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

COMPETENCY BASED CURRICULUM

INDUSTRIAL ROBOTICS & DIGITAL MANUFACTURING TECHNICIAN

(Duration: One Year)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL – 3.5

SECTOR – CAPITAL GOODS & MANUFACTURING

INDUSTRIAL ROBOTICS AND DIGITAL MANUFACTURING TECHNICIAN

(Engineering Trade)

(Revised in 2024)

Version: 3.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL –3.5

Developed By

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1. COURSE INFORMATION

During the one-year duration of Industrial Robotics and Digital Manufacturing Technician trade a candidate is trained on professional Skill, professional Knowledge and Employability Skill related to job role. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The broad components covered in one-year duration are as below:

The trainee learns about safety and environment, use of fire extinguishers, artificial respiratory resuscitation to begin with. Trainee gets the idea about the automation in Manufacturing Industry. This includes the understanding the robotic cell its different components i.e. safety sensors operational equipment and application tools. Working with robots as operator to feed the unfinished parts to the robotic cell by inserting them into the Fixture and taking out the finished product. Learning the robot programming skills by getting familiar with the coordinate system, motion programming parameters, application based dedicated commands. Optimizing the process of robot operation. After developing the programming skills trainee will be able to Set up the and Make the cell Robotic cell ready Power ON and check the status of Robotic cell, adjusting the application parameters of the desired application done by robot. Taking care sequence of Operation, ensuring the location of process points on components, fixtures accuracy in mounting the components. Troubleshooting the automation and production problems in Robotic cells. Applying the Knowledge of Automation theory and Procedures, application-based tools, to understand the Process of Manufacturing in current robotic cell and safety norms.

Optimizing the application parameters, optimizing the cycle time of carrying out the task with robot programs. Making sure of inclusion of all the safety sensors, Inputs and outputs to avoid any type of accident in Workshop. Making dry runs of robots at different speeds to ensure if the robot is following the same path to avoid any kind safety issues to avoid any type of accidents and for insurance of smooth production.

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 'Industrial Robotics and Digital Manufacturing Technician' 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 (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 Robotic 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.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.

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)	840
2	Professional Knowledge (Trade Theory)	240
3	Employability Skills	120
	Total	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

On the Job Training (OJT)/ Group Project	150
Optional Courses (10th/ 12th class certificate along with ITI certification or add on short term courses)	240

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses.

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%.

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 some of 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
- Computer based multiple choice question examination
- Practical Examination

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 for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the	• Demonstration of good skill in the use of

candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the project/job.
(b) Marks in the range of 75%-90% to be allotted during assessment	
Forth is grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
(c) Marks 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. • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

The Job role in Industrial Robotics Includes the as Operator to feed the unfinished parts to the robotic cell by inserting them into the Fixture and taking out the Finished product while taking the safety measures in consideration. Troubleshooting the automation and production problems in Robotic cells. Applying the Knowledge of Automation theory and Procedures, application-based tools, to understand the Process of Manufacturing in current robotic cell and safety norms, setting up the and Making the cell Robotic cell ready Power ON and check the status of Robotic cell, adjusting the application parameters of the desired application done by robot to improve the quality of the finished product.

Second Job role includes the Programming of robot for manufacturing the desired component with required application. Taking care sequence of Operation, ensuring the location of process points on components, fixtures accuracy in mounting the components for manufacturing with different joining processes, optimizing the Robot programs, setting up communication with other peripheral devices in robotic cell by integrating with the external automation controllers, Optimizing the application parameters, optimizing the cycle time of carrying out the task with robot programs.

Making sure of inclusion of all the safety sensors, Inputs and outputs to avoid any type of accident in Workshop. Making dry runs of robots at different speeds to ensure if the robot is following the same path to avoid any kind safety issues and for insurance of smooth production. Taking Backup of robot's time to time. Applying the simulation software knowledge in virtually validating the process. Robot simulation software can help in optimizing the robotic cell structure and reduce the cost in procuring the cell components and rework installing the robotic cell and also it helps in optimizing and improving the programs of robot.

Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Robotic Machine Operator; sets up and operates industrial robots to drill, countersink, and counter bore metallic and non-metallic work pieces used to manufacture aircraft parts or tooling, according to specifications and preprogrammed machine control instructions: Reads work order and specifications to determine prescribed setup and operation. Mounts and positions work piece on locating pins of holding fixture adjacent to a robot, manually or using hoist, and aligns and secures work piece on holding fixture, using template, bolts, hand tools, and power tools. Installs specified type and size of drill bits in end effectors and place send effectors in holding station adjacent to a robot. Loads cassette tape of machine instructions into machine controller or enters commands to retrieve preprogrammed instructions from the mainframe computer. Pushes a button or enters commands to activate a robot that automatically retrieves and secures designated end effectors on robot arm and positions arm for drilling. Operates robots to drill holes in test specimen and measures holes for conformance to specifications, using measuring instruments. Enters commands to start robot, observes

robotic operation, and monitors screen of machine controller formal functions and error messages. Changes worn drill bits or adjusts machine according to error message instructions. Inspects finished work piece for conformance to specifications. Cleans parts, tools, and fixtures, using solvents and rags. May set up and operate robot to perform additional machine operations, such as sealing and fastener installation, to join component parts into complete assembly.

