

SYLLABUS FOR THE TRADE OF
“ATTENDANT OPERATOR”
(CHEMICAL PLANT)

UNDER

CRAFTSMAN TRAINING SCHEME
AND
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 “ATTENDANT OPERATOR (CHEMICAL PLANT)” UNDER
CRAFTSMEN TRAINING SCHEME HELD ON 19TH NOVEMBER 2008,
AT ITI MULUND, MUMBAI, MAHARASTRA**

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

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, Maharashtra.	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, Maharashtra	Member
8. J. A. Pariwal, Training Officer Hindustan Insecticides Ltd., Rasayani, Maharashtra.	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 N O.	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, 2 nd 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	A.N.Manchar Kar, Sci. Demonstrator	B.T.R.I. Mulund	Member
10	Takalkar E.S., Chemical Instructor	B.T.R.I. Mulund	Member
11	S.P. Pradhan, Manager Process Control	Piramal Healthcare , Thane	Member
12	V.I.Raojadeja, Executive (Instrument)	Godrej Indsutries Ltd.Mumbai	Member
13	M.A.Kamerkar Manager(Factory Admn.)	Mazda Colours Ltd., Navi Mumbai	Member
14	D.Mahaboob Basha, Vocational Instructor	Jotun India Pvt. Ltd. Pune	Member
15	Amogh Soman, Sr. Executive -HR	Jotun India Pvt. Ltd., Pune	Member
16	Mrs. Deshmukh J.J. Trade Instructor (Science)	B.T.R.I., Mulund	Member
17	Mr. P.S.Wagh	Principal, ITI., Mumbai	Member
18	L.K.Mukherjee,Dy. Director	CSTARI., Kolkata	Member
19	A. Nandi, Dy. Director	CSTARI., Kolkata	Member
20	P.K.Roy, Dy. Director (Chem)	ATI., Mumbai	Member
21	K.K.Phadris Training Officer	Advanced Trg. Institute, Sion ,Mumbai-22	Member
22	S.J. Wakde Trg. officer	Advanced Trg. Institute, Sion ,Mumbai-22	Member

GENERAL INFORMATION

1	Name of the Trade	Attendant Operator (Chemical Plant)
2	NCO Code	733.10, 733.15, 733.40, 733.50, 733.90, 734.15, 739.20, 741.15, 741.30, 741.60, 742.10, 742.30, 742.60, 743.10, 743.40, 744.20, 744.40, 745.10, 749.34, 773.50, 749.64, 749.72, 749.76, 749.82, 749.86, 773.13, 773.40, 773.50, 773.60, 773.80, 775.40, 775.65, 776.50, 893.20, 902.10, 902.30, 903.10, 722.10, 733.20, 733.45, 733.70, 734.10, 734.25, 739.55, 741.20, 741.10, 741.70, 742.20, 742.40, 742.90, 743.30, 744.10, 744.30, 744.50, 749.30, 749.42, 749.62, 749.68, 749.74, 749.80, 749.84, 749.88, 773.23, 773.40, 773.57, 773.65, 775.30, 775.55, 776.20, 893.10, 893.33, 902.20, 902.50, 903.20
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 : 10
8	Space norms	6.50 sq. mt. / trainee
9	Power Norms	

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

SYLLABUS FOR THE TRADE OF ATTENDANT OPERATOR

(Chemical Plant)

Under Craftsmen Training Scheme

Period of Training: 2 Years

1st Year

Week No.	Practical	Theoretical
1.	<p>Fitting Induction Training: Familiarization with Institute. Importance of trade training. Introduction about machineries & equipments used in chemical trade & work done by trainee. Introduction to safety equipment, first aid & fire fighting equipments and their uses in the section.</p>	<p>Introduction to general safety, personal safety, electrical 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. First aid in chemical plant. Environmental pollution, sources, causes, consequences and controls. Role of attendant operator in the Chemical Industries. Engineering Drawing: Introduction to engineering drawing. Its relevance to the trade. Use of drawing board, T-Square. (X) Physics: Introduction to Physics (X) Workshop Calculation and Science: Introduction to Chemistry, atom. molecule element, compound. Physical &. Chemical change. (X) Mathematics: Introduction Linear measurements and its units.</p>
2.	<p>Use of vice clamps, holding the job in the vice and practice of metal sawing with hacksaw and filing the edges maintaining squareness of all the faces. Marking practice using hermaphrodite caliper, surface gauge, engineers' try square, marking off table etc.</p>	<p>Introduction and use of job holding devices & marking tools in the fitting shop. Description and specification to different types of hammer. Surface gauge its description & construction. use and care of V –Blocks, Marking table, Try Square, Hacksaw frame & Blades, universal scribing block etc. (X) Engineering Drawing: Free hand drawing of straight lines. rectangles. squares. circles. polygon etc. (X) Physics: Units and dimensions. Vernier caliper. spherometer, micrometer, screw gauge, scalar and Vector quantities. their representation resultant. parallelogram and triangle of vector. (X) Workshop Calculation and Science: Gas Laws. Boyle's and Charles law, gas equation diffusion, Graham's law of diffusion, effusion, problems. Dalton's Law of partial pressure. Introduction to radio-activity alpha, beta and gama rays and their properties, radioactive changes alpha ray and beta ray change, group displacement law, definition of isotopes and isobars.</p>

		(X)Mathematics: Solution of linear & quadratic equation with one or two unknowns by algebraic calculations and by graphs.
3.	Filing flat surface and checking the flatness and squareness with engineers' try square. Filing four edges, checking all dimensions with outside caliper and steel rule.	Trade Theory: Files-their types, grades, cut, convexity, specifications, their use and care. chisel its type & uses. (X)Engineering Drawing: Free hand drawing of simple objects such as cube, rectangular blocks, cylinder, cones etc. and their views. (X)Physics : Same as Week No.2 (X)Workshop Calculation and Science : Same as Week No.2 (X)Mathematics : Same as Week No.2
4.	Filing adjoining sides/surfaces maintain the right angle between the sides. Marking of parallel lines using dot punch. Chiseling practice as per marking lines.	Trade Theory: Study of angle plate, parallel blocks, surface plate & their uses. Drill – types, nomenclature, specification, and their functions. Engineering Drawing: Use of set squares/mini drafter and other drawing instruments. Method of fixing a drawing sheet on the board. Layout of drawing sheet (Borderline title block etc.) Use of different scales mm., inch (X)Physics: Same as Week No.2 (X)Workshop Calculation and Science Same as Week No.2 (X)Mathematics : Same as Week No.2
5.	Same as Week No.4	Trade Theory: Same as Week No.4 Engineering Drawing : Same as Week No.4 (X) Physics: Rest and motion. Equation of Motion, motion under gravity, in a circle with constant angular velocity and acceleration. Work, power and energy. (X)Workshop Calculation and Science: Atomic structure, electron, proton, neutron, Rutherford's and Bohr's atom model, Bohr Burry Scheme and examples of distribution of electrons. Classification of elements. Modern Periodic law, table and periodic properties, (X)Mathematics: Same as Week No.2
6.	Making a job on step fitting (Male & female). Marking out the position of holes for drilling.	Trade Theory: Common faults on drill grinding and it's effect on drilling. Study of drill chuck, drifts, sleeves etc. Introduction of drilling machine its - type, parts &

