

SYLLABUS FOR THE TRADE OF
“MAINTENANCE MECHANIC”
(CHEMICAL PLANT)

UNDER

CRAFTSMEN TRAINING SCHEME
&
APPRENTICESHIP TRAINING SCHEME

REVISED ON
2009

by

Government of India
Ministry of Labour & Employment (D.G.E.&T.)
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
EN- Block, Sector- V, Salt Lake,
Kolkata-700091.

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

S/Shri

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

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

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

SL N O.	NAME & DESIGNATION S/Shri	REPRESENTING ORGANIZATION WITH FULL ADDRESS	REMARKS
1.	S.S.Jirimali Manager - Training	HOC Ltd., Rasayani, Dist. Raigad	Chariman
2.	S.M.Sadamate Asstt. App. Adviser (Tech.)	B.T.R.I., Mulund, C/o. J.T.F Mulund, Mumbai	Member
3	D.N. Waghmare Chief Manager	Piramal Health Care Ltd., Balkum, Thane-400068	Member
4	S.K.Gehari (Skilled Staff S.S)	GSK Pharmaceuticals, 2 nd Pokhran, Thane	Member
5	Mali P.N. Training Incharge	Pfizer Ltd., Turbhe Navi Mumbai	Member
6	Sachin B. Dhoni Executive Engg.	RPG Industries Ltd., Navi Mumbai	Member
7	S.K.Sabarai Dy. Manager	M/s. Century Rayon Shahad (Thabe), Maharastra	Member
8	B.N. Chetan Anand	Amines & Plasticizus Ltd. Thane, Maharastra	Member
9	A.N.Manchar Kar, Sci. Demonstrator	B.T.R.I. Mulund	Member
10	Takalkar E.S., Chemical Instructor	B.T.R.I. Mulund	Member
11	S.P. Pradhan, Manager Process Control	Piramal Healthcare , Thane	Member
12	V.I.Raojadeja, Executive (Instrument)	Godrej Indsutries Ltd.Mumbai	Member
13	M.A.Kamerkar Manager(Factory Admn.)	Mazda Colours Ltd., Navi Mumbai	Member
14	D.Mahaboob Basha, Vocational Instructor	Jotun India Pvt. Ltd. Pune	Member
15	Amogh Soman, Sr. Executive -HR	Jotun India Pvt. Ltd., Pune	Member
16	Mrs. Deshmukh J.J. Trade Instructor (Science)	B.T.R.I., Mulund	Member
17	Mr. P.S.Wagh	Principal, ITI., Mumbai	Member
18	L.K.Mukherjee,Dy. Director	CSTARI., Kolkata	Member
19	A. Nandi, Dy. Director	CSTARI., Kolkata	Member
20	P.K.Roy, Dy. Director (Chem)	ATI., Mumbai	Member
21	K.K.Phadnis Training Officer	Advanced Trg. Institute, Sion ,Mumbai-22	Member
22	S.J. Wakde Trg. officer	Advanced Trg. Institute, Sion ,Mumbai-22	Member

GENERAL INFORMATION

1. Name of the Trade : Maintenance Mechanic (Chemical Plant)
2. N.C.O. Code No. : 845.53
3. Entry Qualification : Pass 10th Class Examination with Physics, Chemistry and Mathematics Under 10 + 2 system of education or its equivalent.
4. Duration of Craftsman: Training : 2 Years
5. Duration of Apprenticeship Training : 3 Years including 2 years Basic Training
6. Ratio of Apprentices to Worker : 1: 7
7. Rebate to Ex – ITI trainees for Apprenticeship training : 2 years
8. Space norms : 6.00 sq. mt. / Trainee
9. Power Norms :

SYLLABUS FOR THE TRADE OF
MAINTENANCE MECHANIC (CHEMICAL PLANT)
Under Craftsman Training Scheme

Period of Training: 2 Years

Week No.	Practical	Theoretical
FITTING		
1	<p>Induction Training – Familiarization with Institute. Importance of trade training. Introduction about machineries & equipments used in chemical trade & work done by trainee. Introduction to safety equipment, first aid & fire fighting equipments and their uses in the section.</p>	<p>Introduction & importance of safety & general precautions observed in the workshop. Fire prevention and fire control in chemical industries. Study of personal protective equipments used in chemical plant. First aid in chemical plant. Environmental pollution, sources, causes, consequences and controls. Role of maintenance mechanic in the Chemical Industries.</p> <p>Engineering Drawing – Introduction to engineering drawing. Its relevance to the trade. Use of Drawing Board, T-square.</p> <p>Physics – Introduction to Physics.</p> <p>Workshop Cal. & Science – Introduction to Chemistry. Atom, molecule element, compound. Physical and chemical change.</p> <p>Mathematics – Introduction.</p>
2 to 4	<p>Use of vice clamps, holding the job in the vice and practice of metal sawing with hacksaw and filing the edges maintaining squareness of all the faces. Marking practice using hermaphrodite calliper, surface gauge, engineers' try square, marking off table etc.</p>	<p>Description, construction and uses of different hand tools such as files, chisels, hacksaw & hammer etc.</p> <p>Description, construction and uses of different marking tools such as steel rule, calliper, punches, v-block, scribing block etc.</p> <p>Description construction and uses of different job holding devices.</p> <p>Engineering Drawing – Free hand drawing of straight lines, rectangle, squares, circles, polygon etc. Free hand drawing of simple solids such as cube, rectangular blocks, cylinders, cones etc.</p>

	<p>Filing flat surface and checking the flatness and squareness with engineers' try square. Filing four edges, checking all dimensions with outside calliper and steel rule.</p>	<p>and their views when viewed perpendicular to their base or axis.</p> <p>Physics: Introduction to Physics.</p> <p>Workshop Cal. & Science: Gas Laws. Boyle's and Charlie's Law, gas equation, diffusion, Graham's Law of diffusion, effusion, problems Dalton's effusion, problems Dalton's Law of partial pressure. Introduction of radio-activity alpha, beta and gama rays and their properties, radio-active changes alpha ray and beta ray change, group displacement law, definition of isotopes and isobars.</p>
	<p>Filing adjoining sides/surfaces maintain the right angle between the sides. Marking of parallel lines using dot punch. Chiselling practice as per marking lines.</p>	<p>Mathematics: Solution of linear and quadratic equation with one or two unknowns by algebraic calculations and by graphs.</p>
5 & 6	<p>Making a job on step fitting (Male & female). Marking out the position of holes for drilling. Use of centre drill for drilling operations.</p>	<p>Description, construction, calculation and uses of different linear measuring instruments such as – vernier calliper, micrometer, bevel protractor, height gauge. Nomenclature and uses of different types of drills & reamers.</p> <p>Physics: Rest and motion. Equation of motion, motion under gravity, in a circle with constant angular velocity and acceleration. Work, power and energy.</p> <p>Workshop Cal. & 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, Mendeleett's Periodic Law and table, advantages and disadvantages, statement of modern periodic law.</p> <p>Mathematics: Same as week No. 2 to 4</p>