Programmer, Engineering and Scientific; converts scientific, engineering, and other technical problem formulations to format that can be processed by a computer: Resolves symbolic formulations, prepares flow charts and block diagrams, and encodes resultant equations for processing by applying extensive knowledge of branch of science, engineering, or advanced mathematics, such as differential equations or numerical analysis, and understanding of capabilities and limitations of computer. Confers with other engineering and technical personnel to resolve problems of intent, inaccuracy, or feasibility of computer processing. Enters the program into a computer system. Reviews results of computer runs with the concerned personnel to determine necessity for modifications or reruns. Develops new subroutines or expands program to simplify statement, programming, orcoding of future problems. May direct and co-ordinate activities of COMPUTER PROGRAMMERS working as part of the project team.

Metal Inert Gas/Metal Active Gas/Gas Metal Arc Welder (MIG/MAG/GMAW); perform manual (semi-automatic) MIG/ MAG (GMAW) welding for a range of standard welding job requirements and weld different materials (carbon steel, aluminium and stainless steel) in various positions. The welder can prepare various joints including corner, butt, fillet and tee. Set-up and prepare for operations interpreting the right information from the WPS.

Pick and Place Operator; operates the automated pick-and-place machine for assembling components on the printed circuit board (PCB). The individual on the job, programs, operates and maintains the automated pick-and-place machine for placing different types of components on the surface of PCBs for soldering.

Modeller; is broadly responsible for visualization of the final product; develop clay model from the design, transforming the sketch into digital data i.e., three-dimensional shape and building mock-up which is as close as possible to the real object. A modeller's working characteristics include rapid generation of styling ideas, flexibility in combing existing alternatives and creating aesthetically appealing representations.

Application Maintenance Engineer; is responsible for ensuring the availability of an application or product for end users. Such roles provide on-going/ad-hoc support for software products or customized applications aimed towards correction of faults/bugs or improvement of performance.

Reference NCO-2015:
   a) 3139.1400 - Robotic Machine Operator
   b) 2512.0800 - Programmer, Engineering and Scientific/System Programmer
   c) 7212.0303 - Arc Welder (MIG/MAG/GMAW)

d) 8212.1603 - Pick and Place Assembly Operator

e) 2144.0802 - Modeller

f) 2512.0701 - Application Maintenance Engineer

Reference NOS:

i.	PSC/N9401	ix.	ISC/N9476	xvii.	ISC/N9485
ii.	PSS/N9401	x.	ISC/N9477	xviii.	ISC/N9486
iii.	PSS/N9402	xi.	ISC/N9479	xix.	ISC/N9487
iv.	CSC/N0901	xii.	ISC/N9480	xx.	ISC/N9488
v.	ISC/N9472	xiii.	ISC/N9481	xxi.	ISC/N9489
vi.	ISC/N9473	xiv.	ISC/N9482	xxii.	ISC/N9490
vii.	ISC/N9474	xv.	ISC/N9483		
viii.	ISC/N9475	xvi.	ISC/N9484		

Name of the Trade	INDUSTRIAL ROBOTICS AND DIGITAL MANUFACTURING TECHNICIAN
NCO Code 2015	3139.1400, 2512.0800, 7212.0303, 8212.1603, 2144.0802, 2512.0701
NOS Covered	PSC/N9401, PSS/N9401, PSS/N9402, CSC/N0901, ISC/N9472, ISC/N9473, ISC/N9474, ISC/N9475, ISC/N9476, ISC/N9477, ISC/N9479, ISC/N9480, ISC/N9481, ISC/N9482, ISC/N9483, ISC/N9484, ISC/N9485, ISC/N9486, ISC/N9487, ISC/N9488, ISC/N9489, ISC/N9490
NSQF Level	Level 3.5
Duration of Craftsmen Training	One Year (1200 hours + 150 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination
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) Industrial Robotics and Digital Manufacturing Technician	B.Voc/Degree in Mechanical/Industrial/Mechatronics/Automation & Robotics/Robotics & Automation/Electronics/Electrical Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Mechanical/Industrial/Mechatronics/Automation & Robotics/ Robotics & Automation/Electronics/Electrical Engineering from AICTE/ recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the trade of "Industrial Robotics and Digital Manufacturing Technician" with three years' experience in the relevant field. **Essential Qualification:** Relevant Regular / RPL variants of National Craft Instructor

	Certificate (NCIC) under DGT. *NOTE: - Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.* *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. **OR** 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. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants 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. **OR** 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. **OR** NTC/ NAC in any one of the engineering/ Draughtsman group of trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade OR Regular/RPL variants NCIC in RoDA 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.

