

*Syllabus for the trade  
of*

**ATTENDANT OPERATOR(CHEMICAL PLANT)**  
(SEMESTER PATTERN)

UNDER

**CRAFTSMEN TRAINING SCHEME**

*Revised in: 2015*

By  
Government of India

**Central Staff Training and Research Institute**

Directorate General of Training  
Ministry of Skill Development and Entrepreneurship  
EN -81, Sector-V, Salt Lake City,  
Kolkata-700091

**List of the Members of Trade Committee Meeting for the trade of**

ATTENDANT OPERATOR(CHEMICAL PLANT) held on 24.03.2015 and 25.05.2015 at DVE&T, Mumbai and I.T.I. Mahad, Maharashtra

<b>SR.NO.</b>	<b>NAME &amp; DESIGNATION</b>	<b>REPRESENTING ORGANIZATION WITH FULL ADDRESS</b>	<b>REMARKS</b>
1	G. J. Shivalkar, Principal	I.T.I. Mahad	Chairman
2	Smt. S. G. Thakur, Training Officer	I.T.I. Mahad	Member
3	C. P. Jadhav, Craft Instructor	I.T.I. Panvel	Member
4	S. D. Bait, Craft Instructor	I.T.I. Mahad	Member
5	N. J. Ware, Craft Instructor	I.T.I. Mahad	Member
6	J. H. Suryawanshi Training Officer	I.T.I Mahad	Member
3	P.R. Patil Craft Instructor	I.T.I Mahad	Member
4	S.V.Ghadigaonkar Manager Mechanical	Pidilite Industries Ltd,A-21 MIDC Mahad Dist- Raigad	Member
5	Sukhiraj Shette Manager Maintenance	Sandoz Pvt. Ltd,L-1 MIDC Mahad Dist- Raigad	Member
6	Sanjay Janrao Manager Maintenance	Embio Ltd,E-21,22 MIDC Mahad Dist- Raigad	Member
7	Sameer N. Lahane Dy. Manager Engg.	Shree Hari Chemicals Export Ltd,A-8 MIDC MahadDist- Raigad	Member
8	A Markandeyula Manager Maintenance	Privi Organics Ltd,C-3,4,5,6MIDC MahadDist- Raigad	Member
9	V N Malusare Sr. Manager Engg.	Hical Ltd,A-18 MIDC MahadDist- Raigad	Member
10	S T Dhumane Asst.Manager Engg.	SadhanaNitrochem Ltd, MIDC Roha, Dist- Raigad	Member
11	R.S.Bhosale G.M. Engg.	Elppe chemicals pvt MIDC RohaDist- Raigad	Member
12	S.K. Singh Sr. Executive	Sudarshan chemicals Ltd. MIDC Roha, Dist- Raigad	Member
13	Vineet Singh Manager Maintenance	Pepsico India holdings pvt ltd MIDC Roha. Dist- Raigad	Member

List of the Members of Trade Committee Meeting for the trade of

**ATTENDANT OPERATOR (CHEMICAL PLANT)**

held on 02<sup>nd</sup> July, 2015 at Industrial Training Institute, Maninagar, Ahmedabad, Gujarat

SR. NO.	NAME & DESIGNATION	REPRESENTING ORGANIZATION WITH FULL ADDRESS	REMARKS
1.	Shri Sanjaykumar, Joint Director	CSTARI, Kolkata	Chairman
2.	Shri L. K. Mukherjee, Dy. Director	CSTARI, Kolkata	Member
3.	Shri A. C. Muliya, Dy. Director	Directorate of Employment & Training, Gandhinagar	Member
4.	Shri G. N. Parekh, Dy. Director	Directorate of Employment & Training, Gandhinagar	Member
5.	Shri Yatin K. Shah, Supervisor	J. B. Packaging, Ahmedabad	Member
6.	Shri Krunal J Patel, Manager	Dishman Pharma & Chemical Ltd., Ahmedabad	Member
7.	Shri Praful S Sompura, Q.C. Chemist	Maize Products, Ahmedabad	Member
8.	Shri Kamlesh Prajapati, Director	Technology Exchange Services Pvt. Ltd., Ahmedabad	Member
9.	Shri Imtiyaz Kureshi, Sr. Engg.	Technical Resources & Planning Services Pvt. Ltd., Ahmedabad	Member
10.	Shri P. D. Pendkar, Prod. Manager	Jay Chemical Industries, Ahmedabad	Member
11.	Shri Vijay Sinha, Exe. Incharge	Jay Chemical Industries, Ahmedabad	Member
12.	Shri Prakash Patel, General Manager	Meghmani Dyes & Intermediates Ltd, Ahmedabad	Member
13.	Shri Vishnu Patel, Manager	Meghmani Dyes & Intermediates Ltd, Ahmedabad	Member
14.	Shri Jayeshbhai Dave, Manager	Meghmani Pigments, Ahmedabad	Member
15.	Shri Hetal Shah, Asst. Prod. Manager	Meghmani Pigments, Ahmedabad	Member
16.	Shri Patel Nikesh M, Manager	Mcfills Enterprises Pvt. Ltd, Ahmedabad	Member
17.	Shri Rajendra Mandora, Vice President	RLT Instrumentation Pvt. Ltd, Chennai	Member
18.	Shri Akshit Raycha, Jt. Managing Director	Zenith Healthcare, Ahmedabad	Member
19.	Shri Dr. A. P. Vyas, Principal	Saffrony Institute of Technology, Mehsana	Member
20.	Shri D. B. Chaudhari, Principal	ITI Sachin, Surat	Member
21.	Shri Nilesh H Patel, S. I. AOCP	ITI Vasad, Anand	Member
22.	Shri B. R. Prajapati, S. I. AOCP	ITI Palana, Kheda	Member
23.	Shri H. B. Rajput, S. I. AOCP	ITI Visnagar, Mehsana	Member

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**ATTENDANT OPERATOR (CHEMICAL PLANT)**

held on 02<sup>nd</sup> July, 2015 at Industrial Training Institute, Maninagar, Ahmedabad, Gujarat

SR. NO.	NAME & DESIGNATION	REPRESENTING ORGANIZATION WITH FULL ADDRESS	REMARKS
24.	Shri A. G. Parmar, S. I. AOCP	ITI Kubernagar, Ahmedabad	Member
25.	Shri M. M. Patel, S. I. IMCP	ITI Kubernagar, Ahmedabad	Member
26.	Shri D. D. Dave, S.I. (MMCP)	ITI Kubernagar, Ahmedabad	Member
27.	Smt. S. C. Madi, S. I. (LACP)	ITI Kubernagar, Ahmedabad	Member
28.	Shri S. N. Patel, S. I. (IMCP)	ITI Kubernagar, Ahmedabad	Member
29.	Shri V. R. Patel, S. I. (MMCP)	ITI Kubernagar, Ahmedabad	Member
30.	Ku. R. K. Parmar, S.I. (LACP)	ITI Kubernagar, Ahmedabad	Member
31.	Ku. Z. R. Dave, S. I. (AOCP)	ITI Kubernagar, Ahmedabad	Member
32.	Shri A. B. Shrimali, S. I. (MMCP)	ITI Kubernagar, Ahmedabad	Member

