

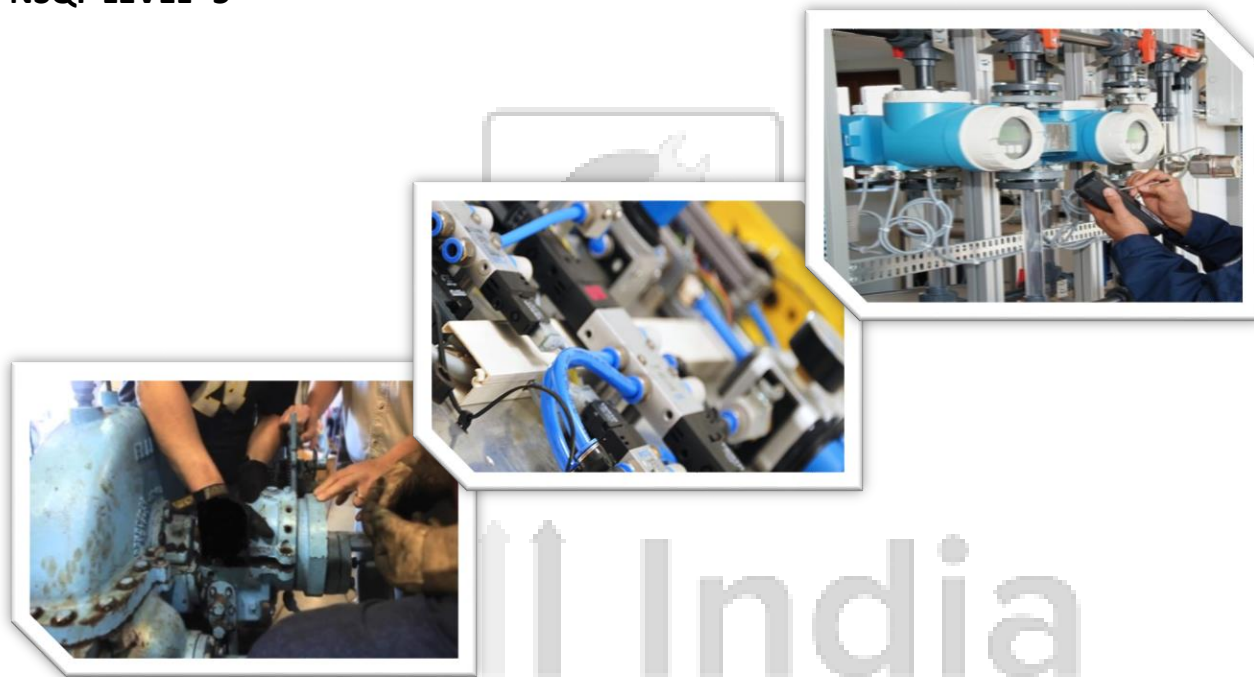
INSTRUMENT MECHANIC

COMPETENCY BASED CURRICULUM

(Duration: 2 Yrs.)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL- 5



SECTOR – INDUSTRIAL AUTOMATION AND INSTRUMENTATION



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

INSTRUMENT MECHANIC

(Revised in 2018)

APPRENTICESHIP TRAINING SCHEME (ATS)



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Developed By

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Directorate General of Training
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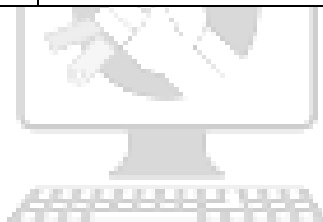
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1.1 Apprenticeship Training Scheme under Apprentice Act 1961

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.

1.2 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.

1.3 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.



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2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under aegis of National Council of Vocational Training (NCVT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes of NCVT for propagating vocational training.

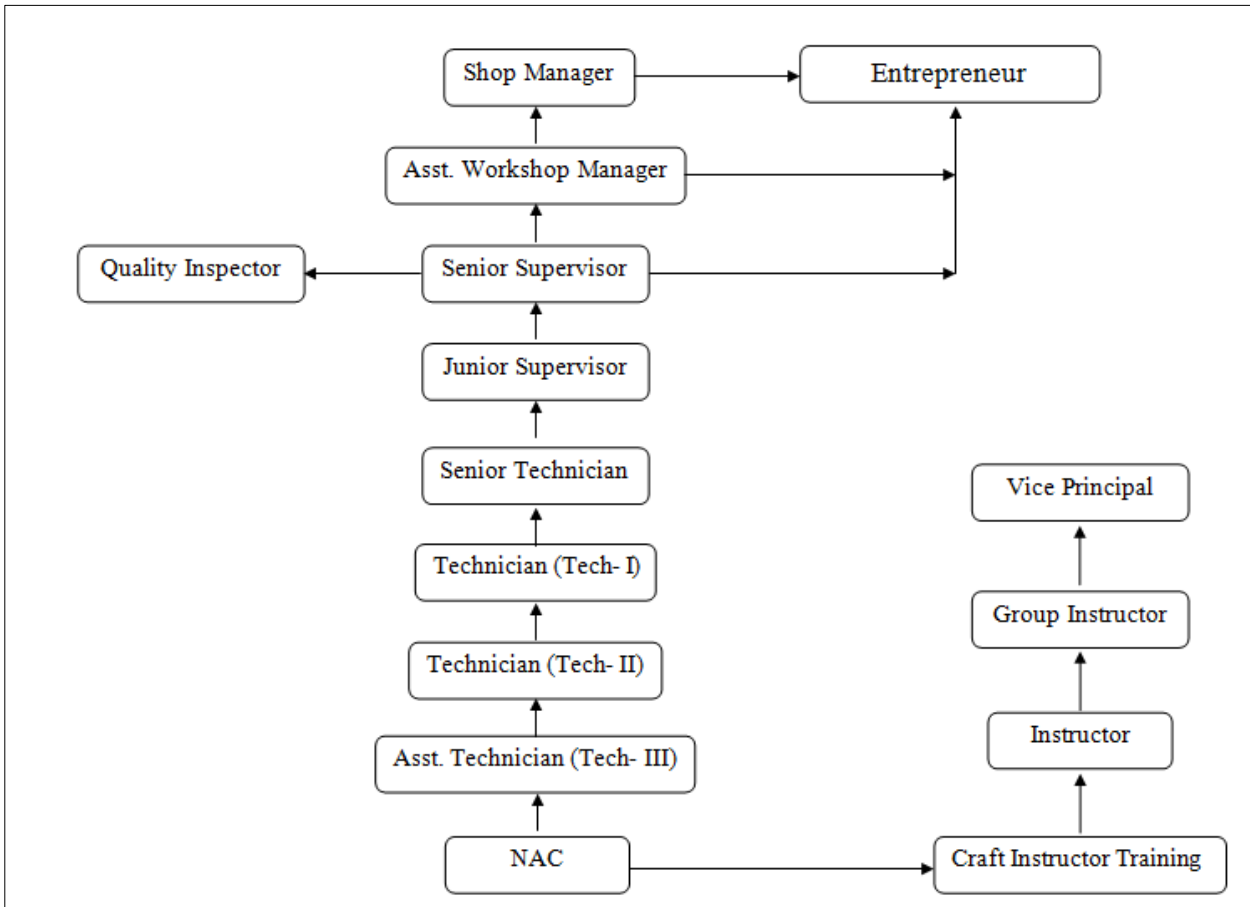
Instrument Mechanic trade under ATS is one of the most popular courses delivered nationwide through different industries. The course is of two years (02 Blocks) duration. It mainly consists of Domain area and Core area. In the Domain area Trade Theory & Practical impart professional - skills and knowledge, while Core area - Workshop Calculation and science, Engineering Drawing and Employability Skills imparts requisite core skills & knowledge and life skills. After passing out the training programme, the trainee is being awarded National Apprenticeship Certificate (NAC) by NCVT having worldwide recognition.

Broadly candidates need to demonstrate that they are able to:

- Read & interpret technical parameters/document, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge, core skills & employability skills while performing jobs and solve problem during execution.
- Check the job/assembly as per drawing for functioning, identify and rectify errors in job/assembly.
- Document the technical parameters related to the task undertaken.

2.2 CAREER PROGRESSION PATHWAYS:

- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Indicative pathways for vertical mobility.



2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years (*Basic Training and On-Job Training*) :-

Total 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

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A. Basic Training

For 02 yrs. Engg. Course :- (Total 06 months: 03 months in 1st yr. + 03 months in 2nd yr.)

For 01 yr. Engg. course :- (Total 03 months: 03 months in 1st yr.)

Sl. No.	Course Element	Total Notional Training Hours	
		For 02 yrs. course	For 01 yr. course
1	Professional Skill (Trade Practical)	550	275
2	Professional Knowledge (Trade Theory)	240	120
3	Workshop Calculation & Science	40	20
4	Engineering Drawing	60	30
5	Employability Skills	110	55
	Total (including Internal Assessment)	1000	500

B. On-Job Training:-

For 02 yrs. Engg. Course :- (Total 18 months: 09 months in 1st yr. + 09 months in 2nd yr.)

Notional Training Hours for On-Job Training: 3120 Hrs.

For 01 yr. Engg. course :- (Total 12 months)

Notional Training Hours for On-Job Training: 2080 Hrs.

C. Total training hours:-

Duration	Basic Training	On-Job Training	Total
For 02 Engg. yrs. course	1000 hrs.	3120 hrs.	4120 hrs.
For 01 yr. Engg. course	500 hrs.	2080 hrs.	2580 hrs.

2.4 ASSESSMENT & CERTIFICATION:

The trainee will be tested for his skill, knowledge and attitude during the period of course and at the end of the training programme as notified by Govt of India from time to time. The Employability skills will be tested in first two semesters only.

a) The **Internal assessment** during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline (section-2.4.2). The marks of internal assessment will be as per the template (Annexure – II).

b) The final assessment will be in the form of summative assessment method. The All India Trade Test for awarding NAC will be conducted by NCVT on completion of course as per guideline of Govt of India. The pattern and marking structure is being notified by govt of India 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 (section-2.4.2) before giving marks for practical examination.

2.4.1 PASS REGULATION

The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects 40%. The candidate pass in each subject conducted under all India trade test.

