7. TRADE SYLLABUS

SYLLABUS FOR MAINTENANCE MECHANIC (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 following safety precautions. *[Basic fitting operation – marking, Hack-sawing, punching, Chiselling, Filing, Drilling, countersinking, counter boring, reaming, Taping etc. Accuracy: ± 0.25mm]*	1. Importance of trade training, List of tools & Machinery used in the trade. (02 hrs) 2. Safety attitude development of the trainee by explaining importance of safety. (05 hrs) 3. Identify various PPEs. (03 hrs) 4. Demonstrate the correct use of appropriate PPE.(05 hrs) 5. First aid methods and basic training. (03 hrs) 6. Safety sign/slogan for Danger. (03 hrs) 7. Safe use of tools and equipment used in the trade. (04 hrs)	• All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. • Introduction about ITI Rules and Regulation. Importance of trade training. SAFETY: • Introduction &Importance of safety, general precautions about safety. PPEs and safety equipment used in chemical industries. Safety slogan. • First aid in workshop &chemical industry. (07 hrs.)
		8. Practice and understand precautions to be followed while working in fitting workshop. (04 hrs) 9. Marking on the job as per drawing with using scriber. (04 hrs) 10. Hold the job in a bench vice	BASIC FITTING: • Safety precautions to be followed in fitting workshop. • Description, construction and uses different • Hand tools - files, chisels, hacksaw & hammer etc.,

		for cutting. (03hrs) 11. Hacksawing over marking (04 hrs) 12. Hold the job in a bench vice horizontally for filing.(03hrs) 13. Select flat files of various grades and length according to a) Size of the job b) Quantity of metal to be removed. c) Material of the job.(06hrs) 14. File flat surface (12hrs) 15. Check & correct the flatness of the filed surface with the blade of try square.(07hrs) 16. Check & correct the squareness of adjacent surfaces (07hrs)	their uses. • Measuring tools - steel rule, caliper, try square • Marking tools - scriber, punches, scribing block combination set etc. (14 hrs.)
		17. File two adjacent sides flat and square.(08 hrs) 18. Apply marking medium on the surface to be marked. (01 hr) 19. Marking dimensions as per drawing (01 hr) 20. File all the other sides to size.(07 hrs) 21. Check flatness & squareness using try square.(01 hr) 22. Check dimensions using outside calliper.(01 hr) 23. Check dimensions with a steel rule.(01 hr) 24. Mark parallel lines using a	**JOB HOLDING DEVICES:** • Description, construction and uses of different job holding devices such as vice, V' Block with clamp etc. • Types of Vice – Bench vice, leg vice, pipe vice, pin vice etc. (07 hrs.)

		jenny calliper & scriber.(02 hrs) 25. Mark curves & circles by jenny calliper & divider.(01 hr) 26. Punch the centre of circle with centre punch and ball peen hammer. (02 hrs)	
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Test various steps fit of components for assembling as per required tolerance. [Step fit, required tolerance: ±0.04 mm]	27. Check the raw material size as per drawing (01 hr) 28. Marking on the job as per drawing with using scriber (02 hrs) 29. Hacksawing over marking (04 hrs) 30. Hold the job in a bench vice for filing.(01 hr) 31. File two adjacent sides at right angles to each other. (12hrs) 32. File two reference surfaces flat &square.(09hrs) 33. Mark & punch the job as per drawing (Both 'A' & 'B'). (03hrs) 34. Separate the part 'A' & 'B' by sawing or drilling.(06hrs) 35. File & finish part 'A' & 'B'. (06hrs) 36. Check & correct dimensions and then assemble two parts.(06hrs)	Linear Measuring Instruments • Description, construction, calculation and uses. • Vernier Calliper, Vernier Depth gauge, Height gauge, Outside Micrometre, Bevel protector. (14 hrs.)
Professional Skill 50 Hrs; Professional Knowledge	Plan and organize the work to make job as per specification applying different types of basic fitting operations and Check	37. File surface flat & parallel within an accuracy. (08 hrs) 38. Mark/locate drilling positions.(01 hr) 39. Prick and centre punch hole locations.(02 hrs)	• Drilling, Countersinking, counter boring. Reaming and tapping. • Description, Nomenclature and uses of Drill, Reamer etc.

14 Hrs	for dimensional accuracy. *[Basic fitting operation – marking, Hack-sawing, punching, Chiselling, Filing, Drilling, countersinking, counterboring, reaming, Taping etc. Accuracy: ± 0.25mm*	40. Centre drill each hole location using appropriate standard centre drills. (05 hrs) 41. Countersink holes to match standard screw heads.(03 hrs) 42. Counter bore holes as per drawing. (03 hrs) 43. Ream the holes to a size by hand-reamer.(02 hrs) 44. Check the reamed holes for their dimensional accuracy with the help of standard cylindrical pins. (01 hr)	(07 hrs.)
		45. Check the given raw material for its size. (01 hr) 46. File and finish the given material to given size.(12 hrs) 47. Determine the tap drill size.(02 hrs) 48. Drill the hole to the required tap drill size.(05 hrs) 49. Cut the threads with the set of taps. (05 hrs)	• Introduction about threading. • Description, nomenclature and uses of different types of threads – metric, BSW, BSF, and BSP etc. • Calculation of tap drill size. (07 hrs.)
Professional Skill 25Hrs; Professional Knowledge 07Hrs	Set the Oxy-acetylene gas welding plant, set Oxy-acetylene flames & join metal components by edge joint observing safety precautions.	50. Demonstration about Safety precautions to be observed in welding workshop. (02 hrs) 51. Demonstration about safety equipment used in Gas welding. (03 hrs) 52. Demonstration about safety equipments& general precaution in welding workshop. (05hrs) 53. Setting up of oxy-acetylene	Gas Welding Safety: • 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. (07 Hrs)

		plant. (05 hrs) 54. Setting of oxy-acetylene flames (Neutral, oxidizing, carburizing). (03 hrs) 55. Fusion run without & with filler rod. (05hrs) 56. Edge Joint without & with filler rod.(02 hrs)	
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Select and ascertain measuring instrument and measure dimension of components and record data.	<u>Vernier caliper</u> 57. Calculate least count& zero error. (05 hrs) 58. Calculate thickness of given object. (08 hrs) <u>Outside Micrometer</u> 59. Calculate least count& zero error. (05 hrs) 60. Calculate thickness of given object. (07 hrs)	Basic physics • Introduction about physics. • Measurement using Vernier calliper and micrometer.(07 hrs)
Professional Skill 125 Hrs; Professional Knowledge 35Hrs	Set up apparatus, instrument and conduct experiments in Physics laboratory to determine physical quantity/constants and verify laws.	<u>Simple pendulum</u> 61. Measure diameter of bob with the help of Vernier calliper. (02 hrs) 62. Find the length of Pendulum. (02 hrs) 63. Record time for 20 oscillations. (04 hrs) 64. Tabulate all readings.(02 hrs) 65. Calculate acceleration due to gravity(g). (02 hrs) 66. Plot the graph of L & T^2. (02 hrs) <u>Law of parallelogram of forces</u>	• Introduction about physics. • Define scaler and vector quantities, their representation, resultant and use. • Laws of oscillations, parallelogram. (07 hrs.)

		67. Attach two pulleys to the mechanical board fixed to the wall as shown in figure.(02 hrs) 68. Fix drawing sheet to the board with pins.(02 hrs) 69. Apply two forces to the pulley by hanging a mass of 100 & 200 grams.(03 hrs) 70. Find resultant force by completing parallelogram and drawing diagonal.(02 hrs) 71. Calculate resultant by formula. (02 hrs)	
		<u>Inclined plane</u> 72. Weigh separately the roller/wooden block and the pan with balance.(02 hrs) 73. Generate angle of inclination of inclined plane.(30^0, 40^0, 50^0,60^0). (03 hrs) 74. Find weights for upward and downward motion of roller for different inclination of plane.(06 hrs) 75. Plot graph (should be straight line). (02 hrs) <u>Screw Jack</u> 76. Find pitch of screw jack.(02 hrs) 77. Put load on the jack and start applying efforts gradually.(05 hrs) 78. Record the observations as the load just moves.(03	Friction • Definition, units and type of friction. • Advantages and disadvantages of friction. • Definition of simple machine. • Types – Screw jack, Lever etc. • Definition – mechanical advantage, percentage velocity ratio, efficiency etc. (07 hrs.)

