Syllabus for the trade

of

ATTENDANT OPERATOR (CHEMICAL PLANT)

(SEMESTER PATTERN)

UNDER

CRAFTSMAN 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
ATTENDANT OPERATOR (CHEMICAL PLANT)
held on 19th & 20th May 2009 at Industrial Training Institute, Mulund , Mumbai, Maharashtra

SL NO.	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, 2nd Pokhran, Thane	Member
5	Mali P.N. Training Incharge	Pfizer Ltd., Turbhe Navi Mumbai	Member
6	Sachin B. Dhoni Executive Engg.	RPG Industries Ltd., Navi Mumbai	Member
7	S.K.Sabarai Dy. Manager	M/s. Century Rayon Shahad (Thabe), Maharastra	Member
8	B.N. Chetan Anand	Amines & Plasticizus Ltd. Thane, Maharastra	Member
9	A.N.Manchar Kar, Sci. Demonstrator	B.T.R.I. Mulund	Member
10	Takalkar E.S., Chemical Instructor	B.T.R.I. Mulund	Member
11	S.P. Pradhan, Manager Process Control	Piramal Healthcare , Thane	Member
12	V.I.Raojadeja, Executive (Instrument)	Godrej Indsutries Ltd.Mumbai	Member
13	M.A.Kamerkar Manager(Factory Admn.)	Mazda Colours Ltd., Navi Mumbai	Member
14	D.Mahaboob Basha, Vocational Instructor	Jotun India Pvt. Ltd. Pune	Member
15	Amogh Soman, Sr. Executive -HR	Jotun India Pvt. Ltd., Pune	Member
16	Mrs. Deshmukh J.J. Trade Instructor (Science)	B.T.R.I., Mulund	Member
17	Mr. P.S.Wagh	Principal, ITI., Mumbai	Member
18	L.K.Mukherjee,Dy. Director	CSTARI., Kolkata	Member
19	A. Nandi, Dy. Director	CSTARI., Kolkata	Member
20	P.K.Roy, Dy. Director (Chem)	ATI., Mumbai	Member
21	K.K.Phadris Training Officer	Advanced Trg. Institute, Sion ,Mumbai-22	Member
22	S.J. Wakde Trg. Officer	Advanced Trg. Institute, Sion ,Mumbai-22	Member

List of members of Trade Committee meeting for the Trade of Attendant Operator (Chemical Plant) 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, Joint Director of Training	CSTARI, Kolkata-91	Member
4.	L.K. Muhkerjee, Deputy Director of Training	CSTARI, Kolkata-91	Member
5.	Ashoke Rarhi, Deputy Director of Training	ATI-EPI, Dehradun	Member
6.	N. Nath, Assistant Director of Training	CSTARI, Kolkata-91	Member
7.	S. Srinivasu, Assistant Director of Training	ATI-EPI, Hyderabad-13	Member
8.	Sharanappa, Assistant Director of Training	ATI-EPI, Hyderabad-13	Member
9.	Ramakrishne Gowda, Assistant Director of Training	FTI, Bangalore	Member
10.	Goutam Das Modak, Assistant Director of Trg./Principal	RVTI, Kolkata-91	Member
11.	Venketesh. Ch. , Principal	Govt. ITI, Dollygunj, 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, 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

1. Name of the Trade : **ATTENDANT OPERATOR (Chemical Plant)**
2. NCO Code No. :
3. Duration : Four Semesters
4. Power Norms : 13 Kw
5. Space Norms : 6.50 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 Painter General or relevant trade

   : b) Preference will be given to a candidate With Craft Instructor Certificate

Note : At Least One Instructor must have Degree/Diploma in paint technology / surface technology

GENERAL INFORMATION

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

Syllabus for the Trade of
"ATTENDANT OPERATOR (Chemical Plant)" under C.T.S.
(Semester Code No. AOC-01)

SEMESTER – I

Week No	Trade Practical	Trade theory	Engg. Drawing	Workshop cal. & science.
01	Fitting Induction Training: Familiarization with Institute. Importance of trade training. Introduction about machineries & equipments used in chemical trade & work done by trainee. Introduction to safety equipment, first aid & fire fighting equipments and their uses in the section.	Introduction to general safety, personal safety, electrical safety & general precautions observed in the workshop. Fire prevention and fire control in chemical industries. Study of personal protection equipments (PPEs) used in chemical plant. First aid in chemical plant. Environmental pollution, sources, causes, consequences and controls. Role of attendant operator in the Chemical Industries	Introduction to engineering drawing. Its relevance to the trade. Use of drawing board, T-Square.	Introduction to Physics Introduction to Chemistry, atom. Molecule element, compound. Physical &. Chemical change. Introduction Linear measurements and its units.
02	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 5alliper, surface gauge, engineers" try square, marking off table etc.	Introduction and use of job holding devices & marking tools in the fitting shop. Description and specification to different types of hammer. Surface gauge its description & construction. Use and care of V –Blocks, Marking table, Try Square, Hacksaw frame & Blades, universal scribing block etc.	Free hand drawing of straight lines. Rectangles. Squares. Circles. Polygon etc.	Units and dimensions. Vernier 5alliper. Spherometer, micrometer, screw gauge, scalar and Vector quantities. Their representation resultant. Parallelogram and triangle of vector. Gas Laws. Boyle's and Charles law, gas equation diffusion, Graham's law of diffusion, effusion, problems. Dalton's Law of partial pressure. Introduction to radio-activity alpha, beta and gamma rays and their properties, radioactive changes alpha ray and beta ray change, group displacement law, definition of isotopes and isobars. Solution of linear & quadratic equation with one or two unknowns by algebraic calculations and by graphs.
03	Filing flat surface and checking the flatness and squareness with	Files-their types, grades, cut, convexity, specifications, their use and	Free hand drawing of simple objects	Same as Week No.2

