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

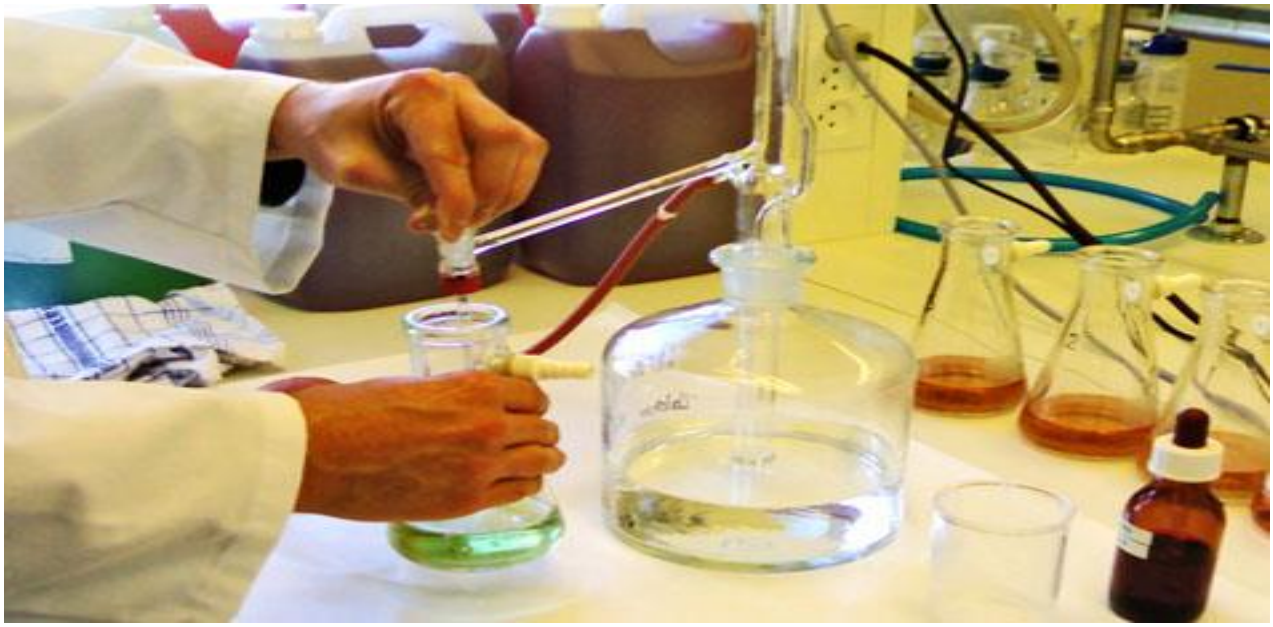
COMPETENCY BASED CURRICULUM

LABORATORY ASSISTANT (CHEMICAL PLANT)

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4



SECTOR – CHEMICALS AND PETROCHEMICALS

Directorate General of Training

LABORATORY ASSISTANT (CHEMICAL PLANT)

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

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

www.cstaricalcutta.gov.in

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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, and Employability skill related to job role. 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 prepared products.

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 Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variantsand Apprenticeship Training Scheme (ATS) are two pioneer programmes of DGT for strengthening 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 (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 DGT 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.
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2.2 PROGRESSION PATHWAYS:

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise to the level of Manager.
- Can become Entrepreneur in the related field.
- 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.

- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

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	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

4	On the Job Training (OJT)/ Group Project	150	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses.

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The Continuous Assessment (Internal) 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 formative assessment template provided on www.bharatskills.gov.in

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure are being notified by DGT 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 Trade Practical and Formative assessment is 60% & for all other 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 some of 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
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examining body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Marks 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	• 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) Marks 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 procedures and practices	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
(c) Marks in the range of more than 90% to be allotted during assessment	
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.	• 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.

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, factional 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

Reference NOS: MIN/N9417, MIN/N 9418, MIN/N 9419,MIN/N9420, MIN/N 9421, MIN/N 9422,MIN/N9423,MIN/N9424,MIN/N9425,MIN/N9426, MIN/N9427, MIN/N 9428, MIN/N9429,MIN/N9430, MIN/N 9431, MIN/N 9432, MIN/N 9433, MIN/N 9434, MIN/N 3103,MIN/N 3104, MIN/N 3105

4. GENERAL INFORMATION

Name of the Trade	**LABORATORY ASSISTANT (CHEMICAL PLANT)**
Trade Code	DGT/1062
NCO - 2015	3111.0300, 3116.0100, 3116.0300, 3116.0500, 3117.0300, 2113.0500
NOS Covered	MIN/N9417, MIN/N 9418, MIN/N 9419,MIN/N9420, MIN/N 9421, MIN/N 9422,MIN/N9423,MIN/N9424,MIN/N9425,MIN/N9426,MIN/N9427,9428, MIN/N9429,MIN/N9430, MIN/N 9431, MIN/N 9432, MIN/N 9433, MIN/N 9434, MIN/N 3103, MIN/N 3104, MIN/N 3105
NSQF Level	Level-4
Duration of Craftsmen Training	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, CP, LC, DW, AA, BLIND, LV, DEAF, HH, AUTISM, ID, SLD
Unit Strength (No. Of Student)	20 (There is no separate provision of supernumerary seats)
Space Norms	96 sq. m
Power Norms	6 KW
Instructors Qualification for	
(i) Laboratory Assistant (Chemical Plant) Trade	B.Voc/Degree in Chemical/ Petro chemical/ Technology/ Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Chemical/Petro Chemical Technology/ Engineering from AICTE/ recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with 2 years' experience in relevant field. **OR** NTC/ NAC passed in the Trade of Laboratory Assistant (Chemical Plant) with 3 years' experience in the relevant field. **<u>Essential Qualification</u>:**

	Relevant regular/RPL variants of National Craft Instructor Certificate (NCIC) under DGT. ***Note: - Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.***
(ii) Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
(iii) Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
(iv) Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above)

	OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
(v) Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES

FIRST YEAR

1. Identify common chemical reagents and prepare various types of solutions following safety precautions.(NOS:MIN/N9417)
2. Plan and estimate the strength of unknown acid, bases and other reagents by redox & iodimetric titration and prepare indicators and results of titration. (NOS:MIN/N9418)
3. Execute precipitation and complex metric titration to determine the strength of unknown reagents and record the data. (NOS:MIN/N9419)
4. Verify the physical/ thermal properties and record the analysis. (NOS:MIN/N9420)
5. Identify and test various electrical components like switches, fuses, conductors etc. (NOS:MIN/N3103)
6. Identify, test various electronic components using proper measuring instruments and apply this knowledge to troubleshoot power supplies. (NOS:MIN/N3104,MIN/N3105)
7. Verify the Electro-chemical properties of electrolytes. (NOS:MIN/N9421)
8. Execute quantitative analysis of metal and non-metal by Gravimetric estimations, perform stoichiometry calculations and record the results. (NOS:MIN/N9422)
9. Perform detection of inorganic substances by qualitative analysis, by dry tests, wet tests and record the procedures. (NOS:MIN/N9423)
10. Assemble, Test, calibrate and troubleshoot the pressure, temperature, recording instrument and controlling instruments. (NOS:MIN/N9424)
11. Read and apply engineering drawing for different application in the field of work. (NOS:MIN/N9402)
12. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)