		hrs) 79. Calculate Mechanical Advantage, velocity. (02 hrs)	
		<u>Young's Modulus</u> 80. Measure Length of wire with meter scale and diameter of wire with screw gauge.(05 hrs) 81. Calculate least count of micrometer.(04 hrs) 82. Start applying weights gradually to hanger by 500 grams (loading) and then removing weights gradually by 500 grams (unloading). (12 hrs) 83. Record the readings for loading and unloading. (02 hrs) 84. Calculate Young's Modulus for wire.(02 hrs)	Elasticity • Definition – Elasticity, stress, strain, elastic limit. • Law – Young's modulus of elasticity. (07 hrs.)
		<u>Ohm's law</u> 85. Arrange the apparatus as per the circuit diagram.(02hrs) 86. Adjust the rheostat to get small deflection in ammeter and voltmeter. (02hrs) 87. Record the readings of ammeter and voltmeter. Take at least six sets of readings.(04hrs) 88. Connect two resistances in series & record readings. (02hrs) 89. Connect two resistances in	Electricity • Introduction about electricity. • Unit of current & voltage • Ohm's law. • Set up of electric cell using series and parallel connections. Electrolysis • Definition of electrolysis. • Faraday's first law • Electroplating • Definition of electrolytic and non-electrolytic solutions. (07 hrs.)

		parallel & record readings. (02hrs) 90. Calculate and prove the ohm's law. (02 hrs) <u>Faraday's first law</u> 91. Prepare copper sulphate solution. (02hrs) 92. Weigh copper electrodes & record their masses. (01 hrs) 93. Connect the electrodes to a cell and ammeter as shown in fig.(04hrs) 94. Pass a steady current for definite time &record.(02 hrs) 95. Calculate electrochemical equivalent of copper.(01 hr) 96. Find out electrolytic property of solution.(01 hr)	
		<u>Coefficient of expansion of solid</u> 97. 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) 98. Fill the steam generator two-thirds full of water and turn it on. (01 hr) 99. Place thermometer in the opening provided. (01 hr) 100. Allow the steam to flow	• Modes of heat transfer – conduction, convection and radiation. • Determination of thermal conductivity. • Temperature &expansion of solid, liquid. • Coefficient of linear and cubical expansion. (07 hrs.)

		through the jacket of apparatus until a steady temperature is reached. (02 hrs) 101. Record the final temperature and spherometer reading. Find coefficient of expansion of rod. (02 hrs) <u>Coefficient of expansion of liquid</u> 102. Weigh empty specific gravity bottle, fill it with water and weigh it again. (02 hrs) 103. Record the initial temperature of water.(01 hrs) 104. Heat the liquid and container (specific gravity bottle) & observe the increase in level of liquid. (02hrs) 105. Calculate coefficient of expansion of liquid. (02 hrs) <u>Thermal conductivity of metal rod</u> 106. Measure the diameter of copper rod using Vernier calliper. Measure the distance (d) between two thermometers. (02 hrs) 107. Place the rod in Searle's apparatus. Place thermometers in the holes provided. (01 hr) 108. Pass the steam through	

		the steam chamber and water through a copper tube surrounded to the other end of the bar.(03 hrs) 109. Record the water flow rate, steady temperatures and time for collecting water. (02 hrs) 110. Calculate the thermal conductivity. (02 hrs)	
Professional Skill 100 Hrs; Professional Knowledge 28Hrs	Set up apparatus, instrument and conduct experiments in Chemistry laboratory to determine concentration of solutions, P^H, melting point, boiling point, compare properties of metals & alloys, prepare chemicals.	<u>Simple distillation by laboratory method</u> 111. Take about 100 ml salty water in distillation flask and arrange expt. Setup as shown in fig. (02 hrs) 112. Heat the water till it vaporizes. (02 hrs) 113. Collect purified water. (01 hr) 114. Record observations and result. (01 hr) <u>Preparation of standard solutions</u> 115. Calculate the equivalent weight of HCl, H_2SO_4, NaOH, (02 hrs) 116. Record the identification code, % composition for above chemicals from reagent bottle. (01 hr) 117. Calculate the normality of chemicals using % composition & from that calculate how many millilitresof concentrated acid/base to make	Chemistry • 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. • Acids, bases and salts-their properties and uses. • Element, atom and molecule. • Definition - Compound, mixture, Physical change, chemical change, Molecular weight, equivalent weight, atomic weight, Normality, molarity and molality. • Volumetric analysis-titrimetric analysis-determination of the amount of substance in solution. Detection of end

		predetermined quantity. (02 hrs) 118. Follow the procedure for the preparation of standard solution. (02 hrs) <u>Titration- HCl- NaOH</u> 119. Prepare standard solution of Hydrochloric acid. (02 hrs) 120. Titrate standard solution of HCl against NaOH using Phenolphthalein indicator. (02 hrs) 121. Repeat titration three times to obtain mean burette reading and record observations. (01 hr) 122. Find Normality & strength of NaOH. (01 hr) <u>Titration – HCl- Na_2CO_3</u> 123. Prepare standard solution of Sodium Carbonate. (02 hrs) 124. Titrate standard solution of HCl against Na_2CO_3 using methyl orange indicator. (02 hrs) 125. Repeat titration three times to obtain mean burette reading and record observations. (01 hr) 126. Find Normality & strength of HCl. (01hr)	point. • Types of Titrimetric analysis.(07 hrs.)
		<u>Allotropic forms of sulphur</u> 127. Prepare monoclinic	Atomic structure • Electrons, protons, neutrons.

		sulphur using filter paper, funnel test tube, spatula, Bunsen burner by melting sulphur and then filtering it to form crystals. Record observations. (03 hrs) 128. Prepare amorphous crystal sulphur and rhombic sulphur following procedure, and record observations. (08 hrs) <u>Properties of mixture and compound</u> 129. Prepare mixture of iron and sulphur. (02 hrs) 130. Prepare compound iron sulphide by heating the mixture. (03 hrs) 131. Perform tests mentioned and record observations. (05 hrs) 132. Compare properties of iron sulphide with mixture of iron and sulphur. (04 hrs)	• Electronic theory of valence. • Classification of elements, • Modern periodic law, periodictable, Groups, periods, periodic properties Allotropy • 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> 133. Take pure and salt water separately in two beakers. Take six iron nails and shine them to expose their surfaces. (02 hrs) 134. Place three of them into the beaker containing pure water and place another three nails into salt water for several hours. (02 hrs)	Water • Sources, hard and soft water, causes and removal of hardness, • water for industrial purposes. • Corrosion- causes, effects and prevention. • Introduction to Effluent treatment plant (ETP) (07 hrs.)

		135. Record the observations. (01hr) <u>Action of acid and base on metals</u> 136. Take Hydrochloric acid and sodium Hydroxide separately. (01 hr) 137. Take six iron nails and shine them to expose their surfaces.(01 hrs) 138. Place three of them into the beaker containing acid and place another three nails into salt base for several hours. (02 hrs) 139. Perform tests mentioned and record observations. (04 hrs) <u>Laboratory preparation Soap</u> 140. Weigh chemicals accurately- caustic soda, vegetable oil. (02 hrs) 141. Add caustic to water in a beaker and stir it to dissolve. Cool the solution. (01 hr) 142. Gradually add vegetable oil to the solution with stirring. (02 hrs) 143. Cool the solution till solid form of soap is obtained. Record observations. (02 hrs) <u>Laboratory preparation copper sulphate</u> 144. Take dilute sulphuric acid in a beaker, add few	

		grams of cupric oxide and stir well. (02 hrs) 145. Let the solid be added in excess. Wait till the effervescence is over. (01 hr) 146. Filter the solution; evaporate the filtrate slowly and carefully. Blue colored copper sulphate crystals are obtained. (02 hrs)	
		<u>Determination of pH</u> 147. Prepare solutions (acidic, basic, neutral) (02 hrs) 148. Calibrate PH meter with buffer solutions. (03 hrs) 149. Dip electrode in each solution and record pH of given solution. (02 hrs) <u>Boiling point determination</u> 150. 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) 151. Introduce the tube into boiling point apparatus in inverted fashion near the bulb of thermometer. (02 hrs) 152. Heat the apparatus and note down the boiling point when bubble enlarges and moves in upward direction. (05 hrs)	Organic chemistry • Definition of pH, pH scale, measurement of pH • Introduction, purification processes, organic reactions- substitution, addition, Elimination, rearrangement reactions, examples. • Nomenclature-Basic rules for Common name &IUPAC name system for alkenes, alkenes &alkynes, their examples. • Boiling point and melting point of organic compounds. (07 hrs.)