	engineers try square. Filing four edges, checking all dimension with outside calliper and steel rule	care. Chisel its type & uses.	such as cube, rectangular blocks, cylinder, cones etc. and their views.	
04	Filing adjoining sides/surfaces maintain the right angle between the sides. Marking of parallel lines using dot punch. Chiselling practice as per marking lines.	Study of angle plate, parallel blocks, surface plate& their uses. Drill – types, nomenclature, specification, and their functions.	Use of set squares/mini drafter and other drawing instruments. Method of fixing a drawing sheet on the board. Layout of drawing sheet (Borderline title block etc.) Use of different scales mm., inch	Same as Week No.2
05	Same as Week No.4	Same as Week No.4	Same as Week No.4	Rest and motion. Equation of Motion, motion under gravity, in a circle with constant angular velocity and acceleration. Work, power and energy. Atomic structure, electron, proton, neutron, Rutherford's and Bohr's atom model, Bohr Burry Scheme and examples of distribution of electrons. Classification of elements. Modern Periodic law, table and periodic properties,
06	Making a job on step fitting (Male & female). Marking out the position of holes for drilling. Grinding of drill bits. Use of centre drill for drilling operations.	Common faults on drill grinding and it"s effect on drilling. Study of drill chuck, drifts, sleeves etc. Introduction of drilling machine its – type, parts & specification.	Types of lines, letter writing in single stroke, dimensioning	same as Week 05
07	Same as week no.6	Same as week no.6	Same as week no.6	S.M. Rotational motion, moment of inertia. Simple machines, requirements of a good balance. Atomic, molecular and equivalent weight (Definition & examples only). Electronic theory of valence Introduction of normal, double and complex salts. Factorization

08	Marking the job using height gauge. Practice of through & blind hole drilling to a specific depth. Practice of enlarge-ment of drill holes, countersinking, counter boring, spot facing and reaming etc.	Principle, construction and calculation of least count of vernier 7alliper, inside & outside micrometer, bevel protector, vernier height gauge. Uses, care and error adjustment of measuring instruments. Calculation of tap drill size.	Same as week No.7	Same as week No.7
09 to 11	Grinding practice of drills, chisels and punches etc. Practice of drilling, tapping and dieing of BSW, and metric threads for various sizes. Practice of radius (convex & concave) filing, checking with radius gauge.	Same s week No.7	Free hand sketches of simple objects.	Static and Kinetic friction their Measurement . Elasticity , stress, strain , Hooks Law. Different Moduli , work done in stretching a wire, Determination of Young's Modulus Law of Mass action Factorization
12	Practice of angular filling checking with bevel protector	Calculation of drilling speed, feed, drilling time etc. Concept of interchangeability system (limit, fits & tolerances).	Geometrical constructions	Surface Tension, surface energy, Angle of contact. Rise of liquid in a capillary tube, different of pressure in a spherical bubble. Viscosity, Poiseuile's formula. Electrolysis Catalysis Area of surface of solids like prism, cylinder, Cone etc.
13	Turning: Introduction, types of work done in the section. Lathe – its parts and functions Checking for proper running, cleaning and oiling of various parts of machine. Practice for setting of tools in tool post in correct centre height. Grinding practice of rough turning tool. Facing & plain turning practice by holding the job on four jaw chuck.	Study of general safety, personal safety, electrical safety, working safety while working on lathe machine. Lathe-its construction, cleaning and oiling. Lathe chucks – types, construction and uses. Common lathe cutting tools types, shapes and different angles.	Geometrical construction of lines, angles and triangles.	Same as Week No.12
14	Same as week no. 13	Same as week no. 13	Same as week no. 13	Density and specific gravity Archimedes's principle, principle of floatation hydrometers. Centre of gravity and equilibrium condition.

15	Practice of centre drilling. Step turning holding the job between centres. Inspection of dimensions using proper measuring instruments.	Lathe, Accessories, such as centre mandrel, collets, catch plate, lathe dog, face plate, lathe steady etc. their uses and care.	Geometrical construction of regular polygons	Same as Week No.14 Same as Week No.12 Inorganic Chemistry : (Physics and Chemistry) Oxidation-Reduction Corrosion- causes & effect prevention.
16	Same as Week No.15	Same as Week No.15	Same as Week No.15	Temperature and its measurement. Expansion of solids, liquids and gases. Metallurgy – General Principle and processes Metallurgy of Copper, aluminium Zinc, Iron & Steel. Volume of solids like prism, sphere, cone etc.
17	Grinding of finishing tool. Practice of finish turning with in the 0.02mm accuracy. Drilling on lathe – drilling through and blind holes.	Common lathe cutting tools – roughing, finishing, grooving, undercut, thread cutting, knife and recessing tool etc. Cutting tool materials. Coolants and Lubricants – their types and uses.	Geometrical construction on plane curves such as cycloid, inviolate, parabola, hyperbola, spiral helix etc.	: Same as Week No.I6
18 & 19	Setting boring tool in tool post. Boring – plain, step & enlargement. Taper turning by swivelling compound rest, tail stock off set method.	Boring tool & its types. Setting of Boring tool. Tapers its types, uses & calculation methods. Different taper turning methods Advantages and disadvantage of tailstock offset method.	Different types of lines uses in engineering drawing as per BIS 696-1972 (Latest Revision)	Calorimetric, change of state 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. Volume of solids like prism sphere, cone etc.
20 to 22	Turning gear blanks with mandrels, knurling practice. Practice of (BSW) & (Metric) thread cutting on lathe. Measurement of thread & its profile.	Knurling tool-types and its uses. Screw thread terminology. Gear Screw thread purpose and forms. Screw thread terminology. Gear calculation for thread cutting, change wheel. Thread measurement	Isometric views of simple solid and hollow Object. Orthographic views of simples objects by 1st angle projects.	Hygrometry Manufacture and the properties of sodium hydroxide and carbonate. Alloys: Preparation properties and uses. Logarithms
23 & 24	Welding- Gas : Introduction-Importance of trade, types of work done. Demonstrate about general safety, personal safety, & precautions observed during gas welding.	Introduction to general safety, personal safety, & precautions observed in the gas welding workshop. Fire prevention and fire control in gas welding workshop. Importance of welding in the maintenance	Orthographic views III angle projection	Same as week No.22

