# Government of Pakistan

# National Vocational and Technical Training Commission

# Prime Minister's Hunarmand Pakistan Program

"Skills for All"

**Course Contents / Lesson Plan**

**Course Title:** INDUSTRIAL AUTOMATION (PLC)

**Duration:** 3 Months

# Course Details / Description & Preliminaries

| Course Title | INDUSTRIAL AUTOMATION (PLC) |
|---|---|
| **Objectives and Expectations** | **Employable skills for DAE in Electrical / Electronic through an intensive course on industrial Automation (PLC)**<br><br>This is a special course designed to address unemployment in the youth. The course aims to achieve the above objective through hands on practical training delivery by a team of dedicated professionals having rich market/work experience. This course is therefore not just for developing a theoretical understanding/back ground of the trainees. Contrary to that it is primarily aimed at equipping the trainees to perform commercially in a market space in independent capacity or as a member of a team.<br><br>The course therefore is designed to impart not only technical skills but also soft skills (i.e. interpersonal/communication skills; personal grooming of the trainees etc.) as well as entrepreneurial skills (i.e. marketing skills; free lancing etc.). The course also seeks to inculcate work ethics to foster better citizenship in general and improve the image of Pakistani work force in particular.<br><br>**Main Expectations:**<br>In short, the course under reference should be delivered by professional instructors in such a robust hands- on manner that the trainees are comfortably able to employ their skills for earning money (through wage/self-employment) at its conclusion.<br>This course thus clearly goes beyond the domain of the traditional training practices in vogue and underscores an expectation that a market centric approach will be adopted as the main driving force while delivering it. The instructors should therefore be experienced enough to be able to identify the training needs for the possible market roles available out there. Moreover, they should also know the strengths and weaknesses of each individual trainee to prepare them for such market roles during/after the training. |
| | I. Specially designed practical tasks to be performed by the trainees have been included in the Annexure-I to this document. The |

| | |
|---|---|
| **Key Features of Training& Special Modules** | record of all tasks performed individually or in groups must be preserved by the management of the training Institute clearly labeling name, trade, session etc. so that these are ready to be physically inspected/verified through monitoring visits from time to time. The weekly distribution of tasks has also been indicated in the weekly lesson plan given in this document.<br>II. In order to materialize the main expectations, a special module on **Job Search & Entrepreneurial Skills** has been included in the later part of this course ($5^{th}$ & $6^{th}$ month) through which, the trainees will be made aware of the Job search techniques in the local as well as international job markets (Gulf countries). Awareness around the visa process and immigration laws of the most favored labor destination countries also forms a part of this module. Moreover, the trainees would also be encouraged to venture into self-employment and exposed to the main requirements in this regard. It is also expected that a sense of civic duties/roles and responsibilities will also be inculcated in the trainees to make them responsible citizens of the country.<br>A module on **Work Place Ethics** has also been included to highlight the importance of good and positive behavior at work place in the line with the best practices elsewhere in the world. An outline of such qualities has been given in the Appendix to this document. Its importance should be conveyed in a format that is attractive and interesting for the trainees such as through PPT slides +short video documentaries. Needless to say that if the training provider puts his heart and soul into these otherwise non-technical components, the image of Pakistani workforce would undergo a positive transformation in the local as well as international job markets.<br>In order to maintain interest and motivation of the trainees throughout the course, modern techniques such as:<br>• Motivational Lecture |

| | |
|---|---|
| | • Success Stories<br>• Case Studies<br>These techniques would be employed as an additional training tool wherever possible (these are explained in the subsequent section on Training Methodology). Lastly, evaluation of the competencies acquired by the trainees will be done objectively at various stages of the training and proper record of the same will be maintained. Suffice to say that for such evaluations, practical tasks would be designed by the training providers to gauge the problem solving abilities of the trainees. |
| **Training Tools/ Methodology** | **(I) Motivational Lectures**<br>The proposed methodology for the training under reference employs motivation as a tool. Hence besides the purely technical content, a trainer is required to include elements of motivation in his/her lecture to inspire the trainees to utilize the training opportunity to the full and strive towards professional excellence. Motivational lectures may also include general topics such as the importance of moral values and civic role & responsibilities as a Pakistani. A motivational lecture should be delivered with enough zeal to produce a deep impact on the trainees. It may comprise of the following:<br>• Clear Purpose to convey message to trainees effectively.<br>• Personal Story to quote as an example to follow. Trainees fit so that the situation is actionable by trainees and not represent a just idealism.<br>• Ending Points to persuade the trainees on changing themselves.<br>A good motivational lecture should help drive creativity, curiosity and spark the desire needed for trainees to want to learn more.<br>Impact of a successful motivational strategy is amongst others commonly visible in increased class participation ratios. It increases the trainees' willingness to be engaged on the practical tasks for longer time without boredom and loss of interest because they can clearly see in their mind's eye where their hard work would take them in short (1-3 years); medium (3 -10 years) and long term (more than 10 years).<br>As this tool is expected that the training providers would make arrangements for regular well planned motivational lectures as part of a coordinated strategy |

interspersed throughout the training period as suggested in the weekly lesson plans in this document.

**(ii) Success Stories**

Another effective way of motivating the trainees is by means of Success Stories. Its inclusion in the weekly lesson plan at regular intervals has been recommended till the end of the training.

