Syllabus for the trade
of

LABORATORY ASSISTANT (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 **LABORATORY ASSISTANT CHEMICAL PLANT** held on 13th &14th Sep.2011 at A.T.I., Mumbai

Sl. No.	Name and Designation ,Shri	Organization	Remarks
1.	S/Shri R. K. Pathak Director In Charge/HOD	ATI, Mumbai	Chairman
2.	Ujjwal Biswas Dy. Director of Trg	ATI, Mumbai	Member
3.	Abhinoy Nandi Dy. Director of Trg	ATI, Mumbai	Member
4.	P.S. More, Training Officer	ATI, Mumbai	Member
5.	S. J. Wakde, Training Officer	ATI, Mumbai	Member
6.	Smt. Kavita K. Phadnis, Training Officer	ATI, Mumbai	Member
7.	A.R.H. Shaikh, Training Officer	ATI, Mumbai	Member
8.	N.V.Nare, Training Officer	ITI, Mahad	Member
9.	J.H.Suryawanshi, Training Officer	ITI, Mahad	Member
10.	D. N. More, Training Officer	ITI, Mahad	Member
11.	A. N. Mancharkar, Instructor	IT I_ Ambarnath	Member
12.	S. Z. Rajput, Instructor	IT I_ Ambarnath	Member
13.	P.R.Patil, Instructor	ITI, Nagathane, Roha	Member
14.	S.S.Barve, Instructor	ITI, Mahad	Member
15.	R.S.Wagh, Instructor	ATI, Mumbai	Member
16.	D. M. Basha, Instructor	ATI, Mumbai	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, 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	:	LABORATORY ASSISTANT (Chemical Plant)
2.	NCO Code No.	:	
3.	Duration	:	2 years (Four Semesters)
4.	Power Norms	:	06 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 in relevant trade
		:	b) Preference will be given to a candidate With Craft Instructor Certificate

Note : At Least One Instructor must have Degree/Diploma in Chemical/Petro chemical

Syllabus for the Trade of
"LABORATORY ASSISTANT (CHEMICAL PLANT) under C .T.S.
(Semester Code No. LAC-01)

SEMESTER – I

Week No.	Trade Practical	Trade Theory	Engineering Drawing	Workshop Calculation & Science
1	Induction Training. Operation of fire extinguisher. Use of personal protective equipments. Introduction to Material Safety Data Sheet (MSDS) and personal protection equipments (PPEs) used in chemical plant.	Induction Training. Fire & Safety in Chemical Lab/Plant. First Aid. Introduction of pollution control.	Introduction to engineering drawing. Its relevance to the trade. Use of drawing board, T-Square, etc.	Introduction to Workshop Calculation and Science Units and conversion classification of units, conversion of units : British system to metric system ,SI System and vice –versa
2	Volumetric Analysis (Acidimetric Titrations) Preparation of solutions of solids, liquids, volatile, non-volatile, etc. substances. Preparation of standard & primary standard solutions	General & Physical Chemistry Introduction to chemistry. Elements, atoms & molecules Chemical & physical changes	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	Arithmetic: Fundamental Operation General Simplifications LCM / GCM - Shop problems
3	Analysis of acids & bases.	Atomic molecular and equivalent weights. Crystallography. Solutions.	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.and their views when viewed perpendicular to their base or axis.	Graph: rules of drawing graph. drawing and reading of simple graph , graph of simple equations and compound equations

4	Analysis of acids & bases.	, the laws of chemical combinations	Writing single stroke letters and numbers as per IS: 1972 (IInd Revision). Geometrical construction on lines, angles and triangles.	Square and Square Roots – methods of finding out square roots, Pythagoras theorem, Shop problem.
5	Analysis of acids & bases.	Periodic table of the elements.	Geometrical construction of lines, angles & triangles.	Ratio & Proportion: Shop problems related to ratio, direct and indirect proportion
6	Oxidation-Reduction titration. Permanganometry -titration using permanganate solution	Periodic study of S & P Block Elements:	Geometrical construction of regular polygons.	Percentage: Changing Percentage to Decimal and Fraction and vice versa. Applied problems. Average
7	Oxidation-Reduction titration. Permanganometry -titration using permanganate solution	Periodic study of: (a) Zero group (b) Transition Elements.	Convention representation of common materials.	Algebra: Basics, simple equations, simultaneous equations, quadratic equation & shop problems.
8	Dichrometry titrations using dichromate solution.	Periodic study of: (a) 4th B group (b) 5th B group (c) 6th B group (d) 7th B group (e) 8th B group elements.	Pictorial drawing Isometric drawing of simple blocks	Logarithms : Introduction, definition, characteristic & mantissa, how to refer log tables and anti log tables, rules while using logarithms, examples
9	Dichrometry titrations using dichromate solution.	Chemical equilibrium. Thermo-chemistry & thermodynamics.	Isometric views of simple solid and hollow Object	Velocity and Speed: rest and motion, vector quantity ,scalar quantity ,speed, velocity , difference between speed & velocity ,acceleration , equations and laws of motion, , Rotational motion,