	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.	of chemical plant and equipment's. Description and uses of tools and equipment's used. Welding terms and their definitions		
25	Project Work / Industrial Visit (Optional)			
26	Examination			

Syllabus for the Trade of
"ATTENDANT OPERATOR (Chemical Plant)" under C.T.S.
(Semester Code No. AOC-02)
SEMESTER - II

Week No	Practical	Trade theory	Engg. Drawing	Workshop cal. & science.
01 to 02	Practice of edge joint with or without filler rod.	Welding methods and types of welding, welding terms and definitions. Common used gases in welding - Oxygen, Hydrogen, Acetylene, $C0_2$ gas etc.. Colour coding of gas cylinders for identification. Chemistry and types of flame.	Exercises on orthographic view of simple solid and hollow objects	Mode of heat transfer. Thermal conductivity and its determination.
03 to 04	Practice on outside corner joints – D, fillet weld-D, inside corner joint.	Introduction to oxy-acetylene welding and its equipments such as regulators, blow pipes etc. Assembly, care and maintenance of gas welding equipments.	Same as week no, 02	Law of thermodynamics Allotropy of hydrogen, carbon, phosphorus and Sulphur, Acids, bases and salts water Sources, hard and soft water, causes and removal of hardness ,dispersion
05	Practice on pipe butt joint - D, pipe T Joint - D	Oxygen cylinder, DA cylinder, description, method of charging and care faults in gas welding, definition of faults, their effect causes and correction.	Same as Week No. 03	Same as week No.03
06	Same as week No. 05	Same as week No. 05	Same as week No. 03	Natural and artificial magnets, their properties and magnetic field. Water for industrial purpose Preparation properties and uses of aluminium chloride potassium, Ferro and Ferric cyanide bleaching powder. Trigonometry- study of sine, cosine, tangent of angles in a right angled triangle & their application in solving, practical problems
07 to 08	Practice of hard surface stilting., Brazing of dissimilar metals Practice in gas cutting for various metal thicknesses..	Hard surfacing-necessity, types methods, application. Destructive test, stilting necessity Type- Flame adjustment, methods and application, methods employed to control distortion and stress relieving.	Same as week No. 3	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. Introduction to organic chemistry, Purification

				processes Organic reaction Substitution, addition (Polymerization). Elimination and rearrangement reactions. Explanation and example Nomenclature LU.P.A.C. and commons system. Classification & Functional Groups. Halo, Hydroxyl, Formal, Carbonyl, carboxyl Amino, Hetro and sulphuric acid Cyclic Acyclic compounds.
09 to 10	P.V.C. welding - practice all types of welding joints- sheet thickness of 3 mm, 4mm, P.V.C Welding– pipe, flange, elbow, Tee etc.	Definition of PVC its type properties and Uses. Water Analysis	Drawing orthographic views of nuts bolts etc.	Same as Week No 8
11 to 12	:Turbidity meter	Objective, procedure, required, explanation and calculations involved in the experiments.	Drawing of different types of thread forms, rivet heads. Keys, coupling	To study triangular and parallelogram of forces with the help of mechanical board.. Determination of coefficient of static friction using inclined plane. Determination of mechanical advantage velocity ratio and % efficiency of simple machine. Determination of acceleration due to gravity by simple pendulum. Determination of Young's Modulus by Seattle's apparatus.
13 to 14	Determination of coefficient of expansion of solid and liquid. Determination of coefficient of Thermal Conductivity of metal rod. Determination of rotation constant of optically active substance by a polarimeter.	Same as Week No. 11	Same as Week No.11	Static electricity - distribution of charge, Potential, capacity and condenser. Current electricity- electricity by chemical action cells. Definition, classification and problems on law of fluid heat transfer, evaporation, transmission of power etc Aliphatic hydrocarbons, saturated and unsaturated (i) Methane ii) ethylene iii) Acetylene
15 to 16	(i) To study Ohm's law and Kirchhoff's law about current and voltage. To study electric cell using series and parallel connections. Determination of specific resistance	Objective, procedure, required, explanation and calculations involved in the experiments.	Same as week no. 37	Laboratory preparation properties and uses. Composition refining cracking and explanation of octane no., flash point calorific value, fire point, viscosity & sulphur contents. Halogen compounds of aliphatic hydrocarbons.