A success story may be disseminated orally, through a presentation or by means of a video/documentary of someone that has risen to fortune, acclaim, or brilliant achievement. A success story shows how a person achieved his goal through hard work, dedication and devotion. An inspiring success story contains compelling and significant facts articulated clearly and easily comprehendible words. Moreover, it is helpful if it is assumed that the reader/listener knows nothing of what is being revealed. Optimum impact is created when the story is revealed in the form of:-

 Directly in person (At least 2-3 cases must be arranged by the training institute)  Through an audio/ videotaped message (2-3 high quality videos must be arranged by the training institute)

It is expected that the training provider would collect relevant high quality success stories for inclusion in the training as suggested in the weekly lesson plan given in this document.

Suggestive structure and sequence of a sample success story and its various shapes can be seen at annexure III.

**(iii) Case Studies**

Where a situation allows, case studies can also be presented to the trainees to widen their understanding of the real life specific problem/situation and to explore the solutions.

In simple terms, the case study method of teaching uses a real life case example/a typical case to demonstrate a phenomenon in action and explain theoretical as well as practical aspects of the knowledge related to the same. It is an effective way to help the trainees comprehend in depth both the theoretical and practical aspects of the complex phenomenon in depth with ease. Case teaching can also stimulate the trainees to participate in discussions and thereby boost their confidence. It also makes class room atmosphere interesting thus maintaining the trainee interest in training till the end of the course.

Depending on suitability to the trade, the weekly lesson plan in this document may

| | |
|---|---|
| | suggest case studies to be presented to the trainees. The trainer may adopt a power point presentation or video format for such case studies whichever is deemed suitable but it's important that only those cases are selected that are relevant and of a learning value. The Trainees should be required and supervised to carefully analyze the cases.<br>For the purpose they must be encouraged to inquire and collect specific information / data, actively participate in the discussions and intended solutions of the problem / situation.<br><br>Case studies can be implemented in the following ways: -<br>I. A good quality trade specific documentary (At least 2-3 documentaries must be arranged by the training institute) ii. Health &Safety case studies (2 cases regarding safety and industrial accidents must be arranged by the training institute) iii. Field visits( At least one visit to a trade specific major industry/ site must be arranged by the training institute) |
| **Intake to the Training** | Since intake level is DAE in Electrical / Electronic so expectations from the trainees are:<br><br>• understanding of basics electrical wiring<br>• Interpretation of basics of engineering drawing & standard symbols<br>• Interpretation of basics of electrical measuring instruments & their uses<br>• Should have concept of Basic Electronics<br>• Should have concept of fundamentals of Digital & Industrial Electronics<br>• Should have concept of Electrical machines & its applications<br>Should have concept of Computer system |
| **Learning Outcome of the Course** | After completion of this course, the trainees must be able to demonstrate their underpinning knowledge of:<br><br>• Occupational Health & Safety.<br>• Interpretation of number systems, logic gates & Boolean algebra.<br>• Understanding the function & uses/applications of different types of switches, Push buttons, fuses/circuit breakers, Relays, Contactors, Timers, counters, sensors, Transducers etc.<br>• To gain knowledge of basic concepts of control systems & automation.<br>• Demonstration of different types of control systems like on/off Control<br>• PLC, its components & Types.<br>• Types of PLC based machines and their applications<br>• Fundamentals of ladder logic diagram<br>• Translate the logic implementation into PLC coding. |

| Scheduled Weeks | Module Title | Days | Learning Units | Home Assignment |
|---|---|---|---|---|
| | Translate relay ladder diagram into PLC coding.<br>• Assign real I/O and internal addresses to inputs and outputs.<br>• Review machine logic of operation and optimize when possible.<br>• Understand the actual process or machine function.<br>• Motor control switchgear and its applications with PLC<br>• Should be able to interpret manufacturer's instructional manual in order to install and connect the PLC system according to the functional diagram<br>• Knowledge & understanding to install, operate & repair PLC systems.<br>• Interpretation of circuit diagrams, service manuals, technical sketches, graphic symbols, wiring diagrams and manufacturer's specifications etc.<br>• Can locate/trace and repair/replace the faulty components of PLC system and also carry out the function tests.<br>• Trouble shooting of the faults in the PLC system, input/output devices and PLC based machines<br>• Common faults in industrial PLC based machines  Knowledge of ADC, DAC and data acquisition systems.<br>• Must be able to make HMI for industrial control room. | | | |
| **Course Execution Plan** | Total Duration of Course: 3 Months (13 Weeks)<br>Class Hours: 5 Hours per day (05 Days/Week)<br>Theory: 20% Practical: 80%<br>Weekly Hours: 25 Hours Per week<br>Total Contact Hours: 325 Hours | | | |
| **Companies Offering Jobs in the respective trade** | Most of Pakistani industries are moving their processes to automatic systems so a person having this knowledge& skill, will have all the industrial opportunities at his choice and can secure job with ease. It is expected that by acquiring sufficient knowledge and skills, the prospects of employability of passed out graduates increases many folds. | | | |
| **Job Opportunities** | • PLC/SCADA Technician in industry (Textile, Leather, Pharmaceuticals, Food Processing, Automotive, Cement etc.)<br>PLC/SCADA consultant for industry and commerce.<br>Automation trainer for workers and lower management of industries. | | | |
| **No of Students** | 25 | | | |
| **Learning Place** | Classroom / Lab / Workshop / Industry | | | |