		Melting point determination 153. 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) 154. Suspend the thermometer in the Thieles tube containing paraffin liquid. (02 hrs) 155. Heat the Apparatus uniformly from its side arm carefully and record temperature as the substance melts. (5 hrs)	
Professional Skill 100 Hrs; Professional Knowledge 28Hrs	Plan, identify and perform different operations related to safety and Arc welding *[Different Operations – select and operate fire extinguisher, straight line beads, single V-butt joint]*	156. Importance of trade training tools & machineries required. (05 hrs) 157. General house-keeping & good shop floor practices. (03 hrs) 158. Development of safety attitude by demonstrating its importance. (02 hrs) 159. Demonstrate safety equipment's & their applications. (05 hrs) 160. Demonstrate firefighting equipment's & their use. (05 hrs) 161. Safe way of using tools & equipment's used in the trade. (01 hrs) 162. Environmental guidelines	Arc Welding • Importance and discipline in arc welding workshop, application in various industries. • Description and application of safety equipment's, toxic fumes, light intensity, ventilation and housekeeping. Environmental hazard, waste management, types of fire and fire extinguishers. • Safety before, during and after are welding operation. (07 hrs.)

		(02 hrs) 163. Disposal of waste. (02 hrs)	
		164. Apply coating & perform marking on job as per drawing. (06 hrs) 165. Carry out punching operation (04 hrs) 166. Hold the job in vice & perform hack-sawing operation as per drawing. (07 hrs) 167. Illustrate electrode coating & their function. (04 hrs) 168. Illustrate function of welding transformer. (04 hrs)	• Precision measuring instruments- verniercaliper, micrometer. • Introduction and definition of welding, Tools and machinery required. • Types of transformer single phase, three phase, step up, step down transformer. • Basic electricity applicable, related electrical terms and definitions. (07 hrs.)
		169. Prepare job to be welded as per given specification. (06 hrs) 170. Perform clamping &grounding operation. (02 hrs) 171. Set- up an arc welding machine. (02 hrs) 172. Strike an arc on the job 173. Straight line bed on MS flat in flat position. (02 hrs) 174. Prepare job for single ' V ' butt joint in flat position. (06 hrs) 175. Perform clamping & grounding. (02 hrs) 176. Strike an arc. (02 hrs) 177. Clean weld with chipping hammer. (03 hrs)	• Heat, temperature and terms related to welding. • Principle and characteristic of arc welding. • Arc length, types, effects of arc length. • Types of welding joints, welding positions, symbols. • Selection of electrode. (07 hrs.)
		178. Prepare job for fillet lap	• Welding detects, causes

		joint as per the drawing. (06 hrs) 179. Take welding run & complete the job. (02 hrs) 180. Prepare job for ' T' joint on MS plate in horizontal position as given. (06 hrs) 181. Take welding run & perform the job. (02 hrs) 182. Clean the welding area with suitable tool. (03 hrs) 183. Shut down the plant. (03 hrs) 184. Put accessories in place. (03 hrs)	and their remedies. • Storage and baking of electrode. • Types of cracks. (07 hrs.)
Professional Skill 100 Hrs; Professional Knowledge 28Hrs	Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice. *[Different operations: - plain turning, facing, step turning, through & step drilling].*	185. Enlist tools & machinery required. (06 hrs) 186. Safe shop floor practices& safety. (04 hrs) 187. Personal protective equipment's & their uses. (04 hrs) 188. Mention preventive measures for electrical accidents &steps to be taken. (02 hrs) 189. Operate the given fire extinguisher. (06 hrs) 190. Mention health& environmental guidelines. (03 hrs)	Turning • Safety precautions in industry and shop floor. • Description of parts of lathe and its accessories. PPE's, their application, study of different fire extinguishers, electrical accidents. Their causes, prevention. • First aid, • Definition of machine-tools and its classification. • History and gradual development of lathe. (07 hrs.)
		191. Inspect the given job for rusting, scaling, corrosion. (01 hr) 192. Practice on hammering, chipping & chisel grinding. (02 hrs) 193. Use of precision measuring instruments.	• Method on using precision measuring instruments, verniercalliper, micrometer depth gauges, sine bars, graduations, reading least count. • Brief description of

		(02 hrs) 194. Identify different components of lathe. (02 hrs) 195. Identify lever positions. (02 hrs) 196. Perform lubrication at various lubricating point. (06 hrs) 197. Cut a round bar in power saw (06 hrs) 198. Mount the check on machine spindle & unload. (04 hrs)	different types of hand tools hammers. • Chisel-material, types and their uses. Study of marking tools, outside, inside callipers, center punch, prick punch, scriber types and uses. Chucks their types, uses, methods, of jobholding in chuck. • Lubrications and maintenance of lathe, lubrications points. • Vice- types and uses classification of lathe in function and construction of different parts of lathe. (07 hrs.)
		199. Identify cutting tools & angles. (01 hr) 200. Hold the job in three jaw chuck. (02 hrs) 201. Perform trueing operation on the given job. (04 hrs) 202. Perform facing operation on job to correct length. (06 hrs) 203. Carryout plain turning operation on job as per drawing specifications. (06 hrs) 204. Perform step turning operation on job as per specification. (06 hrs)	• Lathe cutting tools- different types, shapes and different angles. • Lathe accessories- brief description of Centre, mandrel, catch plate, face plate. • Different operations- performed on lathe-facing, plain turning step turning etc. (07 hrs.)
		205. Identify drill bits. (02 hrs) 206. Draw any drill bit & name its various parts. (04 hrs)	• Parts of drills-name and their function, tang, shank, etc.

		207. Prepare MS flat as per the specification. (04 hrs) 208. Coat the given job. (02 hrs) 209. Perform marking &punching on the job. (04 hrs) 210. Select drill bit. (02 hrs) 211. Perform through drilling on the job. (06 hrs) 212. Remove drill bit & job and place in position. (01 hr)	• Cutting angle of drills. • Types and sizes of drill, their specification. • Cutting angles of drill clearance angle, rake angle.(07 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Plan, identify & perform different operation – Experiments related to safety & gen. awareness in chemical industries. (Diff. operations – Select &operate proper fire extinguisher as per demand, identify chemicals hazards, PPE'S , read & obtain relevant data).	213. Importance of trade in industry. (05 hrs) 214. Importance of PPE's. (04 hrs) 215. Safety signs for danger. (04 hrs) 216. Illustrate basic first aid. (04 hrs) 217. Practice on maintenance documentation. (04 hrs) 218. Prepare MSDS of common chemicals used in chemical industries. (04 hrs)	Maintenance • Role of maintenance mechanic in chemical industries. • General safety in industry. • Study of PPE's and safety equipment, their application. • Work permit system • Material safety data sheet (MSDS). • Standard operating procedures. (SOP) (07 hrs.)
		219. Types of fire & fire extinguishers. (02 hrs) 220. Demonstration about fire extinguisher. (03 hrs) 221. Demonstration Fire fighting. (03 hrs) 222. Demonstration about Fire & smock alarm system. (02 hrs) 223. Disposal of workshop waste material like cotton waste, chips. (05 hrs)	• Fires-their types, prevention and control. • Fire triangle. • Classification of fire. • Fire fighting equipments – Fire extinguisher, fire bucket, fire blanket, Hydrant system. • Fire-alarm, smoke, fume. • Environmental pollution. • Types of pollution-noise, water air, their resources

		224. Housekeeping &workshop cleaning. (05 hrs) 225. Show PPT on pollution control and 5's concept. (05 hrs)	and control, permissible limits. • Importance of good shop practices ISO standards. • Introduction of 5s, concept of their application. (07 hrs.)
Professional Skill 100Hrs; Professional Knowledge 28 Hrs	Identify different types of tools in fitting workshop, Types of fasteners on locking devices, arranged & perform different operations in shop. (Operations – making key ways, scraping & lapping of surfaces.)	226. Identify various fitting tools. (04 hrs) 227. Identify precision measuring instruments. (04 hrs) 228. Measure depth of the given opening with suitable instrument. (04 hrs) 229. Perform calculations. (04 hrs) 230. Identify files. (02 hrs) 231. Draw parallel line on the job with odd leg calliper. (04 hrs) 232. Check level of the machine with spirit level. (03 hrs)	• Description & application of different fitting workshop tools-files, chisel, punch, scribers, callipers, etc. their specifications & use. • Methods of measurement, with spirit levels • Marking block, scribers, micrometers.(07 hrs.)
		233. Identify locking devices. (02 hrs) 234. Perform positive locking with castle nut & split-pin. (08 hrs) 235. Name different types of washers. (02 hrs) 236. Prepare inside square fit. (10 hrs) 237. Demonstrate sequence of operation. (03 hrs)	• Fasteners & locking devices- their types, uses &importance. • Definition of limits, fits & tolerance. • Terminology of limits & fits, their basic size Actual size & deviation. (07 hrs.)
		238. Identify types of chisels. (02 hrs) 239. Nam parts of chisels. (02	• Brief description of different type of keys. • Tappers & allowable