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 assessment. Due consideration should be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising the following:

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

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

Performance Level	Evidence
(a) Weightage in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • Below 70% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • 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	
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.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Weightage in the range of above 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% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

Brief description of Job roles:

Mechanic Precision Instrument, General Mechanic, Precision Instrument General tests, repairs, overhauls and assembles various precision instruments and their parts for efficient performance. Examines instrument for defects. Dismantles components and cleans them in appropriate fluid such as petrol, kerosene etc. to find out extent of damage or wear and tear to parts. Removes minor defects of parts by grinding, filing, drilling, etc. and replaces worn out and damaged parts. Adjusts position of various parts using screwdriver, spanner etc. and assembles instrument to form complete unit. Makes simple electrical connections, solders contact points and performs other tasks as necessary. Tests performance either by visual observation or by conducting simple electrical and mechanical tests and ensures that repaired or assembled instrument conforms to prescribed efficiency. May make new components and assemble new instruments. May specialize in any particular type of instrument like mechanical, hydraulic, pneumatic, electrical, optical, orthopedic etc.

Technician Instrumentation Technician Instrumentation dismantles removes and replaces a range of instruments and faulty peripheral components down to unit and component level, setting up test equipment, troubleshooting components of instruments, calibrating them and also preparing service reports and accurately documenting parts replacement and repair.

Mechanic Precision Instrument, Mechanical Mechanic Precision Instrument, Mechanical makes, alters and adjusts mechanical instruments or mechanical parts of electrical and optical instruments by accurate milling, filing, grinding, lapping and other processes. Studies drawings or samples and examines precision instrument like balance, meters, pressure gauges etc. for defects. Dismantles instrument, cleans metal components in petrol, kerosene oil or otherwise and checks them to find out extent of damage and further serviceability. Makes new parts on lathe milling or other machines, if necessary. Sizes and fits metal parts by filing, scraping, grinding lapping etc. as necessary and ensures their desired accuracy by checking with precision measuring instruments shadow graph and other highly perfect devices. Assembles parts to form complete unit. Gets electrical components repaired by Electrician. Fits electrical and optical parts to instrument and adjusts them as required. Tests repaired or assembled instrument for clarity or vision sensitivity, correct meter and scale readings etc. as required and ensures stipulated performance within prescribed limits. Makes necessary adjustments and seals meters to avoid manipulations. May specialize in particular type of instruments like balance, pressure gauges, meters, the odolites, etc.

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Functional Tester is responsible for checking functions of manufactured industrial equipment such as UPS, inverter, energy meter, PLC, oscilloscope, control panel. The individual at work tests specified functions of every product being assembled on the production line.

Calibrator (Instrument and Apparatus) tests and calibrates controlling, indicating, and measuring instruments and devices, such as monochromators, pressure regulators, tachometers, temperature controls, and thermometers, to ensure specified operating performance, using hand tools, testing and calibrating instruments and equipment, and precision measuring instruments: Reads quality control manual and testing specifications to obtain data to test or calibrate specific devices. Selects and installs accessories, such as adapters, indicating gauges, or holding devices on test or calibration fixture, and connects instrument or device to fixture, according to specifications, using hand tools. Sets controls to regulate factors, such as current flow, timing cycle, pressure, temperature, or vacuum, according to specifications, and activates test or calibration equipment. Observes readings on meters and gauges, and other displays and performance of the device or instrument to identify functional defects and determine calibration requirements. Adjusts calibration mechanisms to obtain specified operational performance of the device or instrument, using hand tools and precision measuring and calibrating instruments and equipment. Applies sealing compound on calibration mechanism to prevent readjustment of settings and loss of calibration. Rejects malfunctioning devices and routes devices to specified department for rework or salvaging of parts. May disassemble instrument or device to determine cause of defective operation and notify supervisory personnel of findings.

Calibration Technician sets, adjusts, validates or verifies mechanical, pneumatic, hydraulic, electrical, electronic, measuring and control instruments using reference standards in accordance with predetermined standard procedures.

Mechanic, Precision Instrument, Electrical Mechanic Precision Instrument Electrical; Meter Repairer, Electrical repairs and sets electrical parts of precision instruments such as megger, voltmeter, ammeter, condensers, galvanometers, etc., to high accuracy for recording correct readings by reviving, replacements and necessary adjustments. Studies drawings, circuit diagrams and other specifications and examines instrument visually to locate any apparent loose connection, short circuits etc. Dismantles instrument using insulated screw drivers, pliers, special spanners etc., and checks components, insulation wiring, fittings and other features with precision mechanical and electrical measuring instruments to locate wear and tear, short circuits and other defects. Cleans necessary or any fluid used in instrument and their various parts using special brushes. Checks gear shell, bearing jewels and other operating parts and repairs or replaces worn out and damaged ones. Assembles parts, replaces insulation and makes electrical wiring and connections according to diagram and prescribed specification. Examines assembled or repaired instrument by standard tests, makes necessary adjustments and ensures correct

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reading and desired performance within prescribed limits. Seals cut-outs, meters etc. to avoid manipulation. May wind coils, set new resistance and perform other electrical functions, if required.

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

Precision Instrument Makers and Repairers, other perform number of low skilled and routine tasks such as dismantling instruments, filing, making connections, operating vacuum machine, soldering, sealing covers, cleaning lenses etc., and is designated as Instrument Mechanic Mate, Instrument Mechanic Helper.

Instrument Mechanic supports the plant operation and all machines operation is safe & running correctly by conducting inspections and preventive maintenance. His job role involves skilled mechanical and electrical and electronic work such as

- Refer manuals, reading and interpreting circuit diagrams, blueprints and schematics
- inspecting and testing the operation of instruments and systems to diagnose faults using testing devices
- writing maintenance reports
- repairing and adjusting system components or removing and replacing defective parts
- calibrating components and instruments
- performing scheduled preventative maintenance work
- installing control and measurement instruments on existing or new plant equipment
- observing safety in accordance with government and company standards

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Reference NCO 2015:

- (i) 7311.0100 – Mechanic Precision Instrument, General
- (ii) 7311.0101 – Technician Instrumentation
- (iii) 7311.0400 – Mechanic Precision Instrument, Mechanical
- (iv) 7543.0801 – Functional Tester
- (v) 7311.1000 – Calibrator (Instrument and Apparatus)
- (vi) 7311.1001 – Calibration Technician
- (vii) 7412.0100 – Mechanic, Precision Instrument, Electrical
- (viii) 7412.0101 – Automation Specialist
- (ix) 7311.9900 – Precision Instrument Makers and Repairers, other

4. NSQF LEVEL COMPLIANCE

NSQF level for Instrument Mechanic trade under ATS: **Level 5**

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

- a. Process
- b. professional knowledge,
- c. professional skill,
- d. core skill and
- e. Responsibility.



The Broad Learning outcome of Instrument Mechanic trade under ATS mostly matches with the Level descriptor at Level- 5.

The NSQF level-5 descriptor is given below:

Level	Process required	Professional knowledge	Professional skill	Core skill	Responsibility
Level 5	Job that requires well developed skill, with clear choice of procedures in familiar context.	knowledge of facts, principles, processes and general concepts, in a field of work or study	a range of cognitive and practical skills required to accomplish tasks and solve problem by selecting and applying basic methods, tools, materials and information.	Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication.	Responsibility for own work and Learning and some responsibility for other's works and learning.

5. GENERAL INFORMATION

Name of the Trade	INSTRUMENT MECHANIC
NCO - 2015	7311.0100, 7311.0101, 7311.0401, 7543.0801, 7311.1000, 7311.1001, 7412.0100, 7412.0101, 7311.9900
NSQF Level	Level – 5
Duration of Apprenticeship Training (Basic Training + On-Job Training)	Two years (02 Blocks each of one year duration).
Duration of Basic Training	a) Block –I : 3 months b) Block – II : 3 months Total duration of Basic Training: 6 months
Duration of On-Job Training	a) Block–I: 9 months b) Block–II : 9 months Total duration of Practical Training: 18 months
Entry Qualification	Passed 10 th Class with Science and Mathematics under 10+2 system of Education or its equivalent
Selection of Apprentices	The apprentices will be selected as per Apprenticeship Act amended time to time.
Instructors Qualification for Basic Training	As per ITI instructors qualifications as amended time to time for the specific trade.
Infrastructure for Basic Training	As per related trades of ITI
Examination	The internal examination/ assessment will be held on completion of each block. Final examination for all subjects will be held at the end of course and same will be conducted by NCVT.
Rebate to Ex-ITI Trainees	01 year
CTS trades eligible for Instrument Mechanic Apprenticeship	1. Instrument Mechanic

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.
- For imparting Basic Training the industry to tie-up with ITIs having such specific trade and affiliated to NCVT.

6. LEARNING OUTCOME

6.1 GENERIC LEARNING OUTCOME

The following are minimum broad Common Occupational Skills/ Generic Learning Outcome after completion of the Instrument Mechanic course of 02 years duration under ATS.

Block I & II:-

1. Recognize & comply safe working practices, environment regulation and housekeeping.
2. Understand and explain different mathematical calculation & science in the field of study including basic electrical. *[Different mathematical calculation & science –units, Fractions & Simplification, square roots, material science, Ratio & Proportion, Percentage, Work, Power & Energy, Algebra, Mensuration, Trigonometry, Mass, weight, density, Pressure]*
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, symbolic representation of fastener and pipe joints, Electrical, electronic and digital symbols, P&I drawing symbols ISA 5.1]*
4. Select and ascertain measuring instrument and measure dimension of components and record data.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
8. Plan and organize the work related to the occupation.

6.2 SPECIFIC LEARNING OUTCOME

Block – I

1. Study personal & plant safety procedures and use of safety equipment, fire and fire fighting facilities/techniques, handling of hazardous chemicals and poisons substances.
2. Understand the different activities of the plant with plant capacity and production.
3. Preparing a Schematic Layout and study of the process and operation of the plant.
4. Perform basic workshop operations using the suitable tools for fitting riveting, drilling etc observing suitable care & safety.
5. Using precision instruments like for job preparation and operation. Correcting and maintenance of precision instruments.

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6. Understand the working principle of electrical measuring instruments. Finding faults and troubleshoot calibrate, connect common electrical measuring instruments, Continuity Testers, meggers, earth resistance testers and multi meters etc.
7. Test, connect with devices, start and control and reverse the direction of rotation of DC motors AC single phase and three phase induction motors, synchronous motors.
8. Read, understand and interpret electrical (Single line diagrams & MCC Panel wiring) & electronic circuits and its drawings.
9. Prepare, cable glanding, crimp, terminate and test various power/instrumentation cables used in industries.
10. Soldering practice, metal to metal, wire to wire, wires to plugs, wires to connectors, wires to component PCB and de-soldering work.
11. Test basic electrical (MCBs, push buttons, relay, contactors)/electronic components (diodes, transistors, capacitors, coils, resistors etc.) using proper measuring instruments.
12. Test and operate electronic based circuit. Basic Trouble shooting in electronic circuits.
13. Configure, install, troubleshoot, upgrade, interconnect given computer system.
14. Test, operate and analyse the basic analog and digital electronic circuits.
15. Test and Operating microcontroller (8051) based systems.