	(Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
(v) Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

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

1. Recognize & comply safe working practices, environment regulation and housekeeping. (NOS: PSC/N9401)
2. Identify the customer needs & Product specifications. (NOS: ISC/N9472)
3. Apply the knowledge of industrial engineering drawing & requirements. (NOS: PSS/N9401)
4. Identify and explain various types of Industrial Robots and perform their configuration. (NOS: ISC/N9473)
5. Identify the Robotic Cell Components & Application tools. (NOS: ISC/N9474)
6. Perform installation check of robot mechanically and electrically. (NOS: ISC/N9475)
7. Power on the Robot and making the cell Healthy for programming. (NOS: ISC/N9476)
8. Run operations with Teach Pendant key functions & user interface for teach pendant. (NOS: ISC/N9477)
9. Identify the Industrial Robot simulation tool/ software. (NOS: ISC/N9489)
10. Apply the knowledge of robotic Coordinate system. (NOS: ISC/N9479)
11. Perform Jogging of the industrial robot using virtual programming pendant. (NOS: ISC/N9480)
12. Demonstrate the need of add on assembly and perform as per application. (NOS: ISC/N9481)
13. Perform work on application-based components used in robotic cells and understanding their parameters. (e.g. Welding system, component holder gripper, external auto operation set up, etc.) (NOS: ISC/N9482)
14. Identify architecture of welding robot system, establish communication with PLC and assemble welding torch for operation. (NOS: ISC/N9483)
15. Perform Interfacing of work piece holding Grippers in Robot. (NOS: ISC/N9484)
16. Perform Importing, Exporting & Selection of robotic program. (NOS: ISC/N9485)
17. Read existing program & execution techniques. (NOS: ISC/N9486)
18. Perform Operation of industrial robot. (NOS: ISC/N9487)
19. Program the Robot following the Safety procedure for Programmer. (NOS: ISC/N9488)
20. Explain the industrial need of robotic programming Simulation. (NOS: ISC/N9489)
21. Create a program with the help of Robotic Simulation software. (NOS: ISC/N9489)
22. Perform remote monitoring and connectivity of Industrial Robot. (NOS: ISC/N9490)
23. Carry out Preventive Maintenance & Basic troubleshooting. (NOS: CSC/N0901)
24. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)
25. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study (NOS: PSS/N9402)

LEARNING OUTCOME	ASSESSMENT CRITERIA
1. Recognize & comply safe working practices, environment regulation and housekeeping. (NOS: PSC/N9401)	Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE).
	First Aid Method and basic training
	Practice and understand precautions to be followed while working.
	Safe use of tools and equipment used in the trade.
2. Identify the customer needs & Product specifications. (NOS: ISC/N9472)	Create check List of customer needs.
	Define product specifications.
	Familiarize with product design & development process.
3. Apply the knowledge of industrial engineering drawing & requirements. (NOS: PSS/N9401)	Reading of industrial drawing.
	Create a check list of dimensions.
	Define Customer specific requirements.
4. Identify and explain various types of Industrial Robots and perform their configuration. (NOS: ISC/N9473)	List out application of industrial robot.
	Identify the various types of robots.
	Identify different configurations of robots.
5. Identify the Robotic Cell Components & Application tools Cell Components. (NOS: ISC/N9474)	Identify the Robotic Cell Components.
	Identify the mechanical installation of robot.
	Familiarize with the working of the peripheral devices.
6. Perform installation check of robot mechanically and electrically. (NOS: ISC/N9475)	Check the safety measures and safety sensors are installed properly.
	Check hydraulic, pneumatic connection.
7. Power on the Robot and making the cell Healthy for programming. (NOS: ISC/N9476)	Standard robot on–off operating procedure.
	Verification of Robotic cell health (Mechanical, Electrical &Safety) checkpoints.
8. Run operations with Teach Pendant key functions & user interface for teach pendant. (NOS: ISC/N9477)	Familiarize with the function of the front and back of the teach pendant.
	Familiarize with the user interface of the teach pendant.
	Working with different touch pendant function keys.

