CURRICULUM

FOR THE TRADE OF

MECHANIC (EMBEDDED SYSTEMSAND PLC)

UNDER

APPRENTICESHIP TRAINING SCHEME

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

CONTENTS

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Co-ordinator for the course: Shri L.K.Mukherjee, DDT and Shri S. A. Pandav, RDD, Vadodara &Surat,Gujarat

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2. BACKGROUND

2.1 Apprenticeship Training Scheme under Apprentice Act 1961

The Apprentices Act, 1961 was enacted with the objective of regulating the programme of training of apprentices in the industry by utilizing the facilities available therein for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart Apprenticeship Training on the job in industry to school leavers and person having National Trade Certificate(ITI pass-outs) issued by National Council for Vocational Training (NCVT) to develop skilled manpower for the industry**.** There are four categories of apprentices namely**; trade apprentice, graduate, technician and technician (vocational) apprentices.**

Qualifications and period of apprenticeship training of **trade apprentices** vary from trade to trade. The apprenticeship training for trade apprentices consists of basic training followed by practical training. At the end of the training, the apprentices are required to appear in a trade test conducted by NCVT and those successful in the trade tests are awarded the National Apprenticeship Certificate.

The period of apprenticeship training for graduate (engineers), technician (diploma holders and technician (vocational) apprentices is one year. Certificates are awarded on completion of training by the Department of Education, Ministry of Human Resource Development.

2.2 Changes in Industrial Scenario

Recently we have seen huge changes in the Indian industry. The Indian Industry registered an impressive growth during the last decade and half. The number of industries in India have increased manifold in the last fifteen years especially in services and manufacturing sectors. It has been realized that India would become a prosperous and a modern state by raising skill levels, including by engaging a larger proportion of apprentices, will be critical to success; as will stronger collaboration between industry and the trainees to ensure the supply of skilled workforce and drive development through employment. Various initiatives to build up an adequate infrastructure for rapid industrialization and improve the industrial scenario in India have been taken.

2.3 **Reformation**

The Apprentices Act, 1961 has been amended and brought into effect from 22nd December, 2014 to make it more responsive to industry and youth. Key amendments are as given below:

- Prescription of number of apprentices to be engaged at establishment level instead of trade-wise.
- Establishment can also engage apprentices in optional trades which are not designated, with the discretion of entry level qualification and syllabus.
- Scope has been extended also to non-engineering occupations.
- Establishments have been permitted to outsource basic training in an institute of their choice.
- The burden of compliance on industry has been reduced significantly.

3. RATIONALE

[Need for Apprenticeship inMechanic (Embedded Systemsand PLC) trade]

An embedded system is the one that has computer-hardware with software integrated in it as the most significant component. It is a dedicated computer-based system, may be independent or part of a large system with the following components: Hardware, Application software, Real Time Operating System (RTOS)

The embedded systems course is aimed at providing high quality training to integrate and operating of software used.

Several fast developing sectors like automobile, communication, medicine, industrial, military, etc. have witnessed increased use of embedded technologies.

Considering the vast scope of this field, ranging from the automobile to consumer electronics and aerospace, the demand for this technology for product development and applications will also continue to grow over time. The use of electronic items is becoming more pervasive in everyone's lives with the use of mobiles, home appliances and more recently use of insulin pumps inside the body, thus providing a chance for you to make a successful career in embedded systems.

4. JOB ROLES: REFERENCE NCO

Brief description of Job roles:

Install, program, and maintain PLC, SCADA and instrumentation equipment at user place. Work with staff to improve the functionality of field operations.

Install sensors, wiring, circuit breakers, over-current protection, isolators, terminal blocks, and network switches.

Maintain equipment records for assigned sites; update records for new equipment installations. Install and maintain other communication equipment.

Working with Programmable Logic Controller (PLC) programming, repair and replacement information to laptop or other archive devices; troubleshoot PLC programs

Test PLCs and other associated equipments for reliability and functionality.
Install and program special software.

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.

Reference NCO:8211.90

5. GENERAL INFORMATION

1. **Name of the Trade** :**MECHANIC (EMBEDDED SYSTEMS AND PLC)**

2. **N.C.O. Code No.** : 8211.90

3. **Duration of Apprenticeship Training (Basic Training + Practical Training):** 2years

3.1 **For Fresher's: -Duration of Basic Training**: -

a) Block –I : 3 months

b) Block – II : 3 months

Total duration of Basic Training: 6 months

Duration of Practical Training (On -job Training): -

a) Block–I: 9 months

b) Block–II : 9 months

Total duration of Practical Training: 18 months

3.2 **For ITI Passed: - Duration of Basic Training**: - NIL

Duration of Practical Training (On -job Training): 12 months

4. **Entry Qualification** : Passed 10th Class under 10+2 System of Education or itsequivalent

5. **Selection of Apprentices** **:** The apprentices will be selected as per Apprenticeship Actamended time to time.

6. Rebate to ITI Passed out Trainees **:** One Year who have Passed one year BBBT and Advancedmodule of Embedded System and PLC in CoE of Electronics sector,

Note: Industry may impart training as per above time schedule for different block, however this is not fixed. The industry may adjust the duration of training considering the fact that all the components under the syllabus must be covered. However the flexibility should be given keeping in view that no safety aspects is compromised.