## GENERAL INFORMATION

1. Name of the Trade : **ATTENDANT OPERATOR(CHEMICAL PLANT)**
2. NCO Code No. :733.10, 733.15, 733.40, 733.50, 733.90,734.15, 739.20, 741.15, 741.30, 741.60,742.10, 742.30, 742.60, 743.10, 743.40,744.20, 744.40, 745.10, 749.34, 773.50,749.64, 749.72, 749.76, 749.82, 749.86,773.13, 773.40, 773.50, 773.60, 773.80,775.40, 775.65, 776.50, 893.20, 902.10,902.30, 903.10, 722.10, 733.20, 733.45,733.70, 734.10, 734.25, 739.55, 741.20, 741.10, 741.70, 742.20, 742.40, 742.90,743.30, 744.10, 744.30, 744.50, 749.30,749.42, 749.62, 749.68, 749.74, 749.80,749.84, 749.88, 773.23,773.40, 773.57, 773.65, 775.30, 775.55, 776.20, 893.10,893.33, 902.20, 902.50, 903.20
2. Duration : 2 Year Course with 4 Semesters of 6 months each
3. Power Norms : 13 Kw
4. Space Norms : 104 sq. mtrs.
5. Entry qualification : Passed 10<sup>th</sup> Class Examination under 10+2 system with Science and Mathematics or equivalent.
6. Unit Size (No. of Trainees) : 16
7. Instructor Qualification : a. Degree in Chemical Technology/ Engineering from recognized University with one experience in the relevant field.
- OR
- b. Diploma in Chemical Technology/ Engineering from recognized board of Technical Education with 2 years post qualification experience in relevant field
- OR
- c. 10<sup>th</sup> Class Passed and NTC / NAC in Trade with 3 years post qualification experience in the relevant field
8. Desirable : CIC in the trade

Note: - At least one instructor must have Degree/ Diploma in the relevant field.

SYLLABUS OF THE TRADE OF		
ATTENDANT OPERATOR(CHEMICAL PLANT) UNDER CTS		
Semester – I (Semester Code No. AOC-01)		
Week No.	TRADE PRACTICAL	TRADE THEORY
1	<b>SAFETY:</b> Demonstration about PPE'S, Safety Equipment, First aid box.	<b>INTRODUCTION:</b> Introduction about ITI Rules and Regulation. Importance of trade training.  <b>SAFETY:</b> Introduction & Importance of safety, General precautions about safety. PPE'S Used in chemical industries. Safety slogan. First aid in industry & Workshop
2 & 3	<b>FITTING:</b> Filing flat surface and Checking flatness and squareness using engineer's Try square.	<b>BASIC FITTING:</b> Description, construction and uses of different hand tools such as Files, Chisels, Hacksaw & Hammer etc. Description, construction and uses of different marking tools such as steel rule, caliper, punches, v-block, scribing block etc.
4	Filing four edges, Checking all dimension with outside caliper and steel rule. Marking of Parallel lines, curve lines using Dot Punch.	<b>JOB HOLDING DEVICES:</b> Description, construction and uses of different job holding devices. Such as vice, V' Block.
5 & 6	Making a job on step fitting (Male & female). Marking out the position of holes for drilling. Use of center drill for drilling operations.	Description, construction, calculation and uses of different Linear Measuring Instruments - Vernier Caliper, Vernier Depth gauge, Height gauge, Micrometer outside, Bevel protector.
7	Drilling Practice, Reaming Practice, Countersinking & Counter Boring Practice,	Drilling ,Reaming and Threading : Nomenclature and uses of Drill, Reamer, and Thread
8	Tapping and Dying of BSW OR Metric thread.	Description, nomenclature and uses of different types of threads – metric, BSW, BSF, and BSP etc. Calculation of tap drill size.
9	<b>GAS WELDING:</b> Demonstration about safety equipment's & general precautions in welding workshop.	<b>SAFETY:</b> Safety & General precautions observed in welding workshop. Importance of Welding in maintenance of chemical plant and equipment. Welding terms and their definition. Types of welding
10	Nut bolting over pipe flange. Riveting and seaming practice on metal sheet.	<b>METAL JOINING METHOD :</b> General introduction about Mechanical method (Riveting, Nut bolting, Seaming etc ). Thermal methods (Soldering, Brazing & Welding)
11	Demonstration about lighting & adjustment of flame.	<b>GAS WELDING:</b> Principal of Gas Welding. Safety precautions before, after & during Gas Welding. Common Gases used in Welding. <b>OXY-ACETYLENE WELDING:</b> Equipment's such as Oxygen cylinder, Acetylene cylinder, cylinder trolley, regulator, and blow pipe, Hose pipe, Assembling, care & maintenance.
12	Edge joint with and without filler rod.	<b>OXY-ACETYLENE FLAME:</b> Types of flame. Uses & Effect of Atmospheric oxidation
13	<b>PHYSICS LAB:</b> Determination of acceleration due to gravity by simple pendulum To study parallelogram of forces with the help of mechanical board.	Introduction to Physics, Measurement with Vernier caliper, Micrometer. Scalar and Vector quantities, their representation, resultant. Triangle and parallelogram laws of forces.
14	Determination of coefficient of static friction by inclined plane. Determination of mechanical advantage velocity ratio and % efficiency of Screw jack.	Newton's laws of motion, Inertia, force, momentum, types of force. Friction- definition, unit, types of friction, laws of friction, advantages and disadvantages of friction
15	Determination of Young's Modulus by Searle's apparatus	<b>ELASTICITY:</b> Stress, strain, elastic limit, Hooke's law. Types of moduli of elasticity, work done in a stretching wire, determination of Young's modulus

SYLLABUS OF THE TRADE OF		
ATTENDANT OPERATOR(CHEMICAL PLANT) UNDER CTS		
Semester – I (Semester Code No. AOC-01)		
Week No.	TRADE PRACTICAL	TRADE THEORY
16	To study Ohm's law about current and voltage. To study electric cell using series and parallel connections	<b>CURRENT ELECTRICITY:</b> Ohm's law, series & parallel connections, specific resistance, Kirchhoff's law
17	Verification of faraday's First law of electrolysis. Determination of Mechanical equivalent of heat using electrical method.	<b>ELECTROLYSIS:</b> Faraday's laws of electrolysis. Thermodynamics- first law of thermodynamics, mechanical equivalent of heat, 'J' by electrical method.
18	Determination of coefficient of expansion of Solid. Determination of coefficient of expansion of liquid. Determination of coefficient of Thermal Conductivity of metal rod	Modes of heat transfer, determination of thermal conductivity. Temperature & its measurement, expansion of solid, liquid and gases
19	<b>CHEMISTRY LAB:</b> Separation of mixture by simple Distillation. Volumetric Analysis-Preparation of Standard Solutions	Introduction of Chemistry, branches of chemistry, importance of chemistry, Safety precautions to be taken in Chemistry Laboratory, different equipment and apparatus used in Laboratory
20	Volumetric Analysis-1-Alkalimetric Titration. Volumetric Analysis-2-Acidimetric Titration	Atom, molecule, Element, compound, mixture, Physical change, chemical change, Acids, bases, salts-their properties. Molecular weight, equivalent weight, atomic weight, Normality, molarity.
21	To study the allotropic forms of Sulphur. To study the properties of mixture and compound (Fe + S & FeS)	<b>ATOMIC STRUCTURE:</b> Electrons, protons, neutrons. Electronic theory of valency. Classification of elements, Modern periodic law, table, Groups, periods, periodic properties.
22	To study action of pure and salt water on metals and alloys. To study action of acids and bases on metals and alloys.	<b>WATER:</b> Sources, hard and soft water, causes and removal of hardness, water for industrial purposes. Introduction to Effluent treatment plant (ETP). Corrosion- causes, effects and prevention. Allotropy of hydrogen, carbon, phosphorus and sulphur
23	Preparation of (a) Soap (b) Copper sulphate	<b>ORGANIC CHEMISTRY:</b> Introduction, purification processes, organic reactions- substitution, addition, Elimination, rearrangement reactions, examples. Nomenclature-Basic rules for Common name & IUPAC name system for alkanes, alkenes & alkynes, their examples.
24	Determination of pH Boiling point measurement of liquid. Melting point Measurement of solid.	Definition of pH, pH scale, measurement of pH. Conductivity, conductivity meter
25	<b>REVISION</b>	
26	<b>EXAMINATION</b>	