<p>7 & 8</p>	<p>Marking the job using height gauge. Practice of through & blind hole drilling to a specific depth. Practice of enlargement of drill holes, countersinking, counter boring, spot facing and reaming etc. tapping and dieing of BSW, and metric threads of various sizes. Grinding practice of chisels and punches etc. Grinding practice of drills, common faults, and their ill effects.</p> <hr/> <p>Radius filling and fitting (convex & concave) both the parts, checking radius with radius gauge.</p>	<p>Description, nomenclature and uses of different types of threads – metric, BSW, BSF, BSP etc. Calculation of tap drill size. Description and uses of drill chuck, drill drifts & sleeves etc. Engineering Drawing: Use of set squares/mini drafter and others drawing instruments. Reading and understanding of simple drawing. Physics: S.M. Rotational motion, moment of inertia, simple machines, requirements of good balance. Workshop Cal. & Science: Atomic, molecular and equivalent weight. Definition and examples only. Electronic theory of valency and definition of double and complex salts. Mathematics: Factorisation.</p>
<p>9</p>	<p>Practice of angular filling (male & female part) and fitting of both the parts, checking angle with bevel protector.</p>	<p>Introduction of drilling machine its – types, parts & specification Engineering Drawing: Free hand sketching of simple object. Method of fixing sheet on the drawing board, line title of different inch. Physics: Static and kinetic friction their measurement. Elasticity, stress, strain, Hooke's Law, different medullae, work done in stretching a wire, determination of young's Modulus. Workshop Cal. & Science: Law of mass action and chemical equilibrium. Mass law equation, relation between Kc. & Kp. Lechateleir's principle and its application to manufacturing processes. Sulphuric acid, ammonia and nitric acid.</p>

10 to 11	Practice on combination fitting- consisting of step, radius and angle.	Mathematics: Mensuration : Area of triangles, rectangle, circle etc.
12 & 13	Practice on dismantling & assembling different types of bearing & bushes.	
TURNING		
14	Demonstrate about shop safety, safety precaution as applied to section. 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 four jaw chuck, turning grinding rough turning tool.	Shop safety, safety precaution as applied to section, Lathe-its construction, cleaning and oiling. Independent chucks different types and construction, uses. Common lathe cutting tools, type, shapes, different angles. Engineering Drawing: Writing single stroke letters and numbers as per IS : 1972 (II nd Revision). Geometrical construction on lines, angles and triangles. Physics: Surface tension, surface energy, angle of contact of liquid in a capillary tube, difference of pressure in a spherical bubble. Viscosity, Poiseuille's formula. Workshop Cal. & Science: Electrolysis. Definition, Faraday's Laws and problems. Application of electrolysis. Analytical and industrial – electroplating, electro-extraction of metals, electro-refining of metals.

		<p>Catalysis. Definition and application. Mathematics: Area of surface of solids like prism, cylinder, cone etc.</p>
15	<p>Setting tools in tool post. Facing operation, centre drilling. Grinding of lathe tools. Plain turning by holding job in the chuck turning to specified dia. Step turning, grinding of finishing tools.</p>	<p>Lathe accessories, such as centre, mandrel, catch plate, face plate, lathe steady etc. Common lathe cutting tools, roughing and finishing tools, knife tool, recessing tool etc. Lathe tool material. Engineering Drawing: Geometrical construction on plane curves such as cycloid, involutes, parabola, hyperbola, spiral, helix etc. Geometrical construction on polygons. Physics: Density and specific gravity, Archimedes's principle, principle of floatation hydrometers. Centre of gravity and equilibrium condition. Workshop Cal. & Science: <u>Inorganic Chemistry</u> Oxidation, Reduction, Corrosion - Definition, causes and prevention. Fertilisers Definition classification importance & examples. Mathematics: Area of surface of solids like prism, cylinder, cone etc.</p>
16 to 21	<p>Drilling on lathe – through and step drilling. Setting of boring tool in tool post. Plain Boring. Taper turning by swivelling, compound rest, and tail stock offset methods.</p>	<p>Drills – construction, types uses of sleeves. Boring tool types. Setting of boring tool. Tapers and its purpose, standard tapers, different methods of taper turning. Taper calculation. Knurling tool, types grades, setting, etc. Taper gauges types and uses. Advantage and disadvantages of offset method. Engineering Drawing: Different types of lines used in engineering drawing as per IS: 696-1972 (latest Revision). Isometric views of simple solid and hollow objects. Physics: Temperature and its measurement. Expansion of solids, liquids and gases. Workshop Cal. & Science: Metallurgy (General principle and processes). Metallurgy of copper, aluminium, zinc, chromium, lead, tin and nickel metals. Mathematics: Volume of solids like prism, sphere, cone etc.</p>

22 to 23	Exercise on knurling, practice on form turning. Thread cutting (BSW), thread cutting (Metric).	Screw thread purpose and forms. Screw thread terminology. Calculation of change wheel. Calculation of pitch, depth, core dia, pitch dia etc. Engineering Drawing: Orthographic views of simple objects by 1 st angle projection. Physics: Calorimetric, change of state. Workshop Cal. & Science: 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. Mathematics: Volume of solids like prism, sphere, cone etc.
WELDING (GAS)		
24 to 26	Introduction-importance of trade, types of work done. Demonstrate about general safety, personal safety, & precautions observed during gas welding. Procedure of fire prevention and fire control in gas welding workshop. Safety equipment's and their uses. Lighting and adjustments of flame. Fusion runs with and without filler rod-D.	Safety and general precautions observed in workshop. Importance of welding in maintenance of chemical plant and equipment. Safety precautions in gas welding. Description and uses of tool and equipment used. Welding terms and their definitions. Engineering Drawing: Orthographic views of simple objects by 3 rd angle projection. Physics: Hygrometry. Workshop Cal. & Science: Manufacture and the properties of Sodium Hydroxide and Carbonate. Alloys: Preparation properties and uses. Mathematics: Logarithm.
27 to 28	Practice of edge joint with or without filler rod -D. Square butt joint-D.	Welding methods and groups of welding, welding terms and definitions. Common gases used in welding- Oxygen, hydrogen acetylene, CO ₂ gas etc. Chemistry and types of flame. Engineering Drawing: Exercises on orthographic view. View of simple solid and hollow object. Physics: Mode of heat transfer. Thermal conductivity and its determination. Workshop Cal. & Science: Laboratory preparation, properties and uses of

