

SYLLABUS FOR ATTENDANT OPERATOR (CHEMICAL PLANT) TRADE			
FIRST YEAR			
Duration	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Professional Skill 100 Hrs; Professional Knowledge 28 Hrs	Plan and organize the work to make job as per specification applying different types of basic fitting operations and Check for dimensional accuracy. [Basic fitting operation – marking, Hack-sawing, punching, Chiselling, Filing, Drilling, countersinking, counterboring, reaming, Taping etc. Accuracy: $\pm 0.25\text{mm}$ ]	<ol style="list-style-type: none"> <li>1. Importance of trade training, List of tools &amp; Machinery used in the trade. (02 hrs.)</li> <li>2. Safety attitude development of the trainee by explaining importance of safety. (05 hrs.)</li> <li>3. Identify various PPEs. (03 hrs.)</li> <li>4. Demonstrate the correct use of appropriate PPE.(05 hrs.)</li> <li>5. First aid methods and basic training. (03 hrs.)</li> <li>6. Safety sign/slogan for Danger. (03 hrs.)</li> <li>7. Safe use of tools and equipments used in the trade. (04 hrs.)</li> </ol>	<p>All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures.</p> <p>Introduction about ITI Rules and Regulation.</p> <p>Importance of trade training.</p> <p><b>SAFETY:</b></p> <p>Introduction &amp; Importance of safety, general precautions about safety. PPEs used in chemical industries. Safety slogan. First aid in workshop &amp; industry. (07hrs)</p>
		<ol style="list-style-type: none"> <li>8. Practice and understand precautions to be followed while working in fitting workshop. (08hrs.)</li> <li>9. Hold the job in a bench vice horizontally for filing.(10hrs.)</li> <li>10. Select flat files of various grades and length according to               <ol style="list-style-type: none"> <li>a) Size of the job</li> </ol> </li> </ol>	<p><b>BASIC FITTING:</b> Safety precautions to be followed in fitting workshop. Introduction to different hand tools such as files, chisels, hacksaw &amp; hammer etc., their uses. Description, construction and uses of different marking tools such as steel rule, caliper, punches, v-block, scribing block etc. (14hrs)</p>



		<p>b) Quantity of metal to be removed.</p> <p>c) Material of the job.(04hrs.)</p> <p>11. File flat surface. (20hrs.)</p> <p>12. Check the flatness of the filed surface with the blade of try square.(04hrs.)</p> <p>13. Check the squareness of adjacent surfaces. (04hrs.)</p>	
		<p>14. File two adjacent sides flat and square.(08hrs.)</p> <p>15. Apply marking medium on the surface to be marked. (01 hr)</p> <p>16. Marking dimensions as per drawing. (01 hr)</p> <p>17. File all the other sides to size.(07 hrs.)</p> <p>18. Check flatness &amp; squareness using try square.(01 hrs.)</p> <p>19. Check dimensions using outside calliper.(01 hrs.)</p> <p>20. Check dimensions with a steel rule. (01 hrs.)</p> <p>21. Mark parallel lines using a jenny calliper &amp; scribe. (02 hrs.)</p> <p>22. Mark curves &amp; circles by jenny calliper &amp; divider. (01 hrs.)</p> <p>23. Punch the centre of circle with centre punch and ball peen hammer. (02 hrs.)</p>	<p><b>JOB HOLDING DEVICES:</b> Description, construction and uses of different job holding devices. Such as vice, V' Block. (07 hrs)</p>
Professional Skill 50 Hrs;  Professional Knowledge	Make a step fit of components for assembling as per required tolerance. <i>[Step fit, required</i>	<p>24. Check the raw material size as per drawing. (02hrs.)</p> <p>25. File two adjacent sides at right angles to each other. (16hrs.)</p>	<p>Description, construction, calculation and uses of different Linear Measuring Instruments – Vernier Calliper, Vernier Depth gauge, Height gauge, Outside</p>



<p>14 Hrs</p>	<p><i>tolerance: <math>\pm 0.04</math> mm]</i></p>	<p>26. File two reference surfaces flat &amp; square. (14hrs.)                  27. Mark &amp; punch the job as per drawing (Both 'A' &amp; 'B'). (04hrs.)                  28. Separate the part 'A' &amp; 'B' by sawing or drilling. (06hrs.)                  29. File &amp; finish part 'A' &amp; 'B'. (06hrs.)                  30. Check dimensions and then assemble two parts. (02hrs.)</p>	<p>Micrometre, Bevel protector. (14 hrs)</p>
<p>Professional Skill 75 Hrs;  Professional Knowledge 21 Hrs</p>	<p>Plan and organize the work to make job as per specification applying different types of basic fitting operations and Check for dimensional accuracy. <i>[Basic fitting operation – marking, Hack-sawing, punching, Chiselling, Filing, Drilling, Taping etc. Accuracy: <math>\pm 0.25</math>mm -do-</i></p>	<p>31. File surface flat &amp; parallel within an accuracy. (16 hrs.)                  32. Mark/locate drilling positions.(10 hrs.)                  33. Prick and centre punch hole locations.(09 hrs.)                  34. Centre drill each hole location using appropriate standard centre drills. (15hrs.)                   35. Check the given raw material for its size. (02 hrs.)                  36. File and finish the given material to given size.(10 hrs.)                  37. Determine the tap drill size.(03 hrs.)                  38. Drill the hole to the required tap drill size.(05 hrs.)                  39. Cut the threads with the set of taps. (05 hrs.)</p>	<p>Drilling, Countersinking, counter boring. Reaming and tapping. Nomenclature and uses of Drill, Reamer (14 hrs)  Description, nomenclature and uses of different types of threads – metric, BSW, BSF, and BSP etc. Calculation of tap drill size. (07 hrs)</p>
<p>Professional Skill 25 Hrs;  Professional Knowledge 14 Hrs</p>	<p>Select and ascertain measuring instrument and measure dimension of components and record data.</p>	<p><u>Vernier caliper</u>                  40. Calculate least count &amp; zero error. (05 hrs.)                  41. Calculate thickness of given object. (08 hrs.)  <u>Outside Micrometer</u>                  42. Calculate least count &amp; zero</p>	<p>Introduction to Physics, Units, dimensions and physical quantities.                  Vernier caliper – parts of a Vernier caliper, principle and uses of a Vernier caliper. Least count and measurement with</p>



		<p>error. (05 hrs.)</p> <p>43. Calculate thickness of given object. (07 hrs.)</p>	<p>Vernier caliper.</p> <p>Outside micrometer –parts of an outside micrometer, working principle, least count and measurement with outside micrometer. (07hrs)</p>
<p>Professional Skill 125 Hrs;</p> <p>Professional Knowledge 35 Hrs</p>	<p>Set up apparatus, instrument and conduct experiments in Physics laboratory to determine physical quantity/constants and verify laws.</p>	<p><u>Simple pendulum</u></p> <p>44. Measure diameter of bob with the help of Vernier calliper.(02 hrs.)</p> <p>45. Find the length of Pendulum.(02 hrs.)</p> <p>46. Record time for 20 oscillations. (04 hrs.)</p> <p>47. Tabulate all readings.(02 hrs.)</p> <p>48. Calculate acceleration due to gravity (g). (02 hrs.)</p> <p>49. Plot the graph of L &amp; T<sup>2</sup>. (02 hrs.)</p> <p><u>Law of parallelogram of forces</u></p> <p>50. Attach two pulleys to the mechanical board fixed to the wall as shown in figure. (02 hrs.)</p> <p>51. Fix drawing sheet to the board with pins. (02 hrs.)</p> <p>52. Apply two forces to the pulley by hanging a mass of 100 &amp; 200 grams. (03 hrs.)</p> <p>53. Find resultant force by completing parallelogram and drawing diagonal. (02 hrs.)</p> <p>54. Calculate resultant by formula. (02 hrs.)</p>	<p>Velocity, its unit, average velocity, speed, average speed, acceleration, Acceleration due to gravity, Newton’s laws of motion.</p> <p>Force, unit of force, Effect of force. Representation of forces resultant. triangle and parallelogram laws of forces (07 hrs)</p>
		<p><u>Inclined plane</u></p> <p>55. Weigh separately the roller/wooden block and the pan with balance. (02 hrs.)</p>	<p>Friction-definition, unit, types of friction, laws of friction, advantages and disadvantages of friction.</p>



