

# **LABORATORY ASSISTANT CHEMICAL PLANT**

**NSQF LEVEL- 6**



**SECTOR - CHEMICALS AND PETROCHEMICALS**

**COMPETENCY BASED CURRICULUM  
CRAFT INSTRUCTOR TRAINING SCHEME (CITS)**



सत्यमेव जयते

**GOVERNMENT OF INDIA**  
Ministry of Skill Development & Entrepreneurship  
Directorate General of Training  
**CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE**  
EN-81, Sector-V, Salt Lake City, Kolkata – 700091

# LABORATORY ASSISTANT CHEMICAL PLANT

(Engineering Trade)

SECTOR – CHEMICALS AND PETROCHEMICALS

(Designed in 2020)

Version 1.0

**CRAFT INSTRUCTOR TRAINING SCHEME (CITS)**

**NSQF LEVEL - 6**

Developed By

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[www.cstaricalcutta.gov.in](http://www.cstaricalcutta.gov.in)

**CONTENTS**

<b>S No.</b>	<b>Topics</b>	<b>Page No.</b>
1.	Course Overview	1
2.	Training System	2-5
3.	General Information	6-7
4.	Job Role	8-9
5.	Learning Outcome	10
6.	Course Content	11-16
7.	Assessment Criteria	17-19
8.	Infrastructure	20-30
9.	Annexure I – List of Trade Experts	31

## 1. COURSE OVERVIEW

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The Craft Instructor Training Scheme is operational since inception of the Craftsmen Training Scheme. The first Craft Instructors' Training Institute was established in 1948. Subsequently, 6 more institutes namely, Central Training Institute for Instructors (now called as National Skill Training Institute (NSTI)), NSTI at Ludhiana, Kanpur, Howrah, Mumbai, Chennai and Hyderabad were established in 1960's by DGT. Since then the CITS course is successfully running in all the NSTIs across India as well as in DGT affiliated institutes viz. Institutes for Training of Trainers (IToT). This is a competency-based course of one year duration. "Laboratory Assistant Chemical plant" CITS trade is applicable for Instructors of "Laboratory Assistant (Chemical Plant)" trade.

The main objective of Crafts Instructor training programme is to enable Instructors explore different aspects of the techniques in pedagogy and transferring of hands-on skills so as to develop a pool of skilled manpower for industries, also leading to their career growth & benefiting society at large. Thus, promoting a holistic learning experience where trainee acquires specialized knowledge, skills & develops attitude towards learning & contributing in vocational training ecosystem.

This course also enables the instructors to develop instructional skills for mentoring the trainees, engaging all trainees in learning process and managing effective utilization of resources. It emphasizes on the importance of collaborative learning & innovative ways of doing things. All trainees will be able to understand and interpret the course content in right perspective, so that they are engaged in & empowered by their learning experiences and above all, ensure quality delivery.

## 2. TRAINING SYSTEM

### 2.1 GENERAL

CITS courses are delivered in National Skill Training Institutes (NSTIs) & DGT affiliated institutes viz., Institutes for Training of Trainers (IToT). For detailed guidelines regarding admission on CITS, instructions issued by DGT from time to time are to be observed. Further complete admission details are made available on NIMI web portal <http://www.nimionlineadmission.in>. The course is of one-year duration. It consists of Trade Technology (Professional skills and Professional knowledge), Training Methodology and Engineering Technology/ Soft skills. After successful completion of the training programme, the trainees appear in All India Trade Test for Craft Instructor. The successful trainee is awarded NCIC certificate by DGT.

### 2.2 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of one year:

S No.	Course Element	Notional Training Hours
1.	<b>Trade Technology</b>	
	Professional Skill (Trade Practical)	640
	Professional Knowledge (Trade Theory)	240
2.	<b>Engineering Technology</b>	
	Workshop Calculation & Science	80
	Engineering Drawing	120
3.	<b>Training Methodology</b>	
	TM Practical	320
	TM Theory	200
	<b>Total</b>	<b>1600</b>

### 2.3 PROGRESSION PATHWAYS

- Can join as an Instructor in a Vocation Training Institute / technical Institute.
- Can join as a supervisor in Industries.

