1.PREFACE

The paper industry is undergoing transformative changes, driven by technological advancements and innovative approaches. Our mission has been to address the complex challenges faced by the paper industry through knowledge in the field and technical competencies.

In recent years, our department has undertaken several enhancements in syllabus, aimed at revolutionizing paper production. We have focused on enhancing material properties, improving manufacturing processes, and advancing sustainability practices. Our focus in syllabus has led to the development of novel paper products with superior qualities, including increased durability, reduced environmental impact, and enhanced functionality.

A cornerstone of our approach has been the integration of cutting-edge technologies such as advanced analytics, automation, and sustainable materials in our curriculum. By including these technologies, we improve the knowledge of students that will contribute to the industry's broader goals of environmental stewardship and resource optimization.

We have consistently engaged with industry leaders, academic researchers, and technological experts to ensure that our advancements in the field are both innovative and applicable. These partnerships have been instrumental in translating our knowledge into practical solutions that benefit the entire paper industry.

The curriculum provides a detailed insight of the methodologies, innovations, and outcomes of recent development in paper industry. Our ultimate goal is to offer a comprehensive resource that illustrates the impact of our work and inspires further innovation within the field.

We are grateful for the support and collaboration of our partners and look forward to continuing our efforts to drive progress in paper technology. We hope that this curriculum will serve as a valuable resource that it will contribute to ongoing developments in the industry.

2.ACKNOWLEDGEMENT

We are grateful to the Commissioner of Technical Education and members of the Academic Board for their invaluable support and guidance in the revision of curriculum.

Our sincere thanks to The Chairman, Seshasayee Paper and Boards limited for his steadfast encouragement and vision, which were essential in framing the curriculum.

We sincerely acknowledge the significant contributions of Industrial Expert Sri.Swapan kumar paul, DGM, M/s. Seshasayee Paper and Boards limited, Erode for his profound expertise and practical insights in the syllabus.

A special thank you goes to the Dr.V.Alagesan, Associate professor, SAASTRA University, Vallam, Tanjore for his crucial support and direction.

We also thank Sri.C.Ramesh Head of Department, Sugar Technology, Government Polytechnic, Thuvakudi, Trichy for his valuable suggestions related to process industries.

I am equally appreciative of the industry partners and our alumni in paper industry for their generous support and collaboration, which greatly enriched the curriculum.

We thank our beloved Principal for the continuous support and guidance in the revision of syllabus.

Lastly, my heartfelt thanks to the dedicated faculty and staff whose tireless efforts and unwavering commitment have been the driving force behind this syllabus revision.

Head of the Department

3.DEPARTMENT VISION, MISSION, PO AND PEOS

The Vision and Mission of the Department

Vision

To **develop** highly skilled, globally competitive, and innovative paper technologists and entrepreneurs by **providing** quality education, **promoting** research and innovation, and **equipping** students with the technical, managerial, and ethical competencies required to **meet** the evolving challenges of the paper industry.

Mission

1. **M1**: **Integrate** sustainable and need-based education through a student-centric teaching-learning environment to meet industry and societal demands.
2. **M2**: **Promote** logical reasoning, creativity, and effective communication to develop competent professionals.
3. **M3**: **Encourage** self-learning and research to **explore** and **adapt** to emerging trends and innovations in paper technology.
4. **M4**: **Foster** ethical values, social responsibility, and a spirit of humanitarian service among students.
5. **M5**: **Inspire** lifelong learning and **develop** resourceful, skilled professionals to serve the evolving needs of the paper industry.

Programme Outcomes (PO's)

After completion of the programme, the student will be able to:

1. **Apply** the knowledge of mathematics, science, chemistry, and engineering fundamentals to solve complex problems in paper technology.
2. **Identify**, **formulate**, and **analyze** problems related to paper industries and propose suitable solutions.
3. **Design**, **develop**, and **evaluate** systems and processes involved in paper manufacturing.
4. **Diagnose** and **troubleshoot** operational issues in paper plant processes effectively.
5. **Select** and **utilize** appropriate techniques, modern tools, and engineering software for engineering practice in paper industries.

6. **Demonstrate** awareness of professional and societal responsibilities in engineering practices.
7. **Assess** the environmental and economic impacts of engineering solutions in a global context.
8. **Apply** ethical principles and **commit** to professional ethics and responsibilities.
9. **Collaborate** effectively as an individual and as a member or leader in diverse teams.
10. **Communicate** effectively with engineering community and society to convey ideas clearly through verbal, written, and graphical means.
11. **Apply** management principles and **implement** engineering and financial knowledge for project execution and change management.
12. **Engage** in independent and lifelong learning to adapt to technological advancements and industry changes.

Programme Educational Objectives (PEOs)

1. Lead a successful career as an employee or an entrepreneur in the field of paper technology and allied fields.

2. Adopt the latest changes and developments in the field of paper technology by updating knowledge and skills.

3. Exhibit effective communication skills to present his or her ideas and thoughts efficiently.

4. Able to work effectively as an individual, in multi disciplines, multicultural environments and society at large.

Programme Specific Outcomes (PSOs)

After completion of the programme, the students will be able to:

1. **Apply** the fundamental concepts and operational methods of pulp and paper production to **operate**, **monitor**, and **control** paper mills, chemical recovery units, and paper machinery effectively.
2. **Analyze**, **evaluate**, and **optimize** the pulp and paper manufacturing processes to improve operational efficiency and performance of industry-specific equipment.

4. REGULATIONS
DIPLOMA COURSES IN ENGINEERING
(TERM PATTERN)
(Implemented from 2023-2024)
G-SCHEME
(Common to all Programmes)

PREAMBLE

Polytechnic colleges contribute significantly to the state's talent pipeline, and it is known that polytechnic was initially started with the primary objective of producing skilled technicians to support mass industrialization.

Today there is a changing manpower need, as TN's economy is beginning to focus on advanced technology and knowledge-based industries, rather than low-cost labour-intensive manufacturing. To produce future- ready talent and bridge the industry-academia gap, it is only pertinent to rethink the existing curriculum and revamp the syllabi.

The current dynamic ecosystem poses challenges that span across fields and demands multidisciplinary knowledge to address them; this has propelled the need for higher technical education to cover diverse areas such as STEM, arts, humanities, design, innovation, business, and entrepreneurship; hence the program is modelled to incorporate all these areas.

The challenges of the 21st century demand young diploma engineers to have a command of the ever-changing body of technical knowledge along with an array of personal, interpersonal, and system-building knowledge that will prepare them with skills & competencies to address the modern-day challenges by building a new generation of machines, methods and materials.

Higher technical institutions being the primary source for companies to source talent, are under pressure to design a dynamic system of technical education to meet the demands.

The program is offered through the core, electives, certifications, capstone projects and other ways to enable a student's transformation. Each domain is carefully crafted to cater to diversified needs, dynamic contexts, and differentiated expectations in a learner-centric environment.

Objective

To retain and further strengthen the quality of the human capital produced by our higher technical education at the diploma level as the force behind the state's social, cultural, and economic pre-eminence.

To seed & nurture agents of change & transformation for the digital future with enduring skills and capabilities by cultivating technological capabilities through a skill-centred approach.

Admission

(i)Candidates seeking admission to the first semester of the Diploma program:

Should have passed the SSLC Examinations prescribed by the Government of Tamil Nadu or any examination of any other board or authority recognized by the Board of Secondary Education as equivalent thereto with eligibility for Higher Secondary Education in Tamil Nadu.

(ii)Lateral Entry Admission:

The candidates who possess a pass is the HSC [Academic] or equivalent prescribed in the Higher Secondary Schools in Tamil Nadu affiliated to the Tamil Nadu Higher Secondary Board, with a pass in at least three of the following subjects: Physics / Chemistry / Mathematics / Computer Science / Electronics / Information Technology / Biology / Informatics Practices / Biotechnology / Technical Vocational Subjects / Agriculture / Engineering Graphics / Business Studies / Entrepreneurship are eligible to apply for Lateral entry admission to the third semester of Diploma programs, as per the rules fixed by the Government of Tamil Nadu. (Or) The candidates who possess a pass in 2-year ITI with appropriate grade or equivalent examination.

(iii)**There is no age limit prescribed for admissions to Diploma programs.**

(iv)**The medium of instruction is English for all courses, examinations, seminar presentations and project work reports, except for the programs offered in Tamil Medium**.

Structure of the Program

The Redesigning and revamp of the Diploma program in the State of Tamil Nadu will focus on improving the employability and entrepreneurship outcomes of the campuses through skill-centric and industry allied curriculum and syllabi. The following structure is being proposed for the new curriculum.

Pathways for Progressive Learning Experience

The program offers 4 different pathways for progressive learning. Entrepreneurs, Higher Education, Technocrats and Technologists have different pathways from which the students will pick one of these pathways that they find fascinating and work to ameliorate their knowledge base over the desired pathway.