6. COURSE STRUCTURE

Training duration details: -

Time (in months)	1-3	4-12	13-15	16-24
Basic Training	Block– I	-----	Block – II	------
Practical Training (On - job training)	----	Block – I	------	Block – II

Components of Training	Duration of Training in Months →																							
↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Basic Training Block - I																								
Practical Training Block - I																								
Basic Training Block - II																								
Practical Training Block - II																								

7. SYLLABUS

7.1 BASIC TRAINING(BLOCK – I & II)

DURATION: 06 MONTHS

GENERAL INFORMATION

1) **Name of the Trade** :**MECHANIC (EMBEDDED SYSTEMS ANDPLC)**
2) **Hours of Instruction** : 1000 Hrs. (500 hrs. in each block)
3) **Batch size** : 20
4) **Power Norms** : 3Kw
5) **Space Norms** : 56 Sq. mtr.
6) **Examination** : The internal assessment will beheld on completion of each Block.
7) **Instructor Qualification** :

a) B.E./B. Tech in Electronics/Electornics & Telecommunication/Electronics & Communication with one year expreience in the relevent field.

OR

b) Diplome in Elctronics/Electronics & telecomunication/Electronics & Communication from recognized board of technical education with two years experience in the relevent field.

OR

c) NTC/NAC in the trade with three years' experience respectively.

8) **Tools, Equipments& Machinery required** : - As per Annexure – I

7.1.1 DETAILSYLLABUS OF CORE SKILL

A. Block– I
Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
1	**Engineering Drawing:** Introduction and its importance - Viewing of engineering drawing sheets. Method of Folding of printed Drawing Sheet as per BIS SP:46-2003 Drawing Instruments : their Standard and uses - Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.	**30**	**Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units.	**20**
2	**Lines :** - Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) - Drawing lines of given length (Straight, curved) - Drawing of parallel lines, perpendicular line - Methods of Division of line segment		**Fractions & Simplification**: Fractions, Decimal fraction, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems Simplification using BODMAS.	
3	**Drawing of Geometrical Figures**: Definition, nomenclature and practice of - - Angle: Measurement and its types, method of bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.		**Square Root** : Square and Square Root, method of finding out square roots, Simple problem using calculator	

4	**Lettering and Numbering** as per BIS SP46-2003: - Single Stroke, Double Stroke, inclined, Upper case and Lower case.		**Ratio &Proportion:** Simple calculation on related problems.	
5	**Free Hand sketch:** Hand tools and measuring instruments used in electronics mechanics trades.		**Percentage:** Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	
6	**Free hand drawing :** - Lines, polygons, ellipse, etc. - Geometrical figures and blocks with dimension. - Transferring measurement from the given object to the free hand sketches.		**Material Science** : Properties - Physical & Mechanical, Types – Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.	

B. Block- II
Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
1	**Symbolic Representation** (as per BIS SP:46-2003) of : - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections - Weld, brazed and soldered joints. - Electrical and electronics element - Piping joints and fittings	**30**	**Mass ,Weight and Density** : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals	**20**
2	**Construction of Scales and diagonal scale**		**Work, Power and Energy**: work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	
3	LED, IRLED, photo diode, photo transistor, opto- coupler symbols symbols of Logic gates			
4	Half adder, full adder, multiplexer and de-multiplexer		**Algebra:** Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	
5	UJT, FET, MOSFET, DIAC, TRIC, SCR, IGBT symbols and circuits of FET Amplifier, SCR using UJT triggering, snubber circuit, light dimmer circuit using TRIAC, UJT based free running oscillator.		**Mensuration:**Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle. Volume of solids – cube, cuboid, cylinder and Sphere. Surface area of solids – cube, cuboid, cylinder and Sphere.	
			Trigonometry: Trigonometrical ratios, measurement of angles. Trigonometric tables. Finding height and distance by trigonometry.	

7.1.1DETAIL SYLLABUS OF PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

A. Block –I
Basic Training

Week No.	Professional Skills (275 Hours)	Professional Knowledge (120 Hours)
1	Tool Identification, safety precautions, familiarization of electronic components	Safety precautions and elementary First aid Passive electronic components – resistor, capacitor, inductor active electronic components BJT, FET, MOSFET, Heat sink, handling of sensitive components
2	Study the specification of different diodes using data sheet Usingthedatasheetidentifytheapplication ofgiventransistor Check the transistor (resistance) using Multimeter,identifythe NPN/PNP transistor	Introduction to Semiconductors and reviewofPNjunctiondiodes, Transistorbiasingcircuits-types
3	Testacommonemitter,commonbase amplifier Construct anemitterfollower,RCcoupled amplifierandplotthegraphthechart Identifytheuseofvarioustypesofheatsink based upon use	CE,CB, CC amplifier,circuit and their characteristics Alpha,beta, voltage gain, Concept of dB,dBm VariousClassificationof amplifiers, RCCoupledamplifier,DC Amplifier, power amplifiers - circuit, operation, & application, transistor power rating & useofheatsink.
4	Constructandtestthe:Hartley,phaseshift oscillator, multivibratorcircuits Studythepindiagramof741IC	Feedback concepts , feedback connection types and their circuits, oscillator – definition, types, circuit and application (phase shift oscillator, wein bridgeoscillator, colpitts oscillator, Hartley oscillator, crystal oscillator etc), multivibrator- definition, types,circuits andapplication. Introductionto operational amplifier