	using wheat stone's Bridge. Verification of faraday's First law of electrolysis. Determination of mechanical equivalent of heat using electrical			Carbon tetrachloride, chloroform, preparation properties and uses Aliphatic acids
17	Chemistry: Separation of mixture by Distillation	Objective, procedure, required, explanation and calculations involved in the experiments.	Drawing of different types of locking devices such as double nut castle nut, pin etc.	Static electricity - distribution of charge, Potential, capacity and condenser. Current electricity- electricity by chemical action cells.
18	Preparation of the following (a) Soap (b) Nitrobenzene (c) Aniline (d) Copper sulphate (e) Ferrous ammonium & sulphate.	Objective, procedure, required, explanation and calculations involved in the experiments.	Drawing of different types of locking devices such as double nut castle nut, pin etc.	Definition, classification and problems on law of fluid heat transfer, evaporation, transmission of power etc Aliphatic hydrocarbons, saturated and unsaturated (i) Methane (ii) ethylene (iii) Acetylene
19	To study the allotropic forms of sulphur.	Objective, procedure, required, explanation and calculations involved in the experiments.	Drawing of different types of thread forms, rivet heads. Keys, coupling	Static electricity - distribution of charge, Potential, capacity and condenser. Current electricity- electricity by chemical action cells. Definition, classification and problems on law of fluid heat transfer, evaporation, transmission of power etc Aliphatic hydrocarbons, saturated and unsaturated (i) Methane (ii) ethylene (iii) Acetylene
20	To study the properties of FeS mixture and FeS compound.	- Do -	- Do -	- Do -
21	To study action of pure salt water on metals and alloys	- Do -	- Do -	- Do -
22	To study the corrosion of metals. To study action of acids and bases on metal alloys Analysis and Treatment of Effluent Water	- Do -	- Do -	- Do -

23	.COD apparatus (Chemical oxygen demand) 2. BOD apparatus (biochemical oxygen demand) 3. TS analyser (Total solid)	- Do -	- Do -	Heating effect of electric current. Electrolysis. Workshop Calculation and Science : Polymerization, Rubber, plastics and Bakelite Preparation properties and uses of oxalic acid, ethyl alcohol, Nitrobenzene, aniline, acetylene. Mathematics : Same as Week No. 39.
24	Volumetric analysis. Qualitative analysis (Inorganic) (Simple without interfering radicals) Determination of Flash point. Determination of pH (by Lovibond). Lovibond Comparator	- Do -	- Do -	Heating effect of electric current. Electrolysis. Workshop Calculation and Science : polymerization, Rubber, plastics and Bakelite Preparation properties and uses of oxalic acid, ethyl alcohol, Nitrobenzene, aniline, acetylene.
25	Project work / Industrial visit			
26	Examination			

Syllabus for the Trade of
"ATTENDANT OPERATOR (Chemical Plant)" under C.T.S.
(Semester Code No. AOC-03)
SEMESTER - III

Week No	Practical	Trade theory	Engg. Drawing	Workshop cal. & science.
01	Introduction to safety equipments and their uses related to chemical plant. Awareness of first aid, fire fighting equipments and hydrant system, material safety data sheet (MSDS), good manufacturing practices, Personal Protective Equipments (PPEs). Review the operation covered in the first year	General safety: Introduction & importance of safety &. General precautions observed in the chemical plant. Fire prevention and fire control in chemical industries. Study of personal protection equipments (PPEs) used in chemical plant. First aid in chemical plant. Introduction to occupational health hazard. environmental pollution, sources, causes, consequences and controls and good manufacturing practices. Role of attendant operator in the Chemical Industries. Review the connected theory covered in the 1st year. Introduction to different sizes of pipes, flanges, allows, sockets, plugs, squares reducers, trees etc.	Orthographic views of machine parts such as bearings, brackets etc.	Pipes: Methods of joining them, expansion joints. Unit Process: Salts from sea water: Process description and flow sheet.
02	Cutting, threading, bending, and fitting of pipes as per drawing. Making different types of pipe joints such as screwed and flanged etc	Bending method, different types of pipes joints. Bending fixtures, standard pipe threads, taps and dies for pipe threads.	Same as Week No.01	Valves, safety devices, diaphragm control valve steam trap. Unit Process : Soda-ash: Process classification, raw materials, chemical reaction process description, flow sheet and uses.
03	Use and maintenance of lagging materials such as glass wool, asbestos, magnesia, thermocole, aeroflex etc. 1.Bernoulli's equation apt. 2.Inclined manometer. 3.U-tube manometer.	Lagging materials types and uses.	Same as Week No.01	Reynold"s number, viscosity, manometer, Bernoulli's equation. Unit Process: Same as Week No. 02
04	Dismantling, overhauling & assembling of globe valves, check valves, needle valves, diaphragm valves, ball valves, stop cock,	Construction, working and uses of various types of valves.	Sectional views of machine.	Application of the Bernouli"s equation in pump, compressor, venturimeter orifice meter, flow nozzle, quantity meters. Unit Process :Caustic

