagnosis and testing, visual inspection, Heavy load test</td>
<td>10 / 20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8.</th>
<th>Troubleshooting techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td>40 / 60</td>
</tr>
</tbody>
</table>
### 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

### 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

<table>
<thead>
<tr>
<th>Total Theory / Lecture Hours:</th>
<th>150 hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Practical / Tutorial Hours:</td>
<td>200 hr</td>
</tr>
<tr>
<td><strong>Total Hours:</strong></td>
<td>350 hrs</td>
</tr>
</tbody>
</table>

#### Recommended Hardware:
For a batch size of 50Nos

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

#### 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),

Reference Books:

- user/service manuals
1.5 Medical Electronics

National Institute of Electronics and Information Technology
ESDM Courses

<table>
<thead>
<tr>
<th>Level Code:</th>
<th>垂直名称:</th>
<th>Vertical Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>L3</td>
<td></td>
<td>Medical Electronics</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Course ID:</th>
<th>Course Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>NL/S/L3/C004</td>
<td>3.5.1 Repair &amp; Maintenance of Dental equipment</td>
</tr>
</tbody>
</table>

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  
<table>
<thead>
<tr>
<th>Module. No</th>
<th>Modules</th>
<th>Minimum No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Basics understanding of Dental Chair</td>
<td>50</td>
</tr>
<tr>
<td>2.</td>
<td>Tools &amp; Aids for servicing &amp; maintenance, Hard &amp; soft tools</td>
<td>200</td>
</tr>
<tr>
<td>3.</td>
<td>Soft Skills</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td><strong>Total Theory / Lecture Hours:</strong></td>
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</tr>
<tr>
<td></td>
<td><strong>Total Practical / Tutorial Hours:</strong></td>
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<tr>
<td></td>
<td><strong>Total Hours:</strong></td>
<td><strong>350</strong></td>
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</table>

Recommended Hardware:
# ESDM Courses

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<th><strong>Level Code:</strong></th>
<th>L3</th>
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</thead>
<tbody>
<tr>
<td><strong>Vertical Name:</strong></td>
<td>Medical Electronics</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Course ID:</strong></th>
<th>NL/S/L3/C006</th>
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</thead>
<tbody>
<tr>
<td><strong>Course Name:</strong></td>
<td>3.5.2 Repair &amp; Maintenance of ECG and ICCU Equipment</td>
</tr>
</tbody>
</table>

## 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, ICCU 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

<table>
<thead>
<tr>
<th>Module No.</th>
<th>Modules</th>
<th>Minimum No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Tools and servicing maintenance of Hard and soft.</td>
<td>75</td>
</tr>
<tr>
<td>2.</td>
<td>Familiarization and working with components, ECG, ICCU equipments</td>
<td>175</td>
</tr>
<tr>
<td>3</td>
<td>Soft Skills</td>
<td>100</td>
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<td></td>
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</tbody>
</table>

Total Theory / Lecture Hours: 250
Total Practical / Tutorial Hours: 100
Total Hours: 350

Recommended Hardware:
<table>
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<tr>
<th>Category</th>
<th>Information</th>
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</thead>
<tbody>
<tr>
<td>Recommended</td>
<td>Software:</td>
</tr>
<tr>
<td></td>
<td>Text Books:</td>
</tr>
<tr>
<td></td>
<td>Reference Books:</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Module. No</th>
<th>Modules</th>
<th>Minimum No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Course Description</td>
<td>Hours</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>1.</td>
<td>Basic Building Blocks of Bio-Medical Equipment</td>
<td>40</td>
</tr>
<tr>
<td>2.</td>
<td>Imaging Equipment</td>
<td>80</td>
</tr>
<tr>
<td>4.</td>
<td>On Job Training</td>
<td>100</td>
</tr>
<tr>
<td>5.</td>
<td>Soft Skills</td>
<td>100</td>
</tr>
</tbody>
</table>

**Total Theory / Lecture Hours:** 250  
**Total Practical / Tutorial Hours:** 100  
**Total Hours:** 350

Recommended Hardware:

Recommended Software:

Text Books:

