SYLLABUS

For the trade of

INSTRUMENT MECHANIC
(CHEMICAL PLANT)

UNDER

CRAFTSMEN TRAINING SCHEME
&
APPRENTICESHIP TRAINING SCHEME

REVISED ON

2009

by

Government of India

Ministry of Labour & Employment (D.G.E.&T.)

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

EN- Block, Sector- V, Salt Lake,

Kolkata-700091.

LIST OF MEMBERS OF THE TRADE COMMITTEE MEETING FOR THE TRADE OF "INSTRUMENT MECHANIC (CHEMICAL PLANT)" UNDER CRAFTSMEN TRAINING SCHEME HELD ON 19TH NOVEMBER 2008, AT ITI MULUND, MUMBAI, MAHARASTRA

S/Shri

1.	A. S. Pande, Dy. Personal Manager , Hindustan Antibiotic Ltd., Pune.	Chairman
2.	V. M. Ghildyal, Director, A. T. I. Mumbai	Member
3.	A. K. Mishara, Joint Director, A. T. I. Mumbai	Member
4 .	S. S. Jarimali, Manager Training, Hindustan Organic Chemicals Ltd. Rasayani, Maharastra.	Member
5.	M. A. Kamerkar, Manager Mazda Colours Ltd,. Turbe, Navi Mumbai.	Member
6.	V. P. Panse, Maintenance Engineer, Borax Morarji Ltd., Ambarnath, Thane, Mumbai.	Member
7.	S. K. Sabaria, Dy. Manager, Century Rayon, Shahad, Thane, Maharastra	Member
8.	J. A. Pariwal, Training Officer Hindustan Insecticides Ltd., Rasayani, Maharastra. .	Member
9.	Prakash Kasekar, Sr. Engineer, RPG Life Sciences Ltd. Navi Mumbai.	Member
10.	Prasad L. Dhole, Amines & Plasticizen Ltd., Turbe, Navi Mumbai.	Member
11.	Dushyant A. Joshi, Asstt. Manager, Godrej Industries Ltd., Vikhroli, Mumbai.	Member
12.	A. P. Khatawer, Sr. Officer, Godrej Industries Ltd., Vikhroli, Mumbai.	Member
13.	Sailesh Kumar, Manager Production, Asian Paints, Bhandup, Mumbai.	Member
14.	Anil N. Kanekar, Engineer Piramal Health Care Ltd. Thane, Mumbai.	Member
15.	S. S. Majumdar, Principal V. P. Polytechnic, Thane, Mumbai	Member
16.	Dr. I. K. Jain, Ex. Joint Director, A. T. I. Chennai	Member
17.	Abhinoy Nandi, Dy. Director, CSTARI, Kolkata.	Member
18.	R. V. Khairnar, Asstt. Director, A. T. I. Mumbai	Member
19.	P. S. Wagh, Principal, ITI Mulund, Mumbai	Member
20.	S. M. Sadamate, Vice Principal, ITI Mulund, Mumbai	Member
21.	S. B. Sardar, Training Officer, CSTARI, Kolkata.	Member
22.	Sunil J. Wakde, Training Officer, A. T. I. Mumbai	Member
23.	E. S. Takalkar, Chem. Instructor, ITI Mulund, Mumbai.	Member
24.	P. S. Rane, Chem. Instructor, ITI Mulund, Mumbai.	Member
25.	G. S. Dharmath, Chem. Instructor, COE, ITI Mulund, Mumbai.	Member
26.	S. E. Deshmukh, Instructor, ITI Mulund, Mumbai.	Member
27.	C. P. Jadhav, Instructor, ITI Mulund, Mumbai	Member

List of Members attended the Trade committee Meeting to review the syllabi for the trades of **(i) Attendant Operator (Chemical Plant) (ii) Laboratory Assistant (Chemical Plant) (iii) Maintenance Mechanic (Chemical Plant) & (iv) Instrument Mechanic (Chemical Plant**) under CTS & ATS on **19th & 20th May 2009** at **Industrial Training Institute, Mulund , Mumbai, Maharashtra**

Director: Shri S.D.Lahiri, CSTARI., Kolkata

SL NO.	NAME & DESIGNATION S/Shri	REPRESENTING ORGANIZATION WITH FULL ADDRESS	REMARKS
1.	S.S.Jirimali Manager - Training	HOC Ltd., Rasayani, Dist. Raigad	Chariman
2.	S.M.Sadamate Asstt. App. Adviser (Tech.)	B.T,R.I., Mulund, C/o. J.T.F Mulund, Mumbai	Member
3	D.N. Waghmare Chief Manager	Piramal Health Care Ltd., Balkum, Thane-400068	Member
4	S.K.Gehari (Skilled Staff S.S)	GSK Pharmaceuticals, 2nd Pokhran, Thane	Member
5	Mali P.N. Training Incharge	Pfizer Ltd., Turbhe Navi Mumbai	Member
6	Sachin B. Dhoni Executive Engg.	RPG Industries Ltd., Navi Mumbai	Member
7	S.K.Sabarai Dy. Manager	M/s. Century Rayon Shahad (Thabe), Maharastra	Member
8	B.N. Chetan Anand	Amines & Plasticizus Ltd. Thane, Maharastra	Member
9	S.J. Wakde Trg. officer	Advanced Trg. Institute, Sion ,Mumbai-22	Member
10	A.N.Manchar Kar Sci. Demonstrator	B.T.R.I. Mulund	Member
11	Takalkar E.S. Chemical Instructor	B.T.R.I. Mulund	Member
12	S.P. Pradhan Manager Process Control	Piramal Healthcare , Thane	Member
13	V.I.Raojadeja Executive (Instrument)	Godrej Indsutries Ltd. Mumbai	Member
14	M.A.Kamerkar Manager(Factory Admn.)	Mazda Colours Ltd., Navi Mumbai	Member
15	D. Mahaboob Basha Vocational Instructor	Jotun India Pvt. Ltd. Pune	Member
16	Amogh Soman Sr. Executive -HR	Jotun India Pvt. Ltd. Pune	Member
17	Mrs. Deshmukh J.J. Trade Instructor (Science)	B.T.R.I., Mulund	Member
18	Mr. P.S.Wagh	Principal, ITI., Mumbai	Member
19	L.K.Mukherjee,Dy. Director	CSTARI., Kolkata	Member
20	A. Nandi, Dy. Director	CSTARI., Kolkata	Member
21	P.K.Roy Dy. Director (Chem)	ATI., Mumbai	Member
22	K.K.Phadris Training Officer	Advanced Trg. Institute, Sion ,Mumbai-22	Member

GENERAL INFORMATION

1	Name of the Trade	Instrument Mechanic (Chemical Plant)
2	NCO Code	841.20, 841.70, 851.20
3	Entry Qualification	(a) Passed 10th class examination under 10+2 system of education with Physics, Chemistry & Mathematics or its equivalent. (b) Passed B.Sc. with Physics & Chemistry.
4	Duration of Craftsmen Training / Basic Training	(a) For 10th class pass:2 Years (b) For B.Sc pass : 6 months
5	Duration of Apprenticeship Training	(a) For 10th class pass: 3 years (Including 2 years Basic Training) (b) For B.Sc. Pass : 1 ½ years (Including 6 months Induction Training)
6	Rebate to Ex – ITI trainees for Apprenticeship training	(a) For 10th class pass:2 Years (b) For B.Sc pass : 6 months
7	Ratio of Apprentices to workers	1 : 7
8	Space norms	6.00 sq. mt. / trainee
9	Power Norms	

Note: The course content for the subject of Social Studies, being common for all trades, are not incorporated in this syllabus.