		<p>56. Generate angle of inclination of inclined plane (<math>30^{\circ}</math>, <math>40^{\circ}</math>, <math>50^{\circ}</math>, <math>60^{\circ}</math>). (03 hrs.)</p> <p>57. Find weights for upward and downward motion of roller for different inclination of plane. (06 hrs.)</p> <p>58. Plot graph (should be straight line). (02hrs.)</p> <p><u>Screw Jack</u></p> <p>59. Find pitch of screw jack. (02 hrs.)</p> <p>60. Put load on the jack and start applying efforts gradually. (05 hrs.)</p> <p>61. Record the observations as the load just moves. (03 hrs.)</p> <p>62. Calculate Mechanical Advantage, velocity. (02 hrs.)</p>	<p>Inclined plane.</p> <p>Simple machines- types of simple machines-pulley, inclined plane, lever, wheel and axle, screw jack.</p> <p>Mechanical advantage, velocity ratio, efficiency of machine (07 hrs)</p>
		<p><u>Ohm's law</u></p> <p>63. Arrange the apparatus as per the circuit diagram. (02hrs.)</p> <p>64. Adjust the rheostat to get small deflection in ammeter and voltmeter. (02hrs.)</p> <p>65. Record the readings of ammeter and voltmeter. Take at least six sets of readings.(04hrs.)</p> <p>66. Connect two resistances in series &amp; record readings. (02hrs.)</p> <p>67. Connect two resistances in parallel &amp; record readings. (02hrs.)</p> <p><u>Faraday's first law</u></p> <p>68. Prepare copper sulphate solution. (02hrs.)</p>	<p>Current electricity, Ohm's law, Kirchhoff's law.</p> <p>Resistances in series and parallel.</p> <p>Electrolysis, Faradays laws of electrolysis.</p> <p>Energy and power, forms of energy- potential, kinetic, heat, light. Mechanical equivalent of heat ('J' by electric method) (14 hrs)</p>



		<p>69. Weigh copper electrodes &amp; record their masses. (02hrs.)</p> <p>70. Connect the electrodes to a cell and ammeter as shown in fig.(02hrs.)</p> <p>71. Pass a steady current for definite time &amp; record.(04hrs.)</p> <p>72. Calculate electrochemical equivalent of copper.(02hrs.)</p> <p><u>Mechanical Equivalent of Heat</u></p> <p>73. Weigh empty calorimeter cup and record its mass. (02hrs.)</p> <p>74. Pour about 200 ml of water into calorimeter &amp; record mass of the calorimeter cup with water. (04hrs.)</p> <p>75. Submerge the heating coil with stirrer into the water and thermometer. (04hrs.)</p> <p>76. Connect the circuit as shown in figure. (04hrs.)</p> <p>77. Start the stop- clock and start the current flowing in the heating coil. (04hrs.)</p> <p>78. Switch off power supply and stop timer when water temperature is 10-12 °C above the initial temperature. (04hrs.)</p> <p>79. Record final temperature of water; calculate the quantity of heat produced and electrical energy. Calculate Mechanical equivalent of heat 'J'. (04hrs.)</p>	
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		<p><u>Coefficient of expansion of solid</u></p> <p>80. Insert the rod in the Pullinger's apparatus and adjust the spherometer screw until the spherometer screw touches the rod. Read the length of rod using the spherometer scale. (02 hrs.)</p> <p>81. Fill the steam generator two-thirds full of water and turn it on. (01 hr)</p> <p>82. Place thermometer in the opening provided. (01 hr)</p> <p>83. Allow the steam to flow through the jacket of apparatus until a steady temperature is reached. (02 hrs.)</p> <p>84. Record the final temperature and spherometer reading. Find coefficient of expansion of rod. (02 hrs.)</p> <p><u>Coefficient of expansion of liquid</u></p> <p>85. Weigh empty specific gravity bottle, fill it with water and weigh it again. (02 hrs.)</p> <p>86. Record the initial temperature of water.(01 hr)</p> <p>87. Heat the liquid and container (specific gravity bottle) &amp; observe the increase in level of liquid. (02hrs.)</p> <p>88. Calculate coefficient of expansion of liquid. (02 hrs.)</p>	<p>Modes of heat transfer – conduction, convection and radiation.</p> <p>Determination of thermal conductivity.</p> <p>Temperature &amp; expansion of solid, liquid.</p> <p>Coefficient of linear and cubical expansion. (07 hrs)</p>
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		<p><u>Thermal conductivity of metal rod</u></p> <p>89. Measure the diameter of copper rod using Vernier calliper. Measure the distance (d) between two thermometers. (02 hrs.)</p> <p>90. Place the rod in Searle's apparatus. Place thermometers in the holes provided. (01 hr)</p> <p>91. Pass the steam through the steam chamber and water through a copper tube surrounded to the other end of the bar. (03 hrs.)</p> <p>92. Record the water flow rate, steady temperatures and time for collecting water. (02 hrs.)</p> <p>93. Calculate the thermal conductivity. (02 hrs.)</p>	
<p>Professional Skill 125 Hrs; Professional Knowledge 35 Hrs</p>	<p>Set up apparatus, instrument and conduct experiments in Chemistry laboratory to determine concentration of solutions, <math>P^H</math>, melting point, boiling point, compare properties of metals &amp; alloys, prepare chemicals.</p>	<p><u>Simple distillation</u></p> <p>94. Take about 100 ml salty water in distillation flask and arrange expt. Setup as shown in fig. (04hrs.)</p> <p>95. Heat the water till it vaporizes. (04hrs.)</p> <p>96. Collect purified water. (02hrs.)</p> <p>97. Record observations and result. (02hrs.)</p> <p><u>Preparation of standard solutions</u></p> <p>98. Calculate the equivalent weight of HCl, <math>H_2SO_4</math>, NaOH. (04hrs.)</p> <p>99. Record the identification</p>	<p>Introduction to Chemistry, branches of chemistry. Importance of chemistry. Safety precautions to be taken in Chemistry Laboratory. Different equipment and apparatus used in Chemistry Laboratory.</p> <p>Acids, bases and salts-their properties and uses. Element, atom and molecule. Compound, mixture, Physical change, chemical change, Molecular weight, equivalent weight, atomic weight, Normality, molarity and</p>



		<p>code, % composition for above chemicals from reagent bottle. (02hrs.)</p> <p>100. Calculate the normality of chemicals using % composition &amp; from that calculate how many millilitres of concentrated acid/base to make predetermined quantity. (04hrs.)</p> <p>101. Follow the procedure for the preparation of standard solution. (04hrs.)</p> <p><u>Titration- HCl- NaOH</u></p> <p>102. Prepare standard solution of Hydrochloric acid. (04hrs.)</p> <p>103. Titrate standard solution of HCl against NaOH using Phenolphthalein indicator. (04hrs.)</p> <p>104. Repeat titration three times to obtain mean burette reading and record observations. (02hrs.)</p> <p>105. Find Normality &amp; strength of NaOH. (02hrs.)</p> <p><u>Titration – HCl- Na<sub>2</sub>CO<sub>3</sub></u></p> <p>106. Prepare standard solution of Sodium Carbonate. (04hrs.)</p> <p>107. Titrate standard solution of HCl against Na<sub>2</sub>CO<sub>3</sub> using methyl orange indicator. (04hrs.)</p> <p>108. Repeat titration three times to obtain mean burette reading and record</p>	<p>molality.</p> <p>Volumetric analysis- titrimetric analysis- determination of the amount of substance in solution.</p> <p>Detection of end point.</p> <p>Types of Titrimetric analysis. (14 hrs)</p>
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		observations. (02hrs.) 109. Find Normality & strength of HCl. (02hrs.)	
		<u>Allotropic forms of Sulphur</u> 110. Prepare monoclinic sulphur using filter paper, funnel test tube, spatula, Bunsen burner by melting sulphur and then filtering it to form crystals. Record observations. (03 hrs.) 111. Prepare amorphous crystal sulphur and rhombic sulphur following procedure, and record observations. (08 hrs.) <u>Properties of mixture and compound</u> 112. Prepare mixture of iron and sulphur. (02 hrs.) 113. Prepare compound iron sulphide by heating the mixture. (03 hrs.) 114. Perform tests mentioned and record observations. (05 hrs.) 115. Compare properties of iron sulphide with mixture of iron and sulphur. (04 hrs.)	<b>ATOMIC STRUCTURE:</b> Electrons, protons, neutrons. Electronic theory of valency. Classification of elements, Modern periodic law, table, Groups, periods, periodic properties  Allotropy of hydrogen, carbon, phosphorus and sulphur. Allotropic forms of sulphur – monoclinic, amorphous and rhombic sulphur. (07 hrs)
		<u>Action of pure and salt water on metals</u> 116. Take pure and salt water separately in two beakers. Take six iron nails and shine them to expose their surfaces. (02 hrs.) 117. Place three of them into the beaker containing pure water and place another	<b>WATER:</b> Sources, hard and soft water, causes and removal of hardness, water for industrial purposes. Corrosion- causes, effects and prevention. Catalyst definition types of catalysts, characteristics of catalysts and use of catalyst.



