**Syllabus for the trade**

**of**

# MAINTENANCE MECHANIC

# (CHEMICAL PLANT)

( SEMESTER PATTERN )

UNDER

CRAFTSMEN TRAINING SCHEME

Designed in: 2013

By

Government of India
Central Staff Training and Research Institute
Directorate General of Employment & Training
Ministry of Labour & Employment
EN -81, Sector-V, Salt Lake City,
Kolkata-700091

**List of the Members of Trade Committee Meeting for the trade of**
**MAINTENANCE MECHANIC (CHEMICAL PLANT)**
**held on** 19th & 20th May 2009 at Industrial Training Institute, Mulund , Mumbai,

| SL NO. | NAME & DESIGNATION S/Shri | REPRESENTING ORGANIZATION WITH FULL ADDRESS | REMARKS |
|---|---|---|---|
| 1. | S.S.Jirimali<br>Manager - Training | HOC Ltd., Rasayani,<br>Dist. Raigad | Chariman |
| 2. | S.M.Sadamate<br>Asstt. App. Adviser (Tech.) | B.T,R.I., Mulund, C/o. J.T.F<br>Mulund, Mumbai | Member |
| 3 | D.N. Waghmare<br>Chief Manager | Piramal Health Care Ltd.,<br>Balkum, Thane-400068 | Member |
| 4 | S.K.Gehari<br>(Skilled Staff S.S) | GSK Pharmaceuticals,<br>2nd Pokhran, Thane | Member |
| 5 | Mali P.N.<br>Training Incharge | Pfizer Ltd., Turbhe Navi<br>Mumbai | Member |
| 6 | Sachin B. Dhoni<br>Executive Engg. | RPG Industries Ltd.,<br>Navi Mumbai | Member |
| 7 | S.K.Sabarai<br>Dy. Manager | M/s. Century Rayon<br>Shahad (Thabe), Maharastra | Member |
| 8 | B.N. Chetan Anand | Amines & Plasticizus Ltd.<br>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 | Piramal Healthcare , Thane | Member |
| 12 | V.I.Raojadeja, Executive (Instrument) | Godrej Indsutries Ltd.Mumbai | Member |
| 13 | M.A.Kamerkar<br>Manager(Factory Admn.) | Mazda Colours Ltd.,<br>Navi Mumbai | Member |
| 14 | D.Mahaboob Basha,<br>Vocational Instructor | Jotun India Pvt. Ltd.<br>Pune | Member |
| 15 | Amogh Soman, Sr. Executive -HR | Jotun India Pvt. Ltd., Pune | Member |
| 16 | Mrs. Deshmukh J.J.<br>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<br>Training Officer | Advanced Trg. Institute,<br>Sion ,Mumbai-22 | Member |
| 22 | S.J. Wakde<br>Trg. officer | Advanced Trg. Institute,<br>Sion ,Mumbai-22 | Member |

***List of members attended the Workshop to finalize the syllabi of existing CTS into Semester Pattern held from 6th to 10th May'2013 at CSTARI, Kolkata.***

| Sl. No. | Name & Designation | Organisation | Remarks |
|---|---|---|---|
| 1. | R.N. Bandyopadhyaya, Director | CSTARI, Kolkata-91 | Chairman |
| 2. | K. L. Kuli, Joint Director of Training | CSTARI, Kolkata-91 | Member |
| 3. | K. Srinivasa Rao,<br>Joint Director of Training | CSTARI, Kolkata-91 | Member |
| 4. | L.K. Muhkerjee,<br>Deputy Director of Training | CSTARI, Kolkata-91 | Member |
| 5. | Ashoke Rarhi,<br>Deputy Director of Training | ATI-EPI, Dehradun | Member |
| 6. | N. Nath,<br>Assistant Director of Training | CSTARI, Kolkata-91 | Member |
| 7. | S. Srinivasu,<br>Assistant Director of Training | ATI-EPI, Hyderabad-13 | Member |
| 8. | Sharanappa,<br>Assistant Director of Training | ATI-EPI, Hyderabad-13 | Member |
| 9. | Ramakrishne Gowda,<br>Assistant Director of Training | FTI, Bangalore | Member |
| 10. | Goutam Das Modak,<br>Assistant Director of Trg./Principal | RVTI, Kolkata-91 | Member |
| 11. | Venketesh. Ch. , Principal | Govt. ITI, Dollygunj,<br>Andaman & Nicobar Island | Member |
| 12. | A.K. Ghate, Training Officer | ATI, Mumbai | Member |
| 13. | V.B. Zumbre, Training Officer | ATI, Mumbai | Member |
| 14. | P.M. Radhakrishna pillai,<br>Training Officer | CTI, Chennai-32 | Member |
| 15. | A.Jayaraman, Training officer | CTI Chennai-32, | Member |
| 16. | S. Bandyopadhyay, Training Officer | ATI, Kanpur | Member |
| 17. | Suriya Kumari .K , Training Officer | RVTI, Kolkata-91 | Member |
| 18. | R.K. Bhattacharyya, Training Officer | RVTI, Trivandrum | Member |
| 19. | Vijay Kumar, Training Officer | ATI, Ludhiana | Member |
| 20. | Anil Kumar, Training Officer | ATI, Ludhiana | Member |
| 21. | Sunil M.K. Training Officer | ATI, Kolkata | Member |
| 22. | Devender, Training Officer | ATI, Kolkata | Member |
| 23. | R. N. Manna, Training Officer | CSTARI, Kolkata-91 | Member |
| 24. | Mrs. S. Das, Training Officer | CSTARI, Kolkata-91 | Member |
| 25. | Jyoti Balwani, Training Officer | RVTI, Kolkata-91 | Member |
| 26. | Pragna H. Ravat, Training Officer | RVTI, Kolkata-91 | Member |
| 27. | Sarbojit Neogi, Vocational Instructor | RVTI, Kolkata-91 | Member |
| 28. | Nilotpal Saha, Vocational Instructor | I.T.I., Berhampore, Murshidabad, (W.B.) | Member |
| 29. | Vijay Kumar, Data Entry Operator | RVTI, Kolkata-91 | Member |