Syllabus
FOR THE TRADE OF INSTRUMENT MECHANIC (CHEMICAL PLANT) - UNDER CTS

Week No.	Trade Theory	Trade Practical	Workshop Science & Calculation	Engineering Drawing
1	2	3	4	5
1.	Introduction to Craftsman Training: Workshop safety, safety Rules and regulations, Use of fire fighting equip-ment in the workshop and First Aids. **General Safety:** Introduction & importance of safety &. general precautions observed in the workshop. Fire prevention and fire control in chemical industries. Study of personal protection equipments (PPEs) used in chemical plant. Awareness about Centralized alarming system First aid in chemical plant. Introduction to occupational health hazard. Environmental pollution, sources, causes, consequences and controls. Importance of cleanliness in Instrument Trade.	Familiarisation of various trades, Issue of workshop dress, hand tool & stationeries. To inculcate cleaning habit of Instruments, Calibrators, and Test Equipment in Instrument Calibration Room/ shop. Introduction to safety equipments and their uses. Awareness of first aid, fire fighting equipments and hydrant system, material safety data sheet (MSDS), Personal protective equipments (PPEs).	Introduction to Workshop Science and Calculation.	Introduction to Engg. Drawing Its relevance to the trade. Use of drawing board and T-square.
2.	Hand Tools: General tools and their materials used in the workshop; Hacksaw, Screw drivers, Spanners. Pliers, Vices, Chisel, AlIen.key set, Tweezers, Hammers etc.	Demonstration & practice on cut-ting mild steel flat, marking of jobs. Exercise on cutting and chipping.	Physical Chemistry (i) Introduction to chemistry. (ii) Gas Laws. (iii) Introduction to ratio activity • **Physics** Units and dimensions, Vernier Caliper, Spherometer, Micrometer, Screw gauge, Scalar & Vector quantities, their representation, resultant parallelogram and triangle of vector.	Free-hand drawing of straight lines, rectangle, squares, circles, polygons, etc.

			• **Mathematics** Solution of 1st & II nd order equations with one or two unknowns algebraic calculations and by Graphs.	
3.	Files-Classification types, material, grade of file, marking tools, steel rule, Tri-square, V- block, Caliper, their uses, care and maintenance.	Filling: Surfaces, sides, exercise with accuracy up to 0.1 mm. Use of different files-Flat, Round, Half round, Triangular, Square	(i) Atomic structure (ii) Classification of elements. • **Physics:** Rest and Motion equation of motion under gravity in a circle with constant angular velocity and acceleration, work, power, Energy. Mathematics Solution of 1st & II nd order equations with one or two unknown algebraic calculations and by graphs.	Free-hand sketches: Simple solid such as cube, cylinder & cones, rectangular blocks etc. and their view when viewed perpendicular to their base or axis.
4.	Drills: Classification, Types, and material of construction, methods of use.. Tapes and Dies: Types of threads, their applications.	Simple exercise of drilling & tapping.	Calculation of hole size for drilling and Tapping. • **Physics** S.H.M., Rotational motion, moment of inertia, Simple machines.	Use of Set square & other drawing instruments. Reading of Simple Blue Prints.
5.	Screw Drivers, Pliers, Spanners, their classification, materials and precautions while using them.	Using proper screw drivers for Tightening and opening the screws. Practice to remove damaged screws.	(i) Law of mass action (ii) Gas Laws (iii) Introduction to radio activity • **Physics:** Static and Kinetic friction, their measurement, Elasticity, Stress, Strain Hook's Law, Determi-nation of Young's modules.	Free-hand sketches of Hand Tools, Screw drivers, Plier, Spanner, Tweezer.
6 & 7	Precision Measuring Instruments: Vernier Caliper, Micrometer, Depth	Measurement by Vernier Caliper, 'Micrometers, Depth Gauge,	• **Physical Chemistry** Surface energy, surface	.Free-hand sketches of Vernier Caliper, micrometer, Depth

	Gauge,Bevel Protractor, Dial Test Indicator, Their principle of measurement, care and maintenance.	Bevel protractor, Dial Test Indicator etc.	Tension, Angle of contact	Gauge, Dial Test Indicator, Bevel protractor.
8 & 9.	Pipes: Grade, materials of different types of pipes. Use of T-bend, Elbow, Reducer, Coupler, different types of valves, Leakages in pipes joints. Procedure for cold and hot bending Non-Ferrous pipes, Method of bending, flaring, cutting of copper, aluminum tubes, Sand filled tube bending, compression fitting.	Threading on pipes, Simple pipe joints by using T-bend, Elbow, Reducer, Coupler bending of pipes, Sealing of pipe joint. Practice on cutting, flaring, bending of copper, aluminum pipes, Practice ERMETO & compression fittings.	Metallurgy of iron pipe, its corrosion and treatment. Metallurgy of non-ferrous pipes their anticorrosive treatment.	Free-hand sketch ot pipe, its sectional views etc. Free-hand sketch on pipe, and its loops, layout etc.
10.	Introduction to Lathe: The principle features & main parts of lathe, Tools for different operations, steps and method of turning. Care and maintenance.	Identification of various parts of Lathe. Familiarisation of precision watchmaker's lathe, Fixing of tools, and jobs on lathe, Simple Exercises of plain, step turning. Checking of tool angle.	Metallurgy of Ferrous metals.	Free-hand sketch of lathe and various lathe tools.
11& 12.	Procedure of taper turning & boring.	Exercises on taper turning and boring.	Calculation of taper angle. • **Physics** Hygrometer	Writing single stroke letters & nos. IS : 696-1972
13 & 14.	Different type of threads including NTP methods of thread cutting, Need of cutting fluids. Precaution to be observed during threading.	Turning practice upto accuracy 0.2 mm. Exercises on thread cutting.	Calculation of Gear train for thread cutting. • **Mathematics** Area of solid surface.	(Revision) Geometrical construction of lines, angles & triangles.
15.	Introduction to Precision Watch-maker's Lathe, Different accessories of Watchmaker Lathe, Its care & maintenance.	Practice on making small parts of instruments, e.g. Nozzle.	Preparation and properties of Sodium hydroxide and carbonate. • **Physics** Mode of heat transfer, Thermal conductivity and its determination	Geometrical construction of parabola, hyperbola, spiral; etc.
16.	Introduction to Engraving: Machine: Its Pentograph and other parts, letters, numbers, ratio etc.	Operation of Engraving Machine, using suitable size of letters, numbers with adjustment, size and ratio.	Allotropy of hydrogen, carbon, phosphorous and sulfur. • **Physics** Dispersion, Spectrophotometer	Different types of lines used in Engineering drawing IS : 969-1972 (Rev)