### 2.4 ASSESSMENT & CERTIFICATION

The CITS trainee will be assessed for his/her Instructional skills, knowledge and attitude towards learning throughout the course span and also at the end of the training program.

a) The **Continuous Assessment (Internal)** during the period of training will be done by **Formative Assessment Method** to test competency of instructor with respect to assessment criteria set against each learning outcomes. The training institute has to maintain an individual trainee portfolio in line with assessment guidelines. The marks of internal assessment will be as per the formative assessment template provided on [www.bharatskills.gov.in](http://www.bharatskills.gov.in).

b) The **Final Assessment** will be in the form of **Summative Assessment Method**. The All India Trade Test for awarding National Craft Instructor Certificate will be conducted by DGT at the end of the year as per the guidelines of DGT. The learning outcome and assessment criteria will be the basis for setting question papers for final assessment. The external 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 CRITERIA

**Allotment of Marks among the subjects for Examination:**

Sl. No.	Subject		Marks	Internal Assessment	Full Marks	Pass Marks	
						Exam	Internal Assessment
1.	Trade Technology	Trade Theory	100	40	140	40	24
2.		Trade Practical	200	60	260	120	36
3.	Engineering Technology	Workshop Cal. & Sc.	50	25	75	20	15
4.		Engineering Drawing	50	25	75	20	15
5.	Training Methodology	TM Practical	200	30	230	120	18
6.		TM Theory	100	20	120	40	12
<b>Total Marks</b>			<b>700</b>	<b>200</b>	<b>900</b>	<b>360</b>	<b>120</b>

The minimum pass percent for Trade Practical, TM practical Examinations and Formative assessment is 60% & for all other subjects is 40%. There will be no Grace marks.

### 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. While assessing, the major factors to be considered are approaches to generate solutions to specific problems by involving standard/non-standard practices.

Due consideration should also 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 of the following:

- Demonstration of Instructional Skills (Lesson Plan, Demonstration Plan)
- Record book/daily diary
- Assessment Sheet
- Progress chart
- Video Recording
- Attendance and punctuality
- Viva-voce
- Practical work done/Models
- Assignments
- Project work

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming yearly 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 be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of an <b>acceptable standard</b> of crafts instructorship with <b>occasional guidance</b> and engage students by demonstrating good attributes of a trainer.	<ul style="list-style-type: none"> <li>• Demonstration of <b>fairly good</b> skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field.</li> <li>• Average engagement of students for learning and achievement of goals while undertaking the training on specific topic.</li> <li>• A fairly good level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson.</li> <li>• Occasional support in imparting effective training.</li> </ul>
(b) Weightage in the range of 75%-90% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a <b>reasonable standard</b> of crafts instructorship with <b>little guidance</b> and engage students by demonstrating good	<ul style="list-style-type: none"> <li>• Demonstration of <b>good</b> skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field.</li> <li>• Above average engagement of students for learning and achievement of goals while undertaking the training on specific topic.</li> <li>• A <b>good</b> level of competency in expressing</li> </ul>

attributes of a trainer.	<p>each concept in terms the student can relate, draw analogy and summarize the entire lesson.</p> <ul style="list-style-type: none"> <li>• Little support in imparting effective training.</li> </ul>
(c) Weightage in the range of more than 90% to be allotted during assessment	
<p>For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a <b>high standard</b> of crafts instructorship with <b>minimal or no support</b> and engage students by demonstrating good attributes of a trainer.</p>	<ul style="list-style-type: none"> <li>• Demonstration of <b>high</b> skill level to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field.</li> <li>• Good engagement of students for learning and achievement of goals while undertaking the training on specific topic.</li> <li>• A <b>high</b> level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson.</li> <li>• Minimal or no support in imparting effective training.</li> </ul>



### 3. GENERAL INFORMATION

<b>Name of the Trade</b>	<b>LABORATORY ASSISTANT CHEMICAL PLANT - CITS</b>
<b>Trade Code</b>	DGT/4045
<b>NCO – 2015</b>	2356.0100, 3111.0300, 3116.0100, 3116.0300, 3116.0500, 3117.0300, 2113.0500
<b>NSQF Level</b>	Level-6
<b>Duration of Craft Instructor Training</b>	One Year
<b>Unit Strength (No. Of Student)</b>	25
<b>Entry Qualification</b>	Diploma/Degree in Chemical Engineering from AICTE recognized Board / University OR National Trade Certificate in the Laboratory Assistant (Chemical Plant) trade. OR National Apprenticeship Certificate in the Laboratory Assistant (Chemical Plant) trade.
<b>Minimum Age</b>	18 years as on first day of academic session.
<b>Space Norms</b>	100 Sq. m
<b>Power Norms</b>	6 KW
<b>Instructors Qualification for</b>	
<b>1. CHEMICAL PLANT - CITS Trade</b>	B.Voc/Degree in Chemical Engineering from AICTE / UGC recognized University with two years' experience in relevant field. OR 03 years Diploma in Chemical Engineering from AICTE/ recognized Board/ University or relevant Advanced Diploma (Vocational) from DGT with five years' experience in relevant field. OR NTC/ NAC passed in the Laboratory Assistant (Chemical Plant) trade with seven years' experience in relevant field. AND <b>Essential Qualification:</b> National Craft Instructor Certificate (NCIC) in <b>LABORATORY ASSISTANT CHEMICAL PLANT</b> Trade in any of the variants under DGT.
<b>2. Workshop Calculation &amp; Science</b>	B.Voc./Degree in any relevant Engineering from AICTE/ UGC recognized Engineering College/ university with two years' experience in relevant field. OR 03 years Diploma in any relevant Engineering from AICTE /recognized board of Technical education or relevant Advanced Diploma

