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# **APPRENTICESHIP CURRICULUM**

## **For**

# **OPERATOR ADVANCED CHEMICAL PLANT**

## **Under**

# **RUBBER SECTOR**

1	<b>Program Title:</b>	OPERATOR ADVANCED CHEMICAL PLANT		
2	<b>Program Code, if any:</b>	N A		
3	<b>Duration for theory (Block I)</b>	500 Hrs. (3 months)		
4	<b>Duration for On the Job Training (Block II)</b>	4000 Hrs. (21 months)		
5	<b>Certifying body for theory component</b>	Gharda Chemicals Ltd		
6	<b>Certifying Body for On the Job training/practical component</b>	Gharda Chemicals Ltd		
7	<b>Minimum eligibility criteria (Educational Qualification and/or technical Qualification and Experience)</b>	Minimum 10 pass with Science subject		
8	<b>Trainer's Qualification and Experience</b>	Degree / Diploma in Chemical Technology/ Engineering from recognized University with two years' experience in the relevant field.		
9	<b>Indicative list of training tools required to deliver this qualification</b>	Refer Annexure A		
10	<b>Formal structure of the curriculum</b>			
	<b>BASIC TRAINING BLOCK 1</b>			
	<b>Module Name with duration</b>	<b>Theory hours</b>	<b>Practical hours</b>	<b>Total Hrs</b>
	Safety in Chemical plant (40 hr)	25 hr	15 hr	40 hr
	Basic Physics and Chemistry (40 hr)	30 hr	10 hr	40 hr
	Study of Utilities (50 hr)	30 hr	20 hr	50 hr
Study of different equipment (100 hr)	40 hr	60 hr	100 hr	

	Pipes and piping (30 hr)	10 hr	20 hr	30 hr
	Basic Maintenance (130 hr)	50 hr	80 hr	130 hr
<b>ON THE JOB TRAINING BLOCK 2</b>				
	<b>Module Name with duration</b>	<b>Theory hours</b>	<b>Practical hours</b>	<b>Total Hrs</b>
	Equipment and machinery operations (1800 hr)	200	1600	1800
	Valves and Pumps (500 hr)	120	380	500
	Heat Exchanger (500 hr)	50	450	500
	Cooling Tower operation (500 hr)	50	450	500
	Analysis and Titration (350 hr)	50	300	350
	Calibration (175 hr)	25	150	175
	Testing of equipment (175 hr)	25	150	175
<b>11</b>	<b>Total Pass marks</b>			
		<b>Pass Marks- Theory</b>	<b>Pass Marks- Practical</b>	
	<b>Basic Training Program</b>	20 out of 50 marks	60 out of 100 marks	
	<b>On the Job Training Program</b>	40 out of 100 marks	180 out of 300 marks	

12	<p><b>Job description –</b></p> <ol style="list-style-type: none"> <li>1. Familiarization with the manufacturing processes and machines used for manufacturing various chemicals.</li> <li>2. Familiarisation with basic concepts of Physics and Chemistry and application of the same in Industry.</li> <li>3. Operating various equipment like Mixer, Crystallizer, Vacuum filters, Dryers, Reactors etc.</li> <li>4. Operating various checking and measuring equipment used for Quality of Product.</li> <li>5. Familiarization of utilities, Colour coding of Pipelines and valves.</li> </ol>
13	<p><b>Employment avenues/opportunities</b></p> <ol style="list-style-type: none"> <li>1. Agriculture Industry.</li> <li>2. Laboratories carrying out quality checks for different chemical products.</li> <li>3. Chemical Industries manufacturing products like pesticides, petroleum chemical products.</li> <li>4. Industries manufacturing chemicals for cosmetics and beauty care.</li> </ol>
14	<b>Curriculum update version and date 3 DEC 2018</b>
15	<b>Curriculum revision date 1 DEC 2020</b>