| | | | | |
|---|---|---|---|---|
| WEEK#1 | Introduction Logic Gates & Boolean Algebra | DAY 1 | • Course Introduction and Motivational Lecture<br>• Course Applications and Institute/Work Ethics(For further detail please see Annexure-III at the end) | **Home Assignment No. 1** *Details may be seen at Annexure-II*<br><br>**Task No. 1** *Details may be seen at Annexure-I*<br><br>**Home Assignment No. 2** *Details may be seen at Annexure-II* |
| | | DAY 2 | • Health & Safety in the Workplace<br>• Introduction to the Job Market | |
| | | DAY 3 | • Binary Number System<br>• Review of Arithmetic Operations with Binary Numbers | |
| | | DAY 4 | • Logic Gates (Symbol, Truth Table, etc.)<br>• Boolean Algebra Basics | |
| | | DAY 5 | • Karnaugh Map (K-Map) and its Applications<br>• Success Stories in the Field | |
| WEEK#2 | Basic Components including Relays, Contactors and their Applications | DAY 1 | • Introduction to Control Transformers and their Applications | **Task No. 2** *Details may be seen at Annexure-I*<br><br>**Home Assignment No. 3** *Details may be seen at Annexure-II*<br><br>**Task No. 3** *Details may be seen at Annexure-I*<br><br>**Monthly Test 1** |
| | | DAY 2 | • Understanding Fuses and Circuit Breakers and their Importance<br>• Exploring Different Types of Switches and their Uses | |
| | | DAY 3 | • Function and Applications of Push Buttons in Electrical Systems<br>• Introduction to Indicators and their Significance | |
| | | DAY 4 | • Relay: Construction, Operation/Working Principle, Types, and Applications | |
| | | DAY 5 | • Contactors: Construction, Operation/Working Principle, Types, and Applications<br>• Case Study 1: Health & Safety (For further details, please refer to Page No: 6) | |

| | | | | |
|---|---|---|---|---|
| WEEK#3 | Timers, Counters, and Industrial Automation | DAY 1 | • Institute/Work Ethics<br>• Timers: Construction, Operation/Working, Principles, Types & Applications | **Task No. 4**<br>*Details may be seen at Annexure-I* |
| | | DAY 2 | • Counters: Construction, Operation/Working, Principles, Types & Applications | |
| | | DAY 3 | • Industrial Automation: Introduction, Types, Advantages | **Home Assignment No. 4**<br>*Details may be seen at Annexure-II* |
| | | DAY 4 | • Role of PLC (Programmable Logic Controller) in Automation | |
| | | DAY 5 | • Control Systems | **Home Assignment No. 5**<br>*Details may be seen at Annexure-II* |
| WEEK#4 | Introduction to PLC and PLC Hardware | DAY 1 | • Introduction to PLC: Definition, History, Types<br>• PLC Configuration: Overview of how PLCs are set up<br>• Sizes & Brands of PLCs | |
| | | DAY 2 | • Applications of PLCs: Overview of different industries and areas where PLCs are used<br>• Advantages of PLCs | **Home Assignment No. 6**<br>*Details may be seen at Annexure-II* |
| | | DAY 3 | • Case Study-2: Detailed analysis of a specific PLC application (refer to Page No: 6) | |
| | | DAY 4 | • Block Diagram of PLC: Overview of the internal structure of a PLC<br>• Components of PLC: Explanation of various components and their functions | **Home Assignment No. 7**<br>*Details may be seen at Annexure-II* |
| | | DAY 5 | • Analog & Digital I/O Modules: Understanding input and output modules for analog and digital signals<br>• Special Modules: Overview | **Monthly Test 2** |

| | | | | |
|---|---|---|---|---|
| | | | of specialized modules used in PLC systems<br>• RS232 and 485 Communication Protocols: Introduction to communication protocols used in PLC systems | |
| WEEK#5 | Introduction to PLC and PLC Hardware | DAY 1 | • Introduction to PLC: Definition, History, Types<br>• PLC Configuration: Overview of how PLCs are set up<br>• Sizes & Brands of PLCs | **Task No. 5**<br>*Details may be seen at Annexure-I*<br><br>**Home Assignment No. 8**<br>*Details may be seen at Annexure-II*<br>**Task No. 6**<br>*Details may be seen at Annexure* |
| | | DAY 2 | • Applications of PLCs: Overview of different industries and areas where PLCs are used<br>• Advantages of PLCs | |
| | | DAY 3 | • Case Study-2: Detailed analysis of a specific PLC application (refer to Page No: 6) | |
| | | DAY 4 | • Block Diagram of PLC: Overview of the internal structure of a PLC<br>• Components of PLC: Explanation of various components and their functions | |
| | | DAY 5 | • Analog & Digital I/O Modules: Understanding input and output modules for analog and digital signals<br>• Special Modules: Overview of specialized modules used in PLC systems<br>• RS232 and 485 Communication Protocols: Introduction to communication protocols used in PLC systems | |
| WEEK#6 | Ladder Logic Programming | DAY 1 | • Master control reset: Understanding the concept of master control reset<br>• Latching: Exploring the operation and application of latching circuits<br>• Interlocking: Understanding interlocking mechanisms and their importance in control systems | **Task No. 7**<br>*Details may be seen at Annexure-I*<br><br>**Task No. 8** |
| | | DAY 2 | • Logic Gates in Ladder Logic | |

