

10. RESOURCE REQUIREMENTS

10.1 Physical Resources

10.1.1 Space requirement

Norms and standards laid down by All India council for Technical Education (AICTE) may be followed to work out space requirement in respect of class rooms, tutorial rooms, drawing halls, laboratories, space required for faculty, student amenities and residential area for staff and students.

10.1.2 Equipment requirement

For three year diploma programme in Chemical Engineering (Pulp and Paper) for student intake of 30, following laboratories and workshops are required corresponding to the curriculum structure suggested by the expert group:

- i) Physics Laboratory
- ii) Chemistry Laboratory
- iii) Mechanical Engineering Laboratory
- iv) Unit Operation and Fluid Mechanics Laboratory
- v) Electrical, Electronics Laboratory
- vi) Heat and Mass Transfer Laboratory
- vii) Pulp Laboratory
- viii) Stock Preparation Laboratory
- ix) Chemical Recovery Laboratory
- x) Paper Testing Laboratory
- xi) Environment Engineering Laboratory
- xii) Instrumentation and Process Control
- xiii) Basic Workshops; Forging; Fitting and Assembly; Carpentry; Welding; Electrical Shop; Molding; Turning, Milling; Advanced Fitting; Grinding Advanced Machine Shop

xiv) Computer Laboratory

The equipment required for laboratories/workshops for (i), (ii), (iii), (v), (xiii) and (xiv) will be as per the standard list approved by All India Council for Technical Education (AICTE). Equipment/Machinery requirement for laboratories/workshops needed for chemical engineering (pulp and paper) course is given in the following pages.

Sr. No.	Particulars	Unit
PAPER TESTING LABORATORY		
1.	Electronics Balance	02
2.	Oven	02
3.	Quadrant Scale Apparatus	01
4.	Template for Quadrant Scale Apparatus	02
5.	Stop Watch	02
6.	Cobb Testing Apparatus	02
7.	Paper Thickness Tester Dead Weight Type (as per TAPPI standard)	01
8.	pH Meter	01
9.	Muffle Furnace	01
10.	Paper Cutter/Template	01
11.	Paper Tensile Tester as per TAPPI standard), Automatically operated	01
12.	Paper Strip Cutter for Tensile Testing	01
13.	Mullen Paper Bursting Strength Tester	02
14.	Paper folding Endurance Tester for Paper	01
15.	Elemendorf Tear Tester for Paper	01
16.	Template/Cutter for Tear Tester	01
17.	Paper Stiffness Tester	01
18.	Infrared and Ultra-violet Lamp	01
19.	Gurley Paper Porosity Tester	02
20.	Bendsten Smoothness Tester	01
21.	Oil Absorption Tester for Paper	01
22.	Photovolt Brightness Tester along with Opacity and Gloss	01
23.	Colour Touch Method Instrument for Measuring Opacity, Fluorescence, CIE Brightness	01
24.	Board/corrugated box crush tester	01
25.	Ink printability tester	01
26.	Air knife coater	01
27.	Paper sheet calendaring equipment	01

28.	Temperature and humidity control system for paper testing laboratory as per TAPPI standard	01
29.	Fluff Tester	01
30.	Quick moisture determination apparatus (electronic type)	01
PAPER STOCK PREPARATION LABORATORY		
31.	Disintegrator for Pulp	01
32.	Valley Beater	01
33.	British Sheet Former	02
34.	Fiber Classifier	01
35.	Double Disc Refiner	01
36.	Degree Shopper Reigler Tester	02
37.	Candian Standard Freeness tester	02
38.	Hydrapulper	01
39.	Drying Rings for BSF Paper Sheet Drying	100
40.	Forced Air Drying Chamber for BSF Sheet Drying	01
HEAT AND MASS TRANSFER LABORATORY		
41.	Double Pipe Heat Exchanger	01
42.	Shell and Tube Heat Exchanger	01
43.	Coiled Evaporator	01
44.	Single Effect Evaporator	01
45.	Boiler House	01
46.	Condenser	01
47.	Open Pan Evaporator	01
48.	Batch Distillation Apparatus	01
49.	Oven	01
50.	Extractor	01
51.	Packed Column	01
52.	Dryer (Tray)	01
53.	Spray Dryer	01
54.	Stem Distillation Apparatus	01
PULP LABORATORY		
55.	Forced Air Circulator Large Size with temperature controller	02
56.	Liquid/Gas Sp. Gravity Meter at Constant Temperature (4°C)	01
57.	Electric Operated Mauffle Furnace Large Size Temperature Range upto 1200°C	02
58.	Laboratory Digester for Wood chips, Pulping along with $\frac{3}{4}$ Autoclave (Rotary Design)	01
59.	Constant Temperature Water Bath along with Agitator and Temperature Controller	01
60.	Brook Field Viscometer DV-III Model	01
61.	Plate Form Type Electronic Balance (5 Kg Capacity)	01