## Curriculum

### I. Theory components (Block I)

Sr. No.	Module Name	Key Learning outcomes
<b>Basic Training Program- Block I</b>		
1	Safety in Chemical plant Theory duration: 25:00 hr Practical Duration 15:00 hr	<ul style="list-style-type: none"> <li>• Identify of Safety equipment.</li> <li>• Use Fire Extinguishers and PPEs.</li> <li>• Apply concept of MSDS in Chemical Industry.</li> <li>• Define Certification of Analysis, TDS, and Standard Operating procedures.</li> </ul>
2	Basic Physics and Chemistry  Theory Duration 30:00 hr Practical Duration: 10:00 hr	<ul style="list-style-type: none"> <li>• Define terms like pressure, temperature etc.</li> <li>• Define Units – conversion of units.</li> <li>• Define basics of Atoms and Molecules.</li> <li>• Define basics of Organic Chemistry.</li> <li>• Prepare different Flow sheets.</li> <li>• Prepare Process block diagram (PBD), process flow diagram (PFD), PID.</li> </ul>

3	<p>Study of Utilities Theory Duration 30:00 hr Practical Duration: 20:00 hr</p>	<ul style="list-style-type: none"> <li>• Study and use various utilities like cooling water, electricity, Chilled water etc. used for processing, cooling, controlling etc.</li> <li>• Demonstrate various processes.</li> </ul>
4	<p>Study of different equipment Theory Duration 40:00 hr Practical Duration: 60:00 hr</p>	<ul style="list-style-type: none"> <li>• Define and apply knowledge of different Linear Measuring Instruments - Vernier Caliper, Vernier Depth gauge, Height gauge, Micrometer, Bevel protector.</li> <li>• Identify the instruments.</li> <li>• Use of the instruments on shop floor.</li> </ul>
5	<p>Pipes and piping Theory Duration 10:00 hr Practical Duration: 20:00 hr</p>	<ul style="list-style-type: none"> <li>• Describe different job holding devices such as vice, V' Block.</li> <li>• Study different pipes used in chemical industry for liquid and gases flow and transportation.</li> <li>• Study and identify Colour coding of pipes.</li> <li>• Identify inside material, direction of flow etc.</li> </ul>
6	<p>Basic Maintenance  Theory Duration 50:00 hr  Practical Duration: 80:00 hr</p>	<ul style="list-style-type: none"> <li>• Study and use different hand tools such as Files, Chisels, Hacksaw &amp; Hammer</li> <li>• Study and use different marking tools such as steel rule, caliper, punches, v-block, scribing block etc.</li> <li>• Apply different maintenance equipment, Apply different hand tools for effective working on shop floor.</li> <li>• Demonstrate use of tee, elbow, union, reducer and valves to fit a pipeline as per drawing</li> <li>• Apply knowledge of appropriate locking devices-Lock nut, castle nut, sawn nut, locking pin, spring lock washer.</li> <li>• Dismantle, clean and assembling various assembled units such as gate valve, globe valve, and check valve.</li> </ul>
7	<p>Employability Skills  Theory Duration 110:00 hr</p>	<ul style="list-style-type: none"> <li>• Apply English Literacy</li> <li>• Apply I.T. Literacy</li> <li>• Practice effective Communication Skills</li> <li>• Apply Entrepreneurship Skills</li> <li>• Demonstrate Productivity</li> <li>• Apply knowledge of Occupational safety , health and Environment Education</li> <li>• Describe Labour Welfare Legislation</li> <li>• Apply Quality Tools</li> </ul>