		<p>carbon dioxide, oxygen, hydrogen, sulphur-dioxide, hydrogen sulphide and halogens (chlorine and bromine). Nitrogen, its oxides, fumigation of nitrogen.</p> <p>Mathematics: Logarithms.</p>
29 to 31	<p>Practice on outside corner Joints-D. Fillet weld-D.</p> <p>Inside corner joint.</p>	<p>Oxy-acetylene welding, equipment such as regulator, blow pipes etc. Assembling, care and maintenance. Effects of atmospheric oxidation, welding positions and types of joints. Edge preparation, methods of heating metals.</p> <p>Engineering Drawing: Exercises on orthographic view of simple solid and hollow objects.</p> <p>Physics: Law of thermodynamics and different thermodynamic processes. Dispersion, Spectrophotometric polarisation.</p> <p>Workshop Cal. & Science: Allotropy of hydrogen, carbon, phosphorus and sulphur. Acids, bases, and salts. Sources, hard and soft water, causes and removal of hardness.</p> <p>Mathematics: Logarithms.</p>
32 to 33	<p>Practice on Pipe butt joint-D &</p> <p>Pipe T-joint-D.</p>	<p>Oxygen cylinder, DA cylinders, Description methods of charging and care. Faults in gas welding. Definition of faults, their effects, causes, correction.</p> <p>Engineering Drawing: Exercises on orthographic view of simple solid and hollow objects.</p> <p>Physics: Natural and artificial magnets, their properties and magnetic field.</p> <p>Workshop Cal. & Science: Water for industrial purpose. Preparation properties and uses of aluminium chloride, potassium Ferro and ferricyanide bleaching power.</p> <p>Mathematics – Trigonometry – study of sine, cosine and tangent of angles in a right angle, triangle and their application in solving practical problems.</p>
34 to 38	<p>Practice of hard surface stiling. Brazing of similar metals. Straight cutting by gas.</p> <p>P.V.C. Welding, all types joints on sheets 3mm, 4 mm, 6 mm.</p>	<p>Hard facing-necessity, types, methods application. Destructive test, stiling-necessity, type flame adjustment-methods and applications. Methods employed to control distortion and stress relieving.</p> <p>Definition of P.V.C., its type properties and uses.</p>

	P.V.C. Welding pipe, Flange, elbow and T etc.	Objective, procedure, apparatus required explanation and calculations involved in the experiment.
PHYSICS		
	<p>i) To study triangular and parallelogram with the help of mechanical board.</p> <p>ii) Determination of co-efficient of static friction using inclined plane.</p> <p>iii) Determination of acceleration due to gravity by simple pendulum.</p> <p>iv) Determination of mechanical advantage, velocity ratio and efficiency of simple machine</p> <p>v) Determination of Young's Modulus by Searle's apparatus.</p>	<p>Engineering Drawing: Exercises on orthographic view of simple solid and hollow objects. Drawing orthographic views, views of nuts, bolts, screws etc. Drawing of different types of thread forms, rivet heads, keys, coupling.</p> <p>Physics: Intensity of magnetic field at a point on magnetic axis and magnetic equation, neutral point. Tangent magneto meter, dip circle and applications of magnet. Static electricity-charge, charging by induction.</p> <p>Workshop Cal. & Science: <u>Organic Chemistry:</u> Introduction to organic chemistry. Purification processes. Organic reactions. Substitution addition (polymerisation) Elimination and rearrangement reactions. Explanation and example. Nomenclature. I.U.P.A.C. & common system. Classification and functional groups. Halo, Hydroxyl, formyl, Carbonyl, Carboxyl, amino, Nitro and Sulphonic Acid – cyclic Acyclic compounds.</p> <p>Mathematics: Trigonometry-study of sine, cosine, tangent of angles in a right angled triangle and their application in solving practical problems.</p>
39 to 44	<p>Determination of co-efficient of expansion of solid and liquid. Measurement of specific heat by calorimeter. Determination of coefficient of thermal conductivity of metal rod. Determination of rotation constant of optically active substance by a polarimeter. To study Ohm's law and Kirchoiff's law about</p>	<p>Objective, procedure, apparatus required explanation and calculations involved in the experiments.</p> <p>Engineering Drawing: Drawing of different types of thread forms, rivet heads, keys, coupling. Drawing of different types of riveted joints such as lap and butt joints.</p> <p>Physics: State electricity distribution of charge, potential, capacity and condenser. Current electricity, electricity by chemical action cells.</p>

	<p>current and voltage. To study electric cell using series and parallel connections. Determination of specific resistance using Whetstone's Bridge. Verification of Faraday's First Law of electrolysis. Determination of mechanical equivalent of heat using electrical method.</p> <p>Chemistry: Separation of mixture of liquids by distillation. Preparation of following – a) soap b) Nitrobenzene c) Aniline d) Copper sulphate & e) Ferrous ammonium sulphate.</p>	<p>Workshop Cal. & 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 and sulphur contents. Halogen compounds of aliphatic hydrocarbons. Carbon tetrachloride, chloroform, preparation properties and uses. Aliphatic Aldehydes and Ketones. Acetaldehyde, Acetone. Preparation properties and uses. Alcohols and acids. Ethyl alcohol and acetic acid – Preparation properties and uses. Carbohydrates. Definition, classification, sugar. Sugar: Preparation properties and uses.</p> <p>Mathematics: Trigonometry-study of sine, cosine, tangent of angles in a right angled triangle & their application in solving practical problems on law of fluids, heat transfer, evaporation, transmission of power etc.</p>
45 to 48	<p>To study the allotropic forms of sulphur.</p> <p>To study the properties of mixtures (FeS) and compound (FeS).</p> <p>To study action of pure salt water on metals and alloys.</p> <p>To study action of acids and bases on metals and alloys.</p>	<p>Objective, procedure, apparatus required explanation and calculations involved in the experiments.</p> <p>Engineering Drawing: Drawing of different types of locking devices such as double nut, castle nut, pin etc.</p> <p>Physics: Magnetic effect of current, electromagnets, Ohm's Law. Kirchoff's Law. Parallel and series circuit connections. Wheaton's Bridge, potentiometer.</p> <p>Workshop Cal. & Science: Oils and fats. Soaps.</p> <p>Mathematics: Trigonometry – study of sine, cosine, tangent of angles in a right angled triangle and their application in solving practical problems, and problems on law of fluids, heat transfer, evaporation, transmission of power etc.</p>

<p>49 to 50</p>	<p>To study corrosion of metals. Volumetric analysis: Qualitative analysis (Inorganic) without interfering radicals.</p>	<p>Objective, procedure, apparatus required explanation and calculations involved in the experiments. Engineering Drawing: Sectional view of simple objects such as brackets, bearings etc. Physics: Heating, effect of electric current. Electrolysis Workshop Cal. & Science: Polymerisation. Definition and explanation with one or two examples. Rubber plastics and bakelite. Preparation, properties and uses of Oxalic acid. Mathematics: Trigonometry – study of sine cosine, tangent of angles in a right angled triangle and their application in solving practical problems, and problems on law of fluids, heat transfer, evaporation, transmission of power etc.</p>
<p>51 to 52</p>	<p>Revision & Examination</p>	<p>Revision & Examination</p>
<p>FITTING & MAINTENANCE</p>		
<p>53</p>	<p>Introduction to safety equipments and their uses. Awareness of first aid, fire fighting equipments and hydrant system, material safety data sheet (MSDS), Personal protective equipments (PPEs). Marking out key ways in shafts, using cross out chisel for key ways. Fitting key into the grooves.</p>	<p>General Safety: Introduction & importance of safety & general precautions observed in the workshop. Fire prevention and fire control in chemical industries. Study of personal protective equipments (PPEs) used in chemical plant. First aid in chemical plant. Introduction to occupational health hazard. Environmental pollution, sources, causes, consequences and controls. Various, types of keys, allowable clearance and tapers, proportion of keys based on dia of shaft. Types and uses of key pullers. Engineering Drawing: Revision and more exercises on orthographic views of machine parts such as bearing, brackets etc. Unit Operation: Fluid Flow: Pipe – their materials of construction, sizes, methods of joining. Pie fittings. Joints for glass pipe. Expansion joints. Unit Processes: Caustic soda and chlorine raw materials, process description, flow sheet and uses.</p>