9. Identify the Industrial Robot simulation tool/software. (NOS: ISC/N9489)	Identify the Robots components.
	Identify the position variation in robots.
	Perform Robot axis movements.
10. Apply the knowledge of robotic Coordinate system. (NOS: ISC/N9479)	Verifying co-ordinate system by multiple motion movements.
	Learning the basics of the coordinate system.
	Demonstrate different types of coordinate system.
11. Perform Jogging of the industrial robot using virtual programming pendant. (NOS:ISC/N9480)	Jogging using virtual programming pendant.
	Jogging of robot in axis mode (joint mode).
	Practice on fixture for Jogging robot with different coordinate systems.
12. Demonstrate the need of add (NOS: ISC/N9481)	Explain the different application tools & their respective components.
	Define add on assembly tools as per application case studies.
13. Perform work on Application based components used in robotic cells and understanding their parameters. (e.g. Welding system, component holder gripper, external auto operation setup, etc. (NOS: ISC/N9482)	Assembling of gripper to manipulator.
	Resolve the incorporate programming pendent & alarm resolution.
	Parameters setting of application based controllers.
14. Identify architecture of welding robot system, establish communication with PLC and assemble welding torch for operation. (NOS: ISC/N9483)	Identify the PLC and robot communication for communicate with HMI.
	Verify Loop control instructions.
	Power source connection with robot controller. Working using ARCON, ARCOFF. Working using WEAVON, WEAVOFF
15. Perform Interfacing of work piece holding Grippers in Robot. (NOS: ISC/N9484)	Performing the different connections of grippers (Electric, Pneumatic etc.)
	Create a program of pick and place with the help of gripper.
16. Perform Importing, Exporting & Selection of robotic program. (NOS: ISC/N9485)	Select existing programmer from system file location & execute the program in manual mode.
	Importing programming file from external source and execute the program manual mode.
	Export the existing program in external device.

17. Read existing program & execution techniques. (NOS: ISC/N9486)	Explain Teach table or fixture for all move commands.
	Execute the program with different modes. (Manual, moderate speed & auto)
18. Perform Operation of industrial robot. (NOS: ISC/N9487)	Explain Teach table or fixture for all motion commands.
	Operating of existing welding program in auto mode with material loading and unloading from jig.
	Operating of existing gripper (Pick and place) program in auto mode.
19. Program the Robot following the Safety procedure for Programmer. (NOS: ISC/N9488)	Create the table reading Program
	Create a program of Pick & place.
	Create a program of advance fixture welding.
20. Explain the industrial need of robotic programming Simulation. (NOS: ISC/N9489)	Calculate the cycle time
	Identify the importance of tool path optimization techniques.
21. Create a program with the help of Robotic Simulation software. (NOS: ISC/N9489)	Creating Virtual field and understanding cube.
	Create a program with the help of simulation software & compare the tool path with manual program.
	Create the welding program in simulation software.
	Create pick and place program in the simulation software.
22. Perform remote monitoring and connectivity of Industrial Robot. (NOS: ISC/N9490)	Remote Monitoring and connectivity of Industrial Robot.
	Understanding the concept & goals of industry 4.0
23. Carry out Preventive Maintenance & Basic troubleshooting. (NOS: CSC/N0901)	Prepare preventive maintenance plan
	Conduct the preventive maintenance as per standard operating procedure.
24. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
25. Demonstrate basic mathematical concept and principles to perform practical	Solve different mathematical problems
	Explain concept of basic science related to the field of study

operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)	

			SYLLABUS FOR INDUSTRIAL ROBOTICS AND DIGITAL MANUFACTURING TRADE		

			DURATION: ONE YEAR

Duration	Reference Learning outcome	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
Professional Skill 35 Hrs. Professional Knowledge 10 Hrs.	LO-1: Recognize & comply safe working practices, environment regulation and housekeeping.	1. Importance of trade training, List of tools & Machinery used in the trade. 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). 3. First Aid Method and basic training. 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. 5. Hazard identification and avoidance. 6. Safety signs for Danger, Warning, caution & personal safety message. 7. Preventive measures for electrical accidents & steps to be taken in such accidents. 8. Use of Fire extinguishers. 9. Practice and understand precautions to be followed while working in fitting jobs. 10. Safe use of tools and equipment's used in the trade.	All necessary guidance to be provided to the newcomers to Become familiar with the working of Industrial Training Institute system Including stores procedures. Soft Skills, its importance and Job area after completion of training. Importance of safety and general precautions observed in the industry /shop floor. Introduction of First aid. Operation of electrical mains and electrical safety. Introduction of PPEs. Response to emergencies e.g.; power failure, fire and system failure. Importance of housekeeping & good shop floor practices. Introduction to 5S concept & its application. Occupational Safety & Health: Health, Safety and Environment legislations & regulations as applicable. Basic understanding on Hot work, confined space work and material handling equipment.
Professional Skill 35 Hrs. Professional Knowledge 10 Hrs.	LO-2: Identify the customer needs & Product specifications.	11. Familiarize with product design & development process. 12. Prepare checklist of customer needs. 13. Define product specifications.	Introduction to product design and development. Customer needs & specification. Importance of customer relationship management.