SYLLABUS OF THE TRADE OF		
ATTENDANT OPERATOR (CHEMICAL PLANT) UNDER CTS		
SEMESTER – II (Semester Code No. AOC-02)		
Week No.	TRADE PRACTICAL	TRADE THEORY
1	<b>SAFETY IN CHEMICAL PLANT:</b> Introduction to safety equipment and their uses in chemical plant. Identify and select appropriate protective equipment.	Importance of safety in chemical plant. Accident- causes and effects of accident, prevention of accidents. Personal protective equipment (PPE) in chemical plants.
2	Read and obtain relevant details from MSDS for a chemical. Determine flash point for given oil sample	Different terms such as Hazard, risk, LEL, UEL TWA, STEL, flash point, fire point, auto ignition temperature. Introduction to occupational health hazard. First aid, material safety data sheet (MSDS). Importance of Housekeeping in chemical industries, Introductory knowledge of ISO-9001(QMS), 14001(EMS) & 18001(OHSMS), Concept of 5'S.
3	Identify and use of fire extinguisher. Study of Fire hydrant system. Study & operate fire alarm system with sprinkler system. Study & operate gas detector with air tight chamber	Fire and fire prevention-Definition of fire, chemistry of fire, fire triangle, classification of fire, causes of fire in chemical industries. Fire detection, firefighting system- hydrants, nozzle and hose pipes, water monitors, and automatic sprinklers. Different types of fire extinguisher.
4	<b>INSTRUMENTATION:</b> To connect the bourdon tube(C-type) pressure gauge and measure pressure. To connect the capsule type pressure gauge and measure pressure.	<b>INTRODUCTION TO INSTRUMENTATION:</b> <b>PRESSURE:</b> Definition, units, conversion of units. Classification of pressure measuring instruments-bourdon type, capsule type, and helical type bellows type, diaphragm type pressure gauges.
5	To measure the temperature using mercury in glass thermometer. To measure the temperature using bi-metallic thermometer.	<b>TEMPERATURE:</b> Definition, units, conversion of units. Classification of temperature measuring instruments-Mercury in glass thermometer, Bimetallic thermometer, RTD thermometer(PT-100), Thermocouple etc.
6	To measure the temperature using R.T.D. thermometer PT100. To study the principle of Thermocouple.	-Do-
7	To connect the Orifice flow meter with the water pipeline and take readings. To connect venturi flow meter and Rota meter in the same water pipeline and compare readings.	<b>FLOW MEASUREMENT:</b> Classification of flow measuring instruments-orifice, venturi, Rota meter, pitot tube, turbine type flow meter.
8	To connect the Sight glass level indicator and take readings. To connect the Air purge level indicator and take readings. To study and connect the capacitance type level indicator.	<b>LEVEL MEASUREMENT:</b> Classification of level measuring instruments-simple float type level indicator, sight glass level indicator, air purge level indicator, capacitance type level indicator.
9	To study the hydrometer. To study the final control element(control valve)	<b>SPECIFIC GRAVITY:</b> Definition and measurement of specific gravity. Working principle of Hydrometer. Construction and working of final control element(Control valve)
10	<b>MAINTENANCE FITTER:</b> Cutting and threading of metal pipe.	<b>Introduction to Maintenance.</b> Types of maintenance-preventive, breakdown, predictive maintenance. Standard pipe threads, Nominal diameter, wall thickness, schedule number, tubing's, taps and dies for pipe threads.
11	Demonstrate use of tee, elbow, union, reducer and valves to fit a pipeline as per drawing.	<b>PIPES &amp; PIPE FITTINGS:</b> Different types of pipe joints- flanged and threaded. Straight connectors, bends or elbows, tees, screwed fittings, coupling,, flanges, bush and collar, plug, stop cock. Binding material, tools for fitting.



<b>SYLLABUS OF THE TRADE OF</b>		
<b>ATTENDANT OPERATOR (CHEMICAL PLANT) UNDER CTS</b>		
<b>SEMESTER – II (Semester Code No. AOC-02)</b>		
<b>Week No.</b>	<b>TRADE PRACTICAL</b>	<b>TRADE THEORY</b>
<b>12</b>	Use and maintenance of lagging materials such as glass wool, asbestos, thermocol.	<b>THERMAL INSULATION:</b> Lagging of utilities lines in chemical industries. Types and uses of lagging materials. Properties of lagging materials.
<b>13</b>	Gasket cutting as per size of given flange diameter.	<b>GASKET:</b> Materials for particular applications-cork sheet, oil-proof paper, asbestos, copper, PTFE, rubber, graphite.
<b>14</b>	Study and Use of appropriate locking devices-Lock nut, castle nut, sawn nut, locking pin, spring lock washer.	<b>Locking Device :</b> Use of correct material and locking devices-Lock nut, castle nut, sawn nut, locking pin, spring lock washer.
<b>15</b>	Dismantle, clean and assemble gate valve, globe valve, check valve.	<b>Valves :</b> Construction, working and uses of various types of valves. Dismantling and assembling of valves. Knowledge about the maintenance of valves. Selecting appropriate type of valve.
<b>16</b>	Dismantle, clean and assemble needle valve, diaphragm valve and ball valve.	Do
<b>17</b>	Dismantle, clean and assemble stop cock, butterfly valve, safety valve.	<b>PUMPS:</b> Classification of pumps. Construction, working principle, uses of different types of pumps. Prevention of leakages around moving parts-stuffing box and mechanical seal.
<b>18</b>	Dismantle, clean and assemble a centrifugal pump. Study of stuffing box and mechanical seal.	Do
<b>19</b>	Dismantle, clean and assemble a gear pump.	Do
<b>20</b>	Study of metering pump and screw pump	Troubleshooting in pumps. Starting procedure and stopping procedure for centrifugal pump.
<b>21</b>	Study and maintenance of Multistage compressor with intercooler and after cooler	Fans, blowers, and compressors-construction, working principle and uses of fans, bowers and compressors.
<b>22</b>	Removal of bearings such as ball bearings. Fitting of bearings such as ball bearings.	<b>BEARINGS:</b> Types, construction and uses of bearings such as ball, roller, bush, etc. their care and maintenance.
<b>23</b>	Dismantle, clean and assemble gear box.	<b>GEARS:</b> Types of gears-spur gear, helical gear, bevel, their uses, care.
<b>24</b>	<b>PROJECT WORK / INDUSTRIAL VISIT</b>	
<b>25</b>	<b>REVISION</b>	
<b>26</b>	<b>EXAMINATION</b>	

