

**TRADE COMMITTEE MEMBERS FOR REVISION OF THE SYLLABUS FOR THE  
TRADE OF INSTRUMENT MECHANIC**

1. Shri S.C.Desai : Chaman  
Regional Director  
RDAT, Barodair
2. Shri R.Bharadwaj : Member  
Chief Instrument Manager,  
Gujarat Refineries, Baroda
3. Shri V.Y.Sane : Member  
Head of the Deptt. ( Elect. Engg. )  
M.S.Polytechnic, Baroda
4. Shri J.R.Deo : Member  
Plant Manager ( Instrument )  
G.S.F.C., Baroda
5. Shri. D.B.Choudhari : Member  
Plant Manager ( Instrument )  
Petrofiles Co-Op Ltd.,Baroda
6. Shri A.N.Shah : Member  
Manager Maintenance ( Elect. & Maint. )  
Gujarat Industrial Power  
Company Ltd.,Baroda
7. Shri M.L.Koli : Member  
Training Officer  
ATI, Mumbai
8. Shri K.V.Rao : Member  
Training Officer ( AVTS )  
ITI, Baroda

**REVIEW COMMITTEE MEMBERS FOR REVISION OF THE SYLLABUS FOR  
THE TRADE OF INSTRUMENT MECHANIC**

1. Shri S.R. Majumdar : Chairman  
Director,  
CSTARI, Calcutta
2. Shri K.P.Chattopadhyay : Member  
Jt. Director  
CSTARI, Calcutta
3. Shri P.K. Bhattacharyya : Member  
Officer Instrumentation  
Hindustan Lever Limited
4. Shri K.V. Rao : Member  
Training Officer ( AVTS )  
ITI, Baroda
5. Shri S.P. Chatterjee : Member  
Dy. Director  
CSTARI, Calcutta
6. Shri S.N.S. Rahi : Member  
Asstt. Director  
CSTARI, Calcutta
7. Shri S. Bhattacharyya : Member  
Training Officer  
CSTARI, Calcutta
8. Shri A.K.Neogy : Member  
Training Officer  
CSTARI, Calcutta

## GENERAL INFORMATION

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|--|---|
| 1. Name of the Trade                   | : INSTRUMENT<br>MECHANIC  |
| 2. N.C.O. Code No.                     | : 841.15  |
| 3. Duration of Craftsman Training      | : Two Years   |
| 4. Duration of Apprenticeship Training | : Three Years Including two Year's Basic Training   |
| 5. Entry Qualification                 | : Passed 10 <sup>th</sup> class Exam. under 10+2 System with Science or Physical Science as one of the Subject or its equivalent. |
| 6. Rebate in Training Period           | : Two Years for Passed out Craftsmen in the Trade of Instrument Mechanic.   |
| 7. Ratio of Apprentice to Workers      | : 1:3   |

### Syllabus for the Trade of Instrument Mechanic under Craftsmen Training Scheme Duration of Training : 2 Years

W e e k N o.	Practical	Theory	Engineering Drawing	Workshop Calculation & Science
1	2	3	4	5
1.	Introduction to Training. Familiarization with the Institute. Layout of shop equipment and machineries. Syllabus, system of Training, Examination, Types of work done by the trainees .Introduction to safety. To observe the Institutional Rules, discipline, Cleaning and forming those habits.	Introduction to the trade importance, safety precautions, First Aid, Importance of the Trade in the development of industrial economy, syllabus topics and course. Introduction to chemical handling, safety and hazards.	—	—
2	Bench Work. Filing practice, Balance of Pressure, Filing surface & sides and checking 90° by try square ( simple exercises involving filing & saving use of	Basic hand tools, Types, Classification use & metal cutting fundamentals.	Familiarization with the drawing equipment, Free hand sketching.	Basic Mathematics related to Workshop problems.

	vice.)			
3.	Simple filing exercises as per dimension up to an accuracy of $\pm 0.5$ mm. Marking Block, Out side & Inside Caliper, Try square, Surface Plate, Angle plate, “ V ” Block.	Measurements & measuring Instruments. Marking tools, Fasteners & Fastening devices.	Types of lines & its use Dimensioning Method, Geometrical drawing, angles, triangles, circle, square, Rectangle, Rhombus, Parallelogram, Pentagon, Hexagon, Heptagon, Regular Polygon.	Review of Fundamentals of Algebra & trigonometry.
4.	Filing exercises involving “V” groove, square groove, radius (inside & outside) up to an accuracy of $\pm 0.2$ mm. Marking & Measuring with the help of Vernier Caliper, Vernier Height Gauge, depth gauge, Micrometers & Radius Gauge.	Precision Measuring Instruments.	-- Do --	Properties & use of cast iron, wrought iron, plain carbon steel, high carbon steel and alloy steel.
5.	Simple fitting exercises involving angular, curved and regular surfaces up to an accuracy of $\pm 0.1$ mm. Marking & measurement with combination set, Vernier Bevel Protractor and other precision Instruments. Template filing. Use sine bar.	Elements & types of screw threads used in Instruments, Calculation of drill size for tapping.	Geometrical drawing of ellipse, oval etc. Free hand sketch of hand tools.	Applied workshop problems.
6.	Drilling precision holes with bench/pillar drilling Machines and reaming. External & Internal Thread cutting with the help of Taps & Dies.	Drills & drilling, Taps & Tappings, dies & Dieing, Lubricants. Basic Hand Tools such as screw drivers, Pliers, spanners.	Lettering both capital & small letters.	Logarithms, use of logarithmic tables for multiplication and division.
7.	Straightening of tube, bending and flaring of tube connection of tube with straight & other couplers. Flare & Ferrule fittings. Checking leakage, Use of Jigs & fixture etc.	Types of pipes used for instrumentation. Tube cutter, flaring tools, swedging tools, equipments & fixtures required for pipe bending, straightening, thread cutting, method of Installation.	Lettering numbers.	Mensuration – area of rectangle, square, triangle, circle, regular polygons etc.
8. to 10.	Lathe Work. Familiarization with the lathe & its accessories, chuck mounting, fixing lathe tools. Plain turning holding the job on lathe	Introduction & function of lathe. Main accessories. Fixing of lathe tools &	Isometric & oblique view of various jobs. Simple	Calculation on volume & weights of solid & hollow

	<p>chuck step turning, grooving, knurling and taper turning, thread cutting &amp; drilling. Holding work between centres &amp; turning with an accuracy of <math>\pm 0.04</math> mm. Grinding of Lathe tools</p>	<p>precautions. Fixing chuck. Taper turning &amp; its calculation. Cutting fluids, cutting speed &amp; feed etc. Introduction of thread cutting on lathe. Calculation of gear train for thread cutting. Drilling on Lathe-method &amp; precautions to be taken. Method to grind lathe tools &amp; precautions to be taken.</p>	<p>orthographic projection of 1<sup>st</sup> angle and 3<sup>rd</sup> angle.</p>	<p>bodies. C.G.S. &amp; M.K.S. system of units of force, weight etc. Defining work, power energy, torque. Laws of conservation of energy, Forms of energy, Kinetic energy &amp; Potential energy.</p>
11 to 15.	<p>Mechanical Measuring (Metrology). Practice on using specific purpose gauges such as Plug, Ring, Snap, Feeler, Screw pitch, go &amp; no go, Dial indicators, Measuring Microscope. Use gauge block directly or with the assistance of some form of comparator, such as Mechanical, electrical, pneumatic and optical flats, monochromatic light sources. Making small instrument parts with an accuracy of <math>\pm 0.02</math> mm.</p>	<p>Fundamental methods of measurement, Direct comparison, using a calibrated system Generalized measuring system. Stages of the generalized measuring system. Calibration standards, dimensions and units of measurements. Certainty/uncertainty, validity of result.</p> <p>Measuring System Response. Introduction, amplitude response, frequency response, Phase response, Delay, rise time and slew rate. Damping and its importance.</p> <p>Standards of Measurements. The Metric system, Base &amp; supplementary units, Derived Units, Multiplying factors standards of lengths, mass, time and frequency. Electronic oscillators, Temperature and electrical units.</p>	<p>Orthographic projection, 1<sup>st</sup> angle &amp; 3<sup>rd</sup> angle.</p>	<p>Forces &amp; motion, Sources of forces, applied to stationary objects. Acceleration, Newton's laws of motion. Lever, classes of lever, Wheel &amp; Axle, Gear train, Inclined plane the wedge, Mechanical advantages. Cam &amp; follower device, Sector &amp; Pinion, Race Pinion, Screw Jack, Pulley &amp; Pulley system. Various motion transfer mechanisms.</p> <p>Problems on measurements, power, energy, force.</p> <p>Problems on Moments.</p>

		<p>Treatment of Uncertainties. Introduction, Nomenclature such as data, error, accuracy precision, resolution, sensitivity, uncertainty dead band, dead zone, deviation etc. classification of errors, systematic errors, systematic errors, systematic, random and illegitimate errors.</p> <p>Displacement and Dimensional Measurement. Introduction, Classification of displacement. Measuring devices, low, medium and high resolution devices, gauge blocks, surface plate, use of comparators, pneumatic comparators, optical methods, monochromatic light, optical flats, the interfero meter, measuring microscopes, feeler microscopes, fixed scale microscopes, traveling microscopes, draw-tube microscopes.</p>		<p>Problems on acceleration speed.</p>
	<p>Practice on making unbounded wire type strain gauges and measuring strain in terms of resistances.</p>	<p>Stress and strain Measurement. Introduction, strain measurement, electrical type strain gauge, electrical resistance type strain gauge bonded wire strain gauge, load</p>		

	<p>Dismantling assembling, repairing and testing of Vibrometer &amp; Accelerometer. Study of Seismic Instruments.</p> <p>Constructional details, repairing and testing of microphones.</p>	<p>cell unbonded resistance type gauge, foil strain gauge, semiconductor gauge, metallic resistance gauge and its application.</p> <p>Measurement of Motion. Sensing element of vibrometers and accelerometers, seismic instrument, measurement of velocity with seismic instrument, vibration &amp; shock testing.</p> <p>Measurement of Sound. Basic acoustical parameters, sound pressure, sound pressure level, microphones, sound level meter.</p>		
16 to 18	<p><b>Optical Instruments.</b> Introduction to optical instruments. Dismantling, assembling, cleaning, fault finding, repairing, checking &amp; testing of Monocular, Telescope, Microscope, Theodolite, Dumpy Level, Camera.</p>	<p>Optics, Various Laws, formation of image, lenses &amp; prism.</p> <p>Description, working principle and use of the instruments mentioned in practical. Testing &amp; correct functioning of the Instruments.</p>	--- do ---	<p>Non ferrous metals- manufacturing processes, properties, application and selection criterion.</p>
19.	<p><b>Basic Electricity.</b> Introduction to fundamental of electricity, Generation of electricity by friction, Identifying +ve &amp; -ve polarities. Identifying and use of various electrical components, their symbols. Measuring current voltage &amp; resistance. Resistance measurement by colour code. Resistance in series &amp; parallel.</p>	<p>Introduction to electricity. Static electricity and current electricity. Magnetism, current, voltage, P.D., E.M.F., resistance, electrical components, conductors &amp; insulators. Electrical circuits. D.C. and A.C. circuits. Importance of earth and grounding.</p>	Blue print reading.	<p>Problems on friction.</p>
20.	<p>Tracing of magnetic field. making series &amp; parallel ckt. Verification of ohm's law .verification of kirchhoff's law. Cells in series &amp; parallel &amp; mixed combination.</p>	<p>Electromagnets &amp; its polarity. Solenoid series &amp; parallel ckt. Ohm's law &amp; kirchhoff's law calculation. Primary and secondary cells (liquid</p>	Sectional views.	<p>Electrical units in M.K.S. system . calculation of specific resistance.</p>