		hrs) 240. Select shaft for preparing key-way. (02 hrs) 241. Select chisel for preparing key way as per specification. (03 hrs) 242. Clamp the job. (05 hrs) 243. Perform chipping operation. (08 hrs) 244. Mention safety taken. (03 hrs)	clearance. • Proportion of key depending upon shaft dia. • Repairing of key ways. (07 hrs.)
		245. Mention types of scrapers& their application. (03 hrs) 246. Select a scraper. (02 hrs) 247. Prepare better mating parts for given bush bearing. (05 hrs) 248. Clean the surfaces. (03 hrs) 249. Check the lapping plate for any foreign material. (02 hrs) 250. Select abrasive. (03 hrs) 251. Perform hand lapping on given flat job. (05 hrs) 252. Care while lapping operation and cleaning surfaces. (02 hrs)	• Description & application of scrapper method of using them • Types of scrappers flat, triangular etc. • Testing the scrapped surfaces, maintain seq. of operation. • Lapping – necessary importance, types of abrasives. • Lapping methods and tools for external, internal and flat surface. (07 hrs.)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Identify & select lagging materials and apply same in accordance with job condition – hot / cold.	253. Cut thermocol sheet of required length. (04 hrs) 254. Insulate given cold pipeline with thermocol. (05 hrs) 255. Retain sheet in position by clamping. (02 hrs) 256. Take required quantity of glass wool. (02 hrs) 257. Insulate hot pipe line. (05	• Lining-importance, necessity required. • Radiation hazards. Corrosion and thermal insulators. • Brief description and application of lead, rubber, FRP and glass lining. • Lagging materials their importance and type of

		hrs) 258. Cut the tin sheet (02 hrs) 259. Coat the glass wool. (03 hrs) 260. Put screws to retain the tin sheet in position. (02 hrs)	application. (07 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Apply range of skills to execute pipe joints, pipe fittings for assembling the line and test for leakages. -	261. Differentiate different pipe joints. (04 hrs) 262. Selects tools required for flanged joint. (02 hrs) 263. Choose suitable gasket sheet. (02 hrs) 264. Cut gasket sheet of required size. (04 hrs) 265. Prepare screwed joint for the pipe line. (06 hrs) 266. Select dia.-die stokes. (02 hrs) 267. Perform threading operation on given pipe line. (04 hrs) 268. State precautions. (01 hr)	• Pipes- knowledge of different pipe materials their specification. • Brief description of different type of pipe joints such as screwed joint, flanged joints etc. • Standard pipe threads, BSP. (07 hrs.)
		269. Identify pipe fittings. (04 hrs) 270. Install given pipe fitting and assemble the pipe line. (06 hrs) 271. Close one end of the pipeline with appropriate pipe fitting. (04 hrs) 272. Cut the gasket as per flange size. (08 hrs) 273. Prepare blind flange on pipeline. (03 hrs)	• Fluid mechanics- definition and types of fluid. • Compressible and incompressible • Knowledge of different types of pipe fittings –Tee, bend, elbow, etc. • Specification of pipe fittings and their applications. • Material of construction, • Gasket-types, uses. (07 hrs.)
Professional	Identify, describe, install different types	274. Identify flow meters. (02 hrs)	• Variable area meters, their principle of operation,

Skill 50 Hrs; Professional Knowledge 14 Hrs	of flow meter, carry out flow measurements &record readings. (Flow meter – Rota meter, Ventury meter, Orifice meter)	275. Install manometer. (04 hrs) 276. Put manometric fluid. (01 hr) 277. Measure differential pressure. (02 hrs) 278. Note down readings. (02 hrs) 279. Install Rotameter. (04 hrs) 280. Measure flow rates and corresponding float positions. (04 hrs) 281. Take readings. (02 hrs) 282. Calibrate. (02 hrs) 283. Safety measures and precaution. (02 hrs)	construction and working. • Measurement of reading • Eye positioning. (07 hrs.)
		284. Identify the orifice meter. (02 hrs) 285. Install orifice meter on given pipeline. (06 hrs) 286. Install manometer. (04 hrs) 287. Measure differential pressure for various flow rates. (04 hrs) 288. Collect the liquid discharged for a specific time. Calculate flow rates. (04 hrs) 289. Calibrate the readings. (04 hrs) 290. Safety measures to be taken. (01 hr)	• Differential pressure measurement. • Knowledge of different types of flow meter. • Description of variable head meters as orifice meter. (07 hrs.)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Identify, select dial gauge, it's construction, parts, graduations, care & use for checking flatness of job.	291. Install given venturimeter. (04 hrs) 292. Install manometer. (02 hrs) 293. For different flow rates-measure differential	• Venturimeter-principle of operation, construction, working, calculation formulas and their coefficients. • Dial gauge indicator,

		pressure. (04 hrs) 294. Measure the volume collected for a specific time. Calculate flow rates. (04hrs) 295. Calibrate the readings. (02 hrs) 296. Identify the dial gauge indicator. (02 hrs) 297. Clamp the dial gauge. (04 hrs) 298. Check flatness with dial gauge indicator. (03 hrs)	construction, its parts, material construction. • Application, care and maintenance of dial gauge. (07 hrs.)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Identify and install / connect instruments / devices to measure pressure, temp., flow & level, record readings. (Instruments / Devices - bourden tube, capsule type gauge, mercury in glass, bimetallic thermometer, RTD, Orifice, venturi, Rotameter, sight glass type, Air purge type & capacitance type level indicator.	299. Identify thermometers. (02 hrs) 300. Measure temperature with thermocouple. (06 hrs) 301. Determine level with the help of float type level indicator. (02 hrs) 302. Note down float position. (02 hrs) 303. Measure volume of container. (04 hrs) 304. Calculate quantity of liquid in containers. (02 hrs) 305. Connect the bourdon tube. (02 hrs) 306. Measure the pressure. (02 hrs) 307. Note down readings. (03 hrs)	Basic Instrumentation • Study of basic instruments for measuring temperature pressure, level and flow. (07 hrs.)
Project Work/ Industrial Training			

SYLLABUS FOR MAINTENANCE MECHANIC (CHEMICAL PLANT) TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 25Hrs; Professional Knowledge 09Hrs	Carryout testing of different types of maintenance- Online, Predictive, Preventive and break down and frequent record keeping.	308. Illustrate different type of maintenance. (04 hrs) 309. Differentiate between preventive & breakdown maintenance. (04hrs) 310. Safe shop floor practices &safety. (04hrs) 311. P.P.E.s, their uses.(03hrs) 312. Check machines for any uneven sound. (02hrs) 313. Explain check list. (04hrs) 314. Maintenance record of equipment. (04hrs)	Maintenance • Maintenance – definition. • Types of maintenance. • Advantage of preventive maintenance. • Breakdown maintenance disadvantages. • Making of check list. (09 hrs)
Professional Skill 100 Hrs; Professional Knowledge 36 Hrs	Plan, dismantle, trouble shoot, clean & reassemble different mechanical components for power transmission & check their functionality.	315. Importance of lubrication.(03hrs) 316. Explain characteristics of good lubricant. (04hrs) 317. Name different lubrication system. (04hrs) 318. Select appropriate lubricant forgiven job. (03hrs) 319. Apply lubricant. (03hrs) 320. Safety observed. (04hrs) 321. Protective equipment's used during lubricant application. (04hrs)	• Lubricant– Definition. • Quality of good lubricant. • Selection of good lubricant. • Methods of lubrication systems. (09 hrs)
		322. Demonstrate importance of bearing's in workshop industry. (05 hrs)	Bearing • Classification of different types of bearings.