## GENERAL INFORMATION

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| 1. | Name of the Trade | : | **Maintenance Mechanic (Chemical Plant)** |
| 2. | NCO Code No. | : | |
| 3. | Duration | : | 2 years (Four Semesters) |
| 4. | Power Norms | : | 13 Kw |
| 5. | Space Norms | : | 6.00 Sq Meter / Trainee |
| 6. | Entry qualification | : | Passed 10th class examination under 10+2 system of education with Science and Mathematics or its equivalent. |
| 7. | Unit Size (No. of Trainees) | : | 16 |
| 8. | Instructor's/ Trainer's Qualification | : | a) Tenth Class Passed + NTC + NAC |
| | | : | b) Preference will be given to a candidate With Craft Instructor Certificate |

Note : At Least One Instructor must have Degree/Diploma in relevant field

## Syllabus for the Trade of
## "MAINTENANCE MECHANIC (CHEMICAL PLANT)" under C .T.S.
### (Semester Code No. MMC-01)
### SEMESTER – I

| Week No. | Trade Practical | Trade Theory | Engineering Drawing | Workshop Calculation & Science |
|---|---|---|---|---|
| 01 | Induction Training – Familiarization with Institute. Importance of trade training. Introduction out machineries & equipments used in chemical trade work done by trainee. Introduction to safety equipment, first aid & fire lighting equipments and their uses in the section. | 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. | Introduction to engineering drawing. Its relevance to the trade. Use of Drawing Board, Tee-square | Introduction to Chemistry. Atom, molecule element, compound. Physical and chemical change. |
| 02 to 04 | 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. Filing adjoining sides/surfaces maintain the right angle between the sides. Marking of parallel lines using dot punch. Chiselling practice as per marking lines. Filing adjoining sides/surfaces maintain the right angle between the sides. Marking of parallel lines using dot punch. Chiselling practice as per marking lines. | Description, construction and uses of different hand tools such as files, chisels, hacksaw & hammer etc. Description, construction and uses of different marking tools such as steel rule, calliper, punches, v-block, scribing block etc. Description construction and uses of different job holding devices. and their views when viewed perpendicular to their base or axis. . | 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 | Boyle‟s and Charlie‟s Law, gas equation, diffusion, Graham‟s Law of diffusion, effusion, problems Dalton‟ 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. Solution of linear and quadratic equation with one or two unknowns by algebraic calculations and by graphs. |

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| 05 to 06 | Making a job on step fitting (Male & female). Marking out the position of holes for drilling.<br>Use of centre drill for drilling operations. | Description, construction, calculation and uses of different linear measuring instruments such as –vernier calliper, micrometer, bevel protractor, height gauge.<br>Nomenclature and uses of different types of drills & reamers. | | Rest and motion..<br>Electron, Atomic structure proton, neutron, Rutherford‟s and Bohr‟s atom model, Bohr Burry scheme and examples of distribution of electrons.<br>Classification of elements.<br>History, Mendeleett‟s Periodic Law and table, advantages and disadvantages, statement of modern periodic law. |
| 07 to 08 | 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.<br>Grinding practice of chisels and punches etc. Grinding practice of drills, common faults, and their ill effects.<br>Radius filling and fitting (convex & concave) both the parts, checking radius with radius gauge | 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. | Use of set squares/mini drafter and others drawing instruments.<br>Reading and understanding of simple drawing. | S.M.Rotational motion, moment of inertia, simple machines, requirements of good balance.<br>Atomic, molecular and equivalent weight.<br>Definition and examples only.<br>Electronic theory of valency and definition of double and complex salts.<br>Factorization. |
| 09 | Practice of angular filling (male & female part) and fitting of both the parts, checking angle with bevel protector. | Introduction of drilling machine its – types,parts & specifications | Free hand sketching of simple object.<br>Method of fixing sheet on the drawing board, line title of different inch. | Static and kinetic friction their measurement.<br>Elasticity, stress, strain, Hooke‟s Law, different medullae, work done in stretching a wire, determination of young‟s Modulus<br>Law of mass action and chemical equilibrium. Mass law equation, |

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| | | | | relation between $K_C$. & $K_P$. Lechateleir‟s principle and its application to manufacturing processes. Sulphuric acid, ammonia and nitric acid. |
| 10 to 11 | Practice on combination fitting- consisting of step, radius and angle. | | | Mensuration : Area of triangles, rectangle, circle etc. |
| 12 to 13 | Practice on dismantling & assembling different types of bearing & bushes. | | | |
| 14 | Demonstrate about shop safety, safety precaution as applied to section. Introduction, types of work done in the section, lathes 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. | Writing single stroke letters and numbers as per IS:1972 (IInd Revision). Geometrical construction on lines, angles and triangle | Surface tension, surface energy, angle of contact of liquid in a capillary tube, difference of pressure in a spherical bubble. Viscosity, Poiseuille‟s formula. Electrolysis Definition, Faraday‟s Laws and problems. Application of electrolysis. Analytical and industrial – electroplating, electro-extraction of metals, electro-refining of metals. Catalysis. Definition and application. Mathematics: Area of surface of solids like prism, cylinder, cone etc. |
| 15 | 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 | 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. | Geometrical construction on plane curves such as cycloid, involutes, parabola, hyperbola, spiral, helix etc. | Density and specific gravity, Archimedes's principle, principle of floatation hydrometers. Centre of gravity and equilibrium condition. Oxidation, Reduction, Corrosion |