Reference Books:
**ESDM Courses**

<table>
<thead>
<tr>
<th>Level Code:</th>
<th>L5</th>
<th>Vertical Name:</th>
<th>Medical Electronics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course ID:</td>
<td>NL/S/L5/C009</td>
<td>Course Name:</td>
<td>3.5.4 Post Diploma in Repair &amp; Maintenance of Hospital Equipment</td>
</tr>
</tbody>
</table>

**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  
 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

<table>
<thead>
<tr>
<th>Module. No</th>
<th>Modules</th>
<th>Minimum No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Basic Block of Biomedical Equipment</td>
<td>30</td>
</tr>
<tr>
<td>2.</td>
<td>ECG Machine and analytical</td>
<td>30</td>
</tr>
<tr>
<td>3.</td>
<td>Diagnostic Equipment</td>
<td>30</td>
</tr>
<tr>
<td>4.</td>
<td>Biomedical instrumentation</td>
<td>30</td>
</tr>
<tr>
<td>5.</td>
<td>Hands on Experience</td>
<td>200</td>
</tr>
<tr>
<td>6.</td>
<td>Soft Skills</td>
<td>30</td>
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<tr>
<td></td>
<td>Total Hours:</td>
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Recommended Hardware:

Recommended Software:
<table>
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<tr>
<th>ESDM Courses</th>
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</thead>
<tbody>
<tr>
<td><strong>Level Code:</strong></td>
</tr>
<tr>
<td><strong>Vertical Name:</strong></td>
</tr>
<tr>
<td><strong>Course ID:</strong></td>
</tr>
<tr>
<td><strong>Course Name:</strong></td>
</tr>
</tbody>
</table>

**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:**

Photocopy and Printer Repair Technician

**Duration of the Course (in hours):** 200

**Minimum Eligibility Criteria and pre-requisites, if any:** 8th 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 ) |
| PK4. that are required to be used |
| PK5. First aid requirements in case of electrical shocks, cuts and other common injuries |
| PK6. Soldering and De-Soldering Techniques |
| PK7. Principle of Operation of Photocopier |
| PK8. Dismantling and assembling of paper feed mechanism, paper tray, Thermal unit and Toner Unit. |
| PK9. Identify the various sensors used in the copier and their fixtures. |
| PK10. Paper trays, Paper feed mechanism and the sensors used for paper movement |
| PK11. Periodic cleaning and servicing of copier machines |
| 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

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Modules</th>
<th>Min: No. of Hours</th>
<th>Theory/ Practical</th>
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<tbody>
<tr>
<td>1.</td>
<td><strong>Introduction to Electricity</strong></td>
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<tr>
<td></td>
<td>Electric Charge, Voltage, Electric Current</td>
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<td></td>
<td>Ohm’s Law, Electric Potential, Cell</td>
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<tr>
<td></td>
<td>Serial and Parallel Circuit, their effect on Voltage and Current</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>5/ 5</td>
<td></td>
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<tr>
<td>2.</td>
<td><strong>Electronic and Electrical components</strong></td>
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<tr>
<td></td>
<td>Active and Passive Components</td>
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<tr>
<td></td>
<td>Resistors, Capacitors and Inductors, their identification, types and application</td>
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<td></td>
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<tr>
<td></td>
<td>Semiconducting Devices: Diodes, its type, characteristics and applications</td>
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<td></td>
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<tr>
<td></td>
<td>Transistors, Integrated Circuits</td>
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<tr>
<td></td>
<td>Study of a transistor, use of a transistor as an amplifier and as a switch.</td>
<td></td>
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<tr>
<td></td>
<td>Analog ICs, 555 timer, IC741, characteristics of 741</td>
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<tr>
<td></td>
<td>Digital ICs, ICS for logic gates, Truth table verification of logic gates</td>
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<td></td>
<td>Connectors</td>
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<td></td>
<td>Fuse, types, Use of Fuses and its rating</td>
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<tr>
<td></td>
<td>Relays and Switches</td>
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<td>Panel Components</td>
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<tr>
<td></td>
<td>Digital electronics – gates and its application, multiplexers, de-multiplexers, counter</td>
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<td>10/ 10</td>
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<tr>
<td>3.</td>
<td><strong>Soldering/ de-soldering techniques</strong></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Soldering Iron, Soldering wire, Soldering Flux, Soldering method,</td>
<td></td>
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<td></td>
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<td>10 / 10</td>
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<tr>
<td>4.</td>
<td><strong>Tools and equipment</strong></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>Screw Driver Set</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tweezers, Different Types of Tweezers, Nose Pliers, Wire Cutter</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Hot air gun</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Liquid solder pest, Magnifying Lamp and Measuring Tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brush, CRO, Nipper</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Test and Measurement Equipment, Multimeter Operation etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Zero defect soldering**  
Desoldering pump, Temperature controlled soldering station,  
Hands-on practices of Soldering