	(Vocational) from DGT with five years' experience in relevant field. OR NTC/ NAC in any Engineering trade with seven years' experience in relevant field. <b>Essential Qualification:</b> National Craft Instructor Certificate (NCIC) in relevant trade. OR NCIC in RoDA or any of its variants under DGT					
<b>3. Engineering Drawing</b>	B.Voc./Degree in relevant Engineering from AICTE/ UGC recognized Engineering College/ university with two years experience in relevant field. OR 03 years Diploma in relevant Engineering from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with five years experience in 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 seven years experience. <b>Essential Qualification:</b> National Craft Instructor Certificate (NCIC) in relevant trade. OR NCIC in RoDA / D'man (Mech /Civil) or any of its variants under DGT					
<b>4. Training Methodology</b>	B.Voc./Degree in any discipline from AICTE/ UGC recognized College/ university with two years' experience in training/ teaching field. OR Diploma in any discipline from recognized board / University with five years' experience in training/teaching field. OR NTC/ NAC passed in any trade with seven years' experience in training/ teaching field. <b>Essential Qualification:</b> National Craft Instructor Certificate (NCIC) in any of the variants under DGT / B.Ed /ToT from NITTTR or equivalent.					
<b>5. Minimum Age for Instructor</b>	21 years					
<b>Distribution of training on Hourly basis: (Indicative only)</b>						
<b>Total Hrs /week</b>	<b>Trade Practical</b>	<b>Trade Theory</b>	<b>Workshop Cal. &amp; Sc.</b>	<b>Engg. Drawing</b>	<b>TM Practical</b>	<b>TM Theory</b>
40 Hours	16 Hours	6 Hours	2 Hours	3 Hours	8 Hours	5 Hours

## 4. JOB ROLE

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### Brief description of job roles:

**Manual Training Teacher/Craft Instructor;** instructs students in ITIs/Vocational Training Institutes in respective trades as per defined job role. Imparts theoretical instructions for the use of tools & equipment of related trades and related subjects. Demonstrate process and operations related to the trade in the workshop; supervises, assesses and evaluates students in their practical work. Ensures availability & proper functioning of equipment and tools in stores.

**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) 2356.0100-Manual Training Teacher/ Craft Instructor
- (ii) 3111.0300 – Laboratory Assistant, Chemical Laboratory
- (iii) 3116.0100 – Laboratory Assistant, Glass and Ceramics
- (iv) 3116.0300 – Laboratory Assistant, Chemical Engineering General
- (v) 3116.0500 – Laboratory Assistant, Petroleum and Lubricants
- (vi) 3117.0300 – Laboratory Assistant, Metallurgical
- (vii) 2113.0500 – Chemist, Analytical

## 5. LEARNING OUTCOME

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

### 5.1 TRADE TECHNOLOGY

1. Demonstrate safe working practices.
2. Demonstrate preparation of solutions and strength of acid, bases and reagents.
3. Demonstrate precipitation and complex metric titration.
4. Demonstrate verification of the physical/ thermal / Electrical / Electro-chemical properties and record the analysis.
5. Demonstrate quantitative analysis of metal, non-metal and inorganic substances
6. Demonstrate execution of operation and calibration of pressure and temperature recording instrument.
7. Demonstrate Preparation and analysis of organic composition.