			po1arisation.	
17 to 19	Soldering, de- soldering, Brazing.: & Crimping: Definition to Soldering, brazing & crimping. The Soldering station with temperature control.	Practice on Soft Soldering de soldiering practice joining various electrical components, wires, and temperature controlled. Soldering Station. Importance of tinning, Crimping & Precautions.	Manufacturing process of HNO3, NH3, HCl and H2S04. • **Physics** (i) Preparation, properties and uses of Aluminum Chloride, Potassium Ferro & ferricyanides, bleaching powder, V_20_5 Glass and Ink. (ii) Fuels • **Mathematics:** Volume of solids like cube, sphere, prism, cone etc.	Isometric views solid and hollow objects. Orthographic view of simple objects by 1st Angle projection.
20 to 21.	Corrosion: Definition, Difference between corrosion & errosion, Prevention of Corrosion, curing of corroded parts.	Application of anti corrosive substances to protect the metal parts.	Alipathic hydrocarbons saturated and unsaturated. • **Physics:** corrosion • **Mathematics:** Trigono-metry-study of sine, cosine, tangent of angles in a right-angled triangle and application in solving Practical problem.	Drawing of orthographic views of simple solid and hollow objects.
22.	INDUSTRIAL VISIT			
23	Basic Electricity: Electricity by chemical method type of primary cell, Storage Battery, Lead acid cell, Alkaline cell, Lithium cell etc.	Study on cells connected in series, parallel as well as in combination. Determination of current and voltage.	Electrolytes of cell-primary, secondary and Rechargeable battery-their chemical actions. • **Physics :**-Heating effect of electric current.	Orthographic views of Primary, Secondary, Rechargeable battery pack. *Mathematics: Logarithms. Circuit diagrams showing ISI symbols of electrical
24	Faraday's Law of Electrolysis: Explanation, Objective, Procedure.	Verification of Faraday's first law of Electrolysis. Precautions to be observed in performing experiments.	Physics: Current electricity by chemical reaction, Cell's magnetic effect of current	

		Determination of mechanical equivalent of heat.		
25 & 26	Generation of electricity by Magnetic effect-Principle of Generators, AC & DC supplies, Units of Electricity. Photo electric cell principle & working. Conductor & Insulator.	Connections of Simple circuits using Ammeter, Voltmeter, Wattmeter with electrical components in series, parallel and combinations. Photo electric cell principle & working.	Ohm's law. Kirchhoff ‘s Law.	ISI symbols of Generator, Voltmeter, Ammeter, Watt-meter.
27 & 28	Introduction to Ohm,s law and Kirchoff’s law. Resistance: Type of resistors, their materials, colour code and uses. Combination of resistance series and parallel Inductance: Self, Mutual Induction-Inductors, Transformers, Relays, Capacitance: Type of capacitors, its construction, values, and their uses.	Verification of Ohm's Law, Kirchhoffs law, precaution to be observed while experimenting the laws, Construction of circuits with choke, transformer, relay. capacitor etc.	Inductive Reactance: Calculation of XL, Capacitive Reactance: XE Impedance(Z) Transformer Ratio.	ISI symbols of Resister, inductor, Capacitor, Trans-former etc.
29 & 30 .	Principle of Motor: AC and DC Motors, type and uses in chemical plants.	Study to construction of motor valves, recorder-motors used in chemical plants-their adjustments and maintenance.	Power factor and its calculation.	Freehand sketches of AC & DC motors.
31 .	Moving Coil Instruments: Ammeter, voltmeter, extension of range. Ohm meter construction, range, sensitivity, accuracy, damping etc.	Measuring of current, voltage in the circuit construct, making of electric bell, Alarm, power circuits.	Calculation of power factor.	Orthographic views of Am meter, Voltmeter
32 .	Moving Iron Instrument, Dynamometer, Wattmeter, Meger, Energy meter-their Principle of Operation & Construction.	Use of electrical meters in measuring and their care and maintenance.	Calculation power with the - current Voltage measured.	ISI symbols of Ammeter, Voltmeter, Wattmeter, Megger, KWh-meter etc.
33 .	Principle, operation and construction of Electrical Test Equipment-Multimeter, LCR Bridge, Whetstone's Bridge.	Use of electrical test equipments. e.g. for measuring the current, voltage etc.	Damping, Accuracy	Freehand sketches of Multimeter.
34 &35	Introduction to Semiconductor Devices: Semiconductor materials-Intrinsic & Extrinsic, P type & N-type materials, charge carriers.	Study the characteristics of conductor, semiconductor & Insulator.	Pressure regulator and steam traps.	Drawing of pressure control process line.

36 & 37	P-N Junction, Depletion zone, Barrier voltage, Diodes, LED, LCD, Zener diode, half wave and full wave rectifiers, filters, fixed and variable voltage regulator. SCRs, DIAC-their application, uses and care.	Making of DC power supply, smooth and regulated output.	Process flow line: pipes their materials, sizes etc. Carryout serviceability checks on DC power supply of Instruments.	Drawing of fluid flow, ISI symbols of Diodes in circuit drawings.
38 & 39	Bipolar Transistors: PNP, NPN, types-amplifier circuits, classification, Biasing, coupling, FET, UJT, MOSFET.	Practice on making transistorized amplifiers by soldering on Vero board.	Reciprocating compressors checking for current functioning, carry out functional checks on transistorized Instruments.	Drawing of process flow system, IS! symbols of Transistors used in circuit drawings.
40 & 41	Introduction to digital electronics:Binary and Hexadecimal number Systems: Logic gates, Circuits, Truth Tables.BCD coding systems.	Experiments on Logic Gates : AND, NAND, OR, NOR, XNOR using Digital IC- Trainer, Preparation of truth table.	Manufacturing process, Flow sheet of Caustic Soda, Chlorine, Conversion from Hexadecimal to Binary.	ISI symbols of Logic Gates.
42 & 43	Introduction to Integrated Circuits: Timer IC, OPAMP etc. their functions, ICs used in various Instruments.	Experiments on IC 555/IC 556, IC 747 with IC-Trainer.	Types of heat Exchanger, double pipes, Shell & Tube heat Exchanger.	Block diagrams of ICs.
44 & 45	Introduction to Microprocessor: Introduction to Computer. Arithmetic Logic unit, Memory, CPU, ROM, RAM, EPROM, etc	Study of Digital ICs on digital trainer Kit, conversion of Analog to Digital, Digital to Analog.	Steam ejectors, Rotary Vacuum pump, Centrifugal pump etc.	
46 & 47	Operational Amplifiers and their use in Instrumentation, Principle, operation & function of CRO.	Using OP-Amp circuits of Astable, Monstable, Bistable multivibrators, Study by Oscilloscope.	Introduction to Film co-efficient and over all film co –efficient on Heat Transfer.	Freehand sketches on process instrument. Freehand sketches on process instrument.
48 .	Application of ICs in various instruments, Recorders and controllers.	Study and identify various ICs used in PCBs of different instruments. Working in PCBs on different circuits, mounting of components, Precautions to be observed while soldering sensitive components on PCBs	Indirect fired Rotary Kiln.	Drawing of pressure, Level flow and temperature control system.