10	Iodo and iodimetry titrations using iodine solution directly or indirectly.	Chemical equilibrium. Thermo-chemistry & thermodynamics.	Orthographic views of simple objects by 1st angle projection	Metals and Non-metals : Properties of metals , types of metals , difference between ferrous and non ferrous metals , classification of iron : pig iron , cast iron, wrought iron ,Steel: types of steel, difference between cast iron and steel, types of alloy steel, Difference between metal & nonmetal
11	Iodo and iodimetry titrations using iodine solution directly or indirectly.	Colloidal osmosis catalysis	Orthographic views of simple objects by 1st angle projection	Heat Treatment :purpose of heat treatment ,methods of heat treatment annealing , normalizing , hardening, tempering, case hardening
12	Precipitation titration.	Metallurgy Metallurgy of: (a) Aluminum. (b) Copper	Orthographic views of simple objects by 3rd angle projection	Density and Specific Gravity Mass ,weight , density , relative density , Archimedes's principle , simple experimental determination
13	Precipitation titration.	Metallurgy of: (a) Silver (b) Chromium	Orthographic views of simple objects by 3rd angle projection .	Surface Tension and Viscosity : Definition and units Different methods of determination
14	Complexo metric titrations	Metallurgy of: (a) Iron & Steel (b) Zinc & its alloys.	Drawing of different types of thread forms, rivet heads, keys, and coupling. Drawing of different types of riveted joints such as lap and butt joints	Friction and Lubrication Definition, co-efficient of friction, limiting friction, laws of limiting friction angle of friction, simple

				problem related to friction, types of lubricant, Advantages and disadvantage of friction
15	Complexo metric titrations	Non-Metals: Preparation, properties & uses of following: (a) Hydrogen & its peroxide. (b) Oxygen (c) Sulphur& its compounds.	Drawing of different types of locking devices such as double nut, castle nut, pin etc	Force : Newton's law of motion, unit of force , to find out resultant force , representation of force , parallel forces ,couple
16	Complexo metric titrations	Preparation, properties & uses of following: (a) Nitrogen & its compounds. (b) Phosphorus & its compounds. (c) Chlorine & its Fluorine and its compounds.	Revision and more exercises on orthographic views of machine parts such as bearing brackets etc.	Law of parallelogram of forces ,condition of equilibrium ,kinds of equilibrium ,,some examples of equilibrium in daily life, triangle law of forces ,converse of triangle of forces , Lami's theorem, jib crane.
17	Physics Lab To study parallelogram of forces with the help of mechanical board. Determination of acceleration due to gravity by simple pendulum Determination of coefficient of static friction using inclinedplane.Determination of mechanical advantage velocity ratio and % efficiency of	Moment and Levers : moments, units, arm of couple and moment of couple , types of Levers Simple machines Simple machines , efforts and load , mechanical advantage, velocity ratio , efficiency of machines , their relationship, examples	Free-hand sketches of Hand Tools, Screw drivers, Plier, Spanner, Tweezer. Free-hand sketches of Vernier Caliper, micrometer, Depth Gauge, Dial Test Indicator, Bevel protractor	Work, Power and Energy. Potential and Kinetic Energy .

	Simple machine Determination of Young's Modulus by Seattle's apparatus			
18	Determination of coefficient of expansion of solid Determination of coefficient of Thermal conductivity of metal rod	Elasticity,: Introduction , stress and strain , modulus of elasticity, different types of stresses, Hooke's law , Young's modulus , Yield point , ultimate, stress-strain graph , modulus of Rigidity. , poison ratio, bulk modulus, factor of safety, examples	ISI symbols of Generator, Voltmeter, Ammeter, Watt-meter. of Resister, inductor, Capacitor, Transformer, AC & DC motors.etc. Drawing of pressure control process line.	Elasticity, Problems on stress and strain , modulus of elasticity, different types of stresses, Hooke's law , Young's modulus , Yield point , ultimate, stress-strain graph , modulus of Rigidity. , poison ratio, bulk modulus, factor of safety, examples
19	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 using wheat stone's Bridge.	Heat and Temperature Heat, unit of heat, temperature, difference between heat and temp. , modes of heat transfer, Boiling point, Melting point, Scale of temp. , specific heat , thermal capacity , water equivalent of heat , interchanges of heat , latent heat of fusion , latent heat of vapour , transmission of heat, thermal expansion of solids, liquids and gases , co-efficient of linear expansion , indicated thermal efficiency , brake thermal efficiency , examples	Drawing different types of pipeline diagram, pipe fitting symbols. Free hand sketching of pipe joints and fittings.	Heat and Temperature Heat and temperature and their units , Boiling point, Melting point, temperature scales , specific heat , thermal capacity interchanges of heat , latent heat of fusion , latent heat of vapour , transmission of heat, thermal expansion of solids, liquids and gases , co-efficient of linear expansion , indicated thermal efficiency , brake thermal efficiency , examples
20	Verification of faraday's First law	Electricity : Electric current, +Ve and -Ve terminals , Use of	Free hand sketches of - Layout of Chemistry	Electricity : simple calculations , Ohm's law ,simple

