

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**

**COURSE CURRICULUM  
COURSE TITLE: PULP & PAPER TECHNOLOGY  
(COURSE CODE: 3360504)**

<b>Diploma Programme in which this course is offered</b>	<b>Semester in which offered</b>
Chemical Engineering	Sixth

**1. RATIONALE**

Out of total paper produced in the country, 35% paper is produced in Gujarat. Diploma engineers are responsible for ensuring paper quality, improving the efficiency of production and reducing the environmental impact of the industrial paper making process. Engineers apply their skill while working in laboratory, production, research, sales and marketing. Engineers use chemicals such as sodium hydroxide and sodium sulphide to chemically remove lignin from wood. They ensure that paper is produced uniformly in the same colour. This course is to enable the diploma engineer to some extent in accomplish the task of selecting chemicals, laboratory operations for the Pulp and Paper Technology.

**2. COMPETENCY**

The course content should be taught and curriculum should be implemented with the aim to develop required skills in the students so that they are able to acquire following competency:

- **Produce paper of required quality by controlling the process appropriately.**

**3. COURSE OUTCOMES (COs)**

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes:

- Apply basic concepts of pulp and paper technology to produce paper.
- Apply reactions and unit operations steps to manufacture pulp.
- Use reactions and unit operations steps appropriately in manufacturing of paper.
- Use reactions and unit operations appropriately in manufacturing cellulose and various lignin chemicals.
- Apply waste disposal techniques.
- Perform various chemical tests to monitor quality of raw material, output quality and influent/effluent

**4. TEACHING AND EXAMINATION SCHEME**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
3	0	2	5	70	30	20	30	

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

## 5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (In Cognitive Domain)	Topics and Sub-topics
<b>Unit – I Basics of Pulp and Paper Technology</b>	1a. Describe the consumption pattern of different types of paper	1.1 Pulp and paper industry 1.2 Consumption pattern of paper
	1b. Describe cellulose raw material 1c. Identify problems and scope in India	1.3 Cellulose raw material 1.4 Problems and scope of pulp and paper industries in India
<b>Unit – II Pulp</b>	2a. Explain various raw materials	2.1 Raw materials
	2b. Differentiate the various pulping processes	2.2 Pulping process: Sulphite pulping, Semi-chemical pulping, Mechanical and Thermo-mechanical pulping, Secondary fibber pulping, R.A.G. pulping, Dissolving pulp
	2c. Describe the Kraft pulping process with flow diagram	2.3 Kraft pulping process
	2d. Compare various types of pulps 2e. Explain chemical recovery process	2.4 Comparison of different types of pulps 2.5 Black liquor recovery process
<b>Unit –III Paper</b>	3a. Differentiate the features of various raw materials used in paper manufacture	3.1 Types of paper products, Various raw materials: Fibrous and Non-Fibrous
	3b. Describe the Wet process for paper Manufacture with flow diagram	3.2 Wet process for paper Manufacture
	3c. Describe Fourdrinier machine 3d. Describe the economics in paper industry	3.3 Fourdrinier machine 3.4 Economics of paper industry
<b>Unit – IV Cellulose and Lignin Chemicals</b>	4a. Describe the properties of cellulose 4b. Prepare chemical cellulose	4.1 Properties of cellulose 4.2 Preparation of chemical cellulose
	4c. Describe the characteristics of Lignin chemicals 4d. Select cellulose and lignin chemicals	4.3 Lignin chemicals: Types, properties of Di-methyl sulphides and Di- methyl sulfoxide 4.4 Applications of cellulose and Lignin chemicals
<b>Unit – V Waste Disposal Techniques</b>	5a. Analyse pollution potentials of Indian pulp and paper industry	5.1 Pollution potentials of Indian pulp and paper industry
	5b. Interpret the characteristics of industrial Lignin water	5.2 Characteristics of Industrial Lignin water
	5c. Apply bio-technical approach for pollution 5d. Apply Lignin waste treatment.	5.3 Bio-technical approach for pollution 5.4 Enzymology for Lignin waste treatment

## 6. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (Theory)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of Pulp and Paper Technology	4	3	4	0	7
II	Pulp	12	4	12	4	20
III	Paper	10	4	10	3	17
IV	Cellulose and Lignin Chemicals	8	3	6	4	13
V	Waste Disposal Techniques	8	3	6	4	13
<b>Total</b>		<b>42</b>	<b>17</b>	<b>38</b>	<b>15</b>	<b>70</b>

**Legends:** R = Remember, U = Understand, A= Apply and above Level (Bloom's revised taxonomy)

**Note:** This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

## 7. SUGGESTED PRACTICAL / EXERCISES

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes mainly in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

*Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.*

S. No.	Unit No.	Practical/Exercise	Approx. Hours Required
1	II	Undertake qualitative analysis of sodium sulphite	2
2	II	Estimate the amount of lignin by kappa number test	4
3	II	Calculate the moisture content present in wood	2
4	II	Perform pre-hydrolysis of the raw material for pulp	4
5	III	Measure gauge (thickness) of various types of papers	2
6	V	Determine the pH for influent/effluent using different techniques	2
7	V	Determine the COD and DO for influent/effluent	2
8	V	Determine the BOD for influent/effluent	4
9	V	Optimize pH for maximum COD removal for black liquor	4
10	V	Estimate the coagulant dose at optimum pH for maximum COD removal	4

11	V	Determine the total solids and dissolved solids present in influent	2
12	I to V	Prepare the report for pulp and paper production by visiting industry	6
13	I to V	Prepare the model/chart showing different operations and processes involve in pulp and paper industry	2
<b>Total</b>			<b>40</b>
<b>Note:</b> Perform any of the practical exercises from above list for total of minimum 28 hours depending upon the availability of resources so that skills matching with the most of the outcomes of every unit are included.			

## 8. SUGGESTED STUDENT ACTIVITIES

Following is the list of proposed student activities. These could be individual and group based.

- i. Explore internet, visit websites of reputed pulp/paper production companies and prepare ppt presentations on different topics (in group of four-five) and present in class
- ii. Study (in group of four-five) the design of some real pulp/paper production plant and identify good features of design and also weaknesses in it, present in class to have a group discussion.
- iii. Collect samples of different types of paper from market and identify their specifications, further explore their production processes.

## 9. SPECIAL INSTRUCTIONAL STRATEGY (If Any)

- i. Show animations/ videos and drawings/models of pulp and paper production processes
- ii. Arrange visit to nearby paper/pulp production industry
- iii. Arrange expert lectures.

## 10 SUGGESTED LEARNING RESOURCES

### A) Books

Sr. No.	Title of Books	Author	Publication
1	Dryden's outlines of Chemical Technology	Rao, M.Gopal, Sitting, Marshall	Affiliated East-West Press Pvt. Ltd. 3 <sup>rd</sup> Edition
2	Shreves' Chemical Process Industries	Austin, George T.	McGraw-Hill Education India Pvt. Ltd - New Delhi, 5 <sup>th</sup> Edition
3	Environmental Pollution and Control in Chemical Process Industries	Bhatia, S.C.	Second Edition 2011 (ISBN: 8174091068)
4	Pollution Management in Industries	Trivedi, R.K.	Environmental Publication, Karad, India
5	Handbook of Pulping and Papermaking	Biermann, Christopher J.	ISBN-13: 978-0120973620

**B) Major Equipment/Materials with Broad Specification**

- i. Simple micrometer,
- ii. Digital micrometer
- iii. Dilute HCl,
- iv. Concentrated H<sub>2</sub>SO<sub>4</sub>, H<sub>2</sub>S, Charcoal
- v. Laboratory pulping unit/ digester, Digester Volume: 20 Liters, Max Pressure: 20Kg/cm<sup>2</sup>, Max Temperature: 200°C, Pump capacity 20 liters/min
- vi. Centrifuge

**C) Software/Learning Websites**

- i. <http://www.youtube.com/watch?v=E4C3X26dxbM>
- ii. [https://www.google.co.in/?gfe\\_rd=crandei=uwn7U4KME6XO8gfW5YGGCCQandgws\\_rd=ssl#q=paper+making+process+pdfandsafe=off](https://www.google.co.in/?gfe_rd=crandei=uwn7U4KME6XO8gfW5YGGCCQandgws_rd=ssl#q=paper+making+process+pdfandsafe=off)
- iii. [www.unitoperation.com](http://www.unitoperation.com)

**11. COURSE CURRICULUM DEVELOPMENT COMMITTEE****Faculty Members from Polytechnics**

- **Prof. Harsh Shukla**, Lecturer in Diploma Chemical engineering, Shri K. J. Polytechnic, Bharuch
- **Prof. (Miss.) Upasana Singh**, Lecturer in Diploma Chemical engineering, Shri K. J. Polytechnic, Bharuch
- **Prof. (Ms.) Parul K. Patel**, Lecturer in Diploma Chemical engineering, G.P. Gandhinagar
- **Prof. (Ms.) Yaminiben Patel**, Lecturer in Diploma Chemical engineering, G.P. Gandhinagar

**Coordinator and Faculty Members from NITTTR Bhopal**

- **Dr. Abhilash Thakur**, Associate Professor, Department of Applied Sciences
- **Dr. Joshua Earnest**, Professor of Electrical & Electronics Engineering.