SYLLABUS OF THE TRADE OF		
ATTENDANT OPERATOR (CHEMICAL PLANT) UNDER CTS		
SEMESTER – III (Semester Code No. AOC-03)		
Week No.	TRADE PRACTICAL	TRADE THEORY
1 & 2	To determine of viscosity of a liquid by Digital viscometer. To determine Reynolds's number and hence the type of flow either laminar or turbulent.	Role of attendant operator in chemical plant. Introduction to Unit Operations and Unit processes, their meanings. Features of unit Operations. <b>FLOW OF FLUID:</b> Definition of fluid, ideal fluid, real fluid, compressible fluid, incompressible fluid. Properties of fluid-viscosity, mass density, surface tension. Manometer, Reynold's Number, Equation of continuity, Bernoulli's theorem.
3, 4 & 5	To determine co-efficient of discharge of orifice meter. To determine co-efficient of discharge of venturi meter. To measure discharge through Rota meter and calibrate it. To find the point velocity at the centre of a tube for different flow rates of water.(Pitote tube)	<b>FLOW MEASURING DEVICES:</b> Working and application of Orifice meter, venturi meter, Rota meter, pitot tube,, flow nozzle. <b>UNIT PROCESS:</b> Difference between Unit operations & Unit Processes. Important chemical processes. Terms related to Unit processes-Raw material, finished product, by-product, conversion, yield, batch process, continuous process. Flow sheet- Types of flow sheet, Process block diagram (PBD), process flow diagram (PFD), PID. Importance of different symbols of unit operations and its use.
6,7 & 8	To study head v/s capacity curve of centrifugal pump. To study head v/s capacity curve of gear pump. To study head v/s capacity curve of reciprocating pump.	Characteristic curves of pumps-the plot of actual head, total power consumption, and efficiency vs. volumetric flow rate. Flow of incompressible fluids in pipes <b>MANUFACTURING PROCESS OF SULPHURIC ACID BY CONTACT PROCESS</b> Raw materials, chemical reactions, process description, flow sheet, uses.
9 & 10	To determine the pressure drop due to friction as fluid flows through a pipe and verify the effect of pipe roughness on friction. To determine the resistance offered by fitting and valve and express them in terms of pipe diameter and velocity head.	Skin friction, pressure drop due to friction in a pipe for laminar and turbulent flow, friction loss from sudden enlargement, sudden contraction, friction losses in pipe fittings and valves. Equivalent length of a fitting
11, 12, 13 & 14	To operate Double pipe Heat exchanger and calculate heat transfer rate. To operate Shell and Tube heat exchanger and calculate rate of heat transfer. To determine the pressure drop due to friction for water flowing through tubes of heat exchanger. To conduct hydraulic test for shell and tube heat exchanger.	<b>HEAT TRANSFER:</b> Mechanism of Heat Transfer in solid, liquid and gases and their application in industries, thermal conductivity, Fourier's law, and resistances in series, plane and round surfaces. Heat transfer equipment, its classification, Heat exchangers, coolers, condenser and chillers. Double pipe heat exchanger, co-current, counter-current flow pattern, Shell and tube heat exchanger-its types, applications in industries, Plate type heat exchanger <b>MANUFACTURING PROCESS OF SODA ASH:</b> Raw materials, chemical reactions, process description, flow sheet, uses. <b>Manufacturing process of Caustic soda</b> - raw materials, chemical reactions, process description, flow sheet, uses
15, 16	To operate plate type heat exchanger to obtain rate of heat transfer. To operate triple effect evaporator to obtain economy of evaporator To operate Rising film and falling film evaporator to obtain economy of the evaporator	<b>EVAPORATION:</b> Definition, classification of evaporators, Capacity, steam economy of evaporators, Multiple effect evaporation, methods of feeding in multiple effect evaporation. <b>Steam Trap:</b> Types, Construction and uses <b>MANUFACTURING PROCESS OF AMMONIA:</b> Raw materials, chemical reactions, process description, flow sheet, uses

<b>SYLLABUS OF THE TRADE OF</b>		
<b>ATTENDANT OPERATOR (CHEMICAL PLANT) UNDER CTS</b>		
<b>SEMESTER – III (Semester Code No. AOC-03)</b>		
<b>Week No.</b>	<b>TRADE PRACTICAL</b>	<b>TRADE THEORY</b>
<b>17&amp; 18</b>	Study of APCM (Air pollution control Measures) ESP /cyclone separator/ water scrubber Study of Effluent Treatment Plant	Effluent Treatment Plant- Introduction, different stages used in ETP Pollution control equipment such as bag filter, electrostatic precipitators, Water scrubber, Reverse osmosis, cyclone separator
<b>19 &amp; 20, 21</b>	Separation of binary liquid mixture by distillation using packed tower. To operate sieve tray distillation column. To study PLC and DCS systems.	<b>DISTILLATION:</b> Concept of distillation, boiling point diagrams, vapour-liquid equilibrium, and equilibrium curves. Raoult's law, Henry's law, relative volatility, constant boiling mixtures- minimum & maximum azeotropes, <b>METHODS OF DISTILLATION:</b> Flash differential, rectification and azeotropic, extractive, vacuum, steam distillation. Reflux ratio: minimum, total, optimum, importance of reflux ratio. Types of distillation column. Column internals. Types of trays/plates. <b>Introduction to PLC system and DCS system</b>
<b>22</b>	Study of storage vessels.	<b>TYPES OF PRESSURE VESSELS:</b> Common terms related to pressure vessels-ASME, API, design pressure, design temperature, operating conditions and hydrostatic test. Corrosion allowance. Material of construction. Different types of storage vessels-Storage of non-volatile, volatile liquids, storage of gases. Fixed or cone roof tanks, Floating roof tanks, cone roof with floating pan
<b>23</b>	Study of distillation of crude oil (Petroleum) &its products.	Manufacturing process of Nitric acid by ammonia oxidation process. Petroleum and petroleum refining of crude oil, its origin, classification, products from refining of crude oil.
<b>24</b>	<b>PROJECT WORK / INDUSTRIAL VISIT</b>	
<b>25</b>	<b>REVISION</b>	
<b>26</b>	<b>EXAMINATION</b>	