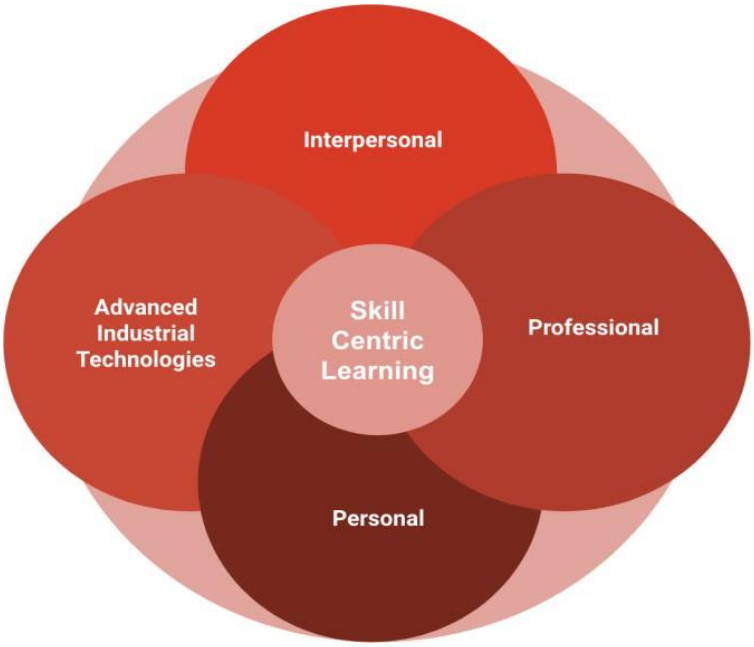
There are courses offered for the specific pathways in their final semesters that will aid them to choose their career in their specific pathways. Pathway direction for the students can be assisted by faculty mentors from time to time.

- **Entrepreneur:**
  Students who aspire to transform opportunity into reality, and create social and economic value for themselves and for others.
- **Higher Education:**
  Students with aspirations of pursuing higher education to acquire higher-order skills and competencies in the domain of interest.
- **Technocrats:**
  Students who aspire to acquire mastery of technical tools and methods to manage people who manage the processes
- **Technologists:**
  Students who aspire to gain leadership in a particular discipline / technology to evolve into Problem Solvers & Innovators

Various Dimensions for Transformation

Today's world is rapidly changing and increasingly interconnected, and the future talent pipeline to be sourced from the campuses needs to adapt to changes that will keep accelerating in the future. The new diploma program focuses on equipping learners with skills that will enable them to cope with the foreseeable social and economic changes and manage often unpredictable realities. The various dimensions of transformation are designed to nurture skills towards holistic human development. Such skills are acquired not only on formal courses but in a variety of contexts throughout the academic curriculum.

Four broad dimensions of skills to ensure holistic human development: (1) Personal, (2) Professional, (3) Interpersonal and (4) Advanced Industrial Technologies skills and competencies.



Integrated Curriculum

An integrated curriculum is based on learning experiences that lead to the acquisition of disciplinary knowledge and its application in a professional environment interwoven with the teaching of personal, interpersonal, and professional skills, and ways in which the integration of emerging technological skills and multidisciplinary connections are made.

Course Levels

A course is a component (a paper/subject) of a program. All the courses need not carry the same weightage. The course should have defined Course Objectives and Course Outcomes. A course may be designed to involve lectures/tutorials/laboratory work/project work/Internships/seminars or a combination of these, to effectively meet the teaching and learning needs and the credits may be assigned suitably.

The programs consist of various levels of courses, structured as

(1) Foundation (F), (2) Concentration (C) and the (3) Specialization (S) courses for a greater understanding of the core concepts of the fundamentals in the initial year of learning and thereby moving towards the specialization areas by choice.

- **Foundation (F) | Year I:** Foundation courses build strong fundamental requirements across mathematics, statistics, science, engineering domain, advanced technologies, social sciences and humanities.
- **Concentration (Cn) | Year II:** Concentration courses shall deliver domain-specific knowledge and technological skills. They are offered as core and electives to provide the requisite mandatory working knowledge of the chosen domain.
- **Specialization(S) | Year III:** Specialization courses are focused on a particular area of study leading to a specific pathway. Some of the courses can also be beyond the program, leading to skills and competencies in emerging technology domains.

Course Types

Every diploma program shall have a curriculum with syllabi comprising Theory, Practicum and Practical courses with well-defined Program Outcomes (PO) as per the Outcome Based Education (OBE) model. The content of each course is designed based on the intended Course Outcomes (CO). Every program shall have a distinct curriculum with syllabi consisting of courses broadly categorized under:

1.Core (C)/Elective (E) - Core / Elective courses are offered to students of a particular program to gain basic and specialized knowledge/skills in a selected field. Core courses are mandatory to complete the program and shall not be exempted or provided with credit equivalence. Elective Courses may be grouped into different domains/streams/specialisations to enable the students to have at least 3 to 5 options. At least 20 students need to express their willingness, for the case of an elective course, to be offered.

2.Practicum (P) - Integrated course taught in a hands-on learning environment. This may be offered wherever theoretical concepts are to be learned simultaneously with relevant practical sessions. Such courses shall be offered only if sufficient laboratory facilities are available to conduct such courses, and both laboratory and theory components shall be considered for continuous assessment. Final evaluation based on the proportion of the credit awarded for the respective component.

3.Lab (L) - Practical Courses taught in a designated lab. This may be offered when conceptual learning has to be augmented by practical experiments and also to bring focus on acquiring skills through doing. Such courses shall be offered only if sufficient laboratory facilities are available to conduct such courses.

4.Field Study (FS) - Offered as a special / curriculum-enriching component to understand certain practical issues/work practices / hands-on training/immersion project/market survey. Field Study, if it forms a part of the course, then credit(s) shall be assigned accordingly, otherwise, such course(s) may be specified in the Grade Sheet without grades.

5.Certification (Cer) - Industry-driven course shall be offered, jointly with an industry that would result in learning the emerging trends / employment potential topics / solving real-time problems. The Contents of the course shall be jointly designed by an industry expert and a suitable faculty member, with relevant assessment and evaluation. Hybrid/Online learning options shall be available. Students are permitted to complete these courses through MOOCs / Professional Certification and credit equivalence (Program Elective or Open Elective), to a maximum of 6 credits.

6.In-House Projects (J) - Capstone Project shall be offered once a student completes >95% of the core courses related to the Diploma program. The Capstone Project is expected to involve concepts from fundamentals to recent developments and may be restricted to one domain or multi- domains / multi-disciplines. Capstone Project shall be offered only after completing all the fundamental courses and offered during the final semester. It shall also focus on Environment, Society, Sustainability, Entrepreneurship and Project Management. In the case of a multidisciplinary project, a suitable co-supervisor shall be opted for the students from the relevant Department for successful completion. Capstone Project may be offered in phases, i.e. Phase I and Phase II (single topic or two different topics). Students are encouraged to submit the softcopy of the complete report for evaluation and abstract in the printed form during the final presentation.

7.Fellowship (Fs) - Up to 6 Months for professional and/or academic development offered by an external organisation identified and nominated by DoTE in India or abroad. Students shall be shortlisted for the same under sponsorship/scholarship by competent authorities and approved by the Head of the Institution.

8.Boot Camp (B) - 2-to-5-day training camps for imparting knowledge and skills in emerging areas. It may be offered jointly by a team of faculty members / external experts with course content that includes interdisciplinary topics from different domains, thereby enhancing the Professional Knowledge & Skills of the students. However, such courses shall not have any significant repetition of other courses offered in that particular diploma program. If a student fails to complete such a course on the first attempt or lacks attendance requirements, they may opt for a different course in the subsequent semester and meet the minimum credit requirements of the program or may re- do the same course whenever offered.

9.Hackathon (H) - 3 to 6 days of problem-solving and building a solution for real-world problems in an intensive/accelerated manner. It may be considered as one of the course types in situations where multiple solutions are expected to a problem or multiple problems are expected to be solved, in a particular industry/research laboratory. Such a course shall be essentially a Practicum and may be offered in a workshop mode. Credit allocation, Assessment and Evaluation shall be based on the respective syllabi designed for the same.

10.Internship (I) - Internship is offered as a credit course with the Industry/Research Laboratories/ other Universities in India or abroad. Credit allocation, Assessment and Evaluation shall be based on the procedures given. Every student is encouraged to gain Credits through an Internship.

11.Audit Courses are optionally registered by a student to understand certain basic/advanced concepts in his / her own discipline or other disciplines offered by the college. In this case, if a candidate fails in an Audit Course, it is not mandatory to repeat that course and these courses shall not be considered for eligibility for awarding the Diploma. Grades shall be awarded as "Completed".

Definition of Credit

Credit is a kind of weightage given to the contact periods* to teach the prescribed syllabus, which is in a modular form. The credit distribution for theory, laboratory and project courses are mentioned in the table below.