	butterfly valves, non return valve etc. 1.Flow nozzle 2.Quantity meter			soda and chlorine: Process classification, raw materials, chemical reaction, process description, flow sheet and uses
05 to 06	Same as Week No. 04 1.Model of spur gear, helical gear, bevel gear. 2. Reduction gear box mechanism	Types of gears, e.g. spur, helical, bevel, their uses and their advantages, and disadvantaged.	Same as Week No. 04	Same as Week No. 04
07	Dismantling, overhauling & assembling of different type of gears, gearboxes (reduction gear box) etc.	Different types of pumps, construction details and their uses	Same as Week No. 04	Pumps-positive displacement and centrifugal
08	Dismantling, overhauling & assembling of different type of pumps such as positive displacement 1.Steam jet ejector model. 2.Lift pump	Causes of misalignment, different methods of checking alignment. Effect of misalignment of shafts, coupling and bearings.	Free hand sketching of parts such as pistons. connecting rod, crank shafts, steam chest etc.	Compressor and vacuum pumps steam jet ejection, lift pump. Unit Process : Sulphuric acid: Process classification, raw materials, chemical reaction, process description flow sheet and uses
09 to 10	Study of different types of compressor their maintenance and trouble shooting of centrifugal, reciprocating, multistage, screw compressors, blowers & fans.	Construction & working of different types of compressor, blowers & fans.	Same as Week No. 10	Modes of heat transfer, thermal conductivity. Fourier's equation Resistance in series plane and round surface. Unit Process : Same as Week No. 10
11to 12	Checking lignment of shafts and coupling of motors, correcting alignment, use of dial gauges. Models of ball bearing, roller bearing, bush needle bearing. Dial guage for alignment testing.	Bearing (their types, construction and uses, such as ball, roller, bush needle bearing etc. their care and maintenance	Free hand drawing of pipe joints and fittings.	Film co-efficient, overall film co-efficient, factors affecting heat transfer co-efficient. Unit Process: Ammonia and complex Fertilizer: process classification, process description with flow sheet, definition of fertilizers and their types
13	Fitting of bearings such as ball bearings, roller bearings, bush bearings etc., their care, lubrication and maintenance.	Use of correct material and locking device such as split pin, lock nut, spring washer, taper washer etc.	Free hand drawing of shaft couplings and flanged etc.	Same as Week No. 11
14	Same as Week No. 13	Same as Week No. 13	Same as Week No. 13	Co-current and counter current

				heat exchanger, double pipe, shell and tube heat exchanger. Plate and finned type exchanger Unit Process : Same as Week No. 12
15	Welding (Arc) Practice on straight line welding beads on MS Plate. Aerobic digestor	Different processes of metal joining, bolting,riveting, soldering, brazing etc. welding terms and their definition	Drawing different types of pipeline diagram, pipe fitting symbols	Nitric acid: Process classification, process description with flow sheets and concentration.
16	Practice on open corner joint on M.S. Plate. Aerobic digestor	Types of joints, classification, use Elementary electricity. Its uses applied to welding. Heat and temperature.Various model of boilerwith simulation	Same as Week No15	Furnace for solids, liquid and gaseous fules using air and steam as mixing fluids. Unit Process: Urea and other fertilizer: process classification, process description with flow sheets
17	Practice on Fillet weld (M.S. Plate) Anaerobic digestor	Description and use of tools and equipment used in arc welding	Free hand drawing of valves-gate, glove plug cock, ball, needle diaphragm and control valves.	Kiln-shaft and rotary (direct and indirect fired). Unit Process : Same as Week No. 16 Evaporation: Horizontal, vertical tube, forced circulation and falling film evaporators. Unit Process : Same as Week No.16
18	Practice on outside corner joints. Anaerobic digestor	Environmental theory	Same as week no. 17	Multiple effect evaporation Methods of feeding in a multiple effect evaporator, steam economy. Unit Process : Class: process classification process description with flow sheet.
19	Practice on single 'V' butt joint. Aeration Unit	Principle of arc welding, types of welding	Drawing sketches of expansion joints and stuffing boxes.	Condensers-contact and surface condense removal.

20	-do-	. Types of welding machines, care and maintenance	Same as Week no. 19	Instrumentation of an evaporator. Unit Process
21	Practice on fillet lap joint and T-joint. Aeration Unit	Advantaged on one over the other. Electrodes, types, method of coating, flux characteristic I.S.I. specification	Same as Week no. 19	Properties of steam, Boilers-fire tubes, water tube, forced circulation, accessories.
22	-do-	--do-	Same as Week no. 19	Water treatment. Unit process : Same as Week no.20
23	Pipe T joints, Butt joints (square butt) Aeration Unit	Arc welding defects, causes and effects, how to overcome. Distortion and its control. Principle of PVC welding.	Same as Week no. 19	Cement: definition of cement and its type, process description with flow sheet.
24	--do--	Simple estimation on fabrication - involving consumption of gasses, electrode, length of weld. Use of hand book and reference tables	Same as Week no. 19	-do-
25	Project work / Industrial visit			
26	Examination			

Syllabus for the Trade of
"ATTENDANT OPERATOR (Chemical Plant)" under C.T.S.
(Semester Code No. AOC-04)
SEMESTER - IV