## 6. COURSE CONTENT

SYLLABUS FOR			
LABORATORY ASSISTANT CHEMICAL PLANT (LACP) – CITS TRADE			
TRADE TECHNOLOGY			
Duration	Reference Learning Outcome	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
Practical - 14 Hrs.  Theory - 5 Hrs	Demonstrate safe working practices.	<ul style="list-style-type: none"> <li>Demonstrate operation of different types of fire extinguishers.</li> <li>Explain Safety Data Sheet (SDS).</li> <li>Demonstrate use of personal protection equipment (PPEs) used in chemical plant.</li> </ul>	Induction to trade training. Fire & Safety in Chemical Lab/Plant. First Aid. Pollution control in Chemical Lab/Plant.
Practical - 121 Hrs.  Theory - 30 Hrs	Demonstrate preparation of solutions and strength of acid, bases and reagents.	Demonstrate preparation of solutions by weighing of solids, liquids, volatiles, non-volatiles, primary standard solutions and secondary standard solutions.  Demonstrate identification of common chemical reagents by - <ol style="list-style-type: none"> <li>performing acid-base reaction,</li> <li>Performing precipitation reaction.</li> <li>Performing colour change reaction.</li> <li>Generation of colour fume.</li> <li>Using Litmus Paper.</li> <li>Performing reaction generating gas with specific smell.</li> </ol>	Elements, atoms & molecules Chemical & physical changes.  Acid, base & salts.  Determination of concentration of solutions by Normality & Molarity.
		Demonstrate Preparation of various reagents for analysis of acid and base. Exhibit Titration between - <ol style="list-style-type: none"> <li>Hydrochloric acid and sodium hydroxide.</li> <li>mixture of sodium carbonate and sodium bi-carbonate with hydrochloric acid</li> <li>vinegar and standard sodium hydroxide.</li> <li>Boric acid and sodium hydroxide.</li> </ol>	Atomic molecular and equivalent weights. Crystallography. Solutions. Laws of chemical combinations

		v. Ammonium Chloride sample and sodium hydroxide	
		<ul style="list-style-type: none"> <li>• Demonstrate Table formation and calculation of result for titration.</li> </ul>	
		<ul style="list-style-type: none"> <li>• Demonstrate preparation of various reagents and indicators required for Redox titration.</li> <li>• Exhibit Redox titrations using –                             <ol style="list-style-type: none"> <li>(i) Potassium iodate solution.</li> <li>(ii) Potassium bromate solution.</li> </ol> </li> <li>• Demonstrate Permanganometry titration using permanganate solution.</li> <li>• Demonstrate Dichrometry titrations using dichromate solution.</li> </ul>	Study of Periodic table. Morphology of materials
		<ul style="list-style-type: none"> <li>• Demonstrate preparation of various reagents and indicators required for Iodometric and Iodimetric titration.</li> <li>• Exhibit Iodometric titration using iodine solution indirectly.</li> <li>• Exhibit Iodimetric titration using iodine solution directly.</li> </ul>	Chemical equilibrium. Thermo-chemistry & Thermodynamics.
Practical - 28 Hrs.  Theory - 20 Hrs	Demonstrate precipitation and complex metric titration.	<ul style="list-style-type: none"> <li>• Demonstrate preparation of various reagents and indicators required for precipitation titration.</li> <li>• Exhibit exact end point detection by -                             <ol style="list-style-type: none"> <li>(i) Mohr method.</li> <li>(ii) Volhard method.</li> </ol> </li> </ul>	Metallurgy of: <ul style="list-style-type: none"> <li>• Aluminum.</li> <li>• Copper</li> <li>• Silver</li> <li>• Chromium</li> <li>• Iron &amp; Steel</li> <li>• Zinc &amp; its alloys.</li> </ul>
		<ul style="list-style-type: none"> <li>• Demonstrate preparation of various reagents and indicators required for complex metric titration.</li> <li>• Exhibit complex metric titration.</li> </ul>	Non-Metals: Preparation, properties & uses of following: <ol style="list-style-type: none"> <li>a) Hydrogen &amp; its peroxide.</li> <li>b) Oxygen</li> <li>c) Sulphur &amp; its compounds.</li> <li>d) Nitrogen &amp; its compounds.</li> <li>e) Phosphorus &amp; its compounds.</li> <li>f) Chlorine &amp; Fluorine and its compounds.</li> </ol>
Practical -	Demonstrate verification of the physical/ thermal /	<b>Physics Lab: -</b> <ul style="list-style-type: none"> <li>• Demonstrate verification of parallelogram of forces.</li> </ul>	Moment and Levers: moments, units, types of Levers. Simple machines, efforts and load,