## II. Practical/On the job Training component (Block II)

Sr. No	Module Name	Key Learning outcomes
<b>On the Job Training Program- Block II</b>		
1	<p>Equipment and machinery operations</p> <p>Theory Duration 200:00 hr</p> <p>Practical Duration: 1600:00 hr</p>	<ul style="list-style-type: none"> <li>• Hands on experience on various advanced equipment and machinery used on shop floor.</li> <li>• Demonstrate Basic Safety in handling the equipment.</li> <li>• Define and measure specific gravity. Working principle of Hydrometer. Construction and working of final control element(Control valve)</li> <li>• Differentiate between Unit operations &amp; Unit Processes.</li> <li>• Apply important chemical processes. Terms related to Unit processes - Raw material, finished product, by-product, conversion, yield, batch process, continuous process.</li> <li>• Define different symbols of unit operations and its applications.</li> <li>• Define Pressure vessels terminology - ASME, API, design pressure, design temperature, operating conditions and hydrostatic test. Corrosion allowance. Material of construction.</li> <li>• Define different types of storage vessels-Storage of non-volatile, volatile liquids, storage of gases. Fixed or cone roof tanks, Floating roof tanks, cone roof with floating pan</li> <li>• Describe different raw materials, chemical reactions, process description, flow sheet, uses of caustic soda ammonia, ethyl alcohol, Sulphuric acid etc.</li> <li>• Apply and learn different types of equipment uses for leaching oil extraction from oil seeds</li> <li>• Describe various equipment used for absorption – columns, factors affecting rate of absorption, tower packing, flooding and flooding velocity.</li> <li>• Use different types of crystallizers.</li> <li>• Describe different filters like plate and frame Filter Press, rotary drum vacuum filter. Working of Sparkler filter, leaf filter, notch filter</li> <li>• Describe and demonstrate mixing equipment</li> <li>• Demonstrate mixing solid-solid, solid-liquid, solid-gas</li> <li>• Define and prevent water pollution, air pollution Define OD,BOD,TDS,TSS</li> </ul>

		<ul style="list-style-type: none"> <li>Identify different Fertilizers, its types &amp; uses</li> <li>Apply Aliphatic hydrocarbons Halogen derivatives of hydrocarbons – aliphatic alcohol, Ethers, Aldehydes, Ketones, Carboxylic acid. Amides &amp; Anhydride, Acid Halides Esters Oil &amp; Fats. Soaps &amp; Detergents.</li> </ul>
2	<p>Valves and Pumps</p> <p>Theory Duration 120:00 hr</p> <p>Practical Duration: 380:00 hr</p>	<ul style="list-style-type: none"> <li>Define units, conversion of units.</li> <li>Classify pressure measuring instruments - Bourdon type, Capsule type, and Helical type bellows type, diaphragm type pressure gauges.</li> <li>Operate different kinds of valves used in piping system. Knowledge of Function of each valve.</li> <li>Derive Head v/s Capacity curve of different pumps.</li> <li>Classify flow measuring instruments - orifice, venturimeter, Rota meter, pitot tube, turbine type flow meter</li> <li>Classify pumps.</li> <li>Demonstrate use of different types of pumps.</li> <li>Describe and identify leakages around moving parts- stuffing box and mechanical seal and methods to prevent it.</li> <li>Troubleshoot pumps.</li> <li>Start and stop centrifugal pump</li> <li>Draw Characteristic curves of pumps -- plot of actual head, total power consumption, and efficiency Vs volumetric flow rate.</li> <li>Demonstrate and use Types of centrifuge.</li> </ul>
3	<p>Heat Exchanger</p> <p>Theory Duration 50:00 hr</p> <p>Practical Duration: 450:00 hr</p>	<ul style="list-style-type: none"> <li>Classify temperature measuring instruments-Mercury in glass thermometer, bimetallic thermometer, RTD thermometer (PT-100), Thermocouple etc.</li> <li>Operate Heat transfer equipment, different types of Heat exchangers, coolers, condenser and chillers. Shell and tube heat exchanger- Plate type heat exchanger</li> <li>Calculate the heat transfer rate.</li> </ul>
4	<p>Cooling Tower operation</p> <p>Theory Duration 50:00 hr</p> <p>Practical Duration: 450:00 hr</p>	<ul style="list-style-type: none"> <li>Define Heat Transfer in solid, liquid and gases.</li> <li>Describe Fourier's law.</li> <li>Operate cooling tower.</li> <li>Apply Safety precautions in cooling tower</li> <li>Apply basic knowledge of the Theory, equilibrium moisture content, drying rate, constant rate period, falling rate period factor affecting rate of drying.</li> <li>Use dryers.</li> </ul>