54	Filing for smoothness of machined surface. Use of Prussian blue for high spots & scrapping.	Scrapers, their uses, type method of scrapping. Tolerance and limits, types of its allowance definition. Engineering Drawing: Revision and more exercises on orthographic views of machine parts such as bearing brackets etc. Unit Operation: Valves-gate, globe, needle, ball, butterfly etc. – their construction and fields of application, check valves, safety devices, pressure-reducing valve. Unit Processes: Caustic soda and chlorine raw materials, process description, flow sheet and uses.
55	Cutting, threading, bending and fitting of pipes as per drawing. Making different types and sizes of pipe joints such as screwed & flanged etc.	Pipes and pipe joints, pipe bending fixtures, standard pipe threads, taps and dies used for pipe threading. Engineering Drawing: Revision and more exercises on sectional views of machine part. Unit Operation: Valves-gate, globe, needle, ball, butterfly etc. – their construction and field of application, check valves, safety devices, pressure reducing valve. Unit Processes: Caustic soda and chlorine raw materials, process description, flow sheet and uses.
56	Use and maintenance of lagging material, such as glass-wool, asbestos, magnesia, thermocole, aeroflex etc.	Lagging material, types, uses. How to use high, medium slow pressure pipe lines, testing leakage etc. Engineering Drawing: Revision and more exercises on sectional views of machine part. Unit Operation: Diaphragm control valve steam traps. Unit Processes: Caustic soda and chlorine raw materials, process description, flow sheet and uses.
57	Preparing pipe lines, using various pipe fittings for metals such as – Aluminium, copper, G.I. Steel, PVC pipes etc.	Standard pipe fittings method. Methods of fitting or replacing them. Engineering Drawing: Free hand sketching of pistons connecting rod, crank shaft, steam chest etc. Unit Operation: Reciprocating pumps and compressors, their working, construction and applications. Unit Processes: Soda ash raw materials, process description,

		flow sheet and uses.
58	Dismantling, overhauling & assembling of globe valves, gate valves, stop cocks, non return valves, ball valves, needle valves etc.	Construction. Engineering Drawing: Free hand sketching of pipe joints and fittings. Unit Operation: Centrifugal pumps and compressors, their working, construction and applications, vacuum pump. Unit Processes: Soda ash raw materials, process description, flow sheet and uses.
59	Same as week no. 58	Construction. Engineering Drawing: Free hand sketching of pipe joints and fittings. Unit Operation: Blower, fans, steam jet ejector, lift pump. Unit Processes: Soda ash raw materials, process description, flow sheet and uses.
60	Fitting and assembling of different gears and gear boxes, reduction gear etc.	Types of gears such as Spur, Helical, bevel, worm & worm wheel etc. – their uses. Engineering Drawing: Free hand sketching of shaft coupling such as butt couplings flanged couplings etc. Unit Operation: Heat transfer, mode of heat transfer, thermal conductivity furriers equation, resistance in series, film coefficient overall film coefficient. Unit Processes: Sulphuric acid raw materials, process description, flow sheet and uses.
61	Dismantling, overhauling and assembling of different type of pump such as positive displacement pumps (reciprocating pump, gear pumps, plunger pumps), centrifugal pumps and vacuum pumps..	Types of pumps, their construction details and uses. Engineering Drawing: Free hand sketching of shaft coupling such as butt couplings flanged couplings etc. Unit Operation: Heat transfer, mode of heat transfer, thermal conductivity furriers equation, resistance in series, film coefficient overall film coefficient. Unit Processes: Sulphuric acid raw materials, process description, flow sheet and uses.
62	Same as week no. 61.	Types of pumps, their construction details and uses. Engineering Drawing: Free hand sketching of shaft coupling such as butt couplings flanged couplings etc. Unit Operation: Double pipe heat exchanger, different types of

		<p>shell and tube heat exchanger.</p> <p>Unit Processes: Sulphuric acid raw materials, process description, flow sheet and uses.</p>
63	<p>Checking the alignment of shaft and couplings of motors, correcting the alignment by using of spirit level & dial gauges.</p>	<p>Causes of mis-alignment, different methods of checking alignment. Effect of mis-alignment on shafts and couplings.</p> <p>Engineering Drawing: Free hand sketching of shaft coupling such as butt couplings flanged couplings etc.</p> <p>Unit Operation: Plate heat exchangers, finned tube exchangers, reaction vessels.</p> <p>Unit Processes: Sulphuric acid raw materials, process description, flow sheet and uses.</p>
64	<p>Fitting and maintenance of compressors blowers, fan, crushers, mixer, pulverisers.</p>	<p>Compressors, blowers, fans, crushers, mixers, pulveriser-their types, construction and uses.</p> <p>Engineering Drawing: Drawing sketches of different types of valves, such as plug cock, globe valve, gate valve, ball valve etc.</p> <p>Unit Operation: Furnaces for solid fuels.</p> <p>Unit Processes: Cement: Raw materials, chemical reaction, process description, flow sheet and uses.</p>
65	<p>Fitting of bearings, such as ball bearing, roller bearing, bush bearing etc. – their care, lubrication and maintenance</p>	<p>Bearing –their types, construction, uses.</p> <p>Engineering Drawing: Drawing sketches of different types of valves, such as plug cock, globe valve, gate valve, ball valve etc.</p> <p>Unit Operation: Burners for liquids and gaseous fuels.</p> <p>Unit Processes: Cement: Raw materials, chemical reaction, process description, flow sheet and uses.</p>
66	<p>Fitting of oil seals, checking and replacing of oil seals, removing bearings using bearing pullers.</p>	<p>Different types of lubricating oils their grades and uses. Bearing puller types, and their use.</p> <p>Engineering Drawing: Drawing sketches of different types of valves, such as plug cock, globe valve, gate valve, ball valve etc.</p> <p>Unit Operation: Kiln: Shaft and rotary, direct fired and indirect fired.</p> <p>Unit Processes; Cement: Raw materials, chemical reaction, process description, flow sheet and uses.</p>

67	Dismantling, cleaning, repairing and reassembling machinery using chain pulley, blocks, jack etc. Safe handling and operation of the same.	Installation, maintenance and overhauling of machinery and levelling, equipment and alignment of machines. Engineering Drawing: Drawing sketches of expansion joints and shifting boxes. Unit Operation: Kiln: Shaft and rotary, direct fired and indirect fired. Unit Processes: Comment: Raw materials, chemical reaction, process description, flow sheet and uses.
68	Same as week no. 67.	Installation, maintenance and overhauling of machinery and levelling, equipment and alignment of machines. Engineering Drawing: Exercises on Blue Print Reading. Unit Operation: Evaporation: Different types of evaporation and their field of applications. Unit Processes: Soap and glycerine – raw materials, chemical reaction process description, flow sheet and uses.
69	Importance of preventive and routine maintenance, log cards, records of maintenance schedules etc.	Types of maintenance, keeping various records of preventive maintenance, log cards, repair schedules. Engineering Drawing: Free hand sketching of simple bearing. Unit Operation: Multiple effect evaporation and feed arrangement. Unit Processes: Soap and glycerine – raw materials, chemical reaction process description, flow sheet and uses.
70	Same as week No. 69.	Same as week No. 69. Engineering Drawing: Free hand sketching of Primmer block, its details and assemble. Unit Operation; Condensers. Unit Processes; Soap and glycerine – raw materials, chemical reaction process description, flow sheet and uses.
71	Maintenance of pressure vessel fittings, making of packing, gaskets.	Different types of pressure vessels, their care and maintenance. Different types of packing materials gaskets etc.

