GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

**COMPETENCY BASED CURRICULUM**

# MANUFACTURING PROCESS CONTROL AND AUTOMATION

**(Duration: One Year)**

## CRAFTSMEN TRAINING SCHEME (CTS)

## NSQF LEVEL –4


## SECTOR – CAPITAL GOODS & MANUFACTURING

Directorate General of Training

# MANUFACTURING PROCESS CONTROL AND AUTOMATION

**(Engineering Trade)**

**(Designed in 2021)**

**Version: 1.0**

## CRAFTSMEN TRAINING SCHEME (CTS)

## NSQF LEVEL –4

Developed By

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# 1. COURSE INFORMATION

The one-year course of **Manufacturing Process Control and Automation** trade is designed to provide training to students with professional Skills &Knowledge regarding industrial automation, Workshop Calculations, Science and Employability Skill related to job role. In addition to this, the candidate entrusted to undertake project work and extracurricular activities to build up confidence. The broad components covered in one-year duration are as below:

Manufacturing Process Control and Automation Sets up Industrial automation, responsible to develop the industrial automated process through PLC, HMI and SCADA and help to develop industry Automation using different components, equipment.

Manufacturing Process Control and Automation technician able to create Industrial Automation Systems like Fixed Automation System, Programmable Automation System, flexible Automation System and Integrated Automation System using PLC, HMI and SCADA. The industrial automation technician can work in Automobile process control, Automation, baker, Confectionery Agriculture, Production, Manufacturing, Fruit, Vegetable Processing, Network Technician, Plastic processing and more.

The Automation Technician will provide routine diagnostic checks for all equipment in automation industries, repair and maintain instruments, electrical wiring, and control systems. They are fluent in cases, have certified knowledge of electronics, mechanics and programmable logic controllers.

Manufacturing Process Control and Automation technician is able to perform operation and programming of programmable logic control PLC. System implementation and high-level process for supervisory management, control and data Complete understanding.

# 2. TRAINING SYSTEM

## 2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of the economy / labor market. The Vocational Training Programs are delivered under the aegis of the Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer Programmes of DGT for propagating vocational training.

CTS courses are delivered nationwide through network of ITIs. The course 'Manufacturing Process Control and Automation' is of one-year duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory and Trade Practical) imparts professional skills and knowledge, while Core area (Workshop calculation & science and Employability Skills) imparts requisite core skill, knowledge and life skills. After passing out of the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

### Trainee broadly needs to demonstrate that they are able to:

- Read and interpret technical parameters/ documentation, plan and organize work processes, identify necessary materials and tools.
- Perform tasks with due consideration to safety rules, accident prevention regulations and environmental protection stipulations.
- Apply professional knowledge & employability skills while performing the job and modification & maintenance work.
- Document the technical parameters related to the task undertaken.

## 2.2 PROGRESSION PATHWAYS

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can join Apprenticeship Programmes in different types of industries leading to a National Apprenticeship Certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming an instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

## 2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of one-year:

| S No. | Course Element | Notional Training Hours |
|---|---|---|
| 1 | Professional Skill (Trade Practical) | 1000 |
| 2 | Professional Knowledge (Trade Theory) | 280 |
| 3 | Workshop Calculation & Science | 80 |
| 4 | Engineering Drawing | 80 |
| 5 | Employability Skills | 160 |
| | **Total** | **1600** |

## 2.4 ASSESSMENT &CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment** (Internal) during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure is being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

### 2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one-year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%. There will be no Grace marks.

## 2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examination body. The following marking pattern to be adopted while assessing:

| Performance Level | Evidence |
|---|---|
| (a) Weightage in the range of 60%-75% to be allotted during assessment | |
| For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices | • Demonstration of good skill in the use of hand tools, machine tools and workshop equipment.<br>• 60-70% accuracy achieved while undertaking different work with those demanded by the component/job.<br>• A fairly good level of neatness and consistency in the finish.<br>• Occasional support in completing the project/job. |
| (b) Weightage in the range of 75%-90% to be allotted during assessment | |
| For this grade, a candidate should produce | • Good skill levels in the use of hand tools, |

| | |
|---|---|
| work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices | machine tools and workshop equipment.<br>• 70-80% accuracy achieved while undertaking different work with those demanded by the component/job.<br>• A good level of neatness and consistency in the finish.<br>• Little support in completing the project/job. |
| (c) Weightage in the range of more than 90% to be allotted during assessment | |
| For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship. | • High skill levels in the use of hand tools, machine tools and workshop equipment.<br>• Above 80% accuracy achieved while undertaking different work with those demanded by the component/job.<br>• A high level of neatness and consistency in the finish.<br>• Minimal or no support in completing the project. |

# 3. JOB ROLE

Manufacturing Process Control and Automation Sets up for the one-year of duration, Industrial automation technician able to develop the industrial automated process through PLC, HMI, SCADA and develop different components, equipment.

The role of this job starts from Technician and at advanced stage chance for PLC Programmer. IT related things like data management, process control. Familiar about different type of job role like electrical, IT and mechanical. Understanding about the working process of assembly line, Error detection through sensor. There are various industries job roles – Automation technician, Automation trainer, Assistant technician etc. All these opportunity are available in industry like Automobile, baker, Agriculture, Production and Manufacturing, Textile, Fruit, Vegetable Processing Network Technician, Pharma, Plastic processing and more. Understanding about pick to light system, which is very accurate and efficient. Robotics is also one of the opportunity. Program testing, installation, technical support. All these things you will learn and perform various practical task. Gain practical knowledge about testing and modification. Coordination between different department like Design engineer, production and purchase. Opportunity to learn about management skill, time and cost reduction and various operation. Automation process provide real time data which is very important for monitor and manage inventory, so inventory management also cover in this course. This is vast system with multiple opportunity and the demand of Manufacturing Process Control and Automation will increase day by day in larger as well as small scale industry. In addition, communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

**Automation Specialist** Individuals at this job are responsible for providing support to production operations through maintenance of process control systems installed at shop floor for various manufacturing processes.

**Reference NCO-2015:**

(i) 7412.0101 - Automation Specialist.