SECOND YEAR

13. Plan and organize the technique (with different unit process and unit operation) of organic compounds. (NOS:MIN/N9425)
14. Plan and organize technique of inorganic substance with quality control. (NOS:MIN/N9426)
15. Analyze different organic compounds to identify the compound and determine various parameters. (NOS:MIN/N9427)

16. Analyze different organic compounds and measurement in respect of waste water management. (NOS:MIN/N9428)
17. Perform quantitative analysis of ore, alloy, organic and inorganic substance. (NOS:MIN/N9429)
18. Perform analysis of fuel gas, sugar, oil, fat, soap and nitrogen in fertilizer. (NOS:MIN/N9430)
19. Operate various measuring instruments used in chemical plant and laboratory. (NOS:MIN/N9431)
20. Perform proximate analysis of coal and calorific value of different fuels. (NOS:MIN/N9432)
21. Perform detection of micro-organism in food, pharmaceutical and other related laboratories. (NOS:MIN/N9433)
22. Perform Experiments on Analyzing Equipment(NOS:MIN/N9434)
23. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Identify common chemical reagents and prepare various types of solutions following safety precautions. (NOS:MIN/N9417)	Plan, work in compliance with standard safety norms.
	Identify the glassware and chemical reagents.
	Prepare oxalic acid by exact weighing and make solution according to marking indicated in the glassware.
	Prepare Sulphuric acid by suitable laboratory reagents.
2. Plan and estimate the strength of unknown acid, bases and other reagents by redox & iodimetric titration and prepare indicators and results of titration. (NOS:MIN/N9418)	Setup electronic/ chemical balance for ideal condition.
	Label the solution with accuracy.
	Observe safety procedure during Titration as per standard norms and guidelines.
	Identify tools and instruments for titration.
	Measure the value of unknown concentration of given sample with following proper procedure.
	Detect exact end point in precipitation method.
	Detect exact end point in complex metric titration method.
3. Execute precipitation and complex metric titration to determine the strength of unknown reagents and record the data. (NOS:MIN/N9419)	Prepare various reagents required for precipitation titration.
	Prepare various indicators required for precipitation titration.
	Practice exact end point detection by Mohr method. (15 hrs.)
	Practice exact end point detection by Volhard method.
	Prepare various reagents required for complex metric titration.
	Prepare various indicators required for complex metric titration.
	Practice complex metric titration by using EDTA.
4. Verify the physical/ thermal properties and record the analysis. (NOS:MIN/N9420)	Plan working in compliance with standard safety norms.
	Identify the instruments.
	Make sure that instruments are ready to do work.
	Measure the value force, acceleration due to gravity and Young Modula's according to direction.
	Measure the value acceleration due to gravity.
	Measure the value Young Modula's according to direction.
	Tabulate the results.

5. Identify and test various electrical components like switches, fuses, conductors etc. (NOS:MIN/N3103)	Measure and test the voltage given cells and battery.
	Connect the cells in series connection and parallel connection.
	Operate the circuit in full swing.
	Measured the resistance and other parameters.
	Tabulate the results.
6. Identify, test various electronic components using proper measuring instruments and apply this knowledge to troubleshoot power supplies. (NOS:MIN/N3104,MIN/N3105)	Measure and test the voltage given cells and battery.
	Connect the cells in series connection and parallel connection.
	Operate the circuit in full swing.
	Verify Ohms Law.
	Verify Kirchhoff's Law.
	Determine specific resistance using wheat stone's Bridge.
7. Verify the Electro-chemical properties of electrolytes. (NOS:MIN/N9421)	Make sure the electrolytic cells are ready to work properly.
	Batteries, Ammeter and voltmeter should be properly connected to circuits.
	Running the operation in full swing.
	Measure the current from Ammeter reading.
	Measure the time for the operation.
	Measure the deposition at cathode and anode by weighing.
	Tabulate the results.
	Verify Faraday's 1st Law.
	Verify Faraday's 2nd Law.
8. Execute quantitative analysis of metal and non-metal by Gravimetric estimations, perform stoichiometry calculations and record the results. (NOS:MIN/N9422	Plan work in compliance with standard safety norms.
	Identify the type of instruments.
	Identify the reagents and glassware for the following experiments.
	Prepare the specific reagents.
	Perform the procedure for chemical reaction.
	Perform the procedure for precipitate collection.
	Dry and weighing the precipitate.
	Tabulate the results in exact norm.
9. Perform detection of	Plan work in compliance with standard safety norms.

inorganic substances by qualitative analysis, by dry tests, wet tests and record the procedures. (NOS:MIN/N9423)	Identify laboratory reagents and glassware for the job.
	Perform reaction with proper quality control.
	Collect desired chemicals by filtration method.
	Dry and weighing the chemicals.
	Tabulate the results in exact norm.
10. Assemble, Test, calibrate and troubleshoot the pressure, temperature and recording instrument. (NOS:MIN/N9424)	Plan work in compliance with standard safety norms.
	Identify the type of electrical instruments for the job.
	Assembled the different parts of the apparatus.
	Calibrate according to norms.
	Measure unknown pressure temperature etc.
11. Read and apply engineering drawing for different application in the field of work. (NOS:MIN/N9402)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
12. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401	Solve different mathematical problems
	Explain concept of basic science related to the field of study
SECOND YEAR	
13. Plan and organize the technique (with different unit process and unit operation) of organic compounds. (NOS:MIN/N9425)	Prepare Acetanilide by Acetylation.
	Determine % yield of Acetanilide.
	Determine Melting point of Acetanilide.
	Prepare Methyl Oxalate by Esterification.
	Determine % yield of Methyl Oxalate.
	Determine Melting point of Methyl Oxalate.
	Prepare sodium benzene sulphonate by Sulphonation.
14. Plan and organize technique of inorganic substance with	Plan work in compliance with standard safety norms.
	Identify specific reagent, apparatus and glassware.

