

Syllabus for  
**Attendant Operator Chemical Plant**

CRAFTSMEN TRAINING SCHEME  
APPRENTICESHIP TRAINING SCHEME

As approved by  
GOVERNMENT OF INDIA

In consultations with  
VOCATIONAL TRAINING

&

CENTRAL APPRENTICESHIP COUNCIL

Issued by

GOVERNMENT OF INDIA

MINISTRY OF LABOUR

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All Trades Syllabi

**Asian Publishers**

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**MEMBERS OF THE TRADE COMMITTEE FOR  
THE TRADE OF ATTENDENT OPERATOR  
(CHEMICAL PLANT)**

- |                                                        |                                                                       |
|--------------------------------------------------------|-----------------------------------------------------------------------|
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| 1. Shri U.N. Naik<br>Dy. General Manager               |                                                                       |
| <b>Members</b>                                         | <b>Representing</b>                                                   |
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| 3. Shri C.V Ramasawmy<br>Chief Chemist                 | : Hindustan Petroleum Corp. Ltd<br>Refinery Division Bombay – 74      |
| 4. Shri S.P Chatterjee<br>Training Manager             | : Rashtriya Chemical & Fertilizers Ltd, Bombay – 74                   |
| 5. Dr. V.K Kabir<br>Chief Chemist                      | : Godrej Soaps Limited,<br>Vikhoroli, Bombay – 79                     |
| 6. Shri Bharat Kaul<br>Instrument Engineer             | : Hindustan Organic Chemical Ltd. Rasayani. Diat. Raigad<br>410207    |
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| 8. Shri. G.M Deshmukh<br>Lecture in Chem. Engg.        | : Shri K. S Gokhle,<br>Manager (Pres.) Dev. & Training                |
| 9. Shri. A. K Gupta<br>Job Instructor                  | : NOCIL THANE.                                                        |
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| 11. Shri.M.R.K Murthy<br>Asstt, Director of Trg.       | : RDAT (Western Regional) Sion<br>Bombay – 22                         |

**Invites**

- |                                                       |                                                     |
|-------------------------------------------------------|-----------------------------------------------------|
| 1. Shri. V.M. Raghavan<br>Regional Director           | : RDAT (Southern Regional)<br>Guindy, Madras-32     |
| 2. Shri. B. Ram Mohan Rao<br>Director                 | : Advanced Training Institute<br>Sion, Bombay -22   |
| 3. Shri. D.P Nandi<br>Director In Charge              | : ATI, Calcutta Dasnagar,<br>Howrah-5               |
| 4. Shri. V. M Ghidayal<br>Asstt. Director of Training | : Advanced Training Institute,<br>Sion, Bombay - 22 |

## General Information

1	Name of the Trade	: Attended Operator(Chemical Plant)
2	Entry Qualification	: (a) Passed 10 <sup>th</sup> Class Examination (S.S. C) under 10 +2 System of educational with Physes , Chemical for the subject of its equivalent (b) Passed B.Sc. with Physics & Chemistry.
3	Duration of Craftsmen Training/Basic Training	(a) 2 Years (for S.S.C passed trainees) (b) 6 month (for B. Sc passed trainees)
4	Duration of Apprenticeship Training	(a) 3 Years for S. S. C passed trainees (including 2 years Basic Training and 1 year Plant/shop floor training) (b) 11 year for B.Sc. passed trainees (including 6 month & a year plant/shop floor training)
5	Ratio of apprentices to worker	1:10
6	Period of rebate allowed towards apprenticeship training Ex. – ITI passed out trainees in the trade	: (a) Full (2 years) for S.S. C passed (b) (6 month) for B.Sc. passed
7	N.O.C code Nos.	: 733'7 733'10 733'15 733,20 733'40 733'45 733'50 733'90 733'10 734'15 734'25 799'20 739'55 741'10 741'15 741'20 741'30 741'60 741'70 722'10 742'20 742'30 742'30 742'40 742'90 743'10 743'30 743'40 740'10 744'20 744'30 744'40 744'50 745'10 749'30 799'34 749'42 749'62 749'64 749'26 749'72 749'74 749'76 749'80 749'82 749'84 749'25 749'88 773'13 773'23 773'40 773'45 773'75 773'80 775'30 775'35 773'75 773'80 775'30 775'35 775'40 775'45 775'65 776'20 776'50 893'10 893'20 899'33 902'10 902'20 902'30 902'50 903'10 903'20

**Note:** The course content for entrepreneurship. Training and that fro the subject for social studies being, common for all trade , are not incorporated in this syllabus

Sole Publishers & Distributors of  
All Trades Syllabus

**Syllabus for the trade of attendant Operator  
(Chemical Plant)  
under Craftsman Training Scheme  
Period of Training : 2 Years      1<sup>st</sup> year**

Week No.	Practical	Theoretical
1		2
		3

1.	<p><b>Fitting</b> Introduction Training: Familiarization with Institute. Importance of trade training. Machinery equipments used in trade. Type of work done by trainee. Type of jobs made by the trainees. Introduction to safety equipments and their users etc.</p>	<p>Importance of safety &amp; general Precaution observed in the workshop. Role of maintains mechanic in the Chemical Industries. Course contents duration Rules pertaining to facilities available in the Institute- hostel medical library and gymkhana.</p> <p><b>Engineering Drawing</b> Introduction to engineering draeing. Its relevance tie the trade. Use for drawing board. T-Square.</p> <p><b>Physics.</b> (X) introduction to Physics.</p> <p><b>Workshop calculation and Science</b> Introduction to chemistry. From earliest time to present day atom, molecule element, compound Physical&amp; chemical change.</p> <p><b>Mathematic</b> Introduction</p>
2.		<p>Marking off table, try Square Bend Vice Hacksaw frame. Hacksaw blades universal scribbling block.</p> <p><b>Engineering Drawing</b> (X) Fee hand drawing of straight lines rectangle,square,circles,polygon etc.</p> <p><b>Physics</b> Units and dimension Venire caliper spherometer, Micrometer,screw,guage,scalar,and vector quantities their representation resultant parallelogram and triangle of vector.</p> <p><b>Workshop Calculation and Science</b> Gas Laws. Boyle's and Charkas law, gas equation diffusion, Graham's law of diffusion,effusion,problems. Dalton's Law of partial pressure. Introduction to radio-active changes alpha ray and beta ray change, group displacement law, definition of isotopes and isobars.</p> <p><b>Mathematics</b> Solution of 1<sup>st</sup> and 2<sup>nd</sup> order equation with one or two unknowns by algebraic calculations and by graphs.</p>

3	Filing the edges flat, and square to the faces. Checking the trueness with the engineers square. Filing square the four edges. Use of vice clamps, checking up all dimensions with outside caliper and steel rule.	<p><b>Trade theory</b> Files-their types, grade, care and uses of various common file. File card and its use.</p> <p><b>Engineering drawing</b> Free hand drawing of simple slides such as cube, rectangular blocks, cylinders, cones etc, and their views.</p> <p><b>Physics</b> Same as week no.2</p> <p><b>Workshop calculation and science</b> Same as week no.2</p> <p><b>mathematics</b> same as week no.2</p>
4.	Exercise on preparation of one of the flat surface filing two of the adjoining sides square to master surface as well as between each other. marking out with scribing block, the work piece properly supported against a V-block or an angle plate. Filing and squaring. Marking of parallel lines, dot punching , checking the chipped edges with the square to reasonable accuracy.	<p><b>Trade theory</b> Convexity of files, its reasons. Right method of fixing handles. Angel plate, parallel blocks, V-block, their uses. Surface plate construction, cutting angles and lips, straight fluted, special types, parts and their function. Use of angel gauge.</p> <p><b>Engineering drawing</b> Use of set squares and other drawing instruments. Reading of simple blue prints.</p> <p><b>Physics</b> Same as week no.2</p> <p><b>Workshop Calculation and science</b> Same as week no.2</p> <p><b>Mathematics</b> Same as week no.2</p>
5.	Same as week no.4	<p><b>Trade Theory</b> Classification of elements History Mendeleett's periodic law and table, aadvantages and disadvantages, statement of modern periodic law. Same as week no.2</p>
6	Filing flat the work piece squaring, edges in relation to master face, marking out the position of holes, dot punching, deepening the points with center punch.	<p><b>Trader Theory</b> Drill bit grinding. Common faults, and their ill effects. Drill chuck, drill drifts sleeves. Drilling machine Introduction types, parts etc.</p> <p><b>Engineering Drawing</b> Reading of simple blue prints</p> <p>(x) <b>physics</b> same as week no. 5</p> <p><b>workshop calculation and science.</b> same as week no. 5</p> <p><b>mathematics</b> same as week no. 5</p>