5	<p>Analysis and Titration</p> <p>Theory Duration 50:00 hr</p> <p>Practical Duration: 300:00 hr</p>	<ul style="list-style-type: none"> <li>• Apply concept of distillation, boiling point diagrams, vapour-liquid equilibrium, and equilibrium curves. Renault's law, Henry's law, relative volatility, constant boiling mixtures- minimum &amp; maximum azeotropes</li> <li>• Apply concept of Flash differential, rectification and azeotrope, extractive, vacuum, steam distillation.</li> <li>• Calculate Reflux ratio: minimum, total and optimum.</li> <li>• Identify Types of trays / plates</li> <li>• Demonstrate Volumetric analysis, Oxidation / Reduction titration.</li> <li>• Apply concept of choice of solvent, distribution coefficient. Equipment used for extraction, Packed and perforated plate towers.</li> <li>• Apply extractions.</li> <li>• Apply adsorption,</li> <li>• Derive atomic &amp; molecular equivalent weight. Percentage of elements in chemical compounds Empirical formulae of chemical compounds. Electrolysis. Analysis, volumetric analysis.</li> </ul>
6	<p>Calibration</p> <p>Theory Duration 25:00 hr</p> <p>Practical Duration: 150:00 hr</p>	<ul style="list-style-type: none"> <li>• Define fluid, ideal fluid, real fluid, compressible fluid, incompressible fluid. Properties of fluid-viscosity, mass density, surface tension. Manometer, Reynold's Number, Equation of continuity, Bernoulli's theorem</li> <li>• Calibrate different gauges used on shop floor.</li> <li>• Perform testing of thermometer, pressure gauges.</li> </ul>
7	<p>Testing of equipment</p> <p>Theory Duration 25:00 hr</p> <p>Practical Duration: 150:00 hr</p>	<ul style="list-style-type: none"> <li>• Perform testing of thermocouple, pyrometer etc.</li> <li>• Apply Digital viscometer to determine viscosity of a liquid.</li> <li>• Apply knowledge of Orifice meter, venturi meter, Rota meter, pivot tube, flow nozzle.</li> </ul>



## Annexure A

### Attachment: List of Tools and Equipment

<b>A: Trade Details</b>					
<b>Sr.</b>	<b>Particulars</b>				
1	Name of the Trade	<b>OPERATOR ADVANCED CHEMICAL PLANT</b>			
2	Duration (In Semester):	4			
3	Intake:	30 per shift			
6	Space Required (in Sq. Meter):	150 sq. m.			
7	Power Required (in KW):	13			
<b>B: Workshop/ Lab Furniture</b>					
<b>Sr.</b>	<b>Name of Item</b>	<b>Category</b>	<b>Qty</b>	<b>Unit</b>	<b>Remark</b>
1	Drum - 100 Litres (Optional)	Equipment	1	Number	Per 1 Unit in a Shift
2	Dust Bin - 50 litres (Optional)	Equipment	1	Number	Per 1 Unit in a Shift
3	Black/ White Board with Stand - 4 X 3 Feet	Furniture	1	Number	Per 1 Unit in a Shift
4	Book Shelf/ Glass Shelf	Furniture	1	Number	Per 1 Unit in a Shift
5	Discussion Table/ Working Table = L:W:H = 8:4:3 Feet - Heavy Wooden Top	Furniture	1	Number	Per 1 Unit in a Shift
6	Instructor/ Office Chair	Furniture	2	Number	Per 1 Unit in a Shift
7	Instructor/ Office Table	Furniture	1	Number	Per 1 Unit in a Shift
8	Notice Board - 2 X 3 Feet	Furniture	1	Number	Per 1 Unit in a Shift
9	Steel Almira - Large (Optional)	Furniture	2	Number	Per 1 Unit in a Shift
10	Steel Locker - 12 Pigeon Hole	Furniture	2	Number	Per 1 Unit in a Shift
11	Steel Rack (Optional)	Furniture	1	Number	Per 1 Unit in a Shift
12	Stool - Height 450 mm	Furniture	10	Number	Per 1 Unit in a Shift