| | | | | |
|---|---|---|---|---|
| | | | Programming: Introduction to logic gates and their implementation in ladder logic programming<br>• On-Delay Timer Ladder Logic Programming: Exploring the programming techniques for on-delay timers | *Details may be seen at Annexure-I*<br><br>**Midterm Assessment** |
| | | DAY 3 | • Off-Delay Timer Ladder Logic Programming: Learning how to program off-delay timers in ladder logic<br>• Retentive On-Delay Timer Ladder Logic Programming: Understanding the programming methods for retentive on-delay timers | |
| | | DAY 4 | • Off-Delay Timer Ladder Logic Programming: Learning how to program off-delay timers in ladder logic<br>• Retentive On-Delay Timer Ladder Logic Programming: Understanding the programming methods for retentive on-delay timers | |
| | | DAY 5 | • Off-Delay Timer Ladder Logic Programming: Learning how to program off-delay timers in ladder logic<br>• Retentive On-Delay Timer Ladder Logic Programming: Understanding the programming methods for retentive on-delay timers | |
| Week 7 | Overview of the previous weeks & Mid Term Examination | | | Task No. 9<br>Details may be seen at Annexure-I<br><br>**Task No. 10**<br>*Details may be seen at Annexure-I* |
| Week 8 | Ladder Logic Programming and Comparators Programming | DAY 1 | • Motivational Lecture (refer to Page No: 4)<br>• Counters Ladder Logic Programming: Introduction to counters and their programming in ladder logic<br>• Up Counter Programming: | |

| | | | | |
|---|---|---|---|---|
| | | | Exploring the programming techniques for up counters | |
| | | DAY 2 | • Down Counter Programming: Learning how to program down counters in ladder logic<br>• Up/Down Counter Programming: Understanding the programming methods for up/down counters | **Task No. 11**<br>*Details may be seen at Annexure-I* |
| | | DAY 3 | • Special Instructions: Exploring special instructions used in ladder logic programming<br>• Online and Offline Simulation of the above tasks: Practicing ladder logic programming using online and offline simulations<br>• Practical Industrial Applications: Discussing real-world applications of ladder logic programming in industrial settings | **Task No. 12**<br>*Details may be seen at Annexure-I* |
| | | DAY 4 | • Comparators Programming: Introduction to comparators and their programming in ladder logic<br>• Greater than and equal to Comparator Programming: Learning how to program comparators for greater than and equal to conditions | |
| | | DAY 5 | • Less than and equal to Comparator Programming: Exploring the programming techniques for comparators with less than and equal to conditions<br>• Equal to Comparator Programming: Understanding the programming methods for comparators with equal to conditions<br>• Online and Offline Simulation of the above tasks: Practicing comparators programming through online and offline simulations | |
| Week 9 | Analog Data and Analog Programming | DAY 1 | • Motivational Lecture (refer to Page No: 4)<br>• ADC and DAC: Introduction to Analog-to-Digital Conversion (ADC) and | |

| | | | | |
|---|---|---|---|---|
| | | | Digital-to-Analog Conversion (DAC)<br>• Analog Values Scaling: Understanding the scaling of analog values and their representation in control systems | **Task No. 14**<br>*Details may be seen at Annexure-I* |
| | | DAY 2 | • Related Problems: Exploring common challenges and issues related to analog data handling and processing<br>• Case Study-4: Analyzing a specific case study related to analog data (refer to Page No: 5) | |
| | | DAY 3 | • Analog IOs Programming: Learning how to program analog input and output modules in PLCs<br>• Applications of Analog Programming in Industry: Understanding the practical applications of analog programming in industrial settings | |
| | | DAY 4 | • Online and Offline Simulation of Analog Programming: Practicing analog programming techniques through online and offline simulations<br>• Practical Industrial Scenarios for Analog I/Os: Discussing real-world scenarios where analog input and output modules are used in industrial automation | |
| | | DAY 5 | • Review and Recap: Consolidating the knowledge and concepts covered during the week<br>• Q&A session: Addressing any questions or doubts regarding analog data and programming | |
| Week 10 | Analog Sensors II, HMI Programming and Job Search | DAY 1 | • Motivational Lecture (refer to Page No: 4)<br>• Interfacing Load Cell with PLC: Understanding the process of connecting load cells to PLC systems<br>• Automation of Load Cell via PLCs: Exploring the automation techniques for | |

| | | | | |
|---|---|---|---|---|
| | | | load cells using PLCs<br>• Programming for Automation of Load Cell: Learning how to program PLCs for load cell automation | **Task No. 15**<br>*Details may be seen at Annexure-I*<br><br>**Task No. 16**<br>*Details may be seen at Annexure-I* |
| | | DAY 2 | • Interfacing Level Sensor with PLC: Understanding the process of connecting level sensors to PLC systems<br>• Automation of Level Sensor via PLCs: Exploring the automation techniques for level sensors using PLCs<br>• Programming for Automation of Level Sensor: Learning how to program PLCs for level sensor automation | |
| | | DAY 3 | • HMI (Human-Machine Interface) Programming: Overview of HMIs and their role in industrial automation<br>• Types of HMIs: Exploring different types of HMIs and their applications<br>• Planning and Designing of HMIs: Understanding the process of planning and designing user-friendly HMIs | |
| | | DAY 4 | • Recipes of HMI: Learning how to create and implement recipe functions in HMI programming<br>• Case Study-5: Analyzing a specific case study related to HMI programming (refer to Page No: 6) | |
| | | DAY 5 | • Session on CV Building: Understanding the importance of building an effective CV (Curriculum Vitae)<br>• How to Make a Notable CV: Learning the strategies and tips for creating a standout CV<br>• Dos and Don'ts of CV Making: Exploring the best practices and common mistakes to avoid in CV creation | |
| Week 11 | Project Design, Business Development & Entrepreneurship, | DAY 1 | • Success Story (refer to Page No: 5 and Annexure-IV): Inspirational talk highlighting a successful project or | |