Block – II

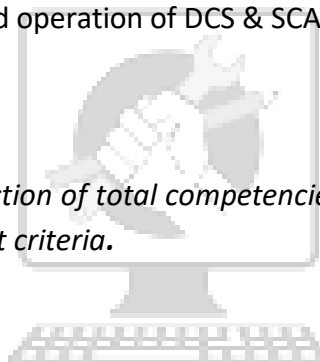
16. Demonstrate of location of the various sensing element, transmitter, controller, final control valve of a control loop.
17. Demonstrate and apply the mounting arrangements for field & control room instruments (Panel mounting, Wall mounting, Yoke mounting etc.).
18. Care, safety and proper use of hydraulic & pneumatic tubing & fittings, coupling and connectors.
19. Dismantling, Cleaning and Re-assembling of Air-Filters, Air Regulators. Connection of pneumatic instruments & adjustment as per name plate.
20. Removal and Re-Fitting of a plant instrument after properly isolating the section of plant. Plant Procedure like SOP work order, clearance Certificates should be noted down by the apprentices.
21. Understand and apply routine works like, Winding of clocks, Filling of Mercury, Cleaning and changing of Inks, Replacement of charts with drawing and returning of materials to and from stores.
22. Calibration and Maintenance of field instruments (displacement, pressure, flow, level, temperature etc.) and panel instruments (indicator, controller, convertor, recorder) used in instrumentation field.
23. Dismantle, inspect, calibrate and assemble various Control Valves, Valve Positioner, Convertor, various types of final elements and actuators.

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24. Familiarization, Installation and Maintenance of various types of Control Loops like ON OFF, PID, feedback control loops etc and components (sensing element, single indicator/recorder, controller and final control element), relays and annunciator.
25. Familiarization with instrument drawing in sketching, identification of instruments symbols and blocks diagrams of existing units in the plant. Instrument and Panel Installation as per layout plan.
26. Familiarization, installation and maintenance of analytical instruments.
27. Installation, testing and maintenance of recorders , data loggers
28. Testing and calibration of digital protocol (HART) instruments. preparation and testing of networking cables.
29. Understand and operating PLC. Executing and correcting small programs in PLC.
30. Understand the working and operation of DCS & SCADA system in the industry.

NOTE:

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



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7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME	
Learning Outcomes	Assessment Criteria
1. Recognize & comply safe working practices, environment regulation and housekeeping.	1.1 Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	1.2 Recognize and report all unsafe situations according to site policy.
	1.3 Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	1.4 Identify, handle and store / dispose off dangerous/unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements.
	1.5 Identify and observe site policies and procedures in regard to illness or accident.
	1.6 Identify safety alarms accurately.
	1.7 Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures.
	1.8 Identify and observe site evacuation procedures according to site policy.
	1.9 Identify Personal Protective Equipment (PPE) and use the same as per related working environment.
	1.10 Identify basic first aid and use them under different circumstances.
	1.11 Identify different fire extinguisher and use the same as per requirement.
	1.12 Identify environmental pollution & contribute to avoidance of same.
	1.13 Take opportunities to use energy and materials in an environmentally friendly manner
	1.14 Avoid waste and dispose waste as per procedure
	1.15 Recognize different components of 5S and apply the same in the working environment.
2. Understand, explain different mathematical calculation & science in the field of study including basic	2.1 Explain concept of basic science related to the field such as units, Fractions & Simplification, square roots, material science, Ratio & Proportion, Percentage, Work, Power & Energy, Algebra, Mensuration, Trigonometry,

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electrical, electronics and instrumentation apply in day to day work[Different mathematical calculation & science –units, Fractions & Simplification, square roots, material science, Ratio &Proportion, Percentage, Work, Power & Energy, Algebra, Mensuration, Trigonometry, Mass, weight, density, Pressure]	Mass, weight, density etc.
	2.2 Measure dimensions as per drawing
	2.3 Use scale/ tapes to measure for fitting to specification.
	2.4 Comply given tolerance.
	2.5 Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.
	2.6 Ensure dimensional accuracy of assembly by using different instruments/gauges.
	2.7 Explain basic electricity, insulation &earthling.
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. [Different engineering drawing- Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, symbolic representation of fastener and pipe joints, Electrical, electronic and digital symbols, P&I drawing symbols ISA 5.1]	3.1 Read & interpret the information on drawings and apply in executing practical work.
	3.2 Read & analyse the specification to ascertain the material requirement, tools, and machining /assembly /maintenance parameters.
	3.3 Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
4. Select and ascertain measuring instrument and measure dimension of components and record data.	4.1 Select appropriate measuring instruments such as micrometers, vernier callipers, dial gauge, bevel protector and height gauge, electrical meters, measuring instruments for pressure, flow, level, temperature etc (as per tool list)
	4.2 Ascertain the functionality & correctness of the instrument.
	4.3 Measure dimension of the components & record data to analyse the with given drawing/measurement.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve	5.1 Explain the concept of productivity and quality tools and apply during execution of job.
	5.2 Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws.

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productivity & quality.	5.3 Knows benefits guaranteed under various acts
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	6.1 Explain the concept of energy conservation, global warming, pollution and utilize the available recourses optimally & remain sensitive to avoid environment pollution.
	6.2 Dispose waste following standard procedure.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	7.1 Explain personnel finance and entrepreneurship.
	7.2 Explain 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.
	7.3 Prepare Project report to become an entrepreneur for submission to financial institutions.
8. Plan and organize the work related to the occupation.	8.1 Use documents, drawings and recognize hazards in the work site.
	8.2 Plan workplace/ assembly location with due consideration to operational stipulation
	8.3 Communicate effectively with others and plan project tasks
	8.4 Assign roles and responsibilities of the co-trainees for execution of the task effectively and monitor the same.
SPECIFIC OUTCOME	
Block-I& II (Section:10)	
<i>Assessment Criteria i.e. the standard of performance, for each specific learning outcome mentioned under block – I & block – II(section: 10) must ensure that the trainee achieves well developed skill with clear choice of procedure in familiar context. Assessment criteria should broadly cover the aspect of Planning (Identify, ascertain, estimate etc.); Execution (perform, illustration, demonstration etc. by applying 1) a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information 2) Knowledge of facts, principles, processes, and general concepts, in a field of work or study 3)Desired Mathematical Skills and some skill of collecting and organizing information, communication) and Checking/ Testing to ensure functionality during the assessment of each outcome. The assessments parameters must also ascertain that the candidate is responsible for own work and learning and some responsibility for other's work and learning.</i>	

BASIC TRAINING (Block – I)**Duration: (03) Three Months**

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1	1. Importance of trade training, List of tools & Machinery used in the trade. 2. Health & Safety: Introduction to safety equipments and their uses. Introduction of first aid, operation of Electrical mains. 3. Occupational Safety & Health 4. Importance of housekeeping & good shop floor practices. 5. Basic safety introduction. 6. Personal protective Equipments (PPE). 7. Use of Fire extinguishers.	• Importance of safety and general precautions observed in the in the industry/shop floor. • All necessary guidance to be provided to the new comers 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. • Introduction of First aid. Operation of electrical mains. Introduction of PPEs. • Introduction to 5S concept & its application. • Response to emergencies eg; power failure, fire, and system failure.
2	<u>Hand Tools and their uses</u> 8. Demonstration and uses of hand tools- screw drivers, pliers, tweezers, tester, wire stripper, electrician knife, steel rule, scribe, punches, hack saw, hammer, files, bench vice and drilling machine. 9. Simple mechanical fixtures. 10. Identification of types of screws, bolts, nuts, washers, rivets, clamps, connectors. 11. Fix screws of different sizes on wooden boards. 12. Cutting of metal blocks using hand/hack saw. 13. Cutting of wooden blocks using hand/hack saw. 14. Simple fitting practice, drilling and grinding practice.	• Identification, specifications, uses and maintenance of commonly used hand tools. Its use for Chipping, filing, sawing, drilling, threading and metal cutting fundamentals. • Different types of Fasteners & Fastening devices and its use. • Working and use of drilling machines and grinding machines.

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3	15. Practice of Marking & measurement with the help of Precision Measuring Instruments. 16. Gauge blocks, sine bar, dial indicators. 17. Vernier Caliper, Vernier Height vernier calipers, 18. Micrometers, bevel protractor, thickness gauges.	• Fundamental of marking tools its selection and use. • Working principle and operation of Precision Measuring Instruments, gauge blocks, sine bar, dial indicators. • Vernier Caliper, Vernier Height vernier calipers. • Micrometers, bevel protractor, thickness gauges.
4	Basics of AC and Electrical Cables 19. Verification of ohm's law. 20. Identification +Ve, -Ve polarities. 21. Identifying and use of various electrical components, their symbols. Wire size measurement technique. 22. Major D.C & A.C circuits. 23. Identify the Phase, Neutral and Earth on power Socket. 24. Use a Tester to monitor AC power. 25. Measure the voltage between phase and ground and rectify earthing. 26. Identify and test different AC mains cables. 27. Skin the electrical wires /cables using the wire stripper and cutter. 28. Prepare the mains cable for termination. 29. Identify the meter for measuring AC & DC parameters.	• Fundamentals of basic electricity, Basic terms such as electric charges, Potential difference, Voltage, Current, Resistance. • Basics of AC & DC. Terms such as +ve cycle, -ve cycle, Frequency, Time period, RMS. • P-P, Instantaneous value. Single phase and Three phase supply. Terms like Line and Phase voltage/ currents. • Insulators, conductors and semiconductor properties. • Different type of electrical cables and their Specifications. • Types of wires & cables, standard wire gauge (SWG).
5	30. Identification, testing & running of Motors and generators. 31. AC/DC motors Different speed controlling techniques.	• Construction and working Principles of AC & DC Motors. • Electricity, types of wave forms, time period and frequency, peak to peak values, RMS values, Average values, Form factor.
6	32. Overhauling & testing of ELECTRICAL INSTRUMENTS. 33. Familiarization with the construction, Overhauling.	• Introduction to electrical measuring instruments, classification of meters, working principles and operation of different types of ammeters,

	34. Testing & calibration of instrument use for voltage, current, frequency, power, power factor and energy.	voltmeters, ohmmeters analog multi meter and its effective use. Working principles and operation of different types instrument use for Frequency, power, power factor energy and its effective use.
7	35. Identify the different types of resistors. 36. Measure the resistor values using colour code and verify the reading by measuring in multi meter. 37. Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter. 38. Identify different inductors. 39. Identify the different capacitors and measure capacitance of various capacitors using LCR meter.	- Resistor-definition, types of resistors, their construction & specific use, color-coding, power rating. - Equivalent Resistance of series parallel circuits. Distribution of V & I in series parallel circuits. KVL& KCL with applications. - Principles of induction, inductive reactance, Capacitance and Capacitive Reactance, - Impedance. Types of capacitors, construction, specifications and applications. - Dielectric constant. Significance of Series parallel connection of capacitors. Electromagnetic Relays, types, construction, specifications- coil voltage and contact current capacity. - Multi meter, use of meters in different circuits. Use of CRO, Function generator, LCR meter.
8	40. Identification, testing of Diodes transistors, UJT, SCR, TRIAC, DIAC. 41. Introduction of oscillators and amplifiers.	- Semiconductor physics. - Forward and reverse bias in diode. - Transistor configurations of CC,CB,CE. - Introduction of amplifier & oscillator and its applications.
9	42. Identify the different types of electronics components using LCR meter. 43. Identification of deflection sensitivity, various controls of CRO. 44. Design of clipper, clamper circuit and identify the output waveforms in CRO.	- Basic electronics measuring instruments are CRO, Signal generators, digital storage oscilloscope. - Construction and working principle of CRO with internal structure. - Circuits of clippers, clampers, types of clamping design.