quality control. (NOS:MIN/N9426)	Perform different unit process step by step.
	Perform different unit operation step by step.
	Collect organic compounds by filtration method.
	Measure yield and melting point of the organic compounds.
15. Analyze different organic compounds to identify the compound and determine various parameters. (NOS:MIN/N9427)	Plan work in compliance with standard safety norms.
	Select appropriate reagents and glassware.
	Analyze the elements for the given organic compounds.
	Analyze the functional group for the given organic compounds.
	Prepare derivative of the organic compounds.
	Measure melting point of the organic compound.
	Measure yield and melting point the derivative.
16. Analyze different organic compounds and measurement in respect of waste water management. (NOS:MIN/N9428)	Follow and maintain procedure to achieve a safe working environment.
	Prepare reagents for COD.
	Perform the experiment with accuracy.
	Prepare reagents for BOD.
	Perform the experiment with accuracy.
	Prepare reagents for turbidity meter.
	Measure TSS in this meter.
	Tabulate the result for COD, BOD and TSS.
17. Perform quantitative analysis of ore, alloy, organic and inorganic substance. (NOS:MIN/N9429)	Perform sample collection.
	Select appropriate reagents, glassware and apparatus.
	Perform chemical reaction with accuracy.
	Collect the desired substances in quantitative ways.
	Weighing accurately.
	Tabulate the result.
18. Perform analysis of fuel gas, sugar, oil, fat, soap and nitrogen in fertilizer. (NOS:MIN/N9430)	Prepare reagents for orsat's apparatus.
	Fill the tube of the apparatus with reagents.
	Operate the instrument according to proper ways.
	Measure the composition of fuel gas.
	Prepare the reagents for acid value, saponification value and iodine value for oil, fat and soap analysis.
	Connect the apparatus with condenser.
	Perform the required chemical reaction.

	Perform the titration accurately.
	Tabulate the result.
	Calculation of acid value for the given oil.
	Calculation of specification value and iodine value for the given oil.
	Prepare reagents.
	Estimate % of sugar in given sample.
	Assembled Soxhlet's apparatus.
	Perform operation with given sample.
	Estimate % of fat in given sample.
	Assembled Kjeldahl's apparatus.
	Perform operation with given sample.
	Prepare table for calculation and estimate % of nitrogen in given sample.
19. Operate various measuring instruments used in chemical plant and laboratory. (NOS:MIN/N9431)	Prepare reagents.
	Perform operation of Polari- meter.
	Prepare graph and table for calculation.
	Perform operation of electrolytic analyzer.
	Prepare buffer solution and other reagents.
	Perform operation of PH meter.
	Perform operation of colorimeter.
	Perform operation of spectro photometer.
	Perform operation of flame photometer.
	Perform operation of refractometer.
	Perform operation of Karlficher apparatus.
	Perform operation of thin layer chromatography.
	Perform operation of paper chromatography.
	Perform operation of quality of water analysis.
	Perform operation of digital moisture balance.
	Perform operation of redwood viscometer.
	Perform operation of Brookfield viscometer.
	Perform operation of electrophoresis apparatus.
	Perform operation of pensky-martin apparatus.
20. Perform proximate analysis of coal and calorific value of different fuels.	Perform weight of coal sample.
	Perform operation of furnace.
	Perform weight the coal sample after furnace operation.

(NOS:MIN/N9432)	Calculate the result of volatile matter in the coal sample.
	Calculate the result of moisture in the coal sample.
	Calculate the result of ash content in the coal sample.
	Calculate the result of fixed carbon in the coal sample.
	Calculate the result of sulphur content in the coal sample.
	Plan work in compliance with standard safety and norms.
	Operate bomb calorimeter in proper way.
	Tabulate and calculate the result of calorific value of coal.
	Operate junker's calorimeter in proper way.
	Tabulate and calculate the result of calorific value of LPG.
21. Perform detection of micro-organism in food, pharmaceutical and other related laboratories. (NOS:MIN/N9433)	Perform operation and familiarity of different parts of a microscope.
	Identify common laboratory equipments and reagents used in microbiology lab.
	Prepare reagents and indicators.
	Perform Gram staining technique for detection of microorganism.
	Detection of colony formation using microscope.
22. Perform Experiments on Analyzing Equipment. NOS:MIN/N9434)	Perform experiment on particle size by particle size analyzer.
	To perform experiment on solid analyzer.
	To perform experiment on total surface area by surface area analyzer.
23. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FOR LABORATORY ASSISTANT (CHEMICAL PLANT) TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 50 Hrs.; Professional Knowledge 06 Hrs.	Identify common chemical reagents and prepare various types of solutions following safety precautions. (NOS:MIN/N9417)	1. Operate different types of fire extinguishers. (05hrs.) 2. Study Safety Data Sheet (SDS). (02hrs.) 3. Identify personal protection equipments (PPEs) used in chemical plant. (03hrs.)	Induction Training. Fire & Safety in Chemical Lab/Plant. First Aid. Introduction of pollution control. (02hrs.)
		4. Identify common chemical reagents by performing acid-base reaction. (04hrs.) 5. Identify common chemical reagents by performing precipitation reaction. (04hrs.) 6. Identify common chemical reagents by Performing colour change reaction. (04hrs.) 7. Identify common chemical reagents by generation of colour fume. (04hrs.) 8. Identify common chemical reagents by using Litmus Paper. (01 hrs.) 9. Identify common chemical reagents by performing reaction generating gas with specific smell. (04 hrs.) 10. Prepare solutions of solids by weighing. (04hrs.)	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. (04hrs.)

		11. Prepare solutions of liquids by weighing. (04hrs.) 12. Prepare solutions of volatiles by weighing. (03 hrs.) 13. Prepare primary standard solutions by weighing. (03 hrs.) 14. Prepare secondary standard solutions by weighing. (03 hrs.) 15. Prepare solutions of non-volatiles by weighing. (02 hrs.)	
Professional Skill 150 Hrs.; Professional Knowledge 36 Hrs.	Plan and estimate the strength of unknown acid, bases and other reagents by redox & iodimetric titration and prepare indicators and results of titration. (NOS:MIN/N9418)	16. Prepare various reagents for analysis of acid and base. (05 hrs.) 17. Prepare various indicators. (05hrs.) 18. Prepare Titration between Hydrochloric acid and sodium hydroxide. (05hrs.) 19. Prepare Titration between mixture of sodium carbonate and sodium bi-carbonate with hydrochloric acid (05hrs.). 20. Prepare Titration between vinegar and standard sodium hydroxide. (09hrs.) 21. Prepare Titration between Boric acid and sodium hydroxide. (08 hrs.) 22. Prepare Titration between Ammonium Chloride sample and sodium hydroxide.(08 hrs.) 23. Prepare Table for calculation of result	Atomic molecular and equivalent weights. Crystallography Solutions. The laws of chemical combinations. (15 hrs.)