		323. Illustrate different types of bearings. (05 hrs) 324. Identify different parts of given bearings. (05 hrs) 325. Safe way of handling bearing. (05 hrs) 326. Precautions while mounting and un-mounting on shafts. (05 hrs)	• Bush bearing, solid bearing, ball bearing, self-alignment bearing etc. Thrust bearing, roller bearing their construction. • Application, care and handling of bearings. (09 hrs)
		327. Inspect shaft mounted bearing. (02hrs) 328. Select proper size bearing puller.(02hrs) 329. Set the puller on the jobby proper positioning of its parts.(04hrs) 330. Perform bearing removal operation.(04hrs) 331. Clean bearing and apply proper lubricant.(02hrs) 332. Select appropriate size of ball bearing.(02hrs) 333. Ensure that pressing block, fitting sleeve etc. Are free of burrs.(04hrs) 334. Mount bearing on shaft by standard procedure with proper tools.(04hrs) 335. Check the bearing for free movement. (01hr)	• Methods of fitting and removing of bearing. • List of tools required for the operation. • Care and handling tools. (09 hrs)
		336. Check the gear box physically, note down the defects.(04 hrs) 337. Mark relative positions of parts using punch etc.(04 hrs) 338. Dismantle gears box by removing it's parts gear	Gear • Types of gears-spur gear, helical gear, bevel gear, worm gear. • Their use and care. • Types of gear boxes. (09 hrs)

		keys, nut bolts etc.(05 hrs) 339. Clean all its parts. (04 hrs) 340. Check for any damages and replace if necessary. (03 hrs) 341. Assemble all parts as markings sequentially. (05 hrs)	
Professional Skill 25Hrs; Professional Knowledge 09Hrs	Identify leakage and replace or repair relevant gasket or gland packing.	342. Inspect given pipeline flange.(02 hrs) 343. Select appropriate gasket material. (03 hrs) 344. Select tools for working.(02 hrs) 345. Carryout necessary if any marking operation. (04 hrs) 346. Select cutting tool.(02 hrs) 347. Perform gasket cutting operation. (05 hrs) 348. Perform punching operation with required tool. (02hrs) 349. Place gasket in position. (03 hrs) 350. Properly tight of flange. (02 hrs)	• Types of gasket and gland packing's. • Material of construction. • Application. (09 hrs)
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	Identify different types of valve, their specific application. Carry out overhauling procedure for different types of valve.	351. Dismantle gate valve using proper hand tools.(02hrs) 352. Check controlling elements for damages, take necessary action. (01hr) 353. Clean, Lubricant, replace gland packing.(01hr) 354. Reassemble valve	Valves: • Differentiate their types and applications. • Principal, Construction, Operating and working of gate valve, globe valve, needle valve. • Their maintenances and troubleshooting. (09 hrs)

		sequentially and check for leakage.(02hrs) 355. Dismantle globe valve with required hand tools. (02hrs) 356. Perform lubrication elements for damages. (02hrs) 357. Perform lubrication, cleaning and replace gland packing. (02hrs) 358. Reassemble all Globe valve and check it for leakage. (02hrs) 359. Dismantle given needle valve. (02hrs) 360. Remove lock nut, bonnet and inspect threads on the stem at terminal ends and vice–versa. (02hrs) 361. Clean all parts with kerosene oil. (04hrs) 362. Reassemble Needle valve and check for proper Functioning. (03hrs)	
		363. Take ball valve and remove its hand wheel, gland nut, bonnet etc. (02hrs) 364. Remove stem. (01hr) 365. Observe parts for any damage, seepage.(02hrs) 366. Clean all parts with appropriate solvent.(02hrs) 367. Reassemble sequentially. (02hrs) 368. Dismantle given plug	Valves: • Differentiate their types and applications. • Principal, Construction, Operating and working of Ball valve, Plug valve, NRV, PSV • Their maintenances and troubleshooting. (09 hrs)

		valve.(02hrs) 369. Remove stem and controlling device. (02hrs) 370. Inspect parts for damage. (01hr) 371. Clean the parts with solvent. (01hr) 372. Reassemble and check for functioning. (02hrs) 373. Take NRV & dismantle parts with suitable tools. (02hrs) 374. Check for hinge & disk. (02hrs) 375. Clean inner part with kerosene. (02 hrs) 376. Reassemble &check for its proper functioning. (02hrs)	
		377. Study construction details, operating & working of diaphragm valve. (02hrs) 378. Select appropriate tools and remove hand wheel bonnet etc. (02hrs) 379. Inspect diaphragm for any damage, take necessary action. (02hrs) 380. Reassemble sequentially and check for proper functioning. (03hrs) 381. Study construction details, operating & working of butterfly valve and remove gland flange by suitable tools. (02hrs) 382. Check ropes and rotate the handle to see	Valves: • Differentiate their types and applications. • Principal, Construction, Operating and working of Diaphragm valve, Butterfly valve, Control valve. • Their maintenances and troubleshooting. (09 hrs)

		tightness of ropes. (02hrs) 383. Replace the gland flange. (02hrs) 384. Check disc movement and locking arrangement. (02hrs) 385. Study the parts of control valve. (02hrs) 386. Dismantle and check for damage/replacement. (02hrs) 387. Reassemble sequentially. (04hrs)	
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	Plan, dismantle, trouble shoot, clean & reassemble different machine, pumps & components for transportation of liquid and check their functionality.	388. Check the centrifugal pump physically and note down the defects.(02hrs) 389. Remove the end cover using proper tools.(03hrs) 390. Remove the impeller gently. (02hrs) 391. Check for key/keyway. (02 hrs) 392. Check the shaft for any kind of damages or play.(03 hrs) 393. Remove gland cover & check for gland packing and replace if required. (04hrs) 394. Check bearing for play. (02hrs) 395. Clean all parts with solvent. (02hrs) 396. Assemble all parts sequentially.(03hrs) 397. Replace gasket/oilpaper if damage & fitend cover. (01hr) 398. Check for proper	Pumping Device for Liquid Centrifugal Pump • Classification of pumps. • Working principal, Construction details, Operating & working, uses of centrifugal pump. • Definition of NPSH • Head vs. capacity relation • Starting & shutting down procedure. • Cavitations& Priming • Maintenance of pump • Trouble shooting. • Types(volute/ diffuser ring type) • Types of impeller • Advantages & disadvantages. (018 hrs)

		functioning (01 hr)	
		399. Check &inspect the test rig. (01hr) 400. Collect the necessary apparatus. (02hrs) 401. Set valve at a certain position &switch on the centrifugal pump.(01hr) 402. Attain steady state. (01hr) 403. Inspect and note down the head developed. (02hrs) 404. Collect the discharge for certain time interval.(02hrs) 405. Calculate the volumetric flow rate. (02hrs) 406. Conduct the procedure for different valve positions & calculate flow rates. (07hrs) 407. Co-relate head developed and capacity of the pump. (04hrs) 408. Interpret the graph of head vs. capacity. (03 hrs)	
		409. Check &inspect reciprocating pump physically not down for any defect.(03hrs) 410. Mark relative positions of parts. (02hrs) 411. Dismantle piston rod, cylinder, and valve assembly.(05hrs) 412. Check NRV'S for proper functioning/ replace it for any warn out parts.	Positive Displacement Pump Reciprocating Pump • Classification of pumps. • Working principal, Construction details, Operating &working, uses of centrifugal pump. • Starting & shutting down procedure. • Maintenance of pump • Trouble shooting.

		(03hrs) 413. Check inside cylinder wall. (02hrs) 414. Check piston head / piston ringer place if necessary. (03hrs) 415. Lubricate moving parts. (02hrs) 416. Assemble all parts sequentially. (05hrs)	• Types(Plunger/ Piston and Single acting / Double acting) • Advantages & disadvantages. (09 hrs)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Verify and plot the graphs for characteristic curve of different types of pump such as centrifugal pump and gear pump.	417. Check the gear pump physically note down for any defects. (01hr) 418. Mark relative positions of gear mesh, body. (01hr) 419. Remove lower casing wear plate, seal ring.(02hrs) 420. Remove drive shaft gear, idle shaft gear, load ring, seal ring.(02 hrs) 421. Coat seals with sealing grease.(01 hrs) 422. Assemble sequentially. (03 hrs) 423. Check alignment of drive & idle shaft.(01 hrs) 424. Check &inspect test ring for gear pump.(01 hrs) 425. Collect apparatus required. (01 hrs) 426. Check inlet &outlet valve, set discharge valve at certain opening position.(01 hr) 427. Switch on the gear pump. (01 hr)	Rotary Pump • Working principal, Construction details, Operating &working, uses of centrifugal pump. • Starting & shutting down procedure. • Maintenance of pump • Trouble shooting. • Types(Gear pump, Screw pump, Lobe pump) • Advantages & disadvantages (09 hrs)

		428. Attain steady state.(01 hr) 429. Note down, head developed by the pump. (01 hr) 430. Collect discharge volume for specific time interval. (01 hr) 431. Calculate Volumetric flow rate.(01 hr) 432. Conduct same procedures for different valve positions. (02 hr) 433. Co-relate head developed capacity of the pump. (01 hr) 434. Interpret the graph of head against capacity of pump. (1 hr) 435. Inspect, clean all components & replace if damaged. (02 hrs)	
		436. Inspect Lobe pump physically. (01hr) 437. Close suction delivery valves. (02hrs) 438. Remove pump cover. (01hr) 439. Remove lobe screw, check “o” ring. (02hrs) 440. Remove job.(02hrs) 441. Dis-assemble mechanical seal.(02hrs) 442. Remove Allen screws, rotor case.(01hr) 443. Remove casing seal ring. (02hrs) 444. Remove stud bolt,	