		<p>three nails into salt water for several hours. (02 hrs.)</p> <p>118. Record the observations. (03 hrs.)</p> <p><u>Action of acid and base on metals</u></p> <p>119. Take Hydrochloric acid and sodium Hydroxide separately. (01 hr)</p> <p>120. Perform tests mentioned and record observations. (04 hrs.)</p> <p><u>Laboratory preparation Soap</u></p> <p>121. Weigh chemicals accurately- caustic soda, vegetable oil. (02 hrs.)</p> <p>122. Add caustic to water in a beaker and stir it to dissolve. Cool the solution. (01 hr)</p> <p>123. Gradually add vegetable oil to the solution with stirring. (02 hrs.)</p> <p>124. Cool the solution till solid form of soap is obtained. Record observations. (02 hrs.)</p> <p><u>Laboratory preparation copper sulphate</u></p> <p>125. Take dilute sulphuric acid in a beaker, add few grams of cupric oxide and stir well. (02 hrs.)</p> <p>126. Let the solid be added in excess. Wait till the effervescence is over. (02 hrs.)</p> <p>127. Filter the solution; evaporate the filtrate</p>	<p>Introduction to Effluent treatment plant (ETP) (07 hrs)</p>
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		<p>slowly and carefully. Blue coloured copper sulphate crystals are obtained. (02 hrs.)</p>	
		<p><u>Determination of pH</u> 128. Prepare solutions (acidic, basic, neutral). (02 hrs.) 129. Calibrate PH meter with buffer solutions. (03 hrs.) 130. Dip electrode in each solution and record pH of given solution. (02 hrs.)</p> <p><u>Boiling point determination</u> 131. Fill a capillary tube to about half its capacity with given liquid whose boiling point is to be determined, seal one end of a capillary tube. (02 hrs.) 132. Introduce the tube into boiling point apparatus in inverted fashion near the bulb of thermometer. (02 hrs.) 133. Heat the apparatus and note down the boiling point when bubble enlarges and moves in upward direction. (05 hrs.)</p> <p><u>Melting point determination</u> 134. Seal one end of a capillary tube by heating. Fill a capillary tube about 4 mm length and attach it to the lower end of the thermometer with thread. (02 hrs.) 135. Suspend the thermometer in the Thieles tube</p>	<p>Definition of pH, pH scale, measurement of pH.</p> <p><b>ORGANIC CHEMISTRY:</b> Introduction, purification processes, organic reactions- substitution, addition, Elimination, rearrangement reactions, examples. Nomenclature-Basic rules for Common name &amp; IUPAC name system for alkanes, alkenes &amp; alkynes, their examples. Boiling point and melting point of organic compounds (07 hrs)</p>



		<p>containing paraffin liquid. (02 hrs.)</p> <p>136. Heat the Apparatus uniformly from its side arm carefully and record temperature as the substance melts. (05 hrs.)</p>	
<p>Professional Skill 50 Hrs;</p> <p>Professional Knowledge 14 Hrs</p>	<p>Plan, identify and perform different operations/experiments related to safety and general awareness in chemical industry.</p> <p><i>[Different Operations – select and operate fire extinguisher, identify chemical hazards, obtain relevant data from MSDS, determine flash point of oil], Identify the dust percentage in Air.</i></p>	<p>137. Select the appropriate type of fire extinguisher for a given class of fire. (04 hrs.)</p> <p>138. Identify different fire extinguishers. (04 hrs.)</p> <p>139. Use fire extinguisher to extinguish fire. (06 hrs.)</p> <p>140. Demonstrate about fire alarm system. (04 hrs.)</p> <p>141. Demonstrate about the gas detector. (07 hrs.)</p> <p>142. Identify hazardous chemical (Spilling of acids). (06 hrs.)</p> <p>143. Obtain the relevant details form Material safety data sheet (MSDS) for chemicals. (05 hrs.)</p> <p>144. To determine the dust percentage in Air for pollution purpose. (10 hrs.)</p> <p>145. Determine flash point for given oil sample. (04 hrs.)</p>	<ul style="list-style-type: none"> <li>• Definition of fire, chemistry of fire, fire triangle classification of fire,</li> <li>• Causes of fire in chemical industries.</li> <li>• Different types of fire Extinguishers</li> <li>• Accident - causes and effects of accident</li> <li>• Prevention of accidents. (07 hrs)</li> <li>• Different terms such as Hazard, risk, LEL, VEL, TWA, STEL</li> <li>• Flash point, fire point auto ignition temp.</li> <li>• Material safety data sheet.</li> <li>• Housekeeping – importance of housekeeping in chemical industries.</li> <li>• Pollution and its controls</li> <li>• Concept of 5S (07 hrs)</li> </ul>
<p>Professional Skill 150 Hrs;</p> <p>Professional Knowledge 42 Hrs</p>	<p>Identify and, install/connect instrument/devices to measure pressure, temperature, flow and level, density and record readings.</p> <p><i>[Different</i></p>	<p>146. Study the parts of bourdon tube pressure gauge. (04 hrs.)</p> <p>147. Connect the bourdon tube pressure gauge. (05hrs.)</p> <p>148. Note down at least five readings (03 hrs.)</p> <p>149. Study the parts of Capsule</p>	<ul style="list-style-type: none"> <li>• Pressure: Definition, unit's conversion of units.</li> <li>• Classification of pressure measuring instruments</li> <li>• Bourdon type, capsule type helical type, bellows type diaphragm type pressure gauges. (06 hrs)</li> </ul>



<i>instrument/devices – Bourdon tube pressure gauge, capsule type gauge, mercury in glass thermometer, bimetal thermometer, RTD, thermocouple, orifice meter, venture meter, rotameter, sight glass level indicator, air purge level indicator, capacitance type level indicator, hydrometer, control valve]</i>	type gauge. (04 hrs.) 150. Connect the Capsule type pressure gauge. (05 hrs.) 151. Note down at least five readings. (04 hrs.)	
	152. Measure temperature using mercury in glass thermometer. (03 hrs.) 153. Note down at least five readings. (02 hrs.) 154. Measure temperature using bimetal thermometer. (03 hrs.) 155. Note down at least five readings. (02 hrs.) 156. Study the R.T.D. Thermometer. (03 hrs.) 157. Measure temperature using RTD (PT 100) thermometer. (02 hrs.) 158. Take five readings of temperature & record. (03 hrs.) 159. Study the construction of thermocouple. (02 hrs.) 160. Study the working of thermocouple instruments. (02 hrs.) 161. Observe the deflection of milli-voltmeter record. (03 hrs.)	<ul style="list-style-type: none"> <li>• Temperature: Definition, units, conversation of units. Classification of temperature measuring</li> <li>• Instruments: Mercury in glass thermometer, bimetallic thermometer, RTD thermometer &amp; Thermocouple. (14 hrs)</li> </ul>
	162. Connect the orifice flow meter with the water pipe line. (03 hrs.) 163. Connect the 'U' tube manometer with orifice flow meter. (03 hrs.) 164. Take different readings by controlling the flow using	<ul style="list-style-type: none"> <li>• Flow Measurement. -</li> <li>• Classification of flow measuring instruments.</li> <li>• Construction, workings &amp; uses of orifice meter, venturimeter, turbine type flow meters (07 hrs)</li> </ul>