7	Same as week no. 6	<p><b>Trader Theory</b> same as week no.6</p> <p><b>Engineering Drawing</b> same as week no.6</p> <p><b>physics</b> (x) S-m. Rotational motion moment of inertial. Simple machines, requirements of a good balance.</p> <p><b>Workshop calculation and science.</b> Atomic, molecular and equivalent weight(Definition of double and complex only) Electronic theory of valence and definition of double and complex salts.</p> <p><b>Mathematics</b> Factorization</p>
8.	<p>Marking out for drilling, using height gauge. Drilling holes with parallel shank drills</p>	<p><b>Trade Theory</b> Vernier caliper-principle, construction Graduation, reading Uses, care and adjustment. Vernier height gauge and Vernier caliper.</p> <p><b>Physics</b> Same as week No. 7 Work Calculation and Science shop Same as week No. 7</p> <p><b>Mathematics</b> Same as week No. 7</p>
9.	<b>Practice on grinding drills,</b>	<b>Trade Theory</b>
To	<p>Screw drivers, chisels of various shape and dot punches etc To recondition them. Drilling and tapping BSW, and metric threads for various sizes. Also threading by using dials for standard bolts.</p>	<p>Micrometer outside principle construction, Name of parts, graduation, reading, uses and cares. Micrometer inside, principle construction, graduation reading Use and care.</p> <p><b>Engineering Drawing</b> Method of mixing a drawing sheet on the board. Layout of drawing sheet (border line little block etc.) Use of different scales mm, inch.</p> <p><b>Physics</b> (X) Static and Kinetic friction, their measurement. Elasticity, stress. Strain, Hooke's law. Different modullii, work done in stretching a wire, determination of Young's Modulus.</p> <p><b>Workshop Calculation and Science</b> (x) Law of mass action</p> <p><b>Mathematics</b> (x) Factorization.</p>

12.	Marking out to dimensions with height gauge chamfering and reducing, checking dimension with V-Caliper and micrometer Checking radius with Radius gauge	<p><b>Trade Theory</b> Taps, size of taps, tapping determination of sizes of drills for tapping.</p> <p><b>Engineering Drawing</b> Writing single stroke</p> <p>Physics (X) Surface Tension surface energy Angle of contact rise of liquid in a capillary tube differ rent of pressure in a spherical bubble. Viscosity Poiseuille s formula <b>Workshop Calculation and Science</b> Electrolysis (X) Recursion if the above weeks</p> <p><b>Mathematics</b> (X) Area of surface of solids like prison cylinder cone etc.</p>
13	<p><b>Turning</b> Introduction types of work done in the sedtion.Latheits parts and functions Check it for proper running cleaning and oiling of various parts. Hikdubg Job but your jaw chuck &amp; turning. Grinding rough turning tool.</p>	<p><b>Trade Theory</b> Shop safety safety precaution as approved to section Lathe its construction, cleaning and oiling. Independent check different types and construction uses. Common lathe cutting tools types, shapes, different angles. Emigrating 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><b>Trade Theory</b> Same as Week. No.13 Engineering Drawing Same as Week No.13</p> <p><b>Physics</b> (X) Density and specific gravity Archimedes principal, principal of Floatation Hydrometers. Center of gravity and equilibrium condition.</p> <p><b>Workshop Calculation and Science</b> Same as week no.12</p> <p><b>Mathematics</b> Same as week no.12</p>
15	Setting tools in tool post Facing operation thus making the job to specified length and center drilling. Grinding of lathe tools. Plain turning by holding joy in the chuck. Turning to sp Same as week no.12ecified dia.	<p><b>Trade Theory</b> Lathe, Accessories, such as center mandrel, catch plate and dog face plate, lathe steady etc. Construction and use.</p> <p><b>Engineering Drawing</b> Geometrical construction of polygons</p> <p>(x) <b>Physics</b> Same as week no.14</p> <p><b>Workshop Calculation and Science</b> <b>Inorganic Chemistry</b> (Physics and Chemistry) Oxidation-Reduction Corrosion</p> <p><b>Mathematics</b> <b>Same as week no.12</b></p>



16	Same as week no.15	<b>Mathematics</b> Volume of solids like prism, sphere, cone etc.
17	Step turning grinding of finishing tool	<b>Trade Theory</b> Common lathe cutting tools, roughing and finishing tool knife tool, recessing tool etc. Lathe tool material. <b>Engineering Drawing</b> Geometrical construction on plane curves such as cycloid, involutes, parabola, hyperbola, spiral helix etc. <b>Physics</b> Same as week No. 16 <b>Workshop calculation and Science</b> Same as week No. 16 <b>Mathematics</b> Same as week No.16
18 & 19	Drilling on lathe. Drilling through and drilling. Blind hole, Setting boring tool in tool post. Boring plane, taper, step.	<b>Trade theory</b> Drills-construction, types. Uses of drill selves. Boring tool types setting of boring tool. <b>Engineering Drawing</b> Different types of lines used in engineering drawing as per IS 696-1972 (IInd Revision) <b>Physics</b> Same as week No.16 <b>Workshop Calculation and Science</b> Same as week No. 16 <b>Mathematics</b> Same as week No.16
20 to 22	Taper turning by swiveling compound rest. Taper turning by off setting tail stock. Turning gear blanks with mandrels, knurling practice.	Engineering Drawing Isometric views of simple solid and hollow object. Physics Calorimetric, change of state <b>Workshop Calculation and Science</b> 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. <b>Mathematics</b> (X) Volume of solids like prism, sphere. come etc.
23 & 24	Tread cutting (BSW) & Thread cutting (Metric)	<b>Trade Theory</b> Screw thread purpose and forms, Screw thread terminology. Calculation of change wheel. Calculation of pitch depth, core die, etc. <b>Engineering Drawing</b> Orthographic views of simple objects by 1 <sup>st</sup> angle projects. <b>Physics</b> Hygrometry <b>Workshop Calculation and Science</b> Manufacture and the properties of sodium hydroxide and carbonate. <b>Alloys</b> : Preparation properties and uses.

		<b>Mathematics</b> (X) Logarithms
25	<b>Welding (Gas)&amp;Introduction-</b> Importance of trade, types of work done, safety equipments and their uses. Lighting	Trade Theory Safety and general precaution observed in the workshop. Importance of welding in the main
	And adjustments of flame Fusion runs with and Without filler rod-D	Tenance of chemical plant and equipments,safty precaution in The gas welding <b>ENGINEERING DRAWING</b> Orthographic views/ of simple Objects by IIIrd angle projection. <b>Physics</b> Same as Week No. 24 Workshop Calculation and Science Same as Week No.24 <b>Mathematics</b> Same as Weeks No. 24
27 & 28.	Edge joint with or with- our filler rod square butt joint	<b>Trade Theory</b> Welding methods and types of welding, welding terms and definitions. Common gases used in welding-Oxygen, Hydrogen, Acetylene, CO2 gas etc. Chemistry and types of flame. Engineering Drawing Exercises on orthographic view Of simple solid and hollow objects. <b>Physics</b> Mode of heat transfer. Thermal conductivity and its determination. Workshop Calculation and Science Laboratory preparation, properties and uses of carbondioonideOxygen, Hydrogen, Sulphardioxide, Hydrogen sulphide and halogens. (Chlorine and bromine) Nitrogen, its oxides, fixation of nitrogen. Mathematics Same as Week No 24.
29. \$ 30	Outside corner joints— D. Fillet weld-D Inside corner joint	Trade Theory-acetylene welding. equipments such as regulators, blow pipes etc. Assembling, care and maintenance.