62.	Pulp Defibrator and Screener (Electric Operated)	01
63.	Microscope with 400, 600, 800, 1000 Magnification Power with Photo Camera Attachments	01
64.	Fuming Chamber for Bleaching of Pulp with Chlorine Dioxide/ Chlorine	01
65.	Deep Freezer for Storage of Cooked Pulp	01
66.	Water Distillation Plant	01
67.	Vacuum Pump for Pulp Filtration and Washing of Unblead and Bleached Pulps	01
CHEMICAL RECOVERY LABORATORY		
68.	Electronic Balance for weighing upto 1/10 milligrams (capacity upto 300 gm)	02
69.	Sp. Gravity Meter at Constant Temperature (i.e. at 4°C) along with cooling device	01
70.	Automatic Black Liquor Burning Furnace Sample Capacity (5ml) Temperature 1200 °C	01
71.	Orsat Apparatus	01
72.	ASTM Distillation Apparatus for Black Liquor	01
ENVIRONMENT ENGINEERING LABORATORY		
73.	UV-Visible Spectrophotometer	01
74.	Stack Gas Monitoring Kit	01
75.	Oven with Temperature Controller and Forced Air Circulation Type	01
76.	B.O.D. Incubator	01
77.	Water Aanlysis Kit	01
78.	Gas Composition Analyser	01
79.	Gas Chromotograph	01
80.	High Volume Sampler	01
81.	Electrical Balance for weighing upto 1/10 of milligram (capacity 200 gms)	01
82.	Bomb Calorimeter	01
UNIT OPERATION AND FLUID MECHANICS LABORATORY		
83.	Centrifuge	01
84.	Ball Mill	01
85.	Mixer	01
86.	Roller mill	01
87.	Compressor, Wet Gas Meter, Blower	01
88.	Jaw Crusher	01
89.	Cyclone Separator	01

90.	Plate and frame filter press	01
91.	Sieve shaker	01
92.	Vacuum pumps	01
93.	Packed column (Randomly packed with Raschig Rings)	01
94.	Agitating equipment	01
95.	Particle setting in fluids (Drag coefficient)	01
96.	Sedimentation apparatus (Measuring Cylinder, 1 lt)	01
97.	Determination of Friction loss through pipe	01
98.	Weirs, v-notch	01
99.	Centrifugal pumps, reciprocating pump, gear pump	01
100.	Redwood Viscometer	01
101.	Rotameter, Venturimeter, Orificemeter, pitot tube	01
102.	Globe valve, check valves	01
103.	Gatevalve	01
104.	Reynolds measuring apparatus	01
105.	Rotary Disk Filter, Vacuum Rotary Drum Filter	01
INSTRUMENTATION AND PROCESS CONTROL LABORATORY		
106.	On-off controller	01
107.	Piezo meter	01
108.	LVDT apparatus	01
109.	Light deflection distance meter	01
110.	Strain gauge	01
111.	Displacement meter	01
112.	Pyrometer	01
113.	Optical Pyrometer	01
114.	Thermopiles	01
115.	Resistance thermometer	01
116.	Gas filled thermometer	01
117.	Vapour filled thermometer	01
118.	Bimetallic thermometer	01
119.	Pitot tube	01
120.	Orifice meter	01
121.	Pneumatic gauge	01
122.	Hydraulic gauges	01
123.	Proportional controller	01
124.	Micro processor based distillation column controller, heat exchanger, evaporator	01
125.	Check valve, butter fly valve, blind valve	01
126.	PID, PD and PI controller	01

10.1.3 Furniture requirement

Norms and standards laid down by AICTE may be followed for working out furniture requirement for this course.

10.2 Human Resources

Weekly work schedule, annual work schedule, student teacher ratio for various group and class-size, staffing pattern, workload norms, qualifications, experience and job description of teaching staff, workshop staff and other administrative and supporting staff may be worked out as per norms and standards laid down by the AICTE.