



GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

LABORATORY ASSISTANT (CHEMICAL PLANT)

(Duration: Two Years)

**CRAFTSMEN TRAINING SCHEME (CTS)
NSQF LEVEL- 5**



SECTOR – CHEMICALS AND PETROCHEMICALS

LABORATORY ASSISTANT (CHEMICAL PLANT)

(Engineering Trade)

(Revised in 2018)

Version: 1.1

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 5

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

EN-81, Sector-V, Salt Lake City,

Kolkata – 700 091

ACKNOWLEDGEMENT

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts and all others who contributed in revising the curriculum. Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

List of Expert members participated for finalizing the course curricula of Laboratory Assistant (Chemical Plant) at ITI, Ambernath, Maharashtra and ITC, Vadodara, Gujarat.			
S No.	Name & Designation Shri/Mr./Ms.	Organization	Remarks
Industry Expert			
1.	Laxmidas Hinduja, MD	Transpek Industries Ltd, Gujarat	Chairman
2.	S. A. Pandav, RDD, Vadodara	DET, Gujarat	Coordinator
3.	L. K. Mukherjee, DDT	CSTARI, Kolkata	Coordinator
4.	Haresh P Chavda Manager	Transpek Ind. Ekalbara Vadodara	Member
5.	M H Patel SR Officer	Nirma Limited, Alindra , Ta Savli , Di. Vadodara	Member
6.	Rinkesh Jadhav , Sr Excucative	Lupin Limited , Gujarat	Member
7.	P H Nasit , Manager	GACL , Vadodara	Member
8.	Rajendra Mandora , Director	Nish Group ,Hajivala Industry , Surat	Member
9.	Rakesh B Mahajan , DY. Manager	Sud Chemical ,Nandesari , Vadodara	Member
10.	Akash Vergurlekar, Mechanical Maintenance Executive	VVF India Ltd. Taloja, Raigad	Member
11.	Jayesh Karnik, Instrumentation Maintenance Executive- Engg. Service	-do-	Member
12.	Pradeep Kumar Pandey, Asst. Deputy Manager	Century Rayon, Mumbai	Member
13.	Deepak M Kanitkar, Executive	Huhtamaki PPL Ltd, Bansri, Thopoli, Raigad	Member
14.	Atul D. Taksande, Sr. Executive P&A	Bombay Dyeing & Manufacturing Co., Patulganga	Member
15.	K. M. Unni Krishnan, Sr. Manager HR & Admin.	ASB International Pvt. Ltd., Ambarnath	Member

**Laboratory Assistant (Chemical Plant)**

16.	Ajit D. Bagwe, Manager- Molding	-do-	Member
17.	Rohan Kadlay, General Manager	Siemens Ltd. , Mumbai	Member
18.	VidyadharTakle, Asst. Manager- Engg. Service	Godrej Industries Ltd., Ambernath	Member
19.	Roshan Vagade, QC- Engineer	Indore Composite Pvt. Ltd., Mumbai	Member
20.	Sandip D. Pisal, Asso. Chief Manager- Painter	Godrej & Boyce Manufacturing Co. Ltd, Mumbai	Member
21.	Rajendra Agashe, Manager- HR	Asian Paints India Ltd. Taloja	Member
22.	Mahesh Bandekar, Coating Officer	Indore Composite Pvt. Ltd., Mumbai	Member
23.	Prashant A Bhosale, Sr. Manager- Production	Jubilant Life Science Ltd., N-34 Additional, ambernath	Member
24.	Udayraj Ransing, Dy. Manager Engg.	-Do-	Member
DGT & Training Institute			
25.	H. N. Bargal, Group Instructor	ITI Ambernath, Thane	Member
26.	Sudhakar P. Patil, Trade Instructor	BTRI Mahad	Member
27.	Prashant R. Patil, Craft Instructor	ITI Nagothane	Member
28.	Manan G Shah , Supervisor Instructor	ITI Tarsali , Vadodara	Member
29.	Piyush D Padhiyar , Supervisor Instructor	ITI Tarsali , Vadodara	Member
30.	N C Gohil , Principal	ITI Gotri , Vadodara	Member
31.	S B Sarvaiya , Principal	ITI Savli, Vadodara	Member
32.	J.T.PATEL, Principal	ITI Vasad, , Vadodara	Member
33.	Nilesh H Patel , Supervisor Instructor	ITI Tarsali , Vadodara	Member
34.	P.K. Bairagi, TO	CSTARI, Kolkata	Member

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1. COURSE INFORMATION

During the two-year duration of Laboratory Assistant (Chemical Plant) trade a candidate is trained on professional skill, professional knowledge, Engineering Drawing, Workshop Calculation & Science and Employability skill. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The broad components covered under Professional Skill subject are as below:-

First Year: - In this year the trainee learns about safety and environment, use of fire extinguishers & PPEs and study MSDS to begin with. He gets the idea of identification of common chemical reagents and preparation of various types of solutions. Determine strength of unknown chemical reagents by various types of titrations. Determine value of different physical parameters of materials. Verify different laws related to physical properties of materials. The trainee will be able to execute quantitative analysis of metal & non-metal by Gravimetric estimation. Perform detection of inorganic substances by qualitative analysis. Operate pressure, temp. & recording instruments.

Second Year: - In this year the trainee will be able to prepare various organic compounds and determine their properties. Prepare various inorganic compounds and determine their properties. Identify various unknown organic compounds and their properties. Measure different organic compound in respect of waste water management. The trainee will perform quantitative analysis of ore, alloy, organic & inorganic substances. Perform analysis of fuel gas, sugar, oil, fat, soap & nitrogen in fertilizer. Operate various measuring instruments used in chemical plant & laboratory. Perform proximate analysis of coal and determine calorific value of different fuels. Detect micro-organism in food, pharmaceutical and other related laboratories.

2. TRAINING SYSTEM

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under aegis of National Council of Vocational Training (NCVT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes of NCVT for propagating vocational training.

Laboratory Assistant (Chemical Plant) trade under CTS is one of the popular courses delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while Core area (Workshop Calculation science, Engineering Drawing and Employability Skills) imparts requisite core skill & knowledge and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by NCVT which is recognized worldwide.

Candidates need broadly to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional knowledge, core skills & employability skills while performing the job and repair & maintenance work.
- Document the technical parameters in tabulation sheet related to the task undertaken.

2.2 CAREER PROGRESSION PATHWAYS:

- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.

2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years: -

S No.	Course Element	Notional Training Hours
1	Professional Skill (Trade Practical)	2320
2	Professional Knowledge (Trade Theory)	540
3	Workshop Calculation & Science	180
4	Engineering Drawing	270
5	Employability Skills	110
6	Library & Extracurricular activities	180
7	Project work	240
8	Revision & Examination	320
	Total	4160

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of the course and at the end of the training program as notified by the Government of India (GoI) from time to time. The employability skills will be tested in the first year itself.

a) The **Internal Assessment** during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain an individual trainee portfolio as detailed in assessment guideline. The marks of internal assessment will be as per the template (Annexure – II).

b) The final assessment will be in the form of summative assessment method. The All India Trade Test for awarding NTC will be conducted by NCVT as per the guideline of Government of India. The pattern and marking structure is being notified by Govt. of India from time to time. **The learning outcome and assessment criteria will be the basis for setting question papers for final assessment. The examiner during final examination will also check** the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

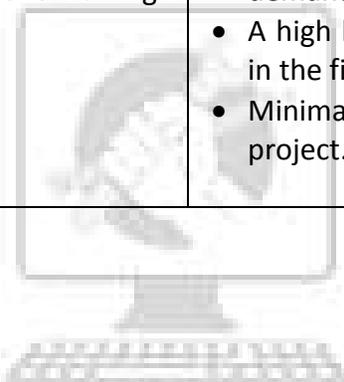
Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work

Evidences of internal assessments are to be preserved until forthcoming examination for audit and verification by examining body. The following marking pattern to be adopted while assessing:

Performance Level	Evidence
(a) Weightage in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	<ul style="list-style-type: none"> • Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the project/job.
(b) Weightage in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety	<ul style="list-style-type: none"> • Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracy achieved while undertaking different work with those

procedures and practices	<p>demanded by the component/job.</p> <ul style="list-style-type: none"> • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
(c) Weightage in the range of more than 90% to be allotted during assessment	
<p>For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.</p>	<ul style="list-style-type: none"> • High skill levels in the use of hand tools, machine tools and workshop equipment. • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.



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3. JOB ROLE

Laboratory Assistant, Chemical Laboratory; arranges and sets various chemicals, instruments and apparatus such as salts, acids, balances, heaters as desired by Chemists for conducting experiments in chemical laboratory. Sets up required apparatus and equipment as directed by Chemist. Performs routine tasks, such as preparations of standard solutions and common reagents, weighing and measuring of salts and chemicals, filtration, precipitation etc. and conducts simple tests as directed by Chemist. Cleans and maintains balances. Maintains laboratory clean and tidy, Keeps required chemicals readily available and replenishes stock from stores. May clean special apparatus, if required.

Laboratory Assistant, Glass and Ceramics; conducts routine tests of silica, clay and other ingredients in laboratories for manufacturing glass and ceramic products. Sets up apparatus required for performing test to determine properties of clay, silica, etc. Prepares solution and reagents. Maintains charts and tables for data observed during experimentation. May undertake tests in laboratory independently.

Laboratory Assistant, Chemical Engineering General; conducts chemical and physical laboratory tests and makes qualitative and quantitative analysis of material for purposes such as development of new products, materials, and processing methods and for maintenance of health and safety standards, working under Biochemists; Chemists, Analytical; Chemists, Inorganic; Chemists, Organic; or Chemists, Physical. Sets up laboratory equipment and instruments, such as ovens, leaching drums, gas cylinders, kilns vacuum chambers autoclaves, pyrometers and gas analyser. Analyses products, such as drugs, plastics, dyes and paints to determine strength, purity and other characteristics of chemical contents. Tests ores, minerals, gases and other materials for presence and percentage of elements and substance, such as Carbon, Tungsten, nitrogen, iron, gold or nickel. Prepares chemical solutions for use in processing materials, such as textile, detergents, paper, felt etc., following standard formulas.

Laboratory Assistant, Petroleum and Lubricants; Crude Tester; Oil Tester; Gas Analyst (Petroleum refining) tests and analyses samples of crude oil and petroleum products during processing stages, using laboratory apparatus and testing equipment and following standard test procedures to determine physical and chemical properties and ensures prescribed standards of products manufactured. Tests samples of crude and blended oils, gases, asphalts, and pressure distillates to determine characteristics, such as boiling, vapor, freeze, condensation, flash and aniline points, viscosity, specific gravity, penetration, doctor solution, distillation and corrosion, using test and laboratory equipment, such as hydrometers, fractionators, fractional distillation apparatus and analytical scales. Analyses contents of products to determine presence of gases, such as propane, isobutane, butane, isopentane, and ethane using appropriate distillation columns. Determines hydro carbon composition of gasolines, blending stocks, and gases using fractional distillation equipment and mass spectrometer. Operates fractional columns to separate crude oil into oils with different boiling points to determine their properties. Analyses composition of products to determine quantitative presence of gum, Sulphur, aromatics olefins, water and sediment. Compares colour of liquid product with charts to determine processing factors measurable by colour.