		<p>control valve. (02 hrs.)</p> <p>165. Tabulate the readings in a table and convert it to lit/min. (03 hrs.)</p> <p>166. Connect the venture flow meter. (03 hrs.)</p> <p>167. Connect differential pressure indicator (U-tube manometer) with the venturimeter. (03 hrs.)</p> <p>168. Connect Rota meter in the same water line in vertical position. (03 hrs.)</p> <p>169. Adjust control valve and take 4 readings of both instruments. (03 hrs.)</p> <p>170. Tabulate the readings &amp; compare. (02 hrs.)</p>	
		<p>171. Fit sight-glass level indicator to the tank. (03 hrs.)</p> <p>172. Fill the tank with water. (02 hrs.)</p> <p>173. Control the water flow to the tank and take readings at regular intervals. (03 hrs.)</p> <p>174. Convert the level into liters by the capacity of the tank. (02 hrs.)</p> <p>175. Connect the Air purge level indicator to the tank filled with water. (03 hrs.)</p> <p>176. Slightly open the air flow control valve and observe the bubble in the bubbler. (02 hrs.)</p> <p>177. Record back pressure &amp; level in the tank. (02 hrs.)</p>	<ul style="list-style-type: none"><li>• Level Measurement –</li><li>• Classification of level measuring instruments – simple float type level indicator, sight glass level indicator, air purge level indicator, Capacitance type level indicator. (07 hrs)</li></ul>



		<p>178. Study the parts of capacitance type level indicator. (03 hrs.)</p> <p>179. Study the functions of capacitance type level indicator. (02 hrs.)</p> <p>180. Connect the instrument and take few readings. (03 hrs.)</p>	
		<p>181. Study the principle of Hydrometer. (06 hrs.)</p> <p>182. Study the function of Hydrometer. (06 hrs.)</p> <p>183. Study the parts of control valve. (07 hrs.)</p> <p>184. Study the operation of control valve. (06 hrs.)</p>	<ul style="list-style-type: none"> <li>• Definition and measurement of specific gravity.</li> <li>• Working principle of Hydrometer.</li> <li>• Construction of final control element (control valve)(07 hrs)</li> </ul>
<p>Professional Skill 150 Hrs;  Professional Knowledge 42 Hrs</p>	<p>Apply a range of skills to execute pipe joints, dismantle &amp; assemble valves &amp; fittings with pipes and test for leakages.<i>[Range of skills – Cutting, Threading, gasket cutting, lagging of pipeline, cleaning and Joining, use of locking devices]</i></p>	<p>185. Hold G.I pipe in pipe vice tightly. (02 hrs.)</p> <p>186. Mark the required length in G I Pipe. (02 hrs.)</p> <p>187. Cut the GI pipe squarely. (05 hrs.)</p> <p>188. Chamfer the edge of pipe slightly. (03 hrs.)</p> <p>189. Select a die of suitable size &amp; fit the die in the diestock. (02 hrs.)</p> <p>190. Hold the pipe in a vice &amp; place the leading side of the die on the chamfer of pipe. (02 hrs.)</p> <p>191. Apply pressure on the diestock evenly and turn in clockwise direction &amp; cut slowly and reverse the die for a short distance in order to break the chips. (04 hrs.)</p> <p>192. Increase the depth of the</p>	<ul style="list-style-type: none"> <li>• Standard pipe threads, nominal diameter, wall thickness, schedule number, die &amp; diestock, tubing. (07 hrs)</li> </ul>



		<p>cut gradually. (03 hrs.) 193. Check the threading using the appropriate sized coupling. (02 hrs.)</p>	
		<p>194. Carefully note down how many pieces of the pipe sections and length of each section are required. (06 hrs.) 195. Cut the required length of the pipes as per drawing. (07 hrs.) 196. Threading of pipe. (06 hrs.) 197. Joining the fitting accessories as per drawing. (06 hrs.)</p>	<ul style="list-style-type: none"> <li>• Different types of pipe joints – flanged and threaded. Straight connections, bedsores, elbows, tees, screwed fittings, coupling, flanges, bush &amp; caller, plug, stop cock, binding material. Tools for fitting. (06 hrs)</li> </ul>
		<p>198. Inspect the pipe line. (03 hrs.) 199. Select the appropriate lagging material. (02 hrs.) 200. Lagging of pipeline. (04 hrs.) 201. Cladding of pipeline. (03 hrs.) 202. Select Gasket material. (02 hrs.) 203. Mark as per flange. (02 hrs.) 204. Cutting of Gasket. (03hrs.) 205. Punching by hollow punch. (03 hrs.) 206. Fitting of Gasket. (03 hrs.)</p>	<ul style="list-style-type: none"> <li>• Thermal insulation – Lagging of utilities in chemical industries.</li> <li>• Types &amp; uses of lagging materials. Properties of lagging materials.</li> <li>• Gasket-materials for particular application cork sheet, oil proof paper, PTFE rubber &amp; graphite. (07 hrs)</li> </ul>
		<p>207. Select appropriate locking device for given service. (02 hrs.) 208. Perform the correct positioning of locking devices (03 hrs.) 209. Proper tightening. (02 hrs.) 210. Nut locking by pin or spring</p>	<ul style="list-style-type: none"> <li>• Locking devices- use of correct material and locking devices – locknut castle nut, saw nut, locking pin, spring lock water.</li> <li>• Construction, working &amp; use of gate valve. (07 hrs)</li> </ul>



		<p>washer. (02 hrs.)</p> <p>211. Dismantle the gate valve using proper hand tools. (04 hrs.)</p> <p>212. Check the parts of gate valve for any damage. (03 hrs.)</p> <p>213. Cleaning, lubrication &amp; replacing stand packing (04 hrs.)</p> <p>214. Assemble all the parts, in sequence. (05 hrs.)</p>	
		<p>215. Dismantle the globe valve using proper hand tools. (04 hrs.)</p> <p>216. Check the parts of globe valve for any damage. (02 hrs.)</p> <p>217. Cleaning, lubrication &amp; replacing stand packing.(03 hrs.)</p> <p>218. Assemble all the parts in sequence. (05 hrs.)</p> <p>219. Remove the top cap using suitable spanner. (03 hrs.)</p> <p>220. Check the disc &amp; hinge pin. (03 hrs.)</p> <p>221. Clean it with kerosene. (03 hrs.)</p> <p>222. Assemble it &amp; check for proper functioning by hand. (02 hrs.)</p>	<ul style="list-style-type: none"> <li>• Construction, working &amp; use of Globe valve &amp; check valve. (07 hrs)</li> </ul>
		<p>223. Take the needle valve &amp; check the threads on end connection. (02 hrs.)</p> <p>224. Remove the lock nut, metal seal bonnet to body &amp; stem. (02 hrs.)</p> <p>225. Clean all parts with</p>	<ul style="list-style-type: none"> <li>• Construction, working &amp; use of needle valve, diaphragm &amp; ball valve. (07 hrs)</li> </ul>



		<p>kerosene oil. (02 hrs.)</p> <p>226. Assemble all the parts in sequence &amp; check it for proper functioning. (02 hrs.)</p> <p>227. Take the diaphragm valve &amp; remove hand wheel, bonnet using proper spanner. (02 hrs.)</p> <p>228. Take our and check the diaphragm. (02 hrs.)</p> <p>229. Assemble it in the same sequence. (02 hrs.)</p> <p>230. Take a ball valve &amp; remove its hand wheel, gland nut, Bonnet, stuffing box, packing. (02 hrs.)</p> <p>231. Remove shaft spindle / stem. (02 hrs.)</p> <p>232. Observe the parts for damage. (02 hrs.)</p> <p>233. Clean the parts with kerosene oil. (02 hrs.)</p> <p>234. Assemble the parts in sequence. (03 hrs.)</p>	
		<p>235. Take the stop clock valve &amp; remove the handle, gland nut &amp; nut check the gland robe. (05hrs.)</p> <p>236. Remove the bonnet with spindle from the body k clean all parts. (04 hrs.)</p> <p>237. Assemble it and check for proper functioning. (04 hrs.)</p> <p>238. Take the butterfly valve &amp; remove the gland flange by using suitable spanner. (04 hrs.)</p>	<ul style="list-style-type: none"><li>• Construction, working &amp; use of stop cock &amp; butterfly valve</li><li>• Maintenance of valve</li><li>• Selection of appropriate type of valve for given service</li></ul> <p>(07 hrs)</p>