Theory (L) - 15 periods	1 credit
Tutorial (T) - 15 periods	1 credit
Practical (P) – 30 periods	1 credit
Internship (I) - 45 periods	1 credit
Project (J) - 30 periods	1 credit

* 1 period = 50 minutes of class

Curriculum Structure

Every program shall have a distinct curriculum with syllabi consisting of courses broadly categorized under Basic Sciences, Basic Engineering, Professional Core, Program Electives, Open Electives, and Certification Courses. Credit distribution for various categories of the courses will follow the guidelines given below, subject to minor variations, as may be suggested by the respective Boards of Studies.

Category	**Credit Range**
Humanities and Social Sciences	11
Basic Science Courses	17-20
Engineering Sciences	6-13
Programme Core	40-51

Program Elective	9-12
Open Elective	10
Industrial Training / Project Work	14
Audit Course	0
Integrated Learning Experiences	
Induction Program	Non-Credits Course
I&E / Club Activity / Community Initiatives	Non-Credits Course
Shop Floor Immersion	Industrial visit
Health & Wellness	PT,Yoga
Student-Led Initiative	Non-Credits Course
Special Interest Groups (Placement Training)	Non-Credits Course
Emerging Technology Seminars	TED, NPTEL Videos

Each program will consist of Basic Science (BS), Engineering Sciences (ES), Professional Core (PC), Program Electives (PE), Open Electives (OE), Audit Courses and In-House Project/Internships/Fellowships.

1. **Basic Sciences:** This course is common to all programs to develop fundamental knowledge of science and mathematics; it also enhances the reasoning and analytical skills amongst students.
2. **Engineering Sciences**: Engineering Science shall create awareness of different specializations of engineering studies. The goal of these courses is to create engineers of tomorrow, who possess the knowledge of all disciplines and can apply their interdisciplinary knowledge in every aspect. It could be any branch of engineering - Civil, Computer Science and Engineering, Electrical, Mechanical, etc.
3. **Professional Core:** This includes core courses designed in the program, which are major courses of the discipline, are required to attain desired outcomes and to ignite critical thinking skills amongst students.
4. **Program Elective:** This includes elective courses that can be chosen from a pool of courses which may be very specific or specialized or advanced or supportive to the program of study or nurtures the candidate's proficiency/skill. This is called a program elective course.
5. **Open Elective:** An elective course chosen generally from another discipline/ subject, to seek interdisciplinary exposure is called an open elective. While choosing the electives, students shall ensure that they do not opt for courses with syllabus contents which are similar to that of their departmental core/elective courses.
6. **Audit Courses:** An audit course is one in which the student attends classes, does the necessary assignments and takes exams. The Institute encourages students

towards extra learning by auditing for the additional number of courses. The results of audit courses shall not be considered for the prescribed “carry over courses” limit.

7. **Humanities and Social Science:** Basic courses offered across language, communication and social science subjects, including any management skills and shall be categorized as Humanities and Social science.
8. **In-House Project/Internships/Fellowships:** Every student must do one major project in the Final year of their program. Students can do their major project in Industry or R&D Lab or in-house or a combination of any two or a fellowship in a reputed organization.

Outcome-Based Education

Outcome-based education aims to create a clear expectation of results that students must achieve. Here, the outcome includes skills, knowledge and attitude. Outcomes inform both the way students are evaluated on a course and the way a course will be organized. Effective learning outcomes are student-centered, measurable, concise, meaningful, achievable and outcome-based (rather than task-based). To identify achievable learning goals and develop plans to meet them, revised Bloom's Taxonomy framework is introduced to allow educators to assess learning on an ongoing basis, encouraging students to reflect on their progress.

All the programs offered should adopt Outcome Based Education (OBE) in order to enhance the opportunities for the students with respect to their career track (through a student-centric approach). The Program Outcomes (POs) of the respective program of study are achieved through the Course Outcomes (COs). Necessary remedial actions are taken at regular intervals to ensure the proper attainment of outcomes by the students. The evaluation procedures outlined are to be followed by the departments before arriving at the data for the Outcome attainment analysis.

1. OBE is an approach to education in which the decisions about the curriculum instruction and assessment are driven by the learning outcomes that the students should display at the end of a program or course.

2. The vision and mission statements are the guiding forces behind an institute / department. The vision statement provides insight into what the department focuses to achieve or become in the future. The mission statement communicates the process involved in achieving the vision. An effective vision statement should be concise, unambiguous, futuristic, and realistic. Aspirational, and inspirational. Furthermore, it shouldn't be generic but rather focus on outcomes specific to the department. A good mission statement should focus on the ways to achieve the vision of the department. It should be brief, clear, informative, simple, and direct.

3. Graduate Attributes (GAs) represent the standard abilities to be looked for in a graduate of any diploma program. They form the Program Outcomes (POs) that reflect the skills, knowledge, and abilities of diploma graduates regardless of the field of study. At the same time, POs are necessarily independent of disciplinary knowledge; rather, these qualities may be developed in various disciplinary contexts. POs are composite statements made-up of multiple aspects relevant to a broader outcome like domain knowledge, design, analysis, etc. They also ensure the holistic development of the students by covering aspects like communication, ethics, project management, etc.,

4. Assessments are designed to measure the POs, and POs give useful guidance at the program level for the curriculum design, delivery, and assessment of student learning. However, they represent fairly high-level generic goals that are not directly measurable. Real observability and measurability of the POs at the course level are very difficult. To connect high-level learning outcomes (POs) with course content, course outcomes and assessments are designed, they are necessary to bring further clarity and specificity to the program outcomes.

5. For each PO, the skills and competencies implied generally require a different assessment methodology. This helps us to create a shared understanding of the competencies that students want to achieve.

6. Course Outcomes (COs) are specific, measurable statements that help the learners to understand the capabilities to be attained by them at the end of the course. COs should highlight what the learner can attain by studying the course and undergoing the evaluation of outcomes prepared for the same. It includes the knowledge to be gained, skills to be acquired and the application of the

same towards solving problems specific to the context. The topics for the course should be decided based on the course outcomes in such a way that the specific topics alone do not map to the specific course outcomes.

7. Revised Bloom's Taxonomy for Assessment Design: It attempts to divide learning into three types of domains (cognitive. affective, and behavioral) and then defines the level of performance for each domain. Conscious efforts to map the curriculum and assessment to these levels can help the programs to aim for higher-level abilities which go beyond remembering or understanding, and require application, and analysis, evaluation or creation.

8. CO-PO course articulation matrix should indicate the correlation between the CO and PO based on the extent to which the CO contributes to the PO. This is mapped at three levels 1, 2 or 3 representing low, medium and high respectively. This also ensures that every PO is covered across the courses offered as a part of the program. The matrix will be adopted for all the courses run by the department.

9. The attainment of COs of any course can be assessed from the performance of the students through continuous and final assessments. The goal of continuous assessment is to understand/realize the critical information about student comprehension throughout the learning process and provides an opportunity for the facilitator to improve their pedagogical approach and for students to improve learning outcomes. The goal of the final assessment is to evaluate student learning outcomes at the end of the course instruction. According to the new regulation, 40% weightage is for the continuous assessment, and 60% weightage is for the final assessment.

10. The PO assessment should be carried out by both direct and indirect assessment. The assessment can be estimated by giving 80% weightage to direct assessment and 20% weightage to indirect assessment. Direct assessment is purely based on CO attainment through the course Assessment Method, and indirect assessment is through the feedback taken from the relevant stakeholders of the system. Indirect assessment can be done in the form of a graduate exit survey where the student is required to answer a questionnaire that reflects their satisfaction with respect to the attainment of POs. The questionnaire should be carefully designed so as to not have the POs themselves as direct questions.

11. Each PO attainment corresponding to a specific course can be determined from the attainment values obtained for each course outcome related to that PO and the CO-PO mapping values. The threshold value of 60%, shall be set for the POs and the same can be modified with due approval of the Authorities.

12. The gap identified in the attainment of the COs and POs can be addressed by organizing talks from the industry, bridge courses, organizing workshops, arranging field visits (industrial visits) with respect to the course, improving the student performance under the innovative teaching-learning process of the institution, etc.,

Academic and Curriculum Flexibility

Academic and curriculum flexibility enhance a student's learning experience by providing various options such as adjusting the timeframe of courses, horizontal mobility, interdisciplinary opportunities, and other benefits through curricular transactions. The types of Academic and curriculum flexibilities are listed below.

1. Break of Study
2. Course Add / Drop
3. Course Withdrawal
4. Credit Equivalence
5. Credit Transfer
6. Examination Withdrawal
7. Fast-Track Option
8. Flexi-Credit System
9. Bridge Course

Break of Study

If a student intends to take a break / temporarily discontinue the program in the middle of a semester/year, during the period of study, for valid reasons (such as Internships, accident or hospitalization due to prolonged ill health) and wishes to re-join the program in the next academic year, student shall intimate stating the reasons.

Break of study is permitted only once during the entire period of the Diploma program for a maximum period of **one year.** The student is permitted to rejoin the program after the break and shall be governed by the rules and regulations in force, at the time of rejoining. **The break shall be notified in the grade sheet**. If a student is detained for want (shortage) of attendance or disciplinary issues, the period spent in that semester shall not be considered a permitted Break of Study.