21.	Measuring capacitance with test bridge. (L.C.R. bridge) Capacitors in series & parallel. Verification of R-L-C ckts. Resonance effect.	& dry) their connections. D.C. circuits.  Various types of capacitors, principles of alternating current, AC & DC electricity, wave forms, frequency, peak values, average values, effective values, impedance, capacitive reactance, inductive reactance, Faraday's law.	---do---	Problems on kirchhoff's law.  ---do---
22.	Experiments on electromagnetic induction. Static testing of electrical components. Voltage divider ckts.	A.C. circuits, resistance in A.C. ckts. Induction & inductance. Self and mutual induction.	Electrical symbols and drawing electrical circuits as IS : 1248.	Composition, properties & uses of non-ferrous alloys.
23.	Experiments on transformers. Measuring current & voltage in primary and secondary winding. Testing auto transformers in its various tappings. Care and maintenance & connection of auto transformer.	Transformers, its cores, transformation ratio. Auto transformer. Current measurement. Instrument transformer. Demagnetizing current & potential transformers.	---do---	---do---
24.	Simple exercises on soldering. Soldering by temperature controlled soldering station. Soldering of various components in vero boards.	Definition and purpose of soldering. Soft soldering . types of soldering irons. Solder & flux. Care & precaution of soldering.	---do---	Simple problems based on AC fundamentals, calculation of periodic time, frequency, wave length, average value, RMS value.
25. to 32.	Electrical measurement & measuring instruments. Familiarisation with the construction of M.I. & M.C.(PMMC) instruments.	Principal of "D" Arsonval meter. The "D" Arsonval movement, working methods, moving coil	Diagram & sketches of electrical measuring instruments, viz,	Calculations on extension of instrument range.



<p>Overhauling &amp; testing of voltmeters &amp; ammeters.</p> <p>Testing &amp; calibration of ammeters &amp; voltmeters of various types.</p> <p>Making shunt of various ranges of ammeters. Making multipliers for different ranges of instrument range.</p> <p>Familiarization with the construction of M.C.(dynamometer type) instruments, overhauling and calibration of dynamometer Type instruments. Measurement of power by wattmeter &amp; calibration of wattmeter.</p> <p>Use of ohm meter ,calibration of ohm meter , use of megger.</p> <p>Familiarisation with the construction of ampere hour meter overhauling and calibration of ampere hour meter.</p> <p>Measurement of three phase and single phase power by voltmeter &amp; ammeter. Overhauling and calibration of KWH meter (energy meter)</p> <p>Practical on frequency meter and power factor meters. R,L,C measurement.</p>	<p>damping, magnetic shielding, parallax error, measurement value, shunt construction &amp; connections, voltage measurements, instrument sensitivity, meter accuracy, changing meter range.</p> <p><b>D.C. instrument.</b> Using a DC ammeter, extending the DC meter range. Selecting a meter, accuracy, sensitivity, connection of voltmeter. Using DC voltmeter.</p> <p><b>Measuring electrical resistance.</b> Ohm meter, operating principles, calibration, using ohm meter, details of megger.</p> <p>AC instruments. Principal of moving iron meters, damping methods, application of moving iron meters, uses of electro dynamometers, AC meters rectifiers, instruments etc.</p> <p><b>Power measuring Instruments.</b> Electro dynamometer, watt meter, thermal watt meters, Wattmeter rating, measuring three phase power, Watt Hour meter, reading a Wattmeter, demand meter, power factor meter, operating factors. Ampere hour meter &amp;</p>	<p>all types of moving coil instruments.</p>	<p>Problems on cells in series, parallel and mixed combinations.</p> <p>RLC calculations, capacitors in series and parallel.</p>
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	<p>Using phase sequence meter &amp; synchroscope.</p> <p>Using oscilloscope for voltage &amp; wave form measurement</p>	<p>energy meter.</p> <p><b>Special instruments.</b> The multimeter, bridge circuits, wheat stone bridge, inductance bridge, voltage tester , continuity tester, Rotation tester, phase sequence in dicator, synchronizing, the synchroscope, frequency meter.</p> <p><b>Indicating Instruments.</b> of terms, the voltmeter, the oscilloscope, connection of electronic Instruments.</p>		<p>Calculations on the cost of repairing/reconditioning of electrical instruments.</p> <p>Problems on electro magnetic induction, transformers.</p>
33 to 45.	<p>Industrial Electronics. Identification of various types of diodes (solid state) ,checking of diodes. Verification the characteristic of diode, use of LEDs &amp; seven segment displays.</p> <p>Identification of transistors, checking of transistors, Verification the characteristic of transistor for all three configuration, I .e., common base, common emitter, common collector.</p> <p>Layout of component and preparation of P.C.B.'s surface mounting device(smd) soldering and desoldering practice.</p>	<p>Semiconductors . introduction to semiconductor, semiconductor diodes , semiconductor, materials, doping semiconductor, junction diodes biasing diodes , diode characteristic, power dissipation , special semiconductor diodes.</p> <p><b>TRANSISTOR.</b> Defining transistor, NPN&amp;PNP transistor, bipolar transistor, operation current gain , voltage gain, and power gain field effect transistor comparison transistor and triodes.</p> <p><b>Printed circuit board.</b> Definition ,materials for board and conductor, single sided pc boards mounting components, conformal coatings, pc board connector ,pc mounting assemblies, tools for repairing pc</p>		<p>Problem of transistor</p>

	<p>Making half-wave &amp; full-wave rectifiers, center tap &amp; bridge type. Study of ripple factor in half wave &amp; full wave rectifier with various filter circuits.</p>	<p>assemblies, exposed to multilayer PCBs.</p> <p><b>Integrated circuit</b>          .Development of ICs, how ICs are made, types of ICs, linear ICs, digital ICs, family of digital ICs, combining analog and digital.</p> <p><b>How to Recognise &amp; Replace semiconductor packages.</b>          Semiconductor packaging identifying leads, manufacturers, data sheet substituting components, chassis mounted component, sockets, tools techniques.</p> <p><b>Rectifiers</b> .Diode rectifiers, Half wave rectifier, full rectifiers Bridge rectifiers, three phase Y full wave and half wave rectifiers, Voltage multiplier circuits diodes rating, parallel and series diodes silicon controlled rectifiers, Diac, Triac, Triggering.</p> <p><b>Filters</b>. Introduction, purpose and use ripple, filter circuit components, capacitance filter, Inductance filters, RC filters, LC filters, voltage dividers and by pass filters.</p> <p><b>Voltage Regulators</b>. Introduction &amp; purpose, shunt regulators, series regulators, IC regulators, switching regulators.</p>	<p>Drawing circuit diagrams of various transistors.</p> <p>Drawing of circuit diagram of rectifier circuit.</p>	<p>Batteries, types construction &amp; applications.</p> <p>Types of fuses, selection and application.</p>
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<p>Assembling of a power supply unit. Trouble shooting of power supply units.</p> <p>To hook up transistor amplifiers &amp; determine their characteristics.</p> <p>Study of FET amplifier. Study of class “A”. class “B” and class “AB” amplifiers.</p> <p>Amplifier performance and multistage amplifiers. Trouble shooting of amplifiers.</p> <p>Use of differential amplifier. Operational amplifier. Study of operational integrator.</p>	<p><b>Power supplies.</b> Introduction, purpose &amp; use. Types of power suppliers, Galvanic cells, DC to AC, DC to DC, AC to AC, AC to DC, UPS and SMPS, battery backup application.</p> <p>Amplifier. Introduction, amplifier, characteristics, transistor amplifiers, characteristics curves, output –input characteristics curves, effect of temperature, operational amplifier and switching amplifiers.</p> <p><b>Single Stage Amplifiers.</b> Allowing operating region, operating points and load lines, operating points stability, biasing circuit, biasing amplifier. FET amplifiers, classifying amplifiers and their operation.</p> <p><b>Multistage amplifiers.</b> Amplifier performance, power gain ,current gain, voltage gain , amplifier efficiency, distortion, maximum power transfer, multistage amplifier couplings, capacitance coupling, transformer coupling and direct coupling amplifier.</p> <p><b>Operational Amplifier.</b> Differential amplifier, differential amplifier</p>	<p>Sketching of different power supply units.</p> <p>Drawing circuit diagram of various types of amplifier.</p> <p>Drawing characteristic curves of single stage amplifier.</p> <p>Drawing multistage amplifiers.</p>	<p>Connectors, sockets, cables, signal connectors, power supply cables.</p> <p>Problems on half wave and full wave rectifiers.</p> <p>Problems on voltage gain power gain of various amplifiers.</p> <p>Examples on voltage gain of RC coupled and transformer coupled amplifier.</p>
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	<p>Study of oscillator as mentioned in theory column.</p> <p>Study of invertors and convertors.</p> <p>Study of multivibrator.</p> <p>Verification of gates, flip-floops etc. study logic ckts. Of all types (address, subtractor, multiplexer, demultiplexer etc.) perform practical on trainers kit or trainer.</p>	<p>with feed back , and ideal opamp, inverting amplifier, virtual ground and summing junction , operational summer, non-in-verting amplifier, operational integrators, and special operational circuits.</p> <p><b>Oscillators and Multivibrators.</b> Oscillators, Oscillators, Oscillators and amplifiers, oscillation and amplifiers. Frequency talk circuits, crystal controlled, armstrong oscillators, RC phase shift oscillators, colpitt, clap, hartely, and IC oscillators.</p> <p><b>Invertors and Convertors.</b> Types of power conversion system, inverter and convertor application, static inverter and convertor, basic magnetic, single transformer invertors, dual transformer invertors, driven invertors, SCR inverter and convertors.</p> <p><b>Multivibrators.</b> Switching circuit, types of multivibrators, astable &amp; monostable, bistable multivibrator, dual trigger flipflop.</p> <p><b>Logic circuits.</b> basic digital ICs, digital logic, Boolean algebra, logical AND, OR , NOT function ,digital application logic state logic switches, positive</p>	<p>Drawing circuit diagram of operational amplifiers.</p> <p>Drawing circuit diagram of various oscillators.</p> <p>Drawing the sketches of different types of gates &amp; logic symbols. Drawing the circuit conventions.</p>	<p>Calculation on negative feedback amplifier, zero decibels and reference level.</p> <p>Problems on oscillators.</p> <p>Simple calculation on multivibrator.</p>
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	<p>Study of signal and control cables, screen cables shield.</p> <p><b>Microprocessors.</b> Practical on microprocessor training kits and trainers applicable to process control instrumentation.</p>	<p>and negative logic, logic symbol conversions, NAND, NOR, Ex-OR, Ex-NOR logic, combining logic circuits, IC logic devices, numeration system, binary coded decimal(BAD), ASCII, grey code, Boolean logic and algebra.</p> <p><b>Logical building bloks.</b> Sequential logic, flip-flops, clocked flip-flops, clock circuits, Schmitt triggers, frequency divider, pules , counter number system.</p> <p><b>Functional counting system.</b> General logic system and subsystems ROM logic, logic subsystem, microprocessors, I/O subsystem, multiple bit devices, data transfer. Introduction to explosion proof, intrinsically safe, zener barriers, weather profners, junction boxes, cable glands, terminators etc.</p> <p>Introduction to computers &amp; micro controllers, purpose and use.</p>	<p>Drawing the block diagram of different microprocessor &amp; computer system.</p>	<p>Conversion of binary to decimal and decimal to binary, octal to decimal and decimal to octal, binary to hexadecimal &amp; hexadecimal to binary. Boolean algebra. Karnaugh</p>
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		<p><b>Computer Hardware.</b>  Computer systems, computer hardware, CPU , CPU operations, fast memory, core memory, ROMs and RAMs, characteristic of ROMs and RAMs. I/P and O/P and peripheral equipments, mass memory, terminals, operator console, printers, MODEMs, Data interface, ADC and DAC. Exposer to EPROM, EPROM and Bipolar PROM. Introduction to languages.</p>		<p>maps, addition, subtraction.  Preparation of truth table.  Calculation on the to repair/reconditi on of Electronic Instruments &amp; Microprocessor s.</p>
		<p><b>Computers and Microprocessors.</b>  Microprocessors define. Microprocessor characteristics, Physical properties, Instructions set, Microprocessors types, Micro computers.</p> <p><b>Microprocessors Applications.</b>  Microprocessor revolution, categories of applications, logic replacement systems, Industrial applications.</p>		
		<p><b>How Microprocessor Functions.</b>  Microprocessor structure, BUS structure, Memory device, Input out devices, computer languages, Examining application input out put devices, Digital I/O dev-ices, Analog I/O device-</p>	<p>Drawing the block diagram of data acquisition system.</p>	