		<p>239. Check the ropes and rotate the handle to see the tightness of rope. (03 hrs.)</p> <p>240. Refix the gland flange. (03 hrs.)</p> <p>241. Check the movement the disc. (02 hrs.)</p>	
<p>Professional Skill 100 Hrs;</p> <p>Professional Knowledge 28 Hrs</p>	<p>Plan, dismantle, clean and assemble different machines &amp; components used for fluid transportation &amp; check functionality. <i>[Different Machines &amp; Components – Pumps- centrifugal, gear pump, metering pump, screw pump, multistage compressor]</i></p>	<p>242. Check the centrifugal pump physically &amp; note down the defects. (02 hrs.)</p> <p>243. Remove the end cover using proper site spanner. (03 hrs.)</p> <p>244. Remove the impeller and flange using Box spanner &amp; what puller. (04 hrs.)</p> <p>245. Check the shaft for any damages and ply of shaft. (03 hrs.)</p> <p>246. Remove the gland cover and check the gland packing. (04 hrs.)</p> <p>247. Check the bearings for any ply. (02 hrs.)</p> <p>248. Clean all parts with kerosene. (02 hrs.)</p> <p>249. Assemble all the parts in the same sequence. (03 hrs.)</p> <p>250. Replace the gasket if damaged  &amp; fix the end cover. (02 hrs.)</p>	<ul style="list-style-type: none"> <li>• PUMP Classification of pumps</li> <li>• Construction, working &amp; use of centrifugal pump</li> <li>• Starting &amp; Shutting down procedure for centrifugal pump</li> <li>• Trouble shooting in centrifugal pump (07 hrs)</li> </ul>
		<p>251. Check the Gear pump physically &amp; note down the defects. (02 hrs.)</p> <p>252. Mark the relative positions of the gear mesh &amp; the body. (02 hrs.)</p> <p>253. Remove cover assembly,</p>	<ul style="list-style-type: none"> <li>• Construction, working &amp; use of Gear pump</li> <li>• Trouble shooting in Gear pump (07 hrs)</li> </ul>



		<p>wear plate, seal ring on the cover assembly. (04 hrs.)</p> <p>254. Remove the idler shaft drive shaft, load ring, preload ring &amp; seal ring. (03 hrs.)</p> <p>255. Carefully inspect all parts &amp; clean them. Dispose of any damaged seals (02 hrs.)</p> <p>256. Remove shaft seal in body assembly. (02 hrs.)</p> <p>257. Coat all seals with seal grease. (02 hrs.)</p> <p>258. Assemble all parts in sequence. (04 hrs.)</p> <p>259. Check for an alignment of drive shaft &amp; Idler shaft. (02 hrs.)</p> <p>260. Inspect gear teeth for alignment &amp; lubricate the complete set. (02 hrs.)</p>	
		<p>261. Study the screw pump - its parts. (04 hrs.)</p> <p>262. Types of screw pump. (03 hrs.)</p> <p>263. Working &amp; application of screw pump. (04 hrs.)</p> <p>264. Maintenance of screw pump. (03 hrs.)</p> <p>265. Study of metering pump - its parts. (03 hrs.)</p> <p>266. Working &amp; application of metering pump. (04 hrs.)</p> <p>267. Maintenance of metering pump. (04 hrs.)</p>	<ul style="list-style-type: none"> <li>• Construction, working &amp; use of Screw pump &amp; metering pump. (07 hrs)</li> </ul>
		<p>268. Study of multistage compressor - its parts. (06 hrs.)</p> <p>269. Working principle of</p>	<ul style="list-style-type: none"> <li>• Construction, working &amp; uses of fans, blowers &amp; compressor. (07 hrs)</li> </ul>



		<p>compressor. (07 hrs.)</p> <p>270. Application of multistage compressor. (06 hrs.)</p> <p>271. Preventive maintenance of multistage compressor. (06 hrs.)</p>	
<p>Professional Skill 50 Hrs;</p> <p>Professional Knowledge 14 Hrs</p>	<p>Plan, dismantle, clean and assemble different damaged mechanical components used for power transmission &amp; check functionality.</p> <p><i>[Different Damage Mechanical Components-, Gearbox, bearings]</i></p>	<p>272. Inspect bearing fitted on shaft &amp; select proper size bearing puller. (02 hrs.)</p> <p>273. Set the jaws bearing puller on the inner cage of bearing &amp; central spindle of puller on centre of shaft. (04 hrs.)</p> <p>274. Tighten the bolt on puller using spanner &amp; remove the bearing. (04 hrs.)</p> <p>275. Inspect &amp; clean the bearing with kerosene oil. (03 hrs.)</p> <p>276. Select appropriate size ball bearing &amp; remove burs, rust or dirt from bearing mounting surfaces. (03 hrs.)</p> <p>277. Ensure that all pressing block, driving plate/ bearing fitting sleeve, hammer is clean, free of burs &amp; of correct size. (03 hrs.)</p> <p>278. Mount the bearing on the shaft &amp; fit it by gently hammering. (04 hrs.)</p> <p>279. Check freeness of bearing. (02 hrs.)</p>	<ul style="list-style-type: none"> <li>Types, construction &amp; uses of bearings such as ball, roller, bush etc. their care &amp; maintenance. (07 hrs)</li> </ul>
		<p>280. Check the gear box physically note down the defects. (04 hrs.)</p> <p>281. Mark the relative position of parts using punch. (04 hrs.)</p>	<ul style="list-style-type: none"> <li>Types of gears - Spur gear, Helical gear, Bevel gear. Their uses &amp; care. (07 hrs)</li> </ul>



		<p>282. Dismantle the gear box by removing its parts- gear, nut bolt, keys. (05 hrs.)</p> <p>283. Clean all parts using kerosene oil. (04 hrs.)</p> <p>284. Check for any damages &amp; replace if necessary. (03 hrs.)</p> <p>285. Assemble all parts as per marking. (05 hrs.)</p>	
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**Project work / Industrial visit**

**Broad area:**

- a) Fire hydrant system
- b) Fire alarm system
- c) Gas detection system
- d) Making of pipe fitting model
- e) Prepare MSDS for particular chemical
- f) Set up assembly of pipes and valves & test for leakage/functionality.

## SYLLABUS FOR ATTENDANT OPERATOR(CHEMICAL PLANT) TRADE

### SECOND YEAR

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Professional Skill 50Hrs;  Professional Knowledge 18 Hrs	Plan, identify & perform experiments to determine viscosity of oil & select oil for particular application at certain temperature, Reynold's Number to predict flow pattern in a conduit.	286. Clean the oil cup and dry it, Mount the bath on the stand & fill it with water. (03 hrs.) 287. Heat the viscometer bath to the desired temperature. Rest the ball valve in the depression in the jet. (03 hrs.) 288. Pour the oil sample into oil cup through a filter. Stir the sample till it attains test temperature. Place the clean, dry standard 50 ml flask below the jet. (03 hrs.) 289. Lift the ball and simultaneously start the stop watch, collect the oil in 50 ml flask & note the time taken in seconds for collection 50 ml of oil. (03 hrs.) 290. Increase the temperature and repeat the procedure and note down the redwood seconds for different temperatures. (03 hrs.) 291. To determine the viscosity of given oil by digital viscometer. (10 hrs.)	<b>Role of attendant operator</b> 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, (09 hrs)
		292. Prepare coloured solution of permanganate & fill it in the pot provided.(05hrs.) 293. Allow the water to flow at	Manometer, Reynold's Number, Equation of continuity, Bernoulli's theorem.



		<p>the lowest possible flow rate. (03 hrs.)</p> <p>294. Introduce the coloured solution through capillary and adjust the flow so that its velocity is same as that of water. (05hrs.)</p> <p>295. Note the colour filament appears as a continuous thread without intermingling with water. Determine the flow rate of water. (05hrs.)</p> <p>296. Repeat the experiment gradually increasing flow rate of water. Observe the flow rate at which the continuous thread just breaks up and colour gets diffused uniformly throughout the tube. (03hrs.)</p> <p>297. Calculate Reynold's number and determine the nature of flow of fluid/flow pattern of liquid.(04 hrs.)</p>	<p><b>Plant Utility:</b> Steam, cooling water, chilled water, brine, instrument air, Nitrogen, vacuum, introduction of boiler, cooling tower, chilling plant, compressor, ejector. (09 hrs)</p>
<p>Professional Skill 75 Hrs; Professional Knowledge 27 Hrs</p>	<p>Plan, identify &amp; perform experiments to measure the flow rate of a fluid using given flow measuring instrument, and hence coefficient of discharge.</p>	<p><b>Flow meters:</b></p> <p>298. Preparation and apparatus setup.(05hrs.)</p> <p>299. To maintain flow at different velocities by operating flow control valve.(05hrs.)</p> <p>300. Note down manometer reading.(05hrs.)</p> <p>301. Water collection at desired time intervals.(05hrs.)</p> <p>302. Graphical representation of flow rate &amp; differential pressure (<math>\Delta H</math>). (05hrs.)</p>	<p><b>Flow meters:</b> Different types of flowmeters, like disc type, flow nozzles, Working, application &amp; construction details of Orifice meter. Its trouble shooting</p> <p><b>Unit Process:</b> Difference between Unit operations &amp; Unit Processes. Important chemical processes. Terms related to Unit Processes- Raw material, finished product, by-product, conversion, yield, batch process, continuous process.</p>