SYLLABUS OF THE TRADE OF		
ATTENDANT OPERATOR (CHEMICAL PLANT) UNDER CTS		
SEMESTER – IV (Semester Code No. AOC-04)		
Week No.	TRADE PRACTICAL	TRADE THEORY
1	Operation of mixer settler	<b>SOLVENT EXTRACTION:</b> Introduction, definition, choice of solvent, distribution coefficient. Equipments used for extraction, Packed and perforated plate towers, application of extractions
2	Study of spray extraction column	<b>LEACHING:</b> Application and different types of equipment uses for leaching oil extraction from oil seeds.
3	Flooding velocity experiment using a packed glass column Absorption & Stripping Experiment	<b>ABSORPTION:</b> Introduction, equipment's used for absorption –columns, factors affecting rate of absorption, tower packing, flooding and flooding velocity.
4	Operation of batch type tank crystallizer	<b>CRYSTALLIZATION:</b> Introduction, concepts of solubility & effect of temperature on solubility, crystallization, methods of super-saturation, Different types of crystallizers & their application in industries.
5	Operation of Plate and frame filter press	<b>FILTRATION:</b> Principles of filtration, types of filtrations such as atmospheric, pressure, vacuum and their specific applications. Rate of filtration
6	Operation of rotary drum vacuum filter	Classification, construction & working of different types of filters used in industries such as plate and frame Filter Press, rotary drum vacuum filter
7&8	Operation of Sparkler filter Operation of Leaf filter Operation of Notch filter	Construction and Working of Sparkler filter, leaf filter, notch filter <b>MANUFACTURING PROCESS OF SUGAR –</b> Raw materials, chemical reactions, process description, flow sheet, uses.
9	Operation of Top/ Bottom driven centrifuge	<b>CENTRIFUGATION:</b> Types of centrifuge construction and working <b>MANUFACTURING PROCESS OF UREA:</b> By synthesis gas - raw materials, chemical reactions, process description, flow sheet, uses.
10	Study & operate sigma mixer	<b>MIXING:</b> Introduction, classification of mixing equipments and it's applications, mixers for mixing solid-solid, solid-liquid, solid-gas
11	Finding rate of drying by using tray dryer / Spray dryer.	<b>ADSORPTION:</b> Theory, adsorbents and applications of adsorption, <b>Fuel:</b> Coal, water gas, producer gas, combustion of fuel.
12	Operation of Rotary drum drier	<b>DRYING:</b> Theory, equilibrium moisture content, factors controlling constant drying rate , constant rate period, falling rate period factor affecting rate of drying, types of dryers and their uses.
13&14	Operation of Blake jaw crusher Operation of Hammer mill Operation of Ball mill	<b>SIZE REDUCTION:</b> Introduction to crushing & grinding, construction, working and applications of size reduction equipment such as jaw / roller Crushers, hammer mill, ball Mill.
15	To carry out sieve analysis with a sieve shaker	<b>SCREENING:</b> Screens, standard screens (Tyler's standard screen) and its principle. mesh number , Classification of Screening equipment's such as trammels , vibrating Screens & their industrial applications..
16	Determination of wet bulb & dry bulb temperature by using Humidification – non humidification method	<b>HUMIDIFICATION &amp; REFRIGERATION:</b> Theory of Humidification and different terms related to Humidification. different types of refrigerants and their properties and specific use in industries

<b>SYLLABUS OF THE TRADE OF</b>		
<b>ATTENDANT OPERATOR (CHEMICAL PLANT) UNDER CTS</b>		
<b>SEMESTER – IV (Semester Code No. AOC-04)</b>		
<b>Week No.</b>	<b>TRADE PRACTICAL</b>	<b>TRADE THEORY</b>
<b>17</b>	Operation of cooling tower	<b>COOLING TOWER:</b> Types of cooling tower working and operating <b>MANUFACTURING PROCESS OF ETHYL ALCOHOL:</b> Raw materials, chemical reactions, process description, flow sheet, uses.
<b>18</b>	Study of belt Conveyor Study of screw conveyor Study of bucket elevator	<b>CONVEYING:</b> Introduction and different types of conveyors. <b>SEDIMENTATION &amp; DECANTATION:</b> Various type of thickeners and sedimentation operation equipment
<b>19</b>	Operation of sedimentation and coagulation	<b>MANUFACTURING PROCESS OF PULP &amp; PAPER:</b> Raw materials, chemical reactions, process description, flow sheet, and uses. <b>Pollution in chemical industry:</b> Sources, types & effect of water pollution, air pollution Definition of COD,BOD,TDS,TSS
<b>20</b>	Study of chemical reactor	<b>PLANT UTILITY:</b> Steam, cooling water, chilled water, brine, instrument air, Nitrogen, vacuum, introduction of boiler, cooling tower, chilling plant, compressor, ejector. <b>CHEMICAL REACTOR:</b> Types of reactor, Parts of reactor
<b>21 to 24</b>	<b>PROJECT WORK / INPLANT TRAINING</b>	
<b>25</b>	<b>REVISION</b>	
<b>26</b>	<b>EXAMINATION</b>	

A: Trade Details					
S.N.	Particulars	As per DGET			
1	Name of the Trade	ATTENDANT OPERATOR (CHEMICAL PLANT)			
2	Duration (In Semester):	4			
3	Intake:	16			
6	Space Required (in Sq. Meter):	104 sq. m.			
7	Power Required (in KW):	13			
B: Workshop/ Lab Furniture					
S.N.	Name of Item	Category	Qty	Unit	Remark
1	Drum - 100 Litres (Optional)	Equipment	1	Number	Per 1 Unit in a Shift
2	Dust Bin - 50 litres (Optional)	Equipment	1	Number	Per 1 Unit in a Shift
3	Black/ White Board with Stand - 4 X 3 Feet	Furniture	1	Number	Per 1 Unit in a Shift
4	Book Shelf/ Glass Shelf	Furniture	1	Number	Per 1 Unit in a Shift
5	Discussion Table/ Working Table = L:W:H = 8:4:3 Feet - Heavy Wooden Top	Furniture	1	Number	Per 1 Unit in a Shift
6	Instructor/ Office Chair	Furniture	2	Number	Per 1 Unit in a Shift
7	Instructor/ Office Table	Furniture	1	Number	Per 1 Unit in a Shift
8	Notice Board - 2 X 3 Feet	Furniture	1	Number	Per 1 Unit in a Shift
9	Steel Almira – Large (Optional)	Furniture	2	Number	Per 1 Unit in a Shift
10	Steel Locker - 12 Pigeon Hole	Furniture	2	Number	Per 1 Unit in a Shift
11	Steel Rack (Optional)	Furniture	1	Number	Per 1 Unit in a Shift
12	Stool - Height 450 mm	Furniture	10	Number	Per 1 Unit in a Shift
C: Workshop/ Lab Infrastructure (Tools, Equipment's, Machines, etc.)					
S.N.	Name of Item	Category	Qty	Unit	Remark
1	Safety shoes ( Regular size )	Consumable	17	Number	Per 1 Unit in a Shift
2	Safety Goggles	Consumable	17	Number	Per 1 Unit in a Shift
3	Safety hand gloves leather ( Regular size )	Consumable	17	Number	Per 1 Unit in a Shift
4	Ear plug	Consumable	17	Number	Per 1 Unit in a Shift
5	Helmet	Consumable	2	Number	Per 1 Unit in a Shift
6	Fire Extinguishers ( CO2 , )	Equipment	1	Number	Per 3 Unit in a Shift
7	Fire Extinguishers ( Dry Chemical powder )	Equipment	1	Number	Per 3 Unit in a Shift
8	Sand bucket	Equipment	2	Number	Per 3 Unit in a Shift
9	Fire blanket	Equipment	2	Number	Per 3 Unit in a Shift
10	Steel Rule - 300 mm, Graduated both in Metric and English Unit	Equipment	6	Number	Per 3 Unit in a Shift
11	Try Square - 150 mm	Equipment	6	Number	Per 3 Unit in a Shift
12	Caliper - Inside Spring - 150 mm	Equipment	6	Number	Per 3 Unit in a Shift
13	Caliper - Outside Spring - 150 mm	Equipment	6	Number	Per 3 Unit in a Shift
14	Divider Spring Type - 150 mm	Tool	6	Number	Per 3 Unit in a Shift
15	Punch Centre - Diameter - 10 mm and Length - 100 mm	Tool	6	Number	Per 3 Unit in a Shift
16	Punch Prick - 100 mm	Tool	6	Number	Per 3 Unit in a Shift
17	Letter and Number Punch - 5mm	Tool	1	Set Each	Per 3 Unit in a Shift
18	Scriber- Straight- 150 mm	Tool	6	Number	Per 3 Unit in a Shift