	Grinding of drill bits. Use of centre drill for drilling operations.	specification. Engineering Drawing: Types of lines, letter writing in single stroke, dimensioning. (X) Physics: same as Week No.5 (X) Workshop Calculation and Science: Same as Week No.5 (X) Mathematics: Same as in week No.5
7.	Same as week no.6	Trade theory: Same as week no. 6 Engineering Drawing: Same as week no. 6 (X) Physics: S.M. Rotational motion, moment of inertia. Simple machines, requirements of a good balance. (X) Workshop Calculation and Science: Atomic, molecular and equivalent weight (Definition & examples only). Electronic theory of valency and introduction of normal, double and complex salts. (X) Mathematics: Factorisation
8.	Marking the job using height gauge. Practice of through & blind hole drilling to a specific depth. Practice of enlargement of drill holes, countersinking, counter boring, spot facing and reaming etc.	Trade Theory: Principle, construction and calculation of least count of vernier caliper, inside & outside micrometer, bevel protector, vernier height gauge. Uses, care and error adjustment of measuring instruments. Calculation of tap drill size. Engineering Drawing : Same as week No.7 Physics: Same as week No.7 Workshop Calculation and Science: Same as Week No.7 Mathematics: Same as week No.7
9 to 11	Grinding practice of drills, chisels and punches etc. Practice of drilling, tapping and dieing of BSW, and metric threads for various sizes. Practice of radius (convex & concave) filing, checking with radius gauge.	Trade Theory : Same as week No.8 Engineering Drawing: Free hand sketches of simple objects. Physics: (X) Static and Kinetic friction, their measurement. Elasticity, stress, strain, Hooke's law. Different moduli, work done in stretching a wire, determination of Young's Modulus. Workshop Calculation and Science: (X) Law of mass action Mathematics : (X) Factorisation.
12.	Practice of angular filing checking with bevel protector.	Trade Theory: Calculation of drilling speed, feed, drilling time etc. Concept of interchangeability system (limit, fits & tolerances). Engineering Drawing: Geometrical constructions.

		<p>Physics: (X) Surface Tension, surface energy, Angle of contact. rise of liquid in a capillary tube, different of pressure in a spherical bubble. Viscosity, Poiseuille's formula.</p> <p>Workshop Calculation and Science: Electrolysis Catalysis (X) Revision of the syllabus of the above weeks.</p> <p>Mathematics : (X) Area of surface of solids like prism, cylinder, cone etc.</p>
13.	<p>Turning: Introduction, types of work done in the section. Lathe - its parts and functions Checking for proper running, cleaning and oiling of various parts of machine. Practice for setting of tools in tool post in correct centre height. Grinding practice of rough turning tool. Facing & plain turning practice by holding the job on four jaw chuck.</p>	<p>Trade Theory: Study of general safety, personal safety, electrical safety, working safety while working on lathe machine. Lathe-its construction, cleaning and oiling. Lathe chucks – types, construction and uses. Common lathe cutting tools types, shapes and different angles.</p> <p>Engineering Drawing: Geometrical construction of lines, angles and triangles. (X) Physics: Same as Week No.12 Workshop Calculation and Science : Same as Week No.12 Mathematics: Same as Week No.12</p>
14	Same as week no. 13	<p>Trade Theory : Same as week no. 13 Engineering Drawing : Same as Week No.13 Physics : (X) Density and specific gravity Archimede's principle, principle of floatation Hydrometers. Center of gravity and equilibrium condition. Workshop Calculation and Science Same as Week No.12 Mathematics : Same as Week No.12</p>
15.	Practice of center drilling. Step turning - holding the job in between centers. Inspection of dimensions using proper measuring instruments.	<p>Trade Theory : Lathe, Accessories, such as center mandrel, collets, catch plate, lathe dog, face plate, lathe steady etc. their uses and care.</p> <p>Engineering Drawing : Geometrical construction of regular polygons. (X) Physics : Same as Week No.14 Workshop Calculation and Science : Same as Week No.12 Inorganic Chemistry : (Physics and Chemistry)</p>

		<p>Oxidation-Reduction Corrosion- causes & effect prevention.</p> <p>Mathematics : Same as Week No. 12</p>
16.	Same as Week No.15	<p>Trade Theory : Same as Week No.15</p> <p>Engineering Drawing : Same as Week No.15</p> <p>Physics : (X) Temperature and its measurement. Expansion of solids, liquids and gases.</p> <p>Workshop Calculation and Science : Metallurgy - General Principle and processes Metallurgy of Copper, aluminum Zinc, Iron & Steel.</p> <p>(X)Mathematics : Volume of solids like prism, sphere, cone etc.</p>
17	Grinding of finishing tool. Practice of finish turning with in the 0.02mm accuracy.	<p>Trade Theory : Common lathe cutting tools – roughing, finishing, grooving, undercut, thread cutting, knife and recessing tool etc. Cutting tool materials. Coolants and Lubricants – their types and uses.</p> <p>Engineering Drawing : Geometrical construction on plane curves such as cycloid, involute, parabola, hyperbola, spiral helix etc.</p> <p>Physics : Same as Week No.16</p> <p>Workshop Calculation and Science : Same as Week No.16</p> <p>Mathematics : Same as Week no.16</p>
18 & 19	Drilling on lathe - drilling through and blind holes. Setting boring tool in tool post. Boring – plain, step & enlargement.	<p>Trade Theory : Boring tool & its types. Setting of Boring tool. Tapers its type's, uses & calculation methods.</p> <p>Engineering Drawing : Different types of lines uses in engineering drawing as per IS 696-1972 (Latest Revision)</p> <p>Physics : Same as Week No. 16</p> <p>Workshop Calculation and Science : Same as Week No. 16</p> <p>Mathematics : Same as Week No. 16</p>
20 to 22.	Taper turning by swiveling compound rest, tail stock off set method. Turning gear blanks with mandrels, knurling practice.	<p>Trade Theory : Different taper turning methods. Advantages and disadvantage of tailstock offset method. Knurling tool-types and its uses.</p> <p>Engineering Drawing : Isometric views of simple solid and hollow Object.</p> <p>(X)Physics : Calorimetry, change of state</p> <p>(X)Workshop Calculation and Science :</p>

		<p>General discussion, occurrence, preparation properties and uses of alkali and alkaline earth metals. Inert gases: Introduction, History of discovery, their position in the periodic table.</p> <p>Mathematics : (X) Volume of solids like prism, sphere, cone etc.</p>
23 & 24	Practice of (BSW) & (Metric) thread cutting on lathe. Measurement of thread & its profile.	<p>Trade Theory : Screw thread purpose and forms. Screw thread terminology. Gear calculation for thread cutting, change wheel. Thread measurement.</p> <p>Engineering Drawing : Orthographic views of simple objects by 1st angle projection.</p> <p>Physics : Hygrometry</p> <p>Workshop Calculation and Science : Manufacture and the properties of sodium hydroxide and carbonate. Alloys: Preparation properties and uses.</p> <p>Mathematics : (X) Logarithms</p>
25 & 26	<p>Welding (Gas): Introduction-Importance of trade, types of work done. Demonstrate about general safety, personal safety, & precautions observed during gas welding. Procedure of fire prevention and fire control in gas welding workshop. Safety equipment's and their uses. Lighting and adjustments of flame. Fusion runs with and without filler rod-D.</p>	<p>Trade Theory : Introduction to general safety, personal safety, & precautions observed in the gas welding workshop. Fire prevention and fire control in gas welding workshop. Importance of welding in the maintenance of chemical plant and equipment's. Description and uses of tools and equipment's used. Welding terms and their definitions.</p> <p>Engineering Drawing : Orthographic views of simple objects by 3rd angle projection.</p> <p>Physics : Same as Week No.24</p> <p>Workshop Calculation and Science: Same as Week No. 24</p> <p>Mathematics : Same as Week No.24</p>
27 & 28	Practice of edge joint with or without filler rod.	<p>Trade Theory : Welding methods and types of welding, welding terms and definitions. Common used gases in welding - Oxygen, Hydrogen, Acetylene, CO₂ gas etc.. Colour coding of gas cylinders for identification. Chemistry and types of flame.</p> <p>Engineering Drawing : Exercises on orthographic view of simple solid and hollow objects.</p> <p>(X)Physics : Mode of heat transfer. Thermal conductivity and its determination.</p> <p>Workshop Calculation and Science :</p>