	of electrolysis.	fuses and switches , conductors and insulators , simple electrical Circuits ,	Laboratory - Electrolytic Analyzer - P^H meter	calculation , electrical insulating Materials,
21 to 22	Verification of faraday's First law of electrolysis	Ohm's law , electrical insulating Materials, Kirchhoff's law, examples, Parallel and series circuit connections. Whetstone's bridge potentiometer.	Free hand sketches of - Redwood Viscometer - Microscope -	Kirchhoff's law, examples, Parallel and series circuit connections. Whetstone's bridge potentiometer.
23 to 24	Determination of mechanical equivalent of heat using electrical method	Electrolysis, conservation of electrical energy into heat energy, Joule's law. mechanical equivalent of heat	Block Diagram of - Photo colorimeter - Flame Photometer - Spectrophotometer	Electrolysis, conservation of electrical energy into heat energy, Joule's law. mechanical equivalent of heat
25	Project Work / Industrial visit (Optional)			
26	Examination			

Syllabus for the Trade of
"LABORATORY ASSISTANT (CHEMICAL PLANT) under C .T.S.
(Semester Code No. LAC-02)
SEMESTER – II

Week No.	Trade Practical	Trade Theory	Engineering Drawing	Workshop Calculation & Science
01	Gravimetric estimations	General & Physical Chemistry	Construction of Isometric scales and drawings. Isometric Projection of simple solids etc.	Mensuration: Introduction , Rectangle, Square, Parallelogram, Trapezium , Rhombus, Triangles , Radius of larger holes that can be inscribed in a given triangle , Pentagon , Hexagon, Circle , Sector , segment of a Circle , Ellipse, length of Belts ,Area of irregular Surface
02	Gravimetric estimations	The structure of atom.	Orthographic views of objects by 1st angle projection	Same as week No.01
03	Gravimetric estimations	The structure of atom	*Orthographic views of objects by 3rd angle projection.*	Same as week No.01
04	Gravimetric estimations	radioactivity	Sectional view of simple objects such as brackets, bearings etc.	Same as week No.01
05	Gravimetric estimations	Chemical bonding electronic theory of valancy	Drawing sketches of different types of valves, such as gate valve, globe valve, ball valve, Plug Valve, check valve etc.	Finding out volumes of solids: cube, rectangular solid, cylinder, hallow cylinder, sphere, hallow sphere, hemisphere, cone, frustum of cone, prism.
06	Gravimetric estimations	Gas laws,Boyles law,Charls law,Gas equation,Grahas Law of diffusion, Daltons law of partial pressure.	Drawing sketches of different types of valves, such as Needle valve, Plug Valve, check valve, diphagram valve etc. .	Same as week No.05

07	Gravimetric estimations	Gas laws, Boyles law, Charlslaw, Gas equation, Grahams Law of diffusion, Daltons law of partial pressure.	Drawing sketches of different types of pumps such as centrifugal, reciprocating and rotary pump ,etc	Same as week No.05
08	Gravimetric estimations	Fertilizer its types & uses	Drawing of Different types of symbols used in chemical industry	Statistics Introduction to statistics, Frequency Distribution Mean, Median & Mode,
09	Inorganic qualitative analysis	Fertilizer its types & uses	Free hand sketches of different types of Shell and tube Heat Exchanges / Evaporators. / Distillation Column.	Statistics Mean Deviation, Standard Deviation.
10	Inorganic qualitative analysis	Atmosphere air	Free hand sketching of spur, helical and bevel gears.	Trigonometry- Trigonometrically ratios, use of Trigonometrically tables , area of triangle by trigonometry, problem based on trigonometric table(sine, cosine, tangent tables)
11	Inorganic qualitative analysis	Atmosphere air	Free Hand Sketch of Process Flow Sheet of Manufacturing of Sulphuric Acid	Same as week No.10
12	Inorganic qualitative analysis	Electro-chemistry & electrolysis	Free Hand Sketches of Process Flow Sheets of Manufacturing- Ammonia and Urea	Same as week No.10
13	Inorganic qualitative analysis	Electro-chemistry & electrolysis	Free Hand Sketches of Process Flow Sheets of Manufacturing of Sugar & Ethyl Alcohol	Finding height and distance by trigonometry , application of trigonometry to shop problems, Problems on measurement of liquid quantity by change in height of liquid
14	Inorganic qualitative analysis	Law of mass action	Free Hand Sketches of Process Flow Sheets of Manufacturing of	Pressure :Types of pressure, Atmos-pheric pressure,