19	Hacksaw Frame - Fixed - 300 mm	Tool	6	Number	Per 3 Unit in a Shift
20	File - Flat - Bastard - 250 mm	Tool	6	Number	Per 3 Unit in a Shift
21	File - Flat - Second Cut - 250 mm	Tool	6	Number	Per 3 Unit in a Shift
22	File - Flat - Smooth - 250 mm	Tool	6	Number	Per 3 Unit in a Shift
23	File - Half Round - Second Cut - 250 mm	Tool	6	Number	Per 3 Unit in a Shift
24	File - Round - Smooth - 250 mm	Tool	6	Number	Per 3 Unit in a Shift
25	File - Triangular - Smooth - 150 mm	Tool	6	Number	Per 3 Unit in a Shift
26	File - Square - Second Cut - 200 mm	Tool	6	Number	Per 3 Unit in a Shift
27	Chisel - Cold - Cross Cut - 9 mm X 150 mm	Tool	6	Number	Per 3 Unit in a Shift
28	Chisel - Cold - Flat - 20 mm X 150 mm	Tool	6	Number	Per 3 Unit in a Shift
29	Hammer - Ball Pein - 250 grams	Tool	6	Number	Per 3 Unit in a Shift
30	Hammer - Ball Pein - 500 grams	Tool	6	Number	Per 3 Unit in a Shift
31	Screw Driver - 9 X 300 mm	Tool	4	Number	Per 3 Unit in a Shift
32	Drill Twist Set - Straight Shank - 3 mm to 13 mm by 0.5 mm	Tool	1	Number	Per 3 Unit in a Shift
33	Drill Twist Set - Tapper shank 12 to 25 mm	Tool	1	Number	Per 3 Unit in a Shift
34	Double Ended Spanner set Metric 6*7 to 30*32	Tool	1 set	Number	Per 3 Unit in a Shift
35	Pipe wrench 14"	Tool	1 set	Number	Per 3 Unit in a Shift
36	Combination Plier	Tool	2	Number	Per 3 Unit in a Shift
37	Tap set -M 8, M10 M12	Tool	2	Number	Per 3 Unit in a Shift
38	Solid die 10/12 mm with die stock	Tool	2	Number	Per 3 Unit in a Shift
39	Gauge Screw Pitch - Metric -0.25 to 6 mm	Equipment	1	Number	Per 3 Unit in a Shift
40	Wire Gauge - Metric	Equipment	1	Number	Per 3 Unit in a Shift
41	Allen Key Set - Hexagonal - 1 - 12 mm, set of 12 Keys	Tool	1	Number	Per 3 Unit in a Shift
42	Vernier Calliper - 0 - 200 mm with least count 0.02mm	Equipment	1	Number	Per 3 Unit in a Shift
43	Vernier Height Gauge - 0 - 300 mm with least count = 0.02 mm	Equipment	1	Number	Per 3 Unit in a Shift
44	Universal Dial Test Indicator - Plunger Type - Range 0 - 10 mm, Graduation 0.01 mm & 0.001mm Reading 0 - 10 with Revolution Counter complete with Clamping Devices and Magnetic Stand	Equipment	2	Number	Per 3 Unit in a Shift
45	Micrometer - Outside - 0 - 25 mm	Equipment	1	Number	Per 3 Unit in a Shift
46	V Block - 75 x 75 x 50 mm with Clamp (Hardened & Ground)	Tool	1	Pair	Per 3 Unit in a Shift
47	Bench Vice - 125 mm	Tool	6	Number	Per 3 Unit in a Shift
48	Anvil - 50 Kg - with stand	Equipment	1	Number	Per 3 Unit in a Shift

49	Surface Plate - Granite - 450 x 450mm with Stand and Cover	Equipment	1	Number	Per 3 Unit in a Shift
50	Drilling Machine - Bench Type - 13 mm Motorized with Standard Accessories	Machine	1	Number	Per 3 Unit in a Shift
51	Pedestal Grinder - Double Ended - 200 mm	Machine	1	Number	Per 3 Unit in a Shift
52	Acetylene Cylinder	Equipment	1	Number	Per 3 Unit in a Shift
53	Oxygen Cylinders	Equipment	1	Number	Per 3 Unit in a Shift
54	Spark Lighter	Equipment	6	Number	Per 3 Unit in a Shift
55	Oxygen Gas Pressure Regulator Double Stage	Equipment	1	Number	Per 3 Unit in a Shift
56	Acetylene Gas pressure Regulator Double Stage	Tool	1	Number	Per 3 Unit in a Shift
57	Rubber Hose - Acetylene, Diameter = 8 mm, Length = 10 meters	Tool	1	Number	Per 3 Unit in a Shift
58	Rubber Hose - Oxygen, Diameter = 8 mm, Length = 10 metres	Tool	1	Number	Per 3 Unit in a Shift
59	Rubber Hose Clips - 1/2 inch	Tool	6	Number	Per 3 Unit in a Shift
60	Tong - Flat - 300 mm	Tool	4	Number	Per 3 Unit in a Shift
61	cylinder Key	Tool	4	Number	Per 3 Unit in a Shift
62	Gas welding torch with nozzle set	Equipment	1	Number	Per 3 Unit in a Shift
63	Instrument for determining 'g' (Simple Pendulum)	Equipment	1	Number	Per 3 Unit in a Shift
64	Mechanical board for testing triangle and parallelogram of forces including all accessories	Equipment	2	Number	Per 3 Unit in a Shift
65	Inclined plane with pulley, pan, weights etc.	Equipment	1	Number	Per 3 Unit in a Shift
66	Simple machines - Screw Jack With Accessories	Equipment	1	Number	Per 3 Unit in a Shift
67	Searle's Apparatus for young's Modulus	Equipment	2	Number	Per 3 Unit in a Shift
68	Calorimeter for determining Joule's mechanical Equivalent of heat by electric method	Equipment	1	Number	Per 3 Unit in a Shift
69	Apparatus for measurement of co-efficient of expansion(thermal) of solid (plunger's apparatus)	Equipment	2	Number	Per 3 Unit in a Shift
70	Apparatus for measurement of thermal conductivity of good and bad conductors	Equipment	1	Number	Per 3 Unit in a Shift
71	Thermometers :	Equipment		Number	Per 3 Unit in a Shift
	(1) 0 to 110° C	Consumable	6	Number	
	(2) 0 to 250° C	Consumable	6	Number	
	(3) 0 to 360 ° C	Consumable	6	Number	
72	Rheostat	Equipment		Number	Per 3 Unit in a Shift
	(a) Rheostat 25 ohms	Equipment	2	Number	
	(b) Rheostat 100 ohms	Equipment	2	Number	
73	Resistance box 0 to 500 ohms	Equipment	2	Number	Per 3 Unit in a Shift