Course Add / Drop

Subject to resource availability, a student has the option to add additional courses within a week after the regular semester begins. Furthermore, a student can drop registered courses before completing the first Continuous Assessment (CA) test in a semester, limited to a maximum of 6 credits. These dropped courses will not be considered as arrears, but the student will need to retake them when they are offered by the institution. In order to carry out these actions, students must obtain permission from the HoD, COE of the institution, and Head of the institution.

Credit Equivalence

It is an option that can be exercised by a student under the following circumstances –

(i) credits earned through Extra and Co-curricular Activities (only against program elective / open elective – Global)

(ii) credits earned through online courses (only against Open Electives - Technical and Global and program electives)

(iii) credits accumulated through Capsule courses, One-Credit courses

Such courses and credits earned shall be presented in the Board comprising the Head of the department, COE, the Principal & Chairman Autonomous Examinations along with the Equivalent Credit(s). (Online Courses offered by Swayam, NPTEL.)

Credit Transfer

Credits earned by a student through Credit Equivalence (as said above) and credits earned by attending and completing the courses successfully, offered by other approved Universities / Institutions / Professional Bodies (only against Technical and Global Open Electives and program electives) shall be considered as "Transferred Credits (specified in the Grade Sheet)" and considered for the calculation of CGPA.

Examination Withdrawal

A student may be permitted to withdraw from appearing for the end semester examination in any course or courses for valid reasons (medically unfit / unexpected family situations / sports approved by the Physical Director / HOD/Principal/DOTE).

This privilege can be availed **ONLY ONCE** during the entire program. Valid documents, for medically unfit / unexpected family situations, shall be submitted by the student within seven days before the commencement of the examination in that course or courses and also recommended by the Head of the Department, approved by the Head of the Institution and COE with intimation to DoTE.

Special cases under extraordinary conditions will be considered on the merit of the case if any student applies for withdrawal, notwithstanding the requirement of mandatory seven days' notice.

Those students who withdraw from any course or courses during the program are eligible for the award of first class and first class with distinction as per the requirement in this regard.

Withdrawal is permitted for the end semester examinations in the final semester, only if the period of study, the student concerned, does not exceed 1 semester after the regular period of 3 years so that his eligibility for distinction is considered.

The final approval for withdrawal will depend on the merit of the case and will be decided by the Head of the Institution.

Note: Exam fee paid will be adjusted in the subsequent semester.

Fast-Track

This option enables a student to complete the minimum credit requirements of a program, to enable

(i) his / her own entrepreneurial venture (start-up),

(ii) An internship in industry/research laboratories / fellowship.

This option is currently available for students to complete the two elective papers offered in Semester 6 in advance [Recommended to be completed in Semester 4 or 5] to avail the last semester for internship/fellowship/do his own start-up/enterprise/project outside the campus. However, such an option shall not be exercised to pursue higher education elsewhere. The duration of the study shall remain the same as per the prescribed syllabi for the fast-track option also.

Flexi-Credit System

It offers a student to earn additional credits than that specified (minimum credits) to a program for which student has enrolled. Such additional credits earned shall be mentioned in the Grade Sheet, as 'Additional Credits Earned'. Credits earned through Flexi-Credit System shall not be considered for the calculation of SGPA or CGPA.

Bridge Course

This is specifically designed for Lateral Entry (LE) students who join the Diploma Program in 2nd year (3rd Semester). This course will be a 40 period in which the faculty gives the gist of important topics that the LE students may have missed in the first year of the program specific to the department concerned.

Integrated Learning Experience

Integrated learning experiences encompass activities that foster the acquisition of disciplinary knowledge, personal and interpersonal skills, and technological proficiency. These experiences promote active engagement in meaningful real-life situations and establish connections between different curricula, co- curricular activities, and extracurricular pursuits across diverse disciplines. Integrated learning experiences are concatenated in the academic curriculum for each semester enabling the students to learn, adapt and transform through experiential learning pedagogy.

This approach enriches the curriculum by incorporating dynamic and up-to-date co-curricular courses and activities that may not be directly aligned with the students' program of study. It prioritizes the holistic development of students, fostering their growth and well-roundedness.

1. Innovation & Entrepreneurship
2. Peer 2 Peer Learning
3. Growth Lab
4. Shop Floor Immersion
5. Health & Wellness
6. Induction Program
7. Special Interest Groups
8. Club Activity
9. Community Initiatives
10. Emerging Tech Seminars
11. Student Led Initiative
12. Industry-Specific Training

Innovation Track

They are offered to the student, to bring awareness on start-up / entrepreneurial ventures through a series of courses/activities. Based on the inputs gained, students can select their electives, specialization, and capstone project and deferred placement option.

Peer 2 Peer Learning

P2P learning involves interactions between students from senior classes, leading to valuable additions and deepening the understanding of certain concepts. This may happen as a part of a scheduled time-table or after instructional hours in a day, by Peers (from senior classes), leading to value addition, enriching the understanding of certain concepts and implementing practically (developing models, prototypes, proofs- of-concept) for learning satisfaction, participating in competitions / competitive examinations. These

efforts are expected to improve teamwork, communication, and understanding of societal needs, project management and life-long learning activities.

Growth Lab

Growth labs play an integral role to stimulate and develop a student's personality & skills in various fields of life. It also teaches about a growth mindset to tackle real-world problems and life challenges. It brings self-confidence and empowerment to transform the inter-personality of the student. The process brings the progression to achieve higher goals in life.

Shop Floor Immersion

This introduces new ideas, inspires participants to further explore them on their own or may illustrate and promote actual process practice through seminars, workshops, Industrial Visits etc that results in learning hands-on skills as it gives the students an opportunity to try out new methods and fail in a safe environment.

Health & Wellness

This aims to teach students about various aspects of health and fitness, including exercise, nutrition, yoga, Mental health, and substance awareness.

Induction Program

It shall be organized to all the students, admitted into first year, to offer the course on Universal Human Value, awareness sessions on campus facilities, academic regulation and curriculum, highlight the culture, values and responsibilities of an Engineer in the Society and the Nation as a whole, besides Institutional infrastructure and facilities and student support systems. Awareness of domain-specific requirements to be organized in the second year of induction.

Special Interest Groups

The training is especially based on the placements on campus. Concepts required for aptitude tests, group discussions, resume building, personal interviews, industry-specific orientation and Business Case Competition are taught to the students.

Club Activity

A small community that attracts people who share the same interests such as music, arts, or sports working on a common goal to develop a sense of unity and teamwork, learning how to work with others in reaching the same goals

Community Initiatives

Community Initiatives involve activities that aim to define values, cultivate empathy, foster social skills, and enhance students' understanding of their community. Through these initiatives, students have the opportunity to build meaningful relationships,

gain insights into different perspectives, and engage with diverse cultures. This engagement enables the development of crucial interpersonal skills.

Emerging Tech Seminars

A technical presentation made by the Students & the cross-functional Members of the Faculty to showcase the technology adopted in the Industry. This collaborative teaching-learning session between the student & the faculty results in a better understanding of the use of technology in various applications.

Student-Led Initiative

A student-led session will help students to acquire and share knowledge on emerging industrial technologies that will comprehend & introduce the emerging technology to the students. This includes student-led Tech talk series & other initiatives.

Industry Specific Training

Gaining information about the industry's way of working and understanding the process. This enables one to understand the various non-technical skills & competencies required for the transformation from a Student to a professional.

Duration of the Program

- A student is ordinarily expected to complete the Diploma program in 6 semesters (for SSLC students) and four semesters (for Lateral Entry students) but in any case, not more than 12 Semesters for SSLC (or equivalent) students and not more than 10 semesters for Lateral Entry students.
- Each semester shall normally consist of 15 weeks with periods of 50 minutes each. The Head of the Institution shall ensure that every faculty imparts instruction as per the number of periods specified in the syllabus and that the faculty teaches the full content of the specified syllabus for the course being taught.
- The Head of the Institution may conduct additional classes for improvement, special coaching, conduct model tests etc., over and above the specified periods.
- The End Semester Examination will normally follow immediately after the last working day of the semester as per the academic schedule prescribed from time to time.
- The total period for completion of the program from the commencement of the first semester to which the student was admitted shall not exceed the maximum period specified irrespective of the period of break of study in order that student may be eligible for the award of the degree. The minimum and maximum period of study shall be;

Diploma program	Min. Period	Max. Period
Full Time	3 Years	6 Years
Full Time [Lateral Entry]	2 Years	5 Years
Sandwich	3.5 Years	6.5 Years
Sandwich [Lateral Entry]	2 5Years	5 5Years

Attendance Requirements

- A student who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a Term.
- Ideally every student is expected to attend all classes of all the attendance.

1. However, in order to make provision for certain unavoidable reasons Participation in sports, the student is expected to attend at least 75% of the classes. Therefore, the student shall secure not less than 75% (after rounding off to overall attendance for each semester.

2. However, a student who secures overall attendance between 65% and 74% in the current semester due to medical reasons (prolonged hospitalization /accident / specific illness) / participation in sports events may be permitted to appear for the current semester examinations, subject to the condition that the student shall submit the medical certificate / sports participation certificate attested by the Head of the Institution.