			-Caustic Soda and Chlorine - Soda Ash	Vacuum pressure, gauge pressure & absolute pressure and its units, pressure measuring devices
15	Inorganic qualitative analysis	Law of mass action	Free Hand Sketches of Process Flow Sheets of petroleum refining process	Balancing of chemical equation.
16	Inorganic qualitative analysis	Study of physical properties of substances	-do-	The mole & pH calculation. Material balance without chemical reaction.
17	Calibration of Bourdon tube pressure gauges Study Manometer	Units of pressure, measurement of pressure by different methods.	Flow Sheet of Manufacturing of Soap and Glycerin	Avogadro's Hypothesis (conversion of mass into volume of chemicals)
18	Calibration of Alcohol in glass thermometer.	Same as week No.18	Flow Sheet of Manufacturing of Soap and Glycerin	*Atomic ,Molecular & Equivalent Weight.*
19	Calibration of bi-metallic thermometer	Temperature scale, different methods of temperature measurement.	Free Hand Sketches of Process Flow Sheets of Manufacturing of Portland Cement	-do-
20	Testing of a Resistance thermometer	Same as week No.18	-do-	Percentage composition, Empirical formula & Molecular formula.
21 to 22	Testing of Thermocouple, Thermocouple Pyrometer	Recorder, On off controller. Transmitter	Instrumentation Diagram of a Distillation Column, an Evaporator & Tray Drier	-do-
23 to 24	Study of recorders transmitters Controllers	-do-	-do-	Percentage Purity.
25	Project Work / Industrial visit (Optional)			
26	Examination			

Syllabus for the Trade of
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(Semester Code No. LAC-03)

SEMESTER – III

Week No.	Trade Practical	Trade Theory	Workshop calculation & Science
01	General introduction.	Introduction to Organic Chemistry.	Introduction of unit processes in chemical industries .Importance and use of symbols , colour coding , block diagram , flow sheeting & specification sheet in chemical process industries
02	Organic Preparation: Acetylation: preparation of acetalide, & percentage yield determination.	Purification of Organic Compounds.	Process classification, raw materials, chemical reactions, manufacturing process description, flow sheet and uses of Sulphuric acid
03	EASTERIFICATION Preparation of Methyl Oxalate& percentage yield determination	Purification of Organic Compounds.	Process classification, raw materials, chemical reactions, manufacturing process description, flow sheet and uses of Soda ash
04	Sulphonation: Laboratory preparation of sodium benzene sulphonate& percentage yield determination	Types of organic reactions	Process classification, raw materials, chemical reactions, manufacturing process description, flow sheet and uses of Caustic Soda and Chlorine
05	Nitration: Laboratory preparation of nitrobenzene. & percentage yield determination Halogination: Preparation of tribromophenol	Classification & nomenclature.	Process classification, raw materials, chemical reactions, manufacturing process description, flow sheet and uses of Nitric acid
06	Oxidation: Laboratory preparation of oxalic acid Reduction Laboratory preparation of aniline:	Aliphatic hydrocarbons Halogen derivatives of hydrocarbons –aliphatic alcohol	Process classification, raw materials, chemical reactions, manufacturing process description, flow sheet and uses of ammonia
07	Diazotization: Preparation of methyl orange , Ozazone,	Ethers, Aldehydes, Ketones	Process classification, raw materials, chemical reactions, manufacturing

	gluecosazone		process description, flow sheet and uses of urea
08	Saponification: Preparation of soap. Preparation of aspirin	Carboxylic acid. Amides & Anhydride, Acid Halides	Process classification, raw materials, chemical reactions, manufacturing process description, flow sheet and uses of Soap and Glycerine
09	Preparation of camphor & phenolphthalein	Esters Oil & Fats. Soaps & Detergents.	Process classification, raw materials, chemical reactions, manufacturing process description, flow sheet and uses of Portland cement
10	Inorganic preparation: Preparation of sodium carbonate. And determination of % of purity,% yield	Amines Cyanogan compounds	Process classification, raw materials, chemical reactions, manufacturing process description, flow sheet and uses of sugar
11	Preparation of copper sulphate. & percentage purity, %yield determination.	Carbohydrates & Protein	Process classification, raw materials, chemical reactions, manufacturing process description, flow sheet and uses and ethyl alcohol
12	Preparation of Mohr's salt& percentage purity, %yield determination	Polymers, Aromatic, Hydrocarbons, aromatic ethers.	Petroleum & petroleum refining crude oil & its origin and classification , distillation of crude
13	Preparation of alum: Ferric or potash alum,& %yield determination	halogen derivatives	unit process involved in petroleum refining , properties of uses of petroleum products
14	Preparation of potassium nitrate. & percentage purity, %yield determination	Compounds with nitrogen urea	Water: Mineral matter, Hardness, Causes of Scale formation & their Removal. Water Treatment & Types of Water used in Industry
15	Analysis of organic compounds to determine : a) elements present b) functional group c) melting point d) preparation of derivative e) M.P. of derivative for following group of compounds alcohols, acids,	-Do -	Boiler feed water treatment and sewage waste water treatment
16	- Do -	Aromatic acids	Global Warming & climate changes and their effects on human life , agriculture ,plants and animals