		Inspect "o" ring & seashore-use. (02 hrs) 445. Inspect rotor for any damage. (02hrs) 446. Inspect burro rotor bolt, grooves.(01 hr) 447. Make sure that pump housing &gear box are clean.(01hr) 448. Reassemble sequentially. (06hrs)	
Professional Skill 25Hrs; Professional Knowledge 09Hrs	Overhaul and troubleshooting of vacuum pump and checking for proper functioning.	449. Switch off power supply & disconnect motor.(01hr) 450. Drain installation within pump area.(02hrs) 451. Remove key, hexagonal bolts, bearings cover, and bearing safely. (04hrs) 452. Unscrew hexagonal bolt and remove stuffing box. (02hrs) 453. Pullout mechanical seal. (02hrs) 454. Unscrew nut and takeout casing.(02 hrs) 455. Open lock nut and pullout rotor. (01hr) 456. Remove control plate. (01hr) 457. Clean all parts carefully and observe sealing and guide disc for any kind of grooves. (04hrs) 458. Coat running surface by sealing gasket. (02hrs) 459. Carryout assembling procedure sequentially. (03hrs) 460. Turn shaft by hand to	Vacuum Pump • Definition of vacuum pump and it's utilisation in chemical industries. • Working principal, construction details, operating & working, and maintenance. • Types - Water and steam jet ejector, Water / Oil Ring vacuum pump • Procedure for vacuum line up and vacuum break up. (09 hrs)

		ensure that pump runs freely before restarting. (01hr)	
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Identify and Check functionality of Power Transmission Device, Belt, Pulleys.	461. Identify the misalignment of motor and pump. (03hrs) 462. Clean the pump and motor. (03hrs) 463. Check and find out the type of parallel misalignment. (04hrs) 464. Move the motor and pump shaft closer to each other and tighten. (04hrs) 465. Keep the straightedge and observe the gap between the straightedge surface and coupling surface. (03 hrs) 466. If gap is found. Adjust provided suitable shim in between basement and gearbox/motor. (02hrs) 467. Keep the straightedge at the rear/front side of the motor pump and observe the gap. (02hrs) 468. If the gap is found. Adjust it by moving the motor. (04hrs)	Power transmission Couplings. • Types of couplings– muff coupling, flange coupling, type coupling. • Application of couplings. (09 hrs)
		469. Select correct size of puller depending upon the size of the shaft and pulley. (01hr) 470. Clean and of the shaft using flat file. To remove any burrs or bulging on the end of the shaft. (02 hrs)	Power transmission Pulleys and Belts. • Size & specification • Belt material • Selection of belt • Load & belt tension • Advantages & disadvantages of belts. (09 hrs)

		471. Place the legs of the puller, diagonally opposite sides of the pulley to hold the pulley firmly. (02hrs) 472. Complete removal of the pulley from the shaft. (01hrs) 473. Apply few drops of oil around the shaft before removing.(01hrs) 474. Tighten the centre screw grandly using correct size spanner and check whether the pulley is coming-out freely from the shaft. (02hrs) 475. Remove burr from the key way in the shaft and the hub. (02hrs) 476. Select a gib head key of the correct section and length. (05 hrs) 477. Fit key with a firm blow with hammer. (02hrs) 478. Measure the longest span length of belt between the pulleys using a steel tape. (01hrs) 479. Find the middle of the longest span of the belt between the pulleys.(01hrs) 480. Push this midpoint inwards then pull tout & note the total reflection. (02hrs) 481. Loosen the lock nuts. (01hrs)	

		482. Tighten the clapping bolt. (01hrs) 483. Tighten the lock nuts. (01hrs)	
Professional Skill 25Hrs; Professional Knowledge 09Hrs	Plan and perform method of Alignment of pulley, shaft, motor, coupling by thread, straight edge, laser system.	484. Familiarization with terms.(02hrs) 485. Learn about machine to be aligned.(02hrs) 486. Carryout sag check.(02hrs) 487. Prepare the machine. (02hrs) 488. Clean mounting surface, file of burrs.(02hrs) 489. Carryout all measurements. (02hrs) 490. Logout graph paper. (04 hrs) 491. Carry preliminary horizontal move. (01hrs) 492. Check off soft foot.(02hrs) 493. Perform vertical moves. (01hrs) 494. Rectify the error.(02hrs) 495. Tight all bolts and recheck indicator reading.(02hrs) 496. Remove alignment brackets. (01hrs)	Alignment of pump • Causes and effects of misalignment • Methods of testing misalignments • Alignment by two dial gauge. • Advance laser alignment techniques. (09 hrs)
Professional Skill 25Hrs; Professional Knowledge 09Hrs	Identify major function of mechanical seals, select and install the same on a pump shaft, discuss care and it's maintenance.	497. Clean and inspect pump parts.(02hrs) 498. Check assembly drawing prior to installation. (02hrs) 499. Remove surface flange, end cover and impeller.(01hrs) 500. Remove gland nuts and gland flange. (01hrs) 501. Orient position of spring	Mechanical seal. • Types of seal. • Material of seal. • Application of mechanical seal. • Oil seals specification. (09 hrs)

		locating collar and mark the same. (02 hrs) 502. Takeout mechanical seal components i.e. Carbon seal, seal cage, rubber seal, gland flange, slingers etc. Sequentially and note down the same. (04hrs) 503. Inspect and clean all parts, check for any damages. (02hrs) 504. Place back flange on shaft and fit the ceramic seal and rest of the assembly. (03hrs) 505. Fit the spring retainer. (02 hrs) 506. Position the spring with its locking collar. (02hrs) 507. Compress gland against stuffing box. (01hrs) 508. Rotate shaft manually to ensure seal is not in bind. (01hrs) 509. Inspect after bringing to the operating conditions. (02hrs)	
Professional Skill 25Hrs; Professional Knowledge 09Hrs	Identify Machinery handling and their installation as per standard procedure, it's planning & implementation.	510. Lift the machine using crowbars. (02hrs) 511. Place the wooden block under the load. (02hrs) 512. Lower the load on the wooden block. (01hr) 513. Place suitable rollers under the load.(02hrs) 514. Remove the wooden blocks from the bed.(02hrs) 515. Check the route of the	• Machinery installation. • Receiving. • Foundation. • Levelling • Installation. • Grouting. • Trail. (09 hrs)

		machine movement and ensure that itis free of obstruction .(02hrs) 516. Push the machine forward slowly with the crowbars. (02hrs) 517. Select suitable anti-vibration pads – depending upon the weight of the machine. (02hrs) 518. Prepare foundation plan forgiven machine. (02hrs) 519. Layout of foundation for given machine.(02hrs) 520. Escalate soil for foundation.(01hrs) 521. Prepare template for foundation. (01hrs) 522. Prepare concrete for foundation.(03hrs) 523. Fixing of foundation bolts. (01hrs)	
Professional Skill 25Hrs; Professional Knowledge 09Hrs	Identify major parts and function of pressure vessel, various pipe fittings, valves, parameters, its care and safety precaution.	524. Inspect the pressure vessel physically. (02hrs) 525. Examine system components including structural attachment and vessel connections. (04 hrs) 526. Identify evidence of leakage or inadequate insulation. (02hrs) 527. Check pressure, reset devices for leakages if any, and rectify the same. (03hrs) 528. Conduct an internal	Pressure vessel • Their types • Care and maintenance • Lifting devices • Working of– chain block, screw jack, hydraulic jack. • Material handling devices • Working of - hand trolley, fork lift etc. (09 hrs)

		inspection for corrosion and wear around nozzles, vessel connections, external fittings or controls. (03hrs) 529. Carryout necessary rectification steps. (04hrs) 530. Keep valve protection caps in place until ready to use. (01hrs) 531. Conduct pressure test for appropriate pressure, (02hrs) 532. Carryout preventive maintenance, determined by the manufacturer. (02hrs) 533. Records all maintenance as per norms for repairs and alternations (R1, R2). (02 hrs)	
Professional Skill 75Hrs; Professional Knowledge 27Hrs	Plan, dismantle, trouble shoot, clean & reassemble different machine & components for transportation of Gases and check their functionality.	534. Operate Reciprocating Compressor. (02 hrs) 535. Remove belt on pulley and check physically. (01hrs) 536. Study Construction details of R. 537. Trouble searching before dismantling. (02 hrs) 538. Safety precautions and Housekeeping, Area cleaning while dismantling. (01hrs) 539. Dismantling. (02 hrs) 540. Trouble searching after dismantling. (02 hrs) 541. Trouble shooting. (02 hrs) 542. Cleaning and Overhauling. (02 hrs)	Utility : Pumping Device for Gas • Compressor • Compressed air and it's utilization in chemical industries. • Type of compressor • Reciprocating Compressor • Working Principal of Reciprocating Compressor • Application, construction, operating, working & maintenance of single stage and multistage reciprocating compressor. (09 hrs)