## 4. GENERAL INFORMATION

| | |
|---|---|
| **Name of the Trade** | **MANUFACTURING PROCESS CONTROL AND AUTOMATION** |
| **Trade Code** | DGT/2021 |
| **NCO – 2015** | 7412.0101 |
| **NSQF Level** | Level 4 |
| **Duration of Craftsmen Training** | One Year (1600 Hours) |
| **Entry Qualification** | Class X Pass plus simultaneously enrolled for class XII through NIOS **or** Class XII pass **or** ITI plus class X |
| **Minimum Age** | 14 years as on first day of academic session. |
| **Eligibility for PwD** | LD, CP, LC, DW, AA, LV, DEAF, AUTISM, MD |
| **Unit Strength (No. Of Student)** | 20 (There is no separate provision of supernumerary seats) |
| **Space Norms** | 120 Sq. m |
| **Power Norms** | 3 KW (extended battery backup mandatory) |
| **Instructors Qualification for** | |
| **(i) Manufacturing Process Control and Automation** | B.Voc/ Degree in Mechanical/ Industrial Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field.<br>**OR**<br>03 years Diploma in Electronics /Industrial Engineering from AICTE/ recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field.<br>**OR**<br>NTC/NAC passed in the trade of "Manufacturing Process Control and Automation" with three years' experience in the relevant field.<br><br>**Essential Qualification:**<br>Relevant National Craft Instructor Certificate (NCIC) in any of the variants under DGT.<br>**NOTE: -Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC** |

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| | **qualifications. However, both of them must possess NCIC in any of its variants.**<br>***Faculty to be trained for 10 days by the machine manufacturer on the usages.*** |
| **(ii) Workshop Calculation & Science** | B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field.<br>**OR**<br>03 years Diploma in Engineering from AICTE/ recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field.<br>**OR**<br>NTC/ NAC in any one of the engineering trades with three years' experience.<br><br>**Essential Qualification:**<br>National Craft Instructor Certificate (NCIC) in relevant trade<br>**OR**<br>NCIC in RoDA or any of its variants under DGT |
| **(iii) Engineering Drawing** | B.Voc / Degree in Engineering from AICTE / UGC recognized Engineering College/ university with one-year experience in the relevant field.<br>**OR**<br>03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field.<br>OR<br>NTC/ NAC in any one of the Electrical trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience.<br><br>**Essential Qualification:**<br>National Craft Instructor Certificate (NCIC) in relevant trade<br>**OR**<br>NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT. |
| **(iv) Employability Skill** | MBA/BBA/Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills from DGT institutes.<br>(Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) |

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| | OR<br>Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills from DGT institutes. |
| **(v) Minimum Age for Instructor** | 21 Years |
| **List of Tools and Equipment** | As per Annexure – I |

**Distribution of training on Hourly basis: (Indicative only)**

| Total Hrs. /week | Trade Practical | Trade Theory | Workshop Cal. & Sc. | Engineering Drawing | Employability Skills |
|---|---|---|---|---|---|
| 40 Hours | 25 Hours | 7 Hours | 2 Hours | 2 Hours | 4 Hours |

# 5. LEARNING OUTCOME

***Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.***

## 5.1 LEARNING OUTCOMES (TRADE SPECIFIC)

1. Adhere to safe working practices, environment regulation and housekeeping.
2. Plan and perform Manufacturing processes, process control & automation.
3. Demonstrate Batch, Discrete, Continuous Manufacturing processes.
4. Apply the knowledge of numbering systems in PLC.
5. Perform Memory organization in PLC and programming Devices.
6. Demonstrate Programmable logic control and its application, Selection criteria and types.
7. Execute Input and output module for programmable logic control.
8. Perform operation of Input output devices of programmable logic control.
9. Operate the variable frequency drive VFD.
10. Install wiring of PLC based control panel.
11. Construct PLC programming ladder diagram and relay instructions.
12. Apply Advance Instruction use in PLC ladder diagram Timer and counter.
13. Perform interfacing of PLC and HMI.
14. Install and configure HMI Application software.
15. Operate Supervisory data control and acquisition system (SCADA).
16. Perform interfacing of SCADA with PLC.
17. Apply the Communication network for SCADA.
18. Enumerate the difference between SCADA and HMI.
19. Develop SCADA Architecture.
20. Plan and execute SCADA with PLC Simulation Example.

# 6. ASSESSMENT CRITERIA

| LEARNING OUTCOME | ASSESSMENT CRITERIA |
|---|---|
| 1. Adhere to safe working practices, environment regulation and housekeeping. | Understand the Importance of trade training, List of tools used in the trade. |
| | Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements. |
| | Identify basic first aid and use them under different Circumstances. |
| | Recognize and report all unsafe situations according to site policy. |
| | Avoid waste and dispose waste as per procedure. |
| | Hazard identification and avoidance. |
| | Identify Different Safety signs for Danger, Warning, caution & personal safety message. |
| | Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures. |
| | Preventive measures for electrical accidents & steps to be taken in such accidents. |
| | Identify safety alarms accurately. |
| | Identify and observe site evacuation procedures according to site policy. |
| | Identify different fire extinguisher and use the same as per requirement. |
| | Avoid waste and dispose waste as per procedure. |
| | Understand the basics of computer file and folder systems. |
| | Recognize different components of 5S and apply the same in the working environment. |
| | Understand the basics of computer file and folder systems. |
| | Recognize different components of 5S and apply the same in the working environment. |
| | |
| 2. Plan and perform Manufacturing processes, process control & automation. | Understand the use of different component in process. |
| | Understand the working of process control system. |
| | Understand the various automation processes. |
| | Elaborate the closed loop feedback system with different application. |
| | |

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| 3. Demonstrate Batch Discrete, Continuous &Manufacturing processes. | Explain the batch manufacturing in industries. |
| | Explain the Discrete manufacturing in industries. |
| | Explain the continuous manufacturing in industries. |
| | Comparison of Batch Discrete, Continuous &Manufacturing processes. |
| | |
| 4. Apply the knowledge of numbering systems in PLC. | Understand the Decimal systems. |
| | Understand the Binary system. |
| | Understand the Octal systems. |
| | Understand the Hexadecimal system. |
| | Contrast the differences from the above numbering systems in PLC programming. |
| | |
| 5. Perform Memory organization in PLC and programming Devices. | Understand how memory organization is used in the PLC. |
| | Understand the bits and words. |
| | Detail the relationship between a logical and a physical address. |
| | Define the term “rack”. |
| | Detail the structure of a typical PLC-5 address format. |
| | Define and compare the various programming devices available. |
| | Spell out the advantages of programming and monitoring PLCs remotely from a centrally located PC. |
| | |
| 6. Demonstrate Programmable logic control and its application, election criteria and types. | Understand the Basic of Programmable logic device and different terminal and there uses. |
| | Understand the how to mount the PLC in control panel. |
| | Explain the communication port in PLC. |
| | Understand the power supply requirements of PLC. |
| | Complete understanding of PLC applications. |
| | |
| 7. Execute Input and output module for programmable logic control. | Working principle input and output module and their uses. |
| | Understand the Input output module connection. |
| | Demonstration of how to connect input and output devices to input output module. |
| | Understand the Input output module configuration in PLC rack. |
| | The I/O intersection of a PLC connects it to external field devices. |
| | |
| 8. Perform operation of Input output devices of programmable logic | Details understanding of Input devices<br>Push buttons, normally open (NO),Normally closed, Proximity Sensor |