Instrument Mechanic

10	45. Implementation of basic gates & universal gates and its output verification. 46. Ex-or an ex-nor gates design. 47. Half adder, full adder, half subtractor and full subtractor.	• Digital Electronics- number system, conversion from to another system, basic gates, its truth table, universal gates and its truth table. • Laws of Boolean algebra, De-Morgan's laws, using NAND gates design of basic gates, using NOR gates. • Half adder, full adder, half subtractor, full subtractor.
11	48. Identification of various indicators, Connectors, ports on the computer cabinet. 49. Identify drives and their capacity. 50. Identify various connectors and cables inside the cabinet & Identify connections to rear side and front panel of the cabinet. 51. Identify various parts of the system unit and motherboard. 52. Configuring and troubleshooting display problems. 53. Practice various features of OS. 54. Install a Printer driver software and test for print outs. 55. Install MS office software. 56. Explore different Menu/Tool/Format/status bars of MS word and practice the options: Editing the text, saving the text, changing the font and size of text. 57. Prepare a power point presentation on any three known topics with various design features. 58. Invoke excel sheet from MS WORD and vice versa. 59. Identify the cables and network components. 60. Making UTP cross cables and testing, Making straight cables and testing, Making cable layout drawing.	• Basic blocks of a computer, Hardware and software, I/O devices, keyboard, types of mouse and their working. • Different types of printers, their function and inter-connection and their advantages HDD, CDD, DVD. Various ports in the computer. • POST Booting concept.
12	61. Assembly language programs on microcontroller address bus and data bus structure, width of data and address bus and its memory size	• Basic of 8051 microcontroller, its address bus and data bus structure, width of data and address bus and its memory size.

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	62. Program counter ,stack pointer etc.	• Instruction sets and Registers of 8051 and their uses.
13	Assessment / Examination (03 days)	

NOTE: -

- *More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.*



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BASIC TRAINING (Block – II)

Duration: (03) Three Months

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1.	64. Study various types of instruments constructions and identifying various parts and section. 65. Record the specification of instrument. 66. Find out the characteristics of linear and angular Displacement Resistive Transducer. 67. Find out the characteristics of linear and angular displacement Capacitive transducer.	• Scope and necessity of instrumentation. • Fundamentals of measurement. Systems-functional block diagram of measurement system. • Basic role, types, characteristics, and Selection of sensor/ transducer for measurement. • Working principle, characteristics and applications of Resistive and capacitive Transducer.
2	68. Select and verify characteristics of Strain gauges. 69. Study Construction, Purpose & Operation of load cells. 70. Study Construction & Operation of different types of Inductive, LVDT&RVDT Transducers for Displacement, Acceleration, Thickness and Vibration measurement .and verify the characteristics. 71. Study Construction & Operation of Vibrometers, and Accelerometers.	• Stress & Strain Measurement.- Working principle of Strain gauges, Types of Strain gauges, Bonding technique & Applications of Strain gauges. • Working principle and applications of Inductive, LVDT&RVDT transducers. • Measurement of vibration and acceleration. -seismic instrument.
3	Pressure Measurement. 72. Study construction, Operation and measure atmospheric pressures using different types of Barometers. 73. Prepare and Measure gauge, vacuum and differential pressures using different types of manometers. 74. Dismantling and assembling of pressure Gauges. Study the construction, adjustments for correct functioning.	• Principle of fluids Pressure, units of pressure, Factors affecting liquid pressure. Pressure relation with volume, temperature and flow. • Types of pressure, their relation-ships. Working principle of Barometers, manometers and applications. • Elastic types of pressure sensors, working and operation of bourdon tube, diaphragms, capsules, and bellows types

	75. Study the construction, circuit operation and adjustments for correct functioning of electronic pressure indicators/ transmitters. 76. Study construction, Operation of Standard Calibrator/Dead weight Tester. 77. Testing & calibration of Pressure gauges, indicators, transmitters with Standard Calibrator/Dead weight Tester 78. Measure vacuum using Vacuum gauges,, & McLeod gauge 79. Maintenance of pressure lines, gauges, transmitters etc.	of Pressure gauges switches and applications. - Working and operation of different types Electrical pressure transducer:- potentiometric, Capacitive, reluctance-servo, LVDT, strain gauge, piezo electric pressure transducer working and application. - Low Pressure Measurement using diaphragm Vacuum gauges, McLeod gauge, thermal conductivity gauges, pirani gauges, thermocouple gauges, Ionization gauge. - Method of pressure instrument calibration. Working principle of Dead weight tester/comparators, low pressure testers. Importance of calibration in Metrology
4	Flow Measurement 80. Study construction and repairing various types of positive displacement flow meters. Oscillating piston type, Rotating vane meter, Nutating disc meter. 81. Study of various types of flow restrictors (orifice, venture, flow nozzle, Pitot tubes) their shape, connections and check etc. 82. Dismantling, checking overhauling and calibration of D.P. cell/ Transmitter (pneumatic & electronic). 83. Dismantling, checking overhauling and calibration of Rota meters 84. Study construction, operation and calibration of turbine flow meter, magnetic flow meters, vortex, mass flow meters etc.	- Basic properties of fluids, fluids in motion, units of flow rate and quantity flow, factors affecting flow rate, Reynolds number. - Working principle of positive displacement flow meters. - Head type of flow meters: flow elements, pressure tapings, DP transmitters. - Variable Area type flow meter-rotameter, constructions, working principle, and application. - Principle of working and application of Mass flow meters. - Electronic inferential flow meters: principle of working and application magnetic flow meter. Turbine flow meter, vortex flow meter, ultrasonic flow meter. - Principle of open channel flow, weirs,

	85. Practice open channel flow measurement. Study construction, operation flow elements and instruments 86. Maintenance of flow meters, flow transmitters and indicators.	notches and flumes. Various shapes and their applications, maintenance, Solid flow measurements and application.
5	Level Measurement 87. Study construction, operation and calibration of Hook type, Sight glass and Float type level measuring instruments on close and open tank. 88. Dismantling, checking, overhauling and calibration of level gauges. 89. Study construction, operation and calibration of hydro Static pressure level measuring instruments, Bubbler system, and differential pressure measurement for close and open tank. 90. Operation & calibration of Electronic Level Indicators and transmitters. 91. Practice liquid level measurement using capacitive, Ultrasonic and radar type level indicators. 92. Preventive maintenance of level gauges, level indicating transmitters and switches etc.	• Introduction to measurement of level, - The principle of operation, use and construction of Hook type, Sight glass type, Buoyancy type level indicator to close and open tank. • Hydrostatic method of level measurements: Air purge method, differential pressure technique. • Electronic Level Measuring Instrument: Variable capacitance, High and low level alarm ON-OFF, Ultrasonic and Magnetic type level indicators, radar type level indicators. • Solid level measurements: various principle of operation, and use.
6	Temperature Measurement 93. Dismantling, Study construction, overhauling and calibration of bimetal, filled system thermometers and switches. 94. Calibration, maintenance & testing of Thermocouple, thermopiles, RTD, Thermostat, 95. operate, test and calibrate optical and radiation pyrometers 96. operation and use of electronic	• Measurement of Temperature: introduction, Temperature scales Solid Expansion Type-Bimetallic thermometers. • Liquid Expansion Type-Mercury in glass thermometer, steel thermometers, Alcohol in glass thermometer, gas and Vapor Pressure thermometers. • Thermocouple & RTD Thermostat:- their ranges, construction, principle of

	temperature calibrator and temperature baths for checking/calibrating temperature measuring instruments and transmitters, Routine maintenance of thermometers, transmitters, switches, compensating cables etc. 97. operation and use of humidity Sensor Instruments	operation, compensating leads, - temperature Recorders. • Principle of working and application of optical and radiation pyrometers etc. • Introduction of electronic temperature calibrator and temperature baths. • Principle of working and application of different types of humidity meters
7	Converters servicing. 98. Reconditioning and Calibration of I/P, P/I, E/I/, E/P, Electronic (power single and three phases), electric to hydraulic ETC. Converters. Final control elements. 99. Study the cut sections of various types of control valves/final control elements and its various components 100. Dismantling, fault finding, repairing, cleaning, reassembling and testing different types of control valves and actuators (electric, pneumatic, and hydraulic) 101. operation, servicing of valve positioned	Converters: • Principle, Construction, operation of I to P, P to I, E/I/, E/P Electronic (power single and three phase), electric to hydraulic ETC. Converters. Final control elements in process loops. • Working principle, operation and applications of Final control elements, actuators (electric, pneumatic, and hydraulic valve), and valve positioned in process loops. Control valve mechanical considerations, selecting control valves, valve positioner.
8	Automatic Industrial control. 102. study the closed loop & open loop system 103. Study the construction, Identification of components of ON-OFF type and PID type controllers (pneumatic and electronic) in the various fields. 104. Rig up ON-OFF type and PID type controllers (pneumatic and electronic) to unit operation and observe the responses. 105. Study operation on cascade, ratio,	Introduction to automatic Industrial control. • Basic block diagram of control systems. Open loop, Closed loop system. • Dynamics of Process, feedback and feed forward control system, Discontinuous Modes of Controller: two position, multi position, single speed and multi speed floating control. • Continuous Modes of controller: ON/OFF, Proportional, integral derivative, PI, and PID • Principle and operation of Electronic, programmable digital and pneumatic