Professional Skill 35 Hrs. Professional Knowledge 10 Hrs.	LO-3: Apply the knowledge of industrial engineering drawing & requirements.	14. Applying GD & Symbol on drawing to understand the importance & intent of component in assembly of final product. 15. Reading of industrial drawing. 16. Create a checklist of dimensions & customer specific requirements.	Introduction to engineering drawing. Concept of limits fits & tolerances & symbols. Importance of interchangeability & ISO standards. Understand industrial engineering special characteristic symbol, Customer specific standards drawing a notation, geometrical dimensions & tolerance. Symbols used in Industrial machining drawing like surface finish, machining operation, surface treatment, GD&T, etc.)
Professional Skill 50 Hrs. Professional Knowledge 10 Hrs.	LO-4: Identify and explain various types of Industrial Robots and perform their configuration.	17. List down the industrial application of industrial robot. 18. Identify the various types of robots. 19. Identify different configuration of robots.	Introduction of Robots & Its Importance in Manufacturing and Production. Types of robots. Applications of robots in manufacturing. Different configurations of robots.
Professional Skill 50 Hrs. Professional Knowledge 10 Hrs.	LO-5: Identify the Robotic Cell Components & Application tools.	20. Identify the Robotic Cell Components & Application tools Cell Components.	Introduction to the Robotic Cell Components. Customizing the industrial robot as per application. Industrial case studies of customization & trending application of robots in industry.
Professional Skill 50 Hrs. Professional Knowledge 10 Hrs.	LO-6: Perform installation check of robot mechanically and Electrically.	21. Check the safety measures and safety sensors are installed properly. 22. Checking of Physical grouting of robot and other peripheral devices (cable trays, fences, fixtures, electric boxes etc.). Check the electric connections Earthing cable, power cable, Pneumatic pipes etc.	Introduction to safety measures of industrial robot. Types of sensor used in industrial robot & their application. Guidelines to ensure safe working practice for industrial robot. Install and inspect the Mechanical components of robotic cell. Install and inspect the electrical connections.
Professional Skill 25 Hrs. Professional Knowledge 05 Hrs.	LO-7: Power on the Robot and making the cell Healthy for programming.	23. Structure and Function of complete Robotics Work cell and its different components. 24. Starting Up and Shutdown Steps Robot. 25. Turning in the main supply	Introduction to robots Structure and functions of robot System (Basic Package) and additional Equipment. Standard robot on – off operating procedure. Concept of Robotic cell health.

		to robot, turn on the stabilizers, electric box, Robot Controller. Turning on the air compressor. Check the Booting of the teach pendent. Check the pneumatic clamps in fixtures, Grippers on robots. 26. Checking complete cell health.	
Professional Skill 37 Hrs. Professional Knowledge 08 Hrs.	LO-8: Run operations with Teach Pendant key functions &user interface for teach pendant.	27. Run Teach mode: Play mode, Remote mode. 28. Run Steps to define Tool co-ordinate system. 29. Run TCP (Tool center point definition). 30. Creating user defined work objects. 31. Create Box, circle, triangle work object definition). 32. Multi-mode selection in virtual programming pendant.	Introduction to Teach pendant. Tool/ work object definition and their calibration.
Professional Skill 37 Hrs. Professional Knowledge 08 Hrs.	LO-9: Identify the Industrial Robot simulation tool/ software.	33. Identify the Robots components. 34. Introduction about Simulation software. Creating new model in Simulation Software. 35. Importing different types of robot. 36. Identify the position variation in robots. 37. Perform Robot axis movements.	Basic components of robots and understanding their respective functions. Introduction to Cycle time and its importance. Understanding the operator job in robot cell. Safety considerations.
Professional Skill 37 Hrs. Professional Knowledge 08 Hrs.	LO-10: Apply the knowledge of robotic Coordinate system.	38. Co-ordinate selection: Joint co-ordinate system, Rectangular co-ordinate system, User or object co-ordinate system, Tool co-ordinate system. Steps to define user co-ordinate system. 39. Defining X, Y, Z co-ordinate system. 40. Verifying co-ordinate	Axis system of Robots, type of joints in robot, Understanding Coordinate system. Different coordinate systems in Robots.