Compares tests results with specifications and recommends processing changes to improve and control quality of products. May test sub-surface cores during drilling operations.

Laboratory Assistant, Metallurgical; conducts routine tests of metals and alloys to determine their physical and chemical properties. Collects metallic wastes, metal samples or ores to be examined. Sets up scientific equipment required for testing. Assist Metallurgist in testing and analyzing different types of metals, their by-products, waste and alloys. May conduct examination of metals on his initiative independently.

Chemist, Analytical; conducts chemical analysis of inorganic and organic samples to ascertain their composition, reaction and properties. Performs basic tasks like Chemist General using instruments, apparatus and standard reagents in the laboratory such as spectroscope, pressure and temperature recording devices, desiccators, balances, acids, alkalize, and standard solution indicators to determine composition, strength or conformity with prescribed standards to ascertain presence or absence of a particular element. Analyses findings and submits report to medical or other authorities. May do statistical interpretation of observations.

Reference NCO-2015:

- (i) 3111.0300 – Laboratory Assistant, Chemical Laboratory
- (ii) 3116.0100 – Laboratory Assistant, Glass and Ceramics
- (iii) 3116.0300 – Laboratory Assistant, Chemical Engineering General
- (iv) 3116.0500 – Laboratory Assistant, Petroleum and Lubricants
- (v) 3117.0300 – Laboratory Assistant, Metallurgical
- (vi) 2113.0500 – Chemist, Analytical

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4. GENERAL INFORMATION

Name of the Trade	Laboratory Assistant (Chemical Plant)
NCO - 2015	3111.0300, 3116.0100, 3116.0300, 3116.0500, 3117.0300, 2113.0500
NSQF Level	Level-5
Duration of Craftsmen Training	Two Years
Entry Qualification	Passed 10 th Class Examination with science and mathematics or its equivalent.
Unit Strength (No. Of Student)	20
Space Norms	96 sq. m
Power Norms	6 KW
Instructors Qualification for	
1. Laboratory Assistant (Chemical Plant) Trade	<p>Degree in Chemical/ Petro chemical/ Technology/ Engineering from recognized University with one-year experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>Diploma in Chemical/Petro Chemical Technology/ Engineering from recognized board of Technical Education with 2 years post qualification experience in relevant field</p> <p style="text-align: center;">OR</p> <p>NTC/ NAC passed in the Trade with 3 years post qualification experience in the relevant field.</p> <p>Essential Qualification: Craft Instructor Certificate in relevant trade under NCVT.</p> <p><i>Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications.</i></p>
2. Workshop Calculation & Science	<p>Degree in Engineering with one-year experience.</p> <p style="text-align: center;">OR</p> <p>Diploma in Engineering with two year's experience.</p> <p>Essential Qualification: Craft Instructor Certificate in RoD & A course under NCVT.</p>
3. Engineering Drawing	<p>Degree in Engineering with one-year experience.</p> <p style="text-align: center;">OR</p>

	Diploma in Engineering with two years' experience. OR NTC / NAC passed in the Draughtsman (Mechanical / Civil) with three years' experience. Essential Qualification: Craft Instructor Certificate in RoD & A course under NCVT.					
4. Employability Skill	MBA OR BBA with two years' experience OR Graduate in Sociology/ Social Welfare/ Economics with Two year's experience OR Graduate/ Diploma with Two years experience and trained in Employability Skills from DGT institutes. AND Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above. OR Existing Social Studies Instructors duly trained in Employability Skills from DGT institutes					
List of Tools and Equipment	As per Annexure – I					
Distribution of training on Hourly basis: (Indicative only)						
Total hours /week	Trade practical	Trade theory	Work shop Cal. &Sc.	Engg. Drawing	Employability skills	Extra-curricular activity
40 Hours	25 Hours	6 Hours	2 Hours	3 Hours	2 Hours	2 Hours

5. NSQF LEVEL COMPLIANCE

NSQF level for **Laboratory Assistant (Chemical Plant)** trade under CTS: **Level 5**

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

- a. Process
- b. professional knowledge
- c. professional skill
- d. core skill
- e. Responsibility

The Broad Learning outcome of **Laboratory Assistant (Chemical Plant)** trade under CTS mostly matches with the Level descriptor at Level- 5.

The NSQF level-5 descriptor is given below:

Level	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
Level 5	Job that requires well developed skill, with clear choice of procedures in familiar context.	Knowledge of facts, principles, processes and general concepts, in a field of work or study	A range of cognitive and practical skills required to accomplish tasks and solve problem by selecting and applying basic methods, tools, materials and information.	Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication.	Responsibility for own work and Learning and some responsibility for other's works and learning.

6. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

6.1 GENERIC LEARNING OUTCOME

1. Recognize & comply safe working practices, environment regulation and housekeeping.
2. Understand and explain different mathematical calculation & science in the field of study including basic electrical. *[Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature etc.]*
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]*
4. Select and ascertain measuring instrument and measure dimension of components and record data.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
8. Plan and organize the work related to the occupation.

6.2 SPECIFIC LEARNING OUTCOME

FIRST YEAR

9. Identify common chemical reagents and prepare various types of solutions.
10. Plan and estimate the strength of unknown acid, bases and other reagents.
11. Execute precipitation and complex metric titration to determine the strength of unknown reagents and record the data.
12. Verify the physical/ thermal properties and record the analysis.
13. Identify and test various electrical components like switches, fuses, conductors etc.
14. Identify, test various electronic components using proper measuring instruments and apply this knowledge to troubleshoot power supplies.
15. Verify the Electro-chemical properties of electrolytes.

16. Execute quantitative analysis of metal and non-metal by Gravimetric estimations.
17. Perform detection of inorganic substances by qualitative analysis.
18. Assemble, Test, calibrate and troubleshoot the pressure, temperature and recording instrument.

SECOND YEAR

19. Plan and organize the technique (with different unit process and unit operation) of organic compounds.
20. Plan and organize technique of inorganic substance with quality control.
21. Analyze different organic compounds to identify the compound and determine various parameters.
22. Analysis of different organic compounds and measurement in respect of waste water management.
23. Perform quantitative analysis of ore, alloy, organic and inorganic substance.
24. Perform analysis of fuel gas, sugar, oil, fat, soap and nitrogen in fertilizer.
25. Operate various measuring instruments used in chemical plant and laboratory.
26. Perform proximate analysis of coal and calorific value of different fuels.
27. Perform detection of micro-organism in food, pharmaceutical and other related laboratories.
28. Perform Experiments on Analyzing Equipment

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7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME	
LEARNING OUTCOME	ASSESSMENT CRITERIA
1. Recognize & comply safe working practices, environment regulation and housekeeping.	1.1 Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	1.2 Recognize and report all unsafe situations according to site policy.
	1.3 Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	1.4 Identify, handle and store / dispose of dangerous/unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements.
	1.5 Identify and observe site policies and procedures in regard to illness or accident.
	1.6 Identify safety alarms accurately.
	1.7 Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures.
	1.8 Identify and observe site evacuation procedures according to site policy.
	1.9 Identify Personal Protective Equipment (PPE) and use the same as per related working environment.
	1.10 Identify basic first aid and use them under different circumstances.
	1.11 Identify different fire extinguisher and use the same as per requirement.
	1.12 Identify environmental pollution & contribute to avoidance of same.
	1.13 Take opportunities to use energy and materials in an environmentally friendly manner
	1.14 Avoid waste and dispose waste as per procedure
	1.15 Recognize different components of 5S and apply the same in the working environment.
2. Understand, explain different mathematical calculation & science in the	2.1 Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure, heat

field of study including basic electrical and apply in day to day work. <i>[Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature etc.]</i>	treatment, center of gravity, friction.
	2.2 Measure dimensions as per drawing
	2.3 Use scale/ tapes to measure for fitting to specification.
	2.4 Comply given tolerance.
	2.5 Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.
	2.6 Ensure dimensional accuracy of assembly by using different instruments/gauges.
	2.7 Explain basic electricity, insulation & earthing.
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. <i>[Different engineering drawing- Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]</i>	3.1 Read & interpret the information on drawings and apply in executing practical work.
	3.2 Read & analyse the specification to ascertain the material requirement, tools, and machining /assembly /maintenance parameters.
	3.3 Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
4. Select and ascertain measuring instrument and measure dimension of components and record data.	4.1 Select appropriate measuring instruments such as micro meters, Vernier callipers, dial gauge, bevel protector and height gauge (as per tool list).
	4.2 Ascertain the functionality & correctness of the instrument.
	4.3 Measure dimension of the components & record data to analyse the with given drawing/measurement.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.	5.1 Explain the concept of productivity and quality tools and apply during execution of job.
	5.2 Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws.
	5.3 Knows benefits guaranteed under various acts
6. Explain energy conservation,	6.1 Explain the concept of energy conservation, global



global warming and pollution and contribute in day to day work by optimally using available resources.	warming, pollution and utilize the available recourses optimally & remain sensitive to avoid environment pollution.
	6.2 Dispose waste following standard procedure.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	7.1 Explain personnel finance and entrepreneurship.
	7.2 Explain role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non-financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.
	7.3 Prepare Project report to become an entrepreneur for submission to financial institutions.
8. Plan and organize the work related to the occupation.	8.1 Use documents, drawings and recognize hazards in the work site.
	8.2 Plan workplace/ assembly location with due consideration to operational stipulation
	8.3 Communicate effectively with others and plan project tasks
	8.4 Assign roles and responsibilities of the co-trainees for execution of the task effectively and monitor the same.

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SPECIFIC LEARNING OUTCOME	
LEARNING OUTCOME	ASSESSMENT CRITERIA
FIRST YEAR	
9. Identify common chemical reagents and prepare various types of solutions.	9.1 Plan, work in compliance with standard safety norms.
	9.2 Identify the glassware and chemical reagents.
	9.3 Prepare oxalic acid by exact weighing and make solution according to marking indicated in the glassware.
	9.4 Prepare Sulphuric acid by suitable laboratory reagents.
10. Plan and estimate the strength of unknown acid, bases and other reagents.	10.1 Setup electronic/ chemical balance for ideal condition.
	10.2 Label the solution with accuracy.
	10.3 Observe safety procedure during Titration as per standard norms and guidelines.
	10.4 Identify tools and instruments for titration.
	10.5 Measure the value of unknown concentration of given sample with following proper procedure.
	10.6 Detect exact end point in precipitation method.
	10.7 Detect exact end point in complex metric titration method.
11. Execute precipitation and complex metric titration to determine the strength of unknown reagents and record the data.	11.1 Prepare various reagents required for precipitation titration.
	11.2 Prepare various indicators required for precipitation titration.
	11.3 Practice exact end point detection by Mohr method. (15 hrs)
	11.4 Practice exact end point detection by Volhard method.
	11.5 Prepare various reagents required for complex metric titration
	11.6 Prepare various indicators required for complex metric titration.
	11.7 Practice complex metric titration by using EDTA.
12. Verify the physical/ thermal properties and record the analysis.	12.1 Plan working in compliance with standard safety norms.
	12.2 Identify the instruments.
	12.3 Make sure that instruments are ready to do work.
	12.4 Measure the value force, acceleration due to gravity and Young Modula's according to direction.
	12.5 Measure the value acceleration due to gravity.
	12.6 Measure the value Young Modula's according to direction.