35 Hrs.  Theory - 25 Hrs	Electrical / Electro-chemical properties and record the analysis.	<ul style="list-style-type: none"> <li>Exhibit determination of acceleration due to gravity (g).</li> <li>Exhibit determination of Young's Modulus (Y).</li> </ul>	mechanical advantage, velocity ratio, efficiency of machines, their relationship, examples.
		<ul style="list-style-type: none"> <li>Exhibit determination of coefficient of expansion of solid.</li> <li>Exhibit determination of coefficient of Thermal conductivity of metal rod.</li> </ul>	Elasticity, 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's ration, bulk modulus, factor of safety, examples.
		<ul style="list-style-type: none"> <li>Exhibit determination of mechanical equivalent of heat.</li> </ul>	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.
		<ul style="list-style-type: none"> <li>Demonstrate verification of Ohm's law.</li> <li>Demonstrate verification of Kirchhoff's law related to current and voltage.</li> <li>Exhibit determination of specific resistance using wheat stone's Bridge.</li> </ul>	Electricity: Electric current, +Ve and -Ve terminals use of fuses and switches, conductors and insulators, simple electrical Circuits. Ohm's law, electrical insulating Materials, Kirchhoff's law, examples, Parallel and series connections. Whetstone's bridge potentiometer.
		<ul style="list-style-type: none"> <li>Demonstrate electrolysis and exhibit verification of Faraday's laws of electrolysis.</li> </ul>	Electrolysis, conversion of electrical energy into heat energy, Joule's law. mechanical equivalent of heat.
Practical - 115 Hrs.	Demonstrate quantitative analysis of metal, non-metal and inorganic	<ul style="list-style-type: none"> <li>Demonstrate preparation of reagents for Gravimetric estimations of – (i) Nickel.</li> </ul>	Structure of atom. Radioactivity, Chemical bonding, Electronic theory of valency,



Theory - 40Hrs	substances	(ii) Iron. (iii) Barium. (iv) Lead. (v) Silicon. <ul style="list-style-type: none"> <li>• Demonstrate execution of chemical reaction between reagents and collection of precipitation for -                      (i) Nickel.                      (ii) Iron.                      (iii) Barium.                      (iv) Lead.                      (v) Silicon.</li> <li>• Demonstrate execution of furnace operation for drying of precipitation and record its quantity.</li> </ul>	Gas laws - Boyle's law, Charl's law, Gas equation, Graham's Law of diffusion, Dalton's law of partial pressure.
		<ul style="list-style-type: none"> <li>• Demonstrate identification of Inorganic substances by their physical properties (colour, solubility, acidic or basic nature).</li> </ul> <p><b>Dry test for Cations:</b></p> <ul style="list-style-type: none"> <li>• Demonstrate identification of Inorganic substances by –                      (i) Dry test tube heating.                      (ii) Flame test.                      (iii) Borax Bead test.                      (iv) Fusion test.</li> </ul> <p><b>Dry test for Anions:</b></p> <ul style="list-style-type: none"> <li>• Demonstrate identification of Inorganic substances by reaction with –                      (i) Dilute acids.                      (ii) Concentrated acids.</li> </ul> <p><b>Wet test for cations:</b></p> <ul style="list-style-type: none"> <li>• Demonstrate identification of Inorganic substances by wet test for metals.</li> </ul> <p><b>Wet test for Anions:</b></p> <ul style="list-style-type: none"> <li>• Demonstrate identification of Inorganic substances by wet test for –                      (i) Chloride.                      (ii) Bromide.                      (iii) Iodide.                      (iv) Flouride.                      (v) Sulphate.                      (vi) Sulphide.</li> </ul>	Fertilizer - its types & uses Atmospheric air, Water & its type, Water Treatment (Purification),

		(vii) Sulphite. (viii) Thiosulphate. (ix) Nitrate & Nitrite. (x) Phosphate. (xi) Chromate. (xii) Carbonate & Bi-Carbonate. (xiii) Borate.	
Practical - 42 Hrs.  Theory - 30 Hrs	Demonstrate execution of operation and calibration of pressure and temperature recording instrument.	<ul style="list-style-type: none"> <li>• Demonstrate execution of Calibration of pressure gauges.</li> <li>• Demonstrate execution of operation of Manometer.</li> <li>• Demonstrate execution of Calibration of Alcohol in glass thermometer. (Analog and Digital)</li> <li>• Demonstrate execution of Calibration of bimetallic thermometer. (Analog and Digital)</li> </ul>	Units of pressure, measurement of pressure by different methods.  Temperature scale, different methods of temperature measurement.
		<ul style="list-style-type: none"> <li>• Demonstrate operation of Resistance thermometer. (Analog and Digital)</li> <li>• Demonstrate execution of operation of Thermocouple.</li> <li>• Demonstrate execution of operation of Thermocouple Pyrometer.</li> </ul>	Thermometer, Thermocouple and pyrometer.
		<ul style="list-style-type: none"> <li>• Demonstrate execution of Operation of recorders. (Analog and Digital)</li> <li>• Demonstrate execution of Operation of Transmitter. (Analog and Digital)</li> <li>• Demonstrate execution of Operation of controller. (Analog and Digital)</li> </ul>	Recorder, On- off controller, Transmitter.
Practical - 285 Hrs.  Theory - 90 Hrs	Demonstrate Preparation and analysis of organic composition.	<ul style="list-style-type: none"> <li>• Demonstrate organic Preparation of –                             <ul style="list-style-type: none"> <li>(i) Acetamide</li> <li>(ii) Methyl oxalate</li> <li>(iii) Sodium</li> <li>(iv) Benzene</li> <li>(v) Sulphate</li> <li>(vi) Nitro benzene</li> <li>(vii) Aniline</li> <li>(viii) Trichloro phenol</li> </ul> </li> </ul>	Purification of organic composition. Types of organic reaction, classification,