		schematic diagramof741,symbol
5	Construct a +ve/-veregulatorusing78XX & 79XX series IC	Regulated Power supply using transistor, 78XX series, 79XX series,
	Construct and verify +ve, -ve biased clipper circuits and observe the wave form shapes. Construct and verify clamper circuit and observe waveform,	Definition of pulse amplitude, duration, repetition, rise time, Step & Ramp Voltage Exponential voltage, Clipping & Clamping circuits , their types and uses, Integrator & differentiator circuits and their applications
6	Draw the pictorial views of different modify components by using different web sites on internet.	Observe and study the specifications of different components and datasheets by using different web sites on internet.
	Demonstration of practical on trainer, bread board, soldering techniques on general purpose PCB, and understanding basic gates with the help of switch and bulb,	Safety precautions and elementary First aid, Introduction to Digital Electronics, introduction of Basic electronics components, introduction of Basic gates & Universal gates. Introduction of logic Family (TTL, CMOS, ECL, SCHOTTKY, RTL, DTL)
7-8	Verify the truth table of and/or invert, NAND, NOR, EX-OR, EX- NOR gates	Comparison of Decimal system with Binary System Digital code: Excess 3 code, grey code, BCD code, ASCII code
	Construct the circuit of Half adder & Full adder and verify the truth table, Construct the Adder cum Subtractor and verify the result. Verify the truth table of RS, D ,JK Flip flop	Arithmetic circuits: 1's & 2's complement, Halfadder&Fulladder,4 bit adder Half & Full subtractor, Adder cum Subtractor. Flip-Flop: Basic RSF lip Flop, D Flip Flop, JK Flip Flop, T Flip Flop Clocked Flip Flop, Timing diagram
9	Construct the shift register using RS/D/JKflipflopandverifytheresult Construct the Asynchronous & Asynchronous counter using D FF /JK Flip flop	Shift Register: Serial to parallel and vice versa, Parallel to parallel and serial to serial, Timing diagram ,important applications Counters: Requirementof Flip Flops, MOD ofcounterSynchronous and Asynchronous counterTimingdiagram, Specialized

		counteri.eRingcounter,Jhonsoncounter
10	Constructthedisplaycircuitusingthe driversandverifytheresult.	Display devices: Various display devices: LED,7segment,LCD,Display drivers, monitors, encoding & decoding
11-12	StudytheAnalogtoDigitalconversion process using a practical setup.	Analogtodigitalconversionusingvarious methods Digital to Analog conversion Logicfamilies:WorkingofstandardTTL& CMOSgates ConceptofECL,Schottkyarrangementetc. HandlingofCMOSIntegratedcircuits.
13	**Revision &Assessment / Examination (03 days)**	

B. Block –II
Basic Training

Week No.	Professional Skills (275 Hours)	Professional Knowledge (120 Hours)
1	Familiarization ofMP kit ProgramExecution using - Data Transfer Group, Logic Group, Arithmetic Group,Branch Group. Interface microprocessor kit with different application boards and run the applications	Introduction to basic Computer architecture, CPU & its specification. Accumulator & Register based processors Microprocessor an overview of 8 bit (8085) Processor, architecture, Interrupt system, Mapping & DMA, Basic programming Concept-Assembler, flowchart, debugging. Addressing modes, types of instructions, Instruction set Comparison with other 8 bit processors.
2	Familiarization ofMC kit ProgramExecution using -Data Transfer Group, Logic Group, Arithmetic Group, Branch Group Study of interfacing techniques	Microprocessor and Microcontroller- A comparison Microcontroller an over view of 8051 & its Architecture, Instruction set, Addressing modes, Programming-Data Transfer, Arithmetic, Logic, Boolean Variable manipulation & branching Instruction
3	Hard ware and software Exercises in ports & Read the status of a switch using MC port pin. Drive a relay using MC port pin Develop & run programs using Timer, Counter & Interrupt applications	I/O ports pins and their functions, I/O Programming, Bit manipulation, Timers, modes of Timers, application of Timer to generate Time Delays. Interrupts and polling, various interrupt SFR's related to Interrupt Programming Edge Triggered and level triggered interrupts Priority of interrupts
4	Transmit & Receive Data with PC using serial link, Connection of Microcontroller kit to PC Interfacing of MC using 8255 and study the working of: Traffic light controller, DAC, ADC, Stepper motor, Elevator, LCD. Keyboard interface.	Difference between serial and parallel Communication, serial Communication protocol, synchronous and Asynchronous communication, Data Framing, RS232 Standard, max 232 chips. Baud Rates, programming Techniques. Various methods of A to D & D to A conversion-counter type ADC, Successive type, Integrating type ADC's Specification of DAC & ADC.