		<p>Laboratory preparation. properties and uses of carbondioxide. oxygen, Hydrogen sulphurdioxide and halogens. (Chlorine and bromine) Nitrogen, its oxides, fixation of nitrogen. Mathematics : Same as Week No.24</p>
29 & 30	Practice on outside corner joints – D, fillet weld-D, inside corner joint.	<p>Trade Theory : Introduction to oxy-acetylene welding and its equipments such as regulators, blow pipes etc. Assembly, care and maintenance of gas welding equipments. Engineering Drawing : Same as week no, 27 Physics : Law of thermodynamics and different thermodynamic processes, dispersion, Spectrophotometer. Polarization Workshop calculation and science : Allotropy of hydrogen, carbon, phosphorus and sulphur Acids, bases and salts water Sources, hard and soft water, causes and removal of hardness Mathematics : Same as Week no. 24</p>
31.	Practice on pipe butt joint - D, pipe T Joint -D	<p>Trade theory : Oxygen cylinder, DA cylinder, description, method of charging and care, faults in gas welding, definition of faults, their effect, causes and correction. Engineering Drawing : Same as Week No. 27 Physics : Same as week No. 29 Workshop calculation and Science : Same as week No. 29 Mathematics : Same as week No. 24</p>
32.	Same as week No. 31	<p>Trade Theory : Same as week No. 31 Engineering Drawing : Same as week no. 27 (X)Physics : Natural and artificial magnets, their properties and magnetic field. Workshop calculation and Science : Water for industrial purpose Preparation properties and uses of aluminum chloride potassium, Ferro and Ferricyanide bleaching powder. Mathematics : (X) Trigonometry- study of sine, cosine, tangent of angles in a right angled triangle & their application in solving, practical problems.</p>
33 & 34	Practice of hard surface stailiting. Brazing of dissimilar metals.	<p>Trade Theory : Hard surfacing - necessity, types methods, application. Destructive test, stailiting necessity.</p>

	Practice in gas cutting for various metal thicknesses.	<p>Type- Flame adjustment, methods and application, methods employed to control distortion and stress relieving.</p> <p>Engineering Drawing : Same as Week No. 27</p> <p>Physics : Intensity of magnetic field at a point on magnetic axis and magnetic equation, neutral point Tangent magneto meter, dip circle and applications of magnet. Static electricity - charge, charging by induction.</p> <p>Workshop calculation and Science : Organic chemistry Introduction to organic chemistry, Purification processes Organic reaction Substitution, addition (Polymerization). Elimination and rearrangement reactions. Explanation and example Nomenclature LU.P.A.C. and commons system. Classification & Functional Groups. Halo, Hydroxyl, Formal, Carbonyl, carboxyl Amino, Hitro and Sulphuric acid Cyclic Acyclic compounds.</p>
35 & 36	<p>P.V.C. welding - practice all types of welding joints-sheet thickness of 3 mm, 4mm, 6mm.</p> <p>P.V.C Welding – pipe, flange, elbow, T etc.</p>	<p>Trade Theory : Definition of PVC its type properties and Uses.</p> <p>Engineering Drawing : Drawing orthographic views of nuts bolts etc.</p> <p>Physics : Same as Week No 33</p> <p>Workshop Calculation and science : Same as week No 33</p> <p>Mathematics : Same as Week No 32.</p>
37 & 38	<p>Physics</p> <p>(i) To study triangular and parallelogram of forces with the help of mechanical board.</p> <p>(ii) Determination of coefficient of static friction using inclined plane.</p> <p>(iii) Determination of mechanical advantage velocity ratio and % efficiency of simple machine.</p> <p>(iv) Determination of acceleration due to gravity by simple pendulum.</p> <p>(v) Determination of Young's Modulus by</p>	<p>Trade Theory (Related to Practical) : Objective, procedure, apparatus/instruments required, explanation and calculations involved in the experiments.</p> <p>Engineering Drawing : Drawing of different types of thread forms, rivet heads. Keys, coupling.</p> <p>Physics : Same as week No. 33</p> <p>Workshop Calculation and Science : Same as Week No.33</p> <p>Mathematics : Same as Week No 32.</p>

	Seattle's apparatus.	
39 & 40.	<p>(i) Determination of coefficient of expansion of solid and liquid</p> <p>(ii) Determination of coefficient of Thermal conductivity of metal rod.</p> <p>(iii) Determination of rotation constant of optically active substance by a polarimeter.</p>	<p>Trade Theory : Same as Week No. 37</p> <p>Engineering Drawing : Same as Week No. 37</p> <p>Physics : Static electricity - distribution of charge, Potential, capacity and condenser. Current electricity-electricity by chemical action cells. Definition, classification and problems on law of fluid heat transfer, evaporation, transmission of power etc</p> <p>Workshop calculation and science : Aliphatic hydrocarbons, saturated and unsaturated (i) Methane (ii) Ethylene (iii) Acetylene Laboratory preparation properties and uses. Composition refining cracking and explanation of octane no., flash point calorific value, fire point, viscosity & sulphur contents. Halogen compounds of aliphatic hydrocarbons. Carbon tetrachloride, chloroform, preparation properties and uses. Aliphatic aldehydes and Ketones. Acetaldehyde, acetone. Preparation properties and uses. Alcohol and Acids. Ethyl - alcohol and acetic acid Preparation properties and uses Carbohydrates Sugar, preparation properties and uses.</p> <p>(X)Mathematics : Trigonometry- study of sine, cosine, tangent of angles in a right angled triangle & their application.</p>
41 & 42.	<p>(i) To study Ohm's law and kirchoff's law about current and voltage.</p> <p>(ii) To study electric cell using series and parallel connections.</p> <p>(iii) Determination of specific resistance using wheat stone's Bridge.</p> <p>(iv) Verification of faraday's First law of electrolysis.</p> <p>(v) Determination of mechanical equivalent of heat using electrical</p>	<p>Trade Theory : Same as week no. 37</p> <p>Engineering Drawing : Drawing of different types of riveted joints such as lap and butt joints.</p> <p>Physics : Same as week no. 39</p> <p>Workshop Calculation and Science : Same as Week No. 39</p> <p>Mathematics : Same as week no. 39</p>

	Method.	
43.	Chemistry: Separation of mixture by Distillation.	Trade Theory : Same as week no. 37 Engineering Drawing Drawing of different types of locking devices such as double nut castle nut, pin etc. Physics : Same as Week No.39 Workshop Calculation and Science : Same as Week No.39 Mathematics : Same as Week No. 39
44.	Preparation of the following (a) Soap (b) Nitrobenzene (c) Aniline (d) Copper sulphate (e) Ferrous ammonium & sulphate.	Trade Theory : Same as Week No. 37 Engineering Drawing : Same as Week No. 43 Physics : Same as Week No. 39 Workshop Calculation and Science : Same as Week No. 39 Mathematics : Same as Week No. 39
45.	To study the allotropic forms of sulphur.	Trade Theory : Same as Week No. 37 Engineering Drawing : Same as Week No. 43 Physics : Magnetic effect of current. electromagnets. Ohm's law. Kirchhoff's law. Parallel and series circuit connections. Wheatstone's bridge, potentiometer. Workshop Calculation and Science : Oils and Fats. Soaps. Introduction to aromatic compounds. Mathematics : Same as Week No. 39
46.	To study the properties of FeS mixture and FeS compound.	Trade Theory : Same as Week No. 37 Engineering Drawing : Same as Week No. 43 Physics : Same as Week No. 45 Workshop Calculation and Science : Same as Week No. 45 Mathematics : Same as Week No. 39
47.	To study action of pure salt water on metals and alloys.	Trade Theory : Same as Week No. 37 Engineering Drawing : Same as Week No. 43 Physics : Same as Week No. 45 Workshop Calculation and Science : Same as Week No. 45 Mathematics : Same as Week No. 39.
48.	To study the corrosion of metals. To study action of acids and bases on metal alloys.	Trade Theory : Same as Week No.37 Engineering Drawing : Same as Week No. 43 Physics : Same as Week No. 45 Workshop Calculation and Science : Same as week No 45 Mathematics : Same as Week No.39
49.	Analysis and Treatment of Effluent Water	Trade Theory : Same as Week No. 37 Engineering Drawing :