		s, Analog I/O devices, data acquisition system.		
54.	<p><b>Fundamentals of Measuring Instruments &amp; Systems.</b>  Practical on Instrumentation Trainer/simulator (real type) and also computerized Instrumentation simulator (package type, Real system and computerized system can be interfaced).</p>	<p><b>Introduction to Process Measurement.</b>  The purpose of process measurement, measurement requirement, uses of measurement, Display requirement, Remote vs. local display, Errors in measurement systems, calibration, noise, response time, measurement system, deterioration, Errors of observation, transmitters, pr-proportionality.</p>	<p>Drawing the block diagram.  Diagrams of process instrumentation systems.</p>	<p>Calculation on the cost to repair/reconditi on process control systems with field mounted, panel mounted and control room mounted.</p>

		<p><b>Basic Process Measurement systems.</b>  System elements interact, translating the measurement, communication, electrical vs. pneumatic output from analog to digital and back, interpreting the output, typical application.</p> <p><b>Principle of Transducer operation.</b>  Signal measurement and transmission, matching the transducer to the application, kids of output, transducer elements, mechanical and electrical element, the nature of pneumatic response, relating distorstion to pressure, the nature of electrical</p>	<p>Free and sketches of the elements of measuring devices.</p>	
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		response, combining effects.		
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	<p><b>Speed and R.P.M. Measurement.</b>Overhauling and Testing of Speedometers and Tachometers.</p> <p><b>Pressure Measurement.</b> Practical on various Pressure sensors and pressure gauges.Repairing,fault finding,Testing &amp; calibration with dead weight tester and manometers.</p> <p>Perform practical on pressure simulator or experimental setup(real &amp; Package type).Pressure transmitters ( SMART &amp; INTELLIGENT TYPE )</p>	<p><b>System Standards and Instruments Calibration.</b> Interpreting specifications accuracy the importance of precision, resolution, transfer function and sensitivity, units of measure, SI units, English unit, calibration laboratory.</p> <p>Introduction to computer in Instrumentation.</p> <p>Fundamentals and use of computerized Instrumentation simulator.</p> <p><b>Speedo Meters &amp;Tachometers.</b>Description, working principle,use,calibration and testing of various types of speedo meters and Tachometers.</p> <p><b>Principle of Pressure in Liquids &amp; Gases.</b> Properties of matter,Principles of liquid pressure,units of pressure Liquids pressure and volume,density and specific gravity.Factors affecting liquid pressure.Gauge pressure and absolute pressure,liquid pressure measurements,gas pressure and temperature relation,temperature &amp; volume relation.Atmospheric pressure,pressure and flow,using pressure to measure flow,Manometers.</p> <p><b>Pressure Sensors.</b>Function</p>	<p>Free hand sketches of the parts of Tachometers &amp; Speedometers.</p> <p>Free hand sketches of pressure sensors &amp; transmitters.</p> <p>Schematic diagrams of</p>	<p>Calculation on the cost to repair/reconditioning Speedometers &amp; Tachometers.</p> <p>Problems on liquid pressure and gas pressure.</p> <p>Bending, Twisting and shearing</p>
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		<p>of measuring instruments, Bourdon tube sensors, other Bourdon tube shapes, Bourdon tube metals, diaphragm pressure sensors, Capsule diaphragm element, Bellows pressure sensors, Dead weight tester, Pressure switch transducers and its calibration.</p> <p><b>Pressure Transducers.</b> Introduction to pr. Sensing instruments, method of conversion, potentiometric pr. Transducers, Capacitive pr. Transducers, reluctance, servo pressure transducers, strain guage pressure transducers, piezo-electric pressure transducer. SMART &amp; INTELLIGENT type pressure transducer.</p> <p><b>Low Pressure Measurement.</b> Vacuum, low pressure, units of low pr. Measurement, method of conversion, gauges, thermal conductivity gauges, pirani gauges, thermocouple gauge, slack diaphragm gauge, ionization gauge, McLeod gauge, capacitance manometer.</p> <p><b>Pressure Instrument Installation &amp; servicing.</b> Elements of pressure transmitters, Installation components, pressure taps, isolation valve, instrument piping, connections and fittings blow down valve, instrument valve, pulsation damper (snubber), diaphragm seal, pressure transmitter, Installation, proce</p>	<p>transducers.</p>	<p>moments. Stress, Strain and Young modulus. Calculation on the cost of repair/reconditioning pressure measuring instruments.</p>
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		dure,locating and mounting,piping,electrical wiring placing into service,guidelines for periodic maintenance,troubleshooting and repair,instrument shop safety.		
68 to 73.	<p><b>Flow Measurement.</b>Checking various types of flow restrictors ( orifice,ventury,flow nozzle and use. )</p> <p>Dismantling,checking overhauling and calibration of D.P. cell/transmitter.</p> <p><b>Rotameter :</b> Fitting of tapered glass tube,checking &amp; testing.</p>	<p><b>Properties of Fluid Flow.</b> Basic properties of fluids,fluids in motion,getting fluids to flow,way of indicating fluid flow rate,factors affectinf flow rate,Reynolds number.</p> <p><b>Primary Measuring Devices.</b> Flow classification,flow measurement methods,flow measurement in completely filled pipes,restricting the flow,the orifice plate,orifice plate design features,special features of orifice plates,orifice plate fittings,the flow nozzle,the ventury location pipe taps,straight pipe requirement. Secondary Measuring Devices. Secondary Measuring devices,basic manometer design,reading the meniscus accuracy,float type mercury manometer.Target meter,the elbow mounted measuring devices,the pitot tube devices.</p> <p><b>Variable Area Instruments.</b> The rotameter,reading a rotameter,factors affecting rotameter performance,measuring gas and liquid flow,specific gravity,presure and temperature,liquid-to-gas conversions,float shapes,special use of</p>	<p>Free hand sketches of the parts of flow measuring instruments.</p> <p>Drawing of various symbols,notations ,colour coding,used in instrumentation.</p>	

	<p>Practical on open channel flow device.</p> <p>Practical on piston meter.</p> <p>Practical on turbine flow meter,quality type flow meter,impeller type flow meter,magnetic flow meter.</p> <p>Fitting &amp; Testing of correct functioning on vortex meter and mass flow meter.</p> <p>Perform practical on Flow simulator ( transparent double tank type ).</p> <p><b>Installation and</b></p>	<p>rotameter.</p> <p><b>Open Channel flow Devices.</b> Principle of open channel flow,the weir,shapes of notches,choice of notch shape,design of a weir,weir plate,precautions,weir maintenance,calculating flow rates,rectangular notch,still water,moving water,cippoletti notch,using nomo-graphs to calculate flow,flumes(parshall flame),flume terminology,flume uses,flume maintenance.</p> <p><b>Flow Measurement-II Positive Displacement Meters.</b> Advantages and disadvantages of positive displacement meters,the piston meter,the reciprocating piston meter,the oscillating piston meter,the rotating vane mater,nutating disk mater,lobed impeller and oval flow meters,the dry gas bellows meter,calibrating positive displacement meters the target flowmeter.</p> <p><b>Turbine and Magnetic Flow Meters.</b> Turbine flow meters- components and operating principles,turbine flow meter construction,magnetic pick ups and readout instruments,types of turbine flow meters,installation of turbine flow meters,Advantages and disadvantages of turbine meters.Magnetic flow meters,principle of operation,construction of magnetic flow meter,output installation tips,advantages and disadvantages.</p> <p><b>Other Fluid Flow Meters.</b></p>	<p>Drawing of various flow restrictors.</p>	
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	<p><b>Maintenance of Flow Instruments.</b> Components for flow measurement system, primary flow elements, pressure taps, piping and fitting valve, DP transmitter, miscellaneous items. Installation of the flow measurement system, pressure taps installation, Instrument piping installation, electrical hookup, the final step, level measurement installation, maintenance, precautions, preventive maintenance, calibration, a DP instrument calibration procedure as mentioned in the theory.</p>	<p>Vortex precision meters, output systems for vortex precision meters, feature of vortex precision meter, vortex shedding meters, Coriolis mass flow meter, thermal flow meters, summary basics of ultrasonic flow meters. The Doppler shift method. The beam deflection method, the frequency difference method, characteristics of ultrasonic flow meters. Metering the flow of solid particles. Measuring volumetric and mass flow rate of solids, volumetric solids flowmeter, mass flowmeter for solids, belt-type solid meters belt speed sensing and signal processing, slurries, constant weight feeders.</p>		
74. to 77	<p><b>Measurement of level.</b> Performing practical on level measurements, i.e., experimental set up for level measurements/process simulator of level measurement (real type, transparent double tank type, computerized package type). Calibration of level transmitters.</p> <p><b>Level instrument servicing.</b> Introduction to instrument servicing. Maintenance, repair and control.</p> <p>Servicing level instruments,</p>	<p><b>Principle of level measurement.</b> Measuring liquid level, surface sensing gauges, storage tank gauges, sight glasses, magnetic gauges, buoyancy, displacement gauges, level switches, mercury level switches, level switches in high pressure tank, level detectors, magnetic reed switches.</p> <p><b>Pressure head instruments.</b> Hydrostatic pressure, specific gravity, pressurized fluids, pressure head instrumentation, air bellows, U-tube manometers, air purge systems, liquid purge systems, force balance diaphragm system.</p> <p><b>Electrical method.</b></p>	Drawing free hand sketches of the parts of level measuring instruments.	Drawing the