**C: Workshop/ Lab Infrastructure (Tools, Equipment's, Machines, etc.)**

Sr.	Name of Item	Category	Qty	Unit	Remark
1	Safety shoes ( Regular size )	Consumable	17	Number	Per 1 Unit in a Shift
2	Safety Goggles	Consumable	17	Number	Per 1 Unit in a Shift
3	Safety hand gloves leather ( Regular size )	Consumable	17	Number	Per 1 Unit in a Shift
4	Ear plug	Consumable	17	Number	Per 1 Unit in a Shift
5	Helmet	Consumable	2	Number	Per 1 Unit in a Shift
6	Fire Extinguishers ( C02 , )	Equipment	1	Number	Per 3 Unit in a Shift
7	Fire Extinguishers ( Dry Chemical powder )	Equipment	1	Number	Per 3 Unit in a Shift
8	Sand bucket	Equipment	2	Number	Per 3 Unit in a Shift
9	Fire blanket	Equipment	2	Number	Per 3 Unit in a Shift
10	First Aid Kit	Consumable	1	Number	Per 1 unit.
11	Hammer - Ball Peen - 250 grams	Tool	6	Number	Per 3 Unit in a Shift
12	Hammer - Ball Peen - 500 grams	Tool	6	Number	Per 3 Unit in a Shift
13	Screw Driver - 9 X 300 mm	Tool	4	Number	Per 3 Unit in a Shift
14	Drill Twist Set - Straight Shank - 3 mm to 13 mm by 0.5 mm	Tool	1	Number	Per 3 Unit in a Shift
15	Drill Twist Set - Tapper shank 12 to 25 mm	Tool	1	Number	Per 3 Unit in a Shift
16	Double Ended Spanner set Metric 6*7 to 30*32	Tool	1 set	Number	Per 3 Unit in a Shift
17	Pipe wrench 14"	Tool	1 set	Number	Per 3 Unit in a Shift
18	Combination Plier	Tool	2	Number	Per 3 Unit in a Shift
19	Tap set –M 8, M10 M12	Tool	2	Number	Per 3 Unit in a Shift

20	Solid die 10/12 mm with die stock	Tool	2	Number	Per 3 Unit in a Shift
21	Gauge Screw Pitch - Metric -0.25 to 6 mm	Equipment	1	Number	Per 3 Unit in a Shift
22	Wire Gauge - Metric	Equipment	1	Number	Per 3 Unit in a Shift
23	Allen Key Set - Hexagonal - 1 - 12 mm, set of 12 Keys	Tool	1	Number	Per 3 Unit in a Shift
24	Vernier Caliper - 0 - 200 mm with least count 0.02mm	Equipment	1	Number	Per 3 Unit in a Shift
25	Vernier Height Gauge - 0 - 300 mm with least count = 0.02 mm	Equipment	1	Number	Per 3 Unit in a Shift
26	Instrument for determining 'g' (Simple Pendulum)	Equipment	1	Number	Per 3 Unit in a Shift
27	Searle's Apparatus for young's Modulus	Equipment	2	Number	Per 3 Unit in a Shift
28	Calorimeter for determining Joule's mechanical Equivalent of heat by electric method	Equipment	1	Number	Per 3 Unit in a Shift
29	Apparatus for measurement of co-efficient of expansion(thermal) of solid (plunger's apparatus)	Equipment	2	Number	Per 3 Unit in a Shift
30	Apparatus for measurement of thermal conductivity of good and bad conductors	Equipment	1	Number	Per 3 Unit in a Shift
31	Resistance box 0 to 500 ohms	Equipment	2	Number	Per 3 Unit in a Shift
32	Specific Gravity bottle 25 cc	Consumable	2	Number	Per 3 Unit in a Shift
33	Rods with screw at one end for Electrochemical equivalent 1) Carbon 2) Zinc 3) Copper	Consumable	2	Number	Per 3 Unit in a Shift
34	Multi meter(digital)	Equipment	2	Number	Per 3 Unit in a Shift
35	Milli voltmeter 1) 0 - 5mv 2) 0- 500mv	Equipment	2	Number	Per 3 Unit in a Shift
36	Digital Stop Watch 1/10	Equipment	1	Number	Per 3 Unit in a