			Types of reactions. (09 hrs)
		<p><b>Venturi Meter :</b></p> <p>303. Preparation and apparatus setup.(05 hrs.)</p> <p>304. To maintain flow at different velocities by operating flow control valve.(05hrs.)</p> <p>305. Note down manometer reading.(05hrs.)</p> <p>306. Water collection at desired time intervals.(05hrs.)</p> <p>307. Graphical representation of flow rate &amp; differential pressure (<math>\Delta H</math>). (05hrs.)</p>	<p>Working, application &amp; construction details of Venturi meter. Its trouble shooting</p> <p><b>Unit Process:</b></p> <p>Flow sheet- Types of flow sheet, Process block diagram (PBD), process flow diagram (PFD), PID. (09 hrs)</p>
		<p><b>Rota Meter :</b></p> <p>308. Preparation and apparatus setup.(05hrs.)</p> <p>309. To maintain flow at different velocities by operating flow control valve.(05hrs.)</p> <p>310. Note down the rotameter reading. (05 hrs.)</p> <p>311. Water collection at desired time intervals.(05hrs.)</p> <p>312. Comparison actual &amp; theoretical flow rate. (05 hrs.)</p>	<p>Working, application &amp; construction details of Rota meter. Its trouble shooting</p> <p><b>Unit Process:</b></p> <p>Importance of different symbols of unit operations and its use. (09 hrs)</p>
		<p><b>Pitot Tube:</b></p> <p>313. Preparation and apparatus setup.(06hrs.)</p> <p>314. To maintain flow at different velocities by operating flow control valve.(06hrs.)</p> <p>315. Note down manometer reading.(06hrs.)</p> <p>316. Observation &amp; Calculation.(07hrs.)</p>	<p>Working, application &amp; construction details of pitot tube. Its trouble shooting</p> <p><b>Manufacturing process of Sulphuric Acid by Contact Process:</b> Properties, Raw materials, chemical reactions (09 hrs)</p>
Professional	Draw the operating characteristics of	317. Preparation and apparatus setup. (05hrs.)	Characteristic curves of pumps- the plot of actual head, total



Skill 75 Hrs;  Professional Knowledge  27 Hrs	different types of pumps to find the optimum conditions for operating the pump and its selection.	318. To adjust discharge pressure with the help of discharge valve.(05hrs.)	power consumption, and efficiency vs. volumetric flow rate. Flow of incompressible fluids in pipes  <b>Manufacturing process of Sulphuric Acid by Contact Process:</b> process description, flow sheet, (09 hrs)
		319. Note down the reading of Suction & Discharge pressure.(05hrs.)	
		320. Note down the flow rate of liquid at particular pressure head.(05hrs.)	
		321. Graphical representation of flow rate & Discharge head ( $H_T$ ). (05hrs.)	
		322. Preparation and apparatus setup. (07hrs.)	Characteristic curves of pumps- the plot of actual head, total power consumption, and efficiency vs. volumetric flow rate.  <b>Unit Process:</b> Uses of Sulphuric acid (09 hrs)
		323. To adjust discharge pressure with the help of discharge valve. (06hrs.)	
		324. Note down the reading of Suction & Discharge pressure. (06hrs.)	
		325. Note down the flow rate of liquid at particular pressure head. (03hrs.)	
		326. Graphical representation of flow rate & Discharge head ( $H_T$ ). (03hrs.)	
		327. Preparation and apparatus setup.(06hrs.)	Characteristic curves of pumps- the plot of actual head, total power consumption, and efficiency vs. volumetric flow rate. (09 hrs)
		328. To adjust discharge pressure with the help of discharge valve.(06hrs.)	
		329. Note down the reading of Suction & Discharge pressure.(04hrs.)	
		330. Note down the flow rate of liquid at particular pressure head.(04hrs.)	
		331. Graphical representation of flow rate & Discharge head	





		streams. (04hrs.) 349. Note down the mass flow rate of both streams. (04hrs.) 350. Calculation &Result.(05hrs.)	chemical reactions (09 hrs)
		351. Preparation and apparatus setup.(04hrs.) 352. Start cold stream in H.E.(04hrs.) 353. Start hot stream in H.E.(04 hrs.) 354. Note down the inlet & outlet temperatures of both streams. (04hrs.) 355. Note down the mass flow rate of both streams. (04hrs.) 356. Calculation &Result.(05hrs.)	Heat transfer equipment, its classification, Heat exchangers, coolers, condenser and chillers. Double pipe heat exchanger, co-current, counter current flow pattern. <b>Manufacturing process of Caustic soda</b> - process description, flow sheet, uses (09 hrs)
		357. Preparation and apparatus setup. (04hrs.) 358. Start cold stream in H.E.(04hrs.) 359. Start hot stream in H.E.(04 hrs.) 360. Note down the inlet & outlet temperatures of both streams. (04hrs.) 361. Note down the mass flow rate of both streams. (04hrs.) 362. Calculation &Result.(05hrs.)	Shell and tube heat exchanger- its types, applications in industries, Plate type heat exchanger <b>Manufacturing process of Ammonia:</b> Raw materials, chemical reactions (09 hrs)
Professional Skill 50 Hrs;  Professional Knowledge 18 Hrs	Plan, identify & operate different Evaporators to obtain economy & heat transfer rate. <i>[Evaporation equipment's-Vertical tube evaporator, multiple effect evaporator]</i>	363. Preparation and apparatus setup. (03hrs.) 364. Loading of evaporator. (03hrs.) 365. Heating the solution. (03hrs.) 366. Maintaining the temperature, pressure & steam flow during operation. (03hrs.) 367. Note down the temperature, pressure & flow parameters.	<b>Evaporation:</b> Definition, classification of evaporators, Capacity, steam economy of evaporators, <b>Manufacturing process of Ammonia:</b> process description, flow sheet, uses (09 hrs)



		<p>(03hrs.)</p> <p>368. Discharge the evaporator &amp; measuring concentrated solution. (03hrs.)</p> <p>369. Calculation &amp; Result. (07hrs.)</p>	
		<p>370. Preparation and apparatus setup. (04hrs.)</p> <p>371. Loading of evaporator. (04hrs.)</p> <p>372. Heating the solution. (03hrs.)</p> <p>373. Maintaining the temperature, pressure &amp; steam flow during operation. (03hrs.)</p> <p>374. Note down the temperature, pressure &amp; flow parameters. (04hrs.)</p> <p>375. Discharge the evaporator &amp; measuring concentrated solution. (04hrs.)</p> <p>376. Calculation &amp; Result. (03hrs.)</p>	<p>Multiple effect evaporation, methods of feeding in multiple effect evaporation. (09hrs)</p>
<p>Professional Skill 25 Hrs;</p> <p>Professional Knowledge 09 Hrs</p>	<p>Plan, identify &amp; operate cyclone separator to remove particulates from an air, gas, or liquid.</p>	<p>377. Preparation and apparatus setup. (06hrs.)</p> <p>378. Measurement of air flow. (06hrs.)</p> <p>379. Weight of dust particles in particular time. (06hrs.)</p> <p>380. Calculation &amp; Result in ppm. (07hrs.)</p>	<p><b>Pollution:</b></p> <p>Sources, types &amp; effect of water pollution, air pollution.</p> <p>Pollution control equipment such as bag filter, electrostatic precipitators, Water scrubber, cyclone separator. (09hrs)</p>
<p>Professional Skill 50 Hrs;</p> <p>Professional Knowledge 18 Hrs</p>	<p>Plan, identify &amp; operate packed distillation column, sieve tray column, identify effect of different packings, demonstrate the effect of height of packing, &amp; effect of reflux ratio.</p>	<p>381. Explain how distillation happens from model. (08hrs.)</p> <p>382. Showing distillate outlet arrangement. (08hrs.)</p> <p>383. Showing bottom outlet arrangement. Showing feed arrangement. (09hrs.)</p> <p>384. Preparation and apparatus setup. (04hrs.)</p>	<p><b>Distillation:</b></p> <p>Concept of distillation, boiling point diagrams, vapour-liquid equilibrium, relative volatility, constant boiling mixtures- minimum &amp; maximum azeotropes, (09 hrs)</p> <p>Flash differential, rectification and azeotropic, extractive,</p>