	<p>in the field, gauge glasses, float actuated instruments, displacer level gauges, pressure head instruments, servicing level instruments, in the shop. Shop repairing and calibration facilities, trouble shooting, reading flow diagram.</p>	<p>Conductivity and capacitance method for measuring the liquid level, capacitance probes, zero and span adjustments, sonic level detectors, radiation level detectors, point level detection.</p> <p><b>Solid level measurement.</b> Using weight to determine level, sonic solid level measurement with microwaves, using capacitance probes to measure solid level, diaphragm switches, automatic bin fillers, tilt switches, rotating paddle detector, nuclear gauges, sonic and micro wave solid level detectors.</p>	<p>circuit diagram of various level measuring systems.</p>	
78 to 81	<p><b>Temperature measurement.</b> Performing practical on temperature measurement with different sensors as in the theory part, in the temperature controlled oil bath/muffle furnace/electrical furnace. Practical on various thermocouples, RTDs and pyrometers.</p> <p><b>Temperature instrument maintenance and calibration.</b> Primary calibration standards, primary standard instruments, secondary standard instruments, instrument inspection, controlled temperature environments, using triple-point baths, other fixed points, temperature</p>	<p><b>Temperature Measurement.</b> Temperature, heat, specific heat, changing physical state, Fahrenheit and Celsius temperature scales, Rankine and Kelvin scales, calibration of temperature scales, primary &amp; secondary standards. Industrial applications of temperature measuring instruments with compensation link &amp; precautions to be taken.</p> <p><b>Bimetallic and Fluid-filled Temperature Instruments.</b> Bimetallic thermometers, liquid-in- glass thermometer, filled system thermometers, thermometer bulbs, types of thermometer bulbs, capillary &amp; Bourdon tubes, temp. transmitters for filled system, advantages &amp; disadvantages of filled systems.</p> <p><b>Electrical Temperature</b></p>	<p>Drawing the sketches of various types of filled system thermometers.</p> <p>Drawing the sketches of various temperature sensors and compensating systems.</p>	<p>Problems on temperature.</p> <p>Calculation on</p>

	<p>references, calibration and testing methods. Perform practical on experimental setup/temperature simulator (real type and package type) for temperature measurements and controls.</p> <p><b>Recorders and Servicing.</b> Overhauling, checking, fault finding, repairing, testing of pneumatic, electrical/electronic recorders, (single point &amp; multipoints).</p> <p><b>Controllers.</b> Practical on PID controller trainer.</p>	<p><b>Instrument.</b> Resistance thermometer, how it works, RTD bridge circuits, lead wire error, RTD elements protecting wells for RTDs, advantages and disadvantages of RTDs, Thermistors, thermocouples, Extension wires, compensation for changes in reference junction temperature, construction of thermocouple junctions, advantages and disadvantages of thermocouples.</p> <p><b>Pyrometry.</b> Molecular activity and electromagnetic radiation, defining pyrometry, effects of emittance, effects of temperature, wave length and radiated energy, pyrometers and wavelengths, narrow band pyrometers, using of optical pyrometer, automatic optical pyrometer, broadband pyrometers, using broadband pyrometers, band pass pyrometers.</p> <p><b>Recorders.</b> Introduction to recorders. Construction, working principle, various parts, installation and use of pneumatic and electronic recorders. Quality of ink marking mechanism, types of charts chart mounting technique, chart driving system, signals and signal conditioning.</p> <p><b>Introduction to controllers.</b> Process variable and setpoint, analog controllers, digital controllers, control ranges and limits, controllers, control ranges and limits, control loop, measuring PV, amplifying signals, final control</p>	<p>Drawing the sketches of the optical and radiation pyrometers.</p> <p>Drawing the free hand sketches of the parts of recorders.</p> <p>Drawing schematic diagram of open loop and closed loop system.</p>	<p>the cost of repairing/reconditioning temp. measuring instruments.</p> <p>Calculation on the cost of repairing/reconditioning recorders.</p> <p>Calculation on the cost of repairing/reconditioning of controllers.</p>
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		elements, current proportioning, Hunting & its effect on the product.		
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	<p><b>Controller Features and Installation.</b> Optional controller feature, remote SP selection, Alarm reset control, dead band adjustments, Indicators, control installation, manuals, electrical noise, electrical noise sources, inadequate primary power, regulating primary power, electrical coupling, temperature effects.</p> <p>Study and use of DCS &amp; SCADA complete with communication system on process trainer.</p> <p>Exposures to distributed control system.</p>	<p><b>Types of Controllers and Their Operation.</b> Types of controller, range limit of controllers, on/off controllers, direct and reverse acting controllers, proportional controllers, current proportioning control, time proportioning control, position proportioning control, automatic/manual split control, pneumatic control. Adaptive, limiting and batch control, ratio control system and cascade control system.</p> <p>Scanning, (scannucators) and annunciators. Basic knowledge and communication protocol.</p> <p><b>Controller Models and Tuning.</b> Controller tuning, setting, controller modes, proportional mode, offset, integral mode, reset mode, derivative mode (rate), single mode controller, two mode controller, three mode controller, tuning the control loop, step-change-response method.</p>		
89 to 92.	<p><b>Basic Industrial Programmable Controllers.</b> Practical on programmable logic controller trainer.</p>	<p><b>Introduction to Programmable Controllers.</b> History of programmable controllers, general characteristics of programmable controllers, some limitation of PLCs, Methods of developing PLC Programmings.</p> <p>Input/Output Devices. Definition</p>	Drawing the schematic diagrams of programmable controllers.	Calculation on the cost to repair/recondition Programmable Controller.



	<p><b>Documentation, Start up &amp; Trouble Shooting.</b> Documentation, system start up. Routine and preventive maintenance, trouble shooting, debugging a problem areas, unreadable signals.</p> <p>Redundancy concept, application of PC &amp; PLC.</p>	<p>of input/output devices, I/O interface, input modules, output modules, input devices, Encoders, output devices, the opto-isolator, safety.</p> <p><b>Processing and Programming Functions.</b> The processor unit, the memory, memory organization, ladder diagrams, data logger, most used programming symbols, start, stop, station example, other programming symbol timers and counters, data manipulation instructions, alternate PLC symbols.</p>		
93 to 95.	<p><b>Final Control Elements.</b> Study of control valves/finl control elements, with VVVM, dyno type etc.</p> <p>Dismantling, fault finding, repairing, cleaning, reassembling and testing of control valves.</p> <p>Assembly of Control Valves. Piping tubing and fitting.</p>	<p><b>Final Control Elements in Process Loops.</b> Final control element, Actuators, load set point compensation, feed back loops, control variables, effects of disturbances on performance, parts of a final control sub-system, control signal, electric control signals, fluidic control signals.</p> <p><b>Electric Actuators.</b> Solenoids, solenoid operated valves, electric motors, DC motors, universal motors, three phase induction motors, single phase induction motors, stepper motors, relay system.</p> <p><b>Pneumatic and Hydraulic Actuators.</b> Pneumatic principles, effects of changing pressure, pressure/volume/temperature relationship, effects of changing temp. pneumatic actuators, diaphragm actuator, spring and springless actuators, direct and reverse acting actuator, piston actuator, positioners, hydraulic principles, effect of temperature, mechanical advantages, one way</p>	Drawing the various parts of control valves and actuators.	Control valve terminology with simple calculations. Calculation on the cost to repair/recondition control valves.

		<p>hydraulic system, two way hydraulic system, hydraulic fluid, Hydraulic maintenance.</p> <p><b>Control Valves.</b> Control valves functions and components.</p> <p>Types of control valves, globe valves, cage valves, butterfly valves, ball valves, sliding gate valves, diaphragm valves, split body valves, capacitive, inductive type valve, proximity switch, I/R switch, micro switch, limit switch, other control valves, control valve flow characteristics, inherent characteristics, mechanical considerations, selecting control valves, valve actuators, valve positioners.</p> <p><b>Control Elements</b></p> <p><b>Applications.</b> Feed water control system, How the feed water control system works, sequential valve control, control and block valves, applying relays in final control elements, relay logic in operation, automatic valve control, furnace control system, controllers and actuators, turbine control system, throttle and governor valves and actuators. Explain to CV accessories like I/P converters, valve positioners, air lockup, relay, quick exhaust valves, bypass relay, air filter regulator, different types of gland packings. Electrical actuators, pneumatic actuators and hydraulic actuators.</p>		
96 to 97.	<b>Basic hydraulics and pneumatics.</b> Practical on Hydraulic trainer.	<p><b>Basic Hydraulics :</b></p> <p><b>Principles of Hydraulics.</b> Fluid power and hydraulics, force, weight and mass, pressure, work, power, energy, incompressibility and non-diffusion, hydrostatic pressure, Pascal's law, transmission of fluid power, fluid flow in pipes, Bernoulli's principle, the effect of heat on</p>	Drawing the sketches of the components of hydraulic systems. Block diagram of hydraulic systems.	Simple calculation on hydraulics. Calculation of the cost of repairing/reconditioning hydraulic systems.