1	2	3
		Work shop 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 right angled triangle & their application in solving, practical problems.
	Hard facing stall ting. Brazing of dissimilar metals. Practice in gas cutting for various thicknesses.	<b>Trade theory</b> Hard facing- necessity, type methods, application, destructive test, stall ting necessity, type- Flame adjustment-methods and application. Methods employed to control distortion and stress relieving. <b>Engineering drawing</b> Same as week no.27 <b>Physics</b> Intensity of magnetic field at a point on magnetic axis and magnetic equation, neutral point, Tangent magneto mete, dipswitches and applications of magnet. Static electricity-charge, charging by induction. <b>Workshop calculation and science</b> <b>Organic chemistry</b> Introduction to organic chemistry purification processes <b>Organic reactions</b> Substitution. addition (poly metrication) Elimination and rearrangement reactions.

<p>33 \$ 34</p>	<p>Hard facing stall ting. Brazing of dissimilar metals. Practice in gas cutting for various thicknesses.</p>	<p><b>Workshop Calculation and Science</b> Water for industrial purpose preparation properties and uses of aluminum chloride potassium Ferro and Ferricyanide bleaching powder.</p> <p><b>Mathematics</b> (x) Trigonometry-study of sine; cosine. Tangent of angles in a right angled triangle \$ their application in solving, practical problems.</p> <p><b>Trade Theory</b> Hard facing-necessity, types methods, application. Destructive test, stall ting necessity, type-Flame adjustment-methods and application. Methods employed to control distortion and stress relieving.</p> <p><b>Engineering Drawing</b> Same as Week No.27</p> <p><b>Physics</b> 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><b>Workshop Calculation and Science</b></p> <p><b>Organic Chemistry</b> Introduction to organic chemistry. purification processes Organic reactions Substitution, addition (polymerization) Elimination and rearrangement reactions.</p>
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<p>35 \$ 36</p>	<p>P.V.C. Welding, all types joints on sheets 3 mm, 4 mm, 6mm. P.V.C. Welding pipe Flange, elbow, T. etc.</p> <p>Physics To study triangular and parallelogram of forces with the help of mechanical board. Determination of coefficient of static friction using inclined plane. Determination of mechanical advantage. Velocity ratio and % efficiency of simple machine Determination of acceleration due to gravity by simple pendulum. Determination of Young's Modulus by Searle's apparatus.</p>	<p>Explanation and example Nomenclature I.U.P.A.C. and common system. Classification \$ Functional Groups. Halo, Hydroxyl, Formby, Carbonyl, Amino, Hydro and Euphonic acid Cyclic Acyclic compounds. <b>Mathematics</b> Same as Week No.32. <b>Trade Theory</b> Definition of P.V.C. its type, properties and uses. <b>Engineering Drawing</b> Drawing orthographic views of nuts bolts. screws etc <b>Physics</b> Same as Week No. 33 <b>Workshop Calculation and Science</b> Same as Week No.33 <b>Mathematics</b> Same as Week No.32. <b>Trade Theory</b> Objective, procedure, apparatus required explanation and calculations involved in the experiments. <b>Engineering Drawing</b> Drawing of different types of thread forms, rivet heads. Keys, coupling. <b>Physics</b> Same as Week No.33 <b>Workshop Calculation and Science</b> Same as Week No. 33 <b>Mathematics</b> Same as Week No.32.</p>
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1	2	3 page no.17
39 & 40	(i)determination of coefficient of expansion of solid and liquid (ii)Determination of coefficient of thermal conductivity of metal rod. (iii)Determination of rotation constant of optically active substance by a polarimeter.	Trade Theory Same as Week No.37 Engineering Drawing Same as Week No.37 Physics Static electricity-distributions of Charge, potential, capacity and Condenser Current electricity-electricity by chemical action cell. Workshop Calculation and Science Aliphatic hydrocarbons, saturated and unsaturated (i)Methane (ii)Ethylene (iii)Acetylene Laboratory preparation properties and uses. Petroleum. Composition, refining, cracking, and explanation of octane no., flash point calorific value, fire point, viscosity & sulphur contents. Halogen compound 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. Definition, classification. Sugar : Preparation properties and uses. Mathematics Trigonometry-study of sine, cosine, tangent of angles in a right angled triangle & their application in solving practical problems, and problems on law of fluids, heat transfer, evaporation, transmission of power etc.

41	(i)To study Ohm's law and Kickoff's law about.	Trade theory Same as week No.37 Engineering Drawing
42	Current and voltage. (ii)To study electric cell using series and parallel connections. (iii)Determination of specific resistance using wheat stone's Bridge. (iv) Verification of Faraday's First law of electrolysis. (v) Determination of mechanical equivalent of heat using electrical method	Drawing of different types of riveted joints such as lap and butt joints. Physics Same as week No.39 Workshop Calculation and Science Same as week No.39 Mathematics Same as week No.39.
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

		<b>Mathematics</b> Same as week no.39.
45.	To study the allotropic forms of sulphur	<b>Trade theory</b> <b>Engineering drawing</b> Same as week no.43. <b>Physics</b> Magnetic effect of current, electromagnetism, ohm's law. Kirchhoff's law. Parallel and series circuit connections. Wheatstone's bridge, potentiometer. <b>Workshop calculation and science</b> Oil and fats. Soaps. Introduction to aromatic compounds. <b>Mathematics</b> Same as week no.39
46.	To study the properties of mixture (Fe+S) and compound (FeS)	<b>Trade Theory</b> <b>Same as week no.37.</b> <b>Engineering drawing</b> Same as week no.43. <b>Physics</b> Same as week no.45 <b>Workshop calculation and science</b> Same as week no.45. <b>Mathematics</b> Same as week no.39.
47.	to study action of pure and salt water on metals and alloys	<b>Trade theory</b> Same as week no.37 <b>Engineering drawing</b> Same as week no.43 <b>Physics</b> Same as week no.45.
		<b>Workshop calculation and sciences</b> Same as week no.45. <b>Mathematics</b> Same as week no.39.
48.	To study action of acids and bases on metals and bases no metals alloys	<b>Trade theory</b> Same as week no.37 <b>Engineering drawing</b> Same as week no.43. <b>Physics</b> Same as week no.45 <b>Workshop calculation and sciences</b> Same as week no.45. <b>Mathematics</b> Same as week no.39.
49.	To study the corrosion of metals	<b>Trade theory</b> Same as week no.37 <b>Engineering drawing</b>



		Sectional view of simple objects Such as brackets, bearings etc. <b>Physics</b> Heating effect of electric current. Electrolysis. <b>Workshop calculation and sciences</b> Polymerization Rubber plastics and back elites preparation properties and uses of oxalic acid, ethyl alcohol, nitrobenzene, aniline, acetylene. <b>Mathematics</b> Same as week no.39.
50.	Volumetric analysis. Qualitative analysis (inorganic ) (simple without interfering radicals ). Determination of flash point.	<b>Trade theory</b> Same as week no.37 <b>Engineering drawing</b> Same as week no.49. <b>Physics</b> Same as week no.49..
	Determination of Ph (lotion)	<b>Workshop calculation and science</b> <b>Same as Week No.49</b> Mathematics <b>Same as Week No.39</b>
51	Revision And Examination	<b>Trade theory</b> Revision and examination
52		<b>Engineering drawing</b> Revision and examination <b>Physics</b> Revision and examination <b>Workshop calculation and science</b> Revision and examination <b>Mathematics</b> Revision and examination