		8255-programmable peripheral device, Concepts of Traffic light control, Fundamentals of Stepper motor- Types, driving methods, Elevator, Key board and LCD.
5	Basic structure of c program Execution & compiling c program Programwith -various data types ,using mathematical operators Programwith input & output operations Programwith simple loops & using 2D array, multidimensional arrays, character string& user defined functions	Introduction to C Language, Constants, variables and Data Types, Operators, Expressions, Input & Output operators, Decision Making and Branching, Looping, Array, Character Strings, User Defined Functions, Structures & Unions, Pointers, Classes in C++ & Stack operations.
6	Exercise on PIC MC	Introduction to PIC MC, Architecture, Instruction set, Additional Features
	Identify physical topology of a network and members of the network, identify the protocols installed and check resource sharing Identify the cables and components in the network Identify controls and ports on servers Identify the hardware of servers and configuration Starting and shutting down servers Identifying and using basic features Using Win 2000/Linux/Unix/Novell features Making UTP cross cables and testing, Making straight cables and testing, Making cable layout drawing Installing information outlet points. Install different common protocols one by one and test communication and features Install and check TCP/IP utilities and services	Network features-Network topologies, protocols- TCP/IP, UDP/FTP, models, types, components, network medias,-specification and standards, types of cables Difference between PC & Server, Server-Usages of Server, Types, Server hardware, Operating system-OS, NOS-features, types.

7	ProgramExecution using Kit and PC Study of interfacing techniques	Architecture of 16 bit (8086) processor, Basic programming Concept- Assembler, flowchart, debugging. Addressing modes, types of instructions, Instruction set,Comparisonwithother16bit processors.
8	Identificationofdifferentdigitalinputand output fielddevicesusedin Process/ mechanical industries categorized W.R.T voltage levels, single end and differential end etc. Operate and test the above mentioned field devices Identifydifferenttypeofcablesusedtocon nectfielddevicestoclosed loop single/multi loop controllers and programmable controllers. Identify differentcablesandconnectors usedtoconnectprogrammingterminals such as, PC etc to the programmable controllers.	Evolutionofdifferentcontroltechniqueslike manual,hardwired,Electronic gate control and programmable control. Advantages and disadvantages of different techniques mentioned above. Differenttypeofanalogganddigital input and output field devices usedinprocessindustries.Types of voltage and current formats used in field devices. Typesofconnections of field devicesto controllers. Typeofcablesusedforconnectingfielddevice sto controllers.
9	Identify the CPU type and the memory inside. Identifytypicalmodulesofthegiven PLCsystems (suchaspowersupply, Digital and Analog I/O(signal modules), basic module, high speed module, special function modules, RTD/Thermocouple etc) Identify the type of connectivity between the CPU and different. Modules ofPLC. Identifythetypeofcommunicationbetwee ndifferentmodules with PLC.	BlockdiagramofabasicPLCsystemandtheArc hitecture,PLCcomponents principles of working of PLCs, Specifications ofPLCs. Different type of modules like Digital and Analog input and output modules and their working Hardware description of I/O, power supply Modules I/O addressing concepts. Types of memory used in PLCs. Memory and its impact on performance of PLC Memory map and Data files used in PLCs Different functional blocks/files and their uses
10	Install the PLC Software on the PC. Configure the software to Communicate with a PLC. Familiarizationwiththesoftwareanduseo f different Data files/ function blocks etc. Develop simple programs and Downloadthemforexecutionforsimpledi gitalI/ODevelopprograms using timers	Different industry Bus communication standards like RS232, RS422, DH, DH+, 485 etc and their characteristics. Different type protocols used in the field of PLCs. Programming of PLCs using different techniques such as Ladder, Instruction list, Control systemflow chart etc. Instruction set covering basic I/O

	and counters and execute. Develop programs to cover different instructions and execute.	operations, timer, counter, data copy, arithmetic Logical, compare type, programcontrol and shift instructions etc., PLC interrupts, PLC subroutines, PLC sequencers. Wiring, entering, documenting and testing program.
11	Developandrunsimpletaskssuchascontrolof arelay,contactor, lamp &motoretcfordifferentinputconditions. Monitorthestatusofthe applicationONLINE. Perform someForceoperations. Developprograms toacquireanalogdatausingAnalog input card. Develop programs to display/controldatausingAnalogoutput card. Makeaclosedloopcontrol systemusing analog I/Os and control a process. PID Control usingPLC. InterruptsusingPLCs. Sub-routinedevelopmentinPLCs. Repeat all the above for any two popular commercial PLCs.	Typesofspecialfunctionmodulessuchasmemorymodule,highSpeed counter, Communication processor module and its importance. **Introduction to SCADA and DCS system**
12	Familiarization and interpretation of the screens and its contents provided for diagnostic purpose in the software. Interpretation of the error codes. Clearing the minor errors and major errors. Troubleshooting screens.	Common faults in a typical PLC- based system with respect to Hardware i.e. power supply, digital/analog I/Os, special function modules, communication modules etc. Diagnostic capabilities of the PLC Software and the typical codes generated by the system for the effective troubleshooting of different modules of PLCs
13	**Assessment / Examination (03 days)**	

7.1.3 EMPLOYABILITY SKILLS

GENERAL INFORMATION

1) **Name of the subject** **:EMPLOYABILITY SKILLS**
2) **Applicability** **:**ATS- Mandatory for fresher only
3) **Hours of Instruction** **: 110 Hrs. (55 hrs. in each block)**
4) **Examination** **:**The examination will be held at the end of two years Training by NCVT.
5) **Instructor Qualification** **:**

i)MBA/BBA with two years experience or graduate in sociology/social welfare/Economics with two years experience and trained in Employability skill from DGET Institute.