		543. Reassembling. (02 hrs) 544. Empty running and checking. (01 hr)	
		545. Operate Centrifugal Compressor. (02 hrs) 546. Remove belt on pulley and check physically. (01 hrs) 547. Study Construction details (02 hrs) 548. Trouble searching before dismantling. (02 hrs) 549. Safety precautions and Housekeeping, Area cleaning while dismantling. (01 hrs) 550. Dismantling. (02 hrs) 551. Trouble searching after dismantling. (02 hrs) 552. Trouble shooting. (02 hrs) 553. Cleaning and Overhauling. (02 hrs) 554. Reassembling. (02 hrs) 555. Empty running & Checking. (01 hrs)	• Centrifugal Compressor • Working Principal of Centrifugal Compressor • Type of compressor • Application, construction, operating, working & maintenance of Centrifugal Compressor. (09 hrs)
		556. Operate Screw Compressor and Lobe Compressor. (02 hrs) 557. Study working. (02 hrs) 558. Study Construction details. (02 hrs) 559. Trouble searching before dismantling. (02 hrs) 560. Safety precautions and Housekeeping, Area cleaning while dismantling. (01 hr) 561. Dismantling (02hrs) 562. Trouble searching after dismantling. (02 hrs)	Screw and Lobe Compressor • Working Principal of Screw and Lobe Compressor • Type of compressor • Application, construction, operating, working & maintenance. (09 hrs)

		563. Trouble shooting. (02 hrs) 564. Cleaning and Overhauling. (02 hrs) 565. Reassembling.(02hrs) 566. Empty running & Checking. (01 hrs)	
		567. Operate Fan and blower. (01hrs) 568. Study working. (02 hrs) 569. Study Construction details. (02 hrs) 570. Trouble searching before dismantling. (02 hrs) 571. Safety precautions and Housekeeping, Area cleaning while dismantling. (01 hrs) 572. Dismantling. (02 hrs) 573. Trouble searching after dismantling. (02 hrs) 574. Trouble shooting. (02 hrs) 575. Cleaning and Overhauling. (02 hrs) 576. Reassembling. (02 hrs) 577. Empty running & checking. (01 hrs)	Fan • Working principal, uses, construction details, working and it's maintenance. Blower • Working principal, uses, construction details, working and it's maintenance. (09 hrs)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Plan, dismantle, trouble shoot, clean & reassemble Air dryers & Air filters.	578. Study working and types of filter. (02hrs) 579. Study Construction details. (02 hrs) 580. Dismantling. (03hrs) 581. Trouble searching after dismantling. (02 hrs) 582. Trouble shooting. (02 hrs) 583. Cleaning and Reassembling. (02 hrs) 584. Study working and types of Air Dryer. (02 hrs) 585. Study Construction details.	• Air treatment - Introduction, RH, Dew point, water trap, Air filters-dry filter, wet filter, coarse filter, micro filter, pressure regulator. • Air dryers-classification, components of a typical compresses air system. (09 hrs)

		(02 hrs) 586. Trouble searching before dismantling. (02 hrs) 587. Dismantling (02 hrs) 588. Trouble shooting. (02 hrs) 589. Cleaning and Reassembling. (02 hrs)	
		590. Operate Cooling Tower pump. (02 hrs) 591. Study working of Cooling Tower. (02 hrs) 592. Study Construction details (02 hrs) 593. Trouble searching before dismantling pump. (02 hrs) 594. Safety precautions and Housekeeping, Area cleaning while dismantling. (01 hrs) 595. Dismantling ID fan and Cooling Tower pump. (02 hrs) 596. Trouble searching after dismantling. (02 hrs) 597. Trouble shooting. (04 hrs) 598. Remove Scale formation and Overhauling Cooling Tower pump and ID fan. (02 hrs) 599. Reassembling.(04 hrs) 600. Checking. (02 hrs)	COOLING TOWER: • Water(Cooling, child, hot, D I) • Construction, types& uses of cooling tower. • Trouble& trouble shooting. • Scale formation, preventive maintenance. • De foaming agent.(09 hrs)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Plan, dismantle, trouble shoot, clean scale formation & reassemble Electrode &Oil fired boiler and identify various operating parts.	601. Operate Electrical Boiler. (02 hrs) 602. Study working. (02 hrs) 603. Study Construction details. (02 hrs) 604. Trouble searching before dismantling. (02 hrs) 605. Safety precautions and	STEAM GENERATION • Steam &its types. • Types of boiler, • Electrode Boiler • Mountings & accessories. • Types of draught, • Working Principal of

		Housekeeping, Area cleaning while dismantling. (01 hrs) 606. Dismantling Boiler and make up pump. (02 hrs) 607. Trouble searching after dismantling. (02 hrs) 608. Trouble shooting. (04 hrs) 609. Remove Scale formation and overhauling make up pump. (02 hrs) 610. Reassembling.(04 hrs) 611. Checking. (01 hrs) 612. Check steam trap for proper functioning (01 hrs)	Electrode Boiler. • Application, construction , operating , working & maintenance, trouble & trouble shooting • Scale formation. • Types of Electrode. • Types of steam trap. • Panel control system (09 hrs)
		613. Operate Oil fired Boiler. (02 hrs) 614. Study working. (02 hrs) 615. Study Construction details. (02 hrs) 616. Trouble searching before dismantling. (02 hrs) 617. Safety precautions and Housekeeping, Area cleaning while dismantling. (01 hr) 618. Dismantling Ignition system. (02 hrs) 619. Trouble searching after dismantling. (02 hrs) 620. Trouble shooting. (04 hrs) 621. Remove Scale formation and overhauling oil pump. (02 hrs) 622. Reassembling. (04 hrs) 623. Checking. (02 hrs)	Oil fired Boiler • Working Principal of Oil fired Boiler • Application, construction, operating, working & maintenance, trouble & trouble shooting • Types of fuel • Scale formation. • Ignition system • Panel control system (09 hrs)
Professional Skill 25Hrs;	Identify different types of refrigerant & it's uses in chemical	624. Study of Refrigeration system. (02 hrs) 625. Study of Refrigerant, its	REFRIGERATION: • Definition of Refrigerant • Types of refrigerant and its

Professional Knowledge 09Hrs	industries and dismantle Air handling unit for cleaning and troubleshooting with due care and safety.	types and properties. (02 hrs) 626. Study of vapor absorption and vapor compression. (02 hrs) 627. Handling of Refrigerants. (02 hrs) 628. Maintenance of Refrigeration unit. (03hrs) 629. Study of Air Handling Unit system. (02 hrs) 630. Maintenance of AHU system. (02hrs) 631. Trouble searching. (03 hrs) 632. Trouble shooting. (04 hrs) 633. Cleaning (02 hrs) 634. Housekeeping and area & equipment cleaning. (01 hr)	properties, • Handling of refrigerant, (09 hrs)
Professional Skill 25Hrs; Professional Knowledge 09Hrs	Plan, dismantle, trouble shoot, clean, overhaul & reassemble Hydraulic jack and check oil level for their functionality.	635. Operate Hydraulic Jack and Hydraulic Trainer. (02 hrs) 636. Study working. (02 hrs) 637. Study Construction details. (02 hrs) 638. Trouble searching before dismantling. (02 hrs) 639. Safety precautions and Housekeeping, Area cleaning while dismantling. (01 hrs) 640. Dismantling Hydraulic Jack. (02 hrs) 641. Trouble searching after dismantling. (02 hrs) 642. Trouble shooting. (04 hrs) 643. Check oil level and grade. (02 hrs) 644. Reassembling.(04 hrs) 645. Checking. (02 hrs)	HYDRAULICS: • Basic principal of Hydraulics • Inherent physical properties of liquids, comparison of molecular structure of solids, liquids & gases, • Basic terms &definition in hydraulics i.e. Force, Pressure, Work, Viscosity, Pascal's law, Hydraulic jack] (09 hrs)

Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Identify, Plan, dismantle, trouble shoot, clean & reassemble different types of Heat exchangers and check functionality.	646. Study Types and uses of heat exchanger. (02 hrs) 647. Study working of Shell & Tube Heat Exchanger. (02 hrs) 648. Study Construction details. (02 hrs) 649. Trouble searching before dismantling. (02 hrs) 650. Safety precautions and Housekeeping, while dismantling. (01 hr) 651. Dismantling. (03 hrs) 652. Trouble searching after dismantling. (02 hrs) 653. Trouble shooting. (04 hrs) 654. Cleaning shell and tube side. (02 hrs) 655. Reassembling.(04 hrs) 656. Checking. (01 hrs)	HEAT TRANSFER: • Definition Heat transfer. • Mode of heat transfer. • Heat exchanger equipment's (condenser, cooler, chiller, boiler, heat recovery boiler, re-boiler) • Types of heat exchanger (double pipe HE, shell& tube HE,) • Advantage disadvantage of the Shell & Tube Heat Exchanger.(09 hrs)
		657. Study Construction details of Vertical Evaporator. (01 hrs) 658. Trouble searching. (02 hrs) 659. Safety precautions and Housekeeping, Area cleaning while dismantling. (02 hrs) 660. Dismantling. (02 hrs) 661. Trouble shooting. (02 hrs) 662. Cleaning scale formation. (02 hrs) 663. Reassembling. (04 hrs) 664. Checking. (02 hrs) 665. Preparation before operating (02 hrs) 666. Start up of Vertical Evaporator (02 hrs) 667. Study working. (02 hrs)	EVAPORATION: • Definition – Evaporation & Condensation. • Working principal, construction details, operating & working, its maintenance. • Types of evaporator. • Triple effect evaporator. • Trouble& trouble shooting. (09 hrs)

		668. Checking. (02 hrs)	
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Plan, dismantle, troubleshoot, clean and reassemble components in different types of distillation column.	669. Study Construction details of Distillation column. (03hrs) 670. Safety precautions and Housekeeping, Area cleaning while dismantling. (02hrs) 671. Dismantling. (04 hrs) 672. Trouble searching after dismantling. (02 hrs) 673. Trouble shooting. (05 hrs) 674. Cleaning and refilling of pickings in column. (03 hrs) 675. Refitting of various pipe line (02 hrs) 676. Reassembling.(02 hrs) 677. Column startup & Checking. (02 hrs)	DISTILLATION: • Definition • Method & types of distillation. • Distillation column. • Types of column (packed & plate) • Construction details, operating &working,. Its maintenance, trouble& trouble shooting. • Types of pickings and plate • Channeling (09 hrs)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Identify different types of filtration unit and carry out its maintenance and trouble shooting.	678. Study Construction details of Plate & Frame Filter. (01 hr) 679. Trouble searching. (02 hrs) 680. Safety precautions and Housekeeping, Area cleaning while dismantling. (02 hrs) 681. Dismantling. (02 hrs) 682. Trouble shooting. (02 hrs) 683. Cleaning scale formation on plate & frame and filter cloth. (02 hrs) 684. Reassembling.(03 hrs) 685. Preparation before operating. (02 hrs) 686. Start filtration.(02 hrs) 687. Study working. (02 hrs) 688. Check MLR clarity. (02 hrs) 689. Washing with relevant	FILTRATION: • Definition, • Filtration media& Filter aid. • Filtration equipment (plate &filter, rotary vacuum filter, centrifuge, Buckner filter, nuetch filter, ANFD, sparkler filter) • Working principal, construction details, operating & working, its maintenance, Trouble& Trouble shooting.(18 hrs)

		solvent. (01 hr) 690. Air drying (01 hr) 691. Collect the cake. (01hr) 692. Study Construction details of Centrifuge. (01 hr) 693. Trouble searching. (02 hrs) 694. Safety precautions and Housekeeping, Area cleaning while dismantling. (02 hrs) 695. Dismantling. (02 hrs) 696. Trouble shooting. (02 hrs) 697. Cleaning scale formation. (02 hrs) 698. Reassembling. (04 hrs) 699. Checking. (02 hrs) 700. Preparation before operating. (02 hrs) 701. Startup of Vertical Evaporator. (02 hrs) 702. Study working. (02 hrs) 703. Checking. (02 hrs)	
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Identify different types of Dryer used for loading wet material in tray dryer and carryout its maintenance, trouble shooting for checking proper functionality.	704. Study Construction details of Tray Dryer. (01 hrs) 705. Trouble searching. (02 hrs) 706. Safety precautions and Housekeeping, Area cleaning. (02 hrs) 707. Trouble shooting. (02 hrs) 708. Cleaning scale formation on tray. (02 hrs) 709. Checking. (02 hrs) 710. Preparation before operating tray dryer. (02 hrs) 711. Material loading in tray. (02 hrs) 712. Arrange tray. (02 hrs) 713. Start air drying. (02 hrs)	DRYING: • Definition, • Drying equipment (tray dryer, Rotary dryer, Spray dryer, FBD, RCVD). • Working principal, construction details, operating & working, its maintenance, Trouble& Trouble shooting. • Sampling plan • Loading & unloading material. Re-drying.(09 hrs)

		714. Start heating. (01 hrs 715. Sampling program. (01 hr) 716. Material unloading.(02 hrs) 717. Cleaning & housekeeping. (02 hrs)	
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Identify term size reduction and operate size reduction machine (Hammer mill, Ball mill). Carry out size analysis with proper screening equipment's &their maintenance.	718. Study working of Hammer mill& ball mill. (02 hrs) 719. Study Construction details. (02 hrs) 720. Trouble searching before dismantling. (02 hrs) 721. Safety precautions and Housekeeping, Area cleaning while dismantling. (02hrs) 722. Dismantling. (04 hrs) 723. Trouble searching after dismantling. (02 hrs) 724. Trouble shooting. (03 hrs) 725. Cleaning and Overhauling. (02 hrs) 726. Reassembling.(04hrs) 727. Empty running & Checking. (02 hrs)	Size Reduction: • Definition, • Advantages of size reduction, • Crushing& Grinding, • Classification, • Equipment's (Blake jaw crusher, Hammer mill, Ball mill, Multimill, Rodmill) • Working principal, construction details, operating & working, its maintenance, Trouble& Trouble shooting.**(09 hrs)**
		728. Study working of Vibratory sieve shaker (02 hrs) 729. Study Construction details. (02 hrs) 730. Trouble searching before dismantling. (02 hrs) 731. Safety precautions and Housekeeping.(02hrs) 732. Dismantling. (04 hrs) 733. Trouble searching after dismantling. (02 hrs) 734. Trouble shooting. (04hrs) 735. Cleaning and Overhauling. (02 hrs) 736. Reassembling.(03 hrs)	SCREENING: • Definition, • Screening equipment (Sieve shaker, vibratory sifter, ultrasonic vibratory sifter) • Working principal, construction details, operating & working, its maintenance, Trouble& Trouble shooting. • Types of sieves • Mesh number • % efficiency of sieve

		737. Empty running & Checking. (02 hrs)	**(09 hrs)**
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Identify different types of term mixing & agitation. Dismantle, troubleshoot, clean and maintenance of different mechanical components.	738. Study working of Agitator. (02 hrs) 739. Study Construction details. (02 hrs) 740. Trouble searching before dismantling. (02 hrs) 741. Safety precautions and Housekeeping. (02hrs) 742. Dismantling. (04 hrs) 743. Trouble searching after dismantling. (02 hrs) 744. Trouble shooting. (04hrs) 745. Cleaning and Overhauling Mechanical seal. (02 hrs) 746. Reassembling.(03 hrs) 747. Empty running & Checking. (02 hrs)	MIXER & AGITATORS: • Definition • Types of mixer • Types of agitators, • Application and construction of agitators. • Vortex • Baffled **(09 hrs)**
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Identify Specification of different types of conveyor belts, construction details, materials used and carry out its operations, maintenance, troubleshooting.	748. Study working of Belt Conveyor. (03 hrs) 749. Study Construction details. (03 hrs) 750. Trouble searching before dismantling. (03hrs) 751. Safety precautions and Housekeeping, Area cleaning while dismantling. (02 hrs) 752. Trouble shooting. (05hrs) 753. Cleaning and Overhauling of drive & driven roller. (04 hrs) 754. Checking integrity of belt.(03 hrs) 755. Empty running & Checking. (02 hrs)	Conveyor • Types of conveyor – Belt conveyor, Bucket conveyor, Screw conveyor, Pneumatic conveyor. • Selection of conveyor. • Working principal, construction details, operating & working, its maintenance, Trouble& Trouble shooting. (09 hrs)
Project work / Industrial Visit			