3. Candidates who have earned more than 50% attendance but fall short of the basic requirement of 65% attendance (in all subjects of the current semester put together) shall be permitted to proceed to the next semester, only one time during the course of study by considering all the papers in that current semester as absent and to complete the program of study. For such candidates by default, the classification of class shall be Second class on successful passing of course.

4. Students who secure less than 50% overall attendance shall not be permitted to write the end Semester examination and not permitted to move to the next semester. They are required to repeat the incomplete semester in the next academic year, as per the norms prescribed.

Award of Marks for Course Attendance

Award of marks for Course attendance to each Course Theory / Practical /Practicum /Project will be as per the range given below

Sl.No	Course Attendance (%)	(Theory / Practical / Practicum) Marks	(Health & Wellness) Marks
1	75 % - 70 %	1	4
2	81 % - 85 %	2	8
3	86 % - 90 %	3	12
4	91 % - 95 %	4	16
5	96 % - 100 %	5	20

Class Committee

Every class shall have a class committee consisting of faculty of the class concerned, student representatives and a chairperson, who is not teaching the class. It is like the 'Quality Circle' (more commonly used in industries) with the overall goal of improving the teaching learning process. The functions of the class committee include:

- Regulations of the diploma program and the details of rules therein.

- Informing the student representatives, the academic schedule including the dates of assessments and the syllabus coverage for each assessment.

- Informing the student representatives, the details of regulations regarding weightage used for each assessment. In the case of practical courses (laboratory / drawing / project work / seminar etc.) the breakup of marks for each experiment / exercise / module of work, should be clearly discussed in the class committee meeting and informed to the students.

- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.

- -Identifying the slow-learners, if any, and requesting the faculty concerned to provide some additional help or guidance or coaching to such students.

- The class committee for a class under a particular branch is normally constituted by the Head of the Department. However, if the students of different branches are mixed in a class (like the first semester which is generally common to all branches), the class committee is to be constituted by the Head of the Institution.

- The class committee shall be constituted within the first week of each semester. At least 4 student representatives (usually 2 boys and 2 girls) shall be included in the class committee, covering all the elective courses.

- The chairperson of the class committee may invite the class adviser(s) and the Head of the Department to the class committee meeting.
- The Head of the Institution may participate in any class committee meeting of the institution.

- The chairperson is required to prepare the minutes of every meeting, submit the same to the Head of the Institution within two days of the meeting and arrange to circulate it among the students and faculty concerned. If there are some points in the minutes requiring action by the management, the same shall be brought to the notice of the Head of the Institution.
- The first meeting of the class committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the regulations.

- Two or three subsequent meetings may be held in a semester at suitable intervals.

- During these meetings the student members representing the entire class, shall meaningfully interact and express the opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching-learning process.

Course Committee for Common Courses

Each common theory course offered to more than one discipline or group, shall have a "Course Committee" comprising all the faculty teaching the common course with one of them nominated as the course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Head of the Institution depending upon whether all the faculty teaching the common course belong to a single department or to several departments. The 'Course Committee' shall meet in order to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests. Wherever feasible, the Course Committee may also prepare a common question paper for the internal assessment test(s).

Assessment and Examination

Performance in each course of study shall be evaluated for a maximum of 100 marks based on one of the following:

(i) Continuous Assessment [40%]:

- Continuous assessment shall be carried out for 100 marks [summation of multiple CAs] for all types of courses and converted to 40 marks.

- Every subject shall have its own framework for continuous assessment designed by the course committee and approved by the academic board as part of the curriculum. The continuous assessment shall be awarded as per the assessment proposed in respective syllabi.
- For One credit courses and Advanced Skill Certification programs, no end semester examination shall be conducted, and final grade will be awarded based on continuous assessment only for 100 marks.

(ii) End Semester Examination [60%]:

- The End Semester Examination will be conducted for 100 marks and shall be converted to 60 marks in the final results.

- The End Semester Examinations (Theory, Practical, Project) of three hours duration will be conducted.

- For Practicum courses, the end semester examination will be conducted as a theory or a practical or a project examination based on the credits for each component, the decision on the mode of exam could be based on the recommendation by the internal committee duly forwarded and approved by Head of the Institute.

- For the project works, the Department will constitute a three-member faculty committee to monitor the progress of the project and conduct reviews regularly.

- If the projects are done in-house, the students must obtain the bonafide certificate for project work from the project guide and Head of the Department, at the end of the semester. Students who have not obtained the bonafide certificate are not permitted to appear for the project Viva Voce examination.

- For the projects carried out in Industry, the students must submit a separate certificate from Industry apart from the regular bonafide certificate mentioned above. For Industry related projects there must be one Mentor / Supervisor from Industry (External), this is in addition to the regular faculty supervision.

- The final examination for project work will be evaluated based on the final report submitted by the project group (of not exceeding four students), and the viva voce by an external examiner.

- The split up of marks for Internal and End Semester Viva Voce can follow the below mentioned rubrics,

Internal Mark Split (40 Marks)			**End Semester (60)**		
Review 1 (10 Marks)	**Review 2 (15 Marks)**	**Review 3 (15 Marks)**	**Record (20 Marks)**	**Presentation (20 Marks)**	**Viva Voce (20 Marks)**
Committee: 5 Marks Supervisor: 5 Marks	Committee: 7.5 Marks Supervisor: 7.5 Marks	Committee: 7.5 Marks Supervisor: 7.5 Marks	External: 10 Internal: 5 Supervisor: 5	External: 10 Internal: 5 Supervisor: 5	External: 10 Internal: 5 Supervisor: 5

- Students who are unable to complete the project work at the end of the semester can apply for an extension to the Head of the Department, with the recommendation from the project guide for a period of a maximum of two months. For those students who extend the project work for two months, Viva Voce will be carried out and results will be declared separately. If the project report is not submitted even beyond the extended time, then students are not eligible to appear for Project Viva Voce Examination.

- The performance of each student in the project group would be evaluated in a viva voce examination conducted by a committee consisting of an external examiner and the Department project coordinator as an internal examiner.

- If a student indulges in malpractice in any of the End Semester Examination / Internal Examinations, student will be liable for punitive action as prescribed by the college from time to time.

Passing Requirements for Award of Diploma

student who secures not less than 40% of total marks prescribed for the course [Internal Assessment + End semester Examinations] with a minimum of 35% of the marks prescribed for the end semester examination, shall be declared to have passed the course and acquired the relevant number of credits. This is applicable for both theory and laboratory courses (including project work).

(i) No Minimum marks for continuous assessment (Internal). (ii) Minimum Marks to be secured in end semester exam is 35 out of 100, (iii) Those who secure minimum mark (35) in end semester examination need to secure minimum of 19 out of 40 in continuous assessment to achieve overall pass percentage of 40% in that particular subject.

If a student fails to secure a pass in a theory course / laboratory course / elective course (same elective course), the student shall register and appear only for the end semester examination in the subsequent semester. In such cases, the internal assessment marks obtained by the student in the first appearance shall be retained and considered valid for all subsequent attempts till the student secures a pass. However, from the third attempt onwards if a student fails to obtain pass marks (Internal Assessment + End Semester Examination), then the student shall be declared to have passed the examination if the student secures a minimum of 35% marks prescribed for the end semester examinations alone.

If any other Elective course is opted by the student, the previous registration is cancelled and henceforth it is to be considered as a new Elective course. The student has to register and attend the classes, earn the continuous assessment marks, fulfil the attendance requirements and appear for the end semester examination.

If a student is absent during the viva - voce examination, it would be considered a failure. If a student fails to secure a pass in Project Work, the student shall register for the course again in the subsequent semester and can do Project Work.

The passing requirement for the courses which are assessed only through purely internal assessments, the passing requirement is 50% of the internal assessment (continuous assessment) marks only.

A student can apply for revaluation of the student's Term examination answer paper in a theory course, as per the guidelines of Autonomous Exam cell, SIT on payment of a prescribed fee along with prescribed application to the Autonomous Examination account.

The Autonomous Examination cell will arrange for the revaluation and the results will be intimated to the student concerned through institute web site

Revaluation is not permitted for laboratory courses and projects.

Award of Grades

The award of letter grades will be decided using absolute grading principle. The performance of a student will be reported using letter grades, each carrying certain points as detailed below:

Letter Grade	Grade Points*	Marks
O (Outstanding)	10	91-100
A+ (Excellent)	9	81-90
A (Very Good)	8	71-80
B+(Good)	7	61-70
B (Average)	6	51-60
C (Satisfactory)	5	40-50
RA (Re-Appearance)	0	<40
SA (Shortage of Attendance)	0	0
W (Withdrawal)	0	0

A student is deemed to have passed and acquired the corresponding credits in a particular course if the

Student obtains any one of the following grades: "O", "A+", "A", "B+", "B", "C".

- 'SA' denotes shortage of attendance and hence prevents students from writing the end semester examinations. 'SA' will appear only in the result sheet.

- "RA" denotes that the student has failed to pass in that course.