		<ul style="list-style-type: none"> <li>• Demonstrate Lab preparation of –             <ul style="list-style-type: none"> <li>(i) Oxalic acid</li> <li>(ii) Soap</li> <li>(iii) Aspirin</li> <li>(iv) <math>\text{Na}_2\text{CO}_3</math></li> <li>(v) Mohr's Salt</li> <li>(vi) Potash</li> <li>(vii) Alum</li> </ul> </li> </ul>	
		<ul style="list-style-type: none"> <li>• Demonstrate Organic qualitative analysis of –             <ul style="list-style-type: none"> <li>(i) Hydrocarbon</li> <li>(ii) Alcohol</li> <li>(iii) Carboxylic acid</li> <li>(iv) Aldehyde</li> <li>(v) Ketone</li> </ul> </li> </ul>	
		<ul style="list-style-type: none"> <li>• Demonstrate Analysis of water – BoD, CoD, Turbidity, TDS</li> <li>• Demonstrate Industrial instrumental method of analysis GC/BOD/COD/AAS /UV/IR / HPLC Flame photometer</li> </ul>	Simple industrial instruments. Method of analysis PH/ TSS/ Viscosity/ Density/ Melting point, Boiling point

<b>SYLLABUS FOR CORE SKILLS</b>
1. Workshop Calculation & Science (Common for all Engineering CITS trades) (80 Hrs)
2. Engineering Drawing (Group I) (120Hrs)
3. Training Methodology (Common for all CITS trades) (320Hrs + 200Hrs)

Learning outcomes, assessment criteria, syllabus and Tool List of above Core Skills subjects which is common for a group of trades, provided separately in [www.bharatskills.gov.in](http://www.bharatskills.gov.in)

## 7. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
<b>TRADE TECHNOLOGY</b>	
1. Demonstrate safe working practices.	1.1 Exhibit procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	1.2 Demonstrate precautions on fire and safety and use of different fire extinguishers as per requirement.
	1.3 Exhibit handling of and store / disposal of waste and dangerous / unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements.
	1.4 Demonstrate First aid procedures in regard to illness or accident.
	1.5 Exhibit safety alarms and site evacuation procedures
	1.6 Demonstrate use of Personal Productive Equipment (PPE) as per related working environment.
	1.7 Exhibit environmental pollution, procedure to avoid the same and use of energy and materials in an environmental friendly manner.
	1.8 Demonstrate different components of 5S and their application in the working environment.
2. Demonstrate preparation of solutions and strength of acid, bases and reagents.	2.1 Demonstrate Preparation of solutions by weighing
	2.2 Exhibit Identification of common chemical reagents
	2.3 Demonstrate Preparation of reagents for analysis of acid and base and exhibit Titration
	2.4 Exhibit Redox titrations
	2.5 Demonstrate Permanganometry / Dichrometry titration
	2.6 Exhibit Iodometric / Iodimetric titration
3. Demonstrate precipitation and complex titration.	3.1 Demonstrate preparation of reagents and indicators required for precipitation titration.
	3.2 Exhibit exact end point detection
	3.3 Demonstrate Preparation of reagents and indicators required for complex metric titration.
	3.4 Exhibit complex metric titration.
4. Demonstrate verification of the physical/ thermal / Electrical / Electro-chemical properties and record the analysis.	4.1 Demonstrate verification of parallelogram of forces and recording of data.
	4.2 Exhibit determination of acceleration due to gravity (g) and recording of data.
	4.3 Exhibit determination of Young's Modulus (Y) and recording of data.
	4.4 Exhibit determination of coefficient of expansion of solid and