Instrument Mechanic

	feed forward control. 106. Identification of Pneumatic and Hydraulic control circuit components. 107. Rig up pneumatic and hydraulic control circuit and Observe the responses 108. Dismantling and assembling of various valves.	controllers and its application, cascade, ratio, feed forward control. Basic principle Pneumatic and Hydraulic, Function of Control circuit component and its application
9-10	PLC 109. Identify all the modules of plc used in system. 110. Wire and connect the digital and analog field devices to the I/O modules. 111. Write and execute small program on logic control, and sequence control 112. Study various network lines. 113. Preparation of network cables and connectors. Testing network cables	PLC - Fundamentals of Programmable logic - Controllers. - PLC architecture- Function of different modules, Hardware selection and configuration- PLC symbols-PLC programming for application. Fundamentals of Net working: - Types of networks used in digital Instrument systems. LAN, WAN, Ethernet. - Types of Cable categories (CAT), and their descriptions. - Various types of Cable connectors various tools used in networking.
11	Telemetry servicing: 114. Study construction, Reconditioning, replacement of parts, adjustment and calibration of transmitters (different type) for process variables. 115. Installing & Operating HART transmitters/devices (I/O). 116. Calibration of HART devices. DCS&SCADA 117. Study and use of DCS & SCADA complete with communication system for automatic process control, 118. Identify all the modules of used in system	Telemetry: - Telemetry in process control, types of SMART transmitters, principle of working of different pressure, flow, level, temperature, etc. Transmitters. Smart devices: - Need of smart devices, HART transmitters features & applications. Working method of HART devices, HART protocol. HART communicators and PC based HART device configuration. Steps in calibration of HART devices. Fundamentals of DCS & SCADA - History of DCS development. - Basic architecture, function of different modules & applications.
12	Analytical instruments:	Analytical instruments: Principle, accessories, Function

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	119. Study the panel control and its function, operation and calibration of the PH meter Conductivity meters, Calorimeter, gas analyzer, Dissolved oxygen meter.	& industrial application of the PH meter Conductivity meters, Calorimeter, gas analyzer, Dissolved oxygen meter.
13	Recorders data loggers 120. Checking, fault finding, repairing, testing of pneumatic, electrical/electronic recorders. (single point & multi point), Check Calibrate paperless LCD/LED recorder.	Recorders: • Introduction to recorders, data loggers Construction, working principle, various parts installation and use of pneumatic and electronic recorders. Strip chart, circular chart. Multi points paperless LCD/LED recorder etc.
Assessment / Examination (03 days)		

NOTE: -

- *More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.*

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9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

Block – I		
Sl. No.	Workshop Calculation and Science (Duration: - 20 hrs.)	Engineering Drawing (Duration: - 30 hrs.)
1.	Unit: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units.	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.
2.	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.	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.
3.	Square Root: Square and Square Root, method of finding out square roots, Simple problem using calculator.	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.
4.	Ratio &Proportion: Simple calculation on related problems.	Lettering and Numbering as per BIS SP46-2003: - Single Stroke, Double Stroke, inclined, Upper case and Lower case.
5.	Percentage: Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	Free Hand sketch: Hand tools and measuring instruments used in electronics mechanics trades.
6.	Material Science : Properties -Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous	Free hand drawing : - Lines, polygons, ellipse, etc. - Geometrical figures and blocks with

	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.	dimension. - Transferring measurement from the given object to the free hand sketches.
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Block – II		
Sl. No.	Workshop Calculation and Science (Duration: - 20 hrs.)	Engineering Drawing (Duration: - 30 hrs.)
1.	Mass ,Weight and Density : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals	Symbolic Representation (as per BIS SP:46-2003) of : - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections - Weld, brazed and soldered joints. - Piping joints and fittings
2.	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.	Construction of Scales and diagonal scale P&I drawing symbols ISA 5.1 cable schedule
3.	Algebra: Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	Electrical and electronics element and components LED, IRLED, photo diode, photo transistor, opto- coupler symbols symbols of Logic gates
4.	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.	Half adder, full adder, multiplexer and de-multiplexer
5.	Trigonometry: Trigonometrical ratios, measurement of angles. Trigonometric tables. Finding height and distance by trigonometry.	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.

9.2 EMPLOYABILITY SKILLS**(DURATION: - 110 HRS.)**

Block – I (Duration – 55 hrs.)		
1. English Literacy		Duration : 20 Hrs. Marks : 09
Pronunciation	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)	
Functional Grammar	Transformation of sentences, Voice change, Change of tense, Spellings.	
Reading	Reading and understanding simple sentences about self, work and environment	
Writing	Construction of simple sentences Writing simple English	
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.	
2. I.T. Literacy		Duration : 20 Hrs. Marks : 09
Basics of Computer	Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
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.	
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.	
Computer	Basic of computer Networks (using real life examples), Definitions of	

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Networking and Internet	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.
3. Communication Skills	
Duration : 15 Hrs. Marks : 07	
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.
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.
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.
Facing Interviews	Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview.
Behavioral Skills	Problem Solving Confidence Building Attitude
Block – II Duration – 55 hrs.	
4. Entrepreneurship Skills	
Duration : 15 Hrs. Marks : 06	

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Concept of Entrepreneurship	Entrepreneur - 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.
Project Preparation & Marketing analysis	Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of PLC, Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.
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.
Investment Procurement	Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.
5. Productivity	
Duration : 10 Hrs. Marks : 05	
Benefits	Personal / Workman - Incentive, Production linked Bonus, Improvement in living standard.
Affecting Factors	Skills, Working Aids, Automation, Environment, Motivation - How improves or slows down.
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.
Personal Finance Management	Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.
6. Occupational Safety, Health and Environment Education	
Duration : 15 Hrs. Marks : 06	
Safety & Health	Introduction to Occupational Safety and Health importance of safety and health at workplace.
Occupational Hazards	Basic Hazards, Chemical Hazards, Vibroacoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.
Accident & safety	Basic principles for protective equipment.

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	Accident Prevention techniques - control of accidents and safety measures.
First Aid	Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person.
Basic Provisions	Idea of basic provision legislation of India safety, health, welfare under legislative of India.
Ecosystem	Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.
Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.
Energy Conservation	Conservation of Energy, re-use and recycle.
Global warming	Global warming, climate change and Ozone layer depletion.
Ground Water	Hydrological cycle, ground and surface water, Conservation and Harvesting of water.
Environment	Right attitude towards environment, Maintenance of in -house environment.
7. Labour Welfare Legislation	
Duration : 05 Hrs. Marks : 03	
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.
8. Quality Tools	
Duration : 10 Hrs. Marks : 05	
Quality Consciousness	Meaning of quality, Quality characteristic.
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.
Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
House Keeping	Purpose of House-keeping, Practice of good Housekeeping.
Quality Tools	Basic quality tools with a few examples.

10. DETAILS OF COMPETENCIES (ON-JOB TRAINING)

BROAD LEARNING TO BE COVERED IN INDUSTRY FOR TURNER TRADE:

1. Safety and best practices /Basic Industrial Culture (5S, KAIZEN, etc.)
2. Record keeping and documentation
3. Selecting proper instrument for measurement, testing and calibrating various measuring instruments.
4. Assembling of different components as per requirement and check functionality.
5. Carryout maintenance of instruments using in process plant and measuring instruments including electronics and electrical instruments.

Note: Actual training will depend on the existing facilities available in the establishments.

The **competencies/ specific outcomes** on completion of On-Job Training are detailed below: -

Block – I

1. Study personal & plant safety procedures and use of safety equipment, fire and fire fighting facilities/techniques, handling of hazardous chemicals and poisons substances.
2. Understand the different activities of the plant with plant capacity and production.
3. Preparing a Schematic Layout and study of the process and operation of the plant.
4. Perform basic workshop operations using the suitable tools for fitting riveting, drilling etc observing suitable care & safety.
5. Using precision instruments like for job preparation and operation. Correcting and maintenance of precision instruments.
6. Understand the working principle of electrical measuring instruments. Finding faults and troubleshoot calibrate, connect common electrical measuring instruments, Continuity Testers, meggers, earth resistance testers and multi meters etc.
7. Test, connect with devices, start and control and reverse the direction of rotation of DC motors AC single phase and three phase induction motors, synchronous motors.
8. Read, understand and interpret electrical (Single line diagrams & MCC Panel wiring) & electronic circuits and its drawings.
9. Prepare, cable glanding, crimp, terminate and test various power/instrumentation cables used in industries.
10. Soldering practice, metal to metal, wire to wire, wires to plugs, wires to connectors, wires to component PCB and de-soldering work.
11. Test basic electrical (MCBs, push buttons, relay, contactors)/electronic components (diodes, transistors, capacitors, coils, resistors etc.) using proper measuring instruments.
12. Test and operate electronic based circuit. Basic Trouble shooting in electronic circuits.
13. Configure, install, troubleshoot, upgrade, interconnect given computer system.
14. Test, operate and analyse the basic analog and digital electronic circuits.

Instrument Mechanic

15. Test and Operating microcontroller (8051) based systems.

Block – II

16. Demonstrate of location of the various sensing element, transmitter, controller, final control valve of a control loop.
17. Demonstrate and apply the mounting arrangements for field & control room instruments (Panel mounting, Wall mounting, Yoke mounting etc.).
18. Care, safety and proper use of hydraulic & pneumatic tubing & fittings, coupling and connectors.
19. Dismantling, Cleaning and Re-assembling of Air-Filters, Air Regulators. Connection of pneumatic instruments & adjustment as per name plate.
20. Removal and Re-Fitting of a plant instrument after properly isolating the section of plant. Plant Procedure like SOP work order, clearance Certificates should be noted down by the apprentices.
21. Understand and apply routine works like, Winding of clocks, Filling of Mercury, Cleaning and changing of Inks, Replacement of charts with drawing and returning of materials to and from stores.
22. Calibration and Maintenance of field instruments (displacement, pressure, flow, level, temperature etc.) and panel instruments (indicator, controller, convertor, recorder) used in instrumentation field.
23. Dismantle, inspect, calibrate and assemble various Control Valves, Valve Positioner, Convertor, various types of final elements and actuators.
24. Familiarization, Installation and Maintenance of various types of Control Loops like ON OFF, PID, feedback control loops etc and components (sensing element, single indicator/recorder, controller and final control element), relays and annunciator.
25. Familiarization with instrument drawing in sketching, identification of instruments symbols and blocks diagrams of existing units in the plant. Instrument and Panel Installation as per layout plan.
26. Familiarization, installation and maintenance of analytical instruments.
27. Installation, testing and maintenance of recorders , data loggers
28. Testing and calibration of digital protocol (HART) instruments. preparation and testing of networking cables.
29. Understand and operating PLC. Executing and correcting small programs in PLC.
30. Understand the working and operation of DCS & SCADA system in the industry.