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| | finishing tools. | | geometrical construction on polygons. | - Definition, causes and prevention. Fertilizers Definition Classification importance & examples Area of surface of solids like prism, cylinder, cone etc. |
| 16 to 21 | Drilling on lathe – through and step drilling.. Setting of boring tool in tool post. Plain Boring.<br><br>Taper turning by swiveling, compound rest, and tail stock offset methods. | Drills – construction, types uses of sleeves.<br>Boring tool types. Setting of boring tool.<br>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 | Different types of lines used in engineering drawing as per IS: 696-1972 (latest Revision). Isometric views of simple solid and hollow objects. | 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. |
| 22 to 23 | Exercise on knurling, practice on form turning. | Screw thread purpose and forms. Screw thread terminology. | Orthographic views of simple objects by first angle projection. | Calorimetric General discussion, occurrence, preparation, properties and uses of alkali and alkaline earth metals. Introduction, history of discovery, their position in the periodic table. |
| 24 | Thread cutting (BSW), thread cutting (Metric). | Calculation of change wheel. Calculation of pitch, depth, core dia, pitch dia etc. | --do-- | Volume of solids like prism, sphere, cone etc |
| 25 | Project Work / Industrial Visit (Optional) | | | |
| 26 | Examination | | | |

## Syllabus for the Trade of
## "MAINTENANCE MECHANIC (CHEMICAL PLANT) under C .T.S.
## (Semester Code No. MMC-02)

### SEMESTER – II

| Week No. | Trade Practical | Trade Theory | Engineering Drawing | Workshop Calculation & Science |
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| 01 to 03 | Introduction-importance of trade, types of work done. Demonstrate about general safety, personal safety, & precaution 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. | Orthographic views of simple objects by 3rd angle projection. | Manufacture and the properties of Sodium Hydroxide and Carbonate. Alloys: Preparation properties and uses. Logarithm. Hygrometry |
| 04 to 05 | 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. | Exercises on orthographic view. View of simple solid and hollow object. | Mode of heat transfer. Thermal conductivity and its determination. Laboratory preparation, properties and uses of carbon dioxide, oxygen, hydrogen, sulphur-dioxide, hydrogen sulphide and halogens (chlorine and bromine). Nitrogen, its oxides, fumigation of nitrogen. Logarithms. |
| 06 to 08 | Practice on outside corner Joints-D. Fillet weld-D. Inside corner joint. | 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. | Exercises on orthographic view of simple solid and hollow objects. | Law of thermodynamics thermodynamic processes. Dispersion, Spectrophotometeric polarisation. Workshop Cal. & Science: Allotropy of hydrogen, carbon, phosphorus and sulphur. Acids, |

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| | | | | bases, and salts. Sources, hard and soft water, causes and removal of hardness.<br>Mathematics: Logarithms. |
| 09 to 10 | Practice on Pipe butt joint-D & Pipe T-joint-D. | Oxygen cylinder, DA cylinders, Description methods of charging and care. Faults in gas welding. Definition of faults, their effects, causes, correction. | Exercises on orthographic view of simple solid and hollow objects. | Natural and artificial magnets, their properties and magnetic field.<br>Water for industrial purpose. Preparation properties and uses of aluminium chloride, potassium Ferro and ferricyanide bleaching power.<br>Trigonometry – study of sine, cosine and tangent of angles in a right angle, triangle and their application in solving practical problems |
| 11 to 15 | Practice of hard surface stilting. Brazing of similar metals. Straight cutting by gas. P.V.C. Welding, all types joints on sheets 3mm, 4 mm, 6 mm. P.V.C. Welding pipe, Flange, elbow and T etc. | Hard facing-necessity, types, methods application. Destructive test, stilting-necessity, type flame adjustment-methods and applications. Methods employed to control distortion and stress relieving.<br>Definition of P.V.C., its type properties and uses. Objective, explanation and calculations involved in the experiment. | Exercises on orthographic view of simple solid and hollow objects.<br>Drawing orthographic views, views of nuts, bolts, screws etc.<br>Drawing of different types of thread forms, rivet heads, keys, coupling. | i) To study triangular and parallelogram with the help of mechanical board.<br>Determination of co- efficient of static friction using inclined plane. Determination of acceleration due to gravity by simple pendulum.<br>Determination of mechanical advantage, velocity ratio and efficiency of simple machine<br>Determination of Young‟s Modulus by Searle’s apparatus.<br>Introduction to organic chemistry. Purification processes.<br>Organic reactions. |

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| | | | | 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, Hitro and Sulphonic Acid – cyclic Acyclic compounds. Mathematics: Trigonometry-study of sine, cosine, tangent of angles in a right angled triangle and their application in solving practical problems. |
| 16 to 20 | 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 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 | Objective, procedure, apparatus explanation and calculations involved in the experiments | Drawing of different types of thread forms, rivet heads, keys, coupling. Drawing of different types of riveted joints such as lap and butt joints. | State electricity distribution potential, capacity and condenser. Current electricity, electricity by chemical action cells Separation of mixture of liquids by distillation. Preparation of following – a) soap b) Nitrobenzene Aniline Copper sulphate & Ferrous ammonium sulphate. Aliphatic hydrocarbons, saturate and saturated. i)Methane ii) Ethylene iii) Acetylene Laboratory |

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| | mechanical equivalent of heat using electrical method. | | | 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. 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. |
| 21 to 24 | To study the allotropic forms of sulphur.<br><br>To study the properties of mixtures (FeS) and compound (FeS). | Objective, procedure, apparatus required explanation and calculations involved in the experiments. Objective, procedure, apparatus required explanation and calculations | Drawing of different types of locking devices such as double nut, castle nut, pin etc. Sectional view of simple objects | Magnetic effect of current, electromagnets, Ohm‟s Law. Kirchoff‟s Law. Parallel andseries circuit connections. Wheatstone |