	<p>Continue practical on trainer.</p> <p>Dismantling and assembling of various valves.</p>	<p>liquids. A typical hydraulic power system.</p> <p><b>Hydraulic Fluids.</b> Functions of hydraulic fluids, physical properties, viscosity, viscosity index, viscosity and pressure, power point, fluid selection, component protection, chemical properties, system contamination, water, dissolve air, foaming, corrosion and rusting, types of hydraulic fluids.</p> <p><b>Directional Control Valves.</b> <b>Directional control valves.</b> classification, review of two way valves, globe, gage, plug, needle, ball, automatic two-way valves, check valves, pilot operated check valves, spool valves, two-way spool valves, three-way spool valves, controlling hydraulic motors, NO and Nc valves, holding valves, four and five way valves, rotary spool valves, schematicsymbols, flow ratings, accessories.</p>	<p>Drawing the sketches of valves and their parts.</p>	
<p><b>98 to 100.</b></p>	<p><b>Basic pneumatics.</b> Pneumatic systems, forces, weight and pressure.</p> <p>Practical on pneumatic training kits.</p> <p>Practical on air filter regulator.</p>	<p><b>Pneumatic Principles.</b> Mass, pressure, work and energy, compressibility, law of pneumatics, transmission of pneumatic fluid power, pneumatic leverage, air properties, air flow in pipe lines, viscosity of air pressure, Bernoulli's law, components of pneumatic power system.</p> <p><b>Primary Air Treatment.</b> Air treatment, preliminary filtering, relative humidity, effects of moisture, water removal, dew point, moisture separators, oil scrubbers, air dryers, ( deliaquescent and absorption types ) air receivers, using a nomograph to size a receiver.</p> <p><b>Secondary Air Treatment.</b></p>	<p>Drawing sketches of the components of pneumatic systems. Block diagram of pneumatic systems.</p>	<p>Simple calculation on pneumatics. Calculation of the cost of repairing/reconditioning pneumatic systems.</p>

	<p>Instrument pipes, schedules, pipe fittings, union, elbow, sockets, reducing sockets, straight coupling, instrument tube and tube fittings, copper tube and its fittings, air net fittings.</p> <p>Practical on pneumatic trainer.</p>	<p>Methods of treatment, contaminate separation, contaminate filtration, filter classification and rating, types of media, surface filters, depth filters, absorption filters, lubricating the air.</p> <p><b>Piping, Hoses and Fitting.</b> Requirement of piping, air flow, piping dimensions and safety factors, piping connections, compressed air piping applications, metallic tubing, tube bending and tube fittings, tube installation, non-metallic tubing hoses, hose fittings and couplings, hose installation.</p> <p><b>Pneumatic Cylinders.</b> Descriptions, double acting cylinders, single acting cylinders, two-piston cylinders, cylinder construction, variations in cylinder mounting, pneumatic cylinder selection, reading the performance charts, cushioning devices.</p>		
<b>101.</b>	<p><b>Analytical Instruments.</b> Exercises on pH meter, conductivity meter, gas chromatograph &amp; GLCs.</p>	<p><b>Analytical Instruments.</b> Exposure to basic analytical instruments. Types of electrodes used for pH measurements. Relation of pH &amp; mV. pH indicator and controllers. Analysis &amp; analysers. Gas analysers. Conductivity &amp; conductivity meters. Application of analyzer in industry. GLCs.</p>	Revision	Revision
<b>102.</b>	<p><b>Quality control &amp; Ecological Considerations.</b> Practicals for assuring quality products avoiding environmental pollution, preventing wastage of energy.</p>	<p><b>Quality Control.</b> Methods to be followed for assuring quality products, conservation of energy &amp; preventing pollution.</p>	-- do --	-- do --
<b>103.</b>	Industrial visit / Tour.	<p><b>Ecological consideration.</b> Methods to be followed to avoid environmental pollution.</p>		

104. **Examination Achievements.** Trainees will be able to
1. Make small instrument parts within an accuracy of  $\pm 0.02$  mm.
  2. Recondition pressure, temperature, level and flow measuring instruments.
  3. Recondition monocular, binocular, prismatic, compass, telescope, microscope, theodolite, dumpy level & single lens with view finder camera.
  4. Recondition ammeter, voltmeter, wattmeter and energymeter.
  5. Maintain process control instrumentation.
  6. Handle analytical instruments.

### **Social Studies**

The syllabus has already been approved and is same for all trades.

## **TRADE : INSTRUMENT MECHANIC**

### **LIST OF TOOLS AND EQUIPMENTS FOR A BATCH/ UNIT OF 16 TRAINEES**

SR.No.	ITEM	NUMBER
<b>TRAINEES TOOL KIT</b>		
1.	<b>STEEL RULE 150 MM (METRIC AND ENGLISH MARKING)</b>	<b>16 NOS.</b>
2.	<b>CALIPER OUTSIDE 100 MM</b>	<b>16 NOS.</b>
3.	<b>WATCH MAKER SCREW DRIVER ( SET OF SIX)</b>	<b>16 SET.</b>
4.	<b>PILER FLAT NOSE 100 MM</b>	<b>16 NOS.</b>
5.	<b>HAMMER BALL PAIN 250 GMS, WITH HANDLE</b>	<b>16 NOS.</b>
6.	<b>TWISE FINE POINT 125 MM</b>	<b>16 NOS.</b>
7.	<b>TWISE ORDINARY 125 MM</b>	<b>16 NOS.</b>
8.	<b>FILE HAND SMOOTH 200 MM</b>	<b>16 NOS.</b>
9.	<b>FILE HALF ROUND 2ND CUT 250 MM</b>	<b>16 NOS.</b>
10.	<b>FILE TRIANGULAR 2ND CUT 250 MM</b>	<b>16 NOS.</b>
11.	<b>FILE SQUARE 2ND CUT 150 MM</b>	<b>16 NOS.</b>
12.	<b>SCREW DRIVER SET OF 5 PIECES</b>	<b>16 SETS</b>

### **TOOL, MEASURING INSTRUMENTS & GENERAL SHOP OUTFIT FOR UNIT**

1.	<b>TRY SQUARE HARDENED BLADE 100 MM</b>	<b>4 NOS.</b>
2.	<b>SPRING DIVIDER 100 MM</b>	<b>4 NOS.</b>
3.	<b>NEON (PHASE) TESTER 230 VOLT</b>	<b>4 NOS.</b>
4.	<b>SWISS FILE, SET OF 12 NOS.</b>	<b>4 SETS</b>
5.	<b>EYE GLASS 3 " FOCUS WATCH MAKER</b>	<b>4 NOS.</b>
6.	<b>GOGGLES SAFETY</b>	<b>4 NOS.</b>
7.	<b>OIL CAN</b>	<b>2 NOS.</b>

8.*	<b>SURFACE PLATE 400 * 400 MM</b>	<b>2 NOS.</b>
9.	<b>UNIVERSAL SCRIBING BLOCK 250 MM PILLAR</b>	<b>2 NOS.</b>
10.	<b>VEE BLOCK WITH CLAMP PAIR</b>	<b>2 NOS.</b>
11.	<b>ANGLE PLATE 150 * 100</b>	<b>2 NOS.</b>
12.*	<b>PUNCH LETTER SET 2 MM</b>	<b>2 NOS.</b>
13.*	<b>PUNCH FIGURES SET 2 MM</b>	<b>2 NOS.</b>
14.	<b>HACKSAW FRAME ADJUSTABLE 200-300 MM</b>	<b>8 NOS.</b>
15.*	<b>HAND DRILL MACHINE 6 MM CAP.</b>	<b>2 NOS.</b>
16.*	<b>CHISEL COLD FLAT 12 MM</b>	<b>4 NOS.</b>
17.*	<b>DRILL TWIST S.S. 1 MM TO 12 MM</b>	<b>2 SETS.</b>
18.*	<b>TAPS AND DYES B.A. SET</b>	<b>1 SET.</b>
19.*	<b>TAPS AND DIES B.S.F. SET</b>	<b>1 SET.</b>
20.	<b>HAMMER BALL PAIN 450 GMS, WITH HANDLE</b>	<b>4 NOS.</b>
21.	<b>SPIRIT LEVEL METAL 100 MM</b>	<b>2 NOS.</b>
22.	<b>ELECTRIC SOLDERING IRON 6 WATT PENCIL TIP</b>	<b>4 NOS.</b>
23.	<b>SINGLE HOT PLATE 1000 WATTS</b>	<b>2 NOS.</b>
24.	<b>FILE FLAT 2ND CUT 250 MM</b>	<b>8 NOS.</b>
25.	<b>FILE FLAT SMOOTH 150 MM</b>	<b>8 NOS.</b>
26.*	<b>FILE WARDING 2ND CUT 100 MM</b>	<b>8 NOS.</b>

27.*	<b>FILE WARDING SMOOTH 100 MM</b>	<b>8 NOS.</b>
28.*	<b>VICE SWIVELVED BASE JAW 100 MM</b>	<b>4 NOS.</b>
29.	<b>VICE BENCH JAW 100 MM</b>	<b>12 NOS.</b>
30.*	<b>VICE PIPE 100 MM</b>	<b>1 NO.</b>
31.	<b>POINTER EXTRACTORS ( PULLER )</b>	<b>4 NOS.</b>
32.*	<b>SCREW PITCH GUGE B.A. &amp; METRIC EACH</b>	<b>1 EACH</b>
33.*	<b>REAMER PARALLEL 1 MM TO 6 MM</b>	<b>1 NO.</b>
34.	<b>PUNCH CENTER 100 × 10 MM</b>	<b>2 NOS.</b>
35.*	<b>BLOW LAMPS 1 PT PARAFFIN</b>	<b>2 NOS.</b>
36.*	<b>TOOL MAKERS CLAMPS 65 × 12 × 25 MM OPENING</b>	<b>2 NOS.</b>
37.	<b>PLIER SIDE CUTTING 150 MM</b>	<b>2 NOS.</b>
38.*	<b>SINE BAR 125 MM PLATE</b>	<b>1 NO.</b>
39.	<b>SPANNER ADJUSTABLE 200 MM</b>	<b>2 NOS.</b>
40.*	<b>STICKS DRESSING CARBORUNDUM 100 MM</b>	<b>1 NO.</b>
41.*	<b>FLARING TOOL SET</b>	<b>1 SET</b>
42.*	<b>MICROMETER OUTSIDE 0 TO 25 MM</b>	<b>2 NOS.</b>
43.*	<b>MICROMETER OUTSIDE 25 TO 50 MM</b>	<b>1 NO.</b>
44.*	<b>VERNIER HEIGHT GUAGE 300 MM</b>	<b>2 NOS.</b>
45.*	<b>COMBINATION SET 300 MM</b>	<b>1 NO.</b>
46.*	<b>VERNIER CALIPER 150 MM</b>	<b>2 NOS.</b>
47.*	<b>STANDARD WIRE GUAGE</b>	<b>1 NO.</b>
48.*	<b>FEELER GUAGE LEAF TYPE, 26 BLADES, ENG. &amp; METRIC.</b>	<b>1 NO.</b>
49.*	<b>RADIUS GUAGE LEAF TYPE 1 TO 15 MM</b>	<b>1 NO.</b>
50.*	<b>DIAL TEST INDICATOR IN MM WITH ACCESSORIES</b>	<b>1 NO.</b>
51.	<b>SPANNER SET 1 MM TO 25 MM</b>	<b>2 SETS</b>
52.*	<b>TAPS SET METRIC</b>	<b>2 SETS</b>

53.*	MICROMETER INSIDE 25 MM WITH EXTENSION UPTO 150 MM	1 NO.
54.	COMBINATION PLIER HEAVY DUTY 150 MM	6 NOS.
55.	FIRE BUCKETS	4 NO.
56.	GLAZED BOARD 2.4 × 1.2 METRES WITH FELT CLOTH AND MARKING PEN SETS(BLUE,BLACK,RED & GREEN)	1 NO.
57.	TUBE CUTTER	1 NO.
58.*	TUBE BENDER	1 NO.
59.*	PNICHING TOOL	1 NO.
60.	COMBINATION PLIER 200 MM	6 NOS.
61.*	ALLEN KEY SET ( METRIC )	2 SETS
62.*	ALLEN KEY SET ( ENGLISH )	2 SETS
63.	SOLDERING STATION ( TEMP,CONTROLLED ).	2 NOS.
64.	SCREW DRIVER 200 MM	6 NOS.
65.	SCREW DRIVER 400 MM	3 NOS.
66.	PHILLIPS SCREW DRIVER 200 MM	2 SETS
67.*	OUTSIDE MICROMETER , 0-25 MM., L.E.D./L.C.D. DISPLAY	2 NOS.
68.	ROUND NOSE PLIER 150 MM	4 NOS.
69.*	MACHINE VICE 150 MM	2 NOS.
70.	MAGNIFYING GLASS 75 MM	2 NOS.

