Birla Institute of Technology & Science, Pilani
Hyderabad Campus

INSTRUCTION DIVISION
FIRST SEMESTER 2016-2017
Course Handout Part II

Date: 01-08-2016

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : CHE G529
Course Title : Paper and Pulp Technology
Instructor-in-Charge : Dr. Ramesh Adusumalli
Instrcutor: Mrs. P. Lakshmi Sirisha

Scope and Objective of the Course:
This course is aimed to give an overview of pulping processes. Conversion of wood to loose fibers is known as Pulping or Cooking. Broad overview of the chemical pulping and mechanical pulping used to make variety of paper grades will be given. In addition to pulping, processes such as bleaching, refining used to make flexible white pulp fibres will be part of the course plan. Formation of paper sheet and properties of pulp and paper will conclude the paper making process. Topics such as recycled paper and water pollution in paper industry are also included. Manufacturing of viscose rayon and lyocell fibres from high grade pulp will be covered under the topic of cellulose derivatives. After the course, students can start working as a trainee or employee in paper mills such as Century Rayon, Ballarpur Paper mills, ITC Bhadrachalam, Grasim industries, etc.

Textbooks:
1. G.A. Smook, "Handbook for Pulp & Paper Technologists", Second edition. Angus wide publications, Vancouver, 2001

Reference books
1. Handbook of pulp and paper technology ed. Kenneth W. Britt, 2004.
2. Wood -Chemistry, Ultrastructure, Reactions – Walter De Gruyter, Berlin,1989
3. Hand book of pulp and paper, paper board and paper-based technology, Engineers India Research Institute

Course Plan:

Lect. No.	Learning objectives	Topics to be covered	Chap. in the Text Book
1-2	Introduction	Definition &types of pulp, Sources of paper making fibres, Fibre chemistry, Types of Paper , Types of cellulose fibres	1.1.-1.2, 1.5-1.7
3-5	Characteristics of Wood and Wood pulp fibres	Tree structure, Characteristics of Wood, Effect of fibre structure on paper properties, Wood species Identification	2.1-2.4, RF-2
6	Wood and Chip Handling	Pulp wood measurement, chipping, Chip handling & Storage, Chip quality control	3.3-3.6

7-8	Mechanical Pulping	Stone groundwood, Refiner mechanical pulping, Thermomechanical, Chemo (thermo) mechanical pulping – CTMP, Heat recovery	5.2-5.6
9-12	Kraft Pulping	Kraft pulping, Chemistry of kraft pulping, operation and control, process modifications, Continious digesters, Cooking of saw dust, bagasse and rice husk	7.3-7.6 & RF-1, Notes
13-14	Processing of pulp	Deknotting, Brown stock washing, Screening, , Centrifugal Cleaning, Thickening, Pulp storage & blending,	9.2-9.7
15-17	Chemical Recovery in Kraft Process	Black liquor oxidation, Evaporation, recovery boiler, recausticizing, calcining,	10.1-10.6, RF-2
18-19	Bleaching	Bleach chemicals, Chlorination & Extraction, Oxygen bleaching, Hypochlorite bleaching, ClO2 bleaching, H2O2 bleaching, O3 bleaching, Bleaching equipment	11.2-11.9, RF-3
20-21	Stock preparation	Beating and Refining, Consistency control, Sizing of paper, dying of paper, Non fibrous materials in Paper making	RF1: 5.1-5.5 & 8.2-8.5
22-23	Paper manufacture: Wet end operations	Flowspreader and headbox, Sheet forming process, Wire part, Twin wire forming, Pressing, Vacuum system	16.2-16.10
24-26	Paper manufacture: Dry end operations	Paper drying, Calendering, Profile control, Reeling, winding and Roll finishing, Supercalendering	5.1-5.3
27-28	Manufacturing specific paper grades	Newsprint, Publication grades, Sack grades, Linerboard, Corrugated medium, Tissue paper grades	20.1-20.7
29-32	Properties and testing of pulp and paper	Testing procedures, Pulp testing, Black liquor testing, Paper testing (Zero-span tensile strength, Burst strength, brightness and opacity)	22.2-22.4, RF1:9.1-9.2
33-36	Cellulose derivatives	Manufacturing and Characterization of Viscose rayon and Tencel (lyocell) fibres; Carboxymethyl cellulose; Nanocellulose fibrils	RF-2 (17.3.4 & 17.4.4), Notes
37-38	Water Pollution Abatement	Sources of pollutants, Environmental monitoring, Primary treatment, Secondary treatment, Color removal, Solids handling	26.2-26.8
39-40	Plant economics	Note book from wood chips, Hardboard from Rice husk and Paper waste recycling plant	RF3: 500-503, 510-513
41	Case study	Tissue Paper production and usage in India	Notes

Lab:

1. Analysis of raw materials (Eucalyptus & Bagasse) –Chipping, removal of moisture (Natural tray draft dryer), Steaming	SCEO lab -2 hrs
2. Wood/Bagasse: Density, microscopic analysis, Water retention value (WRV)	Process control lab- 2hrs
3. Biopulping using fungi followed by pulp analysis using Klason lignin and liquor analysis using HPLC	DEMO lab- EE lab
4. Chemical pulping of eucalyptus (165^{O}C, 2Hrs) and Klason's test for eucalyptus wood samples and Baggase	SCEO lab -2 hrs
5. Kraft cooking of Bagasse (cooking and filtration) and klasons test for pulp obtained from eucalypts and bagasse	SCEO lab- 2 hrs
6. Calorific Value of final Black Liquor , UV analysis of black liquor collected after 1hr, 2hr, 3hr of cooking, Fractional Distillation of final black liquor (distillate and Retentate analysis)	Petroleum lab & EE lab - 2hrs
7. Pulp Analysis(WRV, Microscopy, Cellulose study, Moisture content)	Process control lab- 2hrs
8. Making Handsheet (Beating, Sheet forming)	(SCEO lab 2 hrs)
9. Testing of handsheets (Microscopy, Tensile test, Impregnation of ink)	(Mechanical Dept. lab 2hrs)
10. Making coconut shell powder followed by drying and analysis using supermass colloider	(SCEO lab 2 hrs)

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Test-1	60 mints	15%	10/09: 2:30 – 3:30 PM	Closed book
Test-2	60 mints	15 %	22/10; 2:30 – 3:30 PM	Closed book
Lab / Seminars		30 %		Open book
Surprise tests	10 mints	10%		Closed book
COMPRE	3 hrs	30 % (10%+20 %)	03/12; 9-12 noon	Open book + Closed book

Chamber Consultation Hour: Friday 2-4 PM. Chamber: D201 (opposite to CAD lab)
Notices: All notices related to the course will be uploaded in CMS.
Make-up Policy: For genuine cases make-up will be granted with prior approval. Minimum attendance of 60 % is required for any make-up request. Certificate from authenticated doctor from the Medical Center must accompany make-up application (*only prescription or vouchers for medicines will not be sufficient*)

Dr. Ramesh Adusumalli
INSTRUCTOR-IN-CHARGE