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| | To study action of pure salt water on metals and alloys.<br><br>To study action of acids and bases on metals and alloys. To study corrosion of metals.<br>Volumetric analysis:<br>Qualitative analysis (Inorganic)<br>(Simple without interfering radicals. | involved in the experiments. | such as brackets, bearings etc. | Bridge, potentiometer. Oils and fats. Soaps. 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 Heating, effect of electric current. Electrolysis Polymerisation.<br>Definition and explanation with one or two examples. Rubber plastics and bakelite.<br>Preparation, properties and uses of Oxalic acid<br>Trigonometry – study of sine cosine, tangent of<br>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. |
| 25 | Project work / Industrial visit | | | |
| 26 | Examination | | | |

## Syllabus for the Trade of
## "MAINTENANCE MECHANIC (CHEMICAL PLANT) under C .T.S.
### (Semester Code No. MMC-03)
### SEMESTER – III

| week No. | Trade Practical | Trade Theory | Engineering Drawing | Workshop Calculation & Science |
|---|---|---|---|---|
| 01 | 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).<br><br>Marking out key ways in shafts, using cross out chisel for key ways. Fitting key into the grooves. | 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.<br>Various, types of keys, allowable clearance and tapers, proportion of keys based on dia of shaft. Types and uses of key pullers. | Revision and more exercises on orthographic views of machine parts such as bearing, brackets etc. | Fluid Flow: Pipe–their materials of construction, sizes, methods of joining. Pie fittings. Joints for glass pipe. Expansion joints.<br>Unit Processes:<br>Caustic soda and chlorine process description, flow sheet and uses. |
| 02 | Filling for smoothness of machined surface. Use of Prussian blue for high spots & scrapping. | Scrapers, their uses, type method of scrapping.<br>Tolerance and limits, types of its allowance definition. | Revision and more exercises on orthographic views of machine parts such as bearing brackets etc. | Valves-gate, globe, needle, ball, butterfly etc. – their construction and fields of application, check valves, safety devices, pressure-reducing valve.<br>Unit Processes:<br>Caustic soda and chlorine process description, flow sheet and uses. |
| 03 | 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. | Revision and more exercises on sectional views of machine part. | Valves-gate, globe, needle, ball, butterfly etc. – their construction and field of application, check valves, safety devices, pressure |

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| | | | | reducing valve. Unit Processes: Caustic soda and Chlorine process description, flow sheet and uses. |
| 04 | 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. | Revision and more exercises on sectional views of machine part. | Diaphragm control valve steam traps. Unit Processes: Caustic soda and chlorine process description, flow sheet and uses. |
| 05 | 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. | Free hand sketching of pistons connecting rod, crank shaft, steam chest etc. | Reciprocating pumps and compressors, their working, construction and applications. Unit Processes: Soda ash raw materials, process description flow sheet and uses. |
| 06 | Dismantling, overhauling & assembling of globe valves, gate valves, stop cocks, non return valves, ball valves, needle valves etc. | Construction. | Free hand sketching of pipe joints and fittings | Centrifugal pumps and compressors, their working, construction and applications, vacuum pump. Unit Processes: Soda ash raw materials, process description,flow sheet and uses. |
| 07 | Same as week no. 06 | Construction. | Free hand sketching of pipe joints and fittings. | Blower, fans, steam jet ejector, lift pump. Unit Processes: Soda ash raw materials, process description, flow sheet and uses. |
| 08 | 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. | Free hand sketching of shaft coupling such as butt couplings flanged couplings etc. | Heat transfer, mode of heat transfer, thermal conductivity furriers equation, resistance in series, film coefficient overall film coefficient. Unit |

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| | | | | Processes:<br>Sulphuric acid raw materials, process description, flow sheet and uses. |
| 09 | 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. | Free hand sketching of shaft coupling such as butt couplings flanged couplings etc. | Heat transfer, mode of heat transfer, thermal conductivity furriers equation, resistance in series, film coefficient overall film coefficient.<br>Unit Processes:<br>Sulphuric acid raw materials, description, flow sheet and uses. |
| 10 | Same as week no. 09 | Types of pumps, their construction details and<br>uses. | Free hand sketching of shaft coupling such as butt couplings flanged couplings etc. | Double pipe heat exchanger, different types of shell and tube heat exchanger.<br>Unit Processes:<br>Sulphuric acid raw materials, process description, flow sheet and uses. |
| 11 | Checking the alignment of shaft and couplings of motors, correcting the alignment by using of spirit level & dial gauges. | Causes of mis-alignment, different methods of<br>checking alignment. Effect of mis-alignment on shafts and couplings | Free hand sketching of shaft coupling such as butt couplings flanged couplings etc. | Plate heat exchangers, finned tube exchangers, reaction vessels.<br>Unit Processes:<br>Sulphuric acid raw materials, description, flow sheet and uses. |
| 12 | Fitting and maintenance of compressors blowers, fan, crushers, mixer, pulverisers. | Compressors, blowers, fans, crushers, mixers,<br>pulveriser-their types, construction and uses. | Drawing sketches of different types of valves, such as plug cock, globe valve, gate valve, ball valve etc. | furnaces for solid fuels. Unit Processes:<br>Cement: Raw materials, chemical reaction, process description, flow sheet and uses. Cement: Raw materials, chemical reaction, process description, flow sheet and uses |
| 13 | Fitting of bearings, such as ball bearing, roller bearing, bush | Bearing –their types, construction, uses. | Drawing sketches of different types of valves, | Burners for liquids and gaseous fuels. |