49.	Study of different types of sensors & signal systems. Pressure Measuring Instruments: Definition of pressure, Barometric Pressure, Gauge Pressure, Differential Pressure, Absolute Pressure, their units. Different type of Pressure measuring Instruments, Manometers, Barometers.	Dismantling and assembling of pressure Gauge, Testing of Pressure indicators with Standard Calibrator/Dead weight Tester, Precaution to be observed while testing.	(i) Alcohols & Acids (it) Halogen Compound of aliphatic (iii) Aliphatic aldephydes & ketones Physics: Acids & Alkali, Determination of pH, flash point. Barometer, Atmospheric Pressure, Absolute Pressure. Physics: Tangent Magnetometer, Dip Circle, application of magnets. Charles Law and Boils Law, Preparation of Barograph, error cards.	Free-hand sketch on Chemical laboratory apparatus. ISI symbols of pressure Gauges/Indicators. ISI symbols for pressure, Recorders.
50.	Construction and principle of operation for various pressure gauges. Importance of calibration in Metrology.	Dismantle the pressure gauge and study the construction, adjustments for correct functioning.	(i) Ethers and Esters. (ii) Carbohydrates	ISI symbols of pressure indicator cum-Recorder.
51.	Compound pressure gauges/Vacuum gauges: lts construction uses Principle of operation, construction of Absolute Pressure Gauge Aneroid Barometer.	Calibration of compound pressure gauges/ Vacuum gauges. Calibration of Absolute pressure Gauge. Calibration of Aneroid Barometer.	• **Mathematics:** Trigonometry; sine, Cosine, Cosec of angles in a right angled tri-angle.	ISI symbols of pressure in-dicator cum-Recorder.
52	Revision and Test			
53 & 54	Measurement of Temperature: Liquid Expansion Type-Mercury in glass thermometer, steel thermometers, Alcohol in glass thermometer. Solid Expansion Type- Bimetallic thermometers. Vapour Pressure thermometers.	Carrying out serviceability checks on Temperature Gauges, their routine maintenance, Calibration of expansion thermometers.	• **Heat Energy**- Temperature, units scales / graduations etc. Co-efficient of expansion of solids, liquids and gases.	ISI symbol of temperature indicators.
55 &	Thermocouple & RTD Thermistor,	Calibration, maintenance &	Seebek's theory.	Free-hand sketch of Tem

56.	their ranges, construction, principle of operation, compensating leads, Recorders , pyrometers etc. introduction of electronic temperature calibrator.	reconditioning of Thermocouple, thermopiles, RTD, thermistor, pyrometers. Recorders. Calibration of temperature measuring instruments using electronic temperature calibrator		perature indicator, Recorder.
57	Liquid Level Measurement. 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. Air purge method. Introduction to differential pressure measurement.	Study construction of Hook type, Sight glass and Float type level measuring instruments of close and open tank. Static pressure level measuring instruments, Bubbler system for close and open tank. differential pressure measurement	(i) Introduction to aromatic compounds. (ii) Benzene and its derivatives.	Free-hand sketch of level measuring instruments.
58 & 59	Electronic Level Measuring Instrument: Variable capacitance, High and low level alarm ON-OFF Ultrasonic and Magnetic type level indicators, Admittance.	Differential pressure type level checking calibration of Electronic Level Indicators., Ultrasonic and admittance type level indicators.	Mathematics: Problems on measurement of liquid quantity by change in height of liquid.	ISI symbols of level measuring instruments.
60 & 61	Measurement Fluid Flow: Primary elements used for rate of flow measurement – like orifice meter & venturi meter, Rotameter- its type..	Study of orifice plates, Flow nozzles, Pitot tubes, Venturi heads, their shape and connections etc.	Bernoulli's Theorem: Problems on differential flow measurement using orifices.	Free-hand sketches of various Orifices, Nozzles, Venturi tubes.
62 & 63	Quantity Flow Measurement Volumetric type, Gas flow meter, magnetic flow meter. Turbine flow meter, vertex flow meter, ultrasonic flow meter.	Study of Oscillating piston type, Rotating vane meter, Nutating disc meter.	Mathematics (i) Problems on flow of fluid. (ii Preparation of Oxalic acid.	Free-hand sketches of Gas and water flow meter.
64.	Introduction to Industrial control system. – close loop & open loop system.: ON-OFF controller, Level control, Time control, Photo-control, Fire detecting circuits etc.	Functioning of controllers. close loop & open loop system.: ON-OFF controller, Level control, Time proportional, Photo-control, Fire detecting circuits etc.	Direct fired Rotary kiln.	Isometric views of ICs and other components on PCB
65.	Recorders: Mechanical Recorders-pens, charts, inks etc. Principle of operations, recording systems, time travels.	Calibration of mechanical recorders, adjustment of time travels, changing of charts, ink, minor rectification/repairing. Find out errors and adjustment.	Manufacturing process and flow sheet of sulfuric acid.	Freehand sketches of mechanical Recorder, its ISI symbol.