Note:

- Industry must ensure that above mentioned competencies are achieved by the trainees during their on job training.
- In addition to above competencies/ outcomes industry may impart additional training relevant to the specific industry.

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

INSTRUMENT MECHANIC			
LIST OF TOOLS AND EQUIPMENT for Basic Training (For 20 Apprentices)			
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-09 is required additionally)			
Sl. no.	Name of the Tool & Equipment	Specification	Quantity
1.	Steel Rule (metric and English Marking)	150mm	20 nos.
2.	Watch maker screw driver	Set of six or above	20 nos.
3.	Plier flat Nose	100mm	20 nos.
4.	Hammer ball pain. With handle	250gms	20 nos.
5.	Twiser fine point	125mm	20 nos.
6.	File hand smooth	200mm	20 nos.
7.	File Flat 2nd.cut	200mm	20 nos.
8.	Screw driver set	Set of 5 pieces or above	20 nos.
9.	Adjustable spanner	15 mm	20 nos.
B: TOOLS INSTRUMENTS AND GENERAL SHOP OUTFITS			
10.	Neon(phase) tester	Voltage: 230volt	4nos.
11.	Eye glass 3" focus watchmaker	3" focus	4nos.
12.	Angle plate	-	2nos.
13.	Vee block with clamp pair		2nos.
14.	Hacksaw frame adjustable	200–300 mm	8 nos.
15.	Hammer ball pain	450gms.with handle	2nos.
16.	Electric soldering iron (pencil tip)	6watt	4nos.
17.	Vice bench	jaw 100mm	4nos.

Instrument Mechanic

18.	Pointer extractors (puller)		4nos.
19.	Punch center	100×10mm	2nos.
20.	Plier side cutting	150mm	2nos.
21.	Flaring tool set		1set
22.	Micrometer outside	0to25mm	1no.
23.	Micrometer outside	25to50mm	1no.
24.	Vernier height gauge	300 mm	2nos.
25.	Combination set	300mm	1no.
26.	Vernier caliper	150mm	2nos.
27.	Standard wire gauge	1 to 30 SWG or above can measurable	1no.
28.	Feeler gauge leaf type	26 blades, eng. & metric	1no.
29.	Radius gauge leaf type	1to15mm	1no.
30.	Dial test indicator in mm with accessories.	Standard size	1no.
31.	Micrometer inside	25mmwithextension upto150mm	1no.
32.	Combination plierheavy duty	150mm	6nos.
33.	Fire buckets		4nos.
34.	Tube cutter		1no.
35.	Tube bender		1no.

C: GENERAL MACHINERY INSTALLATIONS

36.	Digital panel meters	3 ½ "digit LED display	6 nos.
37.	Digital line frequency indicator	3 ½ "digit LED display	2nos.
38.	D.C. regulated power supply	(+/-15V / +/- 30V) 0-3 Amp display for voltage and current	2 nos.
39.	Digital multi signal generator with frequencycounter	Generator- 1 MHz or above Square, sign, triangle generation Frequency counter- 10Hz or above	1no.

Instrument Mechanic

		Digital display	
40.	Digital function generator	Generator- 10 MHz or above Digital display	1 no.
41.	Pulse generator	2 MHz or above	1 no.
42.	Digital insulation tester and megger	100 M ohm or above	1no. each
43.	Digital multimeter	3 ½ "digit LED display, current, volt, resistance, transistor, diode measurement facility.	2nos.
44.	Analog multimeter	current, volt, resistance measurement facility	2nos.
45.	Digital L. C.R. bridge/meter	Measures resistance, inductance, capacitance, quality factor etc. Instrument capable to measuring inductance, L, capacitance, C, and resistance, R.	1no.
46.	Wire types traingauge (load cell/cantilevered) Instrument/Trainer		4nos. (2nos. each)
47.	Vibrometer sensing elements with application Trainer	11V.14.5VDC supply voltage, Power consumption: max. 15W Ambient Condition: Operating temperature: 50 C to 400 C (410 F...1040F) Storage temperature: -10°C to 650 C (140 F.... 149° F) LCD Display, Signal out Analog Output, Signal Output DIGITAL OUT, Low Pass Filter, High Pass Filter, Laser, Power Supply PDV-AC, Housing Protection rating: with protective insulation, IP40 Cable length: 3 m	2nos.
48.	Accelomerter		1no.
49.	Seismic instruments		2nos.
50.	Decade resistance, capacitive and inductance boxes	Resistance box-0 to 10 M ohms or above	1no. each

Instrument Mechanic

		Capacitive and inductive box range as required	
51.	DC moving coil millimeters (various ranges)	0-25 mA 0-100 mA 0-250 mA 0-750mA	2nos.
52.	Centre zero galvanometers	30-0-30 or above Size- 100 mm or above	2nos.
53.	AC moving iron type voltmeter(various ranges)	0-50V 0-150V 0-300V	3nos.
54.	AC moving iron type ammeter(various ranges)	0-1A 0-10A 0-50A	3nos.
55.	Wattmeter dynamometer type	Single Phase 3000 watts /10 A or above AC type, 230V compatible	1no.
56.	Power factor meter	Single phase 10 A or above AC type, 230V compatible	1no.
57.	Watt hour meter induction type	Single phase 5 A or above	2nos.
58.	Ampere hour meter	Single phase 10 A or above	1no.
59.	Ohmmeter	0-10M ohms	2nos.
60.	Instrumentation amplifier trainer		1no.
61.	Trainer son network circuits		1no
62.	Discreet component trainer		1no.
63.	Trainer sonlinear circuits i.e. operational amplifiers		1no.
64.	Trainer on basic digital electronics i.e. log icgates Boolean Expression adders ubtractor flip flop counter register converter etc.	The Trainer on Basic Digital Electronics will have a main unit and modules. The main unit will consist of Fixed DC Power Supplies, Adjustable DC Power Supply,	1no.

Instrument Mechanic

		Standard Frequency Outputs, Clock Signal Generator, 2 x 8 i.e. 16 SPDT switches as HI / Low Inputs, 4 Toggle Switches, each with debounce circuit, 2 Nos. pulsar switch with Q and Q' o/p with debounce circuit, Line Signal generator, 2 digit BCD coded thumbwheel Switch, 16 sets of independent LED's to indicate high & low logic state, 4 sets of independent 7 segment LED display with BCD to Seven Segment, Decoder driver, Logic Probe, An 80 / 0.5W speaker with driver circuit, Breadboard Module.	
65.	Trainer son power supplier's half wavere ctifier full wavereg ulated powersupply		2no.
66.	SCR driven/controlled power supply trainer		1no.
67.	Micro Controller Trainer		1 no
68.	Trainer on RS485 to RS232 converter	Trainer with software for test communication with computer, Signal Conversion RS 485-RS232, Power supply 230 Vac/50Hz, Working mode 2-wire half-duplex Transmission distance: RS232: Typical: 15 FT (5m) RS485: Typical 4000FT (1200m) Maximum Baud Rate: 100 Kbit/ s to 10 Mbit/s, "Receive" and "Transmit" modes LED indicators	1 no. each
69.	Pressure Comparator	capacity / Range – 0 -30kg/cm ² or above	1no.
70.	Pressure regulators with filter and	¼ "or 1/8" connection with air filter	1no.

Instrument Mechanic

	input & output gauges	regulator and 4" dial pressure gauges.	
71.	Pressure transmitter for gauge and vacuum	Pressure transmitter: Input 0-7 bar or above Output 4-20 mA Vacuum transmitter Input: 0-30inch Hg Output 4-20 mA	1no.each
72.	Differential pressure transmitter(electronic)	Pressure range: 6.90 to 690 kpa Accuracy: $\pm 0.075\%$ of calibrated span, Static pressure: 2000 psi Output: 4 to 20 mA / HART, Supply voltage: 11.9 - 45 vdc, Operating temperature limits: 80°C, Process connection: 1/4" - 1/8" npt female Electrical connection: 1/2" – 1/4" npt, Conduit Approval: standard waterproof ip67, Flange adaptor: 316 SST, Diaphragm: 316 SST, Display: LCD, Range ability: 100: 1, Fill fluid: silicon, Mounting: 2" Pipe Bracket: stainless steel bracket (angle type) with SS bolts Orifice Plate Assembly, Fluid: Water, Size: Suitable for 1" GI pipeline, Max. Temp.: 45 °C, Orifice Plate made up of SS 304, Sump Tank made up of S.S. 304, 0.5 HP S.S. Pump, Measuring Tank made up of S.S. 304. Whole set-up will mounted on MS structure with suitable piping's and fittings.	1no.
73.	Bourdon tube type, bellow type and Diaphragm type pressure gauges of various ranges	Dial size- 4 inch above Sensing element- SS or phosphor bronze Range- as required	2nos. each

74.	Pressure measurement trainer	1. Consisting one pressure process vessel minimum 20 liter capacity 2. Bourden tube pressure gauge (C and spiral type one each) (0-7 kg/cm²) 3. diaphragm type pressure gauge (0-7 kg/cm²) 4. electronic pressure transmitter (input 0- 7 Kg/cm², output 4 to 20 mA) 5. pneumatic pressure transmitter (input 0-7 kg/cm², output 3 to 15 psi) 6. Pressure switch(0-7 kg/cm²) 7. Absolute pressure gauge (7 kg/cm²) 8. FRL unit with input and output gauge All the instruments are with safety hand valve , flanged arrangement for easy assembling and dismantling, with all necessary accessories and meters for operating and measurement. Tank consisting two extra tapping for connecting any other measurements.	1no.
75.	Pressure controller	Controller: Input- 4 to 20 mA Output-4 to 20 mA Auto and manual tuning Digital display of process and set point Transmitter: Range: 0-5 bar or above Zero and span tunable Output- 4-20 mA Compatible supply Process tank: size as required Control valve: as required I/P converter: i/p 4-20 mA o/p -3-15mA	1 no.
76.	Pressure switch as of various ranges	Range: 0-5 bar, 0-1 bar 0-20 bar or other suitable range	4nos. each

Instrument Mechanic

77.	Different types of manometers	U tube type- mercury filled, 600-0-600 mm or above Well type- 0-30 inch or above Inclined type 0-500 mm or above	1no. each
78.	PtoI and Ito Pconverters	Air filter regulator, pressure Gauges current indicator, air compressor I TO P Converter (input -4-20 mA, output 3-15 psi)	1no. each.
79.	Vacuum tester with Low pressure measuring gauges such as thermal conductivity (pirani) gauge McLeod gauge and vacuum pump.	vacuum tester range 0-30 inch of Hg or above, Vacuum pump - 0-27 inch of Hg or above with gauge and valve. Thermal conductivity (pirani) gauge McLeod gauge specifications as required by system	1no. each.
80.	Vacuum gauge	100mm dial bourdon tube type	1no.
81.	Simple tank type quantity meter	SS tank with glass tube indicator and scale for level measurement in quantity with necessary fitting.	1no.
82.	Impeller type flow meter	Impeller Flow meter type of Suitable range for Water or Viscous fluid with Pulse or 4-20 mA DC or DC Voltage Output with S.S. measuring and sump tank, SS pump fitted on stand for working of flow meter.	1no.
83.	Helical and turbine flow meter	Helical & Turbine type Flow with Suitable range for Water or Viscous fluid with Pulse or 4-20 mA DC or DC Voltage Output with SS measuring and sump tank, SS pump fitted on stand for working of flow meter, mounted on suitable frame structure.	1no.
84.	Pitot tube flow meter	Suitable range pitot tube flow meter for air velocity measurement, with Perspex, long smooth walled pipe, air blower, inclined cum vertical manometer, all fitted on framework.	1no.