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| control. | (NC),Selector Switch ,Limit Switches ,Sensors, Temperature Limit Switch, Temperature Limit Switch, Level Limit Switch etc. |
| | Details understanding Output devices indicators/alarms, Pilot Lights, Buzzer, Actuators, Solenoids Motors, DC motor's, brushless DC motor and Stepper motors etc. |
| | Explain different type Addressing in PLC. |
| | Explain the connection Between input and output devices. |
| | |
| 9. Operate the variable frequency drive VFD. | Understanding of Variable Frequency Drive. |
| | Explain how to Mount of Variable Frequency Drive. |
| | Understand Connection of Variable Frequency Drive with PLC and motor. |
| | Demonstrate How to operate Variable Frequency Drive. Set and control speed of motor by VFD. |
| | |
| 10. Install wiring of PLC based control panel. | Elaborate the all tool that requires for making the PLC control panel. |
| | Explain the Different component use in control panel and mounting. |
| | Understand the Interfacing of all input and output devices to control panel. |
| | Explain the Different component use in control panel and mounting. |
| | Understand the connection diagram of PLC ,SMPS, Drives, connector, transformer, contactor ,DIN rail, indicator lamp, selector switch, push buttons ,cooling fan, MCB and relays etc. |
| | Understand the power supply requirements for different equipment. |
| | Selection criteria Single or multi door Panel Box, Power switches and Harding connector. |
| | Check the all connection and Power on the control panel. |
| | |
| 11. Construct PLC programming ladder diagram and relay instructions. | Demonstration of how to open PLC programming software and basic commands. |
| | Use of Different ladder diagram instruction. |
| | Explain Basic communication method uses in PLC. |
| | Understand to Create simple ladder diagram in PLC programming software. |

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| | Explain the Addressing input output in ladder diagram. |
| | Connect input and output devices as per ladder that diagrams to PLC via input output module. |
| | Compile the PLC ladder diagram in software and see result. |
| | Connect the programming device to PLC and check the connection status of PLC and laptop or PC. |
| | Upload the PLC program from PLC. |
| | Create ladder diagrams for all logic gate and compile and check result. |
| | Create ladder diagrams for small applications with basic instruction and check the result as per ladder logic. |
| | |
| 12. Apply Advance Instruction use in PLC ladder diagram Timer and counters. | Identify and interpret Timers and Counters. Interpret internal instructions. |
| | Identify and define the basic PLC Timer. |
| | Compare the differences between a TON and a TOF PLC Timer. |
| | Explain the purpose of a PLC Timer and counter. |
| | Define terms commonly used with a PLC Timer and Counter. |
| | Compare the differences between an Up-Counter and Down-Counter. |
| | Explain the Advantages of utilizing a PLC Counter and Timers |
| | Offline and Online edit the PLC Program. |
| | |
| 13. Perform Interfacing of PLC and HMI. | Explain connection between PLC to HMI. |
| | Understand the Communication protocol for HMI and PLC communication. |
| | Demonstration the different HMI programming software. |
| | |
| 14. Install and configure HMI Application software. | Create new project in for HMI. |
| | Create new basics application project for HMI. |
| | |
| 15. Operate Supervisory data control and acquisition system (SCADA). | Introduction to SCADA. |
| | SCADA Software Introduction. |
| | Simple Digital System implementation in SCADA software. |
| | Simple analog System implementation in SCADA software. |
| | Create SCADA Animation In SCADA software. |
| | Conveyor Animation Example. |
| | |

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| 16. Perform Interfacing of SCADA with PLC. | Understand the Interfacing of SCADA with PLC. |
| | How to Control PLC Program from SCADA. |
| | Understanding of Digital Alarms Interfacing with PLC. |
| | Understanding Analog Alarms Virtual Simulation. |
| | Explain Analog Alarms Interfacing with PLC. |
| | Basic Report Generation. |
| | |
| 17. Apply the Communication Network for SCADA. | Import and Export SCADA Project using CSV File. |
| | Open Database Connectivity (ODBC). |
| | Understanding of Language Switching, Recipe, Script in SCADA. |
| | Archive and Retrieve Project. |
| | Simple Heat Exchanger Example. |
| | |
| 18. Enumerate the difference between SCADA and HMI. | Demonstrate the difference between SCADA and HMI system. |
| | |
| 19. Develop SCADA architecture. | Explain the Hardware Architecture of SCADA. |
| | Explain the software Architecture of SCADA. |
| | Explain the different layer of SCADA client layer and Data layer |
| | |
| 20. Plan and execute SCADA with PLC Simulation Example. | Perform all SCADA with PLC Simulation Example |
| | |

## 7. TRADE SYLLABUS

| SYLLABUS FOR PROCESS CONTROL AND AUTOMATION TRADE | | | |
|---|---|---|---|
| **DURATION: ONE YEAR** | | | |
| **Duration** | **Reference Learning outcome** | **Professional Skills (Trade Practical)** | **Professional Knowledge (Trade Theory)** |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge 14 Hrs.<br><br>(Week 1-2) | Adhere to safe working practices, environment regulation and housekeeping. | 1. Importance of trade training, List of tools used in the trade. (03 hrs)<br>2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE) such as use of gloves and goggles. (03 hrs)<br>3. First Aid Method and basic training. (03 hrs)<br>4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (03 hrs)<br>5. Hazard identification and avoidance. (03 hrs)<br>6. Safety signs for Danger, Warning, caution & personal safety message. (03 hrs)<br>7. Preventive measures for electrical accidents & steps to be taken in such accidents. (03 hrs)<br>8. Use of Fire extinguishers. (03 hrs)<br>9. Practice and understand precautions to be followed while working in fitting jobs. | All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures.<br>Soft Skills, its importance and Job area after completion of training.<br>Importance of safety and general precautions observed in the in the industry/shop floor.<br>Introduction of First aid.<br>Operation of electrical mains and electrical safety. Introduction of PPEs.<br>Response to emergencies e.g.; power failure, fire, and system failure.<br>Importance of housekeeping & good shop floor practices.<br>Introduction to 5S concept & its application.<br>Occupational Safety & Health: Health, Safety and Environment guidelines, legislations & regulations as applicable.<br>Basic understanding on Hot work, confined space work and material handling equipment. |