17	Analysis of organic compounds to determine : a) elements present b) functional group c) melting point d) preparation of derivative e) M.P. of derivative for following group of compounds, carbohydrates, nitro compounds, amines,	Compounds of double & triple rings	Effluents and Environmental Issues (Air & Water, noise, radiation Pollution).Solid, liquid and gaseous pollutants Sources of air , water, noise, radiation pollutions & their effects.
18	-do-	Compounds of double & triple rings	Effluent Treatment (Water & Air Pollution).Effluent: Types, Sources of effluent, effluent Analysis & Treatment
19	Analysis of organic compounds to determine : a) elements present b) functional group c) melting point d) preparation of derivative e) M.P. of derivative for following group of compounds, halogen compounds, sulphur compounds,	Heterocyclic compounds	Equipments used to control water and air pollution in chemical industries
20	- Do -	Diazomium salts, colour and dyes.	Corrosion : different types of Corrosion , Method of Prevention
21 to 22	Analysis of organic compounds to determine : a) elements present b) functional group c) melting point d) preparation of derivative e) M.P. of derivative for following group of compounds, phenolic compounds, hydrocarbons, aldehydes, keytons & esters, etc.	- Do-	- Do -
23 to 24	- Do -		
25	Project Work / Industrial visit (Optional)		
26	Examination		

Syllabus for the Trade of
"LABORATORY ASSISTANT (CHEMICAL PLANT) under C .T.S.
(Semester Code No. LAC-04)

SEMESTER – IV

Week No.	Trade Practical	Trade Theory
01	ESTIMATIONS-ORE AND ALLOY ANALYSIS: Analysis of bauxite or zinc ore. Aim, chemical required, reaction, method of estimations of elements.	Determination of concentration of solutions by molarity, IMP by weight by grams per litre. The Laws of chemical combination
02	Analysis of brass or analysis of soldering materials. Aim, chemicals & reagent required, reaction, method of estimations of elements.	Law of multiple proportions Determination of atomic & molecular equivalent weight.
03	INORGANIC ESTIMATIONS: estimation of calcium in given tablet. Aim, chemicals & reagent required, reaction, method of operations.	Percentage of elements in chemical compounds Empirical formulae of chemical compounds.
04	Analysis of gas by Orsat's Apparatus .theory of gas analysis. Method of operation.	Empirical formulae of chemical compounds, balancing chemical equation
05	OIL ANALYSIS: Determination of acid value of an oil & or fat. Procedures, chemicals required. Definition of acid value & reaction. Determination of saponification value of an oil or fat. Aim, apparatus & chemicals required. Definition, procedure & reaction.	Electrolysis. Electro chemistry Heat effect of electricity.
06	Estimation of sugar by Lane's & Eynon's method. Estimation of glucose by iodometry. Aim, apparatus & chemicals, reaction, procedure & theory of the experiment.	Calculation based on chemical reactions.
07	Determination of fat by Soxhlet's Extraction method. Aim, apparatus & chemicals required, reaction, procedure & theory of the experiment.	Analysis, volumetric analysis.
08	Estimation of nitrogen by Kjeldahl's method. Aim, apparatus, procedure & theory of the experiment	Acidimetry, Redox method, precipitation method, gravimetric analysis. Indirect method of analysis. Calculation of results of analysis on dry materials.

09	Estimation of formaldehyde by Iodometric method. Aim, apparatus, chemical required, procedure & principle of the experiment.	THERMO CHEMISTRY Heat of dissolving, heat of chemical reactions. i) Hess's law ii) heat of for
10	Estimation of aniline or phenol in the given solution by Bromination method. Aim, apparatus, chemical required, procedure & principle of the experiment.	PH & buffer solution Law of mass action
11	Instrumental analysis Potentiometeric Titrations. Conductometric Titrations.	Analysis of chemical compound by electrical energy.
12	Determination optical rotation of sugar solution.using polarimeter	Radio chemistry, Decay of radio isotopes. Equation of decay half time value.
13	Determination of % of elements by electrolytic analyzer	Introduction to microbiology.
14	Determination of pH by pH meter.	Introduction to Bacteria cell.
15	Calorimetric estimation	Sterilization – Details study
16	Spectrophotometric analysis	Introduction to Nutrition of bacteria.
17	Principle, handling & procedure for following laboratory equipment: a) balance b) microscope c) electrolytic analyzer d) spectrophotometer e) photo calorimeter f) flame photometer g) refractometer (oil sugar) h) Karlfisher Apparatus. i) Orarat's apparatus j) T.L.C., Paper Chromatography k) Gas chromatography l) High performance liquid chromatography m)Moisture balance n) Redwood viscometer o) Melting & boiling point apparatus	Introduction to Industrial Microbiology
18	MICROBIOLOGY Study & use of microscope. Study of common laboratory equipments used in microbiology.	Identification of different micro-organism
19	Preparation of media technique of inoculations.	Micro- organisms & infections. Streptomycin Yeast

20	Study of staining techniques, gram staining.	Micro- organisms & infections. Streptomycin Yeast
21 to 22	Determination of size of micro organism	Bread ,Alcohol, Beers, Wines
23 to 24	Determination of thermal death time.	Bread ,Alcohol, Beers, Wines
25	Revision	
26	Examination	

LIST OF TOOLS AND EQUIPMENT FOR 16 TRAINEES + 0NE FOR THE TRADE OF LABORATORY ASSISTANT (CHEMICAL PLANT)