And

Must have studied in English/Communication Skill and Basic Computer at 12th /diploma level

OR

ii) Existing Social Study Instructor duly trained in Employability Skill from DGET Institute.

7.1.3.1 SYLLABUS OF EMPLOYABILITY SKILLS

A. Block – I
Basic Training

Topic No.	Topic	Duration (in hours)
	English Literacy	**15**
1	**Pronunciation :** Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)	
2	**Functional Grammar** Transformation of sentences, Voice change, Change of tense, Spellings.	
3	**Reading** Reading and understanding simple sentences about self, work and environment	
4	**Writing** Construction of simple sentences Writing simple English	
5	**Speaking / Spoken English** Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.	
	I.T. Literacy	**15**
1	**Basics of Computer** Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
2	**Computer Operating System** Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.	
3	**Word processing and Worksheet** Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the	

	Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets	
4	**Computer Networking and INTERNET** Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Meaning of World Wide Web (WWW), Web Browser, Web Site, Web page and Search Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.	
	Communication Skill	**25**
1	**Introduction to Communication Skills** Communication and its importance Principles of Effective communication Types of communication - verbal, non verbal, written, email, talking on phone. Non verbal communication -characteristics, components-Para-language Body - language Barriers to communication and dealing with barriers. Handling nervousness/ discomfort. Case study/Exercise	
2	**Listening Skills** Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active Listening Skills.	
3	**Motivational Training** Characteristics Essential to Achieving Success The Power of Positive Attitude Self awareness Importance of Commitment Ethics and Values Ways to Motivate Oneself Personal Goal setting and Employability Planning. Case study/Exercise	

4	**Facing Interviews** Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview	
5	**Behavioral Skills** Organizational Behavior Problem Solving Confidence Building Attitude Decision making Case study/Exercise	

B. Block–II
Basic Training

Topic No.	Topic	Duration (in hours)
	Entrepreneurship skill	**15**
1	**Concept of Entrepreneurship** **Entrepreneurship**- Entrepreneurship - Enterprises:-Conceptual issue Entrepreneurship vs. Management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, the process of setting up a business.	
2	**Project Preparation & Marketing analysis** Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of Product Life Cycle (PLC), Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.	
3	**Institutions Support** Preparation of Project. Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes& procedure & the available scheme.	
4	**Investment Procurement** Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.	
	Productivity	**10**
1	**Productivity** Definition, Necessity, Meaning of GDP.	
2	**Affecting Factors** Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.	
3	**Comparison with developed countries** Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.	
4	**Personal Finance Management** Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.	
	Occupational Safety, Health & Environment Education	**15**
1	**Safety & Health** Introduction to Occupational Safety and Health importance of safety and health at workplace.	
2	**Occupational Hazards** Basic Hazards, Chemical Hazards, Vibro-acoustic Hazards, Mechanical Hazards,	

	Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.	
3	**Accident & safety** Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.	
4	**First Aid** Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person	
5	**Basic Provisions** Idea of basic provision of safety, health, welfare under legislation of India.	
6	**Ecosystem** Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.	
7	**Pollution** Pollution and pollutants including liquid, gaseous, solid and hazardous waste.	
8	**Energy Conservation** Conservation of Energy, re-use and recycle.	
9	**Global warming** Global warming, climate change and Ozone layer depletion.	
10	**Ground Water** Hydrological cycle, ground and surface water, Conservation and Harvesting of water	
11	**Environment** Right attitude towards environment, Maintenance of in -house environment	
	Labour Welfare Legislation	**5**
1	**Welfare Acts** Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.	
	Quality Tools	**10**
1	**Quality Consciousness :** Meaning of quality, Quality Characteristic	
2	**Quality Circles :** Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles.	
3	**Quality Management System :** Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.	
4	**House Keeping :** Purpose of Housekeeping, Practice of good Housekeeping.	
5	**Quality Tools** Basic quality tools with a few examples	

7.2 PRACTICAL TRAINING (ON-JOB TRAINING)
(BLOCK – I & II)
DURATION: 18 MONTHS (9 months in each block)

GENERAL INFORMATION

1) **Name of the Trade** :**MECHANIC (EMBEDDED SYSTEMS AND PLC)**
2) **Batch size** : : a) Apprentice selection as per Apprenticeship Guidelines
   b) Maximum 20 candidates in a group
3) **Examination** : i) The internal assessment will be held on completion of each block
   ii) NCVT exam will be conducted at the end of 2nd year.
4) **Instructor Qualification** :
   a. B.E./B. Tech in Electronics/Electornics &Telecommunication/Electronics & Communication with one year expreience in the relevent field.
      OR
   b. Diplome in Elctronics/Electronics & telecomunication/Electronics & Communication from recognized board of technical education with two years experience in the relevent field.
      OR
   c. NTC/NAC in the trade with three years' experience respective in the relevent field.
5) **Infrastructure for On Job Training** : - As per Annexure – II