<table>
<thead>
<tr>
<th>5.</th>
<th><strong>Photocopi ers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Principle of Operation of Photocopier</td>
</tr>
<tr>
<td></td>
<td>Dismantling and assembling of paper feed mechanism, paper tray, Thermal unit and Toner Unit.</td>
</tr>
<tr>
<td></td>
<td>Identify the various sensors used in the copier and their fixtures.</td>
</tr>
<tr>
<td></td>
<td>Fault finding and repairing in electrostatic high voltage unit.</td>
</tr>
<tr>
<td></td>
<td>Dismantling and fitting of drum unit- cleaning of drum unit</td>
</tr>
<tr>
<td></td>
<td>Dismantling and refitting of Carriage unit , mirror unit and light unit</td>
</tr>
<tr>
<td></td>
<td>Paper trays, Paper feed mechanism and the sensors used for paper movement</td>
</tr>
<tr>
<td></td>
<td>Periodic cleaning and servicing of copier machines</td>
</tr>
<tr>
<td></td>
<td>Overall fault finding and repair a photo copier machine.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6.</th>
<th><strong>Printers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Printers and their types.</td>
</tr>
<tr>
<td></td>
<td>Thermal Printers and Inkjet Printer, their Working Principle</td>
</tr>
<tr>
<td></td>
<td>Laser Printers and its operation</td>
</tr>
<tr>
<td></td>
<td>Different Parts of Printer</td>
</tr>
<tr>
<td></td>
<td>Cartridges, toner, drum, their use and its replacement</td>
</tr>
<tr>
<td></td>
<td>Overall fault finding and repair of Printers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7.</th>
<th><strong>Safety and Security Procedures</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reporting incidents, system failures, power failures etc., protection equipment</td>
</tr>
<tr>
<td></td>
<td>First aid requirement in case of electrical shocks and other injuries</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8.</th>
<th><strong>Reading, Writing and Communication Skills</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Understanding Technical Manuals, Reports, Work orders etc.</td>
</tr>
<tr>
<td></td>
<td>Understanding Organizational health and safety instructions</td>
</tr>
<tr>
<td></td>
<td>Types of documentation in organization, their importance, Company guidelines and norms, activities after maintenance process</td>
</tr>
<tr>
<td></td>
<td>Spare management, Service Level Agreements (SLAs)</td>
</tr>
<tr>
<td></td>
<td>Fill-up forms, record sheets, log book etc. as per company procedures</td>
</tr>
<tr>
<td></td>
<td>Customer Communication, Convey proposed solution to the customer, responding queries</td>
</tr>
<tr>
<td></td>
<td>Communication with supervisor, Report for unresolved problems</td>
</tr>
<tr>
<td></td>
<td>Time Management and Team Skills</td>
</tr>
</tbody>
</table>

| 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
**Objective of the Course:**

To obtain proficiency in the different components of PC (processors, motherboard, 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

<table>
<thead>
<tr>
<th>Module No.</th>
<th>Module Name</th>
<th>Minimum No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PC Hardware</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>1. Know your computer, PC case, SMPS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Motherboard of clients, Motherboard of Servers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Hard disks, CPUs - Intel/AMD, Keyboards, Mouse, USB Devices</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Monitors – CRT / TFT / LCD / LED</td>
<td></td>
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<tr>
<td></td>
<td>5. I/O devices – Printers, Webcams, Scanners, Digital Camera</td>
<td></td>
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<tr>
<td></td>
<td>6. USB Wifi, USB BT, USB Storages, UPS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Overhead/LCD/DLP/LED Projectors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Assembling of a PC, Servers and trouble shooting</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>PC Hardware Practical</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>1. Loading and configuration procedure of Microsoft Client O/S – Win XP / Win 7 and Windows 8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Loading and configuration procedure of Linux Clients and server OS</td>
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<tr>
<td></td>
<td>4. Firewall configuration, Antivirus/Internet security loading and configuration procedure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Installation and configuration of I/O devices – Printers, Webcams, Scanners, Digital Camera, USB Wifi, USB BT, USB Storages, Projectors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Multiple OS loading and trouble shooting</td>
<td></td>
</tr>
</tbody>
</table>
### Computer Networking