		<p>Sectional view of simple objects such as brackets, bearings etc.</p> <p>Physics : Heating effect of electric current. Electrolysis.</p> <p>Workshop Calculation and Science : Polymerization, Rubber, plastics and bakelite Preparation properties and uses of oxalic acid, ethyl alcohol, Nitrobenzene, aniline, acetylene.</p> <p>Mathematics : Same as Week No. 39.</p>
50.	Volumetric analysis. Qualitative analysis (Inorganic) (Simple with out interfering radicals) Determination of Flash point. Determination of pH (by Lovibond)	<p>Trade Theory : Same as Week No. 37</p> <p>Engineering Drawing : Same as Week No. 49</p> <p>Physics : Same as Week no. 49</p> <p>Workshop Calculation and Science : Same as Week No. 49</p> <p>Mathematics : Same as Week No. 39</p>
51.& 52	Revision and Examination	<p>Trade Theory : Revision and Examination</p> <p>Engineering Drawing : Revision and Examination</p> <p>Physics : Revision and Examination</p> <p>Workshop Calculation and Science : Revision and Examination</p> <p>Mathematics : Revision and Examination</p>
<p>Note :- Marked (X) contents may be exempted for B.Sc. apprentices</p> <p align="center">TRADE - ATTENDANT OPERATOR (CHEMICAL PLANT) 2ND YEAR</p>		
53.	<p>Introduction to safety equipments and their uses related to chemical plant. Awareness of first aid, fire fighting equipments and hydrant system, material safety data sheet (MSDS), good manufacturing practices, Personal Protective Equipments (PPEs). Review the operation covered in the first year.</p>	<p>General Safety: Introduction & importance of safety & general precautions observed in the chemical plant. Fire prevention and fire control in chemical industries. Study of personal protection equipments (PPEs) used in chemical plant. First aid in chemical plant. Introduction to occupational health hazard. Environmental pollution, sources, causes, consequences and controls and good manufacturing practices. Role of attendant operator in the Chemical Industries.</p> <p>Trade Theory : Review the connected theory covered in the 1st year. Introduction to different sizes of pipes, flanges, allows, sockets, plugs, squares reducers, trees etc.</p> <p>Engineering Drawing : Orthographic views of machine parts such as bearings, brackets etc.</p>

		Unit operation Pipes: Methods of joining them, expansion joints. Unit Process: Salts from sea water: Process description and flow sheet.
54.	Cutting, threading, bending, and fitting of pipes as per drawing. Making different types of pipe joints such as screwed and flanged etc.	Trade Theory : Bending method, different types of pipes joints. Bending fixtures, standard pipe threads, taps and dies for pipe threads. Engineering Drawing : Same as Week No. 53 Unit Operation : Valves, safety devices, diaphragm control valve steam trap. Unit Process : Soda-ash: Process classification, raw materials, chemical reaction process description, flow sheet and uses.
55.	Use and maintenance of lagging materials such as glass wool, asbestos, magnesia, thermocole, aeroflex etc.	Trade Theory : Lagging materials types and uses. Engineering Drawing : Same as Week No. 53 Unit Operation : Reynold's number, viscosity, manometer, Bernoulli's equation. Unit Process: Same as Week No. 54
56.	Dismantling, overhauling & assembling of globe valves, check valves, needle valves, diaphragm valves, ball valves, stop cock, butterfly valves, non return valve etc.	Trade Theory : Construction, working and uses of various types of valves. Engineering Drawing : Sectional views of machine. Unit Operation : Application of the Bernoulli's equation in pump, compressor, venturimeter orifice meter, flow nozzle, quantity meters. Unit Process : Caustic soda and chlorine: Process classification, raw materials, chemical reaction, process description, flow sheet and uses.
57 & 58	Same as Week No. 56	Trade Theory : Types of gears, e.g. spur, helical, bevel, their uses and their advantages, and disadvantages. Engineering Drawing : Same as Week No. 56. Unit Operation : Same as Week No. 56. Unit Process : Same as Week No. 56.
59.	Dismantling, overhauling & assembling of different type	Trade Theory : Different types of pumps, construction details and

	of gears, gearboxes (reduction gear box) etc.	<p>their uses.</p> <p>Engineering Drawing : Same as Week No. 56</p> <p>Unit Operation : Pumps-positive displacement and centrifugal</p> <p>Unit Process : Same as Week No 56.</p>
60.	Dismantling, overhauling & assembling of different type of pumps such as positive displacement pump (reciprocating, gear, plunger pump) & centrifugal pumps.	<p>Trade Theory Causes of misalignment, different methods of checking alignment. Effect of misalignment of shafts, coupling and bearings.</p> <p>Engineering Drawing : Free hand sketching of parts such as pistons, connecting rod, crank shafts, steam chest etc.</p> <p>Unit Operation : Compressor and vacuum pumps steam jet ejection, lift pump.</p> <p>Unit Process : Sulphuric acid: Process classification, raw materials, chemical reaction, process description flow sheet and uses.</p>
61 & 62.	Study of different types of compressor their maintenance and trouble shooting of centrifugal, reciprocating, multistage, screw compressors, blowers & fans.	<p>Trade Theory : Construction & working of different types of compressor, blowers & fans.</p> <p>Engineering Drawing : Same as Week No. 60.</p> <p>Unit Operation : Modes of heat transfer, thermal conductivity. Fourier's equation Resistance in series plane and round surface.</p> <p>Unit Process : Same as Week No. 60.</p>
63 & 64.	Checking alignment of shafts and coupling of motors, correcting alignment, use of dial gauges.	<p>Trade Theory : Bearing (their types, construction and uses, such as ball, roller, bush needle bearing etc. their care and maintenance.</p> <p>Engineering Drawing : Free hand drawing of pipe joints and fittings.</p> <p>Unit Operation : Film co-efficient, overall film co-efficient, factors affecting heat transfer co-efficient.</p> <p>Unit Process: Ammonia and complex Fertilizer: process classification, process description with flow sheet, definition of fertilizers and their types.</p>
65.	Fitting of bearings such as ball bearings, roller bearings, bush bearings etc., their care, lubrication and maintenance.	<p>Trade Theory : Use of correct material and locking device such as split pin, lock nut, spring washer, taper washer etc.</p> <p>Engineering Drawing : Free hand drawing of shaft couplings and flanged etc.</p>

		Unit Operation : Same as Week No. 63 Unit Process : Same as Week No. 63
66.	Same as Week No. 65	Trade Theory : Same as Week No 65 Engineering Drawing : Same as Week No. 65 Unit Operation : Co-current and counter current heat exchanger, double pipe, shell and tube heat exchanger. Plate and finned type exchanger Unit Process : Same as Week No. 64
67.	Welding (Arc) Practice on straight line welding beads on MS Plate.	Trade Theory : Different processes of metal joining, bolting, riveting, soldering, brazing etc. welding terms and their definition. Engineering Drawing : Drawing different types of pipeline diagram, pipe fitting symbols. Unit Operation : Same as Week No. 66 Unit Process : Nitric acid: Process classification, process description with flow sheets and concentration.
68.	Practice on open corner joint on M.S. Plate.	Trade Theory : Types of joints, classification, use Elementary electricity. Its uses applied to welding. Heat and temperature. Engineering Drawing : Same as Week No. 67 Unit Operation : Furnace for solids, liquid and gaseous fuels using air and steam as mixing fluids. Unit Process: Urea and other fertilizer: process classification, process description with flow sheets.
69.	Practice on Fillet weld (M.S. Plate)	Trade Theory : Description and use of tools and equipment used in arc welding. Engineering Drawing : Free hand drawing of valves-gate, globe plug cock, ball, needle diaphragm and control valves. Unit Operation : Kiln-shaft and rotary (direct and indirect fired). Unit Process : Same as Week No. 68
70.	Practice on outside corner joints.	Trade Theory : Types of electric welding metallic, carbon, resistance etc. Engineering Drawing : Same as Week No. 69 Unit Operation :