		oftitration. (10 hrs.)	
		24. Prepare various reagents required for Redox titration (07hrs.). 25. Prepare various indicators required for Redox titration (07hrs.). 26. Prepare Permanganometry titration using permanganate solution. (10hrs.) 27. Prepare Dichrometry titrations using dichromate solution. (10hrs.) 28. Practice Redox titrations using potassium iodate solution. (10hrs.). 29. Practice Redox titrations using potassium bromate solution. (11hrs.)	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)16th group d) 17th group e) 18th group elements. (15 hrs.)
		30. Prepare various reagents required for Iodometric and Iodimetric titration. (10 hrs.) 31. Prepare various indicators required for Iodometric and Iodimetric titration. (10 hrs.) 32. Prepare Iodometric titration using iodine solution indirectly. (10 hrs.) 33. Perform Iodimetric titration using iodine solution directly. (10 hrs.)	Chemical equilibrium. Thermo-chemistry & thermodynamics. (06 hrs.)
Professional Skill 100 Hrs.; Professional Knowledge	Execute precipitation and complex metric titration to determine the strength of unknown reagents and record the data.	34. Prepare various reagents required for precipitation titration. (10 hrs.) 35. Prepare various indicators required for precipitation titration. (10 hrs.) 36. Prepare exact end point	Metallurgy of: • Aluminum. • Copper • Silver • Chromium • Iron & Steel

18 Hrs.	(NOS:MIN/N9419)	detection by Mohr method. (15 hrs.) 37. Prepare exact end point detection by Volhard method. (15 hrs.)	• Zinc & its alloys. (09 hrs.)
		38. Prepare various reagents required for complex metric titration. (10 hrs.) 39. Prepare various indicators required for complex metric titration. (05 hrs.) 40. Prepare complex metric titration by using EDTA. (35 hrs.)	Non-Metals: Preparation, properties & uses of following: a) Hydrogen & its peroxide. b) Oxygen c) Sulphur& its compounds. d) Nitrogen & its compounds. e) Phosphorus & its compounds. f) Chlorine &Fluorine and its compounds. (09 hrs.)
Professional Skill 75 Hrs.; Professional Knowledge 11 Hrs.	Verify the physical/ thermal properties and record the analysis. (NOS:MIN/N9420)	**Physics Lab: -** 41. Verify parallelogram of forces with the help of mechanical board. (03hrs.) 42. Study of various types of Levers. (03hrs.) 43. Study of Simple Machines and finding Velocity Ratio, Mechanical Advantage and Efficiency. (04hrs.) 44. Determine acceleration due to gravity (g) by simple pendulum. (05 hrs.) 45. Determine Young's Modulus (Y) by Searle's apparatus (10 hrs.)	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. (04 hrs.)
		46. Determine coefficient of expansion of solid. (05 hrs.) 47. Determine coefficient of Thermal conductivity of metal rod. (05 hrs.) 48. Determine coefficient of	Elasticity, Introduction, stress and strain, modulus of elasticity, different types of stresses, Hook's Law, Young's modulus, Yield point, ultimate, stress-strain graph,

		Thermal conductivity of insulating material (Rubber).(15hrs.)	modulus of Rigidity, poison ration, bulk modulus, factor of safety, examples. (04 hrs.)
		49. Determine mechanical equivalent of heat by Joule's method. (25hrs.)	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. (03 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Identify and test various electrical components like switches, fuses, conductors etc. (NOS:MIN/N3103)	50. Study various types of electric cells, resistances using series connections and measure various parameters viz. voltage, current, resistance using various meters and instruments etc. (12 hrs.) 51. Study various types of electric cells, resistances using parallel connections and measure various parameters viz. voltage, current , resistance etc. (13 hrs.)	**Electricity:** Electric current, +Ve and -Ve terminals use of fuses and switches, conductors and insulators, simple electrical Circuits. (07 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge	Identify, test various electrical properties using proper measuring	52. Verify Ohm's law (06hrs.) 53. Verify Kirchhoff's law related to current and voltage. (07 hrs.)	Ohm's law, electrical insulating Materials, Kirchhoff's law, examples, Parallel and series circuit

07 Hrs.	instruments and apply this knowledge to troubleshoot power supplies. (NOS:MIN/N3104,MIN/N3105)	54. Determine specific resistance using wheat stone's Bridge. (12 hrs.)	connections. Whetstone's bridge potentiometer. (07 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Verify the Electro-chemical properties of electrolytes. (NOS:MIN/N9421)	55. Perform electrolysis using voltmeter and verify Faraday's First law of electrolysisand second laws of electrolysis. (25 hrs.)	Electrolysis, conservation of electrical energy into heat energy, Joule's law. Mechanical equivalent of heat. (07 hrs.)
Professional Skill 150 Hrs.; Professional Knowledge 36Hrs.	Execute quantitative analysis of metal and non-metal by Gravimetric estimations, perform stoichiometry calculations and record the results. (NOS:MIN/N9422	56. Prepare suitable reagents by weighing for Gravimetric estimations of Nickel. (05 hrs.) 57. Prepare suitable reagents by weighing for Gravimetric estimations of Iron.(10 hrs.) 58. Prepare suitable reagents by weighing for Gravimetric estimations of Barium.(05 hrs.) 59. Prepare suitable reagents by weighing for Gravimetric estimations of Lead.(10 hrs.) 60. Prepare suitable reagents by weighing for Gravimetric estimations of Silicon.(10 hrs.) 61. Perform chemical reaction between reagents and collection of precipitation for Nickel.(10 hrs.) 62. Perform chemical reaction between reagents and collection of precipitation for Iron.(10hrs.) 63. Perform chemical reaction between reagents and collection of precipitation for	General & Physical Chemistry The structure of atom. The structure of atom, Radioactivity, Chemical bonding electronic theory of valency, Gas laws, Boyle's law, Charl's law, Gas equation, Graham's Law of diffusion, Dalton's law of partial pressure. (36 hrs.)

		Barium.(10 hrs.) 64. Perform chemical reaction between reagents and collection of precipitation for Lead.(10 hrs.) 65. Perform chemical reaction between reagents and collection of precipitation for Silicon.(10 hrs.) 66. Perform furnace operation for complete drying of precipitation. (30 hrs.) 67. Estimate quantity of dried precipitation by weighing.(15 hrs.) 68. Prepare table formation and stoichiometric calculation for final estimation of given metal & non-metal.(15 hrs.)	
Professional Skill 165 Hrs.; Professional Knowledge 33 Hrs.	Perform detection of inorganic substances by qualitative analysis,by dry tests, wet tests and record the procedures. (NOS:MIN/N9423)	69. Identify Inorganic substances by their physical properties (colour, solubility, acidic or basic nature). (05hrs.) **Dry test for cations:** 70. Identify Inorganic substances by dry test tube heating. (05hrs.) 71. Identify Inorganic substances by Flame test. (05hrs.) 72. Identify Inorganic substances by Borax Bead test. (05hrs.) 73. Identify Inorganic substances by Fusion test. (05hrs.) **Dry test for Anions:** 74. Identify Inorganic substances by reaction with dilute acids. (05hrs.) 75. Identify Inorganic substances	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. (33 hrs.)