	12.7 Tabulate the results.
13. Identify and test various electrical components like switches, fuses, conductors etc.	13.1 Measure and test the voltage given cells and battery.
	13.2 Connect the cells in series connection and parallel connection.
	13.3 Operate the circuit in full swing.
	13.4 Measured the resistance and other parameters.
	13.5 Tabulate the results.
14. Identify, test various electronic components using proper measuring instruments and apply this knowledge to troubleshoot power supplies.	14.1 Measure and test the voltage given cells and battery.
	14.2 Connect the cells in series connection and parallel connection.
	14.3 Operate the circuit in full swing.
	14.4 Verify Ohms Law.
	14.5 Verify Kirchhoff's Law.
	14.6 Determine specific resistance using wheat stone's Bridge.
15. Verify the Electro-chemical properties of electrolytes.	15.1 Make sure the electrolytic cells are ready to work properly.
	15.2 Batteries, Ammeter and voltmeter should be properly connected to circuits.
	15.3 Running the operation in full swing.
	15.4 Measure the current from Ammeter reading.
	15.5 Measure the time for the operation.
	15.6 Measure the deposition at cathode and anode by weighing.
	15.7 Tabulate the results.
	15.8 Verify Faraday's 1 st Law.
	15.9 Verify Faraday's 2 nd Law.
16. Execute quantitative analysis of metal and non-metal by Gravimetric estimations.	16.1 Plan work in compliance with standard safety norms.
	16.2 Identify the type of instruments.
	16.3 Identify the reagents and glassware for the following experiments.
	16.4 Prepare the specific reagents.
	16.5 Perform the procedure for chemical reaction.
	16.6 Perform the procedure for precipitate collection.
	16.7 Dry and weighing the precipitate.
	16.8 Tabulate the results in exact norm.
17. Perform detection of inorganic substances by qualitative analysis.	17.1 Plan work in compliance with standard safety norms.
	17.2 Identify laboratory reagents and glassware for the job.
	17.3 Perform reaction with proper quality control.

	17.4 Collect desired chemicals by filtration method.
	17.5 Dry and weighing the chemicals.
	17.6 Tabulate the results in exact norm.
18. Assemble, Test, calibrate and troubleshoot the pressure, temperature and recording instrument.	18.1 Plan work in compliance with standard safety norms.
	18.2 Identify the type of electrical instruments for the job.
	18.3 Assembled the different parts of the apparatus.
	18.4 Calibrate according to norms.
	18.5 Measure unknown pressure temperature etc.
SECOND YEAR	
19. Plan and organize the technique (with different unit process and unit operation) of organic compounds.	19.1 Prepare Acetanilide by Acetylation.
	19.2 Determine % yield of Acetanilide.
	19.3 Determine Melting point of Acetanilide.
	19.4 Prepare Methyl Oxalate by Esterification.
	19.5 Determine % yield of Methyl Oxalate.
	19.6 Determine Melting point of Methyl Oxalate.
	19.7 Prepare sodium benzene sulphonate by Sulphonation.
20. Plan and organize technique of inorganic substance with quality control.	20.1 Plan work in compliance with standard safety norms.
	20.2 Identify specific reagent, apparatus and glassware.
	20.3 Perform different unit process step by step.
	20.4 Perform different unit operation step by step.
	20.5 Collect organic compounds by filtration method.
	20.6 Measure yield and melting point of the organic compounds.
21. Analyze different organic compounds to identify the compound and determine various parameters.	21.1 Plan work in compliance with standard safety norms.
	21.2 Select appropriate reagents and glassware.
	21.3 Analyze the elements for the given organic compounds.
	21.4 Analyze the functional group for the given organic compounds.
	21.5 Prepare derivative of the organic compounds.
	21.6 Measure melting point of the organic compound.
	21.7 Measure yield and melting point the derivative.
22. Analysis of different organic compounds and measurement in respect of waste water management.	22.1 Follow and maintain procedure to achieve a safe working environment.
	22.2 Prepare reagents for COD.
	22.3 Perform the experiment with accuracy.
	22.4 Prepare reagents for BOD.
	22.5 Perform the experiment with accuracy.
	22.6 Prepare reagents for turbidity meter.

	22.7 Measure TSS in this meter.
	22.8 Tabulate the result for COD, BOD and TSS.
23. Perform quantitative analysis of ore, alloy, organic and inorganic substance.	23.1 Perform sample collection.
	23.2 Select appropriate reagents, glassware and apparatus.
	23.3 Perform chemical reaction with accuracy.
	23.4 Collect the desired substances in quantitative ways.
	23.5 Weighing accurately.
	23.6 Tabulate the result.
24. Perform analysis of fuel gas, sugar, oil, fat, soap and nitrogen in fertilizer.	24.1 Prepare reagents for orsat's apparatus.
	24.2 Fill the tube of the apparatus with reagents.
	24.3 Operate the instrument according to proper ways.
	24.4 Measure the composition of fuel gas.
	24.5 Prepare the reagents for acid value, saponification value and iodine value for oil, fat and soap analysis.
	24.6 Connect the apparatus with condenser.
	24.7 Perform the required chemical reaction.
	24.8 Perform the titration accurately.
	24.9 Tabulate the result.
	24.10 Calculation of acid value for the given oil.
	24.11 Calculation of specification value and iodine value for the given oil.
	24.12 Prepare reagents.
	24.13 Estimate % of sugar in given sample.
	24.14 Assembled Soxhlet's apparatus.
	24.15 Perform operation with given sample.
	24.16 Estimate % of fat in given sample.
	24.17 Assembled Kjeldahl's apparatus.
	24.18 Perform operation with given sample.
	24.19 Prepare table for calculation and estimate % of nitrogen in given sample.
25. Operate various measuring instruments used in chemical plant and laboratory.	25.1 Prepare reagents.
	25.2 Perform operation of Polari- meter.
	25.3 Prepare graph and table for calculation.
	25.4 Perform operation of electrolytic analyzer.
	25.5 Prepare buffer solution and other reagents.
	25.6 Perform operation of PH meter.
	25.7 Perform operation of colorimeter.
	25.8 Perform operation of spectro photometer.
	25.9 Perform operation of flame photometer.
	25.10 Perform operation of refractometer.



	25.11 Perform operation of Karlficher apparatus.
	25.12 Perform operation of thin layer chromatography.
	25.13 Perform operation of paper chromatography.
	25.14 Perform operation of quality of water analysis.
	25.15 Perform operation of digital moisture balance.
	25.16 Perform operation of redwood viscometer.
	25.17 Perform operation of Brookfield viscometer.
	25.18 Perform operation of electrophoresis apparatus.
	25.19 Perform operation of pensky-martin apparatus.
26. Perform proximate analysis of coal and calorific value of different fuels.	26.1 Perform weight of coal sample.
	26.2 Perform operation of furnace.
	26.3 Perform weight the coal sample after furnace operation.
	26.4 Calculate the result of volatile matter in the coal sample.
	26.5 Calculate the result of moisture in the coal sample.
	26.6 Calculate the result of ash content in the coal sample.
	26.7 Calculate the result of fixed carbon in the coal sample.
	26.8 Calculate the result of sulphur content in the coal sample.
	26.9 Plan work in compliance with standard safety and norms.
	26.10 Operate bomb calorimeter in proper way.
	26.11 Tabulate and calculate the result of calorific value of coal.
	26.12 Operate junker's calorimeter in proper way
	26.13 Tabulate and calculate the result of calorific value of LPG.
27. Perform detection of micro-organism in food, pharmaceutical and other related laboratories.	27.1 Perform operation and familiarity of different parts of a microscope.
	27.2 Identify common laboratory equipments and reagents used in microbiology lab.
	27.3 Prepare reagents and indicators.
	27.4 Perform Gram staining technique for detection of microorganism.
	27.5 Detection of colony formation using microscope.
28. Perform Experiments on Analyzing Equipment.	28.1 perform experiment on particle size by particle size analyzer (8 hrs.)
	28.2 To perform experiment on solid analyzer. (8 hrs.)
	28.3 To perform experiment on total surface area by surface area analyzer. (8 hrs.)

SYLLABUS - LABORATORY ASSISTANT (CHEMICAL PLANT)

FIRST YEAR

Week No.	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
1	Apply safe working practices.	<ol style="list-style-type: none"> Operate different types of fire extinguishers. (15 hrs.) Study Safety Data Sheet (SDS). (05 hrs.) Identify personal protection equipments (PPEs) used in chemical plant. (05 hrs.) 	Induction Training. Fire & Safety in Chemical Lab/Plant. First Aid. Introduction of pollution control.
2	Identify common chemical reagents and prepare various types of solutions.	<ol style="list-style-type: none"> Identify common chemical reagents by performing acid-base reaction. (05 hrs.) Identify common chemical reagents by performing precipitation reaction. (05 hrs.) Identify common chemical reagents by Performing colour change reaction. (05 hrs.) Identify common chemical reagents by generation of colour fume. (05 hrs.) Identify common chemical reagents by using Litmus Paper. (01 hrs.) Identify common chemical reagents by performing reaction generating gas with specific smell. (04 hrs.) 	General & Physical Chemistry Introduction to chemistry. Elements, atoms & molecules Chemical & physical changes. Concept about acid, base & salts. Determination of concentration of solutions by Normality & Molarity, IMP by weight by grams per liter.
3	-do-	<ol style="list-style-type: none"> Prepare solutions of solids by weighing. (05 hrs.) Prepare solutions of liquids by weighing. (05 hrs.) Prepare solutions of volatiles by weighing. (03 hrs.) Prepare solutions of non-volatiles by weighing. (02 hrs.) Prepare primary standard 	



		solutions by weighing. (05 hrs.) 15. Prepare secondary standard solutions by weighing. (05 hrs.)	
4-6	Plan and estimate the strength of unknown acid, bases and other reagents.	16. Prepare various reagents for analysis of acid and base. (10 hrs.) 17. Prepare various indicators. (10 hrs.) 18. Practice Titration between Hydrochloric acid and sodium hydroxide. (08 hrs.) 19. Practice Titration between mixture of sodium carbonate and sodium bi-carbonate with hydrochloric acid (08 hrs.) 20. Practice Titration between vinegar and standard sodium hydroxide. (08 hrs.) 21. Practice Titration between Boric acid and sodium hydroxide. (08 hrs.) 22. Practice Titration between Ammonium Chloride sample and sodium hydroxide.(08 hrs.) 23. Prepare Table formation and calculation of result for titration. (15 hrs.)	Atomic molecular and equivalent weights. Crystallography. Solutions. the laws of chemical combinations
7-10	-do-	24. Prepare various reagents required for Redox titration (10 hrs.) 25. Prepare various indicators required for Redox titration (10 hrs.) 26. Practice Permanganometry titration using permanganate solution. (20 hrs.) 27. Practice Dichrometry titrations using dichromate solution. (20 hrs.) 28. Practice Redox titrations using potassium iodate solution. (20 hrs.) 29. Practice Redox titrations using potassium bromate solution. (20 hrs.)	Periodic table of the elements. Periodic study of S & P Block Elements: Periodic study of: a) Zero group b) Transition Elements of 3-12 groups Periodic study of: a)14th group b)15th group (c)1 6th group c) 17th group d)18th group elements.