		Evaporation: Horizontal, vertical tube, forced circulation and falling film evaporators. Unit Process : Same as Week No.68
71.	Practice on single 'V' butt joint.	Trade Theory : Principle of arc welding, types of welding. Types of welding machines, care and maintenance Engineering Drawing : Same as week no. 69 Unit Operation : Multiple effect evaporation Methods of feeding in a multiple effect evaporator, steam economy. Unit Process : Class: process classification process description with flow sheet.
72.	Practice on fillet lap joint and T-joint.	Trade Theory Advantaged on one over the other. Electrodes, types, method of coating, flux characteristic I.S.I. specification. Engineering Drawing Drawing sketches of expansion joints and stuffing boxes. Unit Operation Condensers-contact and surface condense removal. Instrumentation of an evaporator. Unit Process Cement: definition of cement and its type, process description with flow sheet.
73.	Pipe T joints, Butt joints (square butt)	Trade Theory Arc welding defects, causes and effects, how to overcome. Distortion and its control. Principle of PVC welding. Simple estimation on fabrication - involving consumption of gasses, electrode, length of weld. Use of hand book and reference tables. Engineering Drawing : Same as Week no. 72 Unit Operation Properties of steam, Boilers-fire tubes, water tube, forced circulation, accessories. Water treatment. Unit process : Same as Week no. 72

74.	Unit Operation Lab (i) Flow measurement and calibration of venturimeter, orifice meter and rotameter. (ii) Determination of viscosity of a liquid by viscometer.	Trade Theory : Construction and working of venturimeter, orifice and rotameter. Viscosity and its role. Engineering drawing : Exercises on blue print reading Unit operation : Same as Week No. 73 Unit Process : Iron & Steel: Process description with flow sheet. Definition of steel and its types.
75.	Study of DCS system. Study of PLC.	Trade Theory : Introduction to DCS system. Introduction to PLC. Engineering Drawing : Same as week No. 74 Unit operation : Same as week No. 73 Unit Process : Same as week No. 74
76.	Study of head against capacity curve of centrifugal pump	Trade Theory related to practical : Procedure of conducting the experiment, calculation and precautions to be observed. Engineering Drawing : Free hand sketching of simple bearing blocks. Unit operation : Distillation: Introduction, boiling point diagram, equilibrium curve, relative volatility. Unit process : Same as week No. 74
77.	Study of head Vs. capacity curve of a gear pump.	Trade Theory related to practical : Same as week No. 76 Engineering Drawing : Same as week No. 76 Unit operation : Same as week No. 76
78.	To determine Reynolds's number at different velocities.	Trade Theory related to practical : Same as Week No. 76 Engineering Drawing : Drawing sketches of pumps centrifugal, gear plunger, sliding vane and water ring vacuum pump. Unit operation : Methods of distillation flash, differential, rectification. Unit process : Aluminum: Process description with flow sheet and uses
79.	To determine friction losses in a straight pipe, pipe fitting, valve.	Trade Theory related to practical Same as Week No. 76 Engineering Drawing : Same as Week No. 78 Unit operation : Rectification and Variables affecting rectification, reflux ratio and its importance, types of distillation

		columns. Unit process : Same as Week No. 76
80.	Calculation of overall heat transfer, coefficient for a shell and tube heat exchanger.	Trade Theory related to practical : Same as Week No. 76 Engineering Drawing : Same as Week No. 78 Unit operation : Same as Week No. 79 Unit process : Same as Week No. 78.
81.	To find rate of evaporation of a vertical tube evaporator.	Trade Theory related to practical : Same as Week No. 76 Engineering Drawing : Same as Week No. 78 Unit operation : Same a Week No. 79 Unit process Petroleum & petroleum refining crude oil & its origin and classification distillation of crude, unit process involved properties of petroleum products.
82.	Separation of binary liquid mixture by distillation using packed tower.	Trade Theory related to practical : Sane as Week No. 76 Engineering Drawing : Drawing sketches of steam jet ejectors, and steam traps Unit operation : Same as Week No. 79 Unit process : Same as Week No. 81
83.	Flooding velocity experiment using a packed glass column.	Trade Theory related to practical : Same as Week No. 76 Engineering Drawing : Free hand sketches of different types of shell and tube heat exchanges. Unit operation : Azeotropic, extractive and steam distillation Unit process : Same as Week No. 81
84.	Finding rate of drying curve by tray drier.	Trade Theory related to practical : Same as Week No. 76 Engineering Drawing : Same as Week no. 83 Unit operation ; Instrumentation diagram of distrilation column. Unit process : Same as Week No. 81
85.	Operation of : (i) Plate and frame filter press (ii) Rotary drum vacuum filter. (iii) Top driven centrifuge (iv) Blake jaw crusher (v) Hammer mill (vi) Ball mill (vii)To carry out sieve analysis with a sieve	Trade Theory related to practical : Construction, principle, trouble shooting and precaution to be observed during operation of the equipment. Engineering Drawing : Diagram of distillation column with all accessories. Unit operation : Extraction and leaching application of liquid-liquid extraction, theory, definition, choice of solvent, distribution coefficient. Unit process : Same as Week no.81.

	shaker.	
86.	Same as Week No. 85	Trade Theory : Same as Week No. 85 Engineering Drawing : Free hand sketches of extractors Unit operation : Extractors : single and multistage mixer settler, counter current, Centrifugal Towers : spray, packed and sieve. Unit process : Calcium carbide: manufacture with flow sheet.
87.	Same as Week No. 85	Trade Theory : Same as Week No. 85 Engineering Drawing : Free hand sketches of evaporators. Unit operation : Same as Week No. 86 Unit process : Sugar: manufacture and refining with flow sheet. Hydrogenation of oils, Pulp and paper: definition of pulp and its type & manufacture with flow sheet. Recovery of chemicals from black liquor, Def. of paper & its manufacture with flow sheet.
88.	(i) Operation of a mixer settler (ii) Operation of a spray extraction tower.	Trade Theory related to practical Procedure of conducting, experiment. Calculation and precautions to be observed for mixer settler and spray extraction tower. Engineering Drawing : Same as Week No. 87 Unit operation : Same as Week No. 86 Unit process : Same as Week No. 87
89.	Operation of a multistage compressor. Study of electrical technology such as three phase supply induction motor, starters etc.	Trade Theory : Same as week no. 88 Engineering Drawing : Free hand sketches of crushers, ball mill, hammer mill and centrifuges. Unit operation : Leaching : Application and different types of equipment uses for leaching oil extraction from oil seeds. Unit process : Same as Week No. 87
90.	Same as Week No. 89	Trade Theory : Same as Week No. 88 Engineering Drawing: Flow sheet of sulfuric acid manufacture. Unit operation: Humidity and Air conditioning: Introduction, definition, humidity chart, humidification and its equipment, dehumidifiers, cooling towers. Unit process: Oils and fats refining
91.	Instrumentation Calibration of	Trade Theory : Units of pressure, measurement of pressure by