Instrument Mechanic

85.	Orifice type flow meter	Rota meter, Orifice plate assembly of SS & brass Venturi all suitable for 1" pipe line, SS sump tank, SS measuring tank, SS pump, mercury manometer with scale with required all fittings accessories and mounted on stand to understand working of all three flow meters.	1no.
86.	Venturi tube flow meter		1no.
87.	Rota meter		1no.
88.	Magnetic flow meter	Magnetic flowmeter with HART communication facility & 4-20 mA output along with SS sump tank, SS measuring tank, SS pump and with required all fittings accessories and mounted on stand.	1no.
89.	Vortex flow meter	SS sump tank, SS measuring tank, SS pump, flow meter with HART Communication & 4-20 mA output and with required all fittings accessories and mounted on stand.	1no.
90.	Flow measurement and control trainer	Consisting flow transmitter PID controller, I/P converter, FR unit, Control valve Pump and tank Controller: Input – 4-20 mA o/p 4-20 mA manual and auto tuning I/P - input 4-20 mA O/P 3-15 psi Pump ½ hp or above Flow transmitter – input: as required Output- 4-20 mA	1 no.
91.	Solid flow measurement and Control trainer	Microwave based Solid flow sensor, Hopper, collection tray, control valve, PID controller, electronic circuit chart recorder, current meter, and seamless data transfer unit complete working set up mounted on suitable frame structure.	1 no.

Instrument Mechanic

92.	Flow DP transmitter	Differential pressure transmitter with HART/field bus facility, SS Orifice plate assembly, control valve, actuator, valve positioner, rota meter, air regulator. To study the working principal of DP Transmitter and functioning of it with HART/field bus.	1 no.
93.	Integrated direct level indicator trainer (Hook type, sight glasstype, float type level indicator)	Float Type Level Indicator Made up of M.S. /S.S. with 1/2" drain valve, Float made up of SS-304 of 400 mm (D), 1-meter Measuring. Hook Type Level Indicator made up of M.S./S.S., Chromium Plated Brass Scale & Body, 300 mm range, 0.5 mm accuracy with 0 -300 mm Rack & Pinion scale. Sight Glass Level Indicator made up of M.S./S.S. with Measuring tank, sight glass and drain valve facility, Protection covers for sight glass tube level indicator & MS stand for it.	1no.
94.	Static pressure and air purge type level indicator	Static pressure and air purge Level Indicator with glass tube, SS purge pipe.	1no.
95.	Electrical Type Level indicating transmitter with application trainer		1no. each
96.	Level controller	Level transmitter, Auto- Manual PID controller (with three term facility), communication facility, control valve, I/P converter, S.S. sump tank, measuring tank of suitable height, S.S. pump, circular chart recorder, SCADA software with necessary fitting to run the setup, mounted on suitable frame structure.	1no.

Instrument Mechanic

97.	Level measurement equipment for solid, sonic solid level, microwave, capacitance probes, diaphragm switches, nuclear gauge, sonic and microwave solid level detectors point level detector, conductivity type	Ultrasonic level detector, Microwave level detector Vibrating fork type level switch, Capacitance probe level detector, Point type level Detector. All transmitters and sensors with individual Container as measuring tank suitable to transmitters and mounted common stand such as experimental kit, with switches and indicators.	1 no. each
98.	Stem and dial type bimetallic thermo meter(various ranges)		2nos.
99.	Liquid, Gas and Vapor pressure thermo meter		2nos.each
100.	Temperature Trainer consisting of, RTD'S, the rmistor and different types Thermocouple.		1no.
101.	Temperature transmitter, pneumatic	Scale for Set Point & Process, output 0.2 to 1.0 Kg/cm ² and Input 0 to 100 Deg. C, Selectable Control Mode & Control Action, control valve works on 3 to 15 psi, steam generator, rotameter, S.S. sump tank & S.S. jacketed measuring tank, SS pump, stand with hardware fittings & electrical accessories, mounted on suitable frame structure.	1no.
102.	Temperature transmitter electronic (input RTD,TC)	Type: RTD Pt-100/Pt-1000, 2wires. Mounting: Head Mounting.	1no. each
103.	Temperature Digital Indicator	Input sensor compatible: RTD or thermocouple Digital display	2 nos.
104.	Pyrometer with a llacc essories	Digital /Analog display, 800°C to 1500°C Measurement Range with accessories	1no.
105.	Trainer for measuring and	Made up of S.S. Shell and Tube Heat Exchanger, S.S. cold water tank,	1no.

	controlling of temperature	Pump, Rota meter and a hot water tank with thyristorized heater, Thermocouples, Temperature Transmitter, PID Controller, Control Valve, I/P Converter, Air Regulator, Current Meter, Pressure Gauge, Thyristor Drive, Heater Controller, Temperature Indicator, Circular Chart Recorder. The unit will also consist of necessary piping, fittings Standard pneumatic lines, Software.	
106.	Temperature digital Controller	It consisting a controller, transmitter, Dry block oven or heating system. RTD /Thermocouple transmitter: Sensor: as required Output: 4-20mA Controller: Input – 4-20 mA o/p 4-20 mA manual and auto tuning.	1no.
107.	Digital temperature calibrator, mV/mA injector and measuring unit	DC mV Source & Sink 0 to 199.99mV Range, 0.01mV Resolution ± 0.1% Of F.S Accuracy DC mA Source & Sink 0 to 25 mA Range, 0.01mA Resolution, ±0.25% Of F.S Accuracy, RTD and thermocouple output measurement to calibration of temperature transducers.	1no. each
108.	Pneumatic and electronic recorders (single point and multipoint) Both circular and strip chart types	Circular chart recorder made up of Aluminum, 12" circular type chart, Capillary - 3 mtrs ss-304/copper Ranges in 120°C- 38 to 50 °C, 100 °C, Single pen type. circular recorder. Strip chart recorder Input1: k type thermocouple Input 2: k type thermocouple Range: 0-120 degree.	1no. each

		Speed: 60 mm / hr Type- two pen type 230 vac mains operated	
109.	Paper less LCD/LED recorder setup	Analog input channels support various types of signal, The following options can be selected to input through meter configuration, Voltage signal: 0-5/1-5VDC/0-20/0-100mVDC, Current signal: 0-20/4-20mA DC, Thermal resistance: Pt100, Cu50, Thermocouple: B, E, J, K, S, T 2 Output 1 analog output channel (4-20mA) can drive a maximum load of 750Ω. 1 isolated 24VDC feedback output can supply a current as much as 50mA, Accuracy Real-time display: ±0.2% F.S. Recall accuracy: ±0.2% F.S. Cold junction tolerance: ±2% Clock accuracy: ±2S/Day Notes: Reject cold junction tolerance of thermocouples, Record Interval, Record interval selection, 1/2/5/20/40/60/120/240 second(s). Record Capacity, 4MBit. The user can allocate it to two input channels through instrument configuration (0.5MBit per unit). Record Time, If the power is ON, the total record time T of every channel can be calculated by the Record Interval T and Record Capacity n, See the formula as follows: $T = 0.74 \times n \times t$; Where: T: day; t: S; n: M, the value can be 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5 or 4.0. For example: In case n=4.0, t=240S, this channel can record for T=710.4 days, Alarm	1 no.

		Output, 2 passive Contact Outputs. Contact Capacity: 1A 30VDC. Default: normal open, Communication RS485 mode: Complying with open MODBUS RTU slave protocol, and the baud rate can be set:200/4800/9600/19200/38400/57 600 bps, Screen Display Resolution: 192×64 Scan frequency: 1Hz, Power Supply Rated AC supply voltage: 0.2A @ 90-260VAC, 45-55Hz, Net weight ≤1.0kg, Storage condition Temperature: -20-60°C. Avoid direct exposure to violent sunlight Humidity: <85%RH, Operating condition Temperature: 0-55°C Humidity: 10-85%RH (no coagulation). Notes: Do not operate in an erosive atmosphere. Do not bring liquid or conductive substance into the instrument. Keep airiness near the intake in a good condition.	
110.	Programmable logic controller (micro PLC) trainer	At least digital 4 input & 4 Output, 4 analog input & output) At least digital 8 input & 8 Output, 4 analog input & output with simulation software and hardware for understanding PLC programming and functioning	1 no.
111.	Real PID controller trainer	Pump, sump tank, Heater tank, PC based PID controller module with all three (P+I+D) mode and Auto and manual mode facility to study the PID control action.	1 no.
112.	Electric actuators		1no.
113.	Pneumatic and hydraulic actuators	Travel: 50 mm, Type: Hydraulic Cylinder, Action: Double Acting, Power Pack, Complete arrangement to be fitted on MS fabricated	1no.

Instrument Mechanic

		powder coated Table with necessary piping and wiring.	
114.	Different type of control valves such as gate valves, globe valves, Ball valves, diaphragm valves, butterfly valves etc. electrically/actuated, pneumatic actuated/hydraulic actuated	Gate valves, globe valves, Ball valves, diaphragm valves, butterfly valves electrical/Pneumatic/Hydraulic Actuate.	1no. each.
115.	Valve petitioners, booster relays, gland pickings etc.		1no. each.
116.	Cut section models of various type of control valve	Gate valves, globe valves, Ball valves, diaphragm valves, butterfly valves	1no. each.
117.	Microprocessor trainer kit	Microprocessor Trainer 6.144 MHz Operating Frequency, 8 K ROM, 8 K RAM, ASCII Keyboard Input, LCD Display with interface with ADC / DAC modules, application modules like Seven Segment Display, Stepper Motor Controller, Traffic Light Controller, Elevator Simulator, Temperature measurement, DC Motor controller. Trainer with simulation software.	4 nos.
118.	Air compressor		1 no.
119.	Hydraulic trainer	Hydraulic Trainer with Equipment trays - 2nos., Pressure gauge – 2 nos., Hydraulic Motor - 1 no., 4/2-way hand lever valve - 3nos., 4/3-way hand lever valve with relieving mid-position - 3nos., 4/3-way hand lever valve with closed mid-position - 3nos., 4/3-way hand lever valve with recirculating mid-position - 3 nos., Pressure sequence valve, pressure relief valve – 3 nos., 3-way pressure reducing valve – 2 nos., 2-way flow control valve – 2 nos., One-way flow control valve -	1 no.