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

### Computer Networking Practical

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

**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.
### ESDM Courses

<table>
<thead>
<tr>
<th>Level Code:</th>
<th>Vertical Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>L4</td>
<td>Office Automation, IT &amp; Networking</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course ID:</th>
<th>Course Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>NL/S/L4/C020</td>
<td>1.6.3 CHM-O Level</td>
</tr>
</tbody>
</table>

### Objective of the Course:

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

- 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
- Troubleshoot 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:

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

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 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 & maintain effective working relationships environment & collaboration
- CS15. Take initiatives and progressively assume increased responsibilities
- CS16. Share knowledge with other team members and colleagues
- CS17. Improve social responsibilities and environmental understanding.

Detailed Syllabus of Course

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Modules</th>
<th>Min: No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory/Practical</td>
</tr>
<tr>
<td>1.</td>
<td>PC Hardware &amp; Components</td>
<td>30/30</td>
</tr>
<tr>
<td>2.</td>
<td>PC Architecture</td>
<td>30/20</td>
</tr>
<tr>
<td>3.</td>
<td>Advanced networks and networking peripherals</td>
<td>40/40</td>
</tr>
<tr>
<td>4.</td>
<td>Operating System, Software &amp; Tools</td>
<td>40/40</td>
</tr>
<tr>
<td>5.</td>
<td>Personality Development</td>
<td>34/16</td>
</tr>
</tbody>
</table>
**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.
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 :**
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
Recommended Software:

1. Linux and other popular OS, Office productivity tools.


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
<table>
<thead>
<tr>
<th>Duration of the Course (in hours)</th>
<th>470</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Eligibility Criteria and prerequisites, if any</td>
<td>12th Pass/ITI/Diploma, graduation or more with CHM-O level</td>
</tr>
</tbody>
</table>
### Professional Knowledge:

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

**Reading skills**
- CS18. Read and understand technical manuals, work orders and reports
- CS19. Read and understand organizational health and safety instructions

**Writing Skills**
- CS20. Fill up record sheets clearly, concisely and accurately as per company procedures
- CS21. Prepare a project report based on the objectives, literature survey, methodology, results and conclusion.

**Communication Skills**
- CS22. Communicate relevant information to superiors, subordinates and colleagues
- CS23. Respond appropriately to queries
- CS24. Communicate with customer/customer facing teams & convey proposed solution
- CS25. Communicate through technical documentation.

**Time Management Skills**
- CS26. Plan, procure and execute a project in a given time frame
- CS27. Prioritize and execute tasks in a high-pressure environment
- CS28. Use and maintain resources efficiently and effectively

**Analytical Skills**
- CS29. Analyse (and understand) customer complaints
- CS30. Analyse and provide solution to the co-workers and subordinates.
- CS31. Interpret reports, readings and numerical data
- CS32. Keep up to date with new technology and performance issues

**Other Skills**
- CS33. Create and maintain effective leadership and team environment
- CS34. Take initiatives and progressively assume increased responsibilities
- CS35. Share knowledge with other team members and colleagues
- CS36. Improve social responsibilities and environmental understanding.