| | | | | |
|---|---|---|---|---|
| | Employable Project/Assignment | | entrepreneurial journey<br>• PLC-Based Mini Projects: Introduction to mini projects based on PLC systems<br>• Idea Generation and Planning for Projects: Techniques for generating project ideas and planning their execution | **Task No. 17**<br>*Details may be seen at Annexure-I*<br><br>**Project**<br><br>**Task No. 18**<br>*Details may be seen at Annexure-I*<br><br>**Project Continued…**<br><br>**Monthly Test 5** |
| | | DAY 2 | • Discussions for Selection of Project and Assessing Requirements: Group discussions to evaluate project options and assess their requirements<br>• Groups Formation: Forming groups for project collaboration and teamwork<br>• Problems Identification and Solution: Identifying potential problems in project implementation and developing solutions | |
| | | DAY 3 | • Commissioning Testing and Project Execution: Hands-on session on commissioning and testing project prototypes<br>• Session on Self-Employment: Discussion on self-employment and the steps involved in starting a business<br>• Requirements for Starting a Business: Understanding the capital, physical, and other requirements for starting a business | |
| | | DAY 4 | • Benefits/Advantages of Self-Employment: Exploring the benefits and advantages of pursuing self-employment<br>• Guidelines for Selecting an Employable Project: Providing guidelines to trainees for selecting an employable project similar to a final year project (FYP)<br>• Assigning Independent Projects to Trainees: Assigning individual projects to each trainee based on their acquired skills and interests | |
| | | DAY 5 | • Presentation of Employable Projects: Trainees present their employable projects, | |

| | | | | |
|---|---|---|---|---|
| | | | designed with emerging trends in mind, to industrialists for potential commercialization<br>• Selection of Best Business Idea: Identifying the best business idea among the projects presented<br>• Placement in NAVTTC Business Incubation Center: The chosen business idea is placed in the NAVTTC business incubation center for further commercialization | |
| Week 12 | General Overseas Employment and Case Study 02 - Automation in Batching Sector | DAY 1 | • Automation in Textile Sector: Demonstration of a site visit or presentation by a laboratory trainer to showcase automation in the textile industry<br>• Survey: Conducting a survey to gather relevant information and data related to automation in the textile sector<br>• Feasibility Report: Analyzing the collected data and preparing a feasibility report for implementing automation in the textile sector | **Task No. 18**<br>*Details may be seen at Annexure-I*<br><br>**Project Continued…** |
| | | DAY 2 | • Model Simulation (Prototype): Creating a model simulation or prototype to demonstrate the automation techniques in the textile sector<br>• Motivational Lecture (refer to Page No: 4): Inspirational talk to motivate and encourage trainees in their learning journey<br>• Session on General Overseas Employment Opportunities: Exploring the opportunities available for overseas employment | |
| | | DAY 3 | • Job Search Avenues: Providing guidance on various job search avenues for those interested in overseas employment<br>• Visa Processes and Necessary Requirements: Discussing the visa processes and other | |

| | | | | |
|---|---|---|---|---|
| | | | necessary requirements for working abroad<br>• Immigration Information: Providing information on legal age requirements, health certificates, police clearance, and travel insurance for immigration purposes | |
| | | DAY 4 | • Case Study 02: Automation in Batching Sector: Demonstration of a site visit or presentation by a laboratory trainer to showcase automation in the batching sector<br>• Survey: Conducting a survey to gather relevant information and data related to automation in the batching sector<br>• Feasibility Report: Analyzing the collected data and preparing a feasibility report for implementing automation in the batching sector | |
| | | DAY 5 | • Model Simulation (Prototype): Creating a model simulation or prototype to demonstrate the automation techniques in the batching sector<br>• Review and Recap: Consolidating the knowledge and concepts covered during the week<br>• Q&A session: Addressing any questions or doubts related to the case studies and topics covered | |
| Week 13 | Case Study 03 - Overseas Employment, Case Study 04 - Automation in Pharma Sector, Entrepreneurship, and Final Assessment<br>Day 1: | DAY 1 | • Case Study 03: Overseas Employment<br>• Demonstration of a site visit or presentation by a laboratory trainer in the manufacturing sector<br>• Survey: Conducting a survey to gather relevant information and data related to overseas employment in the chosen countries<br>• Feasibility Report: Analyzing the collected data and preparing a feasibility report for overseas employment in | **Project** |

| | | | | |
|---|---|---|---|---|
| | | | the manufacturing sector<br>• Model Simulation (Prototype): Creating a model simulation or prototype to demonstrate the automation techniques in the manufacturing sector | **Continued…**<br><br>**• Project completion and testing/launching** |
| | | DAY 2 | • Selection of Two Countries of Destination: Focus on trade-specific job prospects, earning levels, and country-specific labor laws, entry and exit requirements in the chosen countries<br>• Case Study 04: Automation in Pharma Sector<br>• Demonstration of a site visit or presentation by a laboratory trainer in the pharma sector<br>• Survey: Conducting a survey to gather relevant information and data related to automation in the pharma sector<br>• Feasibility Report: Analyzing the collected data and preparing a feasibility report for implementing automation in the pharma sector | **Final Assessment** |
| | | DAY 3 | • Model Simulation (Prototype): Creating a model simulation or prototype to demonstrate the automation techniques in the pharma sector<br>• Success Story (refer to Page No: 5 and Annexure-IV): Sharing a success story related to entrepreneurship, possibly from the pharma or manufacturing sector<br>• Fundamentals of Business Development: Introduction to the key concepts of business development and entrepreneurship | |
| | | DAY 4 | • Entrepreneurship and Startup Funding: Exploring the aspects of entrepreneurship, including startup funding and resources<br>• Business Incubation and Acceleration: Understanding | |

| | | | | |
|---|---|---|---|---|
| | | | the importance of business incubation and acceleration programs for startup success<br>• Sales and Marketing Strategies: Discussing effective sales and marketing strategies for new ventures | |
| | | DAY 5 | • Final Project and Final Assessment: Presenting and assessing the final project developed by the trainees, incorporating the concepts learned throughout the course<br>• Recap and Review: Consolidating the knowledge and concepts covered during the week<br>• Q&A Session: Addressing any questions or doubts related to the case studies, entrepreneurship, and final assessment | |