7.2.1 BROAD SKILL COMPONENT TO BE COVERED DURING ON-JOB TRAINING

A. BLOCK – I

1. **Safety and best practices (5S, KAIZEN etc.)**
2. **Record keeping and documentation**
3. **Identification and testing of electronic components/devices**
4. **Repair & Maintenance work**

DURATION: 9 MONTHS (39 WEEKS)	
SL NO	**LIST OF OPERATIONS/SKILLS TO BE COVERED DURING INDUSTRIAL TRAINING**
1	Perform basic mechanical workshop operations using suitable tools for fitting riveting, drilling etc observing suitable care & safety.
2	Test various electrical/electronic components using proper measuring instruments. 1. Introduction to measuring instrument 2. Difference between MI Type and MC Type 3. Difference between analog & Digital Multimeter. 4. Use of analog & Digital Multimeter. 5. Introduction & use of front control of CRO. 6. Measuring Voltage, current, resistance using Multimeter. 7. Measurment of Voltage, current, Frequency and Phase angle using CRO 8. Introduction and use of Wattmeter.
4	Simulate and analyze the analog and digital circuits using Electronic simulator software. 1. Introduction to simulation software 2. Introduction & use of all menu 3. Use of library. 4. Assemble circuit & test. **5.** See the graphical result.
5	Assemble, test and repair the various analog circuits and apply this knowledge to troubleshoot AF amplifier of PA system, fan regulator, light dimmer circuit, display systems, digital clock, digital timer and event counter. 1. Identify the component given for assembly of above circuit. 2. Assemble the circuit with proper precaution. 3. Test the application circuit. 4. Repair, maintenance & troubleshooting the circuit.
6	Assemble various electronic circuits using SMD components and test them using

	suitable test equipment and perform the repair work on the PCB tracks. 1. Introduction to ESD belt. 2. Introduction to identify the SMD component. 3. Soldering concept of SMD, ie. Substrate, Solder paste Machine, component assembly (using pick & place machine), Reflow and Rework etc. 4. Testing of SMD assembled PCB using suitable test jig.
7	Prepare, crimp, terminate and test various cables used in different electronics industries. 1. Introduction to various connector/ Jack used in industry and their use. 2. Use of various crimping tools. 3. Crimping of RJ-11 and RJ 45 connector. 4. Crimping of straight and cross cable.
8	Assemble various combinational & sequential circuit using gates and digital ICs 1. Assemble half and full adder. 2. Assemble & test Multiplexer &demultiplexer. 3. Assemble & test decade, up/down counter. 4. Assemble & test shift register.
9	Constructthedisplaycircuitusingthe driversandverifytheresult.

B. BLOCK – II

1. **Safety and best practices (5S, KAIZEN etc.)**
2. **Record keeping and documentation**
3. **Identification and testing of electronic components/devices**
4. **Repair & Maintenance work**

DURATION: 9 MONTHS (39 WEEKS)	
SL NO	**LIST OF OPERATIONS/SKILLS TO BE COVERED DURING INDUSTRIAL TRAINING**
1.	1) To able to perform Microprocessor 8085 based applications in system programming & applications such as 1. Traffic control system 2. Elevator control system 3. A to D converter 4. D to A converter 5. Stepper motor control 6. LED matrix 7. Keyboard scanner 8. Temperature control system 9. Pulse generator 10. Serial communication with respect to the industries. 2) To connect above systems, Implement the applications & verify the waveform of above applications / signals on CRO. 3) Fault finding in applications circuit with respect to the industries.
2.	1) To understand Microprocessor 8086 based application in system programming & applications such as 1 Traffic control system 2 Elevator control system 3 A to D converter 4 D to A converter 5 Stepper motor control 6 LED matrix 7 Keyboard scanner 8 Temperature control system 9 Pulse generator 10 Serial communication with respect to the industries. 2) To assemble above systems, Implement the applications & verify the

	waveform of above applications / signals on CRO. 3) Fault finding in applications circuit with respect to the industries.
3.	1) To able to operate Microcontroller 8051 based application in system programming & applications such as, 1 Traffic control system 2 Elevator control system 3 A to D converter 4 D to A converter 5 Stepper motor control 6 LED matrix 7 Keyboard scanner 8 Temperature control system 9 Pulse generator 10 Serial communications with respect to the industries. 2) To connect above systems, Implement the applications & view the waveform of above applications / signals on CRO. 3) Fault finding in applications circuit with respect to the industries 4) Fault finding in designed circuit. 5) Applications on Micro controller 8751, 8032, 8052, 8752, 68HC05, 68HC11, 68HC32 based system design with respect to industries. 6) PIC & Microcontroller programmer. 7) To overview the Embedded system and RTOS
4	Configure, install, troubleshoot, upgrade, interconnect given computer system(s) and demonstrate &utilize application packages for different application. 1. Safety precaution while handling pc internal component. 2. Introduction & use of various component used in pc 3. Demo on assembling of PC. 4. Motherboard connection. 5. Symptom of beep 6. Formatting of HDD 7. Installation of OS 8. Installation of Application Software. 9. Installation & Use of Antivirus. 10. Troubleshooting & Maintenance.
5	1) To prepare straight & cross Cable.