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

Sl. No.	Name of the Item	Quantity
1.	Analytical balances of different makes (with rider, optical reading, one pan analytical balance)	2 nos.
2.	Digital balance	5 nos.
3.	Balance (tech.) to 1 kg.	1 no.
4.	Hand centrifuge for determination of fat in milk (Gerber)	2 nos.
5.	Auto-clave electrically heated	1 no.
6.	Centrifuges electrical	2 nos.
7.	Vacuum pump (central, for 20 places)	1 no.
8.	Vacuum pump mounted on moving tables	2 nos.
9.	Electric drying ovens (200°C)	2 nos.
10.	Furnaces (Muffle ovens)(1100°C)	1 no.
11. .	Water baths(6 places)(electrically heated)	4 nos.
12.	Sand bath (to be fabricated)	1 no.
13.	Refrigerator (4,5 cu. Ft.)	1 no.
14.	Chromatographic equipment (paper, column, thin layer)(if available indigenously)	1 each
15.	Stirrers with motors, 230V, AC, capacity 5 – 7 liters	8 nos.
16.	Magnetic stirrers (with heating plate) 2 litres capacity	2 nos.
17.	Mortar , 100mm, porcelain with pestle	6 nos.
18.	Heating plates (electric) 1000 watt	1 no.
19.	Mortar 150 mm. steel / cast iron	1 no.
20.	Desiccators 150 mm. dia.	10 nos.
21.	Desiccators vacuum	2 nos.
22.	Electric heating plates (for Soxleth)	2 nos.
23.	Heating mantles (universal)	6 nos.
24.	Borer for stoppers with sharpener	1 no.
25.	Clamps with spring or screw	24 nos.
26.	Cork press	1 no.
27.	Scissors	2 nos.
28.	Bunsen's burners	30 nos.
29.	Set sieves 20 – 200	1 no.
30.	Shaking machines for sieves & bottles	1 no.
31.	Steam generator (copper) for steam distillation	10 nos.
32.	Hot water funnel	10 nos.
33.	Extraction thimbles	60 nos.
34.	Glass tubes & rods of different diameter	100 kg.
35.	Rubber tubes for water, gas & vacuum, stopper, rubber each glass, plastic & cork of different sizes	20 m
36.	Tongs (forceps) nickel for crucibles & weights	24 nos.
37.	Tongs long for crucibles (muffle furnace)	6 nos.
38.	Spatulas nickel	20 nos.
39.	Test tube stand for 10 – 12 test tubes	24 nos.
40.	Tripods	40 nos.
41.	Asbestos wire gauge	30 nos.

42.	Wire gauge (without asbestos)	30 nos.
43.	Cork rings	24 nos.
44.	Test tube holders	24 nos.
45.	Clamp holders	48 nos.
46.	Clamps	48 nos.
47.	Rings with clamps for filtering & heating	48 nos.
48.	Stands	48 nos.
49.	Stands with clamps for burettes	24 nos.
50.	Pipe clay Triangles	48 nos.
51.	Apparatus for distilling for deminerlizing water	1 no.
52.	Crucible nickel 30 mm. dia, height 40 mm., rabless brushes, liquid soap, acid cleaning mixture for glassware, glass wool, etc.	6 nos.
53.	Erlenmeyer flasks 250 ml.	48 nos.
54.	Erlenmeyer flasks 500 ml.	24 nos.
55.	Burettes 25 ml.	24 nos.
56.	Burettes 50 ml.	12 nos.
57.	Pipettes 10 ml.	48 nos.
58.	Pipettes 25 ml.	48 nos.
59.	Pipettes measuring 0 to 5 ml.	6 nos.
60.	Pipettes measuring 0 to 10 ml.	10 nos.
61.	Pipettes measuring 0 to 1 ml.	6 nos.
62.	Pipettes micro 0 to 0.2 ml.	6 nos.
63.	Pipettes 1ml. (graduated)	12 nos.
64.	Each pipettes automatic 1, 2, 5, 10 ml.	3 nos.
65.	Flasks for distilled water 500 ml.	30 nos.
66.	Vacuum pipettes	4 nos.
67.	Measuring cylinders 25 ml.	10 nos.
68.	Measuring cylinders 50 ml.	24 nos.
69.	Measuring cylinders 100 ml.	24 nos.
70.	Measuring cylinders 250 ml.	24 nos.
71.	Measuring cylinders 500 ml.	12 nos.
72.	Measuring cylinders 1000 ml.	16 nos.
73.	Volumetric flask 100 ml.	24 nos.
74.	Volumetric flask 250 ml.	24 nos.
75.	Volumetric flask 500 ml.	24 nos.
76.	Volumetric flask 1000 ml.	12 nos.
77.	Weighing bottles polyethylene or glass 50 ml.	24 nos.
78.	Weighing bottles polyethylene or glass 100 ml.	12 nos.
79.	Funnels with regular & long stem 7 cm. dia.	24 nos.
80.	Funnels 4 cm. dia.	24 nos.
81.	Funnels 9 cm. dia.	24 nos.
82.	Funnels Buchner different sizes 10 to 25 cm. dia.	6 nos.
83.	Funnels Hirsch	6 nos.
84.	Funnels separatory 50 ml.	12 nos.
85.	Funnels separatory 100 ml.	12 nos.
86.	Funnels separatory 250 ml.	12 nos.
87.	Funnels separatory 500 ml.	6 nos.
88.	Funnels for filter crucibles & Gooch crucibles with rubber rings	24 nos.
89.	Beakers 100 ml. Corning	48 nos.
90.	Beakers 250 ml. Corning	48 nos.