Week No	Practical	Trade theory	Engg. Drawing	Workshop cal. & science.
01	Flow measurement and calibration of venturimeter, orifice meter and rotameter. (ii) Determination of viscosity of a liquid by viscometer.	Construction and working of venturimeter, orifice and rota meter. Viscosity and its role	Exercises on blue print reading	Iron & Steel: Process description with flow sheet. Definition of steel and its types.
02	Study of DCS system. Study of PLC.	Introduction to DCS system. Introduction to PLC.	: Same as week No. 01	: Same as week No. 01
03	Study of head against capacity curve of centrifugal pump	Theory related to practical : Procedure of conducting the experiment, calculation and precautions to be observed.	Free hand sketching of simple bearing blocks.	Distillation: Introduction, boiling point diagram, equilibrium curve, relative volatility. Unit process : Same as week No. 01
04	Study of head Vs. capacity curve of a gear pump.	Same as week No. 03		Same as week No. 03
05	To determine Reynolds's number at different velocities. PUMPS 1.Metering Pump. 2.Screw pump. 3.Air Operated pump. 4.Paralastic pump	Theory related to practical : Procedure of conducting the experiment, calculation and precautions to be observed	Drawing sketches of pumps centrifugal, gear plunger, sliding vane and water ring vacuum pump	Methods of distillation flash, differential, rectification. Unit process : Aluminum: Process description with flow sheet and uses
06	To determine friction losses in a straight pipe, pipe fitting, valve. Friction Through Pipe & Pipe joint apparatus.	Theory related to practical	Same as Week No. 05	Rectification and Variables affecting rectification, reflux ratio and its importance, types of distillation columns. Unit process : Same as Week No.03
07	Calculation of overall heat transfer, coefficient for a shell and tube heat exchanger.	Theory related to practical	Engineering Drawing : Same as Week No. 05	Petroleum & petroleum refining crude oil & its origin and classification distillation of crude, unit process involved properties of petroleum products
08	To find rate of evaporation of a vertical tube	Theory related to practical	: Same as Week No. 05	Petroleum & petroleum refining crude oil & its origin and classification distillation of crude,

	evaporator. Petroleum: Model of plant simulator			unit process involved properties of petroleum products
09	Separation of binary liquid mixture by distillation using packed tower.	Theory related to practical	Drawing sketches of steam jet ejectors, and steam traps	Same as Week No. 08
10	Flooding velocity experiment using a packed glass column.	Theory related to practical	Free hand sketches of different types of shell and tube heat exchanges.	Unit operation :Azeotropic, extractive and steam distillation Unit process : Same as Week No. 08
11	Finding rate of drying curve by tray drier. Distillation column with all instrumentation Accessories (DCS, PLC based	Theory related to practical	Same as Week no. 10	Instrumentation diagram of distrilation column. Unit process : Same as Week No.08
12	Operation of : (i) Plate and frame filter press (ii) Rotary drum vacuum filter. (iii) Top driven centrifuge (iv) Blake jaw crusher (v) Hammer mill (vi) Ball mill (vii)To carry out sieve analysis with a sieve shaker.1. Cyclone separator. 2.Bottom driven centrifuge	Construction, principle, trouble shooting and precaution to be observed during operation of the equipment.	Diagram of distillation column with all accessories	Extraction and leaching application of liquid-liquid extraction, theory, definition, choice of solvent, distribution coefficient. Unit process : Same as Week no.08
13	(i) Operation of a mixer settler (ii) Operation of a spray extraction tower.	Same as Week No.12	Free hand sketches of extractors	Extractors : single and multistage mixer settler, counter current, Centrifugal Towers : spray, packed and sieve. Unit process : Calcium carbide: manufacture with flow sheet.
14	Operation of a multistage compressor. Study of electrical technology such as three phase supply induction motor, starters etc.	Same as Week No.12	Free hand sketches of evaporators	Sugar: manufacture and refining with flow sheet. Hydrogenation of oils, Pulp and paper: definition of pulp and its type & manufacture with flow sheet. Recovery of chemicals from black liquor, Def. of paper & its manufacture with flow sheet.
15	Cooling tower.	Procedure of conducting,	Free hand sketches of Cooling tower	-do-

		experiment. Calculation and precautions to be observed for mixer settler and spray extraction tower.		
16	Instrumentation Calibration of(i) Bourden tube pressure gauges (ii) Manometers Absorption and stripping unit.	Theory related to practical	Free hand sketches of crushers, ball mill, hammer mill and centrifuges.	Leaching : Application and different types of equipment uses for leaching oil extraction from oil seeds.
17	Calibration of (i) Bellow type pressure gauge. (ii) Vacuum gauges. (iii) Compound gauges	Theory related to practical	Flow sheet of sulfuric acid manufacture.	Humidity and Air conditioning: Introduction, definition, humidity chart, humidification and its equipment, dehumidifiers, cooling towers. Oils and fats refining
18	Calibration of mercury in glass thermometer 1.Spray drier. 2.Rotary drum drier	Units of pressure, measurement of pressure by different methods	Flow sheets of urea and nitric acid manufacture	Absorption: Introduction, equilibrium mass transfer coefficient, factors affecting rate of absorption. Absorption towers. Unit process : Soap and Glycerine: process description with flow sheet.
19	Calibration of gas filled thermometer. Calibration of bimetallic thermometer. Study of crystallizer	Theory related to practical	Flow sheet of sugar manufacture	Comparison of different absorption towers and their operation. Operating line, number of stags, effect of variable on absorption. Flooding and flooding velocity. Stripping, methods of stripping. Alcohol: manufacture of ethyl and methyl alcohol with flow sheets.
20	Study of control valves & transmitters.	Theory related to practical	Flow sheet of ethyl alcohol manufacture.	Drying: Introduction, Vapour pressure, curve for water, relative humidity and other definitions, equilibrium in drying. Tray drier. : Same as Week No. 19
21	Study of recorders and controllers. Study of different types of conveyers.	Temperature - its units and different methods of measurement	Flow sheet of cement manufacture. Unit operation	Instrumentation diagram of tray drier, various type of driers, spray drier and drum drier. Unit process : Same as Week No.**19**
22	Calibration of a resistance thermo-couple and thermometer. 1.Lift filter 2.Sparkler filter	Theory related to practical	Flow sheet of pulp manufacture	Crystallization: Introduction classification of crystallizes. Unit process : Same as Week No.1**9**