		by reaction with concentrated acids. (05hrs.) **Wet test for cations:** 76. Identify Inorganic substances by wet test for Gr-I metals. (10 hrs.) 77. Identify Inorganic substances by wet test for Gr-II metals. (10 hrs.) 78. Identify Inorganic substances by wet test for Gr-IIIA metals. (10 hrs.) 79. Identify Inorganic substances by wet test for Gr-IIIB metals. (10 hrs.) 80. Identify Inorganic substances by wet test for Gr-IV metals. (10 hrs.) 81. Identify Inorganic substances by wet test for Gr-V metals. (10 hrs.) **Wet test for Anions:** 82. Identify Inorganic substances by wet test for Chloride. (05 hrs.) 83. Identify Inorganic substances by wet test for Bromide. (10 hrs.) 84. Identify Inorganic substances by wet test for Iodide. (05 hrs.) 85. Identify Inorganic substances by wet test for Flouride. (05 hrs.) 86. Identify Inorganic substances by wet test for Sulphate. (05 hrs.) 87. Identify Inorganic substances by wet test for Sulphide. (05	

		hrs.) 88. Identify Inorganic substances by wet test for Sulphite. (05 hrs.) 89. Identify Inorganic substances by wet test for Thiosulphate. (05 hrs.) 90. Identify Inorganic substances by wet test for Nitrate & Nitrite. (05 hrs.) 91. Identify Inorganic substances by wet test for Phosphate. (05 hrs.) 92. Identify Inorganic substances by wet test for Chromate. (05hrs.) 93. Identify Inorganic substances by wet test for Carbonate & Bi-Carbonate. (05 hrs.) 94. Identify Inorganic substances by wet test for Borate. (05 hrs.)	
Professional Skill 75 Hrs.; Professional Knowledge 11 Hrs.	Assemble, Test, calibrate and troubleshoot the pressure, temperature, recording instrument andcontrolling instruments. (NOS:MIN/N9424)	95. Perform Calibration of Bourdon tube pressure gauges. (04hrs.) 96. Perform operation of Manometer. (04hrs.) 97. Perform Calibration of Alcohol in glass thermometer. (08 hrs.) 98. Perform Calibration of bimetallic thermometer. (09hrs.) 99. Perform operation of Resistance thermometer. (08 hrs.) 100. Perform operation of Thermocouple. (08 hrs.) 101. Perform operation of	Units of pressure and vacuum; various types of pressure and vacuum gauges, manometers; principles of operation of various pressure measuring instruments and devices; Calibration of gauges. Temperature scales, Relationship between various temperature scales; fixed points. Various types of thermometers, thermocouples and pyrometers; Working principles of various temperature measuring instruments; different

		Thermocouple Pyrometer. (09 hrs.)	methods of temperature measurement. (09 hrs.)
		102. Perform Operation of Strip chart and Circular chart recorders. (08 hrs.) 103. Perform Operation of Transmitterand Transducers (PI & IP). (08 hrs.) 104. Perform Operation of controller. (09 hrs.)	Various types of Recorders strip chart, circular chart; principles of operation of various recording instruments and their operations. Various types of Controllers On-off, P, PI, PD, PID principles of operation of various controlling instruments and their operations. Various types of Transmitters and transducers PI, IP; principles of operation of various Transmitters and transducers. (02 hrs.)
ENGINEERING DRAWING (40 Hrs.)			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work. (NOS:MIN/N9402)	**Engineering Drawing:** Introduction to Engineering Drawing and Drawing Instruments – Conventions Sizes and layout of drawing sheets Title Block, its position and content Drawing Instrument Free hand drawing of – Geometrical figures and blocks with dimension Transferring measurement from the given object to the free hand sketches. Free hand drawing of hand tools. Drawing of Geometrical figures: Angle, Triangle, Circle, Rectangle, Square, Parallelogram. Lettering & Numbering – Single Stroke Dimensioning Practice Types of arrowhead Symbolic representation – Different symbols used in the related trades Reading of chemical plant Circuit Diagram Reading of Chemical plant Layout drawing	
WORKSHOP CALCULATION & SCIENCE (28 Hours)			
Professional	Demonstrate basic mathematical concept	**WORKSHOP CALCULATION & SCIENCE:** Unit, Fractions	

Knowledge WCS- 28 Hrs.	and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401	Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, substraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication & division Solving problems by using calculator Square root, Ratio and Proportions, Percentage Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction Material Science Types metals, types of ferrous and non ferrous metals Physical and mechanical properties of metals Mass, Weight, Volume and Density Mass, volume, density, weight and specific gravity Related problems for mass, volume, density, weight and specific gravity Heat & Temperature and Pressure Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales of temperature Heat &Temperature - Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, convection and radiation Concept of pressure - Units of pressure, atmospheric pressure, absolute pressure, gauge pressure and gauges used for measuring pressure Basic Electricity Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC,DC their comparison, voltage, resistance and their units Trigonometry Measurement of angles Trigonometrical ratios
Project work / Industrial visit **Broad areas:**		

a) Estimate Iron as Fe2O3 by gravimetric analysis.
b) Identify interfering radicals present in an inorganic salt mixture.
c) Perform the removal of these interfering radicals.
d) Make Block diagram of process control loop.
e) Calibration of Bourdon type pressure gauge & measure pressure by this.

SYLLABUS FOR LABORATORY ASSISTANT (CHEMICAL PLANT) TRADE			
SECOND YEAR			
Duration	**Reference Learning outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 135Hrs.; Professional Knowledge 38 Hrs.	Plan and organize the technique (with different unit process and unit operation) of organic compounds. (NOS:MIN/N9425)	105. Prepare Acetanilide by Acetylation. (04hrs.) 106. Determine % yield of Acetanilide. (02 hrs.) 107. Determine Melting point of Acetanilide. (02 hrs.) 108. Prepare Methyl Oxalate by Etherification. (10hrs.) 109. Determine % yield of Methyl Oxalate. (04 hrs.) 110. Determine Melting point of Methyl Oxalate. (02 hrs.) 111. Prepare sodium benzene sulphonate by Sulphonation. (10hrs.) 112. Determine % yield of sodium benzene sulphonate. (04hrs.) 113. Determine Melting point of sodium benzene sulphonate. (05 hrs.) 114. Prepare Nitrobenzene by Nitration. (05hrs.) 115. Determine % yield of Nitrobenzene. (05hrs.) 116. Determine Melting point of Nitrobenzene. (02 hrs.) 117. Prepare Tribromophenol by Halogination. (10hrs.) 118. Determine % yield of Tribromophenol. (05hrs.)	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. (38 hrs.)