		<p>385. Loading of sample solution.(04hrs.)</p> <p>386. Maintaining the temperature. (04hrs.)</p> <p>387. Collecting the sample solution.(04hrs.)</p> <p>388. Reflux the sample to improve purity of product.(04hrs.)</p> <p>389. Calculation &amp;Result.(05hrs.)</p>	<p>vacuum, steam distillation. Reflux ratio: minimum, total, optimum, importance of reflux ratio. Types of distillation column. Column internals. Types of trays/plates. (09 hrs)</p>
<p>Professional Skill 25 Hrs;</p> <p>Professional Knowledge 09 Hrs</p>	<p>Identify, types the functionalities of pressure vessels; list various types of pressures, state various terminologies related to pressure vessels.</p>	<p>390. Calculation of volume of different storage tank. (06hrs.)</p> <p>391. Measurement of level. (06 hrs.)</p> <p>392. Material of construction of storage tank. (06hrs.)</p> <p>393. To maintain temperature &amp;pressure.(07hrs.)</p>	<p><b>Different types of storage vessels:</b></p> <p>Storage of non-volatile, volatile liquids, storage of gases. Fixed or cone roof tanks, Floating roof tanks, cone roof with floating pan</p> <p><b>Manufacturing process of Nitric acid by ammonia oxidation process:</b></p> <p>Raw materials, chemical reactions, process description, flow sheet, uses (09hrs)</p>
<p>Professional Skill 50 Hrs;</p> <p>Professional Knowledge 18 Hrs</p>	<p>Identify, operate &amp; state different types of extraction unit &amp; select most appropriate extractor.</p>	<p>394. Preparation and apparatus setup. (04hrs.)</p> <p>395. Analysis of feed &amp;solvent. (04hrs.)</p> <p>396. Stirring. (02hrs.)</p> <p>397. Settling. (02hrs.)</p> <p>398. Separation of raffinate&amp; extract phase. (04hrs.)</p> <p>399. Testing. (04hrs.)</p> <p>400. .Result.(05hrs.)</p> <p>401. Preparation and apparatus setup. (05hrs.)</p> <p>402. Analysis of feed &amp;solvent. (05hrs.)</p> <p>403. Maintaining heavy phase. (05hrs.)</p>	<p><b>Solvent Extraction:</b></p> <p>Introduction, definition, choice of solvent, distribution coefficient. Equipments used for extraction, Packed and perforated plate towers, application of extractions (09 hrs)</p> <p><b>Leaching:</b></p> <p>Application and different types of equipment uses for leaching oil extraction from oil seeds. (09 hrs)</p>



		<p>404. Dispersion of light phase. (04hrs.)</p> <p>405. Analysis of light phase &amp; heavy phase. (04hrs.)</p> <p>406. Result.(02hrs.)</p>	
<p>Professional Skill 50 Hrs;</p> <p>Professional Knowledge 18 Hrs</p>	<p>Operate an absorption column &amp; carry out experiment to determine flooding velocity. Explain about gas absorption, packed tower and different types of packings.</p>	<p>407. Preparation and apparatus setup. (05 hrs.)</p> <p>408. Analysis of gas mixture &amp; solvent. (05 hrs.)</p> <p>409. Contacting of gas &amp; liquid phase. (05 hrs.)</p> <p>410. Maintaining flow rates &amp; pressure. (05 hrs.)</p> <p>411. Analysis of gas phase &amp; liquid phase. (03hrs.)</p> <p>412. Result.(02 hrs.)</p>	<p><b>Absorption:</b> Introduction, equipment's used for absorption –columns, factors affecting rate of absorption, tower packing.</p> <p><b>Manufacturing Process of Sugar:</b> Raw materials, chemical reactions, process description, flow sheet, uses. (09 hrs)</p>
		<p>413. Preparation and apparatus setup. (05hrs.)</p> <p>414. Set liquid flow rate. (05hrs.)</p> <p>415. To maintain gas flow rate at different velocities by operating flow control valve. (05hrs.)</p> <p>416. Note down manometer reading. (05hrs.)</p> <p>417. Graphical representation of flow rate &amp; differential pressure (<math>\Delta H</math>).(05hrs.)</p>	<p>Flooding and flooding velocity. (09 hrs)</p>
<p>Professional Skill 25 Hrs;</p> <p>Professional Knowledge 09 Hrs</p>	<p>Identify types of crystallization equipments and know their basic operations</p>	<p>418. Preparation and apparatus setup. (05hrs.)</p> <p>419. To prepare saturated/super saturated solution using solid solute like NaCl. (5hrs.)</p> <p>420. Formation of crystals, Cooling &amp; Stirring. (5hrs.)</p> <p>421. Separation of crystal &amp; mother liquor. (5hrs.)</p> <p>422. Crystal drying.(5hrs.)</p>	<p><b>Crystallization:</b> Introduction, concepts of solubility &amp; effect of temperature on solubility, crystallization, methods of super-saturation, Different types of crystallizers &amp; their application in industries. (09hrs)</p>
<p>Professional</p>	<p>Identify, operate &amp;</p>	<p>423. Preparation and apparatus</p>	<p><b>Filtration:</b></p>



<p>Skill 100 Hrs; Professional Knowledge 36Hrs</p>	<p>state different types of filtration units. Study the parts and functions of plate and frame filter press &amp; select appropriate unit.</p>	<p>setup. (01 hr.) 424. Assembling filter press properly. (01 hr.) 425. Operating filter press. (04 hrs.) 426. Collection of Filtrate. (02hrs.) 427. Removal of cake. (02 hrs.) 428. Cleaning &amp; reassemble of filter press. (02 hrs.) 429. Preparation and apparatus setup. (02 hrs.) 430. Loading of slurry tub. (01 hr) 431. Application of vacuum &amp; compressed air. (03hrs.) 432. Operating filter unit. (03 hrs.) 433. Collection of Filtrate. (01 hr) 434. Removal of cake. (02 hrs.)</p>	<p>Principles of filtration, types of filtrations such as atmospheric, pressure, vacuum and their specific applications. Construction &amp; working of plate and frame Filter Press.  Factors affecting filtration. Filter media. Construction &amp; working of Rotary drum vacuum filter. (09 hrs)</p>
		<p>435. Preparation and apparatus setup. (01 hr) 436. Assembling filter press properly. (01 hr) 437. Operating filter press. (03 hrs.) 438. Collection of Filtrate (03 hrs.) 439. Removal of cake. (02 hrs.) 440. Cleaning &amp; reassemble of filter press. (01 hr) 441. Preparation and apparatus setup. (01 hr) 442. Application of vacuum. (03 hrs.) 443. Operating filter unit. (03 hrs.) 444. Collection of Filtrate. (03 hrs.)</p>	<p>Construction &amp; working of Sparkler filter <b>Manufacturing Process of Urea:</b> Raw materials, chemical reactions, process description, flow sheet, uses.  Construction &amp; working of Leaf filter (09 hrs)</p>



	<p>445. Removal of cake. (02hrs.) 446. Washing &amp; cleaning of filter unit. (02hrs.)</p>	
	<p>447. Preparation of slurry and apparatus setup. (01 hr) 448. Application of vacuum. (03 hrs.) 449. Operating filter unit. (03 hrs.) 450. Collection of Filtrate (03 hrs.) 451. Removal of cake. (01 hr) 452. Washing &amp; cleaning of filter unit. (02hrs.) 453. Preparation of slurry and apparatus setup. (01 hr) 454. Application of vacuum (03 hrs.) 455. Operating centrifuge. (03 hrs.) 456. Collection of Filtrate (03hrs.) 457. Removal of cake. (01 hr) 458. Washing &amp; cleaning. (01 hr)</p>	<p>Construction &amp; working of Nutch filter</p> <p><b>Centrifugation:</b> Types of Centrifuges. Construction &amp; working of Bottom driven centrifuge. (09 hrs)</p>
	<p>459. Preparation and apparatus setup. (04hrs.) 460. Loading of slurry tank. (04hrs.) 461. Application of vacuum. (04hrs.) 462. Operating filter unit. (04hrs.) 463. Collection of Filtrate. (04hrs.) 464. Removal of cake. (04hrs.) 465. Washing &amp; cleaning of filter unit.(01hr)</p>	<p>Construction &amp; working of Leaf filter (09 hrs)</p>