**LIST OF INSTRUMENTS  
MECHANICAL PRECISION INSTRUMENTS**

SR.NO.	ITEM	NUMBER
1.*	VERNIER MICROMETER ( 0-25 MM ), OUTSIDE	1 NOS.
2.*	VERNIER MICROMETER ( 25-50 MM ), OUTSIDE.	1 NOS.
3.*	VERNIER CALIPER (0-300 MM)	2 NOS.
4.*	PLUG GAUGE	2 NOS.
5.*	RING GAUGE	1 NO.
6.*	SNAP GAUGE	1 NO.
7.*	DIAL TEST INDICATOR, METRIC WITH ALL ACCESSORIES.	2 NOS.
8.*	SURFACE GAUGE	2 NOS.
9.*	TELESCOPIC GAUGE	1 NO.
10.*	VERNIER BEVEL PROTRACTOR	2 NOS.
11.	DIVIDERS, 250 MM	3 NOS,
12.*&	GAUGE BLOCKS	3 NOS.
13.*	COMPARATORS	1 NO.
14.*	MONOCHROMATIC LIGHT SOURCE.	1 NO.
15.*	OPTICAL FLAT	1 NO.
16.	WIRE TYPE STRAIN GAUGE.(BONDED & UNBONDED)	4 NOS.(EACH 2 NOS.)
17.	BONDED & UNBONDED TYPE MICROPHONE.	3 NOS.
18.	VIBROMETER SENSING ELEMENTS.	3 NOS.
19.	ACCELEROMETER	2 NOS.
20.	SESMIC INSTRUMENTS.	2 NOS.
21.	LOAD CELLS OF VARIOUS RANGES.	3 NOS.

22.*	MEASURING MICROSCOPE & TRAVELLING MICROSCOPE.	2 NOS.(ONE EACH)
	ROTATIONAL / VELOCITY INSTRUMENTS	
1.	SPEEDOMETERS ( AT LEAST FOUR DIFFERENT POPULAR MAKE ) WITH ADAPTERS OF VARIOUS SIZES.	4 NO. EACH
2.	CENTRIFUGAL TYPE TACHOMETER.	2 NOS.
3.	DRAG CUP TYPE TACHOMETER.	2 NOS.
4.	ELECTRICAL TACHOMETER.	2 NOS.
5.	CHRONOMETRIC TYPE TACHOMETER.	2 NOS.
6.	DIGITAL TYPE TACHOMETER.	2 NOS.
7.	STROBOSCOPE.	1 NO.
	MECHANISMS	
1.	CAM AND FOLLOWER MECHANISM.	3 NOS.
2.	LEVER AND LINKAGE MECHANISM.	3 NOS.
3.	RATCHER-PAWL MECHANISM.	3 NOS.
4.	SECTOR-PINION MECHANISM.	3 NOS.
5.	PULLY SYSTEM MECHANISM	3 NOS.
6.	WHEEL-AXLE MECHANISM.	3 NOS.
7.	GEAR-TRAIN MECHANISM	3 NOS.
	PRECISION INSTRUMENTS	
1.	DIGITAL PANEL METERS, 3 1/2 DIGIT.	6 NOS.
2.	DIGITAL PANEL METERS, 4 1/2 DIGIT.	6 NOS.
3.	DIGITAL LINE FREQUENCY INDICATOR	2 NOS.
4.	D.C. REGULATED POWER SUPPLIES. (A) LOW TENSION SERIES (SINGLE) (B) LOW TENSION SERIES (DUAL) (C) HIGH TENSION SERIES (D) MULTI OUT PUT SERIES (E) FIXED OUT PUT SERIES	2 NOS. 2 NOS. 2 NOS. 2 NOS. 2 NOS.
5.	DIGITAL SINE/SQUARE GENERATOR ( 1 MHz ) WITH FREQUENCY COUNTER ( 8 DIGIT OR 10 MHz )	1 NO.
6.	DIGITAL FUNCTION GENERATOR	1 NO.
7.	PULSE GENERATOR	1 NO.
8.	DIGITAL FREQUENCY COUNTER	1 NO.
9.	DIGITAL INSULATION TESTER	1 NO.
10.	DIGITAL MULTIMETER	6 NOS.
11.	ANALOG MULTIMETER	4 NOS.
12.	DIGITAL PH METER	1 NO.
13.	DIGITAL L.C.R. BRIDGE	1 NO.
14.	DIGITAL I.C. TESTER	1 NO.



<b>15.</b>	<b>DIGITAL STORAGE OSCILLOSCOPES</b>	<b>1 NO.</b>
<b>16.</b>	<b>DECADE VOLTAGE DIVIDERS</b>	<b>2 NOS.</b>
<b>17.</b>	<b>DECADE ATTENUATORS</b>	<b>2 NOS.</b>
<b>18.</b>	<b>DECADE RESISTANCE BOXES</b>	<b>2 NOS.</b>
<b>19.</b>	<b>DECADE CAPATANCE BOXES</b>	<b>2 NOS.</b>
<b>20.</b>	<b>DECADE INDUCTANCE BOXES</b>	<b>2 NOS.</b>
<b>21.</b>	<b>TRANSISTOR CURVE TRACER</b>	<b>1 NO.</b>
<b>22.</b>	<b>TRANSISTOR TESTER</b>	<b>1 NO.</b>
<b>23.</b>	<b>ELECTRONIC TIMERS</b>	<b>1 NO.</b>
	<b>OPTIONAL INSTRUMENTS</b>	
<b>1.</b>	<b>MONOCULAR</b>	<b>2 NOS.</b>
<b>2.</b>	<b>BINOCULAR</b>	<b>2 NOS.</b>
<b>3.</b>	<b>MAGNETIC COMPASS</b>	<b>2 NOS.</b>
<b>4.</b>	<b>PRISMATIC COMPASS</b>	<b>2 NOS.</b>
<b>5.</b>	<b>TELESCOPE ( ASTRONOMICAL )</b>	<b>2 NOS.</b>
<b>6.</b>	<b>TELESCOPE ( GALLELIAN )</b>	<b>2 NOS.</b>
<b>7.</b>	<b>COMPOUND MICROSCOPE</b>	<b>2 NOS.</b>
<b>8.</b>	<b>TRANSIT THEODOLITE</b>	<b>1 NO.</b>
<b>9.</b>	<b>DUMPY LEVEL</b>	<b>1 NO.</b>
<b>10.</b>	<b>CAMERA, SINGLE LENS WITH VIEW FINDER</b>	<b>2 NOS.</b>
<b>11.</b>	<b>CAMERA ( SLR )</b>	<b>2 NOS.</b>

### GENERAL EQUIPMENT TRAINERS FOR INSTRUMENTATION

<b>S.No.</b>	<b>Item</b>	<b>Number</b>
1.	Instrumentation amplifier trainer.	2 nos.
2.	Voltage controlled oscillator trainer.	2 nos.
3.	Frequency to voltage converter trainer.	2 nos.
4.	Voltage to frequency converter trainer.	2 nos.
5.	8 channel analog multiplexer trainer.	2 nos.
6.	8 channel analog demultiplexer trainer.	2 nos.
7.	FET voltmeter trainer..	2 nos.
8.	Measurement of RMS voltage trainer.	2 nos.
9.	Measurement of average voltage trainer.	2 nos.
10.	Wheatstone`s bridge trainer.	2 nos.
11.	Kelvin`s bridge trainer.	2 nos.
12.	Trainer on C.R.O.	2 nos.
13.	Trainers on transistor of all types.	3 nos.
14.	Trainers on microphone	3 nos.
15.	Trainers on network circuits i.e. Kirchhoff`s law, resonance, electro-magnetic and transformer.	2 nos.
16.	Trainers on linear circuits i.e. operational amplifiers.	2 nos.
17.	Discreet component trainer.	2 nos.

18.	Trainers on power suppliers-Half wave rectifier, full wave rectifier, bridge rectifier and power supply, regulated power supply.	3 nos.
19.	Trainers on basic digital electronics, i.e. logic gates, Boolean expression, adder, subtracter, flip-flop, counter, register, converter etc.	2 nos.
20.	Trainers on transistor amplifier circuits at least one each for all types of amplifiers.	3 nos.
21.	Trainers on oscillators and multivibrators, generators, integrators, triggers and other wave shaping ckts.	3 nos.
22.	Trainers on invertors and converters.	3 nos.
23.	Trainers on stepper motor, SCR motor, serve motor, UJT trigger, circuit breaker, timer and alarm.	3 nos.
24.	SCR driven/controlled power supply trainer.	3 nos.
	<b>Electrical Instruments</b>	
1.	DC moving coil voltmeters. (various ranges)	5 nos.
2.	DC moving coil ammeters. (various ranges)	5 nos.
3.	DC moving coil miliammeters (various ranges)	5 nos.
4.	Centre zero galvanometers	5 nos.
5.	AC moving iron type voltmeter (various ranges)	5 nos.
6.	AC moving iron type ammeters (various ranges)	5 nos.
7.	Wattmeter dynamometer	3 nos.
8.	Voltmeter dynamometer type AC & DC	3 nos.
9.	Voltmeter induction type	3 nos.
10.	Power factor meter	2 nos.
11.	Vibrating reed frequency meter	2 nos.
12.	Wait hour meter induction type 1 ph	3 nos.
13.	Ampere hour meter	2 nos.
14.	Ohm`s meter	2 nos.
15.	Multimeter (analog)	3 nos.
16.	Multimeter (digital)	4 nos.
17.	Potentiometer / Thermocouple test set	1 nos.
18.	Earth Insulation Tester (Megger)	2 nos.
19.	Autotransformer	2 nos.
20.	Synchronoscope	1 nos.
	<b>Pressure Instruments</b>	
1.	“U” tube manometers	2 nos.
2.	Well type manometer	2 nos.
3.	Inclined limp manometers	2 nos.
4.	Ring balance type manometer	2 nos.
5.	Bourdon tube type gauges of various ranges	8 nos.
6.	Capsule type pressure gauges	3 nos.
7.	Aneroid barometers	2 nos.
8.	Dead weight tester	1 nos.
9.	Pressure regulators with filter and input & output gauges	2 nos.
10.	Differential pressure transmitter (pneumatic)	2 nos.
11.	Differential pressure transmitter (electronic)	2 nos.
12.	Diaphragm type pressure gauges of various ranges	4 nos.
13.	Pressure Transducers training kits	1 nos.