		119. Determine Melting point of Tribromophenol. (02 hrs.) 120. Prepare oxalic acid by Oxidation. (15hrs.) 121. Determine % yield of oxalic acid. (05hrs.) 122. Determine Melting point of oxalic acid. (02 hrs.) 123. Prepare Aniline by reduction. (10 hrs.) 124. Determine % yield of Aniline. (05hrs.) 125. Determine Melting point of Aniline.(02 hrs.) 126. Determine % yield of Methyl orange, Ozazone, Glucosazone. (04hrs.) 127. Determine Melting point of Methyl orange. (05 hrs.) 128. Prepare soap by Saponification. (10 hrs.) 129. Determine % yield of soap. (05hrs.) 130. Determine saponification value. (02hr) 131. Prepare Aspirin. (05 hrs.) 132. Determine % yield of Aspirin. (05hrs.) 133. Determine Melting point of Aspirin. (02 hr)	
Professional Skill 125 Hrs.; Professional Knowledge 45 Hrs.	Plan and organize technique of inorganic substance with quality control. (NOS:MIN/N9426)	134. Prepare sodium carbonate. (20 hrs.) 135. Determine % yield & purity. (05 hrs.) 136. Prepare copper sulphate. (20 hrs.) 137. Determine % yield & purity. (5hrs.) 138. Prepare Mohr's salt. (20	Amines Cyanogen compounds Carbohydrates & Protein Polymers, Aromatic, Hydrocarbons, aromatic ethers. halogen derivatives Compounds with nitrogen urea (45 hrs.)

		hrs.) 139. Determine % yield & purity. (05 hrs.) 140. Prepare potash alum. (20 hrs.) 141. Determine % yield & purity. (05 hrs.) 142. Prepare potassium nitrate. (20 hrs.) 143. Determine % yield & purity. (05 hrs.)	
Professional Skill 120 Hrs.; Professional Knowledge 40 Hrs.	Analyze different organic compounds to identify the compound and determine various parameters. (NOS:MIN/N9427)	**Analysis of organic compounds to determine followings:** 144. Element present. (20 hrs.) 145. Functional group. (20 hrs.) 146. Melting point of organic compound. (5 hrs.) 147. Preparation of derivatives. (60 hrs.) 148. Melting point of derivatives for following groups of compounds: Alcohol, acid, carbohydrate, Nitro compounds, Amines, halogen compounds, sulphur compounds, phenolic compounds, Aldehyde, Ketone & Ester. (15 hrs.)	Aromatic acids Compounds of double & triple rings Heterocyclic compounds Diazonium salts, colour and dyes. Percentage of elements in chemical compounds Empirical formulae of chemical compounds. Empirical formulae of chemical compounds, balancing chemical equation. Principles of Material balance as applied in chemical industries; Examples of application of Material balance in heavy chemicals manufacturing viz. Sulphuric acid, Caustic Chlorine Plants. (40 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Analyze different organic compounds and measurement in respect of waste water management. (NOS:MIN/N9428)	149. Analyze given sample of water to determine Chemical Oxygen DemandC.O.D. (05hrs.) 150. Analyze given sample of water to determine	Water Chemistry; Use of water in various industrial application viz. Steam generation; various chemical processes;. Principles of water analysis;

		Biological Oxygen Demand B.O.D. (05hrs.) 151. Analyze given sample of water to determine Total Suspended Solids T.S.S. (05 hrs.) 152. Analyze given sample of water to determine pH using different methods viz. pH paper, Indicators, pH Meter.(05 hrs.) 153. Analyze given sample of water to determine Total Hardness by EDTA method. (06 hrs.) 154. Analyze given sample of Boiler Blow Down water to determine caustic alkalinity.(06 hrs.) 155. Analyze given sample of water to determine Turbidity. (06 hrs.) 156. Analyze given sample of water to determine available chlorine.(06 hrs.) 154.Analyze given sample of water to determine Total Dissolved Solids TDS. (06 hrs.)	Meaning of the terms Hardness; Turbidity TDS, TSS, pH, DO, BOD, COD Available Chlorine, Principles adopted in determination of hardness of raw water; Analysis of Boiler feed water, Boiler Blow down Water. Principles of Analysis of Sewage water, Determination of COD, BOD, TDS, Turbidity and potable water for Municipal use, Principles of Chlorine estimation.(18 hrs.)
Professional Skill 125 Hrs.; Professional Knowledge 45Hrs.	Perform quantitative analysis of ore, estimate element, alloy, organic and inorganic substanceto estimate Pharmaceuticals (Drugs/Drug intermediates)	157. Perform chemical reaction for analysis of Bauxite or Zinc ore. (15 hrs.) 158. Estimate elements. (10 hrs.)	Flow sheet for industrial production of Ammonia, Nitric acis, sulphuric acid, urea, paper, sugar, caustic, chlorine & polymers. (09 hrs.)
		159. Perform chemical reaction for analysis of Brass or Soldering materials.(15 hrs.)	Alloys, Amalgams Definition, examples of Alloys used in industries; Principles of Analysis of Alloys to determine

	substances. (NOS:MIN/N9429)	160. Estimate elements. (10 hrs.)	compositions(09 hrs.)
		161. Perform chemical reaction for analysis of calcium in given tablet. (20 hrs.) 162. Estimate calcium. (5 hrs.)	Drugs/Drug intermediates Definitions, Examples. Principles of Analysis of Drugs/Drug intermediates.(09 hrs.)
		Estimation of formaldehyde by Iodometric method: 163. Prepare reagents. (05 hrs.) 164. Perform titration. (15 hrs.) 165. Prepare table for calculation & estimate % of formaldehyde in given sample. (05 hrs.)	Preservatives, Definition, Use, Examples of common preservatives, Principles of Analysis of Preservatives (09 hrs.)
		Estimation of aniline or phenol in the given solution by Bromination method: 166. Prepare reagents. (05 hrs.) 167. Perform titration. (15 hrs.) 168. Prepare table for calculation & estimate % of aniline or phenol in given sample. (05 hrs.)	Lipids, Definition, Meaning of the terms Oils, Fats, Acid Value, Saponification value, Iodine value; Rancidity Principles of Analysis of Lipids; Hydrogenated fat./Vanaspati Definition, Principles of checking adulteration of Ghee.(09hrs.)
Professional Skill 100 Hrs.; Professional Knowledge 36Hrs.	Perform analysis of fuel gas, sugar, oil, fat, soap and nitrogen in fertilizer. (NOS:MIN/N9430)	169. Prepare reagents for Orsat's Apparatus. (10 hrs.) 170. Perform operation of Orsat's Apparatus. (10 hrs.) 171. Estimate composition of gases. (05 hrs.)	Flue gas., Definitions, Examples, Standard Composition, Principles of Analysis of Flue gas, Solutions used in Orsat's Apparatus, Working Principles (09hrs.)
		172. Determine acid value of an oil or fat. (20hrs.) 173. Determine saponification value of an oil or fat. (20hrs.)	Percentage of elements in chemical compounds Empirical formulae of chemical compounds. Empirical formulae of