---

**Detailed Syllabus of Course**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Modules</th>
<th>Practical</th>
<th>Theory</th>
<th>Total No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Advance PC Hardware &amp; Networking Components</td>
<td>25</td>
<td>35</td>
<td>60</td>
</tr>
<tr>
<td>2.</td>
<td>Data Communication and Computer Networks</td>
<td>35</td>
<td>40</td>
<td>75</td>
</tr>
<tr>
<td>3.</td>
<td>Network Management and Administration</td>
<td>40</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>4.</td>
<td>Linux Administration</td>
<td>35</td>
<td>45</td>
<td>80</td>
</tr>
<tr>
<td>5.</td>
<td>Entrepreneurship Development</td>
<td>10</td>
<td>35</td>
<td>45</td>
</tr>
<tr>
<td>6.</td>
<td>Project</td>
<td>60</td>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td>7.</td>
<td>(Elective) IT Security/ Networking with Advanced components</td>
<td>30</td>
<td>40</td>
<td>70</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Total Practical / Tutorial Hours:</td>
<td>235</td>
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<td></td>
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<tr>
<td>Total Theory / Lecture Hours:</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Hours:</td>
<td>470</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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.
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:**

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

**Recommended Software:**

1. Linux and other popular OS, Office productivity tools.
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**

<table>
<thead>
<tr>
<th>Level Code:</th>
<th>Vertical Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>L2</td>
<td>Telecom Segment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Code:</th>
<th>Course Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>NL/S/L2/C011</td>
<td>1.7.1 Installation/Repair &amp; Maintenance of EPABX System</td>
</tr>
</tbody>
</table>
### 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:

<table>
<thead>
<tr>
<th>The job potentials are as follows:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Job as technician/operator in different telephone exchanges in Government/Private sector</td>
</tr>
<tr>
<td>• Job in telephone industries like BSNL, MTNL and others</td>
</tr>
<tr>
<td>• Job &amp; Repairing Centre</td>
</tr>
<tr>
<td>• Self Employment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration of the Course (in hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 Hrs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum Eligibility Criteria and pre-requisites, if any</th>
</tr>
</thead>
<tbody>
<tr>
<td>9th Pass</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Module. No</th>
<th>Module. Name</th>
<th>Minimum No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory (Hrs.)</td>
</tr>
<tr>
<td>1.</td>
<td>Basic Communication System</td>
<td>05</td>
</tr>
<tr>
<td>2.</td>
<td>Digital Modulation Technique</td>
<td>10</td>
</tr>
<tr>
<td>3.</td>
<td>Modems</td>
<td>05</td>
</tr>
<tr>
<td>4.</td>
<td>Push button Telephones</td>
<td>20</td>
</tr>
<tr>
<td>5.</td>
<td>Electronic Exchange</td>
<td>10</td>
</tr>
<tr>
<td>6.</td>
<td>EPABX systems</td>
<td>10</td>
</tr>
<tr>
<td>7.</td>
<td>Digital Exchange</td>
<td>10</td>
</tr>
</tbody>
</table>

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
VARIABLE 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 ADAPTOERS, CONNECTORS AND SOCKETS USED IN THE TELEPHONE CIRCUITS
FAMILARIATION 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. FAMILARISATION 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:
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:

1.8 Computer Hardware

ESDM Courses

Level Code: L2  Vertical Name: Computer Hardware

Course ID: NL/S/L2/C010  Course Name: 3.8.1 Assembly and Maintenance of Personal Computer

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)  240 Hrs

Minimum Eligibility Criteria and pre-requisites, if any  Polytechnic Diploma/Graduation/ ITI/12th/10th
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 Rebolling 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

<table>
<thead>
<tr>
<th>Module No</th>
<th>Module Name with Detailed syllabus</th>
<th>Minimum No. of Hours (Theory/Practical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Module-I</td>
<td>Introduction to Computer, Uses of Computer, Different between Hardware &amp; 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.</td>
<td>40 Hrs</td>
</tr>
<tr>
<td>➢ Module-II</td>
<td>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.</td>
<td>30 Hrs</td>
</tr>
<tr>
<td>➢ Module-III</td>
<td>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</td>
<td>40 Hrs</td>
</tr>
<tr>
<td>Module-IV</td>
<td>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</td>
<td>50 Hrs</td>
</tr>
<tr>
<td>---</td>
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<td>---</td>
</tr>
<tr>
<td>Module-V</td>
<td>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</td>
<td>30 Hrs</td>
</tr>
<tr>
<td>Module-VI</td>
<td>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.</td>
<td>50 Hrs</td>
</tr>
</tbody>
</table>

Total Theory / Lecture Hours:  
Total Practical / Tutorial Hours:  
Total Hours:  

Recommended Hardware (minimum batch size 10):  
- Different types of Mother Board  
  - Desktop  
- Different types of Cards  
  - VGA  
  - AGP  
  - NIC  
  - Audio  
- Different types of Tools and instrument  
  - 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