23	Calibration of optical Pyrometer, pH meter	Level, different methods of measurement	Flow sheet of aluminium manufacture Flow sheet of soda ash manufacture	Mixing: Mixing liquids with liquids, mixing solids with liquids mixing solids with solids and equipment. Unit process: Same as Week No. **23**
24	Measurement of level, quantity meter and hydrometer	Density, its units and different methods of measurement. final control elements, Transmitters recorders and control1ers	Instrumentation diagram of a distillation column Instrumentation diagram of an evaporator Instrumentation diagram of a drier Flow diagram of a rotary vacuum filter with all accessories. Diagram of open & closed circuit grinding	Centrifugation: Introduction classification of equipment. Paints and varnishes: different types of pigments, ils varnishes, lacquer. Absorption: Theory, absorbents and applications of absorption, Screening: Definitions, classification of screen sedimentation & decantation: Introduction, classification. Settling: Definition and equipment. Unit process :Same as Week No. **24** Crushing and grinding : Introduction and classification of equipment Water treatment precipitation, demineralization processes, sewage waste water treatment, Air Pol1ution Conveying: Introduction and different types of conveyors. Fuels: Coal, water gas, producer gas combustion of fuels.
25	Revision			
26	Examination			

TRADE :- ATTENDANT OPERATOR (CHEMICAL PLANT)
LIST OF TOOLS AND EQUIPMENT

A. TRAINEES TOOL KIT

(For 16 Trainees and one Instructor)

Sl.No.	Name of the Item	Quantity
1.	Outside Spring Caliper 6"/15 cm	17 Nos.
2.	Inside Spring Caliper 6"/15 cm	17 Nos.
3	Livers spring 6”/15 cm	17 Nos.
4.	Center punch 4"/10 cm	17 Nos.
5.	Prick punch 6"/15 cm	17 Nos.
6.	Chisel Cold flat 1 "/2.5 cm	17 Nos.
7.	Chisel cross cut 3/8"X 1/8"	17 Nos.
8.	Chisel diamond point 1/8” /10 cm	17 Nos.
9.	Chisel half round 3/8"/10 mm	17 Nos.
10.	Hammer ball pein I lb	17 Nos.
11.	Hammer ball pein ½ lb	17 Nos.
12.	Hacksaw frame adjustable with pistol grip for 8"-12" blade / 20 cm- 30cm.	17 Nos.
13.	Rule steel 12" English and Metric 30 cm	17 Nos.
14.	Screw Driver 3"X3/8" blade	17 Nos.
15.	Screw Driver l2"X1/2" blade	17 Nos.
16.	Try Square 6" blade/15 cm	17 Nos.
17.	Scriber	17 Nos.
18.	Safety Goggles	17 Nos.
19	File flat 8 "/20 cm rough	17 Nos.
20	File flat 8 "/20 cm 2nd cut	17 Nos.
21	File round 8mm, 8 "/20 cm length, 2nd cut	17 Nos.
22	File round 10mm, 8 "/20 cm length, 2nd cut	17 Nos.
23	File half round 8 "/20 cm length rough	17 Nos.
24	File half round 8 "/20 cm length, 2nd cut	17 Nos.
25	Box drawing instrument	17 Nos.
26	Protractor celluloid circular	17 Nos.
27	Scale (Wood) Draughtsman 12”/30 cm	17 Nos.
28	Set square celluloid 45^{0}	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. Workshop Tools and Equipment

Sl.No.	Name of the Item	Quanti ty
1.*	Surface plate 12" X 12"/30 cm X 30cm Or surface plate 24" X 24"/60 cm X 60 cm	2 1
2.*	Scribing block Universal 12"/30 cm	2
3.*	Marking table 3' X 3' X 3' high	1
4.*	V-Blocks 3" X 1½" (pair) with clamps	2
5.*	Combination set 12 inch	2
6.*	Twist Drill (straight shank) 1/8" to 1/2" by 1/64" (set)	4
7.*	Twist Drill ½ " to 3/4 by1/16" (Mores taper)	1 set
8.*	Twist Drill (Metric) 2 mm to 7 mm by 1 mm	6 set
9.*	Twist Drill (Metric) 8 mm to 12 mm by 1 mm	1 set
10.*	Dial Test indicator with magnetic base	2
11.	Radius Gauge	1
12.	H.S.S. Hand reamers 6 to 12 mm by 2 mm	1set
13.*	Hacksaw frame adjustable for 8"to 12" blades.	6
14.	Bench vice with 5" jaws.	20
15.	Machine vice 6" jaw for drill machine	1
16.*	Working bench 8' X 4' X 2½" fitted with vices	5
17.*	Steel almirah, large with shelves	2
18.*	Letter Punch set - 3mm.	2 sets
19.*	Numbering punch set - 3mm	2 sets
20.	Pipe Die with Die stock ½", ¾"	2 each
21.	Complete set of taps and dies in Metric (8, 10,12 mm)	2 sets each
22.*	File flat 1" bastered	2
23.*	File flat 10" smooth	2
24.*	File triangular 6" 2nd cut	1
25.*	File flat 6" smooth	1
26.*	Oil stone 6" x2" x 1"/15 cm x 5cm x 2.5cm	2
27.*	Oil can ½ pt	4
28.*	Bevel protractor	2
29.*	Chisel flat ½"	1
30*	Chisel cross cut ¼ "/6mm	2
31.*	Micrometer outside 0-1"	I
32.*	Micrometer inside 2" to 8" / 5 cm to 20 cm	2
33.*	Micrometer Metric 0-25 mm	2
34.*	Micrometer inside 50-200 mm capacity	1
35*	Venire caliper 12"	1
36*	Screw pitch gauge Whitworth & Metric	1 each
37*	Wire gauge Imperial standard	1
38*	Allen Keys 1/16" to 1/2" by 1/32"	2 set
39*	Phillips head screw driver set 1- 4 sizes	1 set
40*	Double ended spanners- from 1/8" x 3/16" to1/2" x 9/16"	1set
41	Double ended spanner- from 3/8" x 7/16" to 15/16" x I"	1 set
42	Double ended spanners from 8 x 9 to 20 x 22	1 set