	recording of data.
	4.5 Exhibit determination of coefficient of Thermal conductivity of metal rod and recording of data.
	4.6 Demonstrate verification of Ohm's law and recording of data.
	4.7 Demonstrate verification of Kirchhoff's law related to current and voltage and recording of data.
	4.8 Exhibit determination of specific resistance using wheat stone's Bridge and recording of data.
	4.9 Demonstrate electrolysis and exhibit verification of Faraday's laws of electrolysis and recording of data.
5. Demonstrate quantitative analysis of metal, non-metal and inorganic substances	5.1 Demonstrate preparation of reagents for Gravimetric estimations of metal, non-metal and inorganic substances
	5.2 Demonstrate execution of chemical reaction between reagents and collection of precipitation, drying of precipitation and record its quantity.
	5.3 Demonstrate identification of Inorganic substances by Dry test for Cations
	5.4 Demonstrate identification of Inorganic substances by reaction with Dilute / Concentrated acids
	5.5 Demonstrate identification of Inorganic substances by wet test for metals
	5.6 Demonstrate identification of Inorganic substances by wet test for Anions
6. Demonstrate execution of operation and calibration of pressure and temperature recording instrument.	6.1 Demonstrate Calibration of pressure gauges.
	6.2 Demonstrate operation of Manometer
	6.3 Demonstrate Calibration of Alcohol in glass thermometer. (Analog and Digital)
	6.4 Demonstrate Calibration of bimetallic thermometer. (Analog and Digital)
	6.5 Demonstrate operation of Resistance thermometer. (Analog and Digital)
	6.6 Demonstrate operation of Thermocouple.
	6.7 Demonstrate operation of Thermocouple Pyrometer.
	6.8 Demonstrate Operation of recorders. (Analog and Digital)
	6.9 Demonstrate operation of Transmitter (Analog and Digital)
	6.10 Demonstrate operation of controller (Analog and Digital)
7. Demonstrate Preparation and analysis of organic composition.	7.1 Demonstrate Preparation of – Acetamide / Methyl oxalate / Sodium / Benzene / Sulphate / Nitro benzene / Aniline / Trichloro phenol
	7.2 Demonstrate Lab preparation of – Oxalic acid / Soap / Aspirin / Na <sub>2</sub> Co <sub>3</sub> / Mohr's Salt / Potash / Alum
	7.3 Demonstrate qualitative analysis of – Hydrocarbon / Alcohol / Carboxylic acid / Aldehyde / Ketone
	7.4 Demonstrate Analysis of water – BoD, CoD, Turbidity, TDS

	7.5 Demonstrate Industrial instrumental method of analysis GC/BOD/COD/AAS /UV/IR / HPLC Flame photometer

## 8. INFRASTRUCTURE

LIST OF TOOLS AND EQUIPMENT			
Laboratory Assistant Chemical Plant (LACP) - CITS			
S No.	Name of the Tools & Equipment	Specification	Quantity
<b>A. GENERAL MACHINERY &amp; SHOP OUTFIT</b>			
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 layer Column Type Chromatographic 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	1 No.

		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 nos.
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 $\pm 89$ Deg., Accuracy of 0.01- 0.002 <sup>o</sup> Temperature range of 0-40 oC (accuracy +/- 0.1 Deg C) Response speed of +/- 6 <sup>o</sup> /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, 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 $\pm 1\%$ 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, ASTMD-93 and IS 1448 (Part I) 1270	1 no.

		(P.21) and IS 1209-1953 method B.	
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 <sup>2</sup>	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/ cm <sup>2</sup> to 7 kg/ cm <sup>2</sup> , 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 <sup>th</sup> 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		6 sets

	forces including all accessories		
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 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 $\Omega$ )	0 to 500 ohms.	2 nos.
84.	Rheostat 0-25 Ohms	25 Ohms	2 nos.
85.	Rheostat 0-100 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 1200o 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 necessary Electrodes/probes tomeasure above parameters,	01 set

		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>B. CONSUMABLE GLASSWARE AND MISCELLANEOUS</b>			
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 kjejdahal distillation		As Required
187.	Gas generator (Kipp)	500 ml. (plastic)	As Required
188.	Gas washing bottles (Dreshsler)		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 quarts	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
<b>C. SAFETY</b>			
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 range of particle size distributions, Measurement range: 17 nm to 2500 $\mu\text{m}$ , 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 $\text{cm}^{-1}$ , Resolution better than 0.7 $\text{cm}^{-1}$ , Frequency accuracy (@7300 $\text{cm}^{-1}$ ): < 0.06 $\text{cm}^{-1}$ , Ethernet port for data communication.	As Required
216.	Surface Area Analyzer	Automatic calibration facility, Capable to	As Required