**NOTE:** marked (x) may be deleted for B.SC apprentices  
TRADE-Attendants Operator  
(Chemical Plant)

2<sup>nd</sup> Year

53	Review the operation covered in the first year	<b>Trade Theory</b> Review the connected theory covered in the 1 <sup>st</sup> year. Introduction to different sizes of Pipes, flanges, elbows, Sockets, plugs, squares reducers, trees etc. <b>Engineering Drawing</b> Orthographic views of machine parts such as bearings, brackets etc. <b>Unit Operation</b> Pipes: Methods of joining them, Expansion joints.
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		<p><b>Unit Process</b> Salts from sea water : process Description and flow sheet.</p>
54	Thread coating, bending, Threading of pipes, different types of pipe joints and fittings, such as screw flanged etc.	<p><b>Trade theory</b> Bending method, different types of pipes joints. Bending fixtures, Standard pipe theads taps and dies for pipe threading.</p>
		<p><b>Engineering Drawing</b> Same as Week no.53 <b>Unit Operation</b> Valves, safety devices, diaphragm control valve stream trap. <b>Unit Process</b> Soda-ash: process classification, raw materials, chemical reaction process description flow sheet and uses</p>
55.	Use and maintenance of lagging materials such as glass wool, thermo Cole etc.	<p><b>Trade theory</b> Lagging materials, types and uses. <b>Engineering Drawing</b> Same as Week No:53 <b>Unit Operation</b> Reynolds number, viscosity, Manometer, Bernoulli equation. <b>Unit Process</b> Same as Week No:54</p>
56.	Dismantling and assembling of globe valves,checkvalves, needle valves, diaphragm valves ,ball valves, stop cock, buffer fly valves etc.	<p><b>Trade theory</b> Construction, working and uses of various types of valves. <b>Engineering Drawing</b> Sectional views of machine. <b>Unit Operation</b> Application of the equation in Pump, compressor, venturimeterorifice meter, flow Nozzle, quantity meters. <b>Unit Process</b> Caustic soda and chlorine: Process classification, raw materials, chemical reaction, process description, flow sheet and uses.</p>
57.	Same as Week No.56	<p><b>Trade theory</b> Types of gears, e.g. spur, helical, Bevel, their uses and their advantages, and disadvantages. <b>Engineering Drawing</b> Same as Week No.56 <b>Unit Operation</b> Same as Week No.56</p>
		<p><b>Unit Process</b></p>

		Same as Week No.56
58.	Fittings and assembling of different gears, gear-boxes, reduction gears etc.	<p><b>Trade theory</b> Different types of pumps, Construction details and their Uses.</p> <p><b>Engineering Drawing</b> Same as Week No:56</p> <p><b>Unit Operation</b> Pumps-positive displacement and centrifugal</p> <p><b>Unit process</b> Same as Week No: 56.</p>
59.	Study of different types Of pumps such as centrifugal pumps of different type, gear pumps plunger pumps, reciprocating compressors, multistage compressors, lobe pumps etc., their assembly, maintenance and trouble shooting.	<p><b>Trade theory</b> Cases of misalignment, different Methods of checking alignment. Effect of misalignment of shafts, Coupling and bearings.</p> <p><b>Engineering Drawing</b> Free hand sketching of parts Such as pistons, connecting rod , Crank shafts, steam chats etc.</p> <p><b>Unit Operation</b> Compressor and vacuum pumps Steam jet ejection, lift pumps.</p> <p><b>Unit process</b> Sephardic acid: process classification, raw materials, Chemicals reaction, process Description flow sheet and uses.</p>
60.	Same as Week No:59	<p><b>Trade theory</b> Same as Week No:59</p> <p><b>Engineering Drawing</b> Same as Week No :59</p> <p><b>Unit Operation</b> Modes of hear transfer, Thermal conductivity, Fourier's Equation Resistance in series Plane and round surface.</p> <p><b>Unit process</b> Same as Week No:59</p>
61& 62.	Checking alignment of shafts and coupling of motors ,correcting alignment Use of dial gauges.	<p><b>Trade theory</b> Bearings (their types, construction and uses, Such as ball, roller, bush needle bearing etc. Their care and maintenance.</p> <p><b>Engineering Drawing</b> Free hand drawing of pipe joints and fittings.</p> <p><b>Unit Operation</b> Film co-efficient overall film co-efficient, Factors affecting heat transfer co-effecting.</p> <p><b>Unit Process</b></p>

		Ammonia and complex fertilizer :process Classification, process description, with Flow sheet, definition and their types.
63.	Fitting of bearing such as Ball bearings, roller bearings, bush bearings etc. Their care, lubrication and Maintenance.	<b>Trade theory</b> Use of correct material and locking device such As, alit pin, lock nut, spring washer, taper Washer etc. <b>Engineering Drawing</b> Free hand drawing of shaft coupling and flanged etc. <b>Unit Operation</b> Same as Week No:61 <b>Unit process</b> Same as Week No:61
64.	Same as Week No:63	<b>Trade Theory</b> Same as Week No:63 <b>Engineering Drawing</b> Same as Week No:63 <b>Unit Operation</b> Co-current and counter current heat each ages, Double pipe, plate and finned type exchanger. <b>Unit process</b> Same as Week No:61
65.	Welding (arc) Straight lines beads on M.S. Plate.	<b>Trade theory</b> Different process of metal joining, bolting, Riveting, soldering, brazing etc.welding terms and their definition. <b>Engineering Drawing</b> Drawing different types of pips line diagram, pipe fitting symbols. <b>Unit Operation</b> Same as Week No:64 <b>Unit process</b> Nitric acid :process classification, process Description with flow sheets and concentration.

66.	Open corner joint M.S.plate.	<p><b>Trade theory</b> Types of joints, classification, use Elementary electricity. Its uses applied to welding. Heat and temperature.</p> <p><b>Engineering Drawing</b> Same as Week No: 65</p> <p><b>Unit Operation</b> Furnace for solids, liquid and gaseous fuels using air and steam as Mixing fluids.</p> <p><b>Unit Process</b> Urea and other fertilizers : process Classification, process description with flow sheets.</p>
67.	Fillet weld(M.S.Plate)	<p><b>Trade theory</b> Description and use of tools and equipments used in arc welding.</p> <p><b>Engineering Drawing</b> Free hand drawing of valves-gate, glove plug cock, ball, needle diaphragm and control valves.</p> <p><b>Unit Operation</b> Kiln-shaft and rotary (direct and indirect fired).</p> <p><b>Unit Process</b> Same as Week No :66</p>
68.	Outside corner joints	<p><b>Trade theory</b> Types of electric welding metallic, carbon, resistance etc. and application are length etc.</p> <p><b>Engineering Drawing</b> Same as Week No :67</p> <p><b>Unit Operation</b> Evaporation: Horizontal, vertical tube, forced circulation and falling film evaporators.</p> <p><b>Unit Process</b> Same as Week No :66</p>
69.	Single “v” butt joint.	<p><b>Trade theory</b> Principle of are welding, types of welding . Types of welding machine care and maintenance</p> <p><b>Engineering Drawing</b> Same as Week No :67</p> <p><b>Unit Operation</b> Multiple effect evaporation Methods of feeding in a multiple effect evaporator, steam economy.</p> <p><b>Unit Process</b> Class: process classification process description with flow sheet.</p>
70.	Fillet lap joint and T-joint.	<p><b>Trade theory</b> Advantages of one over the other. Electrodes, types , method of coating, flux , characteristic I.S.I. specification.</p> <p><b>Engineering Drawing</b> Drawing sketches of expansion joints and stuffing boxes.</p>

		<p><b>Unit Process</b>          Condensers-contact and surface condensate removal.          Instrumentation of an evaporator.</p> <p><b>Unit Process</b>          Cement: definition of cement and its type , process description with flow sheet.</p>
71.	Pipe joints , T.Butt	<p><b>Trade theory</b>          Arc welding defects, causes and</p>
		<p>Effects, how to overcome etc. distortion and its control.</p> <p><b>Engineering Drawing</b>          Same as week No.70</p> <p><b>Unit Operation</b>          Properties of steam, Boilers-fire-tubes, water tube, forced circulation, accessories, Water treatment.</p> <p><b>Unit Process</b>          Same as Week no.70</p>
72.	Butt joints(square butt)	<p><b>Trade Theory</b>          Simple estimating involving fabrication, consumption of gases, electrode, length of weld, use of hand book and reference tables.</p> <p><b>Engineering drawing</b>          Exercises on blue print reading</p> <p><b>Unit operator</b>          Same as Week No.71</p> <p><b>Unit Process</b>          Iron &amp; steel: Process description with flow sheet.          efnition of steel and its type.</p>