		system by multiple motion movements.	
Professional Skill 37 Hrs. Professional Knowledge 08 Hrs**.**	LO-11: Perform Jogging of the industrial robot using virtual programming pendant.	41. Jogging using virtual programming pendant. 42. Practice on fixture for Jogging robot with different coordinate systems.	Modes of Jogging in Robot.
Professional Skill 25 Hrs. Professional Knowledge 05 Hrs.	LO-12: Demonstrate the need of add on assembly and perform as per application.	43. Define the add on assembly tools as per application case studies.	Introduction to Application based components used in robotic cells and Industrial case studies of application based modification in robotic cell components.
Professional Skill 25 Hrs. Professional Knowledge 05 Hrs.	LO-13: Perform work on Application based components used in robotic cells and understanding their parameters. (e.g. Welding system, component holder gripper, external auto operation setup, etc.)	44. Assembling of welding robot. 45. List out the end effectors and their functions. 46. Assembling of gripper to manipulator. 47. Resolve the incorporate programming pendent & alarm resolution. 48. Parameters setting of application based controllers.	Assembly guideline of application based tools, Parameters study of application based tools. Learning other peripheral devices and components in robotic cells. Selection of Welding tool for robot.
Professional Skill 77 Hrs. Professional Knowledge 13 Hrs**.**	LO-14: Identify architecture of welding robot system, establish communication with PLC and assemble welding torch for operation.	49. Identify the basic Program structure in robot with the help of teach pendent. 50. Identify the PLC and robot communication for communicate with HMI. 51. Build the conveyor system and its communication with PLC. 52. Assembling of welding torch to manipulator. 53. Selection of welding source programming file. 54. Adjust the Voltage and Amps rating. 55. Start ending and main conditions. 56. Identify architecture of welding robot system. 57. Power source connection	Programming with advance level instructions Loop control instructions Arithmetic and Logical Instructions Shift instructions Methods to create fencing and safety equipment's Steps to work with two different types of Robot at same project.

		with robot controller. Working using ARCON, ARCOFF. Working using WEAVON, WEAVOFF. 58. Practical application demo using interpolation. 59. Quality check of welding and improvement with changing weld parameters. 60. Verify Loop control instructions. 61. Arithmetic and Logical instructions. 62. Verifying the Shift instructions. 63. Create fencing and safety equipment's.	
Professional Skill 37 Hrs. Professional Knowledge 08 Hrs	LO-15: Perform Interfacing of work piece holding Grippers in Robot.	64. Gripper mounting on Robot Flange. 65. Performing the different connections of grippers (Electric, Pneumatic etc.). 66. List out gripper application in robot program & develop machine setting to assign the operation. 67. Interfacing Grippers to Robot using robot I/O. 68. Interfacing Grippers to Robot using PLC. 69. Use of Function Keysin Pendant. 70. Creating a program of pick and place with the help of gripper. 71. Understanding HAND INSTRUCTIONS in Robot. 72. Understanding HANDLING WINDOW in Robot. 73. Low Air Pressure Interlock. 74. Creating the program with gripper application. 75. Practice for program creation with gripper application.	Introduction to handling grippers. Understanding Handling Operation Understanding Major applications of handling Robot, Bin Picking, Part Transfer, Picking & Packing, and Palletizing. Understanding type of Grippers and differences between them: Pneumatic Gripper, Vacuum Gripper, Hydraulic Gripper, Servo-Electric Gripper Factors to be considered for Selecting and Designing a Gripper Understanding the Work function of Solenoid valve Understanding Differences between Single Solenoid, Double Solenoid, Proportional Valve and Servo valve. Path optimization for smooth robot movement and cycle time.
Professional	LO-16: Perform	76. Select existing programmer	Concept of Importing &

Skill 25 Hrs. Professional Knowledge 05 Hrs.	Importing, Exporting & Selection of robotic program.	from system file location & execute the program in manual mode. 77. Importing programming file from external source and execute the program manual mode. 78. Export the existing program in external device.	exporting of robotic program.
Professional Skill 37 Hrs. Professional Knowledge 08 Hrs.	LO-17: Read existing program & execution techniques.	79. Identify the program motion command movements. 80. Practice on Teach table or fixture for all move commands.	Understanding Robot Program Structure. Different Motion Types used in Programming (PTP, Linear, Circular, Spline). Via Point and Process Points. Understanding Different Motion Parameters used in Program Point Recording.
Professional Skill 37 Hrs. Professional Knowledge 08 Hrs.	LO-18: Perform Operation of industrial robot.	81. Follow Safety procedure for an Operator. 82. Run the existing program with manual mode. 83. Run the existing program with moderate speed mode. 84. Run the existing program with auto mode. 85. Operating of existing welding program in auto mode with material loading and unloading from jig. 86. Inspect the welding quality by measuring instruments. 87. Identification of defects in welding & basic correction in program & machine setup with weld feed wire control. 88. Operating of existing gripper (Pick and place) program in auto mode.	Standard robot operating procedure. Safety guidelines of robot operation. Understanding the robotic running mode (speed & automation). Understanding types of welding & their industrial applications. Identification of defects in welding.
Professional Skill 37 Hrs. Professional Knowledge 08 Hrs.	LO-19: Program the Robot following the Safety procedure for Programmer.	89. Follow Safety procedure for Programmer. 90. Move J(Joint), Move L(Linear), Move C (Circular), Move S (Spline). 91. Working with Welding Torch.	Understanding Safety procedure for Programmer Concept and understanding of Program creation. Path optimization for smooth robot movement and cycle time. Arc Welding Application commands used in