	2) To load & operate Network OS. 3) To Load & operate Unix 4) To Load & operate Linux 5) To configure Network Rights. 6) To configure Network Securities.
6	1 To understand & configure PLC. 2 To connect Different I/O device to PLC. 3 Fault finding & maintenance of PLC Based system. To understand & configure SCADA & DCS with respect to industries
7	Project work:- like 1. Traffic control system 2. Elevator control system 3. A to D converter 4. D to A converter 5. Stepper motor control 6. LED matrix 7. Keyboard scanner 8. Temperature control system 9. Pulse generator

8. ASSESSMENT STANDARD

8.1 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 assessment. Due consideration to be given while assessing for team work, avoidance/reduction of scrape/wastage and disposal of scarp/wastage as per procedure, behavioral attitude and regularity in training.

The following marking pattern to be adopted while assessing:

a)Weightage in the range of 60-75% to be allotted during assessment under following performance level:

For this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.

In this work there is evidence of:

- Good skill levels in the use of hand tools, machine tools and workshop equipment
- Many tolerances while undertaking different work are in line 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)Weightage in the range of above75%- 90% to be allotted during assessment under following performance level:

For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.

In this work there is evidence of:

- Good skill levels in the use of hand tools, machine tools and workshop equipment
- The majority of tolerances while undertaking different work are in line 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)Weight age in the range of above 90% to be allotted during assessment under following

performance level:

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.

In this work there is evidence of:

- High skill levels in the use of hand tools, machine tools and workshop equipment
- Tolerances while undertaking different work being substantially in line 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

8.2 FINAL ASSESSMENT- ALL INDIA TRADE TEST

(SUMMATIVE ASSESSMENT FOR TWO YEARS TRADE)

SUBJECTS	Marks	Internal assessment based on competency	Full Marks	Pass Marks	Duration of Exam.
Professional Skill	300	100	400	240	**08 hrs.**
Professional Knowledge	100	20	120	48	3 hrs.
Workshop Cal. & Sc.	50	10	60	24	3 hrs.
Engineering Drawing	50	20	70	28	4 hrs.
Employability Skill	50	--	50	17	2 hrs.
Grand Total	**550**	**150**	**700**	--	

Note:-The candidate pass in each subject conducted under all India trade test

9. FURTHER LEARNING PATHWAYS

On successful completion of the course,

- The trainees will be employed in reputed Industries / Organizations.
- On successful completion of the course trainees can opt for Diploma course (lateral entry). {Applicable for candidates only who undergone ATS after CTS}

Employment opportunities:

On successful completion of this course, the candidates shall be gainfully employed in the following industries:

1. Production & Manufacturing industries.
2. Instrumentation & process/Automation industries.
3. In public/private sector industries in India & abroad.
4. Self employment.

ANNEXURE – I

TOOLS & EQUIPMENT FOR BASIC TRAINING
INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE:MECHANIC (EMBEDDED SYSTEMS AND PLC)
LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

A: TRAINEES TOOL KIT:-

Sl. No.	Name of the items	Quantity (indicative)
1.	Connecting screwdriver 100 mm	10 Nos.
2.	Neon tester 500 V.	6 Nos.
3.	Screw driver set (set of 5)	10 Nos.
4.	Insulated combination pliers 150 mm	6 Nos.
5.	Insulated side cutting pliers 150 mm	8 Nos.
6.	Long nose pliers 150 mm	6 Nos.
7.	Soldering iron 25 W. 240 V.	10 Nos.
8.	Electrician knife	6 Nos.
9.	Tweezers 100mm	10 Nos.
10.	Digital Multimeter (3 ½ digit)	10 Nos.
11.	Soldering Iron Changeable bits 10 W	6 Nos.
12.	De- soldering pump	10 Nos.

B:TOOLS INSTRUMENTS AND GENERAL SHOP OUTFITS

Sl. No	Name of the items	Quantity (Indicative)
1.	Steel rule 300mm	4 Nos.
2.	Steel measuring tape-3 m	4 Nos.
3.	Tools makers vice 100mm (clamp)	1 No.
4.	Tools maker vice 50mm (clamp)	1 No.
5.	Crimping tool (pliers)	2 Nos.
6.	Magneto spanner set	2 Nos.
7.	File flat 200mm bastard	2 Nos.
8.	File flat 200mm second cut	2 Nos.
9.	File flat 200mm smooth	2Nos.
10.	100mm flat pliers	4 Nos.
11.	100mm round Nose pliers	4 Nos.
12.	Scriber straight 150mm	2 Nos.
13.	Hammer ball pen 0.5Kg	1 No.
14.	Allen key set (set of 9)	1 No.
15.	Tubular box spanner (set of 6Nos)	1 set.
16.	Magnifying lenses 75mm	2 Nos.