43	Offset double ended ring spanners from 1/8" X 3/16" to 1/2" X 9/16"	1set
44	Socket set ½ " drive,3/8" to 1 ¼ " with ratchet handle	1 set
45	D E. Spanner from 5/8" x 11/16" to 15/16" x 1"	2
46*	Hammer hide faced	2
47	Pipe wrench stilton pattern 18" long	2
48*	Combination pliers- 8"/20 cm	17
49	Bearing puller 8" dia. (3 leg type)	1
50	Steel tape 10 m.	1
51	Feeler gauge .0005" to .25"	6
52	Pipe cutter (adjustable), 3 wheel type, Ø3" pipe.	1
53*	Pipe vice 3"/ 75 mm	2
54	Leather apron	2
55	Steel rack	2
56	Soldering iron	2
57	Center gauge 55º and 60 º	1 each
58	Knurling Tool	2
59	Centre drill Ø 2, Ø3 mm	2 each
60	Set of sockets (Morse Taper) (0-1,1-2, 2-3)	1 each
61	4 jaw chuck (Independent)	2
62	3 jaw self centering chuck (5"/125 mm)	2
63	Set of tools for lathe	2
64	Lathe dog ½ " to 1½ "	2
65	Drill chuck 0" to ½ " with Morse Taper shank	1
66	Grease pressure gun (Hand operated)	1
67	Face pin spanner 1" to 3" dia	1
68	Tongs round	1
69	Tongs flat	2
70	Anvil	2
71	Welding helmet	1
72	Welding goggles	4 pairs
73	Welding Table 2 ½ „x 2 ½ „x 4' with fire brick top	1
74	Welding gloves	4 pairs
75	Tachometer	1
76	Tap extractors 1/8" to ½ " by 1/16"	1 set
77	Screw extractors sizes 1 to 3	1 set
78	Tools bit holder as Armstrong L.H.	4
79	Tool bit holder as Armstrong R.H.	4
80	Tools bit holder as Armstrong straight	4
81	Pedestal Grinder (D.E) with two 7" wheels rough and smooth (motorized)	2
82*	Drill machine to drill upto ½ "dia.	1
83*	Lathe-30" between center X 6" centers height with standard accessories	2
84	Welding Set - oxy-acetylene (either high or low pressure) and electric.	1each
85	Pipe bending attachment ½", ¾"	1 each
86*	PVC welding torch and accessories	1

C. General Machinery shop outfit (as per the table)

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

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

- **General Machinery shop outfit (as per the table)**

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

Sl. No.	Name and Description of item	Quantity
28.	Potentiometer	2 sets
29.	Whetstone bridge	2 sets
30.	Resistances Center Zero Galvanometer	4 Nos.
31.	(a) Resistance box 0 to 100 ohms (b) Resistance box 0 to 500 ohms	2 Nos. 2 Nos.
32.	Rheostat (a) Rheostat 25 ohms (b) Rheostat 100 ohms (c) Rheostat 500 ohms	 2 Nos. 2 Nos. 2 Nos.
33.	Ammeter 0 to 1 Amp. (DC) 0 to 3 Amp. (DC) 0 to 10 Amp. (AC, DC) 0 to 30 Amp. (AC, DC)	 2 sets 2 sets 2 sets 2 sets
34.	Voltmeter 0 to 1 volt (DC) 0 to 4 volt (DC) 0 to 5 volt (DC) 0 to 10 volt (DC) 0 to 50 volts (DC) 0 to 250 volts (DC/AC)	 2 sets 2 sets 2 sets 2 sets 2 sets 2 sets
35.	Milli voltmeter 0 to 5 Milli volt. 0 to 500 Milli volt.	 2 sets 2 sets
36.	Resistance coils (2 ohms, 5 ohms, 10 ohms, 100 ohms)	2 sets
37.	pH meter	1 set
38.	Charger for battery accumulator	1 set
39.	12 volt hand operated Dynamo, Leclanche cell, Daniel cell, Weston cell, Acidic cell, Head Accumulator, Alkali cell with variable resistances	2 sets
40.	Multi meter	2 Nos.
41.	Battery eliminator	2 Nos.
42.	Diode valve	4 Nos.
43.	Triode valve	4 Nos.

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

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

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