	(i) Bourden tube pressure gauges (ii) Manometers	different methods. Engineering Drawing : Flow sheets of urea and nitric acid manufacture Unit operation : Absorption: Introduction, equilibrium mass transfer coefficient, factors affecting rate of absorption. Absorption towers. Unit process : Soap and Glycerin: process description with flow sheet.
92.	Calibration of (i) Bellow type pressure gauge. (ii) Vacuum gauges. (iii) Compound gauges.	Trade Theory : Same as Week No. 91 Engineering Drawing: Flow sheet of sugar manufacture Unit operation: Comparison of different absorption towers and their operation. Operating line, number of stages, effect of variable on absorption. Flooding and flooding velocity. Stripping, methods of stripping. Unit process : Alcohol: manufacture of ethyl and methyl alcohol with flow sheets.
93.	Industrial visit	Trade Theory : Same as Week No. 91 Engineering Drawing : Flow sheet of ethyl alcohol manufacture. Unit operation : Drying: Introduction, Vapour pressure, curve for water, relative humidity and other definitions, equilibrium in drying. Tray drier. Unit process : Same as Week No. 92
94.	Calibration of mercury in glass thermometer	Trade Theory Temperature - its units and different methods of measurement. Engineering Drawing Flow sheet of cement manufacture. Unit operation Instrumentation diagram of tray drier, various type of driers, spray drier and drum drier. Unit process : Same as Week No.92
95.	Calibration of gas filled thermometer. Calibration of bi-metallic thermometer.	Trade Theory : Same as Week No. 94 Engineering Drawing : Flow sheet of pulp manufacture Unit operation : Crystallization: Introduction classification of crystallizes. Unit process : Same as Week No.92

96.	Calibration of a resistance thermo-couple and thermometer.	Trade Theory : Same as Week No. 94 Engineering Drawing Flow sheet of aluminum manufacture Unit operation Filtration: Introduction, factors affecting filtration, classification of filters. Unit process Plastics & Resin: manufacturing process; condensation, polymerization products, addition polymerization products.
97.	Calibration of optical pyrometer.	Trade Theory : Same as Week No. 94 Engineering Drawing: Flow sheet of caustic soda and chlorine manufacture. Unit operation: Mixing: Mixing liquids with liquids, mixing solids with liquids mixing solids with solids and equipment used. Unit process: Same as Week No. 96
98.	Experiment on a level measurement.	Trade Theory : Level, different methods of measurement. Engineering Drawing : Flow sheet of soda ash manufacture Unit operation : Centrifugation: Introduction classification of equipment. Unit process : Paints and varnishes: different types of pigments, oils varnishes, lacquer.
99.	(i) Experiment on hydrometer. (ii) Study of quantity meter.	Trade Theory : Density, its units and different methods of measurement. Engineering Drawing : Instrumentation diagram of a distillation column. Unit operation Absorption: Theory, absorbents and applications of absorption, Screening: Definitions, classification of screen sedimentation & Decantation: Introduction, classification. Settling: Definition and equipment. Unit process : Same as Week No. 98
100.	Calibration of pH meter.	Trade Theory : pH its definition and different methods of measurement. Engineering Drawing: Instrumentation diagram of an evaporator. Unit operation : Same as Week No. 99

		Unit process : Same as Week No. 98
101.	Study of control valves & transmitters.	Trade Theory : Final control elements, Transmitters. Engineering Drawing : Instrumentation diagram of a drier. Unit operation : Crushing and grinding : Introduction and classification of equipment Unit process : Water treatment precipitation, demineralization processes, sewage waste water treatment, Air Pollution
102.	Study of recorders and controllers.	Trade Theory ; Recorders and controllers Engineering Drawing ; Flow diagram of a rotary vacuum filter with all accessories. Diagram of open & closed circuit grinding. Unit operation : Conveying: Introduction and different types of conveyors. Unit process : Fuels: Coal, water gas, producer gas combustion of fuels.
103 to 104	Revisions and Test.	Trade Theory Revisions and Test. Engineering Drawing Revisions and Test. Unit operation Revisions and Test. Unit process Revisions and Test.

LIST OF TOOLS & EQUIPMENT
(for a batch of 16 Trainees)

TRADE : ATTENDANT OPERATOR (CHEMICAL PLANT)

Trainees Kit

Common to Attendant Operator and Maintenance Mechanic (Chemical Plant) trades

No.	Description	Quantity Required
1.	Outside Spring Caliper 6"/15 cm	17 (1 for Instructor +16 for trainees).
2.	Inside Spring Caliper 6"/15 cm	17
3.	Divider spring 6"/15 cm	17
4.	Center punch 4"/10 cm	17
5.	Prick punch 6"/15 cm	17
6.	Chisel Cold flat 1 1/2" 2.5 cm	17
7.	Chisel cross cut 3/8"X 1/8"	17
8.	Chisel diamond point 1/8" /10 cm	17
9.	Chisel half round 3/8"/10 mm	17
10.	Hammer ball pein 1 lb	17
11.	Hammer ball pein 1/2 lb	17
12.	Hacksaw frame adjustable with pistol grip for 8"-12" blade / 20 cm- 30cm.	17
13.	Rule steel 12" English and Metric 30 cm	17
14.	Screw Driver 3"X3/8" blade	17
15.	Screw Driver 12"X1/2" blade	17
16.	Try Square 6" blade/15 cm	17
17.	Scriber	17
18.	Safety Goggles	17
19.	File flat 8 1/2"/20 cm rough	17
20.	File flat 8 1/2"/20 cm 2nd cut	17
21.	File round 8mm, 8 1/2"/20 cm length, 2nd cut	17
22.	File round 10mm, 8 1/2"/20 cm length, 2nd cut	17
23.	File half round 8 1/2"/20 cm length rough	17
24.	File half round 8 1/2"/20 cm length, 2nd cut	17
25.	Box drawing instrument	17
26.	Protractor celluloid circular	17
27.	Scale (Wood) Draughtsman 12"/30 cm	17
28.	Set square celluloid 45°	17
29.	Set square celluloid 60° – 10 inch	17
30.	Board drawing half imperial size	17
31.	Square – T 24 inch blade	17

Workshop Tools and Equipment

1.*	Surface plate 12" X 12"/30 cm X 30cm Or surface plate 24" X 24"/60 cm X 60 cm	2 1
2.*	Scribing block Universal 12"/30 cm	2
3.*	Marking table 3' X 3' X 3' high	1
4.*	V-Blocks 3" X 1½" (pair) with clamps	2
5.*	Combination set 12 inch	2
6.*	Twist Drill (straight shank) 1/8" to 1/2" by 1/64" (set)	4
7.*	Twist Drill ½ " to 3/4 by 1/16" (Mores taper)	1 set
8.*	Twist Drill (Metric) 2 mm to 7 mm by 1 mm	6 set
9.*	Twist Drill (Metric) 8 mm to 12 mm by 1 mm	1 set
10.*	Dial Test indicator with magnetic base	2
11.	Radius Gauge	1
12.	H.S.S. Hand reamers 6 to 12 mm by 2 mm	1set
13.*	Hacksaw frame adjustable for 8"to 12" blades.	6
14.	Bench vice with 5" jaws.	20
15.	Machine vice 6" jaw for drill machine	1
16.*	Working bench 8' X 4' X 2½' fitted with vices	5
17.*	Steel almirah, large with shelves	2
18.*	Letter Punch set - 3mm.	2 sets
19.*	Numbering punch set - 3mm	2 sets
20.	Pipe Die with Die stock ½", ¾"	2 each
21.	Complete set of taps and dies in Metric (8, 10,12 mm)	2 sets each
22.*	File flat 1' bastered	2
23.*	File flat 10" smooth	2
24.*	File triangular 6" 2 nd cut	1
25.*	File flat 6" smooth	1
26.*	Oil stone 6" x2" x 1"/15 cm x 5cm x 2.5cm	2
27.*	Oil can ½ pt	4
28.*	Bevel protractor	2
29.*	Chisel flat ½"	1
30*	Chisel cross cut ¼ "6mm	2
31.*	Micrometer outside 0-1"	1
32.*	Micrometer inside 2" to 8" / 5 cm to 20 cm	2
33.*	Micrometer Metric 0-25 mm	2
34.*	Micrometer inside 50-200 mm capacity	1
35*	Venire caliper 12"	1
36*	Screw pitch gauge Whitworth & Metric	1 each
37*	Wire gauge Imperial standard	1
38*	Allen Keys 1/16" to 1/2" by 1/32"	2 set
39*	Phillips head screw driver set 1- 4 sizes	1 set
40*	Double ended spanners- from 1/8" x 3/16" to 1/2" x 9/16"	1set
41	Double ended spanner- from 3/8" x 7/16" to 15/16" x 1"	1 set
42	Double ended spanners from 8 x 9 to 20 x 22	1 set