73.	(1) Installation of venture-meter, orifice meter and Rota meter (2) Determination of viscosity of a liquid by viscometer.	<b>Trade theory</b> Procedure of installing venturimeter, orifice and Rota meter, precautions to be observed. <b>Engineering Drawing</b> Same as week No.72 <b>Unit Operation</b> Same as week No.71 <b>Unit process</b> Same as week No.72
74.	Study of head against capacity curve of centrifugal pump	<b>Trade theory</b> Procedure of conducting the experiment, calculation and precautions to be observed. Sketch of the equipment. <b>Engineering Drawing</b> Free hand sketching of simple bearing blocks <b>Unit Operation</b> Distillation : Introduction, boiling point diagram, equilibrium curve <b>Unit Process</b> Same as Week No. 72
75.	Study of head Vs. capacity curve of gear pump	<b>Trade Theory</b> Same as Week No. 74 <b>Engineering Drawing</b> Same as Week No.74 <b>Unit Operation</b> Same as Week No.74 <b>Unit Process</b> Same as Week No.72.
76.	To determine Reynolds's number at different velocities	<b>Trade Theory</b> Same as Week No.74 <b>Engineering Drawing</b> Drawing sketches of pumps centrifugal, gear plunger, sliding vane and water ring vacuum pump. <b>Unit Operation</b> Azeotropes, flash and differential distillation. <b>Unit Process</b> Aluminum: Process description with flow sheet and uses.
77.	To determine friction losses in a straight pipe, pipe fitting, valve	<b>Trade Theory</b> Same as Week No.74 <b>Engineering Drawing</b> Same as Week No.76 <b>Unit Operation</b> Rectification and Variables affecting rectification and instrumentation diagram of a distillation column. <b>Unit Process</b> Same as Week No.76.

78.	To calculate overall heat transfer coefficient for a shell and tube heat exchange	<b>Trade Theory</b> Same as Week No.74 <b>Engineering Drawing</b> Same as Week No.76
		<b>Unit operation</b> Same as week no.77. <b>Unit process</b> Same as week no.76.
79.	To find rate of evaporation of a vertical tube evaporator	<b>Trade theory</b> Same as week no.74. <b>Engineering drawing</b> Same as page no.76. <b>Unit operation</b> Same as week no.77. <b>Unit process</b> Petroleum & petroleum refining crude petrol its origin and classification distillation of crude, unit process involved properties of petroleum products.
80.	Separation of a liquid mixture by distillation using packed tower	<b>Trade theory</b> Same as week no.74. <b>Engineering drawing</b> Drawing sketches of steam jet ejectors, and steam traps. <b>Unit operation</b> Same as week no.77. <b>Unit process</b> Same as week no.79
81.	separation of a liquid mixture by distillation using packed tower	<b>Trade theory</b> Same as week no.74. <b>Engineering drawing</b> Free hand sketches of different types of shell and tube heat exchanges. <b>Unit operation</b> Azeotropic , extractive and steam distillation. <b>Unit process</b> Same as week no.79
82.	Finding rate of drying curve by tray drier	



		<p><b>Unit operation</b> Same as week no. 81.</p> <p><b>Unit process</b> Same as week no .79</p>
83.	Operating of (I) plate and form and fitter press. (II) top-driven centrifuge. (III) ball mill .(IV) black jaw crusher	<p><b>Trade theory</b> Construction, principle, trouble Shooting and precaution to be Observed during operation of the Equipment. Sketches of the Equip- mint.</p> <p><b>Engineering drawing</b> Diagram of distillation column With all accessories.</p> <p><b>Unit operation</b> Extraction and teaching application Of liquid-liquid extraction, theory, definition, choice of solvent, distribution coefficient.</p> <p><b>Unit process</b> Same as week no. 79</p>
84.	Same as week no .83.	<p><b>Trade theory</b> Same as week no. 83.</p> <p><b>Engineering drawing</b> Free hand sketches of extractors.</p> <p><b>Unit operation</b> Extractors: signal and multistage mixer Settler counter current, centrifugal towers: spray 'packed and sieve.</p> <p><b>Unit process</b> Calcium carbide: manufacture with flow sheet.</p>
85.	Same as week no. 83	<p><b>Trade theory</b> Same as week no. 83.</p> <p><b>Engineering drawing</b> Free hand sketches of evaporators.</p> <p><b>Unit operation</b> Same as week no.84</p> <p><b>Unit process</b> Sugar: manufacture and refining with flow sheet.</p>

1	2	3
86	(1) To carry out sieve analysis with a sieve shaker (2) Operation of a mixer settler (3) Operation of a spray extraction tower.	Trade Theory Procedure of conducting, experiment, calculation and precautions to be observe of the equipment. Engineering Drawing Same as week No.85 Unit operation Same as week No. 84
87	Operation of a multistage compressor. Study of electrical technology such as three phase supply induction motor, starter etc.	Trade Theory Same as week No.86 Engineering Drawing Free hand sketches and centrifuges. Unit operation Leaching: Application and different types of equipment used for leaching. Oil extraction from oil seeds. Unit process Same as week No.86
88.	Same as week No.87	Trade Theory Same as week No.86 Engineering Drawing Flow sheet of sulphuric acid manufacture. Unit operation
.		Humidity and Air conditioning: Introduction, definition, humidity chart, humidification and its equipment, dehumidifiers, cooling towers. Unit process Oil and fats refining Trade Theory Units of pressure, measurement of pressure by different methods. Engineering Drawing Flow sheets of user and Nitric acid manufacture Unit process Soap and Glycerin: process description with flow sheet.
89	Calibration of (i) Bourdon tube pressure gauges (ii) Manometers	Trade Theory Same as week No.89 Engineering Drawing Flow sheet of sugar manufacture Unit operation Comparison of different absorption tower and their operation. Operation 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 sheet.
90.	Calibration of (i) bellow type pressure gauge. (ii) Vacuum gauges.	Trade Theory ..... <b>Engineering Drawing</b> Flow sheet of ethyl manufacture

(1)	(2)	(3)
		Unit Process Oils and fats refining
89.	Calibration of (i) Bourdon tube pressure gauges (ii) Manometers	Trade theory Units of pressure, measurement of pressure by 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 & Glycerin: process description with flow sheet.
90.	Calibration of (i) bellow type pressure gauge (ii) Vacuum gauges.	Trade theory Same as week no.89 Engineering Drawing Flow sheet of sugar manufacture Unit operation Comparison of different absorption towers and their operation. Operating line, number of stages, and 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.
91.	Industrial visit	Trade theory ..... Engineering Drawing Flow sheet of ethyl alcohol manufacture. Unit operation Drawing: Introduction, Vapor pressure, curves for water, relative humidity other definitions, equilibrium in drying. Tray drier.

1	2	3
92	Calibration of mercury in glass thermometer	Trade Theory Temperature, its units and different method of measurement. Engineering Drawing Flow sheet of cement manufacture Unit Operation Instrumentation of drier various types of driers spray drier and drum drier Unit Process Same week No.90
93.	Calibration of filled thermometer	Trade Theory Same as week No.92 Engineering Drawing Flow sheet of pulp manufacture Unit Operation Crystallization : Introduction classification of crystallizers. Unit process Same as week No.90
94.	Calibration of bi-metallic thermometer	Trade Theory Same as week No.92 Engineering Drawing Flow sheet of aluminium manufacture Unit operation Filtration: Introduction, factors affecting filtration, classification of filters. unit process Plastics & Resin: manufacturing processes; condensation polymerizing products, addition polymerization products.
95.	Calibration of a resistance thermocouple	Trade theory Same as week No.92 Engineering Drawing Flow sheet of caustic soda and chlorine manufacture