<table>
<thead>
<tr>
<th>Module. No</th>
<th>Module. Name</th>
<th>Minimum No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>INTRODUCTION</strong></td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td><strong>Programmable Logic Devices (PLDs)</strong></td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Introduction, PLDs Types-Simple PLDs (SPLDs), Complex PLDs (CPLDs) and Field Programmable Gate Array (FPGA), there 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.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>System Verilog Code Structure and FPGA Implementation</strong></td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><strong>VLSI Technology</strong></td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Basic MOS Transistor Operations and Electrical Properties, Fabrication Process, Passive Component Fabrication Process, Gyrator Circuit Fabrication for Inductor, Development in Technology and Equipment’s for Oxidation, Diffusion, ION Implantation, Etching, Photolithography etc. Moore’s Law and Nano-Meter VLSI Technology Comparison,</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><strong>VLSI Design- Part 1</strong></td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td><strong>SPICE Modelling for VLSI Design-Part 2</strong></td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td><strong>File Interchange Format for VLSI Design</strong></td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Need for File Inter Change, GDS2 Stream, Caltech Intermediate Format (CIF), Library Exchange Format (LEF), Design Exchange Format (DEF), Standard Delay Format (SDF), DSPF</td>
<td></td>
</tr>
</tbody>
</table>
and SPEF, Advance Library Format (ALE), Waves Waveform and Vector Exchange Specification, Physical Design Exchange Format, Open Access

<table>
<thead>
<tr>
<th>8</th>
<th>Design Verification</th>
</tr>
</thead>
</table>

| 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
4. “Design through Verilog HDL”, T. R. Padmanabhan, B. Bala, Tripura Sundari, Publisher: Willey India (P) Ltd.

**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**
   UVM cookbook (Online reference)
5. Online Methodology Documentation from the Mentor Graphics Verification Methodology Team
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

<table>
<thead>
<tr>
<th>Module No</th>
<th>Module Name</th>
<th>No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory / Practical</td>
</tr>
<tr>
<td>1.</td>
<td>Embedded C with 8051 - Theory</td>
<td>15 /25</td>
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<tr>
<td></td>
<td>• Introduction to ‘C’ programming</td>
<td></td>
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<tr>
<td></td>
<td>• Embedded C Programming with KEIL</td>
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<tr>
<td>2.</td>
<td>8051 Architecture - Theory</td>
<td>10/0</td>
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<tr>
<td></td>
<td>• Architecture of 8051 Family of Microcontrollers</td>
<td></td>
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<tr>
<td>3.</td>
<td>8051 Peripherals - Theory</td>
<td>15/60</td>
</tr>
<tr>
<td></td>
<td>• Timers</td>
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<td></td>
<td>• Interrupts</td>
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<tr>
<td></td>
<td>• Serial Port</td>
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<tr>
<td>4.</td>
<td>Interfacing 8051 to peripheral devices –Theory</td>
<td>15/60</td>
</tr>
<tr>
<td></td>
<td>• LCD</td>
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<tr>
<td></td>
<td>• Key board</td>
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<tr>
<td></td>
<td>• Stepper Motor</td>
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</tbody>
</table>
5. **Embedded C with PIC – Theory**
   - Embedded C Programming with MPLab
   - 15/25

6. **PIC Architecture – Theory**
   - Architecture of PIC Microcontrollers
   - 10/0

7. **PIC Peripherals - Theory**
   - Timers
   - Interrupts
   - ADC
   - Serial Port
   - 15/60

8. **Interfacing PIC to peripheral devices – Theory**
   - LCD
   - Keyboard
   - Stepper Motor
   - 15/60

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**Theory / Lecture Hours:** 110 hrs

**Practical / Tutorial Hours:** 290 hrs

**Total Hours:** 400 hrs

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

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**Recommended Software:**
1. Kiel ‘C’ or similar Embedded C Compiler for 8051
2. MP Lab with PIC –C Compiler/any other appropriate compiler

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**Text Books:**
2. Design with PIC Microcontrollers, Peatman, John B , Pearson Education PTE. Ltd.