<p>Professional Skill 25 Hrs; Professional Knowledge 09 Hrs</p>	<p>Identify the different modules of DCS, function, Wire and connect I/OS field devices to the I/O Modules.</p>	<p>466. Familiar with different faculties and function of DCS system. (05 hrs.) 467. Identify the different modules of DCS and different process instruments in process plant. (10 hrs.) 468. Wire and connect the I/O Module of DCS to field signals. (06hrs.) 469. Install DCS Programming software and establish communication with PC and DCS. (04 hrs.)</p>	<p>Fundamentals of DCS. History of DCS development. Structure of DCS system. Importance of DCS, Use of DCS in chemical industries. (09hrs)</p>
<p>Professional Skill 25 Hrs; Professional Knowledge 09 Hrs</p>	<p>Identify modules of PLC, its function, Wire and connect the digital I/OS field devices to the I/O Module of PLC</p>	<p>470. Identify each module in a rack and mount in the specified slot. (15 hrs.) 471. Wire and connect the digital I/OS field devices to the I/O Module of PLC. (10 hrs.)</p>	<p>Introduction to programmable controllers. History of programmable controllers, general characteristics of programmable controllers, some limitation of PLCs, method of developing PLC programming. (09hrs)</p>
<p>Professional Skill 25 Hrs; Professional Knowledge 09 Hrs</p>	<p>Identify to operate different types of mixing equipment like ribbon blender.</p>	<p>472. Preparation and apparatus setup.(06hrs.) 473. Homogeneous mixing of substances. (09hrs.) 474. Unloading of mixer.(07hrs.) 475. Washing &amp; cleaning.(03hrs.)</p>	<p><b>Mixing:</b> Introduction, classification of mixing equipment's and its applications, mixers for mixing solid-solid, solid-liquid, solid-gas. (09hrs)</p>
<p>Professional Skill 25 Hrs; Professional Knowledge 09 Hrs</p>	<p>Identify, operate different types of drying equipments &amp; determine rate of drying. Demonstrate the effect of operating parameters on drying of solids. Identify the time of drying for the constant rate period &amp;</p>	<p>476. Preparation and apparatus setup.(01 hr) 477. Weighing sample for different trays.(01 hr) 478. Drying operation at constant temperature.(04 hrs.) 479. Weighing sample at regular interval of time.(04 hrs.) 480. Calculation &amp; Result.(02</p>	<p><b>Drying:</b> Definition, factors affecting rate of drying, Different types of dryers, their construction, working &amp; uses. (09 hrs)</p>



	falling rate period. Select appropriate dryer for the given feed.	hrs.) 481. Washing & cleaning. (01 hr) 482. Preparation and apparatus setup. (02 hrs.) 483. Drying operation at constant temperature. (04 hrs.) 484. Weighing product after drying operation. (02 hrs.) 485. Calculation & Result. (02 hrs.) 486. Washing & cleaning. (02 hrs.)	
Professional Skill 50 Hrs;  Professional Knowledge 18 Hrs	Identify, demonstrate, operate different size reduction machines. Find out critical speed of the Ball mill.	487. Preparation and apparatus setup. (03 hrs.) 488. Weighing sample. (03 hrs.) 489. Crushing operation. (04 hrs.) 490. Collection of crushed material. (03 hrs.) 491. Equipment cleaning. (03 hrs.) 492. Preparation and apparatus setup. (02 hrs.) 493. Weighing sample. (03 hrs.) 494. Hammer mill operation. (03hrs.) 495. Collection of crushed material. (03hrs.) 496. Equipment cleaning. (05hrs.) 497. Preparation and apparatus setup. (03hrs.) 498. Weighing sample. (05hrs.) 499. Ball mill operation. (4 hrs.) 500. Collection of grinding material. (03hrs.) 501. Equipment cleaning (03hrs.)	<b>Size Reduction:</b> Introduction. Classification of crushing & grinding equipment. Construction, working and applications of jaw / roller Crushers.  Construction, working and applications of Hammer mill. <b>Manufacturing Process of Ethyl Alcohol:</b> Raw materials, chemical reactions, process description, flow sheet, uses. Construction, working and applications of Ball mill. (18hrs)
Professional	Operate Screening	502. Preparation and apparatus	<b>Screening:</b>



<p>Skill 25 Hrs; Professional Knowledge 09 Hrs</p>	<p>Equipment.Determines creen effectiveness of a sieve.</p>	<p>(05 hrs.) 503. Loading of sieve shaker. (04hrs.) 504. Operating sieve shaker.(04hrs.) 505. Unloading sieve shaker. (04hrs.) 506. Collection &amp; weighing of sample in each sieve.(04hrs.) 507. Observation table.(04hrs.)</p>	<p>Screens, standard screens (Tyler’s standard screen) and its principle. mesh number, Classification of Screening equipment’s such as trammels, vibrating Screens &amp; their industrial applications. (09hrs)</p>
<p>Professional Skill 50 Hrs; Professional Knowledge 18 Hrs</p>	<p>Set up, operate humidification &amp; dehumidification operations. Measure dry bulb &amp; wet bulb temperatures and find out relative humidity. Demonstrate &amp; Operate cooling tower.</p>	<p>508. Preparation and apparatus setup.(05hrs.) 509. Note the reading of wet bulb.(05hrs.) 510. Note the reading of dry bulb.(05hrs.) 511. Compare readings.(05hrs.) 512. Result.(05hrs.) 513. Preparation and apparatus setup.(05hrs.) 514. Note down temperature of inlet water.(05hrs.) 515. Maintain air flow rate.(05hrs.) 516. Take cooled water outlet temperature at specific intervals.(07hrs.) 517. Result.(03hrs.)</p>	<p><b>Humidification &amp; Dehumidification:</b> Theory of Humidification and different terms related to Humidification. (09 hrs) <b>Cooling Tower:</b> Types of cooling tower, their Construction, working. <b>Manufacturing Process of Pulp &amp; Paper:</b> Raw materials, chemical reactions, process description, flow sheet, and uses. (09 hrs)</p>
<p>Professional Skill 25 Hrs; Professional Knowledge 09 Hrs</p>	<p>Identify &amp; demonstrate the various types of conveyors like belt conveyor, screw conveyer and bucket elevators and list their components and uses.</p>	<p>518. Preparation and apparatus setup. (01hr) 519. Start the conveyor.(01hr) 520. Supplyof raw material. (02hrs.) 521. Measurement of speed/time taken for travel from one end to other. (02hrs.) 522. Discharge of material at</p>	<p><b>Conveying:</b> Introduction and different types of conveyors. (09hrs)</p>



		<p>other end and result. (02hrs.)</p> <p>523. Preparation and apparatus setup. (01hr)</p> <p>524. Start the conveyor.(01hr)</p> <p>525. Supply of raw material.(02hrs.)</p> <p>526. Measurement of speed/time taken for travel from one end to other. (02hrs.)</p> <p>527. Discharge of material at other end and result. (02hrs.)</p> <p>528. Preparation and apparatus setup. (01hr)</p> <p>529. Start the Elevator. (01hr)</p> <p>530. Supply of raw material. (02hrs.)</p> <p>531. Measurement of speed/time taken for travel from one end to other. (02hrs.)</p> <p>532. Discharge of material at other end and result. (03 hrs.)</p>	
<p>Professional Skill 50Hrs;</p> <p>Professional Knowledge 18Hrs</p>	<p>Conduct sedimentation operation and draw sedimentation curve. Differentiate between settling, sedimentation and decantation operations.</p> <p>Identify the function of Chemical reactor; list various types of chemical reactors, state various</p>	<p>533. Preparation and apparatus setup. (03hrs.)</p> <p>534. Add coagulant. (03hrs.)</p> <p>535. Stirring for specific period. (03hrs.)</p> <p>536. Settling &amp; separation. (03hrs.)</p> <p>537. Result. (03hrs.)</p> <p>538. Material of construction. (02 hrs.)</p> <p>539. Use of reactor. (03hrs.)</p> <p>540. Fittings &amp; accessories on the reactor. (03 hrs.)</p>	<p><b>Sedimentation &amp; Decantation:</b> Various type of thickeners and sedimentation operation equipment.</p> <p><b>Chemical Reactor:</b> Types of reactor, Parts of reactor. (09hrs)</p>



	accessories of Chemical reactors.	541. Stirrer used.(02hrs.)	
<b>Implant training / Project work (work in a team)</b>			
<b>Broad area:</b>			
a) Crystallization of sugar/salt from saturated/supersaturated solution.			
b) Extraction of oil seeds.			
c) To create a water filtration system from common material. (sand filter)			
d) Slide show presentation of size reduction equipments.			
e) Purification of mud water with the help of sedimentation & coagulation operation.			