74	Resistance coils (2 ohms, 5 ohms, 10 ohms, 100 ohms)	Consumable	2	Number	Per 3 Unit in a Shift
75	Ammeter	Equipment		Number	Per 3 Unit in a Shift
	0 to 1000 mA. (DC)	Equipment	2	Number	
	0 to 10 Amp. (AC, DC)	Equipment	2	Number	
76	Voltmeter	Equipment		Number	Per 3 Unit in a Shift
	0 to 1 volt (DC)	Equipment	2	Number	
	0 to 5 volt (DC)	Equipment	2	Number	
	0 to 10 volt (DC)	Equipment	2	Number	
77	Battery eliminator	Equipment	2	Number	Per 3 Unit in a Shift
78	Specific Gravity bottle 25 cc	Consumable	2	Number	Per 3 Unit in a Shift
79	Rods with screw at one end for Electrochemical equivalent 1) Carbon 2) Zinc 3) Copper	Consumable	2	Number	Per 3 Unit in a Shift
80	Multi meter(digital)	Equipment	2	Number	Per 3 Unit in a Shift
81	Milli voltmeter 1) 0 - 5mv 2) 0- 500mv	Equipment	2	Number	Per 3 Unit in a Shift
82	Digital Stop Watch 1/10 Second	Equipment	1	Number	Per 3 Unit in a Shift
83	pH Meter Digital	Equipment	1	Number	Per 3 Unit in a Shift
84	Steam generator (copper) Cap. 1000ml	Equipment	2	Number	Per 3 Unit in a Shift
85	Burette clamp	Equipment	12	Number	Per 3 Unit in a Shift
86	Bunsen Burners	Equipment	8	Number	Per 3 Unit in a Shift
87	Tripods Stand	Equipment	8	Number	Per 3 Unit in a Shift
88	Asbestos wire gauge	Consumable	8	Number	Per 3 Unit in a Shift
89	Gauge Wire without asbestos	Consumable	8	Number	Per 3 Unit in a Shift
90	Burettes 25ml boroflow	Consumable	8	Number	Per 3 Unit in a Shift
91	Pipettes 10ml	Consumable	8	Number	Per 3 Unit in a Shift
92	H.D.P. Distil water bottle	Consumable	8	Number	Per 3 Unit in a Shift
93	Clamp holders	Consumable	12	Number	Per 3 Unit in a Shift
94	Stands with clamps for burette	Equipment	12	Number	Per 3 Unit in a Shift
95	Triangles clay	Consumable	8	Number	Per 3 Unit in a Shift
96	Measuring cylinder 250 ml Glass	Consumable	8	Number	Per 3 Unit in a Shift
97	Measuring cylinder 500 ml Glass/ Plastic	Consumable	8	Number	Per 3 Unit in a Shift
98	Measuring cylinder 1000 ml Glass/ Plastic	Consumable	8	Number	Per 3 Unit in a Shift
99	Volumetric flask 100 ml	Consumable	8	Number	Per 3 Unit in a Shift
100	Volumetric flask 500 ml	Consumable	8	Number	Per 3 Unit in a Shift
101	Volumetric flask 1000 ml	Consumable	8	Number	Per 3 Unit in a Shift

102	Funnels Dia 7.5cms	Consumable	8	Number	Per 3 Unit in a Shift
103	Beaker 250ml corning	Consumable	8	Number	Per 3 Unit in a Shift
104	Beaker 500 ml corning	Consumable	8	Number	Per 3 Unit in a Shift
105	Bottles for solutions 1000 ml	Consumable	6	Number	Per 3 Unit in a Shift
106	Bottles for solutions 2000 ml	Consumable	6	Number	Per 3 Unit in a Shift
107	Bottles for solutions 500 ml	Consumable	6	Number	Per 3 Unit in a Shift
108	Conical flask –500 ml	Consumable	16	Number	Per 3 Unit in a Shift
109	Conical flask - 250 ml	Consumable	16	Number	Per 3 Unit in a Shift
110	Evaporating dish - 50 ml	Consumable	12	Number	Per 3 Unit in a Shift
111	Watch Glass - 3" dia.	Consumable	8	Number	Per 3 Unit in a Shift
112	Tong - Flat - 300 mm	Equipment	8	Number	Per 3 Unit in a Shift
113	Spatula - 8"	Consumable	8	Number	Per 3 Unit in a Shift
114	Distilled water still 10 lit.	Equipment	1	Number	Per 3 Unit in a Shift
115	Glass test tubes - 15 ml	Consumable	50	Number	Per 3 Unit in a Shift
116	Round Bottom Distillation flask with side neck 500ml	Consumable	6	Number	Per 3 Unit in a Shift
117	Condenser for distillation lebig 30 cm long	Consumable	6	Number	Per 3 Unit in a Shift
118	Rubber cork of ( 2.5 cm, 3cm) size Various size	Consumable	10	Number	Per 3 Unit in a Shift
119	Rubber Tubing (ID- 5mm) 8 / 10 ml	Consumable	10	Meter	Per 3 Unit in a Shift
120	Rubber Bulbs for pipettes	Consumable	6	Number	Per 3 Unit in a Shift
121	Fire alarm system with sprinkler system	Equipment	1	Number	Per 3 Unit in a Shift
122	Gas detector with air tight chamber	Equipment	1	Number	Per 3 Unit in a Shift
123	Bourdon tube(C-type) pressure gauge	Equipment	1	Number	Per 3 Unit in a Shift
124	Capsule type pressure gauge	Equipment	1	Number	Per 3 Unit in a Shift
125	R.T.D. thermometer PT100	Equipment	1	Number	Per 3 Unit in a Shift
126	Venturimeter, orifice meter, rota meter test rig	Equipment	1	Number	Per 3 Unit in a Shift
127	Capacitance Level indicator	Equipment	1	Number	Per 3 Unit in a Shift
128	Sight glass level indicator	Equipment	1	Number	Per 3 Unit in a Shift
129	Hydrometer	Equipment	1	Number	Per 3 Unit in a Shift
130	Final control element (control valves) Pneumatically & Electrically	Equipment	1	Number	Per 3 Unit in a Shift
131	Centrifugal pump.	Equipment	1	Number	Per 3 Unit in a Shift
132	Gear pump	Equipment	1	Number	Per 3 Unit in a Shift
133	Screw pump	Equipment	1	Number	Per 3 Unit in a Shift
134	Bearing removing and fitting kit	Equipment	1	Number	Per 3 Unit in a Shift