		create Automatically necessary mixtures of nitrogen and helium, Detector protection, Electronic valves, software control the unit via USB communication.	
<b>D. FURNITURE</b>			
1.	Steel cupboard with 8 pigeon lockers		03 nos.
2.	Chair with arm		02 nos.
3.	Table for trainer		01 no.
4.	Steel cupboard	180 x 90 x 45cm	02 nos.
5.	Steel cupboard	120 x 60 x 45cm	02 nos.
6.	White board with magnetic duster	6'x4'	01 no.
7.	Metal rack	182 x 182 x 45cm	01 no.
<b>E. LIST OF TOOLS &amp; EQUIPMENTS for Engg. Drawing</b>			
8.	Drawing table for A1 sheet		25 nos.
9.	Stools (Revolving type) Adjustable height		25 nos.
10.	T.O's Table	6ft X 4ft	1 no
11.	T.O's chair revolving		1 no.
12.	D.L.P Projector	2000 lumen or higher	1 no
13.	White board	6FT. x 4FT.	1 no.
14.	Computer 3GHz or latest with 1GB Or higher RAM with compatible motherboard	DVD combo drive with latest x version, hard disk with 160 GB or above, 19" TFT Monitor,1 GB AGP card, 10/100 Ethernet card, Internal modem, UPS with 800 VA / Latest Version	12 nos.
15.	Software:	MS-Office XP or latest version of operating software Auto-CAD with power pack or latest version	12 nos.
16.	Laser Jet printer	Latest model – Print, Copy and Scan 1200x1200dpi, 16MB	1 no.
17.	Computer table		12 nos.
18.	Printer table		1 No
19.	Almirah Steel	6 feet height or higher	1 no.
<b>F. ACCESSORIES FOR TRAINING METHODOLY / AUDIO VISUAL ROOM (Common for all Trades)</b>			
20.	Class Room Chairs	armless / Dual desk may also be allowed	25 /13nos.
21.	Class Room Tables	3ft X 2ft / Dual desk may also be allowed	25 /13nos.
22.	Chair for Trainer (armed) movable		01 no.
23.	Table for Trainer	4 ft X 2 ft with Drawer and cupboard	01 no.
24.	LCD / LED Projector		01 no.
25.	Multimedia Computer System	0.5 KVA	01 set



	with all accessories with UPS		
26.	White Board	6ft X 4 ft.	01 no.
27.	LCD Projector Screen		01 no.
28.	Digital Video Camera (hard Disk) with Tripod stand		01 no.
29.	Air Conditioner for computer room	1.5Ton	As required
30.	Wall charts, Transparencies and DVDs	related to the trade	As required

**Note: -**

1. Internet facility is desired to be provided in the class room.
2. *All the tools and equipment are to be procured as per BIS specification.*

## 8. INFRASTRUCTURE

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

<b>List of Expert members contributed/ participated for finalizing the course curriculum of Laboratory Assistant Chemical Plant - CITS trade</b>			
<b>S No.</b>	<b>Name &amp; Designation Sh/Mr/Ms</b>	<b>Organization</b>	<b>Remarks</b>
1.	C.S. Murthy, Jt.Dir. of Trg.	CSTARI, Kolkata	Chairman
2.	R.R. Patel, Regional Deputy Director	DTET, Govt. of Gujrat	Member
3.	Ketan Patel, Deputy Director	RDSDE, Gandhinagar, Gujrat	Member
4.	Kapil Nayak, B.D. Officer	Berger Paints	Member
5.	G.N. Rathwa, Principal, Class- II	ITI, Sankheda, Chhatadepur, Gujrat	Member
6.	Vivek G. Maehhi, Principal, Class- II	ITI, Anklev, Anand, Gujrat	Member
7.	Smt. S.K. Jadav, Sr. Instructor	ITI, Surat, Gujrat	Member
8.	A.B. Suthar, Sr. Instructor	ITI, Saraspur, Ahmedabad, Gujrat	Member
9.	M.D. Nayak, Principal, Class- II	ITI, Dabhoi, Vadodara, Gujrat	Member
10.	N.H. Patel, Sr. Instructor	ITI, Tarsali, Gujrat	Member
11.	S.M. Patel,	ITI, Tarsali, Gujrat	Member
12.	R.A. Vagdodiya	ITI, Tarsali, Gujrat	Member
13.	M.G. Shah	ITI, Tarsali, Gujrat	Member
14.	Danish Aggarwal, Astt. Director	RDSDE, Gandhinagar, Gujrat	Member
15.	R.N. Manna, Trg. Officer.	CSTARI, Kolkata	Member
16.	Snehashis Bandyopadhyay, Trg. Officer.	CSTARI, Kolkata	Member
17.	Bharat Kr. Nigam, Trg. Officer.	CSTARI, Kolkata	Member