66 & 67	Electrical & Electronic Recorders-principle of operations, recording system, chart motor, ink, pen, moving element etc. punching and dot system, errors and adjustment.	Check Calibrate the Elect/Electronic recorder for its correct functioning, study its construction for minor rectification..	Introduction of evaporation. Types of evaporators.	Freehand sketches of mechanical Recorder, its ISI symbol.
68 & 69	Theory of Integrating system in recording processes variables, Multi-pens recorder and cam arrangements.	Reconditioning of Strip Chart & Circular chart recorders.	Forced circulation evaporator, multiple-effect evaporator	Free-hand sketches on multiple-pens recorders.
70	Potentiometric type recorders: multiples potentiometer type recorder.	Providing different type of recorders trainees to check calibrate individually.	Instrumentation of an evaporator.	Free-hand sketch of Potentiometric type recorder
71&72	Telemetering: Telemetering in process control, types of transmitters, principle of construction of different pressure Transmitters. Mechanical type Differential pressure Transmitter-Principle, construction, operation.	Study construction of DP Transmitter pneumatic type, Calibration of DP Cell (Pneumatic) its range changing and suppression / elevation.	Manufacturing process and flow sheet of Soda Ash.	Free-hand sketch of DP Transmitter (Pneumatic).
73	Principle, Construction of Electronic DP Transmitter, methods of calibration and procedure of adjustments of error.	Reconditioning of DP Cell, replacement of parts, adjustment and calibration.	Distillation, Introduction, Process.	Layout diagram, connection of DP cell (Electronic).
74	Principle, Construction, operation of Temperature Transmitter (Pneumatic and electronic).	Calibration of temperature transmitter and its adjustment.	Boiling point diagram.	Free-hand sketch of Converters.
75	Converters: Principle, Construction, operation of current to air, and pressure to current Converters.	Reconditioning and Calibration of current to air and pressure to current converters.	Raoult's Law, Henry's Law and equilibrium	Free-hand sketch of Converters.
76	Principle of operation, construction and necessity of E.M.F. to current converters. Range adjustment etc.	Reconditioning of E.M.F. to current, current converters and its calibration.	Relative volatility, method of distillation.	Process layout diagram showing converters and other items.
77.	Piping, Tubing connections of DPT, Erection of different types of Transmitters.	Reconditioning and calibration of DPT converters etc.	Rectification, types of distillation columns. Distillation column of process.	Process diagram PI controllers. Diagram of PID process.

78 & 79	Controller's:(Analog & Digital) Open loop, Closed loop, Feed back control system, Modes of control system., its operation, function, advantages & disadvantages.	Study the construction, Identifi-cation of components of ON-OFF type controller (pneumatic and electronic) in the various fields.	Absorption: Introduction, Equilibrium, Mass transfer co-efficient, factor effecting rate of absorption, flooding velocity.	Cascade control system.
80	Proportional Controller: Principle of construction, operation, Proportional Band-Setting, adjustment.	Check calibration of proportional controller, reconditioning, adjustment, setting of proportional Band.	Different type of absorption columns.	Instrumentation diagram of distillation columns.
81	Proportional with Reset/integral action, effect of reset, rate of proportional action.	Setting of restive, proportional Band, Check calibration of controller.	Petroleum Refining.	Instrumentation diagram of PI control system.
82	Control lead and Lag, Step and Frequency response. Derivative action of PID controller.	Observe the step response, frequency response, lead and Lag on PID controller using Simulator.	Extraction : Application of Liquid extraction, theory definitions, choice of solvent.	Instrumentation diagram of distillation columns, evaporator of PID control.
83 & 84	Principle of Electronic controller, study of circuit diagram, components, method of calibration.	Repair/Reconditioning of Electronic controllers, Testing and calibration of PID controllers.	Mixer settler extractor, Spray tower.	Process diagram of Heat exchanger of PID.
85 to 87.	Final control elements:- Types of valves, its function, parts, setting range, calibration etc.	Dismantling, reconditioning, checking and resetting of diaphragm control valves, calibration of diaphragm control valve. Leak test, replacement of valve parts like diaphragm, sealing rings, plugs etc. Laping of valve seats, plug leakage test, calibration of valves. Erection of valve positioner.	Leaching: Introduction and applications.	Instrumentation diagram of Drier, Control valve. Instrumentation for pump, ejectors and symbols for electronics equipments.
88.	INDUSTRIAL VISIT			
89 & 90	Electrical Instruments: Principle, Construction & function of permanent magnet Moving coil meters, Ammeters,	Reconditioning of Ammeter Volt-meter, check calibration of PMMC and MI meters with the calibrators.	Drying: Introduction to water vapour pressure curve for water, relative humidity, moisture.	Circuit drawing and layout of calibration of Elect. Meters.

	voltmeters used in AC & DC Principle, Construction & function of moving coil meters & Digital meters.			
91 & 92	Principle, construction and operation of wattmeter, Power Factor Meters, Energy Meter.	Calibration of Energy Meter, Watt meter	Rotary drier, Spray drier. _	Drawing of Electrical Test Meter etc. Handling and care. circuit of different meters.
93 & 94.	Optical Instruments: Principle, construction & operation of Binocular, Telescopes, Microscopes.	Reconditioning of different types of Microscope, Telescope, Binocular.	Rotary drier, Spray drier.	Free-hand sketch of optical instruments.
95 & 96.	Introduction to PLC.	Understanding the function of PLC and concept	-do-	-do-
97 & 98.	Basics of SCADA and DCS	Industrial visit for understanding SCADA and DCS operating controlling system.	-do-	-do-
99.	Laboratory Instruments: Principle accessories, operation of Industrial Appliances Analytical balance, Air Damping balances, Automatic Recording, (Self registering balance). Moisture Determination Balance Principle, accessories, operations, function and industrial application of apparatus.	Practice to use properly- 1. Balances Sedimentation and Decantation. 2. Dorr Thicker. 3. Moisture & Humidity Manufacturing process of paints and varnish.	Sedimentation and Decantation, Dorr thicker	Free-hand sketch of Analytical Balances.
100.	Principle, accessories, Function industrial application of the apparatus.	Use Care & Maintenance (i) Surface Tension (ii) Viscometer (iii) Pyrometer (iv) Microscope (v) Potentiometer (vi) Conductometer (vii) pH-meter (viii) Polargraph	Manufacturing of Glass. Centrifugation: Top driven centrifuge.	Diagram of pyrometer. Circuit of Potentiometer.
101.	Principle, accessories, Function industrial application of the	(i)Calorimeter, (ii) Spectrometer,	Centrifugation: Top driven centrifuge.	Circuit of Potentiometer.

	apparatus.	(iii) Photo calorimeter, (iv). Flame photometer.		
102	Contd.	(i) Refractometer, (ii) Polarimeter, (iii) Apparatus for Electrophoresis	Manufacturing process and flow sheet of cement. Manufacturing process and flow sheet of cement.	Circuit of Potentiometer.
103 to 104	REVISION AND EXAMINATION			

Contents marked with ● may be exempted for B.Sc. Apprentice trainees.

Social Studies :
The syllabus has already been approved and is same for all the trades.