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

Level Code: L4
Vertical Name: Solar Electronics

Course Code: NL/M/L4/C022
Course Name: 1.10.1 Solar-LED Lighting Products (Design)
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 10th + ITI, 12th 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
<table>
<thead>
<tr>
<th>Module. No</th>
<th>Module. Name</th>
<th>Minimum No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction of light sources and their characteristics</td>
<td>15/15</td>
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<tr>
<td></td>
<td>- Light sources, characteristics of light sources, introduction to light units- candela, lux &amp; nits</td>
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<tr>
<td>2</td>
<td>Comparative study of LED and other light sources</td>
<td>15/15</td>
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<td></td>
<td>- Introduction of LEDs, principles of operation, Efficiency, lifetime and quality of LEDs, type of LEDs.</td>
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<td></td>
<td>- Electrical and Optical behaviour of LEDs with Temperature: Parallel circuit of LEDs, white light production from LEDs.</td>
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<td>- Calculation of current in the use of LEDs : Basic ideas for reliability</td>
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<td></td>
<td>- General principles of working of LED flash light, USB light, automobile taillight and replacement of Bulb and CFL by LED lights.</td>
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<td>- Ideas on quality of light, human visual function: receptors, retina, brain, warm white and daylight white colour spectrum and their effect on human being.</td>
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<tr>
<td>3</td>
<td>Basic Principle , Design and Assembly of LED based products</td>
<td>20/30</td>
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<tr>
<td></td>
<td>- General principles of working of LED luminaries. Design of constant current drive circuits.</td>
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<td></td>
<td>- Assembly and testing procedures for LED based products.</td>
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<td></td>
<td>- 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 &amp; calibrator, magnifying glass, etc.</td>
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<td>- IP rating and CREE standards, SS standards (sorting, setting, standardise, sustain, shining)</td>
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<td>- ESD and work safety precautions.</td>
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<td>- Handling and disposal of hazardous material.</td>
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<tr>
<td>4</td>
<td>Introduction of Renewable Energy &amp; Study of Characteristics of SPV Cells</td>
<td>30/30</td>
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<tr>
<td></td>
<td>- Introduction to Solar Energy as Renewable source, Historical perspective of using Solar energy, Concept of Solar Photovoltaic Cells (SPV), Basic Principle &amp; Working of SPV's.</td>
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<td>- Charging of Battery &amp; Operating life of SPV, Storage battery size &amp; Autonomy of SPV system</td>
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<tr>
<td>5</td>
<td>Installation and maintenance of solar panel</td>
<td>20/30</td>
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<td></td>
<td>- 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</td>
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</tbody>
</table>
equipment, site surveying methods and evaluation parameters,
- 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.

<table>
<thead>
<tr>
<th></th>
<th>Project Work- PCB designing</th>
<th>50/60</th>
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<tbody>
<tr>
<td>6</td>
<td>Introduction to PCB Designing and future scope</td>
<td></td>
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<tr>
<td></td>
<td>- Different techniques to implement circuit</td>
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<td></td>
<td>- Advantages of PCB based products</td>
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<td></td>
<td>- Advantages of designing with CAD softwares</td>
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<td>Designing circuits in schematic</td>
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<td></td>
<td>- To capture the circuit to make a PCB</td>
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<td>- Different techniques of modelling of design</td>
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<td></td>
<td>- Top down and Bottom up methodology for design</td>
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<tr>
<td></td>
<td>- Creating Netlist of design and producing files for layout</td>
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<td></td>
<td>Designing layout of circuits and generating output</td>
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<tr>
<td></td>
<td>- Creating a layout of board using layout tool</td>
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<td>- Auto-routing and manual routing of a board</td>
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<td>- Making footprints of different components</td>
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<td>- Post processing and generating gerber files</td>
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</tbody>
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<thead>
<tr>
<th></th>
<th>Project Work- Led luminaries design</th>
<th>0/20</th>
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<tbody>
<tr>
<td>7</td>
<td>Total Theory / Lecture Hours:</td>
<td>150</td>
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<tr>
<td></td>
<td>Total Practical / Tutorial Hours:</td>
<td>200</td>
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<tr>
<td></td>
<td>Total Hours:</td>
<td>350</td>
</tr>
</tbody>
</table>

**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