11-12	-do-	<p>30. Prepare various reagents required for Iodometric and Iodimetric titration. (10 hrs)</p> <p>31. Prepare various indicators required for Iodometric and Iodimetric titration. (10 hrs)</p> <p>32. Practice Iodometric titration using iodine solution indirectly. (15 hrs.)</p> <p>33. Practice Iodimetric titration using iodine solution directly. (15 hrs.)</p>	Chemical equilibrium. Thermo-chemistry & thermodynamics.
13-14	Execute precipitation and complex metric titration to determine the strength of unknown reagents and record the data.	<p>34. Prepare various reagents required for precipitation titration. (10 hrs)</p> <p>35. Prepare various indicators required for precipitation titration. (10 hrs)</p> <p>36. Practice exact end point detection by Mohr method. (15 hrs)</p> <p>37. Practice exact end point detection by Volhard method. (15 hrs)</p>	Metallurgy of: <ul style="list-style-type: none">• Aluminum.• Copper• Silver• Chromium• Iron & Steel• Zinc & its alloys.
15-16	-do-	<p>38. Prepare various reagents required for complex metric titration. (10 hrs)</p> <p>39. Prepare various indicators required for complex metric titration. (05 hrs)</p> <p>40. Practice complex metric titration by using EDTA. (35 hrs)</p>	Non-Metals: Preparation, properties & uses of following: <ul style="list-style-type: none">a) Hydrogen & its peroxide.b) Oxygenc) Sulphur & its compounds.d) Nitrogen & its compounds.e) Phosphorus & its compounds.f) Chlorine & Fluorine and its compounds.
17	Verify the physical/thermal properties and record the analysis.	Physics Lab: - <p>41. Verify parallelogram of forces with the help of mechanical board. (10 hrs.)</p> <p>42. Determine acceleration due to gravity (g) by simple pendulum. (05 hrs.)</p> <p>43. Determine Young's Modulus (Y) by Searle's apparatus (10 hrs.)</p>	Moment and Levers: moments, units, arm of couple and moment of couple, types of Levers. Simple machines, efforts and load, mechanical advantage, velocity ratio, efficiency of machines, their relationship, examples.

18	-do-	<p>44. Determine coefficient of expansion of solid. (10hrs.)</p> <p>45. Determine coefficient of Thermal conductivity of metal rod. (15hrs.)</p>	<p>Elasticity, Introduction, stress and strain, modulus of elasticity, different types of stresses, Hook's Law, Young's modulus, Yield point, ultimate, stress-strain graph, modulus of Rigidity, poisson ration, bulk modulus, factor of safety, examples.</p>
19	-do-	<p>46. Determine mechanical equivalent of heat by Joule's method. (25 hrs.)</p> 	<p>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.</p>
20	Identify and test various electrical components like switches, fuses, conductors etc.	<p>47. Measure various types of electric cells using series connections. (12 hrs.)</p> <p>48. Measure various types of electric cells using parallel connections. (13 hrs)</p>	<p>Electricity: Electric current, +Ve and -Ve terminals use of fuses and switches, conductors and insulators, simple electrical Circuits.</p>
21	Identify, test various electronic components using proper measuring instruments and apply this knowledge to troubleshoot power supplies.	<p>49. Verify Ohm's law (06hrs.)</p> <p>50. Verify Kirchhoff's law related to current and voltage. (07 hrs.)</p> <p>51. Determine specific resistance using wheat stone's Bridge. (12 hrs.)</p>	<p>Ohm's law, electrical insulating Materials, Kirchhoff's law, examples, Parallel and series circuit connections. Whetstone's bridge potentiometer.</p>
22	Verify the Electro-chemical properties of electrolytes.	<p>52. Perform electrolysis and verify Faraday's First and second laws of electrolysis. (25 hrs.)</p>	<p>Electrolysis, conservation of electrical energy into heat energy, Joule's law. mechanical equivalent of heat.</p>
23-24	<p>Project work / Industrial visit Broad areas:</p>		



	a) Determination of unknown strength of a given acid. b) Determination of percentage purity of a copper sulphate sample by Iodometry. c) Determination of Hardness of a given sample of water. d) Measurement of dia. & volume of different types of shapes by slide callipers. e) Determination of resistance of different wire by using Wheaston's Bridge.	
25-26	Revision	
27-35	Execute quantitative analysis of metal and non-metal by Gravimetric estimations.	<p>53. Prepare suitable reagents by weighing for Gravimetric estimations of Nickel. (10 hrs)</p> <p>54. Prepare suitable reagents by weighing for Gravimetric estimations of Iron.(10 hrs)</p> <p>55. Prepare suitable reagents by weighing for Gravimetric estimations of Barium.(10 hrs)</p> <p>56. Prepare suitable reagents by weighing for Gravimetric estimations of Lead.(10 hrs)</p> <p>57. Prepare suitable reagents by weighing for Gravimetric estimations of Silicon.(10 hrs)</p> <p>58. Perform chemical reaction between reagents and collection of precipitation for Nickel.(15 hrs)</p> <p>59. Perform chemical reaction between reagents and collection of precipitation for Iron.(15 hrs)</p> <p>60. Perform chemical reaction between reagents and collection of precipitation for Barium.(15 hrs)</p> <p>61. Perform chemical reaction between reagents and collection of precipitation for Lead.(15 hrs)</p> <p>62. Perform chemical reaction between reagents and collection of precipitation for Silicon.(15 hrs)</p> <p>63. Perform furnace operation for complete drying of precipitation. (60 hrs)</p> <p>64. Estimate quantity of dried</p>



		precipitation by weighing.(20 hrs) 65. Prepare table formation and stoichiometric calculation for final estimation of given metal & non-metal.(20 hrs)	
36-45	Perform detection of inorganic substances by qualitative analysis.	66. Identify Inorganic substances by their physical properties (colour, solubility, acidic or basic nature). (12 hrs) Dry test for cations: 67. Identify Inorganic substances by dry test tube heating. (08 hrs) 68. Identify Inorganic substances by Flame test. (08 hrs) 69. Identify Inorganic substances by Borax Bead test. (8 hrs) 70. Identify Inorganic substances by Fusion test. (08 hrs) Dry test for Anions: 71. Identify Inorganic substances by reaction with dilute acids. (08 hrs) 72. Identify Inorganic substances by reaction with concentrated acids. (08 hrs) Wet test for cations: 73. Identify Inorganic substances by wet test for Gr-I metals. (10 hrs) 74. Identify Inorganic substances by wet test for Gr-II metals. (10 hrs) 75. Identify Inorganic substances by wet test for Gr-IIIA metals. (10 hrs) 76. Identify Inorganic substances by wet test for Gr-IIIB metals. (10 hrs) 77. Identify Inorganic substances by wet test for Gr-IV metals. (10 hrs) 78. Identify Inorganic substances by wet test for Gr-V metals. (10 hrs) Wet test for Anions: 79. Identify Inorganic substances by	Fertilizer its types & uses Atmosphere air, Electro-chemistry & electrolysis, Water & its type, Water Treatment (Purification), Law of mass action, Le-chatelier's principle and application in chemical industry. Study of physical properties of substances. Study of Rault's Law for dilute solution.



		<p>wet test for Chloride. (10 hrs)</p> <p>80. Identify Inorganic substances by wet test for Bromide. (10 hrs)</p> <p>81. Identify Inorganic substances by wet test for Iodide. (10 hrs)</p> <p>82. Identify Inorganic substances by wet test for Flouride. (10 hrs)</p> <p>83. Identify Inorganic substances by wet test for Sulphate. (10 hrs)</p> <p>84. Identify Inorganic substances by wet test for Sulphide. (10 hrs)</p> <p>85. Identify Inorganic substances by wet test for Sulphite. (10 hrs)</p> <p>86. Identify Inorganic substances by wet test for Thiosulphate. (10 hrs)</p> <p>87. Identify Inorganic substances by wet test for Nitrate & Nitrite. (10 hrs)</p> <p>88. Identify Inorganic substances by wet test for Phosphate. (10 hrs)</p> <p>89. Identify Inorganic substances by wet test for Chromate. (10 hrs)</p> <p>90. Identify Inorganic substances by wet test for Carbonate & Bi-Carbonate. (10 hrs)</p> <p>91. Identify Inorganic substances by wet test for Borate. (10 hrs)</p>	
46-47	Assemble, Test, calibrate and troubleshoot the pressure, temperature and recording instrument.	<p>92. Perform Calibration of Bourdon tube pressure gauges. (13 hrs.)</p> <p>93. Perform operation of Manometer. (12 hrs.)</p> <p>94. Perform Calibration of Alcohol in glass thermometer. (13 hrs.)</p> <p>95. Perform Calibration of bimetallic thermometer. (12 hrs.)</p>	Units of pressure, measurement of pressure by different methods. Temperature scale, different methods of temperature measurement.
48	-do-	<p>96. Perform operation of Resistance thermometer. (08 hrs.)</p> <p>97. Perform operation of Thermocouple. (08 hrs.)</p> <p>98. Perform operation of Thermocouple Pyrometer. (09 hrs.)</p>	Same as week No.47, Thermometer, Thermocouple and pyrometer.
49	-do-	<p>99. Perform Operation of recorders. (08 hrs.)</p>	Recorder, On- off controller, Transmitter.

		100.Perform Operation of Transmitter. (8 hrs.) 101.Perform Operation of controller. (09 hrs.)	
50	Project work / Industrial visit Broad areas: <ol style="list-style-type: none"> Estimate Iron as Fe₂O₃ by gravimetric analysis. Identify interfering radicals present in a inorganic salt mixture. Perform the removal of these interfering radicals. Make Block diagram of process control loop. Calibration of Bourdon type pressure gauge & measure pressure by this. 		
51	Revision		
52	Examination		

Note: -

- Some of the sample project works (indicative only) are given at the mid and end of each year.
- Instructor may design their own projects and also inputs from local industry may be taken for designing such new projects.
- The project should broadly cover maximum skills in the particular trade and must involve some problem solving skill. Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration, work to be assigned in a group (Group of at least 4 trainees). The group should demonstrate Planning, Execution, Contribution and Application of Learning. They need to submit a Project report after completion.
- If the instructor feels that for execution of specific project more time is required then he may plan accordingly in appropriate time during the execution of normal trade practical.



SYLLABUS - LABORATORY ASSISTANT (CHEMICAL PLANT)

SECOND YEAR

Week No.	Reference Learning outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
53-61	Plan and organize the technique (with different unit process and unit operation) of organic compounds.	102. Prepare Acetanilide by Acetylation. (20 hrs.) 103. Determine % yield of Acetanilide. (10 hrs.) 104. Determine Melting point of Acetanilide. (01 hr.) 105. Prepare Methyl Oxalate by Etherification. (15 hrs.) 106. Determine % yield of Methyl Oxalate. (04 hrs.) 107. Determine Melting point of Methyl Oxalate. (01 hr) 108. Prepare sodium benzene sulphonate by Sulphonation. (15 hrs.) 109. Determine % yield of sodium benzene sulphonate. (10 hrs.) 110. Determine Melting point of sodium benzene sulphonate. (05 hrs.) 111. Prepare Nitrobenzene by Nitration. (15 hrs.) 112. Determine % yield of Nitrobenzene. (04 hrs.) 113. Determine Melting point of Nitrobenzene. (01 hr) 114. Prepare Tribromophenol by Halogenation. (20 hrs.) 115. Determine % yield of Tribromophenol. (04 hrs.) 116. Determine Melting point of Tribromophenol. (01 hr) 117. Prepare oxalic acid by Oxidation. (20 hrs.) 118. Determine % yield of oxalic acid. (04 hrs) 119. Determine Melting point of oxalic acid. (01 hr)	Introduction to Organic Chemistry. Purification of Organic Compounds. Purification of Organic Compounds. Types of organic reactions Classification & nomenclature. Aliphatic hydrocarbons Halogen derivatives of hydrocarbons - aliphatic alcohol Ethers, Aldehydes, Ketones Carboxylic acid. Amides & Anhydride, Acid Halides Esters Oil & Fats. Soaps & Detergents.