- "W" denotes withdrawal from the exam for the particular course. The grades RA and W will figure both in the Grade Sheet as well as in the Result Sheet. In both cases, the student has to appear for the end semester examinations as per the regulations.

If the grade RA is given to Theory Courses/ Laboratory Courses it is not required to satisfy the attendance requirements, but has to appear for the end semester examination and fulfill the norms to earn a pass in the respective courses.

If the grade RA is given to courses which are evaluated only through internal assessment, the student shall register for the course again in the subsequent semester, fulfilling the norms as to earn a pass in the course. However, attendance requirements need not be satisfied.

For the Audit Course and Integrated Learning Experience, on its successful completion a 'completed' certificate will be issued by the head of the institute. Every student needs a minimum of 75% attendance in the Audit / integrated Learning experience compulsorily. However, for valid reasons, the Head of the Institution may permit a student to exempt/complete this requirement in the subsequent years. Successful completion of these courses is compulsory for the award of degree. These courses will be monitored by the central committee constituted by DoTE. The grades O, A+, A, B+, B, C obtained for the one/two credit course (not the part of curriculum) shall figure in the Grade Sheet under the title 'Value Added Courses/Internship/Industrial training'.

The courses for which the grades obtained are SA will not figure in the Grade Sheet.

Grade Sheet

After results are declared, Grade Sheets will be issued to each student which will contain the following details: The College in which the student has studied, the list of courses registered during the semester and the grade scored. The Grade Point Average (GPA) for the semester and the Cumulative Grade Point Average (CGPA) of all courses enrolled from the first semester onwards. GPA for a semester is the ratio of the sum of the products of the number of credits acquired for courses and the corresponding points to the sum of the number of credits acquired for the courses in the semester. CGPA will be calculated in a similar manner, considering all the courses registered from the first semester. RA grades will be excluded for calculating GPA and CGPA.

$$\text{CGPA} = \frac{\sum_{i=1}^{n} CiGPi}{\sum_{i=1}^{n} Ci}$$

where **Ci** is the number of Credits assigned to the course

GPi is the point corresponding to the grade obtained for each course

n is number of all courses successfully cleared during the particular semester in the case of GPA and during all the semesters in the case of CGPA.

Award of Diploma

A student shall be declared to be eligible for the award of the Diploma provided the student has,

- Successfully gained the required number of total credits as specified in the curriculum
  Corresponding to the student's program within the stipulated time.

- Successfully completed the course requirements, appeared for the end semester examinations and passed all the subjects within the period as prescribed

- Successfully passed any additional courses prescribed by the Directorate of Technical education whenever the student is readmitted under Regulations 2023 from the earlier regulations.

- Successfully completed the Integrated Learning Experience requirements.
- No disciplinary action pending against the student.
- The award of Diploma must have been approved by the Board of Examinations.

Classification of Diploma Awarded

FIRST CLASS WITH DISTINCTION

A student who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the six semesters (4 semesters in the case of Lateral Entry) in the student's First Appearance. The duration of the program shall be extended up to one additional semester in case of any withdrawals from end semester examination. Withdrawal from examination will not be considered as an appearance.
- Should have secured a CGPA of not less than 8.50.
- One-year authorized break of study (if availed of) shall be permitted within the four years period (three years in the case of lateral entry) for award of First class with Distinction.
- The candidates should NOT have been prevented from writing the end semester examination due to lack of attendance in any semester.

FIRST CLASS

A student who satisfies the following conditions shall be declared to have passed the examination in First class:

- Should have passed the examination in all the courses in all six semesters (4 semesters in the case of Lateral Entry). The duration of the program shall be extended up to one additional semester in case of any withdrawals from end semester examination. Withdrawal from examination will not be considered as an appearance.
- One-year authorized break of study (if availed of) or prevention from writing the end semester examination due to lack of attendance (if applicable) shall be provided with the duration of four years (three years in the case of lateral entry) for award of First class.
- Should have secured a CGPA of not less than 6.50.

SECOND CLASS

- All other students who qualify for the award of the degree shall be declared to have passed the examination in Second Class.

Discipline

Every student is expected to maintain disciplined and respectable behaviour both within and outside the college premises, refraining from engaging in any activities that may tarnish the reputation of the college.

The Head of the Institution shall constitute a disciplinary committee consisting of the Head of the Institution, Two Heads of Department of which one should be from the faculty of the student, to enquire into acts of indiscipline and notify the authorities about the disciplinary action recommended for approval.

In case of any serious disciplinary action which leads to suspension or dismissal, then a committee shall be constituted.

If a student indulges in malpractice in any of the end semester examinations, student shall be liable for punitive action as prescribed by the Board of Examination from time to time. For any malpractices in any continuous assessment, the same shall be reported to the Head of the Institution for disciplinary actions.

Revision of Regulation, Curriculum and Syllabi

The Directorate of Technical Education may from time-to-time revise, amend or change the regulations, curriculum, syllabus and scheme of examinations through the Leadership Committee with the approval of the Board.

5.SALIENT FEATURES OF THE DIPLOMA PROGRAMME IN PAPER TECHNOLOGY

1.	Name of the Programme	:	Diploma in Paper Technology
2.	Duration of the Programme	:	Three and half years
3.	Entry Qualification	:	S.S.L.C or prescribed by Directorate of Technical Education
4.	Intake	:	60
5.	Pattern of the Programme	:	Term Pattern
6.	Ratio between Theory & Practical	:	50:50(Approx.)

7. Industrial Training:

One year industrial training in IV Term and VII Term. Internal assessment 50 marks and external assessment marks will be 50.Total marks allotted to industrial training will be 100.

Distribution of Marks:(Internal)

Daily diary and reports of training	-	30 Marks
Attendance	-	10Marks
Viva	-	10Marks

8. Ecology and Environment:

As per Govt. of India directives, a subject on Environmental Education has been incorporated in the scheme.

9. Entrepreneurship Development:

Entrepreneurship Development and Management has been incorporated in the scheme.

6.EMPLOYMENT OPPURTUNITIES

A range of opportunities for diploma holders in both industries, leveraging their technical skills and knowledge to contribute to various aspects of production, maintenance, quality control, and process optimization is offered in Paper and Process industries.

1. Chemicals and allied industries like

   a. Pulp and Paper industries
   b. Agro industry
   c. Industries based on agricultural residue and recycle fiber
   d. Paper chemical industries
   e. Paper making machineries manufacturing industry
   f. Paper production consultancies
   g. Paper fabrics manufacturing industry
   h. Consumer goods industry
   i. Polymer industry
   j. Currency note production mills
   k. Khadi and village board industry
   l. Packaging industry
   m. Book printing corporation

2. Research Organizations like CPPRI (Central Pulp & Paper Research Institution laboratories, FRI, establishments, pollution control labs.

3. Entrepreneurs to small/tiny units especially Paper, Agro and chemical industry

7.Competency Profile for Diploma Holders in the Paper Industry

The competency profile covers the essential technical skills and knowledge required for diploma holders working in the paper industry. It reflects the diverse technical challenges they may face and the competencies needed to excel in this field.

1. Understanding of Paper Manufacturing Processes

- Raw Material Knowledge: Proficiency in identifying and handling various raw materials, including wood, recycled paper, and chemicals.
- Pulping Techniques: Knowledge of mechanical, chemical, and semi-chemical pulping methods, including the Kraft process and sulfite process.
- Paper Forming: Understanding of the paper forming process, including the use of paper machines, wet end processes, and dry end operations.

2. Equipment Operation and Maintenance

- Machine Operation: Ability to operate and adjust paper machines, including refiners, presses, and dryers.
- Maintenance Skills: Competence in routine maintenance, troubleshooting, and minor repairs of paper production equipment.
- Instrumentation: Knowledge of process control instruments used in monitoring and controlling paper production processes, such as pressure gauges, temperature sensors, and flow meters.

3. Quality Control and Testing

- Quality Standards: Understanding of paper quality standards and specifications, including GSM (grams per square meter), brightness, and smoothness.
- Testing Procedures: Ability to perform various paper tests, such as tensile strength, tear resistance, and fold endurance.
- Troubleshooting: Skills to identify and resolve quality issues, such as defects and inconsistencies in the final product.

4. Chemical and Environmental Management

- Chemical Handling: Knowledge of chemicals used in paper manufacturing, including their safe handling and storage procedures.
- Waste Management: Understanding of waste management practices, including the treatment and recycling of effluents and waste products.
- Environmental Regulations: Awareness of environmental regulations and practices related to the paper industry to minimize environmental impact.

5. Safety Procedures

- Safety Protocols: Knowledge of safety protocols and procedures specific to the paper industry, including the use of personal protective equipment (PPE).
- Emergency Response: Ability to respond to emergencies, such as chemical spills or equipment failures, following established safety procedures.

6. Process Optimization

- Efficiency Improvement: Skills in identifying opportunities for process improvement and efficiency gains in paper production.
- Lean Manufacturing: Familiarity with lean manufacturing principles and practices to reduce waste and improve productivity.