43	Offset double ended ring spanners from 1/8" X 3/16" to 1/2" X 9/16"	1set
44	Socket set ½ " drive, 3/8" to 1 ¼ " with ratchet handle	1 set
45	D E. Spanner from 5/8" x 11/16" to 15/16" x 1"	2
46*	Hammer hide faced	2
47	Pipe wrench stilton pattern 18" long	2
48*	Combination pliers- 8"/20 cm	16
49	Bearing puller 8" dia. (3 leg type)	1
50	Steel tape 10 m.	1
51	Feeler gauge .0005" to .25"	6
52	Pipe cutter (adjustable), 3 wheel type, Ø3" pipe.	1
53*	Pipe vice 3"/ 75 mm	2
54	Leather apron	2
55	Steel rack	2
56	Soldering iron	2
57	Center gauge 55° and 60 °	1 each
58	Knurling Tool	2
59	Centre drill Ø 2, Ø3 mm	2 each
60	Set of sockets (Morse Taper) (0-1, 1-2, 2-3)	1 each
61	4 jaw chuck (Independent)	2
62	3 jaw self centering chuck (5"/125 mm)	2
63	Set of tools for lathe	2
64	Lathe dog ½ " to 1½ "	2
65	Drill chuck 0" to ½ " with Morse Taper shank	1
66	Grease pressure gun (Hand operated)	1
67	Face pin spanner 1" to 3" dia	1
68	Tongs round	1
69	Tongs flat	2
70	Anvil	2
71	Welding helmet	1
72	Welding goggles	4 pairs
73	Welding Table 2 ½ 'x 2 ½ 'x 4' with fire brick top	1
74	Welding gloves	4 pairs
75	Tachometer	1
76	Tap extractors 1/8" to ½ " by 1/16"	1 set
77	Screw extractors sizes 1 to 3	1 set
78	Tools bit holder as Armstrong L.H.	4
79	Tool bit holder as Armstrong R.H.	4
80	Tools bit holder as Armstrong straight	4
81	Pedestal Grinder (D.E) with two 7" wheels rough and smooth (motorized)	2
82*	Drill machine to drill upto ½ "dia.	1
83*	Lathe-30" between center X 6" centers height with standard accessories	2
84	Welding Set - oxy-acetylene (either high or low pressure) and electric.	1each
85	Pipe bending attachment ½", ¾"	1 each
86*	PVC welding torch and accessories	1

Trade-Attendant Operator (Chemical Plant)
LIST OF EQUIPMENT FOR UNIT OPERATION LABORATORY

Sl. No.	Description	Quantity
1.*	Venturimeter	1
2.*	Orificemeter	1
3.*	Rotameter	1
4.*	Centrifugal pumps	2
5.*	Gear pump	1
6.*	Reynolds experiments equipment	1 set
7.*	Shell and tube heat exchanger	1
8.*	Boiler	1
9.*	Vertical tube evaporator	1
10.*	Packed distillation column	1
11.*	Packed tower of glass for flooding velocity experiment	1
12.*	Plate and frame filter press	1
13.*	Top-driven centrifuge	1
14.*	Rotary vacuum filter	1
15.*	Tray drier	2
16.*	Hammer mill	1
17.*	Ball mill	1
18.*	Blake jaw crusher	1
19.*	Mixer-settler type extractor	1
20.*	Spray extraction tower	1
21.*	Viscometer	4
22.*	Lobe blower for filter press	1
23.*	Weighing machine	1
24.*	Multistage compressor fitted with inter-cooler and after coolers	1
25.*	Sieve shaker and sieves	1 set
26.*	Screw Compressor	1
27.*	PLC Kit	1
28.*	DCS Kit.	1
29.*	Gate Valve	1
30.*	Globe valve	1
31.*	Needle valve	1
32.*	Butter fly valve	1
33.*	Non return valve	1
34.*	Ball valve	1
35.*	Solenoid valve	1
36.*	Diaphragm valve	1
37.*	Control valve.	1
38.*	Thermodynamic traps	1
39.*	Reciprocating pump	1

* Common to Attendant Operator and Maintenance Mechanic (Chemical Plant) trades

Trade-Attendant Operator (Chemical Plant)
LIST OF TOOLS, EQUIPMENT AND MATERIALS
FOR PHYSICS LABORATORY

Sl. No.	Description	Quantity
1.	Physical Balance (with weight box)	1 sets
2.	Chemical Balance (with weight box)	3 sets
3.	Viscometer (a) Oswald Viscometer (b) Redwood Viscometer (c) Stop. Watch (1/10 th Seco) (d) Thermostatic bath	3 pieces 3 pieces 6 pieces 2 pieces
4.	Stalagmeter	6 pieces
5.	Travelling microscope	2 Nos.
6.	Specific Gravity bottle	6 Nos.
7.	Pyknometer	6 Nos.
8.	Mechanical board for testing triangle and parallelogram of forces including all accessories	6 sets
9.	Spirit level	3 sets
10.	Inclined plane with pulley, pan, weights etc.	2 sets
11.	Simple machines (wheel and axle). Screw Jack inclined plane with roller or trolley, pulleys or pulley blocks for first, second and third system of pulleys	1 set
12.	Different types of levers	1 et
13.	Instrument for determining 'g' (Simple Pendulum)	2 Sets
14.	Barometer	1No.
15.	Altimeter	1 No.
16.	Seattle's Apparatus for young's Modulus	2 sets
17.	Nicolson' Hydrometer with glass jar	2 sets
18.	Wet and dry bulb thermometer	2 sets
19.	Apparatus for measurement specific heat of solid and liquid (Renaults Apparatus)	2 sets
20.	Apparatus for measurement of co-efficient of expansion (thermal) of slid and liquid	2 sets
21.	Apparatus for measurement of thermal conductivity of good and bad conductors	2 sets
22.	Calorimeter for determining 'Soul's' Mechanic Equivalent of heat and specific heat	4 sets
23.	Thermometers : (1) 0 to 11° C (2) 0 to 36 ° C (3) 0 to 250 ° C	2 dozen 1 dozen 1 dozen
24.	Polarimeter with monochromatic light	2 sets
25.	Abbe refractometer	2 sets
26.	Pulfrish Refractometer	2 sets
27.	Equipment to study Kerchiefs law and Elector chemical	1 set

	equivalent	
28.	Potentiometer	2 sets
29.	Whetstone's bridge	2 sets
30.	Resistances Center Zero Galvanometer	4 Nos.
31.	(a) Resistance box 0 to 100 ohms (b) Resistance box 0 to 500 ohms	2 Nos. 2 Nos.
32.	Rheostat (a) Rheostat 25 ohms (b) Rheostat 100 ohm's (c) Rheostat 500 ohms	2 Nos. 2 Nos. 2 Nos.
33.	Ampere Meter 0 to 1 Amp. (DC) 0 to 3 Amp. (DC) 0 to 10 Amp. (AC, DC) 0 to 30 Amp. (AC, DC)	2 sets 2 sets 2 sets 2 sets
34.	Voltmeter 0 to 1 volt (DC) 0 to 4 volt (DC) 0 to 5 volt (DC) 0 to 10 volt (DC) 0 to 50 volts (DC) 0 to 250 volts (DC/AC)	2 sets 2 sets 2 sets 2 sets 2 sets 2 sets
35.	Millivoltmeter 0 to 5 millivolt. 0 to 500 millivolt.	2 sets 2 sets
36.	Resistance coils (2 ohms, 5 ohms, 10 ohms, 100 ohms)	2 sets
37.	pH meter	1 set
38.	Charger for battery accumulator	1 set
39.	12 volt hand operated Dynamo, Leclanche cell, Daniel cell, Weston cell, Acidic cell, Head Accumulator, Alkali cell with variable resistances	2 sets
40.	Multimeter	2 Nos.
41.	Battery eliminator	2 Nos.
42.	Diode valve	4 Nos.
43.	Triode valve	4 Nos.