91.	Beakers 400 ml. Corning	48 nos.
92.	Beakers 600 ml. Corning	24 nos.
93.	Beakers 1000 ml.	12 nos.
94.	Watch glasses 5 cm.dia.	24 nos.
95.	Watch glasses 7.5 cm.dia.	48 nos.
96.	Watch glasses 10 cm.dia.	48 nos.
97.	Dishes evaporating 5 cm. dia. porcelain, glass	12 nos.
98.	Dishes evaporating 7.5 cm. dia.	24 nos.
99.	Dishes evaporating 10 cm. dia. flat bottom	24 nos.
100.	Dishes evaporating 15 cm. dia.	12 nos.
101.	Dishes evaporating 20 cm. dia.	6 nos.
102.	Thermometers 0 to 110°C	24 nos.
103.	Thermometers 0 to 250°C	12 nos.
104.	Thermometers 0 to 350°C	12 nos.
105.	Thermometers for drying oven	3 nos.
106.	Boiling flasks with round bottom 100ml.	24 nos.
107.	Boiling flasks with round bottom 250ml.	24 nos.
108.	Boiling flasks with round bottom 500ml. for each distilling flasks 50 ml., 100 ml., 250 ml.	12 nos.
109.	Boiling flasks with round bottom 500ml. for each distilling flasks 50 ml, 100 ml, 250 ml – Writz and others	24 nos.
110.	Filtering flasks 250 ml.	24 nos.
111.	Filtering flasks 500 ml.	24 nos.
112.	Filtering flasks 1000 ml.	24 nos.
113.	Flasks soxhlet with condensers	12 nos.
114.	Flasks kjeldahal 250 ml.	24 nos.
115.	Condensers liebig 30 mm. long	24 nos.
116.	Condensers liebig 50 cm. long	12 nos.
117.	Condenser bulb type 30 cm. long	6 nos.
118.	Condenser spiral type 20 cm. long	6 nos.
119.	Connecting tubes for khejeldahal distillation	24 nos.
120.	Ventiles for volumetric analysis (KCl 03, etc.)	24 nos.
121.	CO2 determination apparatus (Schrotter)	6 nos.
122.	Gas generator (Kipp) 500 ml.	5 nos.
123.	Gas washing bottles (Dreshsler)	24 nos.
124.	Drying tubes with one bulb	12 nos.
125.	Crucibles porcelain 5 cm, dia, height 4 cm indigenous	30 nos.
126.	Crucibles quarts 5 cm, dia, height 4 cm indigenous	24 nos.
127.	Gooch porcelain or glass	24 nos.
128.	Filtering 0, 1, 2, 3 glass	6 nos.
129.	Test tube (160 mm x 15 mm.)	500 nos.
130.	Test tube (10 mm.)	400 nos.
131.	Gas sampling tubes	12 nos.
132.	Paiers nessler tubes	24 nos.
133.	Tubes for centrifuge	500 nos.
134.	Tubes for Gerber centrifuge	48 nos.
135.	Bottles with droppers for indicator solutions & semi-micro qualitative analysis 30 ml.	72 nos.
136.	Bottles with droppers for indicator solutions & semi-micro qualitative analysis 50 ml.	72 nos.

137.	Bottles for solids 50 ml.	72 nos.
138.	Bottles for solids 100 ml.	36 nos.
139.	Bottles for solutions 100 ml.	100 nos.
140.	Bottles for solutions 250 ml.	36 nos.
141.	Bottles for solutions 1000 ml.	12 nos.
142.	Bottles for solutions 2000 ml.	12 nos.
143.	Bottles for solutions 3000 ml.	6 nos.
144.	Bottles for solutions 5000 ml.	3 nos.
145.	One pan analytical balances (Metler type) – if available indigenously 0.1 mg. sensibility	5 nos.
146.	LCD Multimedia projector	1 no.
147.	Computer/Laptop (latest configuration) with licentiate operating software.	2 no.
148.	Printer (Printer, Scanner & Copier)	1 no.
149	Microscope x 1000 (Monocular)	1 no.
150	Microscope metallurgical	1 no.
151	Polariometers	2 no.
152	Refractometers (Abbe type with refractive index)	1 no.
153	pH meters	1 no.
154	Potentiometer titration apparatus	1 no.
155	Conduct meter	1 no.
156	Viscometer (Redwood, Brookefield)	1 no.
157	Orsat's Apparatus	1 no.
158	Apparatus for surface tension	1 no.
159	Chromatographic equipment (paper, column, thin layer)(if available indigenously)	1 each
160	Fisher apparatus for moisture determination, if available indigenously	1 no.
161.	Gas chromatography instrument with computer & printer	1 no
162	High performance liquid chromatography instrument with computer & printer	1 no
163	Apparatus for determination of flash point	1 no.
164	Melting point apparatus	1 no.
165	Electrolytic analyser	1no.
166	Photocolorimeter	1no.
167	Uv visible spectrophotometer	1no.
168	Flame photometer	1no.
169	Bourdon Tube Pressure Gauges Different Ranges	2 each
170	Compound Gauge	2 No.
171	Diaphragm Type Pressure Gauge	2 No.
172	Dead Weight Tester with Assoceries	1nos.
173	Comparator with Assoceries & STD Pressure Gauges	1 no.
174	Thermocouple Type K, J,I,T	2 each
175	Digital Millivoltmeter	2 nos.
176	Mercury in Glass Thermometer	4 no.
177	Alcohol in Glass Thermometer	2 No.
178	Filled System Temperature Indicator	2 nos.
179	Bimetallic Thermometer	2 nos.
180	Resistance Thermometer (Pt-100)	6 nos.