7. Technical Documentation and Reporting

- Documentation: Ability to maintain accurate technical documentation, including process records, maintenance logs, and quality reports.
- Reporting: Skills to prepare technical reports and communicate findings to supervisors and management.

8. Computer Skills

- Process Control Software: Proficiency in using computer-based process control systems and software for monitoring and managing paper production.

8.CURRICULUM AREAS AS DERIVED FROM COMPETENCY PROFILE

The following curriculum areas have been derived based on competency profile.

S.NO	Competency	Curriculum Areas / Subjects
1	Basic understanding of concepts and principles related to applied sciences like physics, chemistry and mathematics.	- Physics - Chemistry - Mathematics
2	Development of communication and inter personal skill for effective functioning in the world of work.	- Communication Skills
3	Understanding of basic concepts and principles of mechanical, electrical and civil engineering so as to enable the students to apply the knowledge of these principles to the field of paper and allied industries.	- Engineering Mechanics - General Workshop Practice
4	Ability to read and interpret drawings related to plant layout, process equipment and components and colour codes.	- Engineering Graphics
5	Knowledge of various materials used in chemical processes, their properties and specifications.	- Industrial Chemistry
6	Knowledge and associated skills of various unit operations, unit processes and process instrumentation in process industry	- Engineering Mechanics & Fluid Mechanics - Unit Operations - Process Instrumentation & Control
7	Ability to calculate the quantity of raw materials, energy inputs, manpower requirement and output from the process.	- Process Equipment Design
8	Ability to select the various raw materials and additives, understanding the properties and specifications for the manufacturing of pulp & paper.	- Ppt –I - Ppt - II - Ppt – III
9	Understanding of complete process of making paper starting from the raw material	- Ppt –I - Ppt - II - Ppt – III - Chemical Recovery
10	Appreciation of the need of clean and green environment and its deterioration by various emissions from industry and preventive	- Environmental Education - Pollution Control In Chemical Process Industry

	procedures and knowledge of safety regulations in paper industry.	
11	Development of generic skills of thinking and problem-solving, communication, attitudes and value system for effective functioning in a process industry	- Industrial Visits - Project Work
12	Understanding of the basic principles of managing men, material and machines / equipment for optimum production	- Entrepreneurship Development And Plant Engineering & Management
13	Proficiency in the use of computers	- Computer Applications In Paper Industries
14	Basic manual and machining skills as an aid to function effectively in the process industry	- General Workshop Practice
15	Knowledge of properties and conversion of paper	- Paper Properties And Conversion

ABSTRACT OF CURRICULUM AREAS / SUBJECTS

A. Core Coursed In Engineering / Technology

1. Engineering Mechanics & Fluid Mechanics
2. Pulp and Paper Technology – I
3. Electrical & Electronics Engineering
4. Pulp Technology Laboratory
5. Fluid Mechanics Laboratory
6. Electrical & Electronics Engineering Lab
7. Unit Operations
8. Unit Operations Laboratory
9. Environmental Engineering Lab
10. Industrial Chemistry

B. Applied Coursed In Engineering / Technology

11. Pulping Operation Electrical and Mechanical Maintenance
12. Chemical Recovery Operation and Maintenance
13. Pulp and Paper Technology-II
14. Plant Engineering and Management
15. Chemical Recovery
16. Pulp and Paper Technology-III
17. Process Equipment Design
18. Chemical Recovery and Technical Analysis Lab
19. Paper Technology Lab
20. Control Laboratory Utilities and Instrumentation
21. Paper Making Operation and Mechanical Maintenance
22. Project Work

C. Diversified Coursed In Engineering / Technology

23. Communication & Life Skills Lab
24. Process Instrumentation and Control
25. Power Plant Engineering
26. Process Instrumentation and Control Lab

SESHASAYEE INSTITUTE OF TECHNOLOGY

(AUTONOMOUS)

(An NBA Accredited Computer | Mech | ICE | Paper Tech)

TRICHIRAPALLI– 620010 TAMIL NADU

DEPARTMENT OF PAPER TECHNOLOGY

SEMESTER III

	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	5G233110	Pulp And Paper Technology -I	4-0-0	60	4	Theory
2	Program Core	Theory	5G233210	Basic Mechanical Engineering	3-0-0	45	3	Theory
3	Program Core	Practicum	5G233340	Electrical & Electronics Engineering	1-0-4	75	3	Practical
4	Program Core	Practicum	5G233440	Industrial chemistry	1-0-4	75	3	Practical
5	Program Core	Practical/Lab	5G233520	Pulp Technology Laboratory	0-0-4	60	2	Practical
6	Program Core	Practical/Lab	5G233620	Fluid mechanics Laboratory	0-0-4	60	2	Practical
7	Open Elective	Advanced Skill Certification	5G233760	Advanced Skills Certification - 3	1-0-3	60	2	NA
8	Humanities &Social Science	Integrated Learning Experience	5G233880	Growth Lab	0-0-2	30	0	NA
9	Audit Course	Integrated Learning Experience	5G233881	Induction Program I	-	16	0	-
10	Audit Course	Integrated Learning Experience	5G233882	I&E/ Club Activity/ Community Initiatives	-	15	0	-
11	Audit Course	Integrated Learning Experience	5G233883	Shop floor Immersion	-	8	0	-
12	Audit Course	Integrated Learning Experience	5G233884	Student-Led Initiative	-	23		
12	Audit Course	Integrated Learning Experience	5G233885	Emerging Technology Seminars	-	8	0	-
13	Audit Course	Integrated Learning Experience	5G233886	Health & Wellness	-	30	1	-
	Test & Revisions					**45**		
	Library					**15**		
	Total Periods					**625**	**20**	

SEMESTER IV

	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Project / Industrial Training	5G234173	Pulping Operation Electrical and Mechanical Maintenance		300	9	Project
2	Program Core	Project / Industrial Training	5G234273	Chemical Recovery Operation and Maintenance		300	9	Project
3	Audit Course	Integrated Learning Experience	5G234382	I&E/ Club Activity/ Community Initiatives	-	15	0	-
4	Audit Course	Integrated Learning Experience	5G234383	Emerging Technology Seminars	-	15	0	-
5	Audit Course	Integrated Learning Experience	5G234384	Health & Wellness	-	10	0	-
	Total Periods					**640**	**18**	

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TRICHIRAPALLI– 620010 TAMIL NADU

DEPARTMENT OF PAPER TECHNOLOGY

SEMESTER V

	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	5G235110	Pulp And Paper Technology II	3-0-0	45	3	Theory
2	Program Core	Theory	5G235210	Plant Engineering Management	3-0-0	45	3	Theory
3	Program Core	Theory	5G235310	Unit Operations In Pulp and Paper	3-0-0	45	4	Theory
4	Program Core	Practicum	5G235440	Process Instrumentation And Control	1-0-4	75	3	Practical
5	Program Core	Practicum	5G235540	Environmental Management In Pulp and Paper	1-0-4	75	3	Practical
6	Program Core	Practical/Lab	5G235620	Unit Operations Laboratory	0-0-4	60	2	Practical
7	Open Elective	Advanced Skill Certification	5G235760	Advanced Skill Certification-5	1-0-2	45	2	NA
10	Audit Course	Integrated Learning Experience	5G235882	I&E/ Club Activity/ Community Initiatives	-	30	0	-
11	Audit Course	Integrated Learning Experience	5G235883	Shop floor Immersion	-	8	0	-
12	Audit Course	Integrated Learning Experience	5G235884	Student-Led Initiative	-	24		
12	Audit Course	Integrated Learning Experience	5G235885	Emerging Technology Seminars	-	8	0	-
13	Audit Course	Integrated Learning Experience	5G235886	Health & Wellness	-	30	0	-
13	Audit Course	Integrated Learning Experience	5G235887	Special Interest Groups	-	30	0	-
	Test & Revisions					**60**		
	Library					**15**		
	Total Periods					**595**	**20**	

SEMESTER VI

	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	5G236110	Pulp And Paper Technology III	3-0-0	45	3	Theory
2	Program Core	Practicum	5G236240	Chemical Recovery	1-0-4	75	3	Theory
3	Program Core	Practicum	5G236340	Process Design Concept	1-0-2	45	2	Practical
4	Program Core	Practical/Lab	5G236420	Paper Technology Laboratory	0-0-4	60	2	Practical
5	Project	Project	5G236574	Project Work	-	420	12	Project
	Total Periods					**645**	**22**	

SEMESTER VII

	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Project /Industrial Training	5G237173	Control Laboratory Utilities and Instrumentation		320	10	Project
2	Program Core	Project / Industrial Training	5G237273	Paper Making Operation and Mechanical Maintenance		320	10	Project
	Total Periods					**640**	**20**	