135	Gear box	Equipment	1	Number	Per 3 Unit in a Shift
136	Reynold's equipment	Equipment	1	Set	Per 3 Unit in a Shift
137	Centrifugal pump test rig	Machine	1	Number	Per 3 Unit in a Shift
138	Gear pump test rig	Machine	1	Number	Per 3 Unit in a Shift
139	Reciprocating pump test rig	Machine	1	Number	Per 3 Unit in a Shift
140	Apparatus for determine Frictional losses in straight pipe , pipe fitting	Machine	1	Number	Per 3 Unit in a Shift
141	Double pipe Heat exchanger	Machine	1	Number	Per 3 Unit in a Shift
142	Shell and Tube heat exchanger	Machine	1	Number	Per 3 Unit in a Shift
143	Plate type heat exchanger	Machine	1	Number	Per 3 Unit in a Shift
144	Rising and falling film evaporator	Machine	1	Number	Per 3 Unit in a Shift
145	Triple effect evaporator	Machine	1	Number	Per 3 Unit in a Shift
146	Packed distillation tower.	Machine	1	Number	Per 3 Unit in a Shift
147	Sieve plate distillation column.	Machine	1	Number	Per 3 Unit in a Shift
148	Mixer-settler type extractor	Machine	1	Number	Per 3 Unit in a Shift
149	spray extraction column	Machine	1	Number	Per 3 Unit in a Shift
150	Packed tower of glass for flooding velocity experiment	Machine	1	Number	Per 3 Unit in a Shift
151	Batch type tank crystallizer	Machine	1	Number	Per 3 Unit in a Shift
152	Plate and frame filter press	Machine	1	Number	Per 3 Unit in a Shift
153	Rotary drum vacuum filter	Machine	1	Number	Per 3 Unit in a Shift
154	Bottom driven centrifuge	Machine	1	Number	Per 3 Unit in a Shift
155	Sparkler filter	Machine	1	Number	Per 3 Unit in a Shift
156	Leaf filter	Machine	1	Number	Per 3 Unit in a Shift
157	Notch filter	Machine	1	Number	Per 3 Unit in a Shift
158	Absorption And Stripping Equipment	Machine	1	Number	Per 3 Unit in a Shift
159	Tray dryer/ Spray Dryer	Equipment	1	Number	Per 3 Unit in a Shift
160	Rotary drum drier	Machine	1	Number	Per 3 Unit in a Shift
161	Blake jaw crusher	Machine	1	Number	Per 3 Unit in a Shift
162	Hammer mill	Machine	1	Number	Per 3 Unit in a Shift
163	Ball mill	Machine	1	Number	Per 3 Unit in a Shift
164	Sieve shaker and sieves	Machine	1	Number	Per 3 Unit in a Shift
165	Humidification control equipment with dry and wet bulb Temperature	Equipment	1	Number	Per 3 Unit in a Shift
166	Cooling tower	Machine	1	Number	Per 3 Unit in a Shift
167	Bucket elevator	Machine	1	Number	Per 3 Unit in a Shift

168	Cyclone Separator and water scrubber	Machine	1	Number	Per 3 Unit in a Shift
169	Flash point apparatus	Equipment	1	Number	Per 3 Unit in a Shift
170	Bimetallic thermometer	Equipment	1	Number	Per 3 Unit in a Shift
171	Thermocouple	Equipment	1	Number	Per 3 Unit in a Shift
172	Different types of pipe fittings	Equipment	1	Set	Per 3 Unit in a Shift
173	Locking devices Lock nut , Castle nut	Equipment	1	Set	Per 3 Unit in a Shift
174	Mechanical seal (multiple spring)	Equipment	1	Number	Per 3 Unit in a Shift
175	Redwood viscometer	Equipment	1	Number	Per 3 Unit in a Shift
176	Pitot tube Setup	Equipment	1	Number	Per 3 Unit in a Shift
177	Multistage Reciprocating compressor fitted with intercooler & after cooler	Equipment	1	Number	Per 3 Unit in a Shift
178	Pressure Vessel with all Accessories	Equipment	1	Number	Per 3 Unit in a Shift
179	Reactor Trainer with all Controlling Accessories	Equipment	1	Number	Per 3 Unit in a Shift
180	Digital Viscometer	Equipment	1	Number	Per 3 Unit in a Shift
181	DCS Kit	Equipment	1	Number	Per 3 Unit in a Shift
182	PLC Kit	Equipment	1	Number	Per 3 Unit in a Shift
183	Common Effluent Treatment Plant laboratory size	Equipment	1	Number	Per 3 Unit in a Shift
184	Petroleum Plant Simulator	Equipment	1	Number	Per 3 Unit in a Shift
185	Cut Model of Different Types pumps	Equipment	1	Number	Per 3 Unit in a Shift
186	Various types of valves like Safety valve, Gate valve, Globe valve, check valve, diaphragm valve, ball valve, needle valve, butterfly valve (Flanged and Thread End) 2"/4" dia	Equipment	Each 1	Number	Per 3 Unit in a Shift
187	Metering Pump	Equipment	Each 1	Number	Per 3 Unit in a Shift

**D: Allied Trade Details (Per 1 Unit in a Shift)**

	Name of Allied Trade	No. of Weeks during Course	Remark
1	Fitter	7	
2	Welder	7	

<b>E: Machines/ Equipment of the Allied Trade to be Utilized</b> (These Machines/Equipment's and corresponding Tools have to be provided in case the Allied Trade is not available in the ITI)					
	Name of Item	Category	Qty	Unit	Remark
1	Not Required				Not Applicable
<b>F. Computer Lab Infrastructure</b>					
	Name of Item	Category	Qty	Unit	Remark
1	Not Required				Not Applicable
<b>G: Common Facility Utilization (Per 1 Unit in a Shift)</b> (This section specifies utilization of Common Facilities provided in the ITI)					
	Particulars	Hours per Week		Remark	
1	Computer Lab Utilization (Hours Per Week)	2		Per 1 Unit in a Shift	
2	Drawing Hall Utilization (Hours Per Week)	2		Per 1 Unit in a Shift	
3	Library Hall Utilization (Hours Per Week)	2		Per 1 Unit in a Shift	
4	Class Room Utilization (Hours Per Week)	12		Per 1 Unit in a Shift	
5	CNC Lab Utilization (Hours per Week)	0			
<b>H. Safety</b>					
S.N.	Name of Item	Category	Qty	Unit	Remark
1	Apron - Blue	-	16	Number	Per 1 Unit in a Shift
<b>I: Special Instructions</b> (This section specifies instruction related to Infrastructure Management)					
S.No.	Particulars				
1	Personal Computer with Internet facility				
<b>J: Instructor Facility (Optional)</b> (This section specifies the items to be provided to the Instructor during Training.)					
S.No.	Name of Item	Category	Qty	Unit	Remark
1	Blank CD (rewritable)	Stationary	10	Number	Per 1 Unit in a Shift
2	Box File	Stationary	5	Number	Per 1 Unit in a Shift
3	Calculator - Scientific	Equipment	1	Number	Per 1 Unit in a Shift
4	Eraser	Stationary	1	Number	Per 1 Unit in a Shift
5	Gum Bottle	Stationary	1	Number	Per 1 Unit in a Shift
6	Highlighter pen	Stationary	5	Number	Per 1 Unit in a Shift
7	Office File	Stationary	10	Number	Per 1 Unit in a Shift
8	Paper Rim - A4 Size Zerox Paper	Stationary	1	Number	Per 1 Unit in a Shift
9	Paper Rim - Legal Size Zerox Paper	Stationary	1	Number	Per 1 Unit in a Shift
10	Pen Drive - 8 GB	Stationary	1	Number	Per 1 Unit in a Shift
11	Pencil Box	Stationary	1	Number	Per 1 Unit in a Shift
12	Permanent Marker Pen	Stationary	5	Number	Per 1 Unit in a Shift
13	Paper Punch	Stationary	1	Number	Per 1 Unit in a Shift
14	Register - 200 Pages	Stationary	2	Number	Per 1 Unit in a Shift
15	Sharpener	Stationary	1	Number	Per 1 Unit in a Shift
16	Sketch pen box	Stationary	1	Number	Per 1 Unit in a Shift
17	Stapler Big	Stationary	1	Number	Per 1 Unit in a Shift
18	Stapler Big Pins - Box	Stationary	1	Number	Per 1 Unit in a Shift
19	Stapler Small	Stationary	1	Number	Per 1 Unit in a Shift
20	Stapler Small Pins - Box	Stationary	1	Number	Per 1 Unit in a Shift
21	White Board Marker/Ink Bottle/ Chalk	Stationary	10	Number	Per 1 Unit in a Shift
22	White/ Black Board Duster	Stationary	2	Number	Per 1 Unit in a Shift
23	Torch	Tool	1	Number	Per 1 Unit in a Shift