		120. Prepare Aniline by reduction. (15 hrs.) 121. Determine % yield of Aniline. (04 hrs.) 122. Determine Melting point of Aniline. (01 hr) 123. Determine % yield of Methyl orange, Ozazone, Glucosazone. (04 hrs.) 124. Determine Melting point of Methyl orange. (10 hrs) 125. Prepare soap by Saponification. (20 hrs.) 126. Determine % yield of soap. (04 hrs.) 127. Determine saponification value. (01 hr) 128. Prepare Aspirin. (10 hrs.) 129. Determine % yield of Aspirin. (04 hrs.) 130. Determine Melting point of Aspirin. (01 hr)	
62-66	Plan and organize technique of inorganic substance with quality control.	131. Prepare sodium carbonate. (20 hrs) 132. Determine % yield & purity. (05 hrs.) 133. Prepare copper sulphate. (20 hrs) 134. Determine % yield & purity. (5hrs.) 135. Prepare Mohr's salt. (20 hrs) 136. Determine % yield & purity. (05 hrs.) 137. Prepare potash alum. (20 hrs) 138. Determine % yield & purity. (05 hrs.) 139. Prepare potassium nitrate. (20 hrs) 140. Determine % yield & purity. (05 hrs.)	Amines Cyanogen compounds Carbohydrates & Protein Polymers, Aromatic, Hydrocarbons, aromatic ethers. halogen derivatives Compounds with nitrogen urea
67-74	Analyze different organic compounds to identify the compound and determine various	Analysis of organic compounds to determine followings: 141. Element present. (30 hrs) 142. Functional group. (40 hrs) 143. Melting point of organic	Aromatic acids Compounds of double & triple rings Heterocyclic compounds Diazonium salts, colour and dyes.



	parameters.	<p>compound. (5 hrs)</p> <p>144. Preparation of derivatives. (100 hrs)</p> <p>145. Melting point of derivatives for following groups of compounds: Alcohol, acid, carbohydrate, Nitro compounds, Amines, halogen compounds, sulphur compounds, phenolic compounds, Aldehyde, Ketone & Ester. (25 hrs)</p>	
75-76	Analysis of different organic compounds and measurement in respect of waste water management.	<p>146. Analysis of C.O.D. (08 hrs)</p> <p>147. Analysis of B.O.D. (39 hrs)</p> <p>148. Analysis of T.S.S. (01 hr)</p> <p>149. Analysis of Turbidity. (01 hr)</p> <p>154. Analysis of TDS. (01 hr)</p>	-Do-
77	<p>Project work / Industrial visit</p> <p>Broad Areas:</p> <p>a) Prepare meta-di-nitro benzene.</p> <p>b) Laboratory preparation of methyl red indicator.</p> <p>c) Laboratory preparation of Mohr's salt.</p> <p>d) Determination of SAP value of a given oil & prepare a soap.</p> <p>e) Analysis of a given organic compound.</p>		
78	Revision		
79	Perform quantitative analysis of ore, alloy, organic and inorganic substance.	<p>150. Perform chemical reaction for analysis of Bauxite or Zinc ore. (15 hrs)</p> <p>151. Estimate elements. (10 hrs)</p>	Flow sheet for industrial production of Ammonia, Nitric acid, sulphuric acid, urea, paper, sugar, caustic, chlorine & polymers.
80	-do-	<p>152. Perform chemical reaction for analysis of Brass or Soldering materials. (15 hrs)</p> <p>153. Estimate elements. (10 hrs)</p>	-Do-
81	-do-	<p>154. Perform chemical reaction for analysis of calcium in given tablet. (20 hrs)</p> <p>155. Estimate calcium. (5 hrs)</p>	-Do-
82	-do-	<p>Estimation of formaldehyde by Iodometric method:</p> <p>156. Prepare reagents. (05 hrs)</p> <p>157. Perform titration. (15 hrs)</p> <p>158. Prepare table for</p>	



		calculation & estimate % of formaldehyde in given sample. (05 hrs)	
83	-do-	Estimation of aniline or phenol in the given solution by Bromination method: 159. Prepare reagents. (05 hrs) 160. Perform titration. (15 hrs) 161. Prepare table for calculation & estimate % of aniline or phenol in given sample. (05 hrs)	
84	Perform analysis of fuel gas, sugar, oil, fat, soap and nitrogen in fertilizer.	162. Prepare reagents for Orsat's Apparatus. (10 hrs) 163. Perform operation of Orsat's Apparatus. (10 hrs) 164. Estimate composition of gases. (05 hrs)	-Do-
85-86	-do-	165. Determine acid value of an oil or fat. (08 hrs) 166. Determine saponification value of an oil or fat. (08 hrs) 167. Determine Iodine value of an oil or fat. (09 hrs)	Percentage of elements in chemical compounds Empirical formulae of chemical compounds. Empirical formulae of chemical compounds, balancing chemical equation
87	-do-	Determination of fat by Soxhlet's Extraction method: 168. Construct Soxhlet's apparatus by assembling different parts. (05 hrs) 169. Perform operation with given sample. (15 hrs) 170. Estimate % of fat in given sample. (05 hrs)	Electrolysis. Electro chemistry, electro-chemical series, Heat effect of electricity.
88	-do-	Estimation of nitrogen by Kjeldahl's method: 171. Construct Kjeldahl's apparatus by assembling different parts. (05 hrs) 172. Prepare reagents. (05 hrs) 173. Perform operation with given sample. (10 hrs) 174. Prepare table for calculation & estimate % of nitrogen in	Material balance.



		given sample. (05 hrs)	
89	Operate various measuring instruments used in chemical plant and laboratory.	175. Prepare reagents. (05 hrs) 176. Perform operation of the instrument. (15 hrs) 177. Prepare graph & table for calculation. (05 hrs)	Radio chemistry, Decay of radio isotopes. Equation of decay half time value.
90	-do-	Determination optical rotation of sugar solution by Polari-meter: 178. Prepare reagents. (05 hrs) 179. Perform operation of the instrument. (15 hrs) 180. Prepare graph & table for calculation. (05 hrs)	Introduction to microbiology.
91	-do-	Determination of % of elements by Electrolytic analyzer: 181. Prepare reagents. (05 hrs) 182. Perform operation of the instrument. (20 hrs)	Introduction to Bacteria cell. Lovibond comparator.
92	-do-	Determine the PH of given solutions by using PH-meter & comparator (Visual Calorimeter): 183. Prepare Buffer solution & reagents. (10 hrs) 184. Perform operation of the pH meter. (15 hrs)	Sterilization - Details study
93	-do-	Determine concentration of unknown coloured solution by colorimeter: 185. Prepare reagents. (05 hrs) 186. Perform operation of the instrument. (20 hrs)	Introduction to Nutrition of bacteria.
94	-do-	Determine concentration of unknown solution by Spectrophotometer : 187. Prepare reagents. (05 hrs) 188. Perform operation of the instrument. (20 hrs)	Introduction to Industrial Microbiology.
95-97	-do-	Practice operation of following laboratory instruments: 189. Digital flame photometer (09 hrs) 190. Refractometer (oil/sugar) (09 hrs) 191. Karlfischer apparatus. (09	Fuel (Definition, classification, properties, composition & uses)



		<p>hrs)</p> <p>192. Analysis of water quality used in industry (PH, TDS, TSS, HARDNESS and elements). (14 hrs)</p> <p>193. Digital moisture balance (09 hrs)</p> <p>194. Brookfield viscometer (09 hrs)</p> <p>195. Electrophoresis apparatus (09 hrs)</p> <p>196. Pensky –Martin apparatus (Flash point). (07 hrs)</p>	
98	Perform proximate analysis of coal and calorific value of different fuels.	<p>197. Determine moisture in given sample of coal. (6 hrs)</p> <p>198. Determine volatile matter in given sample of coal. (6 hrs)</p> <p>199. Determine ash content in given sample of coal (Furnace). (7 hrs)</p> <p>200. Determine sulphur & fixed carbon in given sample of coal(C-S Det. App. LECO). (6 hrs)</p>	-Do-
99	-do-	<p>201. Determine calorific value of kerosene oil using Bomb Calorimeter. (8 hrs)</p> <p>202. Determine calorific value of coal using Bomb Calorimeter. (8 hrs)</p> <p>203. Determine calorific value of LPG using Jules Calorimeter. (9 hrs)</p>	<p>Identification of different micro-organism</p> <p>Micro- organisms & infections. Streptomycin Yeast</p> <p>Micro- organisms & infections. Streptomycin Yeast</p> <p>Bread ,Alcohol, Beers, Wines</p>
100	Perform detection of micro-organism in food, pharmaceutical and other related laboratories.	<p>204. Perform Operation of Microscope. (08 hrs)</p> <p>205. Identify common laboratory equipment's used in microbiology. (4 hrs.)</p> <p>206. Prepare media required for inoculations. (05 hrs)</p> <p>207. Identify microorganism by Gram staining technique. (08 hrs)</p>	-Do-

101	Perform Experiments on Analyzing Equipment	208. To perform experiment on particle size by particle size analyzer (8 hrs.) 209. To perform experiment on solid analyzer. (8 hrs.) 210. To perform experiment on total surface area by surface area analyzer. (9 hrs.)	Working, Principles and Uses of Analyzing equipment.
102	Project work / Industrial visit Broad areas: <ol style="list-style-type: none"> Estimation of nitrogen of a given fertilizer by Kjeldahl's method. Prepare Buffer of different pH & measure unknown pH by pH meter. Determination of concentration of copper present in brass sample by Spectrophotometer. Determination calorific value of Kerosene. Identify micro-organism by staining method. 		
103	Revision		
104	Examination		

Note: -

- Some of the sample project works (indicative only) are given at the mid and end of each year.
- Instructor may design their own projects and also inputs from local industry may be taken for designing such new projects.
- The project should broadly cover maximum skills in the particular trade and must involve some problem solving skill. Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration, work to be assigned in a group (Group of at least 4 trainees). The group should demonstrate Planning, Execution, Contribution and Application of Learning. They need to submit a Project report after completion.
- If the instructor feels that for execution of specific project more time is required then he may plan accordingly in appropriate time during the execution of normal trade practical.