		<p>Engineering Drawing: Free hand sketching of Primmer block, its details and assemble.</p> <p>Unit Operation: Preparation of steam. Boilers – fire tube and water tube, accessories, scale formation and its removal.</p> <p>Unit Processes: Soap and glycerine – raw materials, chemical reaction process description, flow sheet and uses.</p>
72	Use of correct materials and locking devices, such as split pin, locknut, spring washer, etc.	<p>Purpose of locking devices, locking nuts, types their application. Washers, types, use.</p> <p>Engineering Drawing: Free hand sketching of Primmer block, its details and assemble.</p> <p>Unit Operation: Preparation of steam, boilers – fire tube and water tube, accessories, scale formation and its removal.</p> <p>Unit Processes: Soap and glycerine – raw materials, chemical reaction process description, flow sheet and uses.</p>
73	Trouble shooting and maintenance of various equipments like compressors, pumps, valves, blowers, fans etc.	<p>Various types of lifting appliances, extractors' pressure, and their uses. Different methods of getting mechanical advantages.</p> <p>Engineering Drawing: Drawing sketches of jaw crusher, ball mill hammer, centrifuge, heat exchanger, evaporators etc.</p> <p>Unit Operation: Distillation: Introduction, boiling point diagram, equilibrium curve, relative volatility</p> <p>Unit Processes: Glass: raw materials, chemical reaction process description, flow sheet and uses.</p>
74	Trouble shooting.	<p>Handling of heavy machinery precaution to be taken etc.</p> <p>Engineering Drawing: Drawing sketches of jaw crusher, ball mill hammer, centrifuge, heat exchanger, evaporators etc.</p> <p>Unit Operation: Methods of distillation: flash distillation, differential distillation and rectification.</p> <p>Unit Processes: Glass: raw materials, chemical reaction process description, flow sheet and uses.</p>

MACHINIST		
75	General introduction to the shaping machine, setting tool in the holder, shaping plain surface by roughing too.	<p>Shaping machine: Working principle, purpose, size and specification, different part and their functions, shaping machine safety.</p> <p>Engineering Drawing: Drawing sketches of jaw crusher, ball mill, hammer mill, centrifuge, heat exchanger, evaporators etc.</p> <p>Unit Operation: Types of distillation column.</p> <p>Unit Processes: Glass: raw materials, chemical reaction process description, flow sheet and uses.</p>
76	Shaping of rectangular block to size and checking up with steel rule, calliper and try square. Marking out for shaping steels, slots etc.	<p>Use of machine vice in shaping machine, methods of holding work in the vice, method of adjusting length and position of strokes.</p> <p>Engineering Drawing: Drawing sketches of jaw crusher, ball mill, hammer mill, centrifuge, heat exchanger, evaporators etc.</p> <p>Unit Operation: Construction of a bubble cap distillation column with accessories. Instrumentation diagram of a distillation column.</p> <p>Unit Process: Petroleum refining.</p>
77	General introduction to slotting machines, setting up job on the table. Setting up tool adjustment of stroke slotting rectangular block to size.	<p>Use of slotting machine, different parts and working principles, specification, different method of setting tool, safety in slotting.</p> <p>Engineering Drawing: Drawing sketches of pumps such as centrifugal, reciprocating and gear pump etc.</p> <p>Unit Operation: Azeotropic & extractive distillation.</p> <p>Unit Process: Petroleum refining.</p>
78	Marking out for slotting, cutting slot, and grooves.	<p>Driving machine in the slotting machine, common method of holding jobs for slotting.</p> <p>Engineering Drawing: Drawing sketches of pumps such as centrifugal, reciprocating and gear pump etc.</p> <p>Unit Operation: Construction of a bubble cap, packed and sieve plate distillation column with accessories.</p> <p>Unit Processes: Petroleum refining.</p>
79	General introduction to milling machines, setting of vice on the table, plain	<p>Milling Machine: Purpose, types and classification, constructional features of milling machine, controls etc. Use of graduated dial.</p>

	milling practice.	<p>Engineering Drawing: Drawing sketches of pumps such as centrifugal, reciprocating and gear pump etc.</p> <p>Unit Operation: Steam distillation.</p> <p>Unit Processes: Petroleum refining.</p>
80	Setting work in the vice fixing plain milling cutter on the arbour. Milling rectangular blades to dimensions.	<p>Milling cutters, types, uses of various milling operation, various common holding device used in milling machines.</p> <p>Engineering Drawing: Exercises on Blue Print Reading.</p> <p>Unit Operation: Extraction and leaching: Application of liquid-liquid extraction, theory and definitions.</p> <p>Unit Processes: Petroleum refining.</p>
81	Making rectangular clocks and straight slot cutting according to dimensions with cylindrical cutters and side and face cutters.	<p>Driving and feeding mechanism of milling machine. Various common milling operations various common holding devices used in milling machine.</p> <p>Engineering Drawing: Free hand sketching of spur, helical and bevel gears.</p> <p>Unit Operation: Mixer-settler extractor, spray towers, packed towers, sieve tray towers, centrifugal extractors.</p> <p>Unit Processes: Petroleum refining.</p>
82	Making rectangular clocks and straight slot cutting according to dimensions with cylindrical cutters and side and face cutters.	<p>Driving and feeding mechanism of milling machine. Various common milling operations various common holding devices used in milling machine.</p> <p>Engineering Drawing: Free hand sketching of spur, helical and bevel gears.</p> <p>Unit Operation: Mixer-settler extractor, spray towers, packed towers, sieve tray towers, centrifugal extractors.</p> <p>Unit Processes: Petroleum refining.</p>
WELDING (ARC)		
83	Straight line beads on M.S.Plate.	<p>Different process of metal joining, bolting, revetting, soldering, brazing etc</p> <p>Engineering Drawing: Exercises on development of simple solids such as prism, cylinder, cone, pyramid etc.</p>