TRADE: INSTRUMENT MECHANIC (CHEMICAL PLANT)
General Installations

CLASS ROOM-CUM-INSTRUMENT SHOP

Sl. No.		
1.	Chalk Board green with sliding sunmica, 3' - 6" x 3' - 0"	01
2.	Desk with sunmica top	01
3.	Chair with Full Table, for training	18
4:	Overhead Projector 3-element lens Twin lamp 2500 lumen.	01
5.	LCD multimedia projector	01
6	Table Lamps Sodium Vapor, 9/18 watt, 230 volts	16
7	Voltage Stabilizer Servo-control 7.5KV A	01
8	Linear IC- Tester	02
9	Digital IC- Tester	02
10	Semiconductor Test set	02
11	Air Compressor	01
12	Capacity Tank (Air/Vacuum)	01
13	Vacuum Pump	01
SHOP INSTALLATION (MACHINES)		
1.	Drill power 3/8" precision, bench type motorised	01
2.	Grinder double ended bench 7" high revolution motorised	01
3.	Engraving Machine model, complete with accessories and two sets of master numbers & alphabets	01
4.	Buffing Machine, 36" Spindle	01
5.	Temperature calibration bath (Dry)	01
6.	Precision Centre Lathe 9' x 3' including bed, accessories Motorise.	02
7.	Instrument Testing Bench with cupboards	08
8.	Bench working 6' x 3' x 2.5'	03
9.	Bench working metal top 6' x 3' x 2.5'	01
10.	Steel Cupboards 6' x 3' x 1.5'	06
11.	Tool Kit Boxes for trainees (steel lockers)	16
12	Signal system trainer’s kits	01
13	Sensors trainer’s Kit	01
14	PLC & SCADA trainer Kit	01
15	DCS Kit	01

LIST OF TOOLS AND EOUIPMENT FOR A BATCH
OR UNIT OF 16 TRAINEES

TRADE: INSTRUMENT MECHANIC (CHEMICAL PLANT)

Tools, equipment etc.-wherever size shown in F.P.S. units are to be procured in metric sizes.

TRAINEES' KIT

SI. No.	NOMENCLATURE	QTY.
1.	Steel Rule flexible 15 cm.	16
2.	Spring Caliper Outside 10 cm.	16
3.	Punch center knurled 10 cm	16
4.	Screw driver set of six, Watchmaker's	16
5.	Screw driver set of five, electrician	16
6.	Plier combination 12 cm.	16
7.	Plier long nose, 10 cm.	16
8.	Nipper side cutting 10 cm.	16
9.	Chisel cold flat 10 cm.	16
10.	Hammer Ball Pain with handle 1A Ib	16
11.	Tweezer fine point stainless steel 12 cm.	16
12.	Tweezer pivot straighting 12 cm.	16
13.	Tweezer bent point 12 cm.	16
14.	File Half round smooth 12 cm.	16
15.	File hand safe second cut 25 cm.	16
16.	File hand safe smooth 15 cm.	16
17.	File round second cut 15 cm.	16
18.	File triangular cut 10 cm.	16
19.	File square cut 10 cm.	16
20.	Hand vice 10 cm.	16
21.	Scriber 4" x 3/16 balls end/I 00 x 5 cm.	16

MEASURING INSTRUMENTS. TOOLS & GENERAL SHOP OUTFIT FOR THE UNIT

1.	Try square with hardened blade 10 cm.	04
2.	Spring Divider 10 cm.	05
3.	Spring Caliper 10 cm	04
4.	Plier side cutting insulated 15 cm.	08
5.	Plier Round Nose 10 cm.	06
6.	Plier snip nose 10 cm.	08
7.	Neon bulb Phase Line Tester 500 Volts	08
8.	File swiss precision assorted set of 12 Nos.	08
9.	File Feather edge smooth 4 "/l 0 cm.	08
10.	Eye glass 3" focus, watch-maker 7.5	08
11.	Goggles safety	08
12.	File Bastared, 12 "/30 cm.	08
13.	Punch pin 4" x 3/32" x 1/8" or 100 x 2.5 x 3 mm	04
14.	Oil stone triangular 3/8" x 4" or 10 x 100 mm.	04
15.	Oil can (pressure delivery)	02
16.	Surface, plate 30 x 30 cm.	02
17.	Universal Scribing block 9" Pillar or 225 mm.	02
18.	V-Block with clamps pair	02

19.	Punch letter set 2 mm.	02
20.	Punch number set 2 mm.	02
21.	Hacksaw frame, adjustable 8" - 12"/20 cm - 30 cm.	08
22.	Hand drilling machine, motorized 230 V	04
23.	Chisel Cold Flat 4"	04
24.	Chisel Diamond point cold 4"	04
25.	Chisel cross cut 4"	04
26.	Chisel cold round 4"	04
27.	Drill Twist S.S 0-60	01 set
28.	Drill Twist S.S.A-Z	01 set
29.	Taps & Dies (B.A. 0-10)	01 set
30.	Hammer Ball Pen 1.5 lbs. with handle	04
31.	Sprit Level metal 4 "/10 mm.	02
32.	Cover Glass (Inverted 'U')	08
33.	Soldering Iron 65 watt 230 volts	04
34.	Soldering Iron 125 watt 230 volts	02
35.	Soldering Iron 10 watt 230 volts	04
36.	soldering station (Temperature control)	01
37.	Screw Driver 8" Heavy Duty	08
38.	Hot plate single 1000 watt 230/250 volts	02
39.	Scrapper Half-round 4 "/10 cm.	04
40.	Scrapper triangular 4 "/10 cm.	04
41.	Anvil bench type 13 kg.	02
42.	Vice bench, Jaw 3 "/7.5 cm.	12
43.	Vice swiveled base, jaw 4"/10 cm.	04
44.	Vice hand, jaw 1 "/2. 5 cm.	08
45.	Vice pipe, jaw 4"/10 cm.	01
46.	Chamois leather 12" x 12 "/30 cm. x 30 cm.	04
47.	Gravers set of six	02 sets
48.	Adaptor morse 1/4" to 1/2" set of four	01 set
49.	Chuck lathe dog 6"/15 cm.	04
50.	Chuck lathe self centering 6"/15 cm.	04
51.	Chuck drilling machine, I /16 "-I /4" cap.	01
52.	Chuck drilling machine, I /16 "-I /4" cap.	01
53.	Pointer Extractor, Stainless steel fine	12
54.	Glass Desiccators with desiccant	08
55.	Screw Pitch Gauge, B.A. W.W. and metric	0l each type
56.	Vice drilling machine, 4 "/100 mm.	01
57.	Hacksaw Midget, 6 "/15 cm.	12
58.	Reamers parallel, 1/16" to 1/4" by 1/32" set of 7	02 sets
59.	Blow Lamps 1 pt. paraffin	02
60.	Center Lathe running tail stock	02
61.	Counter sink 1/4" dia. 1/4" shank 60 degree x 90 degree	02
62.	Counter sink 1/16" dia. 1/2" shank 60 degree x 90 degree	02
63.	Counter sink 3/16" dia.1/2" shank 90 degree	01
64.	Pliers Gas 6"/15 cm.	01
65.	Spanner double ended open B.S.F. 1/4" x 5/16"	12 each
66.	Spanner, adjustable 11 "/22.5 cm.	01
67.	Spanner adjustable, 4"/10 cm.	01
68.	Tools Knurling, revolving head three pairs of wheels for fine, medium course with one set of spare wheels.	02 sets