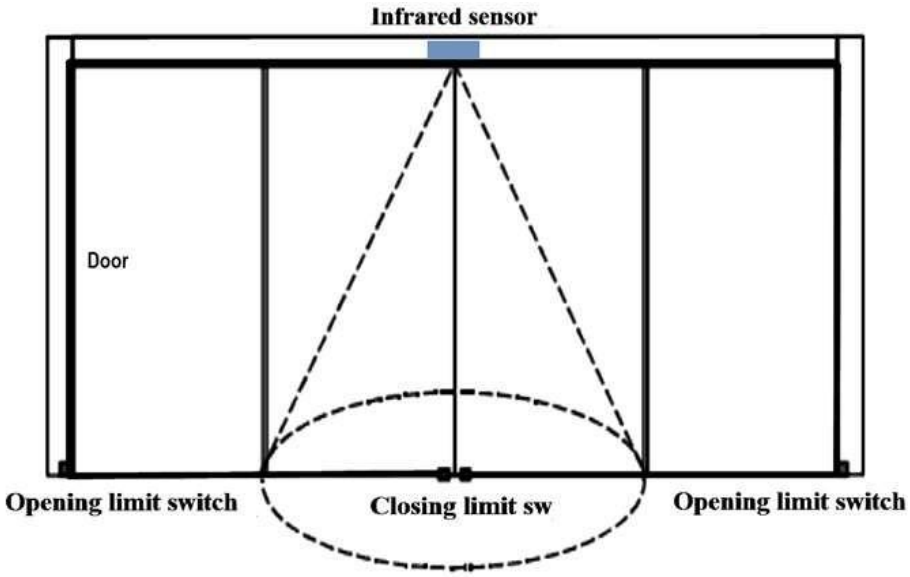
# ANNEXURES

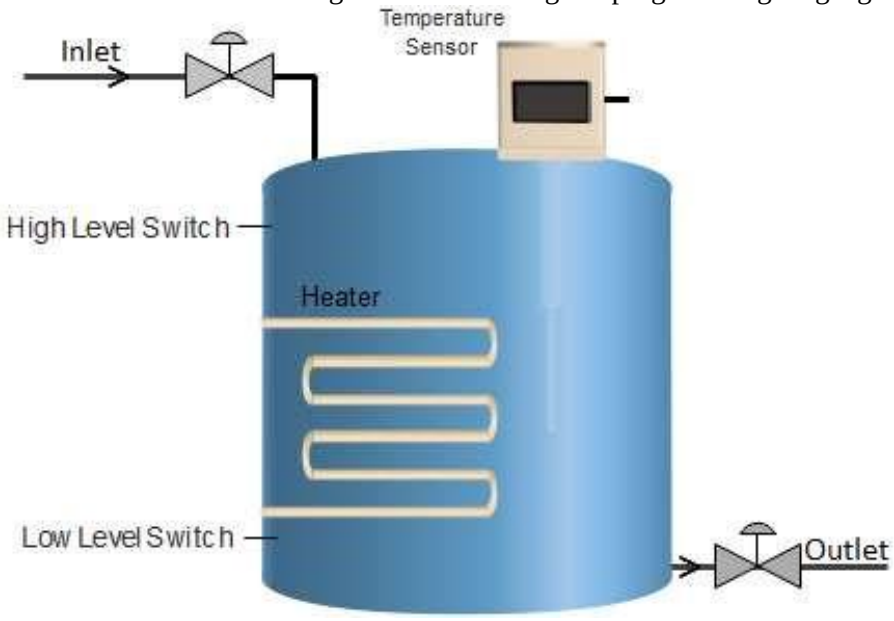
## Annexure-I

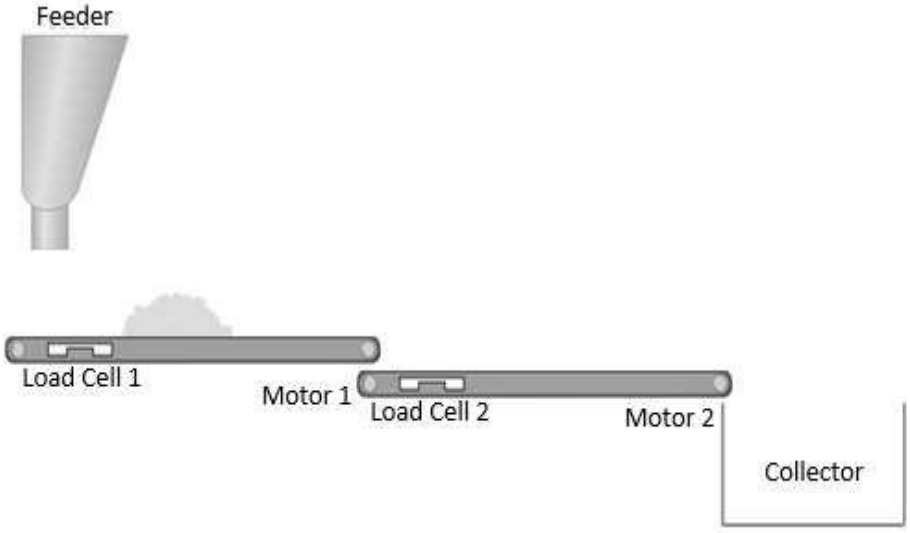
## TASKS FOR INDUSTRIAL AUTOMATION (PLC)