	(a) Potentiometer (b) Capacitive, (c) Reluctive, (d) Strain gauge, (e) LVDT, (f) Load cell, (g) Piezoelectric type, (h) Servo type	Each
14.	Pneumatic indicating controller (PID)	2 nos.
15.	Electronic pressure controller (PID)	2 nos.
16.	Experimental set up for pressure vessel, pressure transmitter, controller, recorder, and final control element, i.e. closed loop system of full scope system, i.e. pressure instrumentation trainer/simulator.	
17.	Power supply unit	1 nos.
18.	Pneumatic calibrator	1 nos.
19.	Electronic calibrator	1 nos.
20.	Pressure switches of various ranges	4 nos.
21.	Other miscellaneous fittings, pipes, tubes, etc.	
22.	Low pressure measuring gauges such as thermal conductivity gauges, pirani gauges and melody gauge	1 no each
23.	P to I and I to P converters	1 no each
24.	Vacuum tester with pump	1 no.
25.	Vacuum gauge, 100 mm dial, Bourdon tube type	2 nos.
26.	Pneumatic regulator with filter and input & output gauges	3 nos.
27.	Diaphragm type pressure gauge	2 nos.
	<b>Flow Meters / Instruments</b>	
1.	Simple tank type quantity meter	2 nos.
2.	Reciprocating piston type flow meter	4 nos.
3.	Impeller type flow meter	4 nos.
4.	Below and liquid seal drum type flow meter	2 no each
5.	Deflecting and rotating vane flow meter	2 no each
6.	Helical and turbine flow meter	2 nos.
7.	Pitot tube flow meter	1 nos.
8.	Orifice type flow meter	2 nos.
9.	Ventury tube flow meter	2 nos.
10.	Tapered tube flow meter	1 no.
11.	Rotameter	2 nos.
12.	Megnetic Flow meter	1 no.
13.	Ring balance flow meter	1 no.
14.	Vortex flow meter	1 no.
15.	Flow control loop set with flow controller, D.P. transmitter, receiver, unit control valae and impulse line, complete experimental set-up for flow measurement and control, i.e. Flow Simulator	1 no.
16.	Coriolis mass flow meter	1 no.
17.	Pump for flow, Suction 1.5 M & Discharge 3 M	2 nos.
18.	Flow nozzle	2 nos.
	<b>Level Instrument</b>	
1.	Hook type level indicator	2 nos.
2.	Sight glass level indicator	2 nos.
3.	Float type level indicator	2 nos.
4.	Static pressure air pure type level indicator	2 nos.
5.	Level transmitter (inter face )	1 nos.
6.	Level control set-up with level transmitter, level recorder(Pneumatic& Electronic), controller & control valve,	

	complete experiment set- up or level simulator	1 no.
7.	Level measurement equipment by electrical method i.e. conductivity, capacitance probes, sonic level detectors, radiator level detectors & point level detectors	1. no 1 no. each
8.	Level measurement equipments for solid, Sonic solid level, Microwave, Capacitance probes, Diaphragm switches, Nuclear gauges, Sonic and microwave solid level detectors.	1 no. each
<b>Temperature Instruments</b>		
1.	Mercury in glass thermometer (various ranges)	6 nos.
2.	Alcohol or other liquid in glass thermometers	2 nos.
3.	Stem and dial type bimetallic thermometer (various ranges)	4 nos.
4.	Mercury in steel remote indicating thermometers	2 nos.
5.	Resistance bulb wheatstone bridge type	2 nos.
6.	Thermocouple type pyrometer with millivtmeter (with different types of thermocouples, thermowells with compensating cables)	1 no.
7.	Optical pyrometer with all accessories	1 no.
8.	Vapour pressure thermometer	2 nos.
9.	Other types of thermometers	3 nos.
10.	Various type pyrometer with lead wires	8 nos.
11.	Thermocouple type pyrometer with millivolt potentiometer for testing pyrometer	1 no.

<b>12.</b>	<b>TEMPERATURE TRANSMITTER ,PNEUMATIC ( INPUT RTD, TC OR BULB )</b>	<b>2 NOS.</b>
<b>13.</b>	<b>TEMPERATURE TRANSMITTER ELECTRONIC</b>	<b>2 NOS.</b>
<b>14.</b>	<b>EXPERIMENTAL SET-UP FOR MEASURING AND CONTROLLING OF TEMPERATURE, CONSISTING OF MEASURING , CONTROLLING, INDICATING , RECORDING AND FINAL CONTROL ELEMENTS, COMPLETE CLOSED LOOP SYSTEM</b>	<b>2 NOS.</b>
<b>15.</b>	<b>TRAINING KITS FOR THERMAL TRANSDUCERS</b>	<b>1 NO.</b>
<b>16.</b>	<b>DIGITAL CALIBRATOR, MV/MA INJECTOR AND MEASURING UNIT</b>	<b>2 NOS.</b>
<b>17.</b>	<b>ELECTRIC FURNANCE , TWIN CHAMBERS ( 300 × 200 × 1200 )</b>	<b>1 NO.</b>
<b>18.</b>	<b>RECORDERS</b>	
<b>1.</b>	<b>PNEUMATIC AND ELECTRONIC RECORDERS(SINGLE POINT AND MULTIPOINT ) BOTH CIRCULAR AND STRIP CHART TYPES</b>	<b>3 NOS.</b>
	<b>CONTROLLERS</b>	
<b>1.</b>	<b>PID CONTROLLER TRAINER CONSISTING OF INSTRUMENT PANEL , DIGITAL COMPUTER AND INTERFACE SYSTEM</b>	<b>1 NO.</b>
<b>2.</b>	<b>REAL PID CONTROLLER - TRAINING KIT</b>	<b>1 NO.</b>
<b>3.</b>	<b>PROCESS SIMULATOR BASED ON DISTRIBUTED CONTROL SYSTEM</b>	<b>1 NO.</b>
<b>4.</b>	<b>PROGRAMMABLE LOGIC CONTROLLER ( PLC) TRAINER</b>	<b>1 NO.</b>
<b>5.</b>	<b>CALIBRATOR FOR PID CONTROLLER ( PNEUMATIC )</b>	<b>1 NO.</b>
<b>6.</b>	<b>PRECISION AIR FILTER REGULATOR WITH INPUT AND OUTPUT GAUGES</b>	<b>2 NOS.</b>
<b>7.</b>	<b>PNEUMATIC RELAY CALIBRATOR</b>	<b>1 NO.</b>

	<b>FINAL CONTROLLING ELEMENTS</b>	
<b>1.</b>	<b>ELECTRIC ACTUATORS</b>	<b>1 NO.</b>
<b>2.</b>	<b>PNEUMATIC AND HYDRAULIC ACTUATORS</b>	<b>1 NO. EACH</b>
<b>3.</b>	<b>DIFFERENT TYPES OF CONTROL VALVES SUCH AS GATE VALVES, GLOBE VALVES, BALL VALVES, DIAPHRAGM VALVES, BUTTERFLY VALVES ETC. ELECTRICALLY ACTUATED, PNEUMATIC ACTUATED AND HYDRAULIC ACTUATED</b>	<b>1 NO. EACH</b>
<b>4.</b>	<b>VALVE POSITIONERS, BOOSTER RELAYS, GLAND PACKINGS ETC.</b>	<b>1 NO. EACH</b>
<b>5.</b>	<b>MOTORIZED CONTROL VALVE</b>	<b>1 NO.</b>
	<b>EQUIPMENT FOR MICROPROCESSOR</b>	
<b>1.</b>	<b>TRAINING KITS OR TRAINERS AS AVAILABLE ON MICROPROCESSORS APPLICABLE TO PROCESS CONTROL AND INSTRUMENTATION</b>	<b>1 NO.</b>
<b>2.</b>	<b>TRAINING KITS ON INTRODUCTION TO COMPUTERS AND COMPUTERS HARDWARE</b>	<b>1 NO.</b>
<b>3.</b>	<b>TRAINING KITS ON HOW MICROPROCESSORS FUNCTION</b>	<b>1 NO.</b>
<b>4.</b>	<b>DATA ACQUISITION SYSTEM ( DAC )</b>	<b>1 NO.</b>
<b>5.</b>	<b>ADC TO DAC CARDS</b>	<b>4 NOS.</b>
<b>6.</b>	<b>DIGITAL I/O CARDS</b>	<b>4 NOS.</b>
<b>7.</b>	<b>TEMPERATURE TRANSMITTER CARDS</b>	<b>4 NOS.</b>
<b>8.</b>	<b>132 COL. DOT MATRIC PRINTER</b>	<b>1 NO.</b>
	<b>EQUIPMENT ON HYDRAULICS AND PNEUMATICS</b>	
<b>1.</b>	<b>HYDRAULIC TRAINER</b>	<b>1 NO.</b>
<b>2.</b>	<b>HYDRAULIC TRAINING KITS</b>	<b>1 NO.</b>
<b>3.</b>	<b>PNEUMATIC TRAINER</b>	<b>1 NO.</b>
<b>4.</b>	<b>PNEUMATIC TRAINING KIT</b>	<b>1 NO.</b>
	<b>ANALYTICAL INSTRUMENTS</b>	
<b>1.</b>	<b>CONDUCTIVITY METER</b>	<b>1 NO.</b>
<b>2.</b>	<b>GAS ANALYSER, ANY SUITABLE TYPE</b>	<b>1 NO.</b>
<b>3.</b>	<b>GLCS</b>	<b>1 NO.</b>
<b>4.</b>	<b>pH INDICATOR</b>	<b>1 NO.</b>
	<b>GENERAL INSTALLATIONS ( MACHINES )</b>	
<b>1.</b>	<b>DRILL POWER, BENCH TYPE, PRECISION, MOTORIZED WITH CHUCK, 0 TO 12 MM CAPACITY</b>	<b>1 NO.</b>
<b>2.</b>	<b>GRINDER, DOUBLE ENDED , BENCH, HIGH REVOLUTIONS MOTORIZED</b>	<b>1 NO</b>
<b>3.</b>	<b>BENCH LATHE, MOTORISED WITH ALL ACCESSORIES</b>	<b>2 NOS.</b>
<b>4.</b>	<b>BUFFING MACHINE, 900 MM SPINDLE</b>	<b>1 NO.</b>
<b>5.</b>	<b>ELECTRIC FURNACE, TWIN CHAMBERS ( 275 × 150 × 150 )</b>	<b>1 NO.</b>