69.	Flaring tool kit up to 20 mm.	01
70.	Taps threading hand, B.S.W. 1/2" set of 3, 1st, 2nd and 3rd. with Tap wrench	02 sets
71.	Taps threading hand, Metric 5, 6, 8, 10 mm. in set of 3, 1st, 2nd and 3rd. -with Tap wrench	02 sets

PRECISION MEASURING INSTRUMENTS

01.	Micrometer Outside, 0-25 mm.	04
02.	Micrometer Outside, 25-50 mm.	01
03.	Micrometer inside with extension rods, 50-210 mm.	01
04	Micrometer Depth, 0"-1"	01
05.	Vernier Caliper, 6"/15 cm.	01
06.	Vernier Height Gauge, with Inches 12" or Metric 300 mm. graduations	01
07.	Vernier Bevel Protractor, with acute attachments	01
08.	Combination set 12"/30 cm.	02
09.	Standard Wire Gauge	04
10.	Dial Test Indicator in mm. with accessories	02
11.	Feeler Gauge leaf type, 0.00 15" to 0.025"	01
12.	Radius Gauge, leaf type 1mm. to 15 mm.	01

ELECTRICAL INSTRUMENTS

01.	Moving coil Voltmeters (various ranges)	04 each
02.	Moving coil Ammeters (various ranges)	04 each
03.	Moving Milliammeter (various ranges)	04 each
04.	Moving Millivoltmeters (various ranges)	04 each
05.	Galvanometer, centre-zero indicating	04 no.
06.	Moving iron AC- Voltmeters, various ranges	04 each
07.	Moving Iron AC-Ammeters, various ranges	04 each
08.	Voltmeter Dynamometer type AC & DC	02 nos.
09.	Ammeter-Dynamometer induction type, AC & DC	02
10.	Wattmeter dynamometer type	01
11.	Power factor meter	01
12.	Hot wire instruments (for current & voltage)	01
13.	Clamp on AC-Ammeter	01
14.	Ohmmeters multi-ranges	01
15.	Earth Insulation testers 500 volts	01
16.	Watt-hour meter	04
17.	Frequency meter, Vibrating reed type	01
18.	Ampere-hour meter	02
19.	Multimeter(AVO)	02
20.	Calibration for Ammeters, Voltmeters, Ohmmeters	01
21.	Calibration for Wattmeters, Energy meters	01
22.	Bridge for Resistance, Capacitance, Inductance	01
23.	Workshop Potentiometer, with Galvo. & std. Cell	01
24.	Regulated power supply with variable DC source	01

HUMIDITY INSTRUMENTS

1.	Hair Hygrometer	02
2.	Wet & Dry bulb Thermometer Type Hygrometer	02
3.	Sling Pyrometer	02

PRESSURE INSTRUMENTS

1.	Manometer, U-tube	01
2.	Manometer, Inclined tube	01
3.	Manometer, well type	01
4.	Barometer Mercury	01
5.	Barometer Aneroid capsule	01
6.	Gas pressure regulator	02
7.	Pressure Indicator Bourden type, (0 -20kg/Sq.cm)	16
8.	Pressure Gauge Capsule type, (0 – 1 kg/sq.cm)	16
9.	Pressure Indicator Bellows tube, (0 – 100mmWC)	16
10.	Dead Weight Tester, with accessories	01

FLUID FLOW METER

1.	Quantity Flow meter, simple tank type	02
2.	Reciprocating piston type flow meter	04
3.	Flow meter impeller type	04
4.	Bellows type Gas flow meter	02
5.	Magnetic flow meter	02
6.	Orifice type differential flow meter	02
7.	Ventury tube differential flow meter	02
8.	Nozzle type differential flow meter	02
9.	Pitot tube differential flow meter	02
10.	Taper tube Rotameter	02

LEVEL INSTRUMENT

1.	Sight Glass Level Indicator	02
2.	Hook type Level Indicator	02
3.	Float type Level Indicator	02
4.	Static pressure and air purge Level Indicator	01
5.	Show piece Ultra-sonic Level Indicator	01
6.	Variable Capacitance type Level Indicator	01

TEMPERATURE INSTRUMENTS

1.	Mercury-in-Glass Thermometers (various ranges)	06
2.	Alcohol or other liquid in glass Thermometers	02
3.	Mercury in Steel Thermometers, Remote Indicating	02
4.	Vapour pressure Thermometers	02
5.	Bi-Metal thermometers, stem & dial (various ranges)	04
6.	RTD Resistance-bulb Wheatstone Bridge Thermometers (PT – 100, PT-1000)	02
7.	Thermo-couple Pyrometers (with different thermocouple)	10
8.	Termo-couple with milli-volt-potentiometer pyrometer	02
9.	Optical Pyrometer	01
10.	Tungsten strip filament lamp for calibration of optical pyrometer	02
11.	Radiation Pyrometer	01

ROTATIONAL SPEED & CIRCULAR VELOCITY INSTRUMENTS

1.		
2.	Techometer Centrifugal	02
3.	Techometer Drag-cup type	02
4.	Techometer Electrical, Synchronous	02
5.	Stroboscope	01
6.	RPM- Tester/Techo. Tester	01

RECORDERS AND CONTROLLERS

1.	Circular Charts Recorder (Potentiometer type)	02
2.	Strip Charts Recorder (Potentiometer type)	02
3.	Measurement of Temperature, pressure level and flow for above recorders	02 each
4.	2-Position controller (ON-OFF type)	02
5.	Proportional Controller	02
6.	Proportional with RESET type Electronic Controller	02
7.	PID controllers (electronics & pneumatics)	01 each
8.	Pneumatic controllers for pressure, Flow, Temperature, and Level with associated equipment	02 each
9.	Transmitters, Pneumatic, Hydraulic and Electronic for above mentioned controllers, recorders, Process Simulator.	02 each
10.	Computers (latest configuration) with licence of operating Software UPS, PRINTER.	02
11.	Hydrometer	02
12.	De-Soldering Gun	04
13.	Vacuum Cleaner with accessories	04
14.	Thermo-Couple welders	01
15.	Sensitive Balance with weight and cover	01
16.	Educational Video CD/DVD on Instrumentation	02 sets
17.	Tool Kit Boxes for trainees, steel lockers	16
18.	Over Head Projectors with 3-Element Lens, 2500 Lumen	01
19.	Fire Extinguisher, Soda-Acid, CTC	01
20.	First Aid Box	01
21.	Steel Cupboards 6' x 4' x 1.5'	06
22.	Misc. Items (substantial quantities): Suitable containers, cables, resistors, capacitors, inductors! chokes, diodes transisters, Ics. sockets, plugs, jacks, pivots, bearings, hair-springs, LEDs., magnets, mercury, switches etc. of assorted sizes.	

SYLLABUS FOR THE TRADE OF INSTRUMENT MECHANIC
(CHEMICAL PLANT)
Under Apprenticeship Training Scheme
Period of Training: 3 years.