9. SYLLABUS - CORE SKILLS

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

S No.	Workshop Calculation and Science	Engineering Drawing
FIRST YEAR		
1.	Unit: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	Engineering Drawing: Introduction and its importance <ul style="list-style-type: none"> - Relationship to other technical drawing types - Conventions - Viewing of engineering drawing sheets - Method of Folding of printed Drawing Sheet as per BIS SP:46-2003
2.	Fractions: Fractions, Decimal fraction, L.C.M., H.C.F., Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using a scientific calculator.	Drawing Instruments: their Standard and uses <ul style="list-style-type: none"> - Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.
3.	Square Root: Square and Square Root, method of finding out square roots, Simple problem using a calculator.	Lines: <ul style="list-style-type: none"> - Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) - Drawing lines of given length (Straight, curved) - Drawing of parallel lines, perpendicular line - Methods of Division of line segment
4.	Ratio & Proportion: Simple calculation on related problems.	Drawing of Geometrical Figures: Definition, nomenclature and practice of <ul style="list-style-type: none"> - Angle: Measurement and its types, method of bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.
5.	Percentage: Introduction, Simple calculation. Changing percentage to	Lettering and Numbering as per BIS SP46-2003:

	decimal and fraction and vice-versa.	<ul style="list-style-type: none"> - Single Stroke, Double Stroke, inclined, Upper case and Lower case.
6.	Material Science: Properties -Physical & Mechanical, Types–Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.	Dimensioning: <ul style="list-style-type: none"> - Definition, types and methods of dimensioning (functional, non-functional and auxiliary) - Types of arrowhead - Leader Line with text
7.	Mass, Weight and Density: Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.	Freehand drawing of: <ul style="list-style-type: none"> - Lines, polygons, ellipse, etc. - Geometrical figures and blocks with dimension - Transferring measurement from the given object to the free hand sketches.
8.	Speed and Velocity: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems.	Sizes and Layout of Drawing Sheets: <ul style="list-style-type: none"> - Basic principle of Sheet Size - Designation of sizes - Selection of sizes - Title Block, its position and content - Borders and Frames (Orientation marks and graduations) - Grid Reference - Item Reference on Drawing Sheet (Item List)
9.	Work, Power and Energy: Work, unit of work, power, unit of power, Horsepower of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	Method of presentation of Engineering Drawing: <ul style="list-style-type: none"> - Pictorial View - Orthogonal View - Isometric view
10.	-----	Symbolic Representation (as per BIS SP:46-2003) of: <ul style="list-style-type: none"> - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections - Weld, brazed and soldered joints - Electrical and electronics element - Piping joints and fittings
11.	Algebra: Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	Construction of Scales and diagonal scale
12.	Mensuration: Area and perimeter of square, rectangle, parallelogram, triangle,	Practice of Lettering and Title Block



	circle, semi-circle. Volume of solids – cube, cuboids, cylinder and Sphere. Surface area of solids – cube, cuboids, cylinder and Sphere.	
13.	Trigonometry: Trigonometrical ratios, measurement of angles. Trigonometric tables	Dimensioning practice: <ul style="list-style-type: none">- Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003)- Symbols preceding the value of the dimension and dimensional tolerance.- Text of dimension of repeated features, equidistance elements, circumferential objects.
14.	Heat & Temperature: Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relations between different scale of temperature, Thermometer, promoter, transmission of heat, conduction, convection, radiation.	Construction of Geometrical Drawing Figures: <ul style="list-style-type: none">- Different Polygons and their values of included angles. Inscribed and Circumscribed polygons.- Conic Sections (Ellipse & Parabola)
15.	Basic Electricity: Introduction, use of electricity, how electricity is produced, Types of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections– series, parallel, electric power, Horsepower, energy, unit of electrical energy.	Drawing of Solid figures (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid) with dimensions.
16.	Levers and Simple Machines: Levers and its types. Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio, Efficiency of machine, Relationship between Efficiency, velocity ratio and Mechanical Advantage.	Free Hand sketch of hand tools and measuring tools used in the respective trades.
17.	–	Projections: <ul style="list-style-type: none">- Concept of axes plane and quadrant- Orthographic projections- Method of first angle and third angle projections (definition and difference)



		- Symbol of 1st angle and 3rd angle projection as per IS specification
18.	-	Drawing of Orthographic projection from isometric/3D view of blocks
19.	-	Orthographic Drawing of simple fastener (Rivet, Bolts, Nuts & Screw)
20.	-	Drawing details of two simple mating blocks and assembled view.
SECOND YEAR		
1.	Density and specific gravity. Archimedes's principle, principle of floatation hydrometers. Centre of gravity and equilibrium condition.	Free-hand sketches of Hand Tools, Screw drivers, Pliers, Spanner, Tweezer. Free-hand sketches of Vernier Caliper, micrometer, Depth Gauge, Dial Test Indicator, Bevel protractor
2.	Pressure, temperature, Boyle's law, Charle's law, Equation of perfect gas. Calculations. Definition - Torque, compression ratio, IHP, BHP, Mechanical efficiency.	ISI symbols of Generator, Voltmeter, Ammeter, Watt- meter. Resister, inductor, Capacitor, Transformer, AC & DC motors.etc. Drawing of pressure control process line.
3.	Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.	Drawing sketches of different types of valves, such as gate valve, globe valve, ball valve, Plug Valve, check valve etc.
4.	Moment and lever-Moments, unit, arm of couple. Principle of Moment, moment of couple, lever, torque. Centre of Gravity, (C.G. Of square, rectangle, triangle, circle, semicircle, cone) & its calculations.	Drawing of different types locking devices such as double nut, castle nut, pin etc. Drawings of different types of keys. Types of couplings such as muff coupling, Half lap coupling, Flange coupling
5.	Definition - viscosity, flash point, fire point, flash points of standard lubricating oils, octane number.	Free hand sketches and symbolic representation of different types of valves-gate valve, globe valve, butterfly valve, ball valve, diaphragm valve, control valve, non-return valve, and needle valve.
6.	Newton's laws of motion, unit of force, find out resultant force, space and vector diagram, representation of force, parallel force, couple, parallelogram law of forces, condition of equilibrium, kind of equilibrium, some examples of equilibrium	Free hand sketches of Belt conveyer , Screw conveyer, Bucket elevator



	in daily life, Lami's theorem.	
7.	Advantages & Disadvantages of friction, Limiting friction, Laws of limiting friction, Coefficient of friction, angle of friction, Inclined plane, Force of friction.	-----
8.	Introduction, Different types of stresses, Hooke's law, Young's modulus or modulus of elasticity, yield point, factor of safety, stress strain graph, Modulus of rigidity, Poisson's ratio, Calculation (i.e. stress, strain, young modulus, factor of safety)	-----
9.	Flow of fluids- Equation of continuity, Bernoulli's theorem, flow measurement by orifice meter, venturi meter, Rota meter, U-tube manometer.	Drawing of pressure, Level, flow and temperature control system.
10.	Further Mensuration:- Volumes of frustums including conical frustums. Graph- Basics, abscissa, co-ordinate etc. $Y = mx$ and $Y = mx + c$ graph	Exercises on blue print reading related to the trade. Free hand sketches of crushers, ballmill, hammermill and centrifuges.
11.	Simple Problems on Profit & Loss. Simple and compound interest.	Free hand sketches of steam jet ejector, steam trap
12.	Transmission of Motion and Power- Belt and pulley system, calculation to find out length of belt, slip of belt, RPM, Dia. Of pulley, circular & dimetral pitch of gear, distance between centre of two gears	Diagram of distillation column with all accessories Free hand sketches of process instrument- such as temperature indicator, level indicator, LIC, TIC, PI, PIC, FI, FIC
13.	DEFINITION: Torque, compression ratio, IHP, BHP, Mechanical efficiency, FHP, Swept volume, piston speed (for reciprocating machine) & Calculations.	Free Hand Sketches of Process Flow Sheets of Manufacturing- Ammonia and Urea
14.	Bending moment (BM), shearing force, Beam -simply supported beam, simply supported beam with distributed load, cantilever with point load at the free end, cantilever with distributed load and its calculation.	-----
15.	Latent heat, sensible heat, saturated steam, wet steam, superheated steam. Reynolds's number, calculation of Reynolds's number at different velocities,	-----

9.2 EMPLOYABILITY SKILLS

Duration: 110 Hrs.	
1. English Literacy	
Duration : 20 Hrs. Marks : 09	
Pronunciation	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)
Functional Grammar	Transformation of sentences, Voice change, Change of tense, Spellings.
Reading	Reading and understanding simple sentences about self, work and environment
Writing	Construction of simple sentences Writing simple English
Speaking / Spoken English	Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.
2. I.T. Literacy	
Duration : 20 Hrs. Marks : 09	
Basics of Computer	Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.
Computer Operating System	Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.
Word processing and Worksheet	Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets.
Computer Networking and Internet	Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Meaning of World Wide Web (WWW), Web Browser, Web Site, Web page and Search Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of



	email. Social media sites and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.	
3. Communication Skills		Duration : 15 Hrs. Marks : 07
Introduction to Communication Skills	Communication and its importance Principles of Effective communication Types of communication - verbal, non verbal, written, email, talking on phone. Non verbal communication -characteristics, components-Para-language Body language Barriers to communication and dealing with barriers. Handling nervousness/ discomfort.	
Listening Skills	Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active Listening Skills.	
Motivational Training	Characteristics Essential to Achieving Success. The Power of Positive Attitude. Self awareness Importance of Commitment Ethics and Values Ways to Motivate Oneself Personal Goal setting and Employability Planning.	
Facing Interviews	Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview.	
Behavioral Skills	Problem Solving Confidence Building Attitude	
4. Entrepreneurship Skills		Duration : 15 Hrs. Marks : 06
Concept of Entrepreneurship	Entrepreneur - Entrepreneurship - Enterprises:-Conceptual issue Entrepreneurship vs. management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.	
Project Preparation & Marketing analysis	Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of PLC, Sales & distribution Management. Different Between	



	Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.
Institutions Support	Preparation of Project. Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.
Investment Procurement	Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.
5. Productivity	
	Duration : 10 Hrs. Marks : 05
Benefits	Personal / Workman - Incentive, Production linked Bonus, Improvement in living standard.
Affecting Factors	Skills, Working Aids, Automation, Environment, Motivation - How improves or slows down.
Comparison with developed countries	Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.
Personal Finance Management	Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.
6. Occupational Safety, Health and Environment Education	
	Duration : 15 Hrs. Marks : 06
Safety & Health	Introduction to Occupational Safety and Health importance of safety and health at workplace.
Occupational Hazards	Basic Hazards, Chemical Hazards, Vibroacoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.
Accident & safety	Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.
First Aid	Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person.
Basic Provisions	Idea of basic provision legislation of India. safety, health, welfare under legislative of India.
Ecosystem	Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.



Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.	
Energy Conservation	Conservation of Energy, re-use and recycle.	
Global warming	Global warming, climate change and Ozone layer depletion.	
Ground Water	Hydrological cycle, ground and surface water, Conservation and Harvesting of water.	
Environment	Right attitude towards environment, Maintenance of in-house environment.	
7. Labour Welfare Legislation		Duration : 05 Hrs. Marks : 03
Welfare Acts	Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.	
8. Quality Tools		Duration : 10 Hrs. Marks : 05
Quality Consciousness	Meaning of quality, Quality characteristic.	
Quality Circles	Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles.	
Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.	
House Keeping	Purpose of House-keeping, Practice of good Housekeeping.	
Quality Tools	Basic quality tools with a few examples.	