		<p>Unit Operation: Leaching, applications, percolation tanks.</p> <p>Unit Processes: Petroleum refining.</p>
84	Open corner joint M.S. Plate.	<p>Types of joints, classifications, uses. Elementary electricity. Its uses applied to welding. Heat and temperature.</p> <p>Engineering Drawing: Exercises on development of simple solids such as prism, cylinder, cone, pyramid etc.</p> <p>Unit Operation: Leaching, applications, percolation tanks.</p> <p>Unit Processes: Petroleum refining.</p>
85	Fillet weld (M.S. Plate)	<p>Description and use of tools and equipment used in Arc welding.</p> <p>Engineering Drawing: Exercises on development fracture of simple object like prism, cylinder, cone, etc.</p> <p>Unit Operation: Agitated vessels and oil extraction from oil seeds.</p> <p>Unit Processes: Petroleum refining.</p>
86	Outside and inside joints. Single 'V' Butt joint.	<p>Types of electric welding metallic, carbon, resistance etc. & application arc length etc.</p> <p>Engineering Drawing: Exercises on development fracture of simple object like prism, cylinder, cone, etc.</p> <p>Unit Operation: Introductory theory and application of absorption.</p> <p>Unit Processes: Petroleum refining.</p>
87	Fillet lap joint and T joint.	<p>Principle of arc welding types of welding and their advantages. Welding machine care and maintenance.</p> <p>Engineering Drawing: Exercises on development of turn objects.</p> <p>Unit Operation: Different towers and packing, their material of construction and properties, stripping methods of stripping.</p> <p>Unit Processes: Petroleum refining.</p>
88	Pipe joints, T-butt joints (Square butt)	<p>Electrodes, types, method of coating, flux, characteristic I.S.I. specification.</p> <p>Engineering Drawing: Construction of simple curves of inter-penetration.</p>

		<p>Unit Operation; Different towers and packing, their material of construction and properties, stripping methods of stripping.</p> <p>Unit Processes: Petroleum refining.</p>
89	Advanced welding (TIG & MIG) with all types of joints	<p>Arc welding defects, causes and effects, how to overcome etc. Distortion and its control.</p> <p>Engineering Drawing: Exercises on inter-penetration of pipe joints such as elbow, tee, lateral etc.</p> <p>Unit Operation: Drying: Introduction, different types of dryer.</p> <p>Unit Processes; Petroleum refining.</p>
90	Practice of different PVC welding process.	<p>Simple estimating involving fabrication, consumption of gas, electrode, length of weld use of hand book and relief tables.</p> <p>Engineering Drawing: Exercises on inter-penetration of pipe joints such as elbow, tee, lateral etc.</p> <p>Unit Operation: Drying : Introduction, different types of dryer</p> <p>Unit Processes: Petroleum refining.</p>
91	I N D U S T R I A L V I S I T	
UNIT OPERATION LABORATORY		
92	Installation of orifice meter, venture meter and rotameter	<p>Orifice taps, construction of orifice meter, venurimeter and rotameter, precaution to be taken during their installation.</p> <p>Engineering Drawing: Free hand detailed drawing of the components related to the trade taking measurements of the actual parts.</p> <p>Unit Operation: Filtration: Introduction and different types of filtration equipment.</p> <p>Unit Processes: Paints and varnishes</p>
93	Making head vs. capacity curve for centrifugal and gear pumps.	<p>Construction of centrifugal and gear pumps, characteristics curves, trouble shooting. Construction of shell and tube exchanger and significance of file co-efficient.</p> <p>Engineering Drawing: Free hand detailed drawing of the components related to the trade taking measurements of the actual parts.</p> <p>Unit Operation: Centrifugation: Top and bottom centrifuges continuous and semi-continuous centrifuges</p>

		Unit Processes: Paints and varnishes
94	Determination of rate of evaporation of a vertical tube evaporator. Separation of a binary liquid mixture in a packed distillation tower.	Construction of vertical tube evaporator. Engineering Drawing: Make working drawing of the above in a suitable scale. Unit Operation: Humidity and Air Conditioning introduction and fundamentals. Unit Processes: Paints and varnishes
95	Operation of (a) Plate and frame filter press, (b) Top driven centrifuge, and (c) Rotary vacuum filter.	Construction, trouble shooting and applications. Engineering Drawing: Make working drawing of the above in a suitable scale. Unit Operation: Crystallisation: Different types of crystallisers. Unit Processes: Paints and varnishes
96	Operation of – a) hammer mill b) ball mill c) Blake jaw crusher	Construction, trouble shooting and applications. Engineering Drawing: Drawing sketches of assembly drawing of the above showing each part in its position, if required in sectoral views. Unit Operation: Adsorption: Theory, various types of adsorbents and their applications. Unit Processes: Paints and varnishes
97	Study of multi-stage compressor. Study of three phase, electrical motors, starters.	Theory of compression, Related electrical technology. Engineering Drawing: Drawing sketches of assembly drawing of the above showing each part in its position, if required in sectional views. Unit Operation; Mixing: Paddles, turbines, propellers, cone and disc. Agitators. Mixing equipments. Unit Processes: Pulp and paper.
INSTRUMENTATION –		
98	Calibration of – a) Bimetallic thermometer b) Thermocouple c) Resistance thermometer d) Mercury in glass	Heat - its mode of transfer, temperature scale, different methods of temperature measurement. Engineering Drawing: Drawing: working drawing of the above assembly in a suitable scale, showing post list

	thermometer.	material etc. Unit Operation: Sedimentation and decantation: colloidal solution, flocculation, Door Thickener. Unit Processes: Pulp and paper.
99 & 100	Calibration of Bourden's tube pressure gauges – a) C-type b) Spiral c) Helix	Pressure: Definition, its units, different methods of pressure measurement. Engineering Drawing: Drawing: working drawing of the above assembly in a suitable scale, showing post list material etc. Unit Operation: Crushing and grinding different equipment, screening. Unit Processes: Pulp and paper
101	Calibration of vacuum gauge, pressure switch, Study of pneumatic control valve, pressure, level, flow, temperature transmitter/ controller, recorders.	Study of vacuum gauge, pressure switch, pneumatic control valve, level controller, flow controller, temperature transmitter/ controller, recorders. Engineering Drawing: Drawing: working drawing of the above assembly in a suitable scale, showing post list material etc. Unit Operation: Drying: introduction, vapour pressure curve for water, relative humidity, rate of drying, tray drier, rotary drier. Instrumentation diagram of tray drier. Unit Processes: Pulp and paper
102 to 104	Revision & Examination.	

LIST OF TOOLS, EQUIPMENT AND MATERIALS
FOR PHYSICS LABORATORY

Sl.No.	N a m e	Quantiy
1	Physical balance (with weight box)	3 sets
2	Chemical balance (with weight box)	3 sets
3	Viscometer :	
	(a) Oswald viscometer	3 pieces
	(b) Redwood viscometer	3 pieces
	(c) Stop watch (1/10 th Secn)	6 pieces
	(d) Thermostatic bath	2 pieces
4	Talagnometer	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, weight 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 pendulum).	2 sets
14	Barometer	1 no.
15	Altimeter	1 no.
16	Searle's apparatus for young's, modules, modules	2 sets
17	Nicholson's Hydrometer with glass jag	2 sets
18	Wet and dry bulb thermometer	2 sets
19	Apparatus for measurement specific heat of solid and liquid (Renault's Apparatus).	2 sets.
20	Apparatus for measurement of coefficient of expansion (thermal) of solid and liquid.	2 sets.
21	Apparatus for measurement of thermal conductivity of good and bad conductor	2 sets
22	Calorimeter for determining mechanical equivalent of heat and specific heat.	4 sets.