		92. Create the table reading Program. 93. Basic programming using move commands. 94. Programming with advance level instructions. 95. Create a program of Pick & place. 96. Create a program of advance fixture welding.	Welding and weld Parameters settings.
Professional Skill 25 Hrs. Professional Knowledge 05 Hrs.	LO-20: Explain the industrial need of robotic programming Simulation.	97. Calculate the cycle time. 98. Calculate the productivity 99. Calculate the machining cost for operation. 100. Identify the importance of tool path optimization techniques.	Concept of tool path optimization. Concept of cycle time & total productivity.
Professional Skill 37 Hrs. Professional Knowledge 08 Hrs.	LO-21: Create a program with the help of Robotic Simulation software.	101. Creating Virtual field and understanding cube. 102. Practice of handling programs. 103. Importing files from some other format to Robot simulation software in to robot. 104. Various types communication interface available in Robot simulation software. 105. Follow Steps to control real time robot using Robot simulation software. 106. Create a program with the help of simulation software & compare the Tool path with manual program. 107. Create the welding program in simulation software. 108. Create pick and place program in the simulation software.	Importing Files from some other format to Robot simulation software Various types communication interface available in Robot simulation software Steps to control real time robot using Robot simulation software.
Professional Skill 25 Hrs. Professional Knowledge 05 Hrs.	LO-22: Perform remote monitoring and connectivity of Industrial Robot.	109. Remote Monitoring and connectivity of Industrial Robot.	Concept of industry 4.0 Remote Monitoring and connectivity of Industrial Robot.

Professional Skill 25 Hrs. Professional Knowledge 05 Hrs.	LO-23: Carry out Preventive Maintenance & Basic troubleshooting.	110. Prepare preventive maintenance plan. 111. Check & top up lubrication oil. 112. Inspect weld wire & replacing of weld wire. 113. Verifying the welding gas. 114. Verifying the pneumatic leakages for operating fixtures. 115. Verify all the safety sensors. 116. Conduct the preventive maintenance as per standard operating procedure.	Use of tool kit used for robotics preventive maintenance & basic troubleshoot.
Engineering Drawing			
Professional Knowledge ED -30 hrs.	LO-24: Read and apply engineering drawing for different application in the field of work.	Introduction to Engineering Drawing and Drawing Instruments – • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Lines- Types and applications in drawing Free hand drawing of – • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Free hand drawing of hand tools and measuring tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke. Dimensioning • Types of arrowheads • Leader line with text • Position of dimensioning (Unidirectional, Aligned) Symbolic representation – • Different symbols used in the related trades. Concept and reading of Drawing in • Concept of axes plane and quadrant • Concept of Orthographic and Isometric projections • Method of first angle and third angle projections (definition and difference) Reading of Job drawing related to trades.	
Workshop Calculation & Science			
Professional al	• LO-25: Demonstrate	• Unit, Fractions • Classification of unit system	

Knowledge WC- 30 Hrs.	basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	- Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units - Measurement units and conversion - Factors, HCF, LCM and problems - Fractions - Addition, subtraction, multiplication & division - Decimal fractions - Addition, subtraction, multiplication & division - Solving problems by using calculator - Square root, Ratio and Proportions, Percentage - Square and square root - Simple problems using calculator - Applications of Pythagoras theorem and related problems - Ratio and proportion - Ratio and proportion - Direct and indirect proportions - Percentage - Percentage - Changing percentage to decimal and fraction - Material Science - Types metals, types of ferrous and non-ferrous metals - Physical and mechanical properties of metals - Introduction of iron and cast iron - Difference between iron & steel, alloy steel and carbon steel - Properties and uses of rubber, insulating materials - Mass, Weight, Volume and Density - Mass, volume, density, weight and specific gravity, numerical related to sections L,C, O. - Related problems for mass, volume, density, weight and specific gravity - Speed and Velocity, Work, Power and Energy - Speed and velocity - Rest, motion, speed, velocity, difference between speed and velocity, acceleration and retardation - Speed and velocity - Related problems on speed & velocity - Heat & Temperature and Pressure - Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals - Heat &Temperature - Transmission of heat - Conduction, convection and radiation - Co-efficient of linear expansion and related problems with assignments - Concept of pressure - Units of pressure, gauge pressure and gauges used for measuring pressure - Basic Electricity - Introduction and uses of electricity, electric current AC, DC their comparison, voltage, resistance and their units - Mensuration