Note : (1) All electrical equipment should be provided with extra 20 meter wire, switcher, terminals for Connection.

(2) All electrical equipment in connection with heat must be provided with necessary thermometer.

* Common to Chemical Trade group including Mech. Maintenance (C.P.)

SYLLABUS FOR THE TRADE OF ATTENDANT OPERATOR
(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 of one year for the apprentices with S.S.C. passed candidates, where as the period of training is 1 ½ years consisting of Induction Training for a period of 6 months and shop-floor training for the remaining period of one year for the B.Sc. Apprentices.

The syllabus of this trade should be considered as a guide for imparting apprenticeship training according to facilities available in the industry.

List of operations / skills to be learnt during Practical Training including Basic Training.

Note:

(1) During inplant training a detail programme is to be drawn for each type of industry according to the needs of the establishment.

(a) A complete flow sheet of the process should be explained to apprentice and gradually made familiar with the work in the establishment and all unit operations and processes carried out in the plant. The apprentice is to work as assistant to the operator in controlling various departments by rotation and in the last few months, he is to be given the chance of working independently in the day shift in a particular department as available in the establishment under close observation, so that on completion of the training the trainee can work as a full fledged operator in the concerned industry.

(b) Study of various hazardous operations in the plant.

(2) (a) The contents of the 2 years basic training in this trade for the candidates with SSC Passed Apprentices is exactly the same as in CTS syllabus.

(b) The contents of 6 months Basic/Induction Training of B.Sc. Apprentices is given below under the heading “Basic Training”.

(c) The contents of the 1 year Shop Floor Training for the candidates who have undergone basic training in Industry, for the Ex-ITI trainees in the trade and for the B.Sc. apprentices who have undergone Induction Training is indicated under the heading “Shop Floor Training”.

Basic / Induction Training: - 6 months for B.Sc. Apprentices)

1. Introduction in safety precautions as applicable to the trade
2. Fitting
3. Turning on various lathes.
4. Welding (gas)
5. Pipe fitting
6. Use and maintenance of lagging materials.
7. Dismantling and assembling of different types of valves.
8. Fitting and assembling of different gears,

9. Study of different types of pumps, compressors etc. their assembly and maintenance.
10. Checking the alignment of shafts and coupling.
11. Fitting of bearings.
12. Welding (Arc).
13. (i) Installation of venturimeter, orifice meter and Rotameter.
(ii) To find out viscosity of a liquid by viscometer.
14. Study of head against capacity curve of a centrifugal pump.
15. Study of head Vs capacity curve of a gear pump.
16. To determine Reynold's number of different velocities.
17. To determine friction losses in a straight pipe, pipe fitting valve.
18. To calculate overall heat transfer co-efficient for a shell and tube heat exchanger.
19. To find rate of evaporation of a vertical tube evaporator.
20. Separation of a liquid mixture by distillation using packed tower.
21. Flooding velocity experiment using a packed tower made of glass.
22. Finding rate of drying curve by tray drier.
23. Operation of :
 - (i) Plate and frame filter press
 - (ii) Top-driven centrifuge.
 - (iii) Rotary vacuum filter.
 - (iv) Hammer Mill.
 - (v) Ball Mill.
 - (vi) Blake Jaw crusher.
24. Calibration of :
 - (i) Pressure measuring instruments
 - (ii) Vacuum measuring instruments.
 - (iii) Temperature measuring instruments
 - (iv) Level measuring instruments.
 - (v) pH meter.
25. Study of diaphragm control valves, transmitters.
26. Study of recorders and controllers.
27. Study of pressure Vessels.

Shop Floor Training : 1 Year

(List of operations in Petro Chemicals, heavy chemicals, fire chemicals, paper and pulp, Cement, Fertilizer and allied industries).

28. Orientation

- (i) The plant and its products, raw materials used capacity of production etc.
- (ii) Different sections of the plant including process, maintenance and their activities.
- (iii) Study of the process and operations carried out in the establishment with the help of simple from sheet under the guidance of plant-in – charge/supervisor/familiarization with the equipment's used in the establishment by actually going round the plant.
- (iv) Writing brief report (Diary of day-to-day work.
- (v) Familiarization with utilities and service lines such as steam water, vacuum, compressed air, refrigeration, air conditioning units etc.

29. Safety

- (i) Cause and prevention of accidents first aid to the injured.
- (ii) Personal safety and use of personal protective equipment
- (iii) House keeping.
- (iv) Fire hazards & Toxic hazards on site & offsite emergencies.
- (v) Isolation of equipment's and ancillaries prior to handing.

30. Quality Control

Familiarization with sample quality control tests.

31. Routine Plant Jobs

- (i) Fitting of flanges of equipment or in pipeline.
- (ii) Fitting of pressure and vacuum gauges, thermometers etc. winding of recorders
- (iii) Removal of chart and inking of pens of recorders.
- (iv) Replacement of packing seal/gasket seal in pipe flanges.
- (v) Changing of belts in pulley.
- (vi) Valves lapping.
- (vii) Cleaning of evaporator tubes, heat exchangers etc.
- (viii) Mitigation of emergencies in the plant i.e. leakage / fix / process chemicals – Toxic Hazards.

32. Reading of process control instruments measuring, flow, temperature, pressure, pH, concentration etc., their inter locking system, automatic signaling instruments for high or low pressure temperature, flow etc.

- (i) Manipulation of automatic control and vice versa during shut down and starts up.
- (ii) Maintaining different parameters e.g. pressure, temperature & flow to monitor ups & down and to correct at these parameters.

33. Standard operation, procedure, process conditions and the corrective action in case of the following equipment available in the industry.

- (i) Pumps, compressors, blowers, fans, steam ejectors.
- (ii) Heat exchangers, furnaces, kilns.
- (iii) Distillation units.
- (iv) Evaporators, condensers and refrigeration units.
- (v) Extraction units.
- (vi) Cooling towers and refrigeration units.
- (vii) Absorption towers.
- (viii) Dryers.
- (ix) Crystallizes.
- (x) Filtration's equipment.
- (xi) Size separation and grinding equipment.
- (xii) Crushing and grinding equipment.
- (xiii) Material handling and conveying equipment.

SYLLABUS FOR RELATED INSTRUCTIONS

1. The apprentices with SSC 10th class pass who after having undergone the course of institutional training, have passed trade test conducted by the National Council for Vocational Training or trade apprentices who have undergone 'Basic Training' in an industry, would continue to receive related instructions during apprenticeship 'Shop Training' in the form of revision of the topics as per the CTS syllabus and information regarding products and process concerning the industry in which the apprentice undergoes Apprenticeship Training besides lectures/films shows on pollution control & Effluent Treatment and practical demonstration on fire fighting & first aid, may also be given.
2. The content of the Related Instruction for S.S.C. apprentices during the 2 years basic training should be the same as the content of 2 years course for ITI trainees in the trade.
3. In the case of trade apprentices with B.Sc. degree who are engaged for apprenticeship training, related instructions should be given on such reduced or modified scale as deemed necessary during the induction/shop Training period and the content of the syllabus should be the same as the content of 2 years course for ITI Trainees in the trade.
4. The syllabus for Related Instructions should be considered as a guide.

The subjects to be taught to the apprentices in Related Instructions:

Trade Theory.

Workshop Calculation and Science.

(X) Physics

(X) Maths.

(X) Chemistry

Unit operation

Unit process.

Social Studies.

Industrial Entrepreneurship.

Engineering Drawing.

Note : Contents marked with (X) may be exempted for B.Sc. Apprentice trainees.