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| | | (03 hrs)<br>10. Safe use of tools and equipment used in the trade by using tweezers for all purposes and handle scrappers. (03 hrs) | |
| | | 11. Demonstrate of the equipment in lab. (05 hrs)<br>12. Perform Computer operation:<br>(i) Create new folder,<br>(ii) Add subfolders,<br>(iii) create application files,<br>(iv) Change appearance of windows,<br>(v) Search for files,<br>(vi) Sort files,<br>(vii) Copy files,<br>(viii) Create shortcut folder,<br>(ix) Create shortcut icon in desktop and taskbar<br>(x) Move files to and from removable disk/ flash drive.<br>(xi) Install a printer from driver software in operating system. (10 hrs)<br>13. Create, save and print a document, worksheet and pdf (portable document format) files. (05 hrs) | Introduction to manufacturing Process Control and automation<br>Basic computer:<br>Introduction to computer, Windows operating system, file management system.<br>Computer hardware and software specification.<br>Knowledge of installation of application software. |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge 14 Hrs. | Plan and perform Manufacturing processes, process control & automation. | 14. Demonstrate the different component use in process. (10 hrs)<br>15. Demonstrate how process control system works. (10 hrs)<br>16. Demonstrate the various | Process: -<br>Process is a series of actions which are carried out in order to achieve a particular result.<br>Process control: -<br>Process control is the ability to monitor and adjust a process to |

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| (Week 3-4) | | automation processes. (15 hrs)<br>17. Demonstrate closed loop feedback system with different application. (15 hrs) | give a desired output. It is used in industry to maintain quality and improve performance.<br>An example of simple process that is controlled is keeping the temperature of a room at a certain temperature using a heater and a thermostat. |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge 14 Hrs.<br><br>(Week 5-6) | Demonstrate Batch, Discrete, Continuous Manufacturing processes. | 18. Demonstrate Discrete manufacturing process. (10 hrs)<br>19. Demonstrate contentious manufacturing process. (10 hrs)<br>20. Demonstrate batch manufacturing process. (15 hrs)<br>21. Demonstrate comparison of Discrete, continues and Batch manufacturing's. (15 hrs) | Discrete manufacturing: - is an industry term for the manufacturing of finished products that are distinct items capable of being easily counted, touched or seen.<br>Continuous manufacturing: Continuous manufacturing concept originated from pig iron production using a blast furnace, where the process operates for multiple years without shutdown.<br>Batch manufacturing: -<br>Batch manufacturing involves multiple discrete steps. After each step in the process, production typically stops so samples can be tested offline for quality. |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge 14 Hrs.<br><br>(Week 7-8) | Apply the knowledge of numbering systems in PLC. | 22. Demonstrate using Decimal systems. (10 hrs)<br>23. Demonstrate using Binary system. (10 hrs)<br>24. Demonstrate using Octal systems. (10 hrs)<br>25. Demonstrate using Hexadecimal systems. (10 hrs)<br>26. Contrast the differences from the above numbering systems in PLC | Number systems are the technique to represent numbers in the computer system architecture, every value that you are saving or getting into/from computer memory has a defined number system. Computer architecture supports following number systems. Binary number system, Octal number system, Decimal number system, Hexadecimal (hex) |

| | | | |
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| | | programming. (10 hrs) | number system. |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge 14 Hrs.<br><br>(Week 9-10) | Perform Memory organization in PLC and programming Devices. | 27. Demonstrate how memory organization is used in the PLC. (10 hrs)<br>28. Demonstrate bits and words. (10 hrs)<br>29. Show Relationship between a logical and a physical address. (10 hrs)<br>30. Show structure of a typical PLC address format. (10 hrs)<br>31. Define programming device And Compare the various programming Devices. (10 hrs) | Programming device:<br>The programming device is used to enter the required program into the memory of the processor.<br>The program is developed in the device and then transferred to the memory unit of the PLC.<br>The memory unit is where the program is stored that is to be used for the control actions to be exercised by the microprocessor. |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge 14 Hrs.<br><br>(Week 11-12) | Demonstrate Programmable logic control and its application, selection Criteria and types. | 32. Demonstrate programmable logic device and different terminal and their uses. (15 hrs)<br>33. Demonstrate mounting of Programmable logic device and input power supply requirements. (15 hrs)<br>34. Demonstrate communication port in PLC and their application. (20 hrs) | Programmable logic device: -<br>PLC is a digital electronic device that uses a programmable memory to store instructions and to implement specific functions such as logic, sequence, timing, counting and arithmetic to control machines and process.<br>Use a programmable memory to store the instructions and specific functions that include On/Off control, timing counting, sequencing, arithmetic and data handling.<br>Block diagram of PLC. Working principle of PLC. |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge 14 Hrs. | Execute Input and output module for programmable logic control. | 35. Demonstration of input output module. (10 hrs)<br>36. Demonstration of how to connect input and output devices to input output module. (10 hrs)<br>37. Demonstrate the mount and | Input and Output Module: -<br>Input and Output Module Provides signal conversion and isolation between the internal logic- level signals inside the PLC and the field's high level signal.<br>The I/O intersection of a PLC |