List of Tools & Equipment			
LABORATORY ASSISTANT (CHEMICAL PLANT) (For batch of 20 Candidates)			
S No.	Name of the Tools and Equipment	Specification	Quantity
A. GENERAL MACHINERY & SHOP OUTFIT			
1.	Digital balance	LCD /LED display accuracy: 0.1mg, capacity 200 Gms.	5 nos.
2.	Balance (tech.)	LCD /LED display accuracy: 1gm ,1 gm to 10 kg capacity.	1 no.
3.	Auto-clave electrically heated	Capacity: 55 lit, Material: SS 304, pressure gauge, temp. range 121 to 125 °C, temp. accuracy $\pm 0.5\%$ with auto cycle controller and solenoid valve foot lifting and drum.	1 no.
4.	Vacuum pump mounted on moving tables	0.5 HP electrical motor cap: 50 LPM /2 CFM, oil cooled	2 nos.
5.	Electric drying ovens	Working temp :200°C size: 450*450*450 mm, inner SS chamber and outer body M.S powder coated and controlled by PID Controller and Air circulation facility.	2 nos.
6.	Water baths 6 places, electrically heated	Double Walled with Digital controller cum indicator with Stirring Arrangement inside stainless Steel Temp. Range Amb, +5deg.c. To 95. deg.c./-0.2	4 nos.
7.	Sand bath		1 no.
8.	Refrigerator(Deep Freezer Double Door Type)	Single door, Auto defrosting. 200-liter capacity made up of complete S.S.	1 no.
9.	Chromatographic equipment	Paper, column, thin layerColumn Type Chromatographic Equipment: Gas Chromatograph, The Gas	1 No.

		Chromatograph should be Microcontroller based system with oven, PLC based pneumatic module, temperature controller cum programmer module, FID and TCD Module, PC based Data station and also remote display unit for displaying concentration of one key component of the sample via RS 485 port, Windows based single channel software, With All accessories. Liquid Chromatographic Equipment: With Solvent delivery system, Injector, UV – VIS detector, HPLC column:	
10.	Stirrers with motors	230V, AC, capacity 5 - 7 liters with regulator	8 nos.
11.	Magnetic stirrers (with heating plate)	2 liters capacity with heating coil	2 nos.
12.	Mortar	100mm, porcelain with pestle	6 nos.
13.	Heating plates (electric)	1000 watt	1 no.
14.	Mortar & pestle	150 mm. steel / cast iron	1 no.
15.	Electric heating plates	With C.I top 16 "x18 "size and regulator	2 nos.
16.	Heating mantles (universal)		6 nos.
17.	Borer for stoppers with sharpener		1 no.
18.	Clamps with spring or screw		*20 nos.
19.	Cork press		1 no.
20.	Scissors		2 nos.
21.	Bunsen's burner		*20 nos.
22.	Set sieves automatic	20 – 200 mesh	1 no.
23.	Shaking machines for sieves & bottles		1 no.
24.	Steam generator (copper) for steam distillation	2 liters	10 nos.
25.	Hot water funnel with thermometer	1 liter, 0 to 110 *C	10 nos.
26.	Tongs (forceps) nickel for crucibles &		*20 nos.



	weights		
27.	Tongs long for crucibles (muffle furnace)		6 nos.
28.	Spatulas nickel		20 nos.
29.	Test tube stand	For 10 - 12 test tubes	*20 nos.
30.	Tripods		*20 nos.
31.	Test tube holders		*20 nos.
32.	Clamp holders		*20 nos.
33.	Clamps(Forced Head)		*20 nos.
34.	Retort Rings with clamps for filtering & heating		*20 nos.
35.	Stands Burret		*20 nos.
36.	Stands with clamps for burettes		*20 nos.
37.	Apparatus for distilled water and demineralizing water	Cap: 10 liter/hr, made of S.S with water level cut off	1 each
38.	Crucible nickel	30 mm. dia, height 40 mm.,	6 nos.
39.	One pan analytical balances	0.1mg. To 100 Gm. Sensibility	5 nos.
40.	LCD Multimedia projector		1 no.
41.	Computer (latest configuration) with licentiate operating software.		1 no.
42.	Printer (Printer, Scanner & Copier)		1 no.
43.	Microscope	x 1000 (Monocular)	1 no.
44.	Polarimeters with extra sodium lamp	Optical wavelength of 589nm, Measuring range of ± 89 Deg., Accuracy of 0.01- 0.002° Temperature range of 0-40 oC (accuracy +/- 0.1 Deg C) Response speed of +/- 6°/sec	2 no.
45.	Refractometers (Abbe type with refractive index)	Range of measurement nD 1.3000 – 1.7000, scale reading +0.001 and 0.0001 by estimation, Sugar scale 0.95% (+0.5%), Dispersion of nD + 0.0005	1 no.
46.	pH meter Digital	With PH Range of 1 -14, Resolution of 0.01 pH, Temperature Range up to 0.0oC to 100oC, Digital LED/LCD Display, Power Supply of 230VAC $\pm 10\%$, with auto calibration facility, auto manual temp., compensation facility,	1 no.

		PH Electrode. To study the measurement of PH.	
47.	Potentiometric titration apparatus	Range: 0 to+ 1999.9mV Resolution: 1 mV	1 no.
48.	Conductivity meter	Microprocessor based, Auto ranging, Automatic End point function, LCD display, Accuracy $\pm 1\%$ F.S., up to 3 point calibration, Reset function, conductivity buffer option, Hold and Auto off function, temperature compensation.	1 no.
49.	Orsat's Apparatus with glassware		1 no.
50.	Karl Fisher apparatus for moisture determination	Sample size: 1 - 50 mg of water K. F. Dispensing resolution: 0. 05 ml. fully automatic.	1 no.
51.	Apparatus for determination of flash point	This apparatus is made as per IP 34, ASTM D-93 and IS 1448 (Part I) 1270 (P.21) and IS 1209-1953 method B.	1 no.
52.	Melting point apparatus	Made up of S.S. with 1% accuracy. 0.5 deg. C, with range up to 360 deg. C, temp. set point facility, digital display.	1 no.
53.	Electrolytic analyser	Analyzer for analysis of (i) Hydrogen (ii) Nitrogen (iii) Sulphur (iv) Chlorine employing electrode / induction furnace along with sensor/detectors.	1no.
54.	Photo-colorimeter	With Wave length of 400nm to 700nm, Resolution of 0.01A, LED light source and display, Accessories like Cuvettes, Operation Manual,Cover	1no.
55.	Bourdon Tube Pressure Gauges Different Ranges	100 mm dia, S.S. body, range: 6,10,20,30 kg/cm ²	2 each
56.	Compound Gauge	100 mm dia, S.S. body	2 No.
57.	Diaphragm Type Pressure Gauge	With Dial Size of 150 mm,	2 No.
58.	Spectroscopy-IR/NMR/UV-Visible Spectrophotometer, FTIR	UV-Visible Spectrophotometer: double beam wave length 190-1100 Nm, USB data output port LCD display, D2 lamp & tungsten	2 nos.



		lamp, printer port, multifunction software highly accurate silicon photo diode detector.	
59.	Dead Weight Tester with Accessories	Range of 0 kg/ cm ² to 7 kg/ cm ² , S.S. Sensing Element, Top & Bottom Chamber, Movement Case. To study the measurement of pressure.	1no.
60.	Heating plate (electric)	1000 watt	4 no.
61.	Pressure regulating Valve		2 No.
62.	Oswald viscometer (Consumable)	MOC: Borosilicate Glass Size: 120X1 mm Overall height: 237 mm Ready to use.	3 pieces
63.	Redwood viscometer	As per IS 1448 & IP 70 with stop watch & thermometers.	3 pieces
64.	Stop watch (Digital)	1/10 th Sec.	6 pieces
65.	Thermostatic bath	Made up of 300 x 250 x 100 mm, double wall construction inner being of stainless steel outer of M.S. duly storing paint finish and gap filled to temperature insulation with glass wool 6 holes of 75 mm dia, 8 Ltr. Ready to use.	2 pieces
66.	Specific gravity bottle	MOC: Borosilicate Glass	6 nos.
67.	Pyknometer 10ml	Made up of anodized aluminum or S.S.	6 nos.
68.	Mechanical board for testing triangle and parallelogram of forces including all accessories		6 sets
69.	Spirit level		3 sets
70.	Different types of levers		1 set
71.	Instrument for determining 'g' (simple pendulum).		2 sets
72.	Barometer		1 no.
73.	Searle's apparatus for young's modulus		2 sets
74.	Wet and dry bulb thermometer	Made up of S.S. with water filling facility.	2 sets
75.	Apparatus for measurement of coefficient of expansion (thermal) of solid and liquid.	It will consist of a half-meter long chromium plated rod, Steam prepared in copper steam boiler of 2-liter capacity, 2	2 sets.



		Thermometers, 1 hot plate of 1kw. Ready to use.Mounted on Suitable Frame Structure.	
76.	Apparatus for measurement of thermal conductivity of good and bad conductor	Made up of S.S. with heater assembly of 1000 watt, 300 mm (D) test specimen, 8 J type sensors, Dimmer state, Voltmeter and Amperemeter & Temperature indicator.	2 sets
77.	Calorimeter for determining mechanical equivalent of heat and specific heat.		4 sets.
78.	Polarimeter with monochromatic light (with extra sodium lamp 35W)	Touch screen color display, temperature display, measuring mode, optical rotation, specific rotation, sugar, concentration, measuring range: - 45 deg to 45 deg, LED light source. Ready to use instrument.	2 sets
79.	Abbe refractometer (Digital)	With Range of measurement nD 1.3000 – 1.7000, Sugar scale 0.95% (+0.5%), Dispersion nD + 0.0005, LCD Display, printer interface. Ready for experiment.	2 sets
80.	Equipment to study Kirchhoff's law and Electrochemical equivalent		1 set
81.	Whetstone's bridge		2 sets
82.	Resistance box	0 to 100 ohms	2 nos.
83.	Resistance box (1,2,5,10 Ω)	0 to 500 ohms.	2 nos.
84.	Rheostat0-25 Ohms	25 Ohms	2 nos.
85.	Rheostat0-100 ohms	100 Ohms	2 nos.
86.	Rheostat	500 Ohms	2 nos.
87.	Ammeter	0 to 1 Amp (DC)	2 sets
88.	Ammeter	0 to 5 Amp (DC)	2 sets
89.	Ammeter	0 to 10 Amp (AC, DC)	2 sets
90.	Ammeter	0 to 30 Amp (AC, DC)	2 sets
91.	Volt meter	0 to 1 volt (DC)	2 sets
92.	Volt meter	0 to 4 volt (DC)	2 sets
93.	Volt meter	0 to 5 volt (DC)	2 sets
94.	Volt meter	0 to 10 volt (DC)	2 sets
95.	Volt meter	0 to 25 volt (DC)	2 sets
96.	Volt meter	0 to 50 volt (DC)	2 sets
97.	Milli voltmeter	0 to 5 mV	2 nos.
98.	Milli voltmeter	0 to 50 mV	2 nos.