1	2	3
		Unit operating Mixing: Mixing liquids with liquids, mixing solids with liquids, mixing solids with solids and equipment used. Unit process Same as week No.94
96.	Calibration of resistance thermometer	Trade theory Same as week No.92. Engineering Drawing Flow sheet of soda ash manufacture Unit operation Centrifugation: Introductions, classification of equipment. Unit process Paints and varnishes: different types of pigments, oil, varnishes, lacquer.
97.	Experiment on a level measurement	Trade theory Level, different methods of measurement. Engineering Drawing Instrumentation diagram of a distillation column. Unit operation Absorption: Theory, door bents, and applications of absorptions, Screening: Definition, classification of screen sedimentation & Decantation: Introduction, classification. Setting: Definition and equipment. Unit process Same as week No.96
98.	(i) Experiment on hydrometer (ii) Study of quantity meter	Trade theory Density, its units and different methods of measurement. Engineering Drawing Instrumentation diagram of an evaporator. Unit operation Same as week N0.97

(1)	(2)	(3)
		Unit process Some as Week No.96
99.	Calibration of PH meter	Trade theory PH its definition and different method of measurement. Engineering Drawing Instrumentation diagram of a drier. Unit operation Same as Week No.97 Unit Process Water treatment precipitation. Demineralization processes, Air pollution.
100.	Study of diaphragm, control valve, transmitter.	Trade theory Final control element, Transmitter Engineering Drawing Flow diagram of a rotary vacuum filter with all accessories. Unit operation Crushing and grinding: introductions and classification of equipment. Unit Process Fuel: Coal, water gas producer gas combustion of fuels.
101.	Study of record and controllers	<b>Trade theory</b> Record and controllers Engineering Drawing Diagram of open & closed circuit grinding. Unit operation Conveying: introduction and different types of conveyors. Unit Process Same as Week No. 100
102.	Revision and examinations	Trade theory Revision and examinations. Engineering Drawing Revision and examinations. Unit operation Revisions and examinations. Unit Process Revisions and examinations.

TRADE : ATTENDANT OPERATOR (CHEMICAL PLANT)

## LIST OF TOOLS &amp; EQUIPMENT

(For a batch of 16 Trainees)

	Description	Quantity	Required
1.	Caliper outside spring 6"/15 cm	17	(1 for instructor+16 for trainees )
2.	Caliper inside spring 6"/ 15cm	17	"
3	Livider spring 6"/15cm	17	"
4	Center punch 4"/10	17	"
5	Prick punch 6"/15cm	17	"
6	Chisel cold flat 1"/2.5cm	17	"
7	Chisel cross cut 3/8"/*1/8"	17	"
8	Chisel diamond point 3/8"/10 mm	17	"
9	Chisel half round 3/8"/10 mm	17	"
10	Hammer ball pen 1 lb handled	17	"
11	Hammer ball pen 1/2 lb handled	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"*3/8"blade	17	"
15	Screw Driver 12"*1/2"blade	17	"
16	State engineers 6" blade/15cm	17	"
17	Scriber	17	"
18	Safety Goggles	17	"
19	Box drawing instruments	17	"
20	Protractor celluloid 6" semicircular	17	"
21	Scale (wood) Draughtsman 12"/30 cm	17	"
22	Set square celluloid 45 <sup>0</sup> -8inch	17	"

TRADE : ATTENDANT OPERATOR (CHEMICAL PLANT)  
 LIST OF TOOLS & EQUIPMENT  
 (for a batch of 16 Trainees)

	Description	Quantity	Required
	Trainees Kit		
1.	Caliper outside spring 6"/15 cm	17	(1for instructor+16for trainees)
2.	Caliper inside spring 6"/15cm	17	"
3.	Livider spring 6"/15cm	17	"
4.	Centre punch 4"/10cm	17	"
5.	Prick punch 6"/15cm	17	"
6.	Chisel Cold flat 1"/2.5cm	17	"
7.	Chisel diamond point 3/8"/10mm	17	"
8.	Chisel Diamond point 3/8"/10mm	17	"
9.	Chisel half round 3/8"/10mm	17	"
10.	Hammer ball pin 1 lb handled	17	"
11.	Hammer ball pin 1/2lb handled	17	"
12.	Hacksaw frame adjustable with pistol grip for 8" -12" blade /20cm-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.	Square engineers 6" blade /15 cm	17	"
17.	Scriber	17	"
18.	Safety Goggles	17	"
19.	Box drawing instruments	17	"
20.	Protractor celluloid 6" semicircular	17	"
21.	Scale (wood) Draughtsman 12"/30 cm	17	"
22.	Set square celluloid 45° – 8 inch	17	"
	Description	Quantity	Required
23.	Set square celluloid 60 -10 inch	17	"
24.	Board drawing half imperial size	17	"
25.	Square –T 24 inch blade Workshop Tools Equipment	17	"
1.	Surface plate 12" x12"/30 cm x 30 cm	2	
2.	Or surface plate 24" X 24 '60cm x60 CM	1	
3.	Scribing block universal	2	
4.	Marking table 3' x2x (3' high)	1	
5.	V-Blocks 3"x1 (pair) with clamps	2	
6.	Combination set 12 inch	2	
7.	File handles	96	
8.	Drill twist (straight shank)1/8" to 1/2"by 1/64"(set)	4	



9.	Telescopic gauges ½"-6"	1	
10.	Magnetic indicator and base	2	
11.	Drills twist / to ¾ by 1/16" (Morse taper)	1 set	
12.	Drills twist (Metric) 2mm to 7 mm by 1 mm	6 set	
13.	Drills twist (Metric) 8mm to 12mm by 1 mm	1 set	
14.	Drills straight shank wire gauge sizes 1 to 60 with gauge	1 set	
15.	Drills straight shank letter gauge sizes A to Z with gauge	1 set	
16.	H.S.S. hand reamers 3 to 12 mm by 1 mm	1 set	
17.	H.S.S./ Machine reamers 3 to 19 mm	1 set	
18.	H.S.S. Machine reamers with M.T. shank 1/8" to ¾" by 1/16"	1 set	
19.	H.S.S. hand taper pin reamer ½" to 5/8" by 1/16"	1 set	
20.	Hacksaw frame adjustable for 8" to 12 blades	6	
21.	Hand vice 1"/25 mm	4	
22.	Working bench 6' x 2' with 2 vices 5" jaws	3	
23.	Working bench 8' x 4' 2' with vices 5" jaws	4	

24.	Elmira steel, large with shelves	1	
25.	Tool boxes of drawers fitted in the working bench	16	
26.	Punch letter set 3 mm	1	
27.	Punch figure set 3 mm	1	
28.	Taps and dies complete set in box B.A.,B.S.F. B.S.W., American and metric	1 set each	
29.	File flat 12" bastard	12	
30.	File flat 10" 2 <sup>nd</sup> cut	12	
31.	File flat 10" smooth	12	
32.	File three square 6" and cut	6	
33.	File flat 6" smooth	12	
34.	Stone oil 6" x 2" x 1"/15 cm x 5 cm x 2.5 cm	2	
35.	Can oil ½ pt	2	
36.	Scraper half round 10"/25cm	2	
37.	Scraper half 10"/25cm	6	
38.	Scraper triangular 10"/25cm	2	
39.	Scraper hook type 10"handled	2	
40.	Bevel protractor	1	
41.	Sine bar -200 mm	1	
42.	Chisel cold flat ½ inch	6	
43.	Chisel cross cut 1/4/6 mm	6	
44.	Micrometer outside 0-1"	4	
45.	Micrometer inside 2" to 8" cap/5cm to 20 cm	1	
46.	Micrometer metric 0-25 mm to	2	
47.	Micrometer inside 50-200 mm cap	1	
48.	Veneer calipers 12"	2	
49.	Screw pitch gauge 55 <sup>0</sup> and 60 <sup>0</sup>	1 each	
50.	Wire gauge imperial standard	1	
51.	Dial test indicator	2	
52.	Allen keys 1/16" to 1/2" x 1/32"	2 sets	
53.	Hammer hide faced	2	
54.	Pipe wrench still son pattern 18" long	2	
55.	Chain wrench 3" pipe/75 mm	2	
56.	Pier-combination 8"/20 cm	16	
57.	Phillips head screw driver set 1-4 sizes	1 set	