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| (Week 13-14) | | remove the input and output module in PLC rack. (15 hrs)<br>38. Input output module configuration in PLC rack. (15 hrs) | connects it to external field devices.<br>The main purpose of the I/O interface is to condition the various signals received from or sent to the external input and output devices.<br>Input modules converts signals from discrete or analog input devices to logic levels acceptable to PLC's processor.<br>Output modules converts signal from the processor to levels capable of driving the connected discrete or analog output module<br>Types of Input output module: - DC input module. AC input module. AC/DC output module. Sinking and sourcing |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge 14 Hrs.<br><br>(Week 15-16) | Perform operation of Input output devices of programmable logic control. | 39. Demonstration of all input output devices like sensor and motors. (10 hrs)<br>40. Explain the speciation of all demonstrate input output devices. (10 hrs)<br>41. Demonstrate the mount and remove the input and output devices and their connection. (15 hrs)<br>42. Addressing Input output devices in PLC. (15 hrs) | The I/O section communicates between the I/O sections and the CPU to carry out programmed functions.<br>Input Devices: -<br>Push buttons, Normally open push buttons, Normally closed push buttons, Selector Switch, Limit Switches, Sensors etc.<br>Output Devices: - indicators/alarms, Pilot Lights, Buzzer, Actuators, Solenoids<br>Motors: -DC motor's, brushless DC motor and Stepper motors etc. |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge | Operate the variable frequency drive VFD. | 43. Demonstration of Variable Frequency Drive. (10 hrs)<br>44. Mounting of Variable Frequency Drive. (10 hrs)<br>45. Connection of Variable | VARIABLE FREQUENCY DRIVE VFD: -<br>AC motor speed is controlled in two ways – either by controlling the voltage or frequency. |

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| 14 Hrs.<br><br>(Week 17-18) | | Frequency Drive with PLC and motor. (10 hrs)<br>46. Operate Variable Frequency Drive. Set and control speed of motor by VFD. (10 hrs)<br>47. Demonstrate Small PLC program for VFD operation. (10 hrs) | Frequency controlling gives better control due to constant flux density than voltage control. This is where the working of VFDs comes to play. It is a power conversion device that converts the fixed voltage, fixed frequency of the input power to the variable voltage, the variable frequency output to control AC induction motors.<br>It consists of power electronic devices (like IGBT, MOSFET), high speed central controlling unit (such as a microprocessor, DSP), and optional sensing devices depending on the application used.<br>Working of VFDs |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge 14 Hrs.<br><br>(Week 19-20) | Install wiring of PLC based control panel. | 48. Demonstrate all tool that requires for making the PLC control panel. (05 hrs)<br>49. Cut DIN rail as per our requirements and fixed in control panel. (05 hrs)<br>50. Mount different devices on DIN rail. (10 hrs)<br>51. Connect all equipment's by different types of cables. (10 hrs)<br>52. Check all connection before power on the control panel by millimeter. (10 hrs)<br>53. Demonstration of SMPS and their connections. (10 hrs)<br>54. Power on the control panel. (06 hrs) | Programmable Logic Controller Panel: -<br>It consists of DIN rail for equipment mounting<br>Cable channel, Terminal for wire connection, VFD, PLC, Power splay SMPS, Relay, Contactor, Fan, Connectors, Input outputs module, Power sockets, Transformer, HMI, Selector switch, Push button, Indicating lamp etc. |
| Professional Skill 125 Hrs.; | Construct PLC programming ladder diagram and relay | 55. Demonstration of how to open PLC programming software and basic | PLC Programming: -<br>PLC program consists of a set of instructions either in textual or |

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| Professional Knowledge<br>35 Hrs.<br><br>(Week 21-25) | instructions. | commands. (05 hrs)<br>56. Use of Different ladder diagram instruction. (05 hrs)<br>57. Basic communication method uses in PLC. (05 hrs)<br>58. Create simple ladder diagram in PLC programming software. (10 hrs)<br>59. Address the input output in ladder diagram. (15 hrs)<br>60. Connect input and output devices as per ladder that diagrams to PLC via input output module. (15 hrs)<br>61. Compile the PLC ladder diagram in software and see result. (15 hrs)<br>62. Connect the programming device to PLC and check the connection status of PLC and laptop or PC. (15 hrs)<br>63. Download the ladder diagram program in PLC memory card and check result. (10 hrs)<br>64. Upload the PLC program from PLC. (05 hrs)<br>65. Create ladder diagrams for all logic gate and compile and check result. (05 hrs)<br>66. Create ladder diagrams for small applications with basic instruction and check the result as per ladder logic. (10 hrs)<br>67. Example: -A signal lamp is required to be switched on if a pump is running and the pressure is satisfactory, or if | graphical form, which represents the logic that governs the process the PLC is controlling. There are two main classifications of PLC programming languages which are further divided into many sub-classified types.<br><br>Textual Language<br>Instruction list<br>Structured text<br>Graphical Form<br>Ladder Diagrams (LD) (i.e. Ladder Logic)<br>Function Block Diagram (FBD)<br>Sequential Function Chart (SFC)<br>Ladder Logic: -<br>Ladder logic is the simplest form of PLC programming. It is also known as “relay logic”. The relay contacts used in relay controlled systems are represented using ladder logic.<br><br>Construct basic PLC programming instructions<br>Identify and define XIC and XIO output instructions<br>Identify and interpret Timers and Counters.<br>Interpret internal instructions. |

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| | | the lamp test switch is closed. In this application, if there should be an output from the lamp inputs from both pump and pressure sensors are required. Hence, AND logic gates are used. (10 hrs) | |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge 14 Hrs.<br><br>(Week 26-27) | Apply Advance Instruction use in PLC ladder diagram Timer and counter. | 68. Create ladder diagram with different type of timer and counter and check the output result. (10 hrs)<br>69. Application base on Timer instruction. (10 hrs)<br>70. Application base on counter instruction. (10 hrs)<br>71. Online edit the plc Program. (10 hrs)<br>72. Offline edit the plc Program. (10 hrs) | **PLC Programming Instruction Timer and Counter: -**<br>PLC timers are instructions that provide the same functions as on-delay and off-delay mechanical and electronic timing relays.<br>In general, there are three types of PLC timer delays, ON-delay timer, OFF-delay timer and retentive timer on.<br>The terms represented in the timer block in the PLC are a Preset value which means the delay period of the timer, an Accumulated value which is the current delay of the timer.<br>TON timer or ON delay timer<br>TOFF timer or OFF delay timer:<br>COUNERT<br>A counter is a PLC instruction that either increments (counts up) or decrements (counts down) an integer number value when prompted by the transition of a bit from 0 to 1 (“false” to “true”).<br>Counter instructions come in three basic types:<br>Up counters, Down counters, and Up/Down counters.<br>Both “Up” and “Down” counter |