		174. Determine Iodine value of an oil or fat. (10hrs.)	chemical compounds, balancing chemical equation (18 hrs.)
		Determination of fat by Soxhlet's Extraction method: 175. Construct Soxhlet's apparatus by assembling different parts. (02hrs.) 176. Perform operation with given sample. (08hrs.) 177. Estimate % of fat in given sample. (02hrs.)	Electrolysis, Electro chemistry, electro-chemical series, Heat effect of electricity. (05hrs.)
		Estimation of nitrogen by Kjeldahl's method: 178. Construct Kjeldahl's apparatus by assembling different parts. (04hrs.) 179. Prepare reagents. (04hrs.) 180. Perform operation with given sample. (03hrs.) 181. Prepare table for calculation & estimate % of nitrogen in given sample. (02hrs.)	Fertilizer its types & uses, Examples, compositions; Meaning of the term NPK, Principles of Analysis of Fertilizers. Material balance. (04hrs.)
Professional Skill 110 Hrs.; Professional Knowledge 29 Hrs.	Operate various measuring instruments used in chemical plant and laboratory. (NOS:MIN/N9431)	182. Prepare reagents. (05 hrs.) 183. Perform operation of the instrument. (10 hrs.) 184. Prepare graph & table for calculation. (05 hrs.)	Radio chemistry, Decay of radio isotopes. Equation of decay half time value. (07 hrs.)
		Determination optical rotation of sugar solution by Polari-meter: 185. Prepare reagents. (05 hrs.) 186. Perform operation of the instrument. (10 hrs.) 187. Prepare graph & table for calculation. (05 hrs.)	Introduction to microbiology. (07 hrs.)

		Determination of % of elements by Electrolytic analyzer: 188. Prepare reagents. (05 hrs.) 189. Perform operation of the instrument. (05 hrs.) **Determine the PH of given solutions by using PH-meter & comparator (Visual Calorimeter):** 190. Prepare Buffer solution & reagents. (05hrs.) 191. Perform operation of the pH meter. (05 hrs.)	Introduction to Bacteria cell. Lovibond comparator. (03 hrs.) Sterilization - Details study. pH Meaning, scale, different methods of finding pH; Working Principles of Visual Colorimeter; Working Principles of PH-meter (02 hrs.)
		Determine concentration of unknown coloured solution by colorimeter: 192. Prepare reagents. (10 hrs.) 193. Perform operation of the instrument. (05 hrs.) **Determine concentration of unknown solution by Spectrophotometer :** 194. Prepare reagents. (10 hrs.) 195. Perform operation of the instrument. (05hrs.)	Colorimetric Analysis Applications Examples, &Principles of Colorimetric Analysis. Introduction to Nutrition of bacteria. (05 hrs.) **Spectrophotometer** Application, Examples, Working Principles of Electrolytic Analyzer, Features & specification of **Spectrophotometer,** Precautions to be observed. Introduction to Industrial Microbiology. (05 hrs.)
		Practice operation of following laboratory instruments: 196. Digital flame photometer (05hrs.) 197. Refractometer (oil/sugar) (05hrs.) 198. Karlfischer apparatus. (05hrs.) 199. Analysis of water quality used in industry (PH, TDS, TSS, HARDNESS and elements). (05hrs.)	Fuel (Definition, classification, properties, composition & uses) (09 hrs.)

		200. Digital moisture balance (05hrs.) 201. Brookfield viscometer (05hrs.) 202. Electrophoresis apparatus (05hrs.) 203. Pensky –Martin apparatus (Flash point). (10hrs.)	
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Perform proximate analysis of coal and calorific value of different fuels. (NOS:MIN/N9432)	204. Determine moisture in given sample of coal. (03hrs.) 205. Determine volatile matter in given sample of coal. (03hrs.) 206. Determine ash content in given sample of coal (Furnace). (03hrs.) 207. Determine sulphur& fixed carbon in given sample of coal(C-S Det. App. LECO). (03hrs.)	Fuels its types & uses, Examples of Solid, Fuels, compositions; Meaning of the terms Moisture, VCM, Ash, FC, CV Principles of Analysis of Coal, Working Principles of Bomb Calorimeter.(05 hrs.)
		208. Determine calorific value of kerosene oil using Bomb Calorimeter. (04hrs.) 209. Determine calorific value of coal using Bomb Calorimeter. (06hrs.) 210. Determine calorific value of LPG using Jules Calorimeter. (03hrs.)	Identification of different micro-organism Micro- organisms & infections. Streptomycin Yeast Micro- organisms & infections. Streptomycin Yeast Bread, Alcohol, Beers, Wines (04 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Perform detection of micro-organism in food, pharmaceutical and other related laboratories. NOS:MIN/N9433)	211. Perform Operation of Microscope. (08 hrs.) 212. Identify common laboratory equipment's used in microbiology. (02hrs.) 213. Prepare media required for inoculations. (05 hrs.)	**Microbiology techniques**, Applications, Examples of Gram +ve& Gram –ve Microbes, Methods of media preparation & incubation. Meaning of Disinfectant, Antiseptic, Reidel- Walker Coefficient, Working Principles

		214. Identify microorganism by Gram staining technique. (10hrs.)	of Microscope. (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Perform Experiments on Analyzing Equipment. NOS:MIN/N9434)	215. To perform experiment on particle size by particle size analyzer (08 hrs.) 216. To perform experiment on solid analyzer. (08 hrs.) 217. To perform experiment on total surface area by surface area analyzer. (09 hrs.)	**Particle size Analyzer** Application, various types Examples, Working Principles ofParticle size AnalyzerFeatures& specification of Particle size Analyzer Precautions to be observed, Tyler series, Relationship between Particle size & Surface area. Working, Principles and Uses of Analyzing equipment. (09 hrs.)
WORKSHOP CALCULATION & SCIENCE (22 Hours)			
Professional Knowledge WCS- 22 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)	**<u>WORKSHOP CALCULATION & SCIENCE:</u>** Friction Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication Friction - Co- efficient of friction, application and effects of friction in workshop practice Algebra Algebra - Addition , subtraction, multiplication & division Algebra - Theory of indices, algebraic formula, related problems Estimation and Costing Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing	

Project work / Industrial visit

Broad areas:

a) Estimation of nitrogen of a given fertilizer by Kjeldehal's method.
b) Prepare Buffer of different pH & measure unknown pH by pH meter.
c) Determination of concentration of copper present in brass sample by Spectrophotometer.
d) Determination calorific value of Kerosene.
e) Identify micro-organism by staining method.

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs. + 60 Hrs.)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in/dgt.gov.in

ANNEXURE-I

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 ^{o}C, temp. accuracy ±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 completeS.S.	1 no.
9.	Chromatographic equipment	Paper, column, thin layerColumn Type Chromatographic	1 No.

		Equipment: Gas Chromatograph, The Gas 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	1liter, 0 to 110 C	10 nos.