The period of training for this trade is 3 years, Consisting of Basic Training for a period of 2 years and Shop-Floor training for the remaining period for the apprentices.

The syllabus of this should be considered as guide for imparting Apprenticeship Training according to the facilities available in the industry.

LIST OF OPERATIONS/SKILLS TO BE LEARNT DURING PRACTICAL TRAINING INCLUDING BASIC TRAINING

Note:

1. During the Basic Training for the 10th class pass and Induction Training for B.Sc. degree holders, Operations/skills to be taught to the apprentices are indicated under the heading "Basic Training". The remaining operation/skills coming in the list should be learnt by the apprentices during the Shop-Floor Training as indicated under the heading "Shop Training". The apprentices should have more practice on those operation/skills which are learnt during the Basic Training and additional operations/skills during the Shop-Floor training and develop the correct method of doing the work.
2. (a) The contents of the 2 years Basic Training in this trade, is exactly the same as in C.T.S. syllabus.
   (b) The contents of the 1 year Shop-Floor Training for candidates who have undergone Basic Training in an Industry and for the Ex-I.T.I. trainees in the trade are as indicated under the heading "Shop Training"

BASIC TRAINING: 2 years

(Contents are same as the CTS part of 2 years)

SHOP FLOOR TRAINING: 1 YEAR

1. Operation:

1.1. The plant and its different products capacity of production etc. Their activities including process and maintenance.
1.2. Preparing a Schematic Layout of the plant. (material flow & instrument)
1.3. Study of personal & plant safety procedures and use of safety equipment, fire and fire fighting facilities/techniques, handing of hazardous chemicals and poisons substances.
1.4. Study of the process and operation in brief.
1.5. Reading a (process & instrument) flow sheet of a process. Making a simple flow sheet of a unit.

2. **Instrument Training:**

2.1 Study of location of the various elements like sensing element, transmitter, controller, final control valve of a control loop.
2.2 Study of instruments mountings like Panel mountings, Wall mountings and Yoke mountings. etc.
2.3 Care, safety and proper use of pneumatics fittings, coupling and associated tools.
2.4 Dismantling, Cleaning and Re-assembling of Air-Filters, Air Regulators.
2.5 Giving or Removing Input, Output and Air supply connections of a pneumatic instruments.
2.6 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.
2.7 Doing simple 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.
2.8 Learning how to isolate system for connection of Electrical components.
2.9 Use of Continuity Tester, multimeter, Workshop, Potentiometer. Doing simple soldering works.

2.10 Fabrication of thermo-couple (Brazing etc.) using seal pot. Fabrication of thermo- couple (Brazing etc.) using seal pot.
2.11 Soldering practice, metal to metal, wire to wire. wires to plugs, wires to connectors, wires to strokes, wires to terminal blocks.

3. **Instrument Shop**
3.1 Installation and maintenance of circular and strip chart recorder inking system, sensing elements etc.
3.2 Familiarisation, Installation and Maintenance of Control Loops and components (sensing clement, single indicator/recorder, controller and final control element), relays and announciater.
3.3 Familiarisation with instrument drawing in sketching, identification of instruments symbols and block diagrams of existing units in the plant.,
3.4 Calibration and Installation of other primary elements like thermocouple millivoltmeter, Potentiometer, capillary lube, pH-meter, liquid lever indicator, orifice meter, pitot tube and other flow meters.
3.5 Removal and Installation of transmission loop connecting sensing element and controller, final control elements etc.
3.6 Instrument and Panel Installation as per Blue Prints.
3.7 Repairing and Fabrication and fitting small parts and components like nozzles, bellows, hair-spring, pins etc. to plant instruments.
3.8 Familiarisation with maintenance scheduled & maintenance activity including calibration (Logging) followed in. the instrument shops.
3.9 Introduction and familiarisation with safe, protective storage procedure and inventry system followed for instruments and their components in the establishments.
3.10 Introduction to the operation of Digital/Analog computers, if available.
3.11 Familiarisation with the analytical laboratory instrument.

Note:

The apprentice should not be allowed to work alone in the plant. He will work along with a instrument technician. The apprentices must maintain a work diary as record of his inplant training.

SYLLABUS FOR RELATED INSTRUCTIONS (3RD YEAR)
The syllabus given for related instruction should be considered as guide: Subject to be taught to the apprentices are as given here under:
(A.) Trade Theory
(B.) Workshop Calculation & Science
(C.) Engineering Drawing
(D.) Social Studies.

(A.) Trade Theory
1. Importance of safety - matters in Industry.
2. Different Safety aspects related to Chemical Industry.
3. Idea of Safety control systems.
4. How to minimise accidents, special. Mention of techniques used to reduce explosion hazards.
5. Pinpointing some accident prone industries.
6. Basic concepts of Computer & Computer aided control system.
7. Some specific examples of computer aided control system & special mention to touch screen technology.
8. Concept of basic metrology, fundamentals of metrology.
9. Instrumental methods for assisting inspectors in manually gazing parts, work pieces, zigs, etc.
10. Dimensionally oriented motion control systems for machine-tools assembly lines, welding, painting, fabricating etc.
11. Familiarization with position-sensitive operations-various types of transducers & their field of

application. Various recorders. Digital instrumentation.

12. Details of instrumentation arrangement around a distillation column, a digester, Heat Exchanger, reactors, boiler, water treatment plant, power generating plant etc.

B. Workshop Calculation and Science

1. Physics

(i) Units and dimensions (Recap); concept of error, accuracy, precision, how to minimise error handling of an instrument, concept of calculation error. Simple Numerical problems.

(ii) Viscosity - definition, experimental, determination etc.
Concept of viscosity as an indicative tool of quality of a material.

(iii) Properties of fluid & fluid dynamics.

(iv) Critical study of physical properties of different metals, polymers & other material of construction of instruments.

2. Chemistry

(i) Quality of water - Hard, soft etc. Industrial methods of water softening.

(ii) Petroleum Chemistry.

Unit operation: Distillation

(iii) Ideas of pollution in chemical & other industries, various factors of pollutions & their containment.

Unit process - Petroleum
Refineries : Petrochemicals

Unit operation : Separation-techniques

(iv) Concept of pH and its instrumental technique of measurement.

Unit OP : Membrane technology & its application in instruments.
Unit process: Sewage treatment techniques. 3. Mathematics: (i) Techniques of graph plotting & cure fittings.

C. Engineering Drawing

1. Revision of silent points of the topics covered in previous two years.
2. Code of practice for engineering drawing to IS : 696.
3. Drawing orthographic views of the actual objects in the workshop.
4. Drawing half sectional view of the actual objects in the workshop.
5. Drawing isometric views of simple objects in the shop floor.
6. Free-hand sketching of the actual components/parts related to the trade.
7. Free-hand sketching and preparation of layout drawings and composition along with lettering and typography.
8. Blue print reading for application in the shop floor.
9. Practice in Auto-CAD.

D. Social Studies

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