| Task No. | Task | Description |
|---|---|---|
| **1** | Make an OR & AND circuits. | Make an OR & AND circuit, draw it logic and circuit diagrams, also draw the truth table for this circuit. |
| **2** | Controlling of a lamp/LED from two different places. | Make a circuit to control one lamp/LED from two different places using SPDT switch and also draw,<br>Circuit diagram, logic diagram and truth table. |
| **3** | Operating lamp/LED & buzzer using Relay & Contactor logic. | Make a circuit using Relay & Contactor logic to control a lamp & buzzer in the following way, When the lamp is "ON" the buzzer remaining deactivated.<br>When the lamp turned "OFF" the buzzer circuit is then activated automatically until the lamp is again operated.<br>Draw logic, circuit diagrams and truth table. |
| **4** | Circuit to control 2 lamps automatically. | Make a circuit to control 2 lamps. First, L1 is "ON" for 7 sec then turned "OFF" automatically & at that instant L2 become energized and remained "ON" for 3 sec, this cycle is repeated until interrupted.<br>Draw circuit, logic diagrams and truth table. |
| **5** | Implement given Boolean Functions with the help of PLC Program. | Simulate PLC Program to implement the following Boolean functions with Don't Care Condition.<br><br>$F(A,B,C,D)=\sum m(0,1,5,9,13,14,15) + d(3,4,7,10,11)$ |

| | | |
|---|---|---|
| **6** | Using PLC Program to make Forward- Reverse Circuit (with limit switches) for a 3-Phase Motor. | Run a 3-phase motor in the Forward and Reverse direction with the help of PLC using Ladder Diagram programming language. This circuit is used to change the direction of rotation of a 3-Phase induction motor (i.e. forward &backward or upward & downward). Forward-Reverse movement of a 3Phase motor can be obtained by changing its phase sequence. Also draw its electrical and Ladder Logic diagrams. |
| **7** | PLC Program to Latch and Unlatch Output With Time Delay. | Prepare, execute, and demonstrate a PLC Program to implement Latching and Unlatching of output with a particular time delay in PLC using Ladder Diagram. |
| **8** | Operating Seven Segment Display using PLC Program. | Prepare, execute, and demonstrate a PLC Program to displaying 0-9 digits using 7 Segment LED Display interfacing with PLC using Ladder Diagram programming language. |
| **9** | Using PLC Program to Drive two Motors Simultaneously with Interlocking. | Two Motors are running in a sequence one by one for a particular time. If the start button is pressed Motors run in sequence such that 1st Motor stays ON for 5secs and then 2nd Motor is turned ON and stays ON for 5secs. And the cycle is repeated until it is interrupted. While motors are running in the sequence, if one motor is running and the button of other motor is pressed, then the running Motor should stop and the other motor should run. Implement this logic in PLC using Ladder Diagram programming language. Also draw its electrical and Ladder Logic diagrams. |
| **10** | PLC Program for Burglar Alarm Security System | Prepare, execute, and demonstrate a PLC Program for Burglar Alarm Security System. Consider the design of a Burglar Alarm for a house. This alarm will be activated if an unauthorized person is detected by a Window Sensor or a Motion Detector. Implement this Alarm System in PLC using Ladder Diagram programming language. |
| **11** | PLC Program for a Car Parking System | A parking plot has total capacity of Cars. Number of empty spots are displayed on the display outside the Parking Plot and which spots are available is to be indicated by LEDs. Implement this in PLC using Ladder Diagram programming language. |

| | | |
|---|---|---|
| **12** | Automatic Door Open Close Control System with the help of PLC Program. | Prepare, execute, and demonstrate a PLC Program to implement logic for the automatic door open & close system using ladder diagram programming language.<br>  <br> |

| | | |
|---|---|---|
| **13** | PLC Program for Heating water in the Tank by Heater using RTD as temperature detector. | Implement the process to control Heating and maintaining high and low level of water in the tankusing PLC Ladder Diagram programming language.<br>  <br> |

| | | |
|---|---|---|
| **14** | PLC Program to Control the Sequence of Conveyors and Interlocking Them | A feeder drops material on the conveyor which sends the dropped material to collector through one more conveyor. Conveyor must start automatically. When material falls on conveyor belt 1, motor 1 should start, and when material in present on conveyor belt 2, motor 2 remain On. Implement automation of this in PLC using Ladder Diagram programming language.<br>  <br> |
| **15** | PLC Program to Maintain the Capacity of a Particular Classroom using HMI Interface. | A classroom has a capacity of maximum 25 students. There are two doors, one for Entry and the other for Exit. When number of students in the classroom is less than 25, Entry door has a Green light on it which remains ON. When number of students in the classroom is 25 or more than that, Red light goes ON turning OFF the Green light which indicates that the classroom has reached its maximum capacity and is full. |
| **16** | **Mini Project:** Making of an ATS Circuit, with the help of PLC Program. | This circuit is widely used in industries. The trainees have to make such circuit with the following options.<br>1. When the main supply goes down, The Generator Will Turn ON automatically after 5 Min.<br>2. When the Generator Turned ON, the load shifts to Generator after 3 min. automatically.<br>3. When the main supply become available, shift load immediately on main while the Generator will then run without load for 3 min. and then turn OFF automatically.<br>Implement this logic in PLC using Ladder Diagram programming language. Also draw its electrical and Ladder Logic diagrams. |
| **17** | Making in Automatic StarDelta Starter with the help of PLC Program. | 3-phase induction motors (squirrel cage) are needed some suitable starting mechanism/arrangement because at the time of starting it draw a huge amount of current and when such large machines are started directly, it ultimately can cause damage to the machine or attached equipment. Implement the logic in PLC using Ladder Diagram programming language. Also draw its electrical and Ladder Logic diagrams. |