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| | bearing etc. – their care, lubrication and maintenance | | such as plug cock, globe valve, gate valve, ball valve etc. | Unit Processes:<br>Cement: Raw materials, chemical reaction,<br>process description, flow sheet and uses |
| 14 | Fitting of oil seals,<br>checking and replacing of oil seals, removing bearings using bearing pullers. | Different types of lubricating oils their grades and uses. Bearing puller types, and their use. | Drawing sketches of different types of valves, such as plug cock, globe valve, gate valve, ball valve etc. | Kiln: Shaft and rotary, direct fired and indirect fired.<br>Unit Processes;<br>Cement: Raw materials, chemical reaction, process description, flow sheet and uses. |
| 15 | 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 | Drawing sketches of expansion joints and shifting boxes | Kiln: Shaft and rotary, direct fired and indirect fired.<br>Unit Processes:<br>Comment: Raw materials, chemical reaction, process description, flow sheet and uses |
| 16 | Same as week no. 15 | Installation, maintenance and overhauling of machinery and levelling, equipment and alignment of machines. | Exercises on Blue Print Reading | Evaporation: Different types of evaporation<br>and their field of applications.<br>Unit Processes:<br>Soap and glycerine – raw materials, chemical reaction process description, flow sheet and uses. |
| 1 7 | Importance of preventive<br>and routine maintenance, log cards, records of maintenance<br>schedules etc. | Types of maintenance, keeping various records<br>of preventive maintenance, log cards, repair schedules. | Free hand sketching of simple bearing. | Multiple effect evaporation arrangement.<br>Unit Processes:<br>Soap and glycerine – raw materials, chemical reaction process description, flow sheet and uses. |
| 18 | Same as week No. 17 | Same as week No. 17 | Free hand sketching of Primmer block, its details and assemble. | Unit Processes;<br>Soap and glycerine – raw materials, chemical reaction |

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| | | | | process description, flow sheet and uses. Condensers |
| 19 | 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. | Free hand sketching of Primmer block, its details and assemble. | Preparation of steam. Boilers – fire tube and water tube, accessories, scale formation and its removal. Unit Processes: Soap and glycerine – raw materials, chemical reaction process description, flow sheet and uses. |
| 20 | Use of correct materials and locking devices, such as split pin, locknut, spring washer, etc | Purpose of locking devices, locking nuts, types their application. Washers, types, use. | Free hand sketching of Primmer block, its details and assemble. | Preparation of steam, boilers – fire tube and water tube, accessories, scale formation and its removal. Unit Processes: Soap and glycerine – raw materials, chemical reaction process description, flow sheet and uses. |
| 21 | Trouble shooting and maintenance of various equipments like compressors, pumps, valves, blowers, fans etc. | Various types of lifting appliances, extractors' pressure, and their uses. Different methods of getting mechanical advantages | Drawing sketches of jaw crusher, ball mill hammer, centrifuge, heat exchanger, evaporators etc. | Distillation: Introduction, diagram, equilibrium curve, relative volatility Unit Processes: Glass: raw materials, chemical reaction process description, flow sheet and uses. |
| 22 | Trouble shooting. | Handling of heavy machinery precaution to be taken etc. | Drawing sketches of jaw crusher, ball mill hammer, centrifuge, heat exchanger, evaporators etc. | Methods of distillation: flash differential distillation and rectification. Unit Processes: Glass: raw materials, chemical reaction process description, flow sheet and uses. |
| 23 | Machinist General introduction to the shaping machine, | Shaping machine: Working principle, purpose, size and specification,. | Drawing sketches of jaw crusher, ball mill, hammer mill, centrifuge, | Types of distillation column. Unit Processes: Glass: raw materials, chemical |

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| | | | heat exchanger, evaporators etc. | reaction process description, flow sheet and uses. |
| 24 | setting tool in the holder, shaping plain surface by roughing too. | different part and their functions, shaping machine safety | --do-- | --do-- |
| 25 | Project Work / Industrial Visit (Optional) | | | |
| 26 | Examination | | | |

## Syllabus for the Trade of
## "MAINTENANCE MECHANIC (CHEMICAL PLANT) under C .T.S.
**(Semester Code No. MMC-04)**
**SEMESTER – IV**

| week No. | Trade Practical | Trade Theory | Engineering Drawing | Workshop Calculation & Science |
|---|---|---|---|---|
| 01 | Shaping of rectangular block to size and checking up with steel rule, calliper and try square. Marking out for shaping steels, slots etc. | Use of machine vice in shaping machine, methods of holding work in the vice, method of adjusting length and position of strokes. | Drawing sketches of jaw crusher, ball mill, hammer mill, centrifuge, heat exchanger, evaporators etc. | Construction of a bubble cap distillation column with accessories. Instrumentation diagram of a distillation column. Unit Process: Petroleum refining. |
| 02 | General introduction to slotting machines, setting up job on the table. Setting up tool adjustment of stroke slotting rectangular block to size. | Use of slotting machine, different parts and working principles, specification, different method of setting tool, safety in slotting. | Drawing sketches of pumps such as centrifugal, reciprocating and gear pump etc. | Azeotropic & extractive distillation. Unit Process: Petroleum refining. |
| 03 | Marking out for slotting, cutting slot, and grooves. | Driving machine in the slotting machine, common method of holding jobs for slotting. | Drawing sketches of pumps such as centrifugal, reciprocating and gear pump etc. | Construction of a bubble cap, packed and sieve plate distillation column with accessories. Unit Processes: Petroleum refining. |