9. SCHEME OF EVALUTION.

COURSE TYPE THEORY END EXAM THEORY

<table>
<tr><th>Assessment Method</th><th colspan="2">Assessment Marks</th><th>Converted Marks</th><th>Internal Marks</th><th>External Marks</th><th>Total Marks</th></tr>
<tr><td>Cycle Test – I (Unit – I & II) (2 Hours) (Written Test)</td><td>60 Marks</td><td rowspan="2">Best of CT–I and CT–II</td><td rowspan="2">10 Marks</td><td rowspan="7">40 Marks</td><td rowspan="8">60 Marks</td><td rowspan="9">100 Marks</td></tr>
<tr><td>Cycle Test – II (Unit – III &IV) (2 Hours) (Written Test)</td><td>60 Marks</td></tr>
<tr><td>Model Theory Examinations (AllUnits) (3 Hours)</td><td colspan="2">100 Marks</td><td>10 Marks</td></tr>
<tr><td>* Assignment – 2 Nos.(2 Nos. x 10 Marks)</td><td colspan="2">20 Marks</td><td>10 Marks</td></tr>
<tr><td>MCQ</td><td colspan="2">10 Marks</td><td>5 Marks</td></tr>
<tr><td>Attendance</td><td colspan="2">5 Marks</td><td>5 Marks</td></tr>
<tr><td>END THEORY EXAMINATIONS (3 Hours)</td><td colspan="2">100 Marks</td><td>60 Marks</td><td></td></tr>
<tr><td colspan="6">TOTAL</td></tr>
</table>

Cycle Test Question Pattern

Part A – 6 Questions x 2 marks = 12 Marks
Part B – 6 Questions x 8 marks = 48 Marks
Total Marks = 60 Marks

In Each Unit (4 Questions answer any 3) and Part – B (4 Questions answer any 3)

End Theory Examination Question Pattern

Part A – 10 Questions x 2 Marks = 20 Marks
Part B – 10 Questions x 8 Marks = 80 Marks
Total Marks = 100 Marks

In Each Unit (3 Questions answer any 2) and Part – B (3 Questions answer any 2)

Assignment :

- 2 Assignments covers all 5 Units 20 Marks converted to 10 Marks

MCQ :

- Each Unit 10 Questions - 50 Questions 50 Marks converted to 5 Marks

COURSE TYPE PRACTICUM END EXAM THEORY

<table>
<tr><th>Assessment Method</th><th colspan="2">Assessment Marks</th><th>Converted Marks</th><th>Internal Marks</th><th>External Marks</th><th>Total Marks</th></tr>
<tr><td>Cycle Test – I (Unit – I & II)(2 Hours) (Written Test)</td><td>60 Marks</td><td rowspan="2">Best of CT–I and CT–II</td><td rowspan="2">10 Marks</td><td rowspan="7">40 Marks</td><td rowspan="8">60 Marks</td><td rowspan="9">100 Marks</td></tr>
<tr><td>Cycle Test – II (Unit – III &IV) (2 Hours) (Written Test)</td><td>60 Marks</td></tr>
<tr><td>Model Practical Examination (3 Hours)</td><td colspan="2">100 Marks</td><td>10 Marks</td></tr>
<tr><td>Model Theory Examinations (All Units) (3 Hours)</td><td colspan="2">100 Marks</td><td>10 Marks</td></tr>
<tr><td>Assignment -2 Nos.
2 x 10 Marks</td><td colspan="2">20 Marks</td><td>5 Marks</td></tr>
<tr><td>Attendance</td><td colspan="2">5 Marks</td><td>5 Marks</td></tr>
<tr><td>END THEORY EXAMINATIONS (3 Hours)</td><td colspan="2">100 Marks</td><td>60 Marks</td><td></td></tr>
<tr><td colspan="6">TOTAL</td></tr>
</table>

Cycle Test Question Pattern

Part A – 6 Questions x 2 marks = 12 Marks
Part B – 6 Questions x 8 marks = 48 Marks
Total Marks = 60 Marks

In Each Unit (4 Questions answer any 3) and Part – B (4 Questions answer any 3)

End Theory Examination Question Pattern

Part A – 10 Questions x 2 Marks = 20 Marks
Part B – 10 Questions x 8 Marks = 80 Marks
Total Marks = 100 Marks

In Each Unit (3 Questions answer any 2) and Part – B (3 Questions answer any 2)

Assignment :

- 2 Assignments covers all 5 Units 20 Marks converted to 10 Marks

MCQ :

- Each Unit 10 Questions - 50 Questions 50 Marks converted to 5 Marks

COURSE TYPE PRACTICAL END EXAM PRACTICAL

<table>
<tr><th>Assessment Method</th><th colspan="2">Assessment Marks</th><th>Converted Marks</th><th>Internal Marks</th><th>External Marks</th><th>Total Marks</th></tr>
<tr><td>Cycle Test – I Practical Examinations PART A Exercises (2 Hours)</td><td>50 Marks</td><td rowspan="2">Best of CT–I and CT–II</td><td rowspan="2">10 Marks</td><td rowspan="6">40 Marks</td><td rowspan="6">60 Marks</td><td rowspan="7">100 Marks</td></tr>
<tr><td>Cycle Test – II Practical Examinations PART B Exercises (2 Hours)</td><td>50 Marks</td></tr>
<tr><td>Model Practical Examinations All Exercises (3 Hours)</td><td colspan="2">100 Marks</td><td>15 Marks</td></tr>
<tr><td>Practical Document submission (Each Exercise / Experiment Drawing plate should be evaluated to 10 Marks</td><td colspan="2">10 Marks</td><td>10 Marks</td></tr>
<tr><td>Attendance</td><td colspan="2">5 Marks</td><td>5 Marks</td></tr>
<tr><td>END PRACTICAL EXAMINATIONS (3 Hours)</td><td colspan="2">100 Marks</td><td>60 Marks</td><td></td></tr>
<tr><td colspan="6">TOTAL</td></tr>
</table>

SCHEME OF EVALUATION

Cycle Test I & II

PART	DESCRIPTION	MARKS
1	Aim & Procedure	35
2	Execution and Result	15
	Total	50

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
1	Aim (05) ,Program from Part – A (30)	35
2	Aim (05) ,Program from Part – B (30)	35
3	Executing any one program (Part A or Part –B)	15
4	Output	10
5	Viva Voce	05
	Total	100

COURSE TYPE PRACTICUM END EXAM PRACTICAL

<table>
<tr><th>Assessment Method</th><th colspan="2">Assessment Marks</th><th>Converted Marks</th><th>Internal Marks</th><th>External Marks</th><th>Total Marks</th></tr>
<tr><td>Cycle Test – I Practical Examinations PART A Exercises (2 Hours)</td><td>50 Marks</td><td rowspan="2">Best of CY–I and CY–II</td><td rowspan="2">10 Marks</td><td rowspan="6">40 Marks</td><td rowspan="7">60 Marks</td><td rowspan="8">100 Marks</td></tr>
<tr><td>Cycle Test – II Practical Examinations PART B Exercises (2 Hours)</td><td>50 Marks</td></tr>
<tr><td>Model Theory Examinations (3 Hours)</td><td>100 Marks</td><td>15 Marks</td><td rowspan="2">15 Marks</td></tr>
<tr><td>Model Practical Examinations (3 Hours)</td><td>100 Marks</td><td>15 Marks</td></tr>
<tr><td>Practical Document/ Drawing Plate submission (Each Exercise / Experiment / Drawing plate should be evaluated to 10 Marks.</td><td colspan="2">10 Marks</td><td>10 Marks</td></tr>
<tr><td>Attendance</td><td colspan="2">5 Marks</td><td>5 Marks</td><td></td></tr>
<tr><td>END PRACTICAL EXAMINATIONS (3 Hours)</td><td colspan="2">100 Marks</td><td>60 Marks</td><td></td></tr>
<tr><td colspan="6">TOTAL</td></tr>
</table>

SCHEME OF EVALUATION
CYCLE TEST I & II

PART	DESCRIPTION	MARKS
1	Aim & Procedure	35
2	Execution and Result	15
	Total	50

SCHEME OF EVALUATION
Model Theory Examination

Part A – 10 Questions x 2 Marks = 20 Marks
Part B – 10 Questions x 8 Marks = 80 Marks
Total Marks= 100 Marks

In Each Unit Part - A (3 Questions answer any 2)
Part - B (3 Questions answer any 2)

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
1	Aim (05) ,Program from Part – A (30)	35
2	Aim (05) ,Program from Part – B (30)	35
3	Executing any one program (Part A or Part –B)	15
4	Output	10
5	Viva Voce	05
	Total	100

COURSE TYPE PROJECT/INTERNSHIP END EXAM PROJECT

Assessment Method	Assessment Marks	Converted Marks	Internal Marks	External Marks	Total Marks
Punctuality and regularity. (Attendance)	10 Marks	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Level/proficiency of practical skills acquired. Initiative in learning / working at site	10 Marks	10 Marks			
Self-expression / communication skills. Interpersonal skills / Human Relation.	10 Marks	10 Marks			
Report and Presentation.	10 Marks	10 Marks			
END PROJECT EXAMINATIONS	100 Marks	60 Marks			
TOTAL					

SCHEME OF EVALUATION
END SEMESTER EXAMINATION- PROJECT

PART	DESCRIPTION	MARKS
1	Daily Activity Report snd Attendