

2

SYLLABUS FOR
Attendant Operator Chemical Plant

UNDER
CRAFTSMEN TRAINING SCHEME
&
APPRENTICESHIP TRAINING SCHEME

As approved by
GOVERNMENT OF INDIA

In consultation with
THE NATIONAL COUNCIL FOR
VOCATIONAL TRAINING
&
CENTRAL APPRENTICESHIP COUNCIL

Issued by
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GENERAL INFORMATION

1	Name of the Trade	Attendant Operator (Chemical Plant)
2	Entry Qualification	Pass in 10 th class examination under 10 +2 system of education with science and math or its equivalent. or passed B.Sc. with Physics, Chemistry and Mathematics as subject
3	Duration of Craftsmen Training / Basic Training	2 Years (for S.S.C. passed trainees)
4	Duration of Apprenticeship Training	Three Years (for S.S.C. passed trainees)

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

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**SYLLABUS FOR THE TRADE OF ATTENDANT OPERATOR
(Chemical Plant)**

Under Craftmen 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. Machinery, equipment's used in trades. Type of work done by trainee, type of jobs made by the trainee. Introduction to safety equipment and their uses etc.</p>	<p>Importance of safety & general precautions observed in the workshop. Role of maintenance mechanic in the Chemical Industries. Course contents, duration. Rules pertaining to facilities available in the Institute-hostel, medic, library and gymkhana. Engineering Drawing Introduction to engineering drawing. Its relevance to the trade. Use of drawing board. T-Square. Physics (X) Introduction to Physics Workshop Calculation and Science Introduction to Chemistry. From earliest time to present day atom, molecule element, compound. Physical & Chemical change</p>
2.	<p>Exercise on cutting with hacksaw filing flat and squares. Marking using hermophrodite caliper, surface gauge, engineers square marking off table etc.</p>	<p>Mathematics Introduction Linear measurements and its units. Scribe, dividers, calipers, construction and uses. Center punch, dot punch, hammers- their types and uses. Surface gauge description construction. Use and care V-Blocks Marking off table, Try Square, Bend Vice Hacksaw frame, hacksaw blades, universal scribing block. Engineering Drawing (X) Free hand drawing of straight lines,</p>

		<p>screw gauge, scalar and Vector quantities, their representation resultant, parallelogram and triangle of vector. 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 gamma rays and their properties, radioactive changes alpha ray and beta ray change, group displacement law, definition of isotopes and isobars. Mathematics Solution of 1st and 2nd order equation with one or two unknowns by algebraic calculations and by graphs.</p>
3.	<p>Filing the edges flat and square to 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>	<p>Trade Theory Files-their types, grade, care and uses of various common files. File card and its use. Engineering Drawing Free hand drawing of simple solids such as cube, rectangular blocks, cylinder, cones etc. and their views. Physics Same as Week No.2 Workshop Calculation and Science Same as Week No.2 Mathematics Same as Week No.2</p>
4.	<p>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. Making out with scribing properly supported against a V-Block or an angle plate</p>	<p>Trade Theory Convexity of files, its reasons. Right method of fixing handles. Angle plate, parallel blocks, V-block, their uses. Surface plate construction, cutting angles and lips, straight fluted special types, parts and their function. Use of angle gauge. Engineering Drawing Use of set squares and other drawing</p>

	chipped edges with the square to reasonable accuracy.	Same as Week No.2 Workshop Calculation and Science Same as Week No.2 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 Physics (X) Rest and motion. Equation of Motion, motion under gravity, in a circle with constant angular velocity and acceleration. Work, power and energy. 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 History Mendeleev's Periodic law and table, advantaged and disadvantages, statement of modern periodic law. Mathematics Same as Week No.2
6.	Filing flat the work piece squaring, edges in relation to master face, marking out the position of holes, punching, deepening the points with center punch.	Trade Theory Drill bit grinding. Common faults and their ill effects. Drill chuck, drill drifts sleeves. Drilling machine. Introduction types, parts etc. Engineering Drawing Reading of simple blue prints (X) Physic same as Week No 5

7.	Same as week no.6	Trade theory Same as week no. 6 Engineering Drawing Same as week no. 6 Physics (X) S.M. Rotational motion, moment of inertia. Simple machines, requirements of a good balance. Workshop Calculation and Science Atomic, molecular and equivalent weight (Definition & examples only) Electronic theory of valence and Definition of double and complex salts. Mathematics Factorisation
8.	Marking out for drilling. Using height gauge. Drilling holes with parallel shank drills.	Trade Theory Vernier caliper-principle, construction, Graduation, reading Uses, care and adjustment. Vernier height gauge and Vernier caliper. Physics Same as week No. 7 Worship Calculation and Science Same as Week No.7 Mathematics Same as week No.7
9 to 11	Practice on grinding drills, screw drivers, chisels of various shapes and dot punches etc. To recondition them. Drilling and tapping BSW, and metric threads for various sizes. Also threading by using dais for standard bolts.	Trade Theory Micrometer outside-principle construction, Name of parts, graduation, reading uses and cares. Micrometer inside, principle construction, graduation reading Use and care. Engineering Drawing Method of fixing a drawing sheet on the board. Layout of drawing sheet (Borderline title block etc.) Use of different scales mm., inch. Physics (X) Static and Kinetic friction, their

		<p>modullii, work done in stretching a wire, determination of Young's Modulus.</p> <p>Workshop Calculation and Science (X) Law of mass action Mathematics (X) Factorisation.</p>
12.	<p>Marking out to dimensions with height gauge chamfering and reducing, checking dimensions with V-caliper and micrometer, checking radius with radius gauge.</p>	<p>Trade Theory Taps, size of taps tapping determination of sizes of drills for tapping. Engineering Drawing Writing single stroke 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. Worship Calculation and Science Electrolysis Catalysis (X) Revision of the syllabus of the above weeks Mathematics (X) Area of surface of solids like prison, cylinder, cone etc.</p>
13.	<p>Turning Introduction, types of work done in the section. Lathe -its parts and functions Check it for proper running, cleaning and oiling of various parts. Holding job in your jaw chuck & turning. Grinding rough turning tool.</p>	<p>Trade Theory Shop safety, safety precaution as applied to section. Lathe-its construction, cleaning and oiling. Independent shuck different types and construction uses. Common lathe cutting, tools types, shapes, different angles. 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</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.	<p>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 job in the chuck. Turning to specified etc.</p>	<p>Trade Theory Lathe, Accessories, such as center mandrel, catch plate and dog face plate, lathe steady etc. Construction and use. Engineering Drawing Geometrical construction of polygons (X) Physics Same as Week No.14 Workshop Calculation and Science3 Inorganic Chemistry (Physics and Chemistry) Oxidation-Reduction Corrosion Mathematics Same as Week NO.12</p>
16.	Same as Week No.15	<p>Trade Theory Same as Week No.15 Engineering Drawing Same as Week No.15 Physics (X) Temperature and its measurement. Expansion of solids, liquids and gases. Workshop Calculation and Science Metallurgy (General Principle and processes) Metallurgy of Copper, aluminum Zinc, Chromium, lead, tin and nickel metals Mathematics Volume of solids like prism, sphere, cone</p>

17.	Step turnings, Grinding of finishing tool	<p>Trade theory Common lathe cutting tools roughing and finishing tool, knife tool, recessing tool etc. Lathe tool material. Engineering Drawing Geometrical construction on plane curves such as cycloid, involute, parabola, hyperbola, spiral helix etc. Physics Same as Week No.16 Workshop Calculation and Science Same as Week No.16 Mathematics Same as Week no.16</p>
18 & 19.	Drilling on lathe. Drilling through and drilling blind hole. Setting boring tool in tool post. Boring plain, taper, step.	<p>Trade Theory Drills-construction types. Uses of drill sleeves. Boring tool types Setting of Boring tool. Engineering Drawing Different types of lines uses in engineering drawing as per IS 696-1972 (IInd Revision) Physics Same as Week No. 16 Workshop Calculation and Science Same as Week No. 16 Mathematics Same as Week No. 16</p>
20 to 22.	Taper turning by swiveling compound rest. Taper turning by off setting tail stock. Turning gear blanks with mandrels, knurling practice.	<p>Trade Theory Tapers and its purpose, standard tapers, different methods of taper turning. Taper calibration, Knurling tool-types, and uses, Advantages and disadvantage of offset method. Engineering Drawing Isometric views of simple solid and hollow Object. Physics Calorimetry, change of state Workshop Calculation and Science General discussion, occurrence,</p>

		<p>Inerts gases : Introduction, History of discovery, their position in the periodic table. Mathematics (X) Volume of solids like prism, sphere, cone etc.</p>
23 & 24	Thread cutting (BSW) Thread cutting (Metric)	<p>Trade Theory Screw thread purpose and forms. Screw thread terminology. Calculation of change wheel. Calculation of pitch depth, addendum, etc. Engineering Drawing Orthographic views of simple objects by 1st angle projection. Physics Hygrometry Workshop Calculation and Science Manufacture and the properties of sodium hydroxide and carbonate. Alloys : Preparation properties and uses. Mathematics (X) Logarithms</p>
25 & 26.	Welding (Gas) Introduction-Importance of trade, types of work done, safety equipment's and their uses. Lighting and adjustments of flame. Fusion runs with and without filler rod-D	<p>Trade Theory Safety and general precaution observed in the workshop. Importance of welding in the maintenance of chemical plant and equipment's. Safety precautions in the gas welding. Description and uses of tools and equipment's used. Welding terms and their definitions. Engineering Drawing Orthographic views of simple objects by 3rd angle projection. Physics Same as Week No.24 Workshop Calculation and Science Same as Week No. 24 Mathematics Same as Week No.24</p>
27 & 28.	Edge joint with or without filler rod square butt joint.	<p>Trade Theory Welding methods and types of welding,</p>

		<p>Acetylene, CO₂ gas etc. Chemistry and types of flame.</p> <p>Engineering Drawing</p> <p>Exercises on orthographic view of simple solid and hollow objects.</p> <p>Physics</p> <p>Mode of heat transfer. Thermal conductivity and its determination.</p> <p>Workshop Calculation and Science</p> <p>Laboratory preparation, properties and uses of carbon dioxide, oxygen, Hydrogen sulphur dioxide and halogens.</p> <p>(Chlorine and bromine) Nitrogen, its oxides, fixation of nitrogen.</p> <p>Mathematics</p> <p>Same as Week No.24</p>
29 & 30	<p>Outside corner joints- D.Fillet weld-D Inside corner joint</p>	<p>Trade theory</p> <p>Oxy-acetylene welding, equipment such as regulators, blow pipes etc. Assembly, care and maintenance</p> <p>Engineering Drawing</p> <p>Same as week no, 27</p> <p>Physics</p> <p>Law of thermodynamics and different thermodynamic processes, dispersion, Spectrophotometer. Polarization</p> <p>Workshop calculation and science / Allotropy of hydrogen, carbon, phosphorus and sulphur</p> <p>Acids, bases and salts water</p> <p>Sources, hard and soft water, causes and removal of hardness</p> <p>Mathematics</p> <p>Same as Week no. 24</p>
31	<p>Pipe butt joint – D, pipe T joint -D</p>	<p>Trade theory</p> <p>Oxygen cylinder, DA cylinder, description, method of charging and care, Faults in gas Welding, definition of faults, their effected cause correction</p> <p>Engineering Drawing</p> <p>Same as Week No. 27</p> <p>Physics</p>

		<p>Workshop calculation and Science</p> <p>Same as week No. 29</p> <p>Mathematics</p> <p>Same as week No. 24</p>
32	<p>Same as week no. 31</p>	<p>Trade theory</p> <p>Same as week no. 31</p> <p>Engineering Drawing</p> <p>Same as week no. 27</p> <p>Physics</p> <p>Natural and artificial magnets, their properties and magnetic field.</p> <p>Workshop calculation and Science</p> <p>Water for industrial purpose Preparation properties and uses of aluminum chloride potassium, ferro and Ferricyanide bleaching powder</p> <p>Mathematics</p> <p>(X) Trigonometry- study of sine, cosine, tangent of angles in a right angled triangle & their application in solving, practical problems</p>
33 & 34	<p>Hard facing stalling</p> <p>Brazing of dissimilar metals</p> <p>Practice in gas cutting for various thickness</p>	<p>Trade Theory</p> <p>Hard facing – necessity, types methods, application. Destructive test, stalling necessity. Type- Flame adjustment, methods and application, Methods employed to control distortion and stress relieving</p> <p>Engineering Drawing</p> <p>Same as Week No. 27</p> <p>Physics</p> <p>Intensity of magnetic field at a point on magnetic axis and magnetic equation, neutral point</p> <p>Tangent magneto meter, dip circle and applications of magnet. Static electricity – charge, charging by induction</p> <p>Workshop calculation and Science</p> <p>Organic chemistry</p> <p>Introduction to organic chemistry, Purification processes</p> <p>Organic reaction</p>

		Elimination and rearrangement reactions. Explanation and example Nomenclature I.U.P.A.C. and commons system. Classification & Functional Groups. Halo, Hydroxyl, Formal, Carbonyl, carboxyl Amino, Nitro and Sulphuric acid Cyclic Acyclic compounds.
35 & 36	P.V.C. Welding, all types joints on sheet 3 mm, 4mm, 6mm. P.V.C Welding pipe Flange, elbow, T. etc.	Trade theory Definition of PVC its type properties and uses Engineering Drawing Drawing orthographic views of nuts bolts etc. Physics Same as Week No 33 Workshop Calculation and science Same as week No 33 Mathematics Same as Week No 32.
37 & 38	Physics (i) (i) To study triangular and parallelogram of forces with the help of mechanical board. (ii) (ii) Determination of coefficient of static friction using inclined plane. (iii) (iii) Determination of mechanical advantage velocity ratio and % efficiency of simple machine. (iv) (iv) Determination of	Trade Theory Objective procedure apparatus required explanation and calculations involved in the experiments. Engineering Drawing Drawing of different types of thread forms, rivet heads. Keys, coupling. Physics Same as week No. 33 Workshop Calculation and Science Same as Week No.33 Mathematics Same as Week No 32.

	(v)	simple pendulum. (v) Determination of Young's Modulus by Seattle's apparatus.	
39 & 40	(i) (ii) (iii)	(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 – distribution of charge , Potential, capacity and condenser Current electricity- electricity by chemical action cells. Workshop calculation and science Aliphatic hydrocarbons, saturated and unsaturated (i) (i) Methane (ii) (ii) Ethylene (iii) (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. Carbontetrachloride, 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

		problem and problems on law of fluid heat transfer, evaporation, transmission of power etc
41 & 42	(i) (i) To study Ohm's law and kerchiof's law about current and voltage (ii) (ii) To study electric cell using series and parallel connections (iii) (iii) Determination of specific resistance using wheat stone's Bridge (iv) (iv) Verification of faraday's First law of electrolysis . (v) (v) Determination of mechanical equivalent of heat using electrical method	<u>Trade Theory</u> Same as week no. 37 Engineering Drawing 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	<u>Trade Theory</u> 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

	following (a) Soap (b) Nitrobenzene (c) Aniline (d) Copper sulphate (e) Ferrous ammonium & sulphate.	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	<u>Trade Theory</u> Same as Week No. 37 Engineering Drawing Same as Week No. 43 Physics Magnetic effect of current, electromagnets. Ohm's law. Kirchoff's law. Parallel and series circuit connections. Wheatstion'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 mixture (Fe+S) and compound (FeS)	<u>Trade Theory</u> 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 and salt water on metals and alloys	<u>Trade Theory</u> Same as Week No. 37 Engineering Drawing Same as Week No. 43 Physics Same as Week No. 45

		Same as Week No. 39.
48.	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.	To study the corrosion of metals	Trade Theory Same as Week No. 37 Engineering Drawing Sectional view of simple objects such as brackets, bearings etc. Physics Heating effect of electric current. Electrolysis. Workshop Calculation and Science Polymerization Rubber plastics and backbites Preparation properties and uses of oxalic acid, ethyl alcohol, Nitrobenzene, aniline, acetylene. Mathematics Same as Week No. 39.
50.	Volumetric analysis. Qualitative analysis (Inorganic) (Simple with out interfering radicals) Determination of Flash point. Determination of pH (by Lovibond)	Trade Theory Same as Week No. 37 Engineering Drawing Same as Week No. 49 Physics Same as Week no. 49 Workshop Calculation and Science Same as Week No. 49 Mathematics Same as Week No. 39

51 & 52.	Revision and Examination	Trade Theory Revision and Examination Engineering Drawing Revision and Examination Physics Revision and Examination Workshop Calculation and Science Revision and Examination Mathematics Revision and Examination
Note :- Marked (X) may be deleted for B.Sc. APPRENTICES		
TRADE – ATTENDANT OPERATOR (CHEMICAL PLANT) 2ND YEAR		
53	Review the operation covered in the first year	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. Engineering Drawing Orthographic views of machine parts such as bearings, brackets etc. Unit operation Pipes : Methods of joining them, expansion joints. Unit Process Salts from sea water : Process description and flow sheet.
54.	Thread cutting, bending, threading of pipes, different types of pipe joints and fittings, such as screw 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

55.	Use and maintenance of lagging materials such as gas wool, thermocole etc.	<p><u>Trade Theory</u> Lagging materials types and uses. Engineering Drawing Same as Week No. 53 Unit Operation Reynolds's number, viscosity, manometer, Bernoulli's equation. Unit Process Same as Week No. 54</p>
56.	Dismantling and assembling of globe valves, check valves, needle valves, diaphragm valves, ball valves, stop cock, butterfly valves etc.	<p><u>Trade Theory</u> Construction, working and uses of various types of valves. Engineering Drawing. Sectional views of machine. Unit Operation Application of the 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.</p>
57.	Same as Week No. 56	<p><u>Trade Theory</u> Types of gears, e.g. spur, helical, bevel, their uses and their advantages, and disadvantaged. Engineering Drawing Same as Week No. 56. Unit Operation Same as Week No. 56. Unit Process Same as Week No. 56.</p>
58.	Fitting and assembling of different gears, gearboxes, reduction gears etc.	<p><u>Trade Theory</u> Different types of pumps, construction details and their uses. Engineering Drawing Same as Week No. 56 Unit Operation Pumps-positive displacement and</p>

59.	Study of different types of pumps such as centrifugal pumps of different types, gear pumps plunger pumps reciprocating compressors, multistage compressors, lobe pumps etc., their assembly, maintenance and trouble shooting.	<p><u>Trade Theory</u> Cases of misalignment, different methods of checking alignment. Effect of misalignment of shafts, coupling and bearings. Engineering Drawing Free hand sketching of parts such as pistons, connecting rod, crank shafts, steam chest etc. Unit Operation Compressor and vacuum pumps steam jet ejection, lift pump. Unit Process Sulphuric acid: Process classification, raw materials, chemical reaction, process description flow sheet and uses.</p>
60.	Same as Week No. 59	<p><u>Trade Theory</u> Same as Week No. 59. Engineering Drawing Same as Week No. 59. Unit Operation Modes of heat transfer, thermal conductivity, Fourier's equation Resistance in series plane and round surface. Unit Process Same as Week No. 59</p>
61 & 62.	Checking alignment of shafts and coupling of motors, correcting alignment, use of dial gauges.	<p><u>Trade Theory</u> Bearing (their types, construction and uses, such as ball, roller, bush needle bearing etc. their care and maintenance. Engineering Drawing Free hand drawing of pipe joints and fittings. Unit Operation Film co-efficient, overall film co-efficient, factors affecting heat transfer co-efficient. Unit Process Ammonia and complex Fertilizer : process classification, process description with flow sheet, definition of fertilizers and</p>

	bearings, bush bearings etc., their care, lubrication and maintenance.	such as split pin, lock nut, spring washer, taper washer etc. Engineering Drawing Free hand drawing of shaft couplings and flanged etc. Unit Operation Same as Week No. 61 Unit Process Same as Week No. 61
64.	Same as Week No. 63	Trade Theory Same as Week No 63 Engineering Drawing Same as Week No. 63 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. 61
65.	Welding (Arc) Straight lines beads on MS Plate	Trade Theory Different process 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. 64 Unit Process Nitric acid : Process classification, process description with flow sheets and concentration.
66.	Open corner joint M.S.Plate.	Trade Theory Types of joints, classification, uses Elementary electricity. Its uses applied to welding. Heat and temperature. Engineering Drawing Same as Week No. 65 Unit Operation

		Urea and other fertilizer : process classification, process description with flow sheets.
67.	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, glove plug cock, ball, needle diaphragm and control valves. Unit Operation Kiln-shaft and rotary (direct and indirect fired). Unit Process Same as Week No. 66
68.	Outside corner joints	Trade Theory Types of electric welding metallic, carbon, resistance etc. and application are length etc. Engineering Drawing Same as Week No. 67 Unit Operation Evaporation : Horizontal, vertical tube, forced circulation and falling film evaporators. Unit Process Same as Week No.66
69.	Single 'V' butt joint.	Trade Theory Principle of arc welding, types of welding. Types of welding machine care and maintenance Engineering Drawing Same as week no. 67 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.
70.	Fillet lap joint and T-joint.	Trade Theory

		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.
71.	Pipe joints, T. Butt	Trade Theory Arc welding defects, causes and effects, how to overcome etc. Distortion and its control. Engineering Drawing Same as Week no. 70 Unit Operation Properties of steam, Boilers-fire tubes, water tube, forced circulation, accessories. Water treatment. Unit process Same as Week no. 70
72.	Butt joints (square butt)	Trade Theory Simple estimating involving fabrication, consumption of gasses electrode, length of weld, use of hand book and reference tables. Engineering drawing Exercises on blue print reading Unit operation Same as Week No. 71 Unit Process Iron & Steel : Process description with flow sheet. Definition of steel and its types.
73.	(i) (i) Installation of venturimeter, orifice meter and rotameter (ii) (ii) Determination of	Trade Theory Procedure of installing venturimeter, orifice and rotameter, precautions to be observed Engineering Drawing Same as week No. 72 Unit operation

	liquid by viscometer.	Unit Process Same as week No. 72
74.	Study of head against capacity curve of centrifugal pump	Trade Theory Procedure of conducting the experiment, calculation and precautions to be observed. Sketch of the equipment. Engineering Drawing Free hand sketching of simple bearing blocks Unit operation Distillation : Introduction, boiling point diagram, equilibrium curve. Unit process Same as week No. 72
75.	Study of head Vs. capacity curve of a gear pump	Trade Theory Same as week No. 74 Engineering Drawing Same as week No. 74 Unit operation Same as week No. 74
76.	To determine Reynolds's number at different velocities	Trade Theory Same ad Week No. 74 Engineering Drawing Drawing sketches of pumps centrifugal, gear plunger, sliding vane and water ring vacuum pump. Unit operation Azeotropes; flash and differential distillation. Unit process Aluminum: Process description with flow sheet and uses.
77.	To determine friction losses in a straight pipe, pipe fitting, valve	Trade Theory Same as Week No. 74 Engineering Drawing Same as Week No. 76 Unit operation Rectification and Variables affecting diagram of a distillation column. Unit process Same as Week No. 76

78.	To calculate overall heat transfer coefficient for a shell and tube heat exchange	Trade Theory Same as Week No. 74 Engineering Drawing Same as Week No. 76 Unit operation Same as Week No. 77 Unit process Same as Week No. 76.
79.	To find rate of evaporation of a vertical tube evaporator	Trade Theory Same as Week No. 74 Engineering Drawing Same as Week No. 76 Unit operation Same as Week No. 77 Unit process 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	Trade Theory Same as Week No. 74 Engineering Drawing Drawing sketches of steam jet ejectors, and steam traps Unit operation Same as Week No. 77 Unit process Same as Week No. 79
81.	Flooding velocity experiment using a packed tower made of glass.	Trade Theory Same as Week No. 74 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. 79
82.	Finding rate of drying curve by tray drier	Trade Theory Same as Week No. 74 Engineering Drawing Same as Week No. 76

		Same as Week No. 81 Unit process Same as Week No. 79
83.	Operation of (i) Plate and frame and fitter press (ii) (ii) Top-driven centrifuge (iii) (iii) Ball mill (iv) (iv) Blake jaw crusher	Trade Theory Construction, principle, trouble shooting and precaution of be observed during operation of the equipment. Sketches of the equipment. Engineering Drawing Diagram of distillation column with all accessories. Unit operation Extraction and teaching application of liquid-liquid extraction, theory, definition, choice of solvent, distribution coefficient. Unit process Same as Week no.79.
84.	Same as Week No. 83	Trade Theory Same as Week No. 83 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.
85.	Same as Week No. 83	Trade Theory Same as Week No. 83 Engineering Drawing Free hand sketches of evaporators. Unit operation Same as Week NO. 84 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 soap & its manufacture with flow

86.	(1) (1) To carry out sieve analysis with a sieve shaker (2) (2) Operation of a mixer settler (3) (3) Operation of a spray extraction tower.	Trade Theory Procedure of conducting, experiment, calculation and precautions to be observed sketch of the equipment Engineering Drawing Same as Week No. 85 Unit operation Same as Week No. 84 Unit process Same as Week No. 85
87.	Operation of a multistage compressor. Study of electrical technology such as three phase supply induction motor, starters etc.	Trade Theory Same as week no. 86 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. 85
88.	Same as Week No. 87	Trade Theory Same as Week No. 86 Engineering Drawing Flow sheet of sulfuric acid manufacture. Unit operation Humidity and Air conditioning : Introduction, definition, humidity chart, humidification and its equipment, dehumidifiers, oolong towers. Unit process Oils and fats refining
89.	Calibration of (i) (i) Bourdon tube pressure gauges (ii) (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

		Soap and 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 stags, 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, curve for water, relative humidity and other definitions, equilibrium in drying. Tray drier. Unit process Same as Week No. 90
92.	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 of tray various type of driers, drier spray drier and drum drier Unit process Same as Week No.90
93.	Calibration of gas filled thermometer	Trade Theory Same as Week No. 92 Engineering Drawing Flow sheet of pulp manufacture Unit operation Crystallization : Introduction classification

		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 aluminum manufacture Unit operation Filtration : Introduction, factors affecting filtration, classification of filters. Unit process Plastics & Resin : manufacturing process ; condensation, polymerization products, addition polymerization products.
95.	Calibration of a resistance thermos-couple	Trade Theory Same as Week No. 92 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. 94
96.	Calibration of resistance thermometer	Trade Theory Same as week no. 92 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.
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, adsorbents and

		sedimentation & Deacantation : Introduction, classification. Settling : Definition and equipment. Unit process Same as Week No. 96
98.	(i) (i) Experiment on hydrometer (ii) (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 No. 97 Unit process Same as Week No. 96
99.	Calibration of PH meter	Trade Theory PH its definition and different methods of measurement. Engineering Drawing Instrumentation diagram of a drier. Unit operation Same as Week No. 97 Unit process Water treatment precipitation, demineralization processes, sewage waste water treatment, Air pollution.
100.	Study of diaphragm, control valve, transmitters.	Trade Theory Final control elements, Transmitters. Engineering Drawing Flow diagram of a rotary vacuum filter with all accessories. Unit operation Crushing and grinding : Introduction and classification of equipment Unit process Fuels : Coal, water gas, producer gas combustion of fuels.
101.	Study of recorders and controllers	Trade Theory Recorders and controllers Engineering Drawing

		types of conveyors. Unit process Same as Week No. 100
102 To 104.	Revisions and examinations	Trade Theory Revisions and examinations. Engineering Drawing Revisions and examinations. Unit operation Revisions and examinations. Unit process Revisions and examinations.

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

No.	Description	Quantity	Required
1. 1.	Trainees Kit Caliper outside spring 6"/15 cm	17	(1 for Instructor + 16 for trainees)
2. 2.	Caliper inside spring 6"/15 cm	17	"
3. 3.	Livers spring 6"/15 cm	17	"
4. 4.	Center punch 4"/10 cm	17	"
5. 5.	Prick punch 6"/15 cm	17	"
6. 6.	Chisel Cold flat 1 1/2" X 2.5 cm	17	"
7. 7.	Chisel cross cur 3/8" X 1/8"	17	"
8. 8.	Chisel half round 3/8"/10 mm	17	"
9. 9.	Chisel half round 3/8"/10 mm	17	"
10. 10.	Hammer ball pein 1 lb	17	"
11. 11.	Hammer ball pein 1/2 lb	17	"
12. 12.	Hacksaw frame adjustable with pistol grip for 8"-12" blade/20 cm- 30 cm	17	"
13. 13.	Rule steel 12" English and Metric/30 cm	17	"
14. 14.	Screw Driver 3"X3/8" blade	17	"

18. 18.	Safety Goggles	17	"
19. 19.	Box drawing instruments	17	"
20. 20.	Protractor celluloid 6"	17	"
21. 21.	Scale (Wood) Draughtsmen 12"/30 cm	17	"
22. 22.	Set square celluloid 45"-8 inch	17	"
23. 23.	Set square celluloid 60"-10 inch	17	"
24. 24.	Board drawing half imperial size	17	"
25. 25.	Square-T 24 inch blade	17	"

Workshop Tools and Equipment

1. 1.	Surface plate 12" X 12"/30 cm X 30 cm	2	
2. 2.	Or surface plate. 12" X 12"/60 cm X 60 cm	1	
3. 3.	Scribing block Universal 12"/30 cm	2	
4. 4.	Marking table 3' X 2' X (3' high)	1	
5. 5.	V-Blocks 3" X 1 1/2 (pair) with clamps	2	
6. 6.	Combination set 12 inch	2	
7. 7.	File handles	96	
8. 8.	Drill twist (straight shank) 1/8" to 1/2" by 1/64" (set)	4	
9. 9.	Telescopic gauges 1/2" - 6"	1	
10. 10.	Magnetic indicator and base	2	
11. 11.	Drill twist/ 1/2" to 3/4 by 1/16" (Mores taper)	1 set	
12. 12.	Drills twist (Metric) 2 mm to 7 mm by 1 mm	6 set	
13. 13.	Drills twist (Metric) 8 mm to 12 mm by 1 mm	1 set	
14. 14.	Drills straight shank wire gauge sizes 1 to 60 with gauge	1 set	
15. 15.	Drills straight shank letter gauge	1 set	

17.	17.	H.S.S. Machine reamers 3 to 19 mm	1 set
18.	18.	H.S.S. Machine reamers with M.T. shank 1/8" to 3/4: by 1/16"	1 set
19.	19.	H.S.S. hand taper pin reamer 1/2" to 5/8" by 1/16"	1 set
20.	20.	Hacksaw frame adjustable for 8" to 12 blades.	6
21.	21.	Hand vice 1/25mm	4
22.	22.	Working bench 6' x 2 1/2' with 2 vices 5" jaws.	3
23.	23.	Working bench 8' X 4' X 2 1/2' with vices 5' jaws	4
24.	24.	Almirah steel, large with shelves	2
25.	25.	Tool boxes of drawers fitted in the working bench	2
26.	26.	Punch letter set 3mm.	2
27.	27.	Punch figure set 3mm	2
28.	28.	Taps and dies complete set in box B.A., B.S.F.B.S.W., American and Metric	16
29.	29.	File flat 112" blustered	2
30.	30.	File flat 10" 2 nd cut	2
31.	31.	File flat 10" smooth	2
32.	32.	File three square 6" and cut	1
33.	33.	File flat 6" smooth	1 each
34.	34.	Stone oil 6" x 2" x 1"/15 cm x 5cm x 2.5cm	2
35.	35.	Can oil 1/2 pt	4

38.	38.	Scraper triangular 10"/25cm	2
39.	39.	Scraper hook type 10" handled	2
40.	40.	Bevel protractor	2
41.	41.	Sine Bar—200mm	2 sets
42.	42.	Chisel cold flat 1/2inch	1
43.	43.	Chisel cross cut 1/4"/6mm	2
44.	44.	Micrometer outside 0—1"	1
45.	45.	Micrometer inside 2" to 8" cap/5 cm to 20 cm	2
46.	46.	Micrometer Metric 0-25 mm	2
47.	47.	Micrometer inside 50-200 mm cap	1
48.	48.	Venire caliper 12"	1
49.	49.	Screw pitch gauge 55 and 60	1 each
50.	50.	Wire gauge Imperial standard	1
51.	51.	Dial test indicator	2
52.	52.	Allen Keys 1/16" to 1/2" X 1/32"	2 set
53.	53.	Hammer hide faced	2
54.	54.	Pipe wrench stilton pattern 18" long	2
55.	55.	Chain wrench 3" pipe/75 mm	2
56.	56.	Pliers-combination 8"/20 cm	16

		whitworth sizes from 1/8" X 3/16" to 1/2" X 9/16"	
59.	59.	Double ended spanner-set of 7 A/F sizes from 3/8 : X 7/16" to 15/16" X 1"	1 set
60.	60.	Double ended spanners set of metric sizes from 8 X 9 to 20X22	1 set
61.	61.	Overhead projector	1
62.	62.	Projector for slider and filmstrips with screed	1
63.	63.	Projector for 16 mm films	1
64.	64.	Projector for 8 mm supper films	1
65.	65.	Double offset double ended ring spanners set of 7 whitworth sizes from 1/8" X 3/16" to 1/2" X 9/16"	1 set
66.	66.	Socket set 1/2" drive, 3/8" to 1 1/4" with ratchet handle	1 set
67.	67.	Gear puller 8" dia. capacity at 3 leg type	1
68.	68.	Steel tape 10 ft. in case	1
69.	69.	Mater precision level 15" long (Each division to read 0005" per foot)	1
70.	70.	Feeler gauge .0005" to .25"	6
71.	71.	Arbor press	1
72.	72.	Bar straightening press	1
73.	73.	Fry press	1
74.	74.	Bar type torque wrench max, reading 100 ft. lbs.	1
75.	75.	Pipe cutter, 3 wheel type, 3" pipe	1

77.	77.	Pipe vice 3"/75 mm	2
78.	78.	Plumb bob	2
79.	79.	Chain hoist 2 to cap	1
80.	80.	Framing square 24" X 2" X 16" X 1 1/2"	2
81.	81.	Cast iron came back straight edges 3 ft. and 5 ft.	1 each
82.	82.	Masons tool trawls of various types	1 set
83.	83.	Smiths brass rule 24", 2 fold	2
84.	84.	Caliper 8" inside	2
85.	85.	Wing compass 10" or 12"/25 cm to 30 cm	2
86.	86.	Hand hammer 2 lab with handle	2
87.	87.	Hammer smith 4 lbs. With handle	2
88.	88.	Leather apron	2
89.	89.	Steel rack	2
90.	90.	Prick punch	2
91.	91.	Mallets-various	16
92.	92.	Soldering iron copper but 10 ozs	2
93.	93.	Snip straight 10"/25 cm	2
94.	94.	Setting hammer with handle	2
95.	95.	Rivets tools set consisting of rivet snaps, pricking punch and holding up dolly	1

98.	98.	Combination drill (Gentling)	4
99.	99.	Set of more sockets (0-1, 1-2, 2-3)	1
100.	100.	10 jaw chuck independent	2
101.	101.	Self centering chuck 5"/125 mm	2
102.	102.	Set of tools for lathe	2
103.	103.	Lathe doge 1/2" to 1 1/2"	2
104.	104.	D E.Spanner from 5/8" X 11/16" to 15/16" to 1" whitworth sizes	2
105.	105.	Gauge for ginning and setting screw cutting tools	2 sets
106.	106.	Drill chuck 0" to 1 1/2" Morse taper	1
107.	107.	Grinder with two 7" wheels rough and smooth (motorized)	2
108.	108.	Drilling machine to drill unto 1/2" dis	1
109.	109.	Lathe-30" between center X 6" centers height with standard accessories	2
110.	110.	Belt lacer	2
111.	111.	Grease pressure gun (Hand)	1
112.	112.	Mandrels 5" X 1/2" 6" X 3/4"	1
113.	113.	Monkey wrench 15"	1 each
114.	114.	Pin spanner 1" to 3" dia	1
115.	115.	Engineering Ratchet brace with universal drilling pillar	1 set
116.	116.	Blow lamp	1

		head bit	
118.	118.	Tongs round	1
119.	119.	Tongs flat	2
120.	120.	Smiths square	1
121.	121.	Cold set rotted	2
122.	122.	Hot set rotted	2
123.	123.	Swages top and bottom 1/2", 3/4", "(pair)	1 each
124.	124.	Falter (rotted) 2 1/2" square	2
125.	125.	Falter top and bottom 1/2", 3/8" (pairs)	1 each
126.	126.	Swage block 14" X 14" 5" with stand	1
127.	127.	Anvil 1 cwt.	2
128.	128.	Shovel	2
129.	129.	Rake	2
130.	130.	Poker	2
131.	131.	Hardy	2
132.	132.	Welding plant oxy-acetylene complete (either high or low pressure) and electric	1
133.	133.	Welding helmet	1
134.	134.	Goggles pairs welders 4"/10 cm	4 pairs
135.	135.	Table welding 4' X 2 1/2' fire brick top on stand	1
136.	136.	Gloves pairs (for welders)	4
137.	137.	R.P.M. Indicator	1

139.	139.	Screw extractors sizes I to 3	1 set
140.	140.	Floor crane 35 cwt. Cap	1 pair
141.	141.	Forge with chimney and trough fitted with blower	1
142.	142.	Tool makers buttons	1 set
143.	143.	Steel rule 12 inch	6
144.	144.	Caliper outside 6 inch spring	6
145.	145.	Caliper inside 6 inch spring	6
146.	146.	Set of models, geometrical and samples of machinery parts as necessary of metal, wood and plastic	1
147.	147.	Logarithmic slide rule made by Faber, Germany	1
148.	148.	File half round 2nd cut 8/20 cm	6
149.	149.	File round 8" X 2 nd cut 8"/20 cm	6
150.	150.	Pipe wrench stilton pattern 6", 12", 24" long	2 each
151.	151.	Anvil stand	2
152.	152.	Tools bit holder as armstrong L.H.	4
153.	153.	Tool bit holder as armstrong R.H.	4
154.	154.	Tools bit holder as armstrong straight	4
155.	155.	Machine vice swiveling base 6' jaw	1
156.	156.	Shaper tool holder turret type	6
157.	157.	Base chucks for slower	1
158.	158.	Shaper indexing	

159.	159.	Plain milling cutter 65 X 100 X 27 mm bore	2
160.	160.	Side and face cutter different sizes	2 each
161.	161.	Equal angle cutter 45deg., 60deg., 90deg.	2 each
162.	162.	Single angle cutter 45deg., 60deg., 70 deg., 80deg both R.H., L.H. milling slot cutter 6 mm, 10 mm, 20 mm thick	2 each
163.	163.	Slitting saw 3 mm, 5 mm, 6 mm thick	6
164.	164.	Pipe bending springs 8"/20 cm	4
165.	165.	Pipe bending springs 1/2"	4
166.	166.	Pipe bending springs 5/8"	2
167.	167.	Pipe bending springs 3/4"	4
168.	168.	Carpenters planes	4
169.	169.	Carpenters saws	4
170.	170.	Carpenters chisel sets	4
171.	171.	Carpenters Mallets	1
172.	172.	Slotter 16" stroke motorized	1
173.	173.	Slotter 9" stroke motorized	1
174.	174.	Milling machine plain type horizontal	1
175.	175.	Milling machine universal motorized	1
176.	176.	Vertical milling machine motorized	1

Materials:

1. Mild steel flat
Thickness : 12 mm, 10 mm, 6 mm
2. Mild steel round
Diameter : 40 mm, 25 mm, 12 mm, 10 mm
40-50 kg of the above mentioned materials will be necessary for every trainee.

3. Rough Timber
4. Plywood
5. Masonic board
6. Plastic board
7. Plastic tubes 25 mm

About 10 kg to the above mentioned material will be used by every trainee.
In addition to this brushes, glue, varnish, paint for general use, will also be required.

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

	Description	Quantity
1.	Venturimeter	1
2.	Orificemeter	1
3.	Rotameter	1
4.	Centrifugal pumps-2 Nos.	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 flow	

23.	Weighing machine	1
24.	Multistage compressor fitted with interceders and after coolers	1
25.	Sieve shaker and sieves	1 set

* Common to Attendant Operator and Mech. Maint (C.P.) trades

**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 sets
2.	Chemical Balance (with weight box)	3 sets
3.	Viscometer	
	(a) (a) Cs Wale Viscometer	3 pieces
	(b) (b) Redwood Viscometer	3 pieces
	(c) (c) Stop. Watch (1/10 th Seco)	6 pieces
	(d) (d) Thermostatic bath	2 pieces
4.	Stalagnometer	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 set
13.	Instrument for determining 'g' (Simple	2 Sets

14.	14.	Barometer	1 No.
15.	15.	Altimeter	1 No.
16.	16.	Seattle's Apparatus for young's Modulus	2 sets
17.	17.	Nicolson' Hydrometer with glass jar	2 sets
18.	18.	Wet and dry bulb thermometer	2 sets
19.	19.	Apparatus for measurement specific heat of solid and liquid (Renaults Apparatus)	2 sets
20.	20.	Apparatus for measurement of co-efficient of expansion (thermal) of solid and liquid	2 sets
21.	21.	Apparatus for measurement of thermal conductivity of good and bad conductors	2 sets
22.	22.	Calorimeter for determining 'Soul's' Mechanic Equivalent of heat and specific heat	4 sets
23.	23.	Thermometers : (1) (1) 0 to 11 C -2 dozen (2) (2) 0 to 36 C -1 dozen (3) (3) 0 to 250 C -1 dozen	
24.	24.	Polarimeter with monochromatic light	2 sets
25.	25.	Abbe refractometer	2 sets
26.	26.	Pulfrish Refractometer	2 sets
27.	27.	Equipment to study Kerchief's law and Elector chemical equivalent	1 set
28.	28.	Potentiometer	2 sets
29.	29.	Whetstone's bridge	2 sets
30.	30.	Resistances Center Zero Galvanometer	4 Nos.
31.	31.	Resistance box (a) (a) Resistance box 0 to 100 ohms (b) (b) Resistance box 0 to 500 ohms	2 Nos. 2 Nos.