	Second				Shift
37	pH Meter Digital	Equipment	1	Number	Per 3 Unit in a Shift
38	Steam generator (copper) Cap. 1000ml	Equipment	2	Number	Per 3 Unit in a Shift
39	Burette clamp	Equipment	12	Number	Per 3 Unit in a Shift
40	Bunsen Burners	Equipment	8	Number	Per 3 Unit in a Shift
41	Tripods Stand	Equipment	8	Number	Per 3 Unit in a Shift
42	Weight Balance up to 10 kg	Equipment	1	Number	Per 1 Unit
43	Asbestos wire gauge	Consumable	8	Number	Per 3 Unit in a Shift
44	Gauge Wire without asbestos	Consumable	8	Number	Per 3 Unit in a Shift
45	Burettes 25ml boroflow	Consumable	8	Number	Per 3 Unit in a Shift
46	Pipettes 10ml	Consumable	8	Number	Per 3 Unit in a Shift
47	H.D.P. Distil water bottle	Consumable	8	Number	Per 3 Unit in a Shift
48	Clamp holders	Consumable	12	Number	Per 3 Unit in a Shift
49	Stands with clamps for burette	Equipment	12	Number	Per 3 Unit in a Shift
50	Triangles clay	Consumable	8	Number	Per 3 Unit in a Shift
51	Measuring cylinder 250 ml Glass	Consumable	8	Number	Per 3 Unit in a Shift
52	Measuring cylinder 500 ml Glass/ Plastic	Consumable	8	Number	Per 3 Unit in a Shift
53	Measuring cylinder 1000 ml Glass/ Plastic	Consumable	8	Number	Per 3 Unit in a Shift
54	Volumetric flask 100 ml	Consumable	8	Number	Per 3 Unit in a Shift
55	Volumetric flask 500 ml	Consumable	8	Number	Per 3 Unit in a Shift
56	Volumetric flask 1000 ml	Consumable	8	Number	Per 3 Unit in a