	Description	Quantity	Required
58	Double ended spanners-set of 7 whit worth sizes Forms 1/8"x3/16"to1/2"x9/16"	1 set	
59	Double ended spanner-set of 7 A/F sizes from 3/8"x7/16' to 15/16x1"	1set	
60	Double ended spanners-set of metric sizes from 8x9 to 20x22	1 set	
61	Overhead projector	1	
62	Projector for slides and filmstrips with screed	1	
63	Projector for 16 mm films	1	
64	Projector for 8 mm supper films	1	
65	Double offset double ended ring spanners set of 7 whit worth sizes form 1/8"x3/16"to1/2"x9/16"	1set	
66	Socket puller 1/2"drive, 3/8" to1/ with ratchet handle	1 set	
67	Geer puller 8" die, capacity at 3 kg type	-	
68	Steel tape 10ft. in case	1	
69	Master precision level 15" long (Each division to read 0005" per foot)	1	
70	Feeler gauge 0005" to 25'	6	
71	Arbor press	1	
72	Bar straightening press	1	
73	Fry press	1	
74	Bar type torque wrench max, reading 100ft.3"pipe	1	
75	Pipe cutter ,3wheel type, 3"pipe	1	
76	Pipe die set complete with die stock &bushing For pipes from 1/8" to1"dia	1	
77	Pipe vice 3"/75 mm	2	
78	Plumb bob	2	
79	Chain hoist 2 ton cap	1	
80	Cast iron camera back straight edges 3 ft. and 5 ft.	1 each	
81	Framing square 24"x2"x16"x1 1/2"	2	
82	Masons tool travels of various types	1 set	
83	Smiths brass rule 24",2fold	2	
84	Caliper 8"inside	2	
85	Wing compass 10" or 12"/25 cm to 30 cm	2	
86	Hand hammer 2lab with handle	2	

	Description	Quantity	Required
87	Hammer smith 4 lbs . with handle	2	
88	Leather apron	2	
89	Steel rack	2	
90	Pick punch	2	
91	Mallets- various	16	
92	Soldering iron copper but 10 ooze	2	
93	Snip straight 10"/25 cm	2	
94	Setting hammer with handle	2	
95	Riveters tools set consisting of rivet snaps, pricking punch and holding up dolly	1	
96	Center gauge 55 and 60	1 each	
97	Tool knurling	2	
98	Combination drill (Centering)	4	
99	Set of mores sockets (0-1,1-2,2-3	1	
100	10 jaw chuck independent	2	
101	Self centering chuck 5"/125 mm	2	
102	Set of tools for lathe	2	
103	Lathe dogs ½" to 1 ½"	2	
104	D E. spanner from 5/8"x 11/16" to 15/16" to 1' whit worth sizes	2sets	
105	Gauge for grinding and setting screw cutting tools	1	
106	Drill chuck 0"to1/2" Morse taper	2	
107	Grinding and setting screw cutting tools	1	
108	Drilling machine to drill up to ½"dia	2	
109	Lathe -30" between centers x 6" centre height with standard accessories	2	
110	Belt lacer	1	
111	Grease pressure gun (Hand)	1	
112	Mandrels 5" x1/2",6" x3/4"	1each	
113	Monkey wrench15"	1	
114	Pin spanner 1" to 3" die	1set	
115	Engineers Ratchet brace with universal drilling pillar	1	
116	Blow lamp	2	
117	Carpenters, Ratchet brace with ½ " screw driver bit and No.4 Phillips head bit	1	
118	Tongs round	2	

	Description	Quantity
119	Tongs flat	2
120	Smiths square	1
121	Cold set rotted	2
122	Hot set rotted	2
123	Swages top and bottom ½", ",(pair)	1 each
124	Flatter (rotted) 2 ½" square	2
125	Faller top and bottom /", 3/8" (pairs)	1 each
126	Swage block 14" x14" 5" with stand	1
127	Anvil 1cwt	2
128	Shovel	2
129	Rake	2
130	Poker	2
131	Hardin	2
132	Welding plant oxy- acetylene complete (either high or low pressure) and electric	1
133	Welding helmet	
134	Goggles pairs welders 4"/10 cm	4 pairs
135	Table welding 4' x2 ½' fire brick top on stand	1
136	Gloves pairs (for welders)	4
137	R.P.M. Indicator	1set
139	Screw extractors sizes 1 to 3	1 set
140	Floor crane 35 cwt. cap	1 pair
141	Forge with chimney and trough fitted with blower	1
142	Tool makers buttons	1 set
143	Steel rule 12 inch	6
144	Caliper outside 6 inch spring	6
145	Caliper inside 6 inch spring	6
146	Set of models , geometrical and samples of machinery parts as necessary of metal , wood and plastic	1
147	Logarithmic slide rule made by fiber ,Germany	1
148	File half 2ndcut 8"/20 cm	6
149	File round 8" x2nd cut 8"/20 cm	6
150	Pipe wrench stilton pattern 6",12",24" long	2 each
151	Anvil stand	2
152	Tool bit holder as Armstrong L.H.	4
153	Tool bit holder as Armstrong R.H.	4
154	Tool bit holder as Armstrong straight	4

Description	Quality	Required
155	Machine vice swiveling base 6'jaw	1
156	Shaper tool holder turret type	6
157	Base chucks for slitter	1
158	Shaper indexing centers	1
159	Plain milling cutter 65x100x27mm bore	2
160	Side and face cutter different sizes	2 each
162.	Single angle cutter 45°, 60°, 70°,	2 each
163.	80° both R.H., L.H. Milling slot cutter 6 mm, 10mm 20 mm thick	6
164.	Spirit level 8"/20 cm	4
165.	Pipe bending springs 1/2"	4
166.	Pipe bending springs 5/8"	2
167.	Pipe bending springs 3/4"	4
168.	Carpenters planes	4
169.	Carpenters saws	4
170	Carpenters chisel sets	4
171.	Carpenters Mallets	1
172.	Shaper 16" stroke motorized	1
173.	Slotted 9" stroke motorized	1
174.	Milling machine plain type horizontal	1
175.	Milling machine universal motorized	1
176.	Vertical milling machine motorized	1

#### Material

1.	Mild steel flat Thickness: 12mm,10mm, 6mm
2.	Mild steel round Diameter: 40mm, 25mm,12mm, 10mm 40-50kg of the above mentioned materials will be necessary for every trainee.
3.	Rough Timber
4.	Plywood
5.	Masonries board
6.	Plastic board
7.	Plastic tubes 25mm

Trade-Attendant Operator (Chemical plant)  
LIST OF EQUIPMENTS  
FOR UNIT OPERATION LABORATORY

Description		Quantity
1.	Venturimeter	1
2.	Orifice meter	1
3.	Rota meter	1
4.	Centrifugal pumps-2 Nos.	2
5.	Gear pumps	1
6.	Reynolds experiment equipment	1 set
7.	Shell and tube heat exchange	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

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

S.NO.	Name	Quantity
1.	Physical Balance (with weight box)	1 set
2.	Chemical Balance (with weight box)	3 set
3.	Viscometer (a) CS Weld Viscometer (b) Redwood Viscometer (c) Stop. Watch (1/10th Saco) (d) Thermostatic bath	3 pieces 3 pieces 6 pieces 2 pieces
4.	Stalagnometer	6 pieces
5.	Traveling microscope	2 No:
6.	Specific Gravity bottle	6 No:
7.	Cyclometer	6 No s:
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, weight etc.	2 Sets
11.	Simple machines (Wheel and axle), Screw Jack inclined plane with roller or trolley, pulleys or pulley blocks for first, seconds and third system and third system of pulleys)	1 Sets
12.	Different types of level	1 Set
13.	Instrument for determining 'g' (simple pendulum)	2 sets
14.	Barometer	1 No
15.	Altimeter	1 No
16.	Searle's Apparatus for Young's Modulus	2 Sets
17.	Nicholson' Hydrometer with glass jar	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 solid and liquid	2 Sets
21.	Apparatus for measurement of thermal conductivity of good and bad conductors	2 sets
22.	Calorimeter for determining "Souls" 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	
24.	Polar meter with monochromatic light	2 sets
25.	Abe Refract meter	2 sets
26.	Pupfish Refract meter	2 sets
27.	Equipment to study Kickoff's law and Electro chemical equivalent	1 sets
28.	Potentiometer	2 sets
29.	Whetstone's bridge	2 sets