		- Area and perimeter of square, rectangle and parallelogram - Area and perimeter of Triangles - Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse - Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder - Finding the lateral surface area, total surface area and capacity in liters of hexagonal, conical and cylindrical shaped vessels - Trigonometry - Measurement of angles - Trigonometrical ratios - Trigonometrical tables

Project work / Industrial visit: -

Project work/OJT involving the mounting of application tools on robot, programming the robot and operating the robot for provided Part Components in Robotic cell, CAD to Robots, Spot Welding, Gluing, Gasketing, Quality Control (Vision based), Gas Cutting.

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 hrs.)

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/ www.dgt.gov.in

List of Tools & Equipment
Industrial Robotics and Digital Manufacturing Technician **(For batch of 20 Candidates)**
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. Equipment
1.	Robot for Arc Welding	Robot 6 kg or more Payload, 5 Axis or more for Handling with Pneumatic Gripper	1 No.
2.	Robot For Pick and Place	Robot 6 kg or more Payload, 5 Axis or more for Handling with Pneumatic Gripper	1 No.
3.	Robot Controller for welding robot		1 No.
4.	Robot Controller for Handling Robot		1 No.
5.	Welding Power Source	Compatible with Arc welding Robot	1 No.
6.	Welding Power Source for Robots with arc welding package	Compatible with Robot	1 No.
7.	Programming Pendant for welding robot and Handling robot	Compatible with Robot as per Industry Standard	1 No.
8.	Standard welding cell with safety fence, fixture, HMI		1 No.
9.	Isolation transformer		1 No.
10.	PLC Control Panel		1 No.
11.	Welding Table		1 No.
12.	Pick and Place table		1 No.
13.	Input conveyor for palletizing		1 No.
14.	Earthing Cable	6mm Sq.1core Copper cable	1 No.
15.	Robot Power Wiring	10mmSq.4 Core copper cable	1 No.
16.	Robot Power Wiring	4mm Sq.3core copper cable	1 No.
17.	Welding wire, gas hose and gas regulator		1 No.
18.	Piping/Hose pipe up to robot gripper		1 No.
19.	Air Compressor for Robot	3 Hp or More	1 No.
20.	Steel rule	30 cm & 60 cm graduated both in English & Metric units	02 Nos.
21.	Hand Gloves	_	02 Nos.

22.	Safety Shoes	_	02 Nos.
23.	Helmet	_	02 Nos.
C. TOOLS & GENERAL SHOP OUTFIT			
24.	Allen Screwdriver Wrench Tool	6Pcs T Handle Ball Ended Hex Key	02 Nos.
25.	Digital Multimeter		01 No.
Note: - Internet facility is desired to be provided in the class room.			

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.

S. No.	Name & Designation Sh./Mr./Ms	Organization	Remarks
	List of Expert members contributed/ participated for finalizing the course curriculum of Industrial Robotics and Digital Manufacturing Technician at Pune on 13.03.2024		
1.	G.C. Saha, Jt. Director/HoD	CSTARI, Kolkata	Chairman
2.	Dr. Ishtiaq Khan	TATA Technologies Ltd., Pune	Member
3.	Prashant Handigund	TATA Technologies Ltd.	Member
4.	Daniel D'Souza	TIF Labs	Member
5.	Paresh G. Kenkare	Govt. ITI Aundh, Pune	Member
6.	Yogesh M. Torpe	Govt. ITI Aundh, Pune	Member
7.	Zubin Damania	Autofina Robotics	Member
8.	Abhijeet Band	Autofina Edutech	Member
9.	Rushabh Parekh	-Do-	Member
10.	Swapnil Maske	-Do-	Member
11.	N Prem Kumar	Govt. ITI, Tindivanam	Member
12.	Dr. D Vivekanandan	Govt. ITI, Dharmapuri	Member
13.	Sachin B. Pawade	Govt. ITI Pamprichinehwad, Pune	Member
14.	Uday Bhole	Scientech, Indore	Member
15.	Satyendra Pawar	Scientech, Indore	Member
16.	Jahir Khatib	TATA Technologies Ltd.	Member
17.	Anil Dhole	TATA Technologies Ltd.	Member
18.	Sandeep Nimsalka	TATA Technologies Ltd.	Member
19.	Mandar Bhale	TATA Technologies Ltd.	Member
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21.	Nagarjun M.	Yaskawa	Member
22.	Shweta Nayak	Yaskawa	Member
23.	Satish Karade	Govt. ITI Phaltan, Satara	Member
24.	Budhaditya Biswas	CSTARI, Kolkata	Member
25.	P K Bairagi	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