23	Thermometers :	
	(i) 0 to 11C : 2 Dozen (ii) 0 to 36 C : 1 Dozen (iii) 0 to 250 C : Dozen	
24	Polarimeter with monochromatic light	2 sets
25	Abbe refractometer	2 sets
26	Pulfrish refractometer	2 sets
27	Equipment to study kirchoff's law and Electrochemical equivalent	1 set
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. 2 nos.
32	Rheostat : a) Rheostat 25 Ohms b) Rheostat 100 Ohms c) Rheostat 500 Ohms	2 nos. 2 nos. 2 nos.
33	Ammeter a) 0 to 1 Amp (DC) b) 0 to 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	Volt meter a) 0 to 1 volt (DC) b) 0 to 4 volt (DC) c) 0 to 5 volt (DC) d) 0 to 10 volt (DC) e) 0 to 50 volt (DC) f) 0 to 25 volt (DC)	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, 10 Ohms)	2 sets
37	PH meter	1 set
38	Charger for battery accumulator	1 set
39	12 volt hand operated Dynamo lachlanchacel denial cell, Weston cell, acidic cell, den, accumulator, alkali cell with enable resistances	2 sets.
40	Multimeter	2 nos.
41	Battery eliminator	2 nos.
42	Diode valve	4 nos.
43	Triode valve	4 nos.

LIST OF TOOLS & EQUIPMENT FOR A BATCH OF 16 TRAINEES

Sl. No.	Description	Quantity
TRAINEES KIT – Common to Attendant Operator and Maintenance Mechanic (Chemical Plant) trades		
1	Caliper outside spring 6"/15 cm	17 1 for instructor
2	Caliper inside spring 6"/15 cm	17
3	Divider spring 6"/15 cm	17
4	Centre punch 4"/10 cm	17
5	Prick punch 6"/15 cm	17
6.	Chisel cold flat 1"2.5 cm	17
7	Chisel cross out 3/8" x 1/8"	17
8	Chisel diamond point 1/8" /10 cm	17
9	Chisel half round 3/8"/10 cm	17
10	Hammer ball pein 1 lb, Handled	17
11	Hammer ball pein ½ lb. handled	17
12	Hacksaw frame – adjustable with pistol grip for 8" – 12" blade/20 cm. – 30 cm	17
13	Rule steel 12" English and metric 30 cm	17
14	Screw driver 3" x 3/8" blade	17
15	Screw driver 12" x ½ blade	17
16	Try Square 6" blade/15 cm	17
17	Scriber	17
18	Safety goggles	17
19	File flat 8 "/20 cm rough	17
20	File flat 8 "/20 cm 2nd cut	17
21	File round 8mm, 8 "/20 cm length, 2nd cut	17
22	File round 10mm, 8 "/20 cm length, 2nd cut	17
23	File half round 8 "/20 cm length rough	17
24	File half round 8 "/20 cm length, 2nd cut	17
25	Box drawing instrument	17
26	Protractor celluloid circular	17
27	Scale (Wood) Draughtsmen 12"/30 cm	17
28	Set square celluloid 45°	17
29	Set square celluloid 60° – 10 inch	17
30	Board drawing half imperial size	17
31	Square – T 24 inch blade	17

WORKSHOP TOOLS & EQUIPMENT -		
1.*	Surface plane 12" x 12/30 cm x 30 cm. or surface plate 24" X 24"/60 cm x 60 cm	2 1
2.*	Scribing block universal 12" x 30 cm	2
3.*	Marking table 3'x2'x(3' high)	1
4.*	V-blocks 3"x1-1/4" (pair) with clamps	2
5.*	Combination set 12"	2
6.	File handles	96
7.*	Drill twist (straight shank) 1/8" to 1/2" by 1/64" (set)	4
8.	Telescopic gauges 1/2" – 6"	1
9.	Magnetic indicator and base	2
10.*	Drill twist 1/2" to 3/4" by 1/16" (Morse taper).	1 set
11.*	Drills twist (Metric) 2mm to 7 mm by 1 mm	6 sets
12.*	Drills twist (Metric) 8mm to 12 mm by 1 mm	1 set
13.	Drill straight shank wire gauge sizes 1 to 60 with gauge	1 set
14.	Drills straight shank letter gauge sizes A to Z with gauge	1 set
15.	H.S.S. hand reamers 3 to 12 mm by 1 mm	1 set
16.	H.S.S. machine reamers 3 to 19 mm	1set
17.	H.S.S. machine reamers with M.I. shank 1/8" to 3/4" by 1/16"	1 set
18.*	Hacksaw frame adjustable for 8" to 12" blades	6
19.	Hand vice 1"/25 mm	4
20.	Working bench 6' x 2 1/2' with 2 vices 5" jaws	5
21.*	Working bench 8'x4'x2 1/2' with vices 5" jaws	4
22.*	Almirah	1
23.	Tool boxes of drawers fitted in the working bench	16
24.*	Punch letter set	1
25.*	Punch figure set	1
26.	Taps and dies complete set in box B.A., S.S.F. B.S.U. American and Metric	1 in each 12
27.*	File flat 12' bastard	12
28.	File flat 10" 2 nd cut	12
29.*	File flat 10" smooth	6
30.*	File three square 6" and cut	12
31.*	File flat 6" smooth	2
32.*	Stone oil 6"x 2"x1"/15 cm x5 cm x 2.5 cm	2
33.*	Can oil 1/2 pt	2
34.	Scraper half round 10"/25 cm	6
35	Scraper half 10"/25 cm	2
36	Scraper hook type 10" handled	2
37	Scraper triangular 10"/25 cm	2
38.*	Bevel protractor	1
39	Sine bar 200 mm	6
40*	Chisel cold flat 1/2"	6
41*	Chisel cross cut 1/4"/6 mm	4
42*	Micrometer outside 0-1"	4
43*	Micrometer inside 2" to 8" can/5 cm to 20 cm	2
44*	Micrometer metric 0-25 mm	1
45*	Micrometer inside 50-200 mm cm	2

46*	Vernier callipers 12"	2
47*	Screw pitch gauge 550 and 60 ⁰	1 each
48*	Wire gauge – imperial standard	1
49*	Dial test indicator	2
50*	Allen keys 1/16" to 1/2" x 1/32"	2 sets
51*	Hammer hide faced	2
52*	Pipe wrench 3" pipe/ 75 mm	2
53*	Plier – combination 8"/20 cm	16 sets
54*	Phillips head screw driver set 1-4 sizes	1 set
55*	Double ended spanners set of 7 without sizes from 1/8" x 3/16" to 1/2" x 9/16"	1 set.