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| 04 | General introduction to milling machines, setting of vice on the table, plain milling practice. | Milling Machine: Purpose, types and classification, constructional features of milling machine, controls etc. Use of graduated dial | Drawing sketches of pumps such as centrifugal, reciprocating and gear pump etc. | Steam distillation. Unit Processes: Petroleum refining. |
| 05 | Setting work in the vice fixing plain milling cutter on the arbour. Milling rectangular blades to dimensions. | Milling cutters, types, uses of various milling operation, various common holding device used in milling machines | Exercises on Blue Print Reading | Extraction and leaching: Application of liquid-liquid extraction, theory and definitions. Unit Processes: Petroleum refining. |
| 06 | Making rectangular clocks and straight slot cutting according to dimensions with cylindrical cutters and side and face cutters | Driving and feeding mechanism of milling machine. Various common milling operations various common holding devices used in milling machine. | Free hand sketching of spur, helical and bevel gears | Mixer-settler extractor, spray towers, packed towers, sieve tray towers, centrifugal extractors. Unit Processes: Petroleum refining. |
| 07 | Making rectangular clocks and straight slot cutting according todimensions with cylindrical cutters and side and face cutters. | Driving and feeding mechanism of milling machine. Various common milling operations various common holding devices used in milling machine. | Free hand sketching of spur, helical and bevel gears. | Mixer-settler extractor, spray towers, packed towers, sieve tray towers, centrifugal extractors. Unit Processes: Petroleum refining. |
| 08 | WELDING (ARC)Straight linebeads on M.S.Plate. | Different process of metal joining, bolting, revetting, soldering, brazing etc | Exercises on development of simple solids such as prism, cylinder, cone, pyramid etc. | Unit Operation: Leaching, applications, percolation tanks. Unit Processes: Petroleum refining. |
| 09 | Open corner joint M.S. Plate. | Types of joints, classifications, Elementary electricity. Its uses applied to welding. Heat and temperature | -do- | Leaching, applications, percolation tanks. Unit Processes: Petroleum refining. |
| 10 | Fillet weld (M.S.Plate) | Description and use of tools and equipment used in Arc welding. | Exercises on development fracture of simple object like prism, cylinder, cone, etc. | Agitated vessels and oil extraction from oil seeds. Unit Processes: Petroleum refining. |

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| 11 | Outside and inside joints.<br>Single „V" Butt joint. | Types of electric welding metallic, carbon, resistance etc. & application arc length etc. | Exercises on development fracture of simple object like prism, cylinder, cone, etc | Introductory theory and application of absorption.<br>Unit Processes:<br>Petroleum refining. |
| 12 | Fillet lap joint and T joint. | Principle of arc welding types of welding and their advantages.<br>Welding machine care and maintenance. | Exercises on development of turn objects | Different towers and packing, their material of construction and properties, stripping methods of stripping.<br>Unit Processes:<br>Petroleum refining. |
| 13 | Pipe joints, T-butt joints (Square butt) | Electrodes, types, method of coating, flux, characteristic I.S.I. specification | Construction of simple penetration. | Different towers and packing, their material of construction and properties, stripping methods of stripping.<br>Unit Processes:<br>Petroleum refining |
| 14 | Advanced welding (TIG & MIG) with all types of joints | Arc welding defects, causes and effects, how to overcome etc.<br>Distortion and its control. | Exercises on inter-penetration of pipe joints<br>such as elbow, tee, lateral etc. | Unit Operation:<br>Drying: Introduction, different types of dryer.<br>Unit Processes;<br>Petroleum refining. |
| 15 | Practice of different PVC welding process. | Simple estimating involving fabrication, consumption of gas, electrode, length of weld use of hand book and relief tables. | Exercises on inter-penetration of pipe joints such as elbow, tee, lateral etc. | Drying : Introduction, different types of dryer<br>Unit Processes:<br>Petroleum refining |
| 16-17 | Installation of orifice meter, venture meter and rotameter | Orifice taps, construction of orifice meter, venurimeter and rotameter, precaution to be taken during their installation. | Free hand detailed drawing of the components<br>related to the trade taking measurements of the actual parts. | Unit Operation:<br>Filtration: Introduction and different types of filtration equipment. Unit Processes: Paints and varnishes |
| 18 | Making head vs. capacity curve for centrifugal and gear pumps. | Construction of centrifugal and gear pumps, characteristics curves, trouble shooting. Construction of shell | Free hand detailed drawing of the components related to | Centrifugation: Top and bottom centrifuges continuous and semi- |

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| | | and tube exchanger and significance of file co-efficient | the trade taking measurements of the actual parts. | continuous centrifuges Paints and varnishes |
| 19 | 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. | Make working drawing of the above in a suitable scale. | Humidity and Air Conditioning introduction and fundamentals. Unit Processes: Paints and varnishes |
| 20 | Operation of (a) Plate and frame filter press, (b) Top driven centrifuge, and (c) Rotary vacuum filter. | Construction, trouble shooting and applications. | Make working drawing of the above in a suitable scale. | Crystallization: Different types of crystallizers. Unit Processes: Paints and varnishes |
| 21 | Operation of – a) hammer mill b) ball mill c) Blake jaw crusher | Construction, trouble shooting and applications. | Drawing sketches of assembly drawing of the above showing each part in its position, if required in secteral views. | Adsorption: Theory, absorbents and their applications. Unit Processes: Paints and varnishes |
| 22 | Study of multi-stage compressor. Study of three phase, electrical motors, starters. | Theory of compression, Related electrical technology. | Drawing sketches of assembly drawing of the above showing each part in its position, if required in sectional views. | Mixing: Paddles, turbines, propellers, cone and disc. Agitators. Mixing equipments. Unit Processes: Pulp and paper. |
| 23 to 24 | Instrumentation –Calibration of – a) Bimetallic thermometer b) Thermocouple c) Resistance thermometer d )Mercury in glass thermometer.<br><br>Calibration of Bourden‟s tube pressure gauges – a) C-type b) Spiral c) Helix Calibration of vacuum gauge, pressure switch, Study of pneumatic control valve, pressure, | Heat - its mode of transfer, temperature scale, different methods of temperature measurement. Pressure: Definition, its units, different methods of pressure Measurement. Study of vacuum gauge, pressure switch, pneumatic control valve, level controller, flow controller, temperature transmitter / controller, recorders. | working drawing of the above assembly in a suitable scale, showing post list rawing :working assembly in a suitable scale, showing post list material etc. Drawing: working rowing of the above assembly in a suitable scale, showing post list material etc. . | Sedimentation and decantation: colloidal solution, flocculation, Door Thickener. Unit Processes: Pulp and paper. Crushing and grinding different equipment, screening. Unit Processes: Pulp and paper Drying: introduction, vapour pressure curve for water, relative humidity, rate of |