					Shift
57	Funnels Dia 7.5cms	Consumable	8	Number	Per 3 Unit in a Shift
58	Beaker 250ml corning	Consumable	8	Number	Per 3 Unit in a Shift
59	Beaker 500 ml corning	Consumable	8	Number	Per 3 Unit in a Shift
60	Bottles for solutions 1000 ml	Consumable	6	Number	Per 3 Unit in a Shift
61	Bottles for solutions 2000 ml	Consumable	6	Number	Per 3 Unit in a Shift
62	Bottles for solutions 500 ml	Consumable	6	Number	Per 3 Unit in a Shift
63	Conical flask –500 ml	Consumable	16	Number	Per 3 Unit in a Shift
64	Conical flask - 250 ml	Consumable	16	Number	Per 3 Unit in a Shift
65	Evaporating dish - 50 ml	Consumable	12	Number	Per 3 Unit in a Shift
66	Watch Glass - 3" dia.	Consumable	8	Number	Per 3 Unit in a Shift
67	Tong - Flat - 300 mm	Equipment	8	Number	Per 3 Unit in a Shift
68	Spatula - 8"	Consumable	8	Number	Per 3 Unit in a Shift
69	Distilled water still 10 lit.	Equipment	1	Number	Per 3 Unit in a Shift
70	Glass test tubes - 15 ml	Consumable	50	Number	Per 3 Unit in a Shift
71	Round Bottom Distillation flask with side neck 500ml	Consumable	6	Number	Per 3 Unit in a Shift
72	Condenser for distillation leg 30 cm long	Consumable	6	Number	Per 3 Unit in a Shift
73	Rubber cork of ( 2.5 cm, 3cm) size Various size	Consumable	10	Number	Per 3 Unit in a Shift
74	Rubber Tubing (ID- 5mm) 8 / 10 ml	Consumable	10	Meter	Per 3 Unit in a Shift
75	Rubber Bulbs for pipettes	Consumable	6	Number	Per 3 Unit in a Shift
76	Fire alarm system with	Equipment	1	Number	Per 3 Unit in a

	sprinkler system				Shift
77	Gas detector with air tight chamber	Equipment	1	Number	Per 3 Unit in a Shift
78	Bourdon tube(C-type) pressure gauge	Equipment	1	Number	Per 3 Unit in a Shift
79	Capsule type pressure gauge	Equipment	1	Number	Per 3 Unit in a Shift
80	R.T.D. thermometer PT100	Equipment	1	Number	Per 3 Unit in a Shift
81	Venturimeter, orifice meter, rota meter test rig	Equipment	1	Number	Per 3 Unit in a Shift
82	Capacitance Level indicator	Equipment	1	Number	Per 3 Unit in a Shift
83	Sight glass level indicator	Equipment	1	Number	Per 3 Unit in a Shift
84	Hydrometer	Equipment	1	Number	Per 3 Unit in a Shift
85	Final control element (control valves) Pneumatically & Electrically	Equipment	1	Number	Per 3 Unit in a Shift
86	Centrifugal pump.	Equipment	1	Number	Per 3 Unit in a Shift
87	Gear pump	Equipment	1	Number	Per 3 Unit in a Shift
88	Screw pump	Equipment	1	Number	Per 3 Unit in a Shift
89	Bearing removing and fitting kit	Equipment	1	Number	Per 3 Unit in a Shift
90	Gear box	Equipment	1	Number	Per 3 Unit in a Shift
91	Reynold's equipment	Equipment	1	Set	Per 3 Unit in a Shift
92	Centrifugal pump test rig	Machine	1	Number	Per 3 Unit in a Shift
93	Gear pump test rig	Machine	1	Number	Per 3 Unit in a Shift
94	Reciprocating pump test rig	Machine	1	Number	Per 3 Unit in a Shift
95	Apparatus for determine	Machine	1	Number	Per 3 Unit in a

	Frictional losses in straight pipe , pipe fitting				Shift
96	Double pipe Heat exchanger	Machine	1	Number	Per 3 Unit in a Shift
97	Shell and Tube heat exchanger	Machine	1	Number	Per 3 Unit in a Shift
98	Plate type heat exchanger	Machine	1	Number	Per 3 Unit in a Shift
99	Rising and falling film evaporator	Machine	1	Number	Per 3 Unit in a Shift
100	Triple effect evaporator	Machine	1	Number	Per 3 Unit in a Shift
101	Packed distillation tower.	Machine	1	Number	Per 3 Unit in a Shift
102	Sieve plate distillation column.	Machine	1	Number	Per 3 Unit in a Shift
103	Mixer-settler type extractor	Machine	1	Number	Per 3 Unit in a Shift
104	spray extraction column	Machine	1	Number	Per 3 Unit in a Shift
105	Packed tower of glass for flooding velocity experiment	Machine	1	Number	Per 3 Unit in a Shift
106	Batch type tank crystallizer	Machine	1	Number	Per 3 Unit in a Shift
107	Plate and frame filter press	Machine	1	Number	Per 3 Unit in a Shift
108	Rotary drum vacuum filter	Machine	1	Number	Per 3 Unit in a Shift
109	Bottom driven centrifuge	Machine	1	Number	Per 3 Unit in a Shift
110	Sparkler filter	Machine	1	Number	Per 3 Unit in a Shift
111	Leaf filter	Machine	1	Number	Per 3 Unit in a Shift
112	Notch filter	Machine	1	Number	Per 3 Unit in a Shift
113	Filter papers, PH papers etc.	Consumable	As reqd	Number	Qty as required in lab
114	Absorption And Stripping	Machine	1	Number	Per 3 Unit in a