17.	Continuity tester	6 Nos.
18.	Hacksaw frame adjustable	2 Nos.
19.	Cold chisel 20mm	1 No.
20.	Scissors 200mm	1 No.
21.	Handsaw 450mm	1 No.
22.	Hand Drill Machine	2 Nos.
23.	First aid kit	1 No.
24.	Fire Extinguisher	2 Nos.
25.	Bench Vice	1 No.
26.	Dual DC regulated power supply 30-0-30 V, 2 Amps	4 Nos.
27.	DC regulated variable power supply 0-24 V, 1Amp	2 Nos.
28.	LCR meter (Digital)	1 No.
29.	CRO Dual Trace 20 MHz (component testing facilities)	2 Nos.
30.	Signal Generator, 0-100 KHz	2 Nos.
31.	Analog multimeter	4 Nos.
32.	Function generator (Triangular, square and sine wave)	2 Nos.
33.	Dimmer start 3 Amps	2 Nos.
34.	Analog Component Trainer	2 Nos.
35.	Op Amp trainer	2 Nos.
36.	Digital IC Trainer	2 Nos.
37.	Digital IC Tester	1 No.
38.	Digital and Analog Bread Board Trainer	2 Nos.
39.	Rheostats various values and ratings	2 Nos.
40.	Computers in the assembled form (including cabinet, motherboards, HDD, DVD, SMPS, Monitor, KB, Mouse, LAN card, Blue-Ray drive and player), MS Office education version.	2 Nos.
41.	Laptops latest configuration	1 No.
42.	Laser jet Printer	1 No.
43.	INTERNET BROADBAND CONNECTION	1 No.
44.	Electronic circuit simulation software with 6 user licenses	1 No.
45.	Different types of Analog electronic components, digital ICs, power electronic components, general purpose PCBs, bread board, MCB, ELCB	As required
46.	8085 based Microprocessor Kit	2
47.	8051 Based Microcontroller kit	2
48.	Interfacing Modules such as DAC, ADC, TRAFFIC LIGHT, STEPPER MOTOR, LCD, Display & Key board	4 each
49.	8086 based 16 bit Trainer Kit	2
50.	PIC Microcontroller Kit	2
51.	Compiler on C language	1
52.	Components (MC, Memories, Resistors, cap, wires ETC)	As required
53.	Soldering Iron (Temperature Controlled)	6
54.	PIC programmer	1
55.	In-circuit emulator	1
56.	PLC Trainer Systems (SIEMENS & ALLENBRADLEY)	1 each

57.	PLC development software for Siemens & Allen Bradley PLC systems.	1 each
58.	Working models for PLCs	
59.	a) Bottle fill trainer	1
60.	b) Speed control module	1
61.	c) Batch process reactor	1
62.	d) Start delta starter	1
63.	e) Discrete application trainer	1
64.	SCADA software	1

Note: In case of basic training setup by the industry the tools, equipment and machinery available in the industry may also be used for imparting basic training.

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: MECHANIC (EMBEDDED SYSTEMS AND PLC)

LIST OF TOOLS& EQUIPMENTS FOR 20 APPRENTICES

1) Space Norms : 45 Sq. m.(For Engineering Drawing)

2) Infrastructure:

A: TRAINEES TOOL KIT:-

Sl. No.	Name of the items	Quantity (indicative)
1.	Draughtsman drawing instrument box	20 Nos.
2.	Set square celluloid 45^0 (250 X 1.5 mm)	20 Nos.
3.	Set square celluloid 30^0-60^0 (250 X 1.5 mm)	20 Nos.
4.	Mini drafter	20 Nos.
5.	Drawing board (700mm x500 mm) IS: 1444	20 Nos.

B: FURNITURE REQUIRED

Sl. No.	Name of the items	Quantity (indicative)
1	Drawing Board	20 Nos.
2	Models : Solid & cut section	as required
3	Drawing Table for trainees	as required
4	Stool for trainees	as required
5	Cupboard (big)	01 No.
6	White Board (size: 8ft. x 4ft.)	01 No.
7	Trainer's Table	01 No.
8	Trainer's Chair	01 No.

ANNEXURE – II

INFRASTRUCTURE FOR ON-JOB TRAINING

TRADE: MECHANIC (EMBEDDED SYSTEMS AND PLC)

For Batch of 20 APPRENTICES

Actual training will depend on the existing facilities available in the establishments. However, the industry should ensure that the broad skills defined against On-Job Training part (i.e. 9 months + 9 months) are imparted. In case of any short fall the concern industry may impart the training in cluster mode/ any other industry/ at ITI.

ANNEXURE-III

GUIDELINES FOR INSTRUCTORS AND PAPER SETTERS

1.Due care to be taken for proper & inclusive delivery among the batch. Some of the following some method of delivery may be adopted:

A) LECTURE
B) LESSON
C) DEMONSTRATION
D) PRACTICE
E) GROUP DISCUSSION
F) DISCUSSION WITH PEER GROUP
G) PROJECT WORK
H) INDUSTRIAL VISIT

2. Maximum utilization of latest form of training viz., audio visual aids, integration of IT, etc. may be adopted.

3. The total hours to be devoted against each topic may be decided with due diligence to safety & with prioritizing transfer of required skills.