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| | level, flow, temperature transmitter/ controller, recorders. | | | drying, tray drier, rotary drier. Instrumentation diagram of tray drier Pulp and paper |
| 25 | Revision | | | |
| 26 | Examination | | | |

**LIST OF TOOLS AND EQUIPMENT FOR 16 TRAINEES + 0NE**
**FOR THE TRADE OF MAINTENANCE MECHANIC (CHEMICAL PLANT)**

## A. Trainees Tool Kit

| Sl.No | Name of the Item | Quantity |
|---|---|---|
| 1 | Caliper outside spring 6”/15 cm | 17 nos. |
| 2 | Caliper inside spring 6”/15 cm | 17nos. |
| 3 | Divider spring 6”/15 cm | 17nos. |
| 4 | Centre punch 4”/10 cm | 17nos. |
| 5 | Prick punch 6”/15 cm | 17 nos. |
| 6. | Chisel cold flat 1”2.5 cm | 17 nos. |
| 7 | Chisel cross out 3/8” x 1/8“ | 17 nos. |
| 8 | Chisel diamond point 1/8” /10 cm | 17 nos. |
| 9 | Chisel half round 3/8”/10 cm | 17 nos. |
| 10 | Hammer ball pein 1 lb, Handled | 17 nos. |
| 11 | Hammer ball pein ½ lb. handled | 17nos. |
| 12 | Hacksaw frame – adjustable with pistol grip for 8” – 12” blade/20 cm. – 30 cm | 17 nos. |
| 13 | Rule steel 12” English and metric 30 cm | 17 nos. |
| 14 | Screw driver 3” x 3/8” blade | 17nos.nos. |
| 15 | Screw driver 12” x ½ blade | 17nos. |
| 16 | Try Square 6” blade/15 cm | 17nos. |
| 17 | Scriber | 17nos. |
| 18 | Safety goggles | 17nos. |
| 19 | File flat 8 "/20 cm rough | 17nos. |
| 20 | File flat 8 "/20 cm 2nd cut | 17nos. |
| 21 | File round 8mm, 8 "/20 cm length, 2nd cut | 17nos. |
| 22 | File round 10mm, 8 "/20 cm length, 2nd cut | 17nos. |
| 23 | File half round 8 "/20 cm length rough | 17nos. |
| 24 | File half round 8 "/20 cm length, 2nd cut | 17nos. |
| 25 | Box drawing instrument | 17nos. |
| 26 | Protractor celluloid circular | 17 nos. |
| 27 | Scale (Wood) Draughtsman 12”/30 cm | 17 nos. |
| 28 | Set square celluloid $45^{o}$ | 17 nos. |
| 29 | Set square celluloid $60^{0}$ – 10 inch | 17 nos. |
| 30 | Board drawing half imperial size | 17 nos. |
| 31 | Square – T 24 inch blade | 17 nos. |

## B. General Machinery shop outfit (as per the table)

| Sl.No. | Name and Description of item | Quantity |
|---|---|---|
| 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 |

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|---|---|---|
| | (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 withroller 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 :<br>(i) 0 to 11C : 2 Dozen<br>(ii) 0 to 36 C : 1 Dozen<br>(iii) 0 to 250 C : 1 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<br>(a) Resistance box 0 to 100 ohms<br>(b) Resistance box 0 to 500 ohms. | <br>2 nos.<br>2 nos. |

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| 32 | Rheostat :<br>a) Rheostat 25 Ohms<br>b) Rheostat 100 Ohms<br>c) Rheostat 500 Ohms | <br>2 nos.<br>2 nos.<br>2 nos. |
| 33 | Ammeter<br>a) 0 to 1 Amp (DC)<br>b) 0 to Amp (DC)<br>c) 0 to 10 Amp (AC, DC)<br>d) 0 to 30 Amp (AC, DC) | <br>2 sets<br>2 sets<br>2 sets<br>2 sets. |
| 34 | Volt meter<br>a) 0 to 1 volt (DC)<br>b) 0 to 4 volt (DC)<br>c) 0 to 5 volt (DC)<br>d) 0 to 10 volt (DC)<br>e) 0 to 50 volt (DC)<br>f) 0 to 25 volt (DC) | <br>2 sets<br>2 sets<br>2 sets<br>2 sets<br>2 sets<br>2 sets |
| 35 | Millivoltmeter<br>a) 0 to 5 mv<br>b) 0 to 500 mv | <br>2 sets<br>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. |
| 44 | Venturimeter | 1 |
| 45 | Orificemeter | 1no |
| 46 | Rotameter | 1 |
| 47 | Centrifugal pumps-2 Nos. | 2 |
| 48 | Gear pump | 1 |
| 49 | Reynolds experiments equipment | 1 set |
| 50 | Shell and tube heat exchanger | 1 |
| 51 | Boiler | 1 |
| 52 | Vertical tube evaporator | 1 |
| 53 | Packed distillation column | 1 |
| 54 | Packed tower of glass for flooding velocity experiment | I |
| 55 | Plate and frame filter press | I |
| 56 | Top-driven centrifuge | 1 |
| 57 | Rotary vacuum filter | 1 |
| 58 | Tray drier | 2 |
| 59 | Hammer mill | 1 |
| 60 | Ball mill | 1 |
| 61 | Blake jaw crusher | 1 |
| 62 | Mixer-settler type extractor | 1 |
| 63 | Spray extraction tower | 1 |
| 64 | Viscometer | 4 |
| 65 | Lobe blower for filter press | 1 |