	Equipment				Shift
115	Tray dryer/ Spray Dryer	Equipment	1	Number	Per 3 Unit in a Shift
116	Rotary drum drier	Machine	1	Number	Per 3 Unit in a Shift
117	Blake jaw crusher	Machine	1	Number	Per 3 Unit in a Shift
118	Hammer mill	Machine	1	Number	Per 3 Unit in a Shift
119	Ball mill	Machine	1	Number	Per 3 Unit in a Shift
120	Sieve shaker and sieves	Machine	1	Number	Per 3 Unit in a Shift
121	Humidification control equipment with dry and wet bulb Temperature	Equipment	1	Number	Per 3 Unit in a Shift
122	Cooling tower	Machine	1	Number	Per 3 Unit in a Shift
123	Bucket elevator	Machine	1	Number	Per 3 Unit in a Shift
124	Cyclone Separator and water scrubber	Machine	1	Number	Per 3 Unit in a Shift
125	Flash point apparatus	Equipment	1	Number	Per 3 Unit in a Shift
126	Bimetallic thermometer	Equipment	1	Number	Per 3 Unit in a Shift
127	Thermocouple	Equipment	1	Number	Per 3 Unit in a Shift
128	Different types of pipe fittings	Equipment	1	Set	Per 3 Unit in a Shift
129	Locking devices Lock nut , Castle nut	Equipment	1	Set	Per 3 Unit in a Shift
130	Mechanical seal (multiple spring)	Equipment	1	Number	Per 3 Unit in a Shift
131	Redwood viscometer	Equipment	1	Number	Per 3 Unit in a Shift
132	Pitot tube Setup	Equipment	1	Number	Per 3 Unit in a Shift
133	Multistage Reciprocating	Equipment	1	Number	Per 3 Unit in a



	compressor fitted with intercooler & after cooler				Shift
134	Pressure Vessel with all Accessories	Equipment	1	Number	Per 3 Unit in a Shift
135	Batch Reactor Trainer with all Controlling Accessories for product mixing, chemical reaction, distillation etc.	Equipment	1	Number	Per 3 Unit in a Shift
136	Digital Viscometer	Equipment	1	Number	Per 3 Unit in a Shift
137	DCS Kit	Equipment	1	Number	Per 3 Unit in a Shift
138	PLC Kit	Equipment	1	Number	Per 3 Unit in a Shift
139	Common Effluent Treatment Plant laboratory size	Equipment	1	Number	Per 3 Unit in a Shift
140	Petroleum Plant Simulator	Equipment	1	Number	Per 3 Unit in a Shift
141	Cut Model of Different Types pumps	Equipment	1	Number	Per 3 Unit in a Shift
142	Various types of valves like Safety valve, Gate valve, Globe valve, check valve, diaphragm valve, ball valve, needle valve, butterfly valve (Flanged and Thread End) 2"/4" dia	Equipment	Each 1	Number	Per 3 Unit in a Shift
143	Metering Pump	Equipment	Each 1	Number	Per 3 Unit in a Shift