Trade-Maintenance Mechanic (Chemical Plant)
LIST OF EQUIPMENT
FOR UNIT OPERATION LABORATORY

Sl. No.	Description	Quantity
1.*	Venturimeter	1
2.*	Orificemeter	1
3.*	Rotameter	1
4.*	Centrifugal pumps-2 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 filter press	1
23.*	Weighing machine	1
24.*	Multistage compressor fitted with inter-cooler and after coolers	1
25.*	Sieve shaker and sieves	1 set
26.*	Screw Compressor	1
27.*	PLC Kit	1
28.*	DCS Kit.	1
29.*	Gate Valve	1
30.*	Globe valve	1

31.*	Needle valve	1
32.*	Butter fly valve	1
33.*	Non return valve	1
34.*	Ball valve	1
35.*	Solenoid valve	1
36.*	Diaphragm valve	1
37.*	Control valve.	1
38.*	Thermodynamic traps	1
39.*	Reciprocating pump	1
40.	Bearing puller & sleeve Kit.	1
41.	Vacuum pump (water ring/oil ring)	1

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

****Work shop machineries & advanced welding machineries for MMCP may not be required for the Institutes, those having the allied trade like Turning, Milling & Welding.**

Work shop Machineries for MMCP

Sl.	Description	Quantity
1.*	Drilling machine to drill upto ½ "dia.	1
2.*	Lathe-30" between center X 6" centers height with standard accessories	2
3.	Milling machine plain type horizontal	1
4.	Milling machine universal motorized	1
5.	Vertical milling machine motorized	1

Advanced Welding Machineries for MMCP

Sl.	Description	Quantity
1.	TIG Machine	1
2.	MIG Machine	1
3.*	PVC welding torch & required accessories	1

SYLLABUS FOR THE TRADE OF MAINTENANCE MECHANIC
(CHEMICAL PLANT)
UNDER
APPRENTICESHIP TRAINING SCHEME

Period of Training : 3 years

PRACTICAL TRAINING MECHANIC MAINTENANCE (CHEMICAL PLANT):

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.

The syllabus for 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, operations/skills to be taught to the apprentices are indicated under the heading “Basic Training” the remaining operations/skills shown in list should be learnt by the apprentices during the Shop Floor Training as indicated under the heading “Shop Floor 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 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 the 1 year Apprenticeship Training for the Ex ITI trainees in the trade and apprentices who have completed 2 years Basic Training in the Industry are as indicated under the heading “Shop Training”.
- (c) The subject to be taught to the apprentices in Related instruction:
- (1) Trade Theory.
- (2) Workshop Calculation & Science: (a) Physics (b) Mathematics (d) Engineering Drawing (e) Chemistry.

BASIC TRAINING: 2YEARS

1. Introduction in safety precautions as applicable to the trade.
2. Fitting.
3. Turning on various lathes.
4. Welding (gas).
5. Physics
 - Triangle and parallelogram forces.
 - Determination of co-efficient of static friction.
 - Determination of acceleration due to gravity.
 - Determination of mechanical advantage etc.
 - Determination of Young’s Modulus.
 - Determination of co-efficient of friction of solid and liquid.
6. Chemistry:
 - 6.1 Chemical and physical analysis-preparation, study of physical and chemical, properties- organic and inorganic substances.
7. Making out key ways and fitting.

8. Filing, scrapping of seat surfaces and bearing surfaces.
9. Pipe fitting.
10. Uses and maintenance of lagging materials.
11. Dismantling and assembling different types of valves.
12. Fitting, assembling of different types of gears.
13. Study of different types of pumps, compressors, etc.
14. Checking the alignment of shafts and coupling.
15. Fitting of bearings.
16. Fitting of seals.
17. Dismantling, cleaning, repairing and re-assembling machinery.
18. Preventive maintenance.
19. Maintenance of pressure vessels fittings.
20. Use of correct materials devices.
21. Trouble shooting and maintenance.
22. Machinist.
 - Operations on shaping machines.
 - Operations on slotting machines.
 - Operations on milling machines.
23. Welding (Arc).
24. Unit operations (Lab.).
 - Installation of venturimeter, orifice meter and Rota meter.
 - To find out viscosity of a liquid by viscometer.
 - Study of head against capacity curve of a centrifugal pump.
 - To find out rate of evaporation of vertical tube evaporator.
25. Operations of:
 - Plate and frame fitter press.
 - Top-driven centrifuge.
 - Rotary vacuum filter.
 - Hammer mill.
 - Ball mill.
 - Black jaw crusher.
26. Study of multistage compressor.
27. Study of three phase electrical motors, starters, etc.
28. Instrumentation :
 - Calibration of (a) bimetallic thermometer.
 - (b) thermocouple
 - (c) resistance thermometers.
- 28.2 Calibration of Bour dents tube pressure gauge.
 - (a) C – type (b) Spiral (c) Helix
- 28.3 (a) Calibration of hydrometers,
 - (b) Study of quantity meter,
 - (c) Experiments on level measurement.
- 28.4 (a) Calibration of PH meter
 - (b) Study of diaphragm control valve, solenoid valve transmitters and recorders.
- 28.5 Revision and examination.

SHOP FLOOR TRAINING : One year

List of operations in petrol chemicals, heavy chemical, fine chemical, paper and pulp, cement fertilizer and allied industries, pulp and paper.

29. Orientation :

The plant and its product, raw materials need, capacity of production, its hazards. Different sections of the plant including process, maintenance and their activities.

Study of the process and operations carried out in the establishments with the help of simple flow sheet under the guidance of plant-in-charge / supervisory familiarization with the equipment, used in the establishment by actually going round the plant.

Writing brief report (Diary) of day to day work.

Familiarization with utilities and service lines such as steam, water, vacuum, compressed air, refrigeration, air conditioning units etc.

30. Safety :

Cause and prevention of accidents.

Personal safety and use of personal protective equipments.

House keeping.

Fire prevention and fire fighting.

Isolation of equipment and ancillaries prior to handling over to the maintenance section.

31. Maintenance shop :

Fitting of simple parts of machines and equipments such as keys, gland, mechanical seal etc.

Threading pipes, drilling, reaming and tapping blocks.

Expanding tubes in the tube sheet of heat exchanger.

Scraping and bedding of bearing.

Valves lapping.

Pipe fabrication and replacement as per the Blue Print.

Cutting of threads on pipes and rods by dies.

Gas and arc welding on pipes, if available.

PVC welding, if available.

Lead lining and rubber lining, if available.

32. Routine maintenance, preventive maintenance, overhauling and installation, depending on their availability in the industry of the following equipment / material.

Pumps, compressors, blowers, fans and steam ejectors.

Heat exchangers, furnace, kilns.

Evaporators and their accessories.

Distillation and absorption columns.

Material handling and conveying equipments.

Filtration equipments including centrifuges.

Sedimentation, decantation settling equipments and mixers.

Cooling towers and air-conditioning units.

Extractors – extraction and leaching equipments.

Absorption units.

Crystallizers and driers.

Crushing and grinding equipments including screens.

Power transmission – line shaft, clutches reduction gear, coupling etc.
Special equipments such as glass, PVC and rubber lined etc.
Thermal insulation.