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| | | | instructions have single inputs for triggering counts, whereas "up/down" counters have two trigger inputs: one to make the counter increment and one to make the counter decrement. |
| Professional Skill 25 Hrs.<br><br>Professional Knowledge 07 Hrs.<br><br>(Week 28) | Perform interfacing of PLC and HMI. | 73. To connect PLC to HMI. (08 hrs)<br>74. Communication protocol for HMI and PLC communication. (08 hrs)<br>75. Demonstration of HMI programming software. (09 hrs) | INTERFACING OF PLC AND HMI: - The PLC and HMI is connected through the different types of communication cable.<br>Most industrial HMI panels come equipped with touch-sensitive screens, allowing operators to press their fingertips on displayed objects to change screens, view details on portions of the process, etc. |
| Professional Skill 25 hrs.<br><br>Professional Knowledge 07 Hrs.<br>(Week 29) | Install and configure HMI Application software. | 76. To create HMI Application in HMI design Software. (10 hrs)<br>77. Upload and download the Program in HMI. (15 hrs) | Understanding HMI Application. Different type of HMI screen. |
| Professional Skill 25 Hrs.;<br><br>Professional Knowledge 07 Hrs.<br><br>(Week 30) | Operate Supervisory data control and acquisition system (SCADA). | 78. SCADA Software Introduction. (02 hrs)<br>79. Simple Digital System implementation in SCADA software. (03 hrs)<br>80. Simple analog System implementation in SCADA software. (05 hrs)<br>81. Create SCADA Animation In SCADA software. (05 hrs)<br>82. Conveyor Animation Example in SCADA. (05 hrs)<br>83. Visibility Concept in SCADA. (05 hrs) | SCADA stands for "Supervisory Control and Data Acquisition". SCADA is a type of process control system architecture that uses computers, networked data communications and graphical Human Machine Interfaces (HMIs) to enable a high-level process supervisory management and control. SCADA systems communicate with other devices such as programmable logic controllers (PLCs) and PID controllers to |

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| | | | interact with industrial process plant and equipment.<br>SCADA systems form a large part of control systems engineering. SCADA systems gather pieces of information and data from a process that is analyzed in real-time (the "DA" in SCADA). It records and logs the data, as well as representing the collected data on various HMIs. |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge 14 Hrs.<br><br>(Week 31-32) | Perform interfacing of SCADA with PLC. | 84. Interfacing of SCADA with PLC. (10 hrs)<br>85. Control PLC Program from SCADA. (10 hrs)<br>86. Digital Alarms Interfacing with PLC. (10 hrs)<br>87. Analog Alarms Virtual Simulation. (10 hrs)<br>88. Analog Alarms Interfacing with PLC Basic Report Generation. (10 hrs) | Master Terminal Unit (MTU)<br>MTU is the core of the SCADA system. It comprises a computer, PLC and a network server that helps MTU to communicate with the RTUs. MTU begins communication, collects and saves data, helps to interface with operators and to communicate data to other systems.<br>Remote Terminal Unit (RTU)<br>Being employed in the field sites, each Remote Terminal Unit (RTU) is connected with sensors and actuators. RTU is used to collect information from these sensors and further sends the data to MTU. RTUs have the storage capacity facility. So, it stores the data and transmits the data when MTU sends the corresponding command. |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge | Apply the Communication network for SCADA. | 89. Import and Export SCADA Project using CSV File. (05 hrs)<br>90. Open Database Connectivity (ODBC). (05 hrs) | Data Communication<br>The SCADA system uses a wired network to communicate between users and devices. Real-time applications use a lot of |

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| 14 Hrs.<br><br>(Week 33-34) | | 91. To create Report. (05 hrs)<br>92. To use Script. (05 hrs)<br>93. Language Switching. (05 hrs)<br>94. Archive and Retrieve Project. (05 hrs)<br>95. Simple Heat Exchanger. (10 hrs)<br>96. Chemical Reactor.(10 hrs) | sensors and components which should be controlled remotely. The SCADA system uses internet communications. All information is transmitted through the internet using specific protocols. Sensors and relays are not able to communicate with the network protocols so RTUs used to communicate sensors and network interfaces.<br>Information/Data Presentation<br>The normal circuit networks have some indicators which can be visible to control but in the real-time SCADA system, there are thousands of sensors and alarm which are impossible to be handled simultaneously. The SCADA system uses the human-machine interface (HMI) to provide all of the information gathered from the various sensors**.**<br>Monitoring/Control<br>The SCADA system uses different switches to operate each device and displays the status of the control area. Any part of the process can be turned ON/OFF from the control station using these switches. SCADA system is implemented to work automatically without human intervention but in critical situations, it is handled by manpower. |
| Professional Skill 25 Hrs. | Enumerate the difference between SCADA and HMI. | 97. SCADA Application 1. (12 hrs)<br>98. SCADA Application 2. (13 | A HMI is just like a SCADA a monitoring device which displays the status of the machine. The |

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| Professional Knowledge 07 hrs.<br><br>(Week 35) | | hrs) | main difference is that SCADA is a remote monitoring system, whereas HMI is local to machine. A HMI for example, would be placed on the control panel near a part of a machine, whereas SCADA would be set up in a control room, far away from the machine itself.<br>Okay, so now we understand that HMI and SCADA are more likely just interfaces. However, the question 'What is the difference between a DCS and a PLC?' still remains. The answer isn't simple as a PLC/HMI combination can do a lot of the same things a DCS does.<br>PLCs are inserted type controllers of ladder logic with set-points of programmable parameter for a control function of automation. Commonly, HMI is a PC based interface with frequently configurable software and broader functionality. ... It will all base on the HMI/software functionality that you have for the FBD. |
| Professional Skill 50 Hrs.;<br><br>Professional Knowledge 14 hrs.<br><br>(Week 36-37) | Develop SCADA architecture. | 99. SCADA Application 3. (25 hrs)<br>100. SCADA Application 4. (25 hrs) | Hardware Architecture<br>The generally SCADA system can be classified into two parts:<br>Client layer<br>Data server layer<br>The Clint layer caters to the man-machine interaction.<br>The data server layer handles most of the process of data activities.<br>Software Architecture |