26.	Tongs (forceps) nickel for crucibles & weights		(20+1) nos.
27.	Tongs long for crucibles (muffle furnace)		6 nos.
28.	Spatulas nickel		(20+1) nos.
29.	Test tube stand	For 10 - 12 test tubes	(20+1) nos.
30.	Tripods		(20+1) nos.
31.	Test tube holders		(20+1) nos.
32.	Clamp holders		(20+1) nos.
33.	Clamps(Forced Head)		(20+1) nos.
34.	Retort Rings with clamps for filtering & heating		(20+1) nos.
35.	Stands Burret		(20+1) nos.
36.	Stands with clamps for burettes		(20+1) 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.	CPU: 32/64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. RAM:-4 GB DDR-III or Higher, Wi-Fi Enabled. Network Card: Integrated Gigabit Ethernet, with USB Mouse, USB Keyboard and Monitor (Min. 17 Inch. Licensed Operating System.	1 no.
42.	Printer (Printer, Scanner & Copier)		1 no.
43.	Microscope	x 1000 (Monocular)	1 no.
44.	Polariometers with extra sodium lamp	Optical wavelength of 589nm, Measuring range of ± 89 Deg., Accuracy of 0.01- 0.002º 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	1 no.

		nD + 0.0005	
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 ±10%, with auto calibration facility, auto manual temp., compensation facility, PH Electrode. To study the measurement of PH.	1 no.
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 ±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, ASTMD-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	1no.

		700nm, Resolution of 0.01A, LED light source and display, Accessories like Cuvettes, Operation Manual,Cover	
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 lamp, printer port, multifunction software highly accurate silicon photo diode detector.	2 nos.
59.	Dead Weight Tester with Accessories	Range of 0 kg/ cm2 to 7 kg/ cm2, 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.	Pyknometer10ml	Made up of anodized aluminum	6 nos.

		or S.S.	
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 Thermometers, 1 hot plate of 1kw. Ready to use.Mounted on Suitable Frame Structure.	2 sets.
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	2 sets

		interface. Ready for experiment.	
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 colour matching 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	02 Nos.

		Neutral, used for to measure colority of liquid, solid and powder sample.	
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^{o} 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	Arrange all proper NOCs and equipment from municipal / competent authorities.	As per requirement
107.	LPG Cylinder		01 No.
108.	Water testing kit (all parameters)	Measuring range: Ph (0 to 14 Accuracy +/-0.01), TDS, Conductivity, Temperature And DO, read out: LCD manual with all 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.	01 set
109.	Air Conditioner	2 Ton	As required
B. CONSUMABLE GLASSWARE AND MISCELLANEOUS			

110.	Desiccators	150 mm. dia.	As Required
111.	Desiccators vacuum	Borosilicate glass	As Required
112.	Extraction thimbles		As Required
113.	Glass tubes & rods of different diameter	Borosilicate glass	As Required
114.	Rubber tubes for water, gas & vacuum, stopper, rubber each glass, plastic & cork of different sizes		As Required
115.	Asbestos wire gauge		As Required
116.	Wire gauge (without asbestos)		As Required
117.	Cork rings		As Required
118.	Pipe clay Triangles		As Required
119.	Erlenmeyer flasks	250 ml.	As Required
120.	Erlenmeyer flasks	500 ml.	As Required
121.	Burettes	25 ml.	As Required
122.	Burettes	50 ml.	As Required
123.	Pipettes Volumetric	10 ml.	As Required
124.	Pipettes Volumetric	25 ml.	As Required
125.	Pipettes measuring	0 to 5 ml.	As Required
126.	Pipettes measuring	0 to 10 ml.	As Required
127.	Pipettes measuring	0 to 1 ml.	As Required
128.	Pipettes	micro 0 to 0.2 ml.	As Required
129.	Pipettes	1ml. (graduated)	As Required
130.	Each pipettes automatic	1, 2, 5, 10 ml.	As Required
131.	Flasks for distilled water	500 ml.	As Required
132.	Vacuum pipettes	Borosilicate glass	As Required
133.	Measuring cylinders	25 ml. Borosilicate glass	As Required
134.	Measuring cylinders	50 ml. Borosilicate glass	As Required
135.	Measuring cylinders	100 ml. Borosilicate glass	As Required
136.	Measuring cylinders	250 ml. Borosilicate glass	As Required
137.	Measuring cylinders	500 ml. Borosilicate glass	As Required
138.	Measuring cylinders	1000 ml. Borosilicate glass	As Required
139.	Volumetric flask	100 ml. Borosilicate glass	As Required
140.	Volumetric flask	250 ml. Borosilicate glass	As Required
141.	Volumetric flask	500 ml. Borosilicate glass	As Required
142.	Volumetric flask	1000 ml. Borosilicate glass	As Required
143.	Weighing bottles	polyethylene or glass 50 ml.	As Required
144.	Weighing bottles	polyethylene or glass 100 ml.	As Required
145.	Funnels with regular & long stem	7 cm. dia. Borosilicate glass	As Required

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

178.	Filtering flasks	1000 ml. Borosilicate glass	As Required
179.	Flasks soxhlet with condensers	Borosilicate glass	As Required
180.	Flasks kjeldahal	250 ml. Borosilicate glass	As Required
181.	Condensers liebig	30 mm. long, Borosilicate glass	As Required
182.	Condensers liebig	50 cm. long, Borosilicate glass	As Required
183.	Condenser bulb type	30 cm. long, Borosilicate glass	As Required
184.	Condenser spiral type	20 cm. long, Borosilicate glass	As Required
185.	Connecting tubes for khejeldahal distillation		As Required
186.	Gas generator (Kipp)	500 ml. (plastic)	As Required
187.	Gas washing bottles (Dreshsler)		As Required
188.	Drying tubes with one bulb (Calcium chloride)		As Required
189.	Crucibles porcelain	5 cm, dia, height 4 cm indigenous	As Required
190.	Crucibles quarts	5 cm, dia, height 4 cm indigenous	As Required
191.	Gooch porcelain or glass		As Required
192.	Filtering crucible	No. 0, 1, 2, 3 glass	As Required
193.	Test tube	160 mm x 15 mm.	As Required
194.	Test tube	10 mm.	As Required
195.	Gas sampling tubes		As Required
196.	Pairs nessler tubes		As Required
197.	Tubes for centrifuge		As Required
198.	Bottles with droppers for indicator solutions & semi-micro qualitative analysis	30 ml.	As Required
199.	Bottles with droppers for indicator solutions & semi-micro qualitative analysis	50 ml.	As Required
200.	Bottles for solids	50 ml.	As Required
201.	Bottles for solids	100 ml.	As Required
202.	Bottles for solutions	100 ml.	As Required
203.	Bottles for solutions	250 ml.	As Required
204.	Bottles for solutions	1000 ml.	As Required
205.	Bottles for solutions	2000 ml.	As Required
206.	Bottles for solutions	3000 ml.	As Required
207.	Bottles for solutions	5000 ml.	As Required
C. SAFETY			
209.	Appron	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 range of particle size distributions, Measurement range: 17 nm to 2500 µm, Light source: Red semiconductor laser (680 nm wavelength)	As Required
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. Internet facility is desired to be provided in the classroom.
2. *All the tools and equipment are to be procured as per BIS specification.*

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्