## Annexure-II

# ASSIGNMENTS FOR INDUSTRIAL AUTOMATION (PLC)

| Assign. No. | Assignment |
|---|---|
| 1 | Prepare safety charts. Showing general & Trade specific safety measure (text/pictorial). Each trainee will prepare different chart. |
| 2 | Simplify the following Boolean expression using K-Map, also draw logic diagrams (Before & after simplification)<br><br>f (W,X,Y,Z) = ∑ (1,3,4,6,9,11,12,14) |
| 3 | Draw neat & clean sketches (along with their symbols) of various components you have learnt in this week on drawing sheet(s)/Chart(s). |
| 4 | What is the difference between timers & counters? Explain function of Timer & Counter in PLC, enlist different types of timers and counters and draw their symbols, also write down its advantages. |
| 5 | What do you mean by automation? What are their types? Write down advantages of industrial automation with examples. |
| 6 | What is PLC? Enlist different the different sizes & brands of PLC, also write down the uses and advantages of PLC. |
| 7 | What do you mean by physical protocol of communication? What is the difference between RS232 and 485? How & why we can convert RS232 to 485? Draw the Block diagram of PLC and Pinout of RS232 & 485 connector (both male, female) on drawing sheet(s)/Chart(s). |
| 8 | Enlist the complete step by step procedure to install PLC software. Also write the method to configure PLC software for desired task. Evident screenshots is mandatory. |

## Annexure-III

# Workplace/Institute Ethics Guide

Work Ethics is a standard of conduct and values for job performance. The modern definition of what constitutes good work ethics often varies. Different businesses have different expectations. Work ethic is a belief that hard work and diligence have a moral benefit and an inherent ability, virtue or value to strengthen character and individual abilities. It is a set of values centered on importance of work and manifested by determination or desire to work hard.

The following ten work ethics are defined as essential for employee's success:

1. **Attendance:**

   Be at work every day possible, plan your absences don't abuse leave time. Be punctual every day.

2. **Character:**

   Honesty is the single most important factor having a direct bearing on the final success of an individual, corporation, or product. Complete assigned tasks correctly and promptly. Look to improve your skills.

3. **Team Work:**

   The ability to get along with others including those you don't necessarily like. The ability to carry your own weight and help others who are struggling. Recognize when to speak up with an ideas and when to compromise by blend ideas together.

4. **Appearance:**

   Dress for success, set your best foot forward, personal hygiene, good manner, remember that the first impression of who you are, can last a life time

5. **Attitude:**

   Listen to suggestions and be positive, accept responsibility. If you make a mistake, admit it. Values workplace safety rules and precautions for personal and co-worker safety. Avoids unnecessary risks. Willing to learn new processes, systems and procedures in light of changing responsibilities.

6. **Productivity:**

   Do the work correctly, quality and timelines are prized. Get along with fellows, cooperation is the key to productivity. Help out whenever asked, do extra without being asked. Take pride in your work, do things the best you know how. Eagerly focuses energy on accomplishing tasks, also referred to as demonstrating ownership. Takes pride in work.

7. **Organizational Skills:**

Make an effort to improve, learn ways to better yourself. Time management; utilize time and resources to get the most out of both. Takes an appropriate approach to social interactions at work. Maintains focus on work responsibilities.

8. **Communication:**

**Written communication,** being able to correctly write reports and memos

**Verbal communications,** being able to communicate one on one or to a group.

9. **Cooperation:**

Follow institute rules and regulations, learn and follow expectations. Get along with fellows, cooperation is the key to productivity. Able to welcome and adapt to changing workplace situations and the application of new or different skills.

10. **Respect:**

Work hard, work to the best of your ability. Carry out orders, do what's asked the first time.

Show respect, accept and acknowledge an individual's talents and knowledge. Respects diversity in the workplace, including showing due respect for different perspectives, opinions and suggestions.

# Annexure-IV

## SUGGESTIVE FORMAT AND SEQUENCE ORDER OF SUCCESS STORY

| S. No | Key Information | Detail/Description |
|---|---|---|
| 1. | **Self & Family background** | Self-introduction<br>Family background and socio economic status,<br>Education level and activities involved in<br>Financial hardships etc. |
| 2. | **How he came on board NAVTTC Training/ or got trained through any other source** | Information about course, apply and selection<br>Course duration, trade selection<br>Attendance, active participation, monthly tests, interest in lab work |
| 3. | **Post training activities** | How job / business (self-employment) was set up<br>How capital was managed (loan (if any) etc.).<br>Detail of work to share i.e. where is job or business being done; how many people employed ( in case of self-employment/ business )<br>Monthly income or earnings and support to family<br>Earning a happy life than before |
| 4. | **Message to others (under training)** | Take the training opportunity seriously<br>Impose self-discipline and ensure regularity<br>Make Hard work pays in the end so be always ready for the same. |

**Note: Success story is a source of motivation for the trainees and can be presented in a number of ways/forms in a NAVTTC skill development course as under: -**

1. **To call a passed out successful trainee of institute. He will narrate his success story to the trainees in his own words and meet trainees as well.**
2. **To see and listen to a recorded video/clip (5 to 7 minutes) showing a successful trainee Audio video recording that has to cover the above mentioned points.**
3. **The teacher displays the picture of a successful trainee (name, trade, institute, organization, job, earning etc.) and narrates his/her story in teacher's own motivational words.**