6.	<b>BENCH WORKING 1800 × 900 × 900 MM</b>	<b>6 NOS.</b>
7.	<b>INSTRUMENT TESTING BENCH WITH CUP-BOARDS</b>	<b>8 NOS.</b>
8.	<b>STEEL CUP BOARD / STEEL ALMIRAH 1800 × 1200 × 450 MM ( WITH FIVE SHELVES )</b>	<b>8 NOS.</b>
9.	<b>STEEL CUP BOARDS WITH EIGHT LOCKERS FOR TRAINEES ( 1800 × 1200 × 450 MM )</b>	<b>2 NOS.</b>
10.	<b>OVERHEAD PROJECTOR WITH ALL ACCESSORIES</b>	<b>1 NO.</b>
11.	<b>HYDROMETERS ( LAB. &amp; STORAGE BATTERY TESTING TYPE )</b>	<b>2 NOS.</b>
12.	<b>HAIR HYGROMATER</b>	<b>2 NOS.</b>
13.	<b>WET &amp; DRY BULB THERMOMETER HYGROMETER</b>	<b>2 NOS.</b>
14.	<b>SLING PSYCHROMETER HYGROMETER</b>	<b>2 NOS.</b>
15.	<b>FIRE EXTINGUISHERS</b>	<b>3 NOS.</b>
	<b>* CAN BE USED FROM OTHER TRADES/ SECTIONS OF THE INSTITUTE/CENTER</b>	

**SYLLABUS FOR THE TRADE OF INSTRUMENT MECHANIC  
UNDER APPRENTICESHIP TRAINING SCHEME  
PERIOD OF TRAINING -- 3 YEARS**

**NOTE : THE CONTENT OF THE SYLLABUS FOR THE APPRENTICES DURING THE FIRST YEAR AND SECOND YEAR TRAINING WILL BE THE SAME AS THE CONTENT OF THE FIRST YEAR AND THE SECOND YEAR SYLLABUS OF THE CRAFTSMEN TRAINING SCHEME FOR THE TRADE OF INSTRUMENT MECHANIC**

**THIRD YEAR :**

**SHOP FLOOR TRAINING ( PRACTICAL )**

- 1. SAFETY PRECAUTION TO BE FOLLOWED IN THE WORKSHOP/ PLANT OF THE INDUSTRIAL ESTABLISHMENT.  
PREVENTION OF ACCIDENTS. AWARENESS ON CHEMICAL HAZARDS.**
- 2. MANUFACTURING INSTRUMENT PARTS THROUGH BENCH AND MACHINE WORKS.**
- 3. PRACTICE ON USING PRECISION MEASURING INSTRUMENTS. EXERCISES INVOLVING MECHANICAL MEASURING ( METROLOGY ).**
- 4. OVERHAULING AND TESTING OF OPTICAL INSTRUMENTS.**
- 5. TESTING, CALIBRATION, USING AND APPLICATION OF VARIOUS ELECTRICAL MEASURING INSTRUMENT FOR INDUSTRIAL PURPOSE RELATED TO INSTRUMENTATION INCLUDING DIGITAL MULTIMETER.**
- 6. FABRICATION OF POWER SUPPLY UNITS , REGULATED, POWER SUPPLY UNIT. TESTING AND TROUBLESHOOTING.**
- 7. INSPECTING, TESTING, REPAIRING AND USING OF SINGLE GENERATOR AND FREQUENCY GENERATOR.**
- 8. EXERCISES ON FLIP-FLOPS, REGISTERS, SHIFT REGISTERS, ADDER, SUBTRACTOR, MULTIPLEXER AND DE-MULTIPLEXER, MEMORY CIRCUITS IN DIGITAL ELECTRONICS.**
- 9. EXERCISES ON MICROPROCESSOR, ITS STRUCTURE , MEMORY DEVICE, I/O DEVICES, DATA**

- ACQUISITION SYSTEM. INDUSTRIAL APPLICATION OF MICROPROCESSORS.
- 10. TESTING, CALIBRATION, SETTING AND INSTALLATION OF SMART AND INTELLIGENT TYPE TRANSMITTERS.**
- 11. DEVELOPING PROGRAMME OF A PROGRAMMABLE LOGIC CONTROLLER.**
- 12. PRACTICE ON COMMANDING , CONTROLLING, FAULT FINDING AND REPAIRING OF DISTRIBUTED CONTROL SYSTEM, DETAILS WORKING OF D.C.S.**
- 13. PRACTICE ON WORKING , INSTALLATION AND LINING UP OF T.D.C. APPLICATION OF TDC IN INDUSTRY.**
- 14. EXERCISES ON GAS CHROMATOGRAPH, TESTING, FAULT FINDING, REPAIRING ON ANALYSERS, APPLICATION OF ANALYSERS IN THE INDUSTRY.**
- 15. EXERCISES ON pH METERS. TESTING OF pH ELECTRODES, PREPARATION OF BUFFER SOLUTION. TESTING, CALIBRATION AND INSTALLATION OF pH MEASURING AND CONTROLLING INSTRUMENTS.**
- 16. EXERCISES ON PNEUMATIC DRYERS & AIR COMPRESSORS.**
- 17. EXERCISES ON HYDRAULIC INSTRUMENTATION & ITS APPLICATION IN INDUSTRY.**
- 18. REVISION.**

#### RELATED INSTRUCTION

##### TRADE THEORY

- 1. SAFETY AT WORK. PREVENTION OF ACCIDENTS. OBSERVE THE RULES STRICTLY.**
- 2. REVISION OF BASIC MECHANICS AND MEASURING METHOD.**
- 3. REVISION OF 1ST YEAR, 2ND YEAR, THEORY TOPICS.**
- 4. ELECTRICAL MEASURING INSTRUMENTS INCLUDING DIGITAL MULTIMETER, PREFERABLY THEIR APPLICATION FOR INDUSTRIAL PURPOSE.**
- 5. DEEP AND DETAIL STUDY AND APPLICATION OF ELECTRONIC MEASURING DEVICE. INTEGRATED CIRCUITS, MULTI-LAYER PCBs, POWER SUPPLIES, OPERATIONAL AMPLIFIERS AND TROUBLESHOOTINGS.**
- 6. SINGLE GENERATOR, SWEEP FREQUENCY GENERATOR AND OSCILLOSCOPES.**
- 7. DIGITAL ELECTRONICS, MICROPROCESSORS AND THEIR INDUSTRIAL APPLICATION.**
- 8. DEVELOPING PROGRAMMABLE LOGIC CONTROLLER PROGRAMME**
- 9. DISTRIBUTED PROCESS CONTROL SYSTEM.**
- 10. T.D.C. (TOTAL DISTRIBUTED CONTROL)**
- 11. ANALYTICAL INSTRUMENTATION USED IN INDUSTRY.**
- 12. INTRODUCTION TO pH. pH. MEASURING AND CONTROLLING INSTRUMENTATION.**
- 13. PNEUMATICS AND HYDRAULICS, THEIR RULE IN INDUSTRIAL APPLICATION.**
- 14. INDUSTRIAL VISIT TO OTHER THAN THE INDUSTRIES IN WHICH THE APPRENTICE IS BEING WORKED.**
- 15. REVISION.**

##### WORKSHOP CALCULATION AND SCIENCE

- 1. REVISION OF THE WORK OF PREVIOUS TWO YEARS.**

2. **SHOP PROBLEMS APPLICABLE TO THE TRADE.**
3. **FORCE : REPRESENTATION BY A VECTOR , PRINCIPLE OF MOMENT, LEVER SYSTEMS, SIMPLE APPLICATIONS. THE BEAM BALANCE, FORCE, ACCELERATIONS AND VELOCITY.**
4. **SIMPLE SPRING AND RELATED CALCULATIONS.**
5. **NON-METALS, GLASS, RUBBER, VULCANITE, EBONITE, FIBRE, PLASTIC, CARBON, CERAMICS, QUARTZ, REFRACTORIES, OILS, OTHER LIQUIDS AND SPECIAL SOLUTIONS, THERMAL AND ELECTRICAL INSULATING METALS, SHELLAC, DRYING AGENTS, ADHESIVES, LACQUERS, FLUXES, WITH BRIEF REFERENCE TO THEIR SPECIAL PROPERTIES.**
6. **CHEMICAL EFFECTS OF CURRENT, APPLICATION TO PLATING AND ANODISING.**
7. **HYDROSTATICS : PRESSURE AND FLOW OF LIQUIDS AND GASES. UNITS, USED, CONVERSIONS, ABSOLUTE AND GAUGE PRESSURE.**
8. **OPTICS : THE NATURE OF LIGHT, PROPAGATION OF LIGHT, REFLECTION OF LOGHT AT PLANE AND CURVED SURFACES ( WITH EMPHASIS ON SPHERICAL SURFACES ). REFLECTION AND REFRACTION OF PLANE WAVE AT A PLANE JUNCTION THROUGH TRANSPARENT MEDIA, INTERNAL REFLECTION.**
9. **MEANING OF STRESS, STRAIN, MODULOUS OF ELASTICITY, ULTIMATE TENSILE STRESS, FACTOR OF SAFETY AND DIFFERENT TYPES OF STRESSES. HOOKS LAW, STRAIN GAUGES, MEANING OF TENACITY, ELASTICITY, MALLEABILITY, BRITTLINESS, HARDNESS, COMPRESSIBILITY AND DUCTILITY.**
10. **SYSTEMS OF POWER TRANSMISSIONS GEAR, BELT DRIVES AND COUPLINGS, DETERMINATIONS OF POWER TRANSMISSIONS SPEED AND SIZE OF PULLEYS AND GEARS.**
11. **DESCRIPTIVE EXPLANATION OF EXPANSION OF SOLIDS, LIQUIDS AND GASES DUE TO HEAD-CO-EFFICIENT OF EXPANSION. BRIEF DESCRIPTION OF TRANSFERENCE OF HEAT-CONDUCTION, CONVECTION AND RADIATION.**

#### ENGINEERING DRAWING

1. **REVISION OF THE WORK OF PREVIOUS TWO YEARS.**
2. **DEVELOPMENT OF SURFACES AND SIMPLE OBJECTS.**
3. **CONSTRUCTION OF ISOMETRIC SCALE.**
4. **FREE HAND SKETCHING AND PRODUCTION OF WORKING DRAWINGS OF OPTICAL, MECAHNICAL OR ELECTRICAL INSTRUMENTS AND THEIR COMPONENTS.**
5. **FREE HAND SKETCHING OF DETAILED COMPONENTS FROM ASSEMBLIES.**
6. **ADVANCED BLUE PRINT READING.**
7. **CODE OF PRACTICE FOR GENERAL ENGINEERING DRAWING ACCORDING TO B.I.S. ( IS : 696 )**
8. **THIRD ANGLE & SECTIONAL VIEWS OF INSTRUMENT COMPONENTS.**
9. **WIRING AND SCHEMATIC DIAGRAMS :  
CONVENTIONAL REPRESENTATION OF COMMAN ELECTRICAL COMPONENTS SUCH AS SWITCHES,  
COILS, FUSES, RESISTORS, CAPACITORS, INDUCTORS, ETC. ( IS : 1248 )**
10. **BLOCK DIAGRAM , SCHEMATIC AND CIRCUIT DIAGRAM OF COMMAN RANGE TEST EQUIPMENTS.**
11. **SYMBOLS, NOTATIONS, COLOUR CODING, USED INSTRUMENTATION.**
12. **SYMBOLS USED IN ELECTRONICS.**

#### SOCIAL STUDIES

**THE SYLLABUS HAS ALREADY BEEN APPROVED AND IS THE SAME FOR ALL TRADES.**