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| 66 | Weighing machine | 1 |
| 67 | Multistage compressor fitted with inter-cooler and after coolers | 1 |
| 68 | Sieve shaker and sieves | 1 set |
| 69 | Screw Compressor | 1 |
| 70 | PLC Kit | 1 |
| 71 | DCS Kit. | 1 |
| 72 | Gate Valve | 1 |
| 73 | Globe valve | 1 |
| 74 | Surface plane 12" x 12/30 cm x 30 cm. or .surface plate 24" X 24"/60 cm x 60 cm | 2<br>1 |
| 75 | Scribing block universal 12" x 30 cm | 2 |
| 76 | Marking table 3"x2"x(3" high) | 1 |
| 77 | V-blocks 3"x1-1/4" (pair) with clamps | 2 |
| 78 | Combination set 12" | 2 |
| 79 | File handles | 96nos. |
| 80 | Drill twist (straight shank) 1/8" to ½" by 1/64" (set) | 4 |
| 81 | Telescopic gauges ½" – 6" | 1 |
| 82 | Magnetic indicator and base | 2 |
| 83 | Drill twist ½" to ¾" by 1/16" (Morse taper). | 1 set |
| 84 | Drills twist (Metric) 2mm to 7 mm by 1 mm | 6 sets |
| 85 | Drills twist (Metric) 8mm to 12 mm by 1 mm | 1 set |
| 86 | Drill straight shank wire gauge sizes 1 to 60 with gauge | 1 set |
| 87 | Drills straight shank letter gauge sizes A to Z with gauge | 1 set |
| 88 | H.S.S. hand reamers 3 to 12 mm by 1 mm | 1 set |
| 89 | H.S.S. machine reamers 3 to 19 mm | 1set |
| 90 | H.S.S. machine reamers with M.I. shank 1/8" to ¾" by 1/16" | 1 set |
| 91 | Hacksaw frame adjustable for 8" to 12" blades | 6 |
| 92 | Hand vice 1"/25 mm | 4 |
| 93 | Working bench 6" x 2 ½" with 2 vices 5" jaws | 5 |
| 94 | Working bench 8"x4"x2 ½" with vices 5" jaws | 4 |
| 95 | Almirah | 1 |
| 96 | Tool boxes of drawers fitted in the working bench | 16 |
| 97 | Punch letter set | 1 |
| 98 | Punch figure set | 1 |
| 99 | Taps and dies complete set in box B.A., S.S.F.<br>B.S.U. American and Metric | 1 in each 12 |
| 100 | File flat 12" bastard | 12 |
| 101 | File flat 10" 2nd cut | 12 |
| 102 | File flat 10" smooth | 6 |
| 103 | File three square 6" and cut | 12 |
| 104 | File flat 6" smooth | 2 |
| 105 | Stone oil 6"x 2"x1"/15 cm x5 cm x 2.5 cm | 2 |
| 106 | Can oil ½ pt | 2 |
| 107 | Scraper half round 10"/25 cm | 6 |
| 108 | Scraper half 10"/25 cm | 2 |
| 109 | Scraper hook type 10" handled | 2 |
| 110 | Scraper triangular 10"/25 cm | 2 |
| 111 | Bevel protractor | 1 |
| 112 | Sine bar 200 mm | 6 |
| 113 | Chisel cold flat ½" | 6 |

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| 114 | Chisel cross cut ¼”/6 mm | 4 |
| 115 | Micrometer outside 0-1” | 4 |
| 116 | Micrometer inside 2” to 8” can/5 cm to 20 cm | 2 |
| 117 | Micrometer metric 0-25 mm | 1 |
| 118 | Micrometer inside 50-200 mm cm | 2 |
| 119 | Vernier calipers 12” | 2 |
| 120 | Screw pitch gauge 550 and $60^0$ | 1 each |
| 121 | Wire gauge – imperial standard | 1 |
| 122 | Dial test indicator | 2 |
| 123 | Allen keys 1/16” to ½” x 1/32” | 2 sets |
| 124 | Hammer hide faced | 2 |
| 125 | Pipe wrench 3” pipe/ 75 mm | 2 |
| 126 | Pliers – combination 8”/20 cm | 16 sets |
| 127 | Phillips head screw driver set 1-4 sizes | 1 set |
| 128 | Double ended spanners set of 7 without sizes from 1/8” x 3/16” to ½” x 9/16” | 1 set. |
| 129 | Needle valve | 1 |
| 130 | Butter fly valve | 1 |
| 131 | Non return valve | 1 |
| 132 | Ball valve | 1 |
| 133 | Solenoid valve | 1 |
| 134 | Diaphragm valve | 1 |
| 135 | Control valve. | 1 |
| 136 | Thermodynamic traps | 1 |
| 137 | Reciprocating pump | 1 |
| 138 | Bearing puller & sleeve Kit. | 1 |
| 139 | Vacuum pump (water ring/oil ring) | 1 |
| .140 | Drilling machine to drill upto ½ "dia. | 1 |
| 141 | Lathe-30" between center X 6" centers height with standard accessories | 2 |
| 142 | Milling machine plain type horizontal | 1 |
| 143 | Milling machine universal motorized | 1 |
| 144 | Vertical milling machine motorized | 1 |
| 145. | TIG Machine | 1 |
| 146 | MIG Machine | 1 |
| 147 | PVC welding torch & required accessories | 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