32.	32.	Rheostat (a) (a) Rheostat 25 ohms (b) (b) Rheostat 100 ohm's (c) (c) Rheostat 500 ohms	2 Nos. 2 Nos. 2 Nos.
33.	33.	Ampere Meter (a) (a) 0 to 1 Amp. (DC) (b) (b) 0 to 3 Amp. (DC) (c) (c) 0 to 10 Amp. (AC, DC) (d) (d) 0 to 30 Amp. (AC, DC)	2 sets 2 sets 2 sets 2 sets
34.	34.	Voltmeter (a) (a) 0 to 1 volt (DC) (b) (b) 0 to 4 volt (DC) (c) (c) 0 to 5 volt (DC) (d) (d) 0 to 10 volt (DC) (e) (e) 0 to 50 volts (DC) (f) (f) 0 to 250 volts (DC/AC)	2 sets 2 sets 2 sets 2 sets 2 sets 2 sets
35.	35.	Millivoltmeter (a) (a) 0 to 5 mv. (b) (b) 0 to 500 mv.	2 sets 2 sets
36.	36.	Resistance coils (2 ohms, 5 ohms, 10 ohms, 100 ohms)	2 sets
37.	37.	PH meter	1 set
38.	38.	Charger for battery accumulator	1 set
39.	39.	12 volt hand operated Dynamo, Leclanche cell, Daniel cell, Weston cell, Acidic cell, Head Accumulator, Alkali cell with variable resistances	2 sets
40.	40.	MultiMate	2 Nos.
41.	41.	Battery eliminator	2 Nos.
42.	42.	Diode valve	4 Nos.
43.	43.	Triode valve	4 Nos.

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

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

* Common to Chemical Trade group including Mech, Maintenance (G.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 for the apprentices with S.S.C., whereas 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 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 the Basic Training for S.S.C. holders and Induction Training for B.Sc. degree holders,

Operations/skills heading 'Basic Training': The remaining operations/skills coming in the list should be the apprentices at the shop-floor training as indicated under the heading 'Shop Training'. The apprentices should have more practice on those operations/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 CTS Syllabus (Skills) topics,

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

(c) The contents of the 1 year Shop Floor Training for the candidates who have under gone

basic training in Industry and for the Ex-ITI 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. 1. Introduction in safety precautions as applicable to the trade
2. 2. Fitting
3. 3. Turning on various lathes.

- X 5. Physics
 - X 5.1 Triangle and Parallelogram of forces
 - X 5.2 Determination of co-efficient of static friction
 - X 5.3 Determination of acceleration due of gravity
 - X 5.4 Determination of Mechanical advantage etc.
 - X 5.5 Determination of Young's modulus
 - X 5.6 Determination co-efficient friction of solid and liquid
- X 6. 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. 7. Pipe fitting
8. 8. Use and maintenance of lagging materials.
9. 9. Dismantling and assembling of different types of valves.
10. 10. Fitting and assembling of different gears,
11. 11. Study of different types of pumps, compressors etc. their assembly and maintenance.
12. 12. Checking the alignment of shafts and coupling.
13. 13. Fitting of bearings.
14. 14. Welding (Arc).
15. 15. (I) Installation of venturimeter, orifice meter and Rotameter.
(ii) To find out viscosity of a liquid by viscometer.
16. 16. Study of head against capacity curve of a centrifugal pump.
17. 17. Study of head VA capacity curve of a gear pump.
18. 18. To determine Reynold's number of different velocities.
19. 19. To determine friction losses in a straight pipe, pipe fitting valve.
20. 20. To calculate overall heat transfer co-efficient for a shell and tube heat exchanger.
21. 21. To find rate of evaporation of a vertical tube evaporator.
22. 22. Separation of a liquid mixture by distillation using packed tower.
23. 23. Flooding velocity experiment using a packed tower made of glass.
24. 24. Finding rate of drying curve by tray drier.
25. 25. **Operation of :**
 - (i) (i) Plate and frame filter press
 - (ii) (ii) Top-driven centrifuge.
 - (iii) (iii) Rotary vacuum filter.
 - (iv) (iv) Hammer Mill.
 - (v) (v) Ball Mill.
 - (vi) (vi) Plate Jaw crusher

- (iii) (iii) measuring instruments Temperature
- (iv) (iv) Level measuring instruments.
- (v) (v) P.H. Meter.
27. 27. Study of diaphragm control valves, transmitters.
28. 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. 29. Orientation**
- (i) (i) The plant and its products, raw materials used capacity of production etc.
- (ii) (ii) Different sections of the plant including process, maintenance and their activities.
- (iii) (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) (iv) Writing brief report (Diary of day to day work.
- (v) (v) Familiarization with utilities and service lines such as steam water, vacuum, compressed air, refrigeration, air conditioning units etc.
- 30. 30. Safety**
- (i) (i) Cause and prevention of accidents first aid to the injured.
- (ii) (ii) Personal safety and use of personal protective equipment
- (iii) (iii) House keeping.
- (iv) (iv) Fire prevention and fighting.
- (v) (v) Isolation of equipment's and ancillaries prior to handing.
- 31. 31. Quality Control**
- familiarization with sample quality control tests.

32. Routine Plant Jobs

- (I) Even tightening of flanges of equipment or pipe line.
- (II) Fitting of pressure and vacuum gauges, thermometers etc. winding of recorders

- (VII) (VII) Cleaning of evaporator tubes, heat exchangers etc.
33. 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) (i) Manipulation of automatic control and vice versa during shut down and start up.
33. 33. Standard operation, procedure, process conditions and the corrective action in case of the following equipment available in the industry.
- (i) (i) Pumps, compressors, blowers, fans, steam ejectors.
- (ii) (ii) Heat exchangers, furnaces, kilns.
- (iii) (iii) Distillation units.
- (iv) (iv) Evaporators and refrigeration units.
- (v) (v) Extraction units.
- (vi) (vi) Cooling towers and refrigeration units.
- (vii) (vii) Absorption towers.
- (viii) (viii) Dryers.
- (ix) (ix) Crystallizes.
- (x) (x) Filtration's equipment.
- (xi) (xi) Size separation and grinding equipment.
- (xii) (xii) Crushing and grinding equipment.
- (xiii) (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.

3. 3. In the case to 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
4. should be the same as the content of 2 years course for IYI Trainees in the trade.
5. The syllabus for Related Instructions should be considered as a guide. The subjects to be taught to the apprentices in Related Instructions:
 1. 1. Trade Theory.
 2. 2. Workshop Calculation and Science.
 - (a) (a) (X) Physics
 - (b) (b) (X) Maths.
 - (c) (c) (X) Chemistry
 - (d) (d) Unit operation
 - (e) (e) Unit process.
 3. 3. Social Studies.
 4. 4. Industrial Entrepreneurship.
 5. 5. Engineering Drawing.

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