30.	Resistances Centre Zero Galvanometer	4 Nos.
31.	Resistance box (a) Resistance box 0 to 100 ohms (b) Resistance box 0 to 500 ohms	2 Nos. 2Nos.
32.	Rheostat (a) Rheostat 25 ohms (b) Rheostat 100 ohms (c) Rheostat 500 ohms	2Nos. 2Nos. 2Nos.
33.	Ampere Meter (a) 0 to 1 Amp. (DC) (b) 0 to 3 Amp. (DC) (c) 0 to 10 Amp. (AC, DC) (d) 0 to 30 Amp. (AC, DC)	2 sets 2 sets 2 sets 2 sets
34.	Voltammeter (a) 0 to 1 volt (DC) (b) 0 to 4 volt (DC) (c) 0 to 5 volt (DC) (d) 0 to 10 volts (DC) (e) 0 to 50 volts (DC) (f) 0 to 250 volts (DC/AC)	2 sets 2 sets 2 sets 2 sets 2 sets 2 sets
35.	Millivoltmeter (a) 0 to 5 mv. (b) 0 to 500 mv.	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, Laclanche cell, Daniel cell, Weston cell, Acidic cell, Head Accumulator, Alkali cell with variable resistances	2 sets
40	Millimeter	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, switchers, terminals for connection

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

Syllabus for the trade of attendant operator

(Chemical plant)

UNDER APPERTICESHIP TRAINING SCHEME PERIOD OF TRAINING SCHEME

Period of training: 3 years

The period of training or this trade is 3 years consisting of basic training for a period for the apprentices with **s.s.c.**, whereas the period of training is 1 years consisting of induction training for a period of 6 months and shop-floor training for the reaming period for the B.Sc. Apprentices.

The syllabus of this trade should be considered as a 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: (I) DURING THE BASIC TRAINING FOR S.S.C. holders 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 operations/skills coming in the list should be learnt by the apprentices at 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 for the candidates with s.s.c. is exactly the same as in **CTS** syllabus.

(B) the contents of 6 months induction training are as per C.T.S. syllabus (skills) tapioca, Marked (x) may be deleted for B.Sc. apprentices.

© the contents of the 1 year shop floor training for the candidates who have undergone basic training in industry and for the ex. I.T.I. Trainees in the trade and for the B.Sc. apprentices who have undergone induction training are as indicated under the heading "shop floor training".

Basic training . 2 years (induction training -6 months for B.Sc. apprentices).

- 1 introduction in safety precautions as applicable to the trade
- 2 fitting

- 3 turning of various lathes.
  - 4 welding (gas)
  - X5 physics
  - X5'1 TRIANGLE AND PARALLELOGRAM OF FORCES
  - X5'2 determination of co-efficient of static friction
  - X5'3 determination of acceleration due to gravity
  - X5'4 determination of mechanical advantage etc.
  - X5'5 determination of young's modulus
  - X5'6 determination co-efficient friction of solid and liquid
  - X6 chemistry: chemical and physical analysis-preparation study of physical and chemical properties of organic and inorganic substances.
- Note. Marked (x) may be deleted for B.Sc. apprentices
- 7 pipe fitting
  - 8 use and maintenance of lagging materials.
  - 9 dismantling and assembling of different types of valves.
  - 10. Fitting and assembling of different gears.
  - 11 study of different types of pamper, compressor etc. their assembly and maintenance.
  - 12. Checking the alignment of shafes and coupling.
  - 13. Fitting of bearings.
  - 14 welding (arc)
  - 15 (i) installation of venturimeter, orifice meter and Rota meter,  
(ii) To find out viscosity of a liquid and coupling.
  - 16. Study of head against capacity curve of a centrifugal pump.
  - 17. study of head VA capacity curve of a gear of a gear pump.
  - 18. To determine Reynolds's number of different velocities.
  - 19. To determine friction losses in a straight pipe, pipe fitting valve.
  - 20. To calculate overall heat transfer co-efficient for a shell and tube heat exchanger.
  - 21. To find rate of evaporation of a vertical tube evaporator.
  - 22. Separation of a liquid mixture using a packed tower.
  - 23. Flooding velocity velocity experiment using a packed tower made of glass.
  - 24. Finding rate of drying curve by tray drier.
  - 25. Operation of:
    - (i) Plate and frame filter press.

- (2) Top-driven centrifuge.
- (3) rotary vacuum filter.
- (4) Hammer mill.
- (5) Roll mill.
- (6) Blake jaw crusher.

26. Calibrations of :

- (1) Pressure measuring instruments.
- (2) Vacuum measuring instruments.
- (3) Temperature measuring instruments.
- (4) Level measuring instruments.
- (5) P.H. Meter,

27. Study of diaphragm control valves, transmitters.

28. Study of recorders and controllers.

Shop floor training : 1 year

(List of operations in petro chemicals, heavy chemicals, fire chemicals, paper and pulp, cement fertilizer and allied industries);

29. Orientation

- (1) The plant and its products, raw materials used capacity of production etc.
- (2) Different sections of the plant including process maintenance and their activities.
- (3) Study of the process and operations carried out in the establishment with the help of simple flow sheet under the guidance of plant-in-charge/supervisor/familiarization with the equipments used in the establishment by actually going round the plant.
- (4) Writing brief report (Diary) of day to day work.
- (5) Familiarization with utilities and service line such as steam water vacuum compressed air, refrigeration, air-conditioning unites etc.

30. Safety

- (1) Cause and prevention of accidents first aid to the injured .
- (2) Personal safety and use of personal protective equipments .
- (3) House keeping .
- (4) Fire prevention and fighting .
- (5) Insulation of equipments and ancillaries prior to handing over to the maintenance action.

31. Quality control

Familiarization with sample quality control test.

32. Routine plant jobs

- (1) Even tightening of flanges of equipments or pipeline .
- (2) Fitting of pressure and vacuum gauges, thermometers etc. winding of recorders.
- (3) Removal of chart and inking of pens of recorders.
- (4) Replacement of joints in pipe flanges.
- (5) Changing of belts in pulley.
- (6) Valves lapping.
- (7) Cleaning of evaporator tubes, heat exchangers etc.

33. Reading of process control instruments measuring low temperature, pressure PH , concentration etc.,their matter

locking system, automatic signaling instruments for high or low pressure temperature, flow etc.

(1) Manipulation of automatic control to manual control and vice versa during shut down and start up.

34. Standard oprration,procedure ,process conditions and the corrective action in care of the following equipments available in the industry.

- (1) Pumps, compressors, blowers ,fans, steam .
- (2) Heat exchangers, furnaces , kilns.
- (3) Distillation units.
- (4) Evaporators and condensers.
- (5) Extraction units.
- (6) Cooling towers and condensers.
- (7) Absorption towers.
- (8) Dryers.
- (9) Crystallizers.
- (10) Filtration equipment.
- (11) Size separation and settling equipments.
- (12) Crushing and grinding equipments.
- (13) Crushing and grinding equipment.
- (14) Material handling and conveying equipments.

#### 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 apprentice 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 CTSSyllabus and information regarding products and process concerning the industry in which the approach agreement. 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 be considered a a guide.

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

1. Trade Theory.

- (2) Top-driven centrifuge.
- (3) rotary vacuum filter.
- (4) Hammer mill.
- (5) Rell mill.
- (6) Blake jaw crusher.

26. Celebration of :

- (1) Pressure measuring instruments.
- (2) Vacuum measuring instruments.
- (3) Temperature measuring instruments.
- (4) Level measuring instruments.
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4. The syllabus for Related Instructions be considered a a guide.

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

1. Trade Theory.

2. Workshop Calculation and Science.

(a) (X) Physics      (b) (X) Math's.      (c) (X) Chemistry      (d) Unit operation      (e)

Unit process.

3. Social Studies.

4. Industrial Entrepreneurship.

5. Engineering Drawing.

Note. Marked (X) may be deleted for B.Sc. Apprentices.