99.	Digital Milli voltmeter	0 to 200mv	2 nos.
100.	Resistance coils	5 Ohms, 10 Ohms, 50 Ohms, 100 Ohms	2 sets
101.	Digital Viscometer	Measuring range in mpa/Cp,LED display/LCD, with diff Measurement with 4 spindles, provided with RS 232 C interface. Ready for use instrument.	2 Nos.
102.	Comparator (Visual Colorimeter)	Measuring principle visual, Visual measurement of colourmatching to determine material colour, Replaceable sample chamber liner, Transmittance and reflectance modes, Measurement range: 0.1-79.9 Red, 0.1-79.9 Yellow, 0.1-49.9 Blu, 0.1 – 3.9 Neutral, used for to measure colority of liquid, solid and powder sample.	02 Nos
103.	Automatic Titration Apparatus	Display 16 character x 2 lines Alphanumeric BL LCD Ready for use instrument.	02 Nos.
104.	Gas fuming chamber with exhaust	Made up of S.S chamber min 4'x2'x2'with air exhaust and working platform of S.S. sheet, It will be designed so as to throw-out all toxic/harmful vapours&fumes, Working Table top is acid/alkali resistant, 6 mm thick Front facing door with toughened glass, the unit will be fitted with fluorescent light and a gas cock, and Drain valve.	01 No.
105.	Furnace 1200° C	Range: 1100 deg Made up of M.S. 12"X6"X16" size, Muffle ovens 1100 deg. C, PID, sensor, with proper insulation.	01 No.
106.	Fire Extinguisher	Chemical Foam type	01 No.
107.	Sand Bucket set		01 No.
108.	LPG Cylinder		01 No.
109.	Water testing kit (all parameters)	Measuring range: Ph (0 to 14 Accuracy +/-0.01), TDS, Conductivity, Temperature And DO, read out: LCD manual withall	01 set



		necessary Electrodes/probes to measure above parameters, and with electrode stand with holding clamp buffers, sample containers minimum 5, semiconductor probe Instrument Will be in Ready to Use (in carrying case) Condition.	
110.	Air Conditioner	2 Ton	02 Nos.
B. CONSUMABLE GLASSWARE AND MISCELLANEOUS			
111.	Desiccators	150 mm. dia.	As Required
112.	Desiccators vacuum	Borosilicate glass	As Required
113.	Extraction thimbles		As Required
114.	Glass tubes & rods of different diameter	Borosilicate glass	As Required
115.	Rubber tubes for water, gas & vacuum, stopper, rubber each glass, plastic & cork of different sizes		As Required
116.	Asbestos wire gauge		As Required
117.	Wire gauge (without asbestos)		As Required
118.	Cork rings		As Required
119.	Pipe clay Triangles		As Required
120.	Erlenmeyer flasks	250 ml.	As Required
121.	Erlenmeyer flasks	500 ml.	As Required
122.	Burettes	25 ml.	As Required
123.	Burettes	50 ml.	As Required
124.	Pipettes Volumetric	10 ml.	As Required
125.	Pipettes Volumetric	25 ml.	As Required
126.	Pipettes measuring	0 to 5 ml.	As Required
127.	Pipettes measuring	0 to 10 ml.	As Required
128.	Pipettes measuring	0 to 1 ml.	As Required
129.	Pipettes	micro 0 to 0.2 ml.	As Required
130.	Pipettes	1ml. (graduated)	As Required
131.	Each pipettes automatic	1, 2, 5, 10 ml.	As Required
132.	Flasks for distilled water	500 ml.	As Required
133.	Vacuum pipettes	Borosilicate glass	As Required
134.	Measuring cylinders	25 ml. Borosilicate glass	As Required
135.	Measuring cylinders	50 ml. Borosilicate glass	As Required
136.	Measuring cylinders	100 ml. Borosilicate glass	As Required
137.	Measuring cylinders	250 ml. Borosilicate glass	As Required
138.	Measuring cylinders	500 ml. Borosilicate glass	As Required
139.	Measuring cylinders	1000 ml. Borosilicate glass	As Required
140.	Volumetric flask	100 ml. Borosilicate glass	As Required
141.	Volumetric flask	250 ml. Borosilicate glass	As Required



142.	Volumetric flask	500 ml. Borosilicate glass	As Required
143.	Volumetric flask	1000 ml. Borosilicate glass	As Required
144.	Weighing bottles	polyethylene or glass 50 ml.	As Required
145.	Weighing bottles	polyethylene or glass 100 ml.	As Required
146.	Funnels with regular & long stem	7 cm. dia. Borosilicate glass	As Required
147.	Funnels	4 cm. dia. Borosilicate glass	As Required
148.	Funnels	9 cm. dia. Borosilicate glass	As Required
149.	Funnels Buchner different sizes	10 to 25 cm. dia. Borosilicate glass	As Required
150.	Funnels Hirsch	10 cm. Borosilicate glass	As Required
151.	Funnels separatory	50 ml. Borosilicate glass	As Required
152.	Funnels separatory	100 ml. Borosilicate glass	As Required
153.	Funnels separatory	250 ml. Borosilicate glass	As Required
154.	Funnels separatory	500 ml. Borosilicate glass	As Required
155.	Funnels for filter crucibles & Gooch crucibles with rubber rings	Borosilicate glass	As Required
156.	Beakers	100 ml. Corning Borosilicate glass	As Required
157.	Beakers	250 ml. Corning Borosilicate glass	As Required
158.	Beakers	400 ml. Corning Borosilicate glass	As Required
159.	Beakers	600 ml. Corning Borosilicate glass	As Required
160.	Beakers	1000 ml. Borosilicate glass	As Required
161.	Watch glasses	5 cm.dia.	As Required
162.	Watch glasses	7.5 cm.dia.	As Required
163.	Watch glasses	10 cm.dia.	As Required
164.	Dishes evaporating	5 cm. dia. porcelain, glass	As Required
165.	Dishes evaporating	7.5 cm. dia.	As Required
166.	Dishes evaporating	10 cm. dia. flat bottom	As Required
167.	Dishes evaporating	15 cm. dia.	As Required
168.	Dishes evaporating	20 cm. dia.	As Required
169.	Thermometers	0 to 110°C	As Required
170.	Thermometers	0 to 250°C	As Required
171.	Thermometers	0 to 350°C	As Required
172.	Thermometers for drying oven (L shape)		As Required
173.	Boiling flasks with round bottom	100ml. Borosilicate glass	As Required
174.	Boiling flasks with round bottom	250ml. Borosilicate glass	As Required
175.	Boiling flasks with round bottom	500ml. for each distilling flasks 50 ml., 100 ml., 250 ml. Borosilicate glass	As Required
176.	Boiling flasks with round bottom	500ml. for each distilling flasks 50 ml, 100 ml, 250 ml - Writz and others, Borosilicate glass	As Required
177.	Filtering flasks	250 ml. Borosilicate glass	As Required
178.	Filtering flasks	500 ml. Borosilicate glass	As Required

179.	Filtering flasks	1000 ml. Borosilicate glass	As Required
180.	Flasks soxhlet with condensers	Borosilicate glass	As Required
181.	Flasks kjeldahal	250 ml. Borosilicate glass	As Required
182.	Condensers liebigh	30 mm. long, Borosilicate glass	As Required
183.	Condensers liebigh	50 cm. long, Borosilicate glass	As Required
184.	Condenser bulb type	30 cm. long, Borosilicate glass	As Required
185.	Condenser spiral type	20 cm. long, Borosilicate glass	As Required
186.	Connecting tubes for kjeldahal distillation		As Required
187.	Gas generator (Kipp)	500 ml. (plastic)	As Required
188.	Gas washing bottles (Dreschler)		As Required
189.	Drying tubes with one bulb (Calcium chloride)		As Required
190.	Crucibles porcelain	5 cm, dia, height 4 cm indigenous	As Required
191.	Crucibles quartz	5 cm, dia, height 4 cm indigenous	As Required
192.	Gooch porcelain or glass		As Required
193.	Filtering crucible	No. 0, 1, 2, 3 glass	As Required
194.	Test tube	160 mm x 15 mm.	As Required
195.	Test tube	10 mm.	As Required
196.	Gas sampling tubes		As Required
197.	Pairs nessler tubes		As Required
198.	Tubes for centrifuge		As Required
199.	Bottles with droppers for indicator solutions & semi-micro qualitative analysis	30 ml.	As Required
200.	Bottles with droppers for indicator solutions & semi-micro qualitative analysis	50 ml.	As Required
201.	Bottles for solids	50 ml.	As Required
202.	Bottles for solids	100 ml.	As Required
203.	Bottles for solutions	100 ml.	As Required
204.	Bottles for solutions	250 ml.	As Required
205.	Bottles for solutions	1000 ml.	As Required
206.	Bottles for solutions	2000 ml.	As Required
207.	Bottles for solutions	3000 ml.	As Required
208.	Bottles for solutions	5000 ml.	As Required
C. SAFETY			
209.	Apron	White	As Required
210.	Hand Gloves (Nitrile)		As Required
211.	Acid Alkali Goggles		As Required
212.	Nose Mask (Cotton)		As Required
213.	Ear Plug		As Required
214.	Particle Size Analyzer	Capable of measuring a wide	As Required

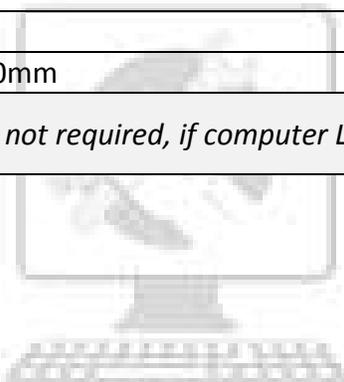
		range of particle size distributions, Measurement range: 17 nm to 2500 μm , Light source: Red semiconductor laser (680 nm wavelength)	
215.	Solid Analyzer	Casting: rugged all-metal with integral handles, Spectral range 3700 to 15000 cm^{-1} , Resolution better than 0.7 cm^{-1} , Frequency accuracy (@7300 cm^{-1}): < 0.06 cm^{-1} , Ethernet port for data communication.	As Required
216.	Surface Area Analyzer	Automatic calibration facility, Capable to create Automatically necessary mixtures of nitrogen and helium, Detector protection, Electronic valves, software control the unit via USB communication.	As Required

Note: -

1. Quantity marked with * has been increased as per the batch size.
2. Internet facility is desired to be provided in the class room.
3. *All the tools and equipment are to be procured as per BIS specification.*

Tools & Equipment for Employability Skills		
S No.	Name of the Equipment	Quantity
1	Computer (PC) with latest configurations and Internet connection with standard operating system and standard word processor and worksheet software	10 nos.
2	UPS - 500Va	10 nos.
3	Scanner cum Printer	1 no.
4	Computer Tables	10 nos.
5	Computer Chairs	20 nos.
6	LCD Projector	1 no.
7	White Board 1200mm x 900mm	1 no.

Note: Above Tools & Equipment are not required, if computer LAB is available in the institute.



FORMAT FOR INTERNAL ASSESSMENT

Name & Address of the Assessor:		Year of Enrollment:												
Name & Address of ITI (Govt./Pvt.):		Date of Assessment:												
Name & Address of the Industry:		Assessment location: Industry / ITI												
Trade Name:		Examination:				Duration of the Trade/course:								
Learning Outcome:														
S No.	Maximum Marks (Total 100 Marks)		15	5	10	5	10	10	5	10	15	15	Total Internal Assessment Marks	Result (Y/N)
	Candidate Name	Father's/Mother's Name	Safety Consciousness	Workplace Hygiene & Economical use of materials	Attendance/ Punctuality	Ability to follow Manuals/ Written instructions	Application of Knowledge	Skills to Handle Tools/ Equipment/ Instruments/ Devices	Economical use of Materials	Working Strategy	Quality in Workmanship/ Performance	VIVA		
1														
2														