181	Heating plate (electric) 1000 watt	4 no.
182	Thermostatic bath	2 pieces
183	T.C. Pyrometer	2 N0.
184	Digital Multimeter	4 No.
185	Pressure regulating Valve	2 No.
186	Quantity meters, Orifice meter ,Rotameter	1 each
187	Circular chart Recorder	2 No.
188	PH meter	1 No.
189	Diaphragm control valve, Air to open	1 No.
190	Diaphragm control valve, Air to Close	1 No.
191	Capacitance Type Level Transmitter	1 No.
192	Pressure Transmitter	1 No.
193	On off Controller	1 No.
194	Physical balance (with weight box)	3 sets
195	Chemical balance (with weight box)	3 sets
196	Viscometer :	
197	(a) Oswald viscometer	3 pieces
198	(b) Redwood viscometer	3 pieces
199	(c) Stop watch ($1/10^{th}$ Secn)	6 pieces
200	(d) Thermostatic bath	2 pieces
201	Talagnometer	6 pieces
202	Travelling microscope	2 nos.
203	Specific gravity bottle	6 nos.
204	Pyknometer	6 nos.
205	Mechanical board for testing triangle and parallelogram of forces including all accessories	6 sets
206	Spirit level	3 sets
207	Inclined plane with pulley, pan, weight etc.	2 sets
208	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
209	Different types of levers	1 set
210	Instrument for determining ‘g’ (simple pendulum).	2 sets
211	Barometer	1 no.
212	Altimeter	1 no.
213	Searle’s apparatus for young’s, modules, modules	2 sets
214	Nicholson’s Hydrometer with glass jag	2 sets
215	Wet and dry bulb thermometer	2 sets
216	Apparatus for measurement specific heat of solid and liquid (Renault’s Apparatus).	2 sets.
217	Apparatus for measurement of coefficient of expansion (thermal) of solid and liquid.	2 sets.
218	Apparatus for measurement of thermal conductivity of good and bad conductor	2 sets
219	Calorimeter for determining mechanical equivalent of heat and specific heat.	4 sets.

220	Thermometers (i) 0 to 110 C (ii) 0 to 210 C (iii) 0 to 300 C	06 No. 06 No. 06 No.
221	Polarimeter with monochromatic light	2 sets
222	Abbe refractometer	2 sets
223	Pulfrish refractometer	2 sets
224	Equipment to study Kirchhoff's law and Electrochemical equivalent	1 set
225	Potentiometer	2 sets
226	Whetstone's bridge	2 sets
227	Resistances Centre zero galvanometer	4 nos.
228	Resistance box (a) Resistance box 0 to 100 ohms (b) Resistance box 0 to 500 ohms.	 2 nos. 2 nos.
229	Rheostat : a) Rheostat 25 Ohms b) Rheostat 100 Ohms c) Rheostat 500 Ohms	 2 nos. 2 nos. 2 nos.
230	Ammeter a) 0 to 1 Amp (DC) b) 0 to Amp (DC) c) 0 to 10 Amp (AC, DC) d) 0 to 30 Amp (AC, DC)	 2 sets 2 sets 2 sets 2 sets.
231	Volt meter a) 0 to 1 volt (DC) b) 0 to 4 volt (DC) c) 0 to 5 volt (DC) d) 0 to 10 volt (DC) e) 0 to 50 volt (DC) f) 0 to 25 volt (DC)	 2 sets 2 sets 2 sets 2 sets 2 sets 2 sets
232	Millivoltmeter a) 0 to 5 mV b) 0 to 50 mV Digital Millivoltmeter a) 0 to 200mv	 2 No. 2 No. 2 No
233	Resistance coils (5 Ohms, 10 Ohms, 50 Ohms,100 Ohms)	2 sets
234	PH meter	1 set
235	Charger for battery accumulator	1 set
236	12 volt hand operated Dynamo lachlanchacell denial cell, Weston cell, acidic cell, den, accumulator, alkali cell with enable resistances	2 sets.
237	Multimeter Analog & Digital	2 each
238	Battery eliminator	2 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 AOCP/MMCP/IMCP