Instrument Mechanic

		4nos., Non-return valves – 4 nos., Shut-off valve- 4 nos., Diaphragm accumulator with shut-off block – 1 no., Weight up to 10 kg- 1 no., 2/2 way plunger / stem actuated – 2 nos., Standard hoses with quick connectors, Flow dividing valve – 1 no., 5-way distributor with pressure gauge - 1no.	
120.	Pneumatic trainer	Pneumatic trainer consists with Pressure Gauge, Pneumatic Motor, Single Acting Cylinder, Double Acting Cylinder, Air Filter Regulator Lubricator with Pressure Gauge, Hand Lever Operated Valves: 2 Nos, 5/2 way& 3/2-way, Solenoid Valve: 2 Nos, 5/2 way&3/2-way, Pilot Operated Valve: 5/3 Spring Centered, 5/2Spring Returned, 3/2 Pilot Operated. Palm Operated Valve: 3/2-way Valve, Roller Lever Valve: 5/2 way, 3/2-way Valve, Shuttle Valve: OR Valve, AND Valve: Dual Pressure Valve, Flow Control Valve, Non-Return Valve, Block Manifold: 6 ways, Plastic Tubing as per require, Quick Push-Pull connectors, Air Compressor.	1 no.
121.	Conductivity meter AND Experimental set up for online conductivity measurement	Online conductivity meter with 4-20 mA output, Conductivity sensor, SS Reactor tank, SS feed tanks, pump, stirrer, hardware and electrical accessories mounted on good quality frame work with software.	1 no. each
122.	pH meter Experimental set up for online pH measurement	Online PH meter with 4-20 mA output, PH electrode, SS Reactor tank, SS feed tanks, pump, stirrer, hardware and electrical accessories on stand with software.	1 no. each
123.	Different type of Hygrometer		1no. each
124.	Hydrometer		1no.

Instrument Mechanic

125.	Experimental set up for online dissolved oxygen measurement	SS Measuring Tank, Dissolved oxygen Meter, dissolved oxygen sensor, hardware and electrical accessories on stand with software.	1 no.
126.	Computers(latest configuration) with tables (For operating various control system trainers) Licensed operating system, Latest Office (licensed version)		04 nos.
127.	LCD multimedia projector		01 no.
128.	Broad band internet connection		01 no.
129.	Printer(Scan/copy)		01 no.
130.	Networking tool kit		02 nos.
131.	Electronic (HART/Field bus/profibus type device compatible) calibrator	Microprocessor base HART Communicator calibrator with Full multi-bus communicator for HART, FOUNDATION Field bus and Profi bus PA instruments. Touch Screen LCD display.	1 no.
132.	Low pressure measuring gauges such as thermal conductivity gauge, McLeod gauge	Digital display of pirani type (thermal conductivity type) Vacuum measurement, mercury in glass tube McLeod gauge with inclination provision, close vessel for create vacuum, fitted on frame work.	1 no.
133.	Vacuum gauge digital	Compound gauge with digital display, as per selection of fluid	1 no.
134.	Pressure Transmitter, Pneumatic	Transmitter output 0.2 to 1.0 Kg/cm ² , PID Scale for Set Point & Process, Input & Output 0.2 to 1.0 Kg/cm ² , Selectable Control Mode & Control Action, control valve works on 3 to 15 psi, air regulators, pressure gauges, SS pressure vessel, air compressor, stand with hardware fittings & electrical accessories.	1 no.

Instrument Mechanic

135.	Thermal Mass Flow Meter	Inline Thermal mass flow meter with digital display, RS485 / RS232 communication, output 4-20 mA with air compressor & digital anemometer. Complete set ready to use.	1 no. each.
136.	Piston Type flow meter	Flow meter along with sump Tank, Measuring Tank, Pump, and all accessories for working set-up.	1 no. each.
137.	Edge flow meter	Edge flow meter with digital display for sludge flow measurement with open impeller mud pump with tank, suitable structure to complete experimental set-up.	1 no.
138.	Flow control loop set with flow controller recorder, D.P. transmitter, receiver, unit control valve and impulse line, computer complete experimental set- up for flow measurement	DP transmitter, Auto- Manual PID controller (with three term facility), communication facility, control valve, I/P converter, S.S. sump tank, rotameter, circular chart recorder, SCADA software with necessary fitting to run the set up.	1 no.
139.	Experimental closed loop set up for solid flow measurement and Control with storage vessel, hopper, solid flow sensor, controller, Recorder and final control element	Microwave based Solid flow sensor, Hopper, collection tray, control valve, PID controller, electronic circuit chart recorder, current meter, and seamless data transfer unit. complete working set up mounted on suitable frame structure.	1 no.
140.	Coriolis mass flow meter	Coriolis mass flow meter with HART communication, output 4-20 mA along with sump Tank, Measuring Tank, Pump, and accessories with stand, seamless data transfer unit, mounted on suitable frame structure.	1 no.
141.	Flow nozzle	SS Flow nozzle flange Type, sump tank, measuring tank, pump, mercury manometer, mounted on suitable frame structure.	1 no.

Instrument Mechanic

142.	Flow Transmitter, Pneumatic	Transmitter output 0.2 to 1.0 Kg/cm ² , PID Scale for Set Point & Process, Input & Output 0.2 to 1.0 Kg/cm ² , Selectable Control Mode & Control Action, control valve works on 3 to 15 psi, SS orifice assembly, rotameter, air regulator, pressure gauge, sump tank, SS pump, stand with hardware fittings & electrical accessories	1 no.
143.	Level transmitter (interface) (HART/Field bus/profibus compatible)	Min. measuring range 1100 mm, SS sump tank, suitable measuring tank, S.S. pump, with hardware and fitting to understand level Interface measurement.	1no.each
144.	Level Transmitter, Pneumatic	Transmitter output 0.2 to 1.0 Kg/cm ² , PID Scale for Set Point & Process, Input & Output 0.2 to 1.0 Kg/cm ² , Selectable Control Mode & Control Action, control valve works on 3 to 15 psi, rotameter, air regulator, pressure gauge, sump tank & measuring tank, SS pump, stand with hardware fittings & electrical accessories	1 no.
145.	Paperless LCD/LED recorder setup	Min. 4 channels, RS 232 through RS 485 Converter Communication, heating and stirring for water bath, PID, 4 nos. of thermocouples, necessary wiring and fittings.	1 no.
146.	Strip chart and Pneumatic recorder both single and multi-point	Digital current source, air regulator, pressure gauge and temperature transducers, Pneumatic Chart Recorder Single Point & multi point 0-100 % range, input 3-15 psi, Electrical chart drive, zero adjustment, wall mounted, Electronic Strip Chart Recorder Single Point & multi point 0-100 % range, any one fix input for each channel RTD, Thermocouple or 4-20 mA,	1 no.

Instrument Mechanic

		All fitted on panel and stand, with electrical accessories.	
147.	Data acquisition system (DAS)	SS measuring tank, S.S. sump tank, S.S. pump, four type of transmitter (pressure, flow, temperature and level), with data acquisition module hardware as well as software.	1 no



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**INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING
DRAWING**

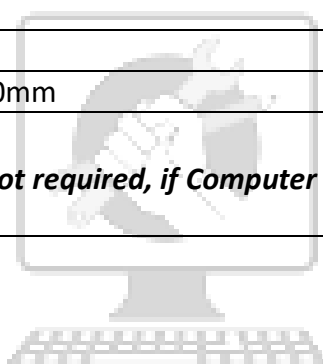
**TRADE: INSTRUMENT MECHANIC
LIST OF TOOLS& EQUIPMENTS FOR -20APPRENTICES**

1) **Space Norms** : 80 Sq. m. (For Engineering Drawing)

2) **Infrastructure:**

A : TRAINEES TOOL KIT:-			
Sl. No.	Name of the items	Specification	Quantity
1.	Draughtsman drawing instrument box		20+1 set
2.	Set square celluloid	45 (250 X 1.5 mm)	20+1 set
3.	Set square celluloid	30-60 (250 X 1.5 mm)	20+1 set
4.	Mini drafter		20+1 set
5.	Drawing board	700mm x500 mm IS: 1444	20+1 set
B : Furniture Required			
Sl. No.	Name of the items	Specification	Quantity
1.	Drawing Board		20
2.	Models : Solid & cut section		as required
3.	Drawing Table for trainees		as required
4.	Stool for trainees		as required
5.	Cupboard (big)		01
6.	White Board	size: 8ft. x 4ft.	01
7.	Trainer's Table		01
8.	Trainer's Chair		01

TOOLS & EQUIPMENTS FOR EMPLOYABILITY SKILLS		
Sl. No.	Name of the Equipment	Quantity
1.	Computer (PC) with latest configurations and Internet connection with standard operating system and standard word processor and worksheet software	10 Nos.
2.	UPS - 500VA	10 Nos.
3.	Scanner cum Printer	1 No.
4.	Computer Tables	10 Nos.
5.	Computer Chairs	20 Nos.
6.	LCD Projector	1 No.
7.	White Board 1200mm x 900mm	1 No.
Note: - Above Tools & Equipments not required, if Computer LAB is available in the institute.		



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FORMAT FOR INTERNAL ASSESSMENT

Name & Address of the Assessor :						Year of Enrollment :									
Name & Address of ITI (Govt./Pvt.) :						Date of Assessment :									
Name & Address of the Industry :						Assessment location: Industry / ITI									
Trade Name :			Semester:			Duration of the Trade/course:									
Learning Outcome:															
Sl. No	Candidate Name	Father's/Mother's Name	Maximum Marks (Total 100 Marks)	15	5	10	5	10	10	5	10	15	15	Total internal assessment Marks	Result (Y/N)
				Safety consciousness	Workplace hygiene	Attendance/ Punctuality	Ability to follow Manuals/ Written instructions	Application of Knowledge	Skills to handle tools & equipment	Economical use of materials	Speed in doing work	Quality in workmanship	VIVA		
1															
2															