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| | | | Most of the servers are used for multitasking and real-time database. The servers are responsible for data gathering and handling. The SCADA system consists of a software program to provide trending, diagnostic data, and manage information such as scheduled maintenance procedures, logistic information. |
| Professional Skill 75 Hrs.;<br><br>Professional Knowledge 21 hrs.<br><br>(Week 38-40) | Plan and execute SCADA with PLC Simulation Example. | 101. SCADA with PLC Simulation Example 04. (15 hrs)<br>102. SCADA with PLC Simulation Example 05. (15 hrs)<br>103. SCADA with PLC Simulation Example 07. (20 hrs)<br>104. SCADA with PLC Simulation Example 08. (25 hrs) | SCADA with PLC Simulation Example |
| **Project work / Industrial visit: -**<br>Process control using PLC, HMI and SCADA and Industrial visit to Automation industries. Create new basics project in for HMI | | | |
| **Revision & Examination** | | | |

| SYLLABUS FOR CORE SKILLS |
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| 1. Workshop Calculation & Science (Common for one year course) (80 hours) |
| 2. Engineering Drawing (80 hours) |
| 3. Employability Skills (Common for all CTS trades) (160 hours) |

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in

**ANNEXURE-I**

| List of Tools & Equipment | | | |
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| **Manufacturing Process Control and Automation (For batch of 20 Candidates)** | | | |
| **S No.** | **Name of the Tools and Equipment** | **Specification** | **Quantity** |
| **A. Trainees Tool kit** | | | |
| 1. | Industrial Workstation (Computer) (Common to other trades) | Latest version compatible for running CAD software, preloaded with latest configurations and Internet connection with standard operating system | 20 Nos. |
| 2. | UPS (Common to other trades) | 3 KVA With Battery & Trolley | 1 No. |
| 3. | Server with rack - Intel Xeon Silver (Common to other trades) | 4114 2.2G, 10C/20T, 9.6GT/s, 14M Cache, Turbo, HT (85W) DDR4-2400, 600GB x 5 Nos. 10K RPM SAS, 12Gbps 512n 2.5in Hot plug Hard Drive. | 1 No. |
| 4. | PLC Software | | As required |
| 5. | AC Drives | | As required |
| 6. | Energy Meters | | As required |
| 7. | Sensors | | As required |
| 8. | Electrical wiring and Accessories | | As required |
| 9. | Mounting kit | | As required |
| 10. | Network accessories and cables | | As required |
| 11. | System Set up and integration with Design. | | As required |
| 12. | SCADA Software | | As required |
| **B. DRAWING AND CAD LAB TOOLS** | | | |
| 7. | Steel rule | 30 cm & 60 cm graduated both in English & Metric units | 20 Nos. |
| 8. | Micrometer Outside | 0-50 mm outside | 10 Nos. |
| 9. | Vernier Caliper | 0-15 cm | 10 Nos. |
| 10. | Micrometer Inside | up to 20 mm | 10 Nos. |
| 11. | Hand Gloves | | 10 Nos. |
| 12. | Safety Shoes | | 10 Nos. |
| 13. | Helmet | | 10 Nos. |
| **C. TOOLS & GENERAL SHOP OUTFIT** | | | |
| 1. | “V ” block | V-Block pair 7 cm with clamps | 10 Nos. |
| 2. | “V ” block | V-Block 15 cm with clamps | 10 Nos. |

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| 3. | Metal L | Metal - L - 15cm | 10 Nos. |
| 4. | Metal L | Metal - L - 30cm | 10 Nos. |
| 5. | Angle Plate | 10 x 20 cm. | 10 Nos. |
| 6. | Spirit Level | 15 cm metal | 10 Nos. |
| 7. | File warding | 15 cm smooth | 10 Nos. |
| 8. | File knife edge | 15 cm smooth | 10 Nos. |
| 9. | File cut saw | 15 cm smooth | 10 Nos. |
| 10. | File feather edge | 15 cm smooth | 10 Nos. |
| 11. | File triangular | 15 cm smooth | 10 Nos. |
| 12. | File round | 20 cm second cut | 10 Nos. |
| 13. | File square | 15 cm second cut | 10 Nos. |
| 14. | File square | 25 cm second cut | 10 Nos. |
| 15. | File triangular | 20 cm second cut. | 10 Nos. |
| 16. | File flat | 30 cm second cut. | 10 Nos. |
| 17. | File flat | 20 cm bastard | 10 Nos. |
| 18. | File flat | 30 cm bastard. | 10 Nos. |
| 19. | File Swiss type | Needle set of 12. | 10 Nos. |
| 20. | File half round | 25 cm second cut. | 10 Nos. |
| 21. | File half round | 25 cm bastard. | 10 Nos. |
| 22. | File round | 30 cm bastard. | 10 Nos. |
| 23. | File hand | 15 cm second cut. | 10 Nos. |
| 24. | Card file. | ---- | 10 Nos. |
| 25. | Oil Stone | 15 cm x 5 cm x 2.5 cm | 10 Nos. |
| 26. | Pliers combination | 15 cm | 10 Nos. |
| 27. | Blow Lamp | 0.50 liters. | 10 Nos. |
| 28. | Spanner | D.E. 6 -26 mm set of 10 pcs. | 10 Nos. |
| 29. | Spanner adjustable | 15 cm | 10 Nos. |
| 30. | Box spanner | Set 6-25 mm set of 8 with Tommy bar. | 10 Nos. |
| 31. | Glass magnifying | 7 cm | 10 Nos. |
| 32. | Clamp toolmaker | 5 cm and 7.5 cm set of 2. | 10 Nos. |
| 33. | Clamp “C” | 5 cm | 10 Nos. |
| 34. | Clamp “C” | 10 cm | 10 Nos. |
| 35. | Scraper flat | 15 cm. | 10 Nos. |
| 36. | Scraper triangular | 15 cm | 10 Nos. |
| 37. | Scraper half round | 15cm | 10 Nos. |
| 38. | Chisel | cold 9 mm cross cut 9 mm diamond. | 10 Nos. |
| 39. | Chisel | cold 19 mm flat | 10 Nos. |
| 40. | Chisel | cold 9 mm round noze. | 10 Nos. |

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| 41. | Motorized +Tennon Saw | ---- | 10 Nos. |
| 42. | Hand hammer | 1 kg. with handle Ball Peen | 10 Nos. |
| 43. | Hacksaw | frame fixed 30 cm. | 10 Nos. |
| 44. | Mallets Wooden | ---- | 10 Nos. |
| 45. | V-Block, Files, mallets, screwdrivers, chisels, etc. | ---- | 10 Nos. |
| 46. | Hand Drilling Machine | Rated input power: 600W, Power output: 301W, Rated torque: 1.8 Nm | 10 Nos. |
| 47. | Metal Saw | No-Load Speed: 3,800 rpm, Saw blade diameter 355 mm, Saw blade bore 25.4 mm | 10 Nos. |
| 48. | Straight Grinder HEAVY DUTY with attachments | No-Load Speed: 10000 – 30000 rpm, Rated power output: 380W | 10 Nos. |
| 49. | Professional Air Blower | Power consumption: 820 W, No-load speed: 16000rpm, Flow rate: 0-4.5 m3/s | 10 Nos. |
| 50. | Jig Saw Portable | Input Power: 900W, No-load speed: 11,000 rpm, Disc Diameter: 100 | 10 Nos. |
| 51. | Hammer Drill Wired | Drill type: hammer, optimum power transfer | 10 Nos. |
| 52. | Hand Held Sander / Polisher | No Load Speed: 11000 rpm | 10 Nos. |
| 53. | Digital Dial Torque Wrench | Range: 20 to 280 Nm | 10 Nos. |
| 54. | Lifting Tackle/Sling | 1 Ton×2mtr | 10 Nos. |
| 55. | Impact Wrench | 1/2 inch drive | 10 Nos. |
| 56. | Laser Light Pen | --- | 10 Nos. |
| 57. | Surface Plate | Cast iron | 10 Nos. |
| 58. | Digital Screw Pitch Gauge | Working voltage: 3.0 V / DC, Measure precision: 0.1 degree | 10 Nos. |
| 59. | Laser Distance Measurement Instrument | Levelling Accuracy (Vial): +/- 0.2degree, Measuring Accuracy Typical: +/- 1/16 inch (1.5 mm) | 10 Nos. |
| 60. | Palm Scale | Capacity-500gms, Least Count-0.1g | 10 Nos. |
| 61. | Allen Screwdriver Wrench Tool | 6Pcs T Handle Ball Ended Hex Key | 10 Nos. |
| 62. | Universal Quick Adjustable Multi-function Wrench Spanner | Range: 6-32mm | 10 Nos. |
| 63. | Double Ended Wrench Hex Socket Spanner | 8 In 1, Range: 6-32mm | 10 Nos. |
| **D. MEASURING INSTRUMENT** | | | |
| 64. | Steel Rue | 60 cm. | 10 Nos. |
| 65. | Vernier Caliper | 0- 15 cm | 10 Nos. |
| 66. | Micrometer outside. | 0 – 50 mm | 10 Nos. |
| 67. | Micrometer Inside | 0 to 20 mm | 10 Nos. |

## ANNEXURE- II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts, trainers of ITIs, NSTIs, faculties from universities and all others who contributed in creating the curriculum.

Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

| **List of Expert members contributed/ participated for finalizing the course curriculum of Manufacturing Process Control and Automation.** | | | |
|---|---|---|---|
| **S. No.** | **Name & Designation Sh./Mr./Ms** | **Organization** | **Remarks** |
| 1. | G.N. Eswarappa, JDT | CSTARI, Kolkata | Coordinator |
| 2. | Tushar Chaudhary | Tata Technologies Ltd. | Subject Expert |
| 3. | Shreyash Gajlekar | Tata Technologies Ltd. | Subject Expert |
| 4. | Akshay Narayankar | Tata Technologies Ltd. | Subject Expert |
| 5. | Ravindra Bhadoriya | Tata Technologies Ltd. | Subject Expert |
| 6. | Vijay B Hiremath, Senior Manager | Badve Engineering Ltd., Komal Plast Tech., Plot No. 163/A, Belur Industrial Area, Dharwad- 580011 | Industry Expert |
| 7. | Viinod Atpadkar, Chief Executive Office | SVR Info Tech, 301/302 Amber Plaza, Nr. Bank of MH, Sinhgad College Road, Ambegaon BK, Pune-411046 | Industry Expert |
| 8. | Sunil J, Partner | Modtech Engineering, Plot No. 95, Behind Omex Auto, Bommasandra Jiganl Link Road, Jigini Post, Bengaluru-562105, Karnataka | Industry Expert |
| 9. | Bhagyashree Gapchup | XM Excellence Pvt. Ltd., J/05, SN118/A, Aditya Nakoda Enclave Parvati, Maharashtra, Pune- 411030 | Industry Expert |
| 10. | Shakuntala Pawar, Head HR | Mutha Engineering Pvt. Ltd, Unit 1: H-21, Old MIDC area, Satara- 415004 | Industry Expert |
| 11. | Ajay Gujar, COO- Robotics Division | Yaskawa India Pvt. Ltd., Electronic City Phase 1, Hosur Road, Bengaluru-560100, Karnataka | Industry Expert |
| 12. | Harish Mankur, Engineer | KGTTI | Industry Expert |
| 13. | A. Rarhi, DDT | CSTARI, Kolkata | Member |
| 14. | B. Biswas, Training Officer | CSTARI, Kolkata | Member |
| 15. | P.K. Bairagi, TO | CSTARI, Kolkata | Coordinator |

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| 16. | R.N. Manna, TO | CSTARI, Kolkata | Member |
| 17. | Bharat Kumar Nigam, TO | CSTARI, Kolkata | Member |
| 18. | K.V.S. Narayana, TO | CSTARI, Kolkata | Member |
| 19. | Himanshu, ADT | CSTARI, Kolkata | Member |
| 20. | B. Sharanappa, ADT | CSTARI, Kolkata | Member |
| 21. | Bhagat Singh, ADT | CSTARI, Kolkata | Member |
| 22. | Vijay Kumar, ADT | CSTARI, Kolkata | Member |
| 23. | Vijaya Raju, ADT | CSTARI, Kolkata | Member |

## ABBREVIATIONS:

| | |
|---|---|
| CTS | Craftsmen Training Scheme |
| ATS | Apprenticeship Training Scheme |
| CITS | Craft Instructor Training Scheme |
| DGT | Directorate General of Training |
| MSDE | Ministry of Skill Development and Entrepreneurship |
| NTC | National Trade Certificate |
| NAC | National Apprenticeship Certificate |
| NCIC | National Craft Instructor Certificate |
| LD | Locomotor Disability |
| CP | Cerebral Palsy |
| MD | Multiple Disabilities |
| LV | Low Vision |
| HH | Hard of Hearing |
| ID | Intellectual Disabilities |
| LC | Leprosy Cured |
| SLD | Specific Learning Disabilities |
| DW | Dwarfism |
| MI | Mental Illness |
| AA | Acid Attack |
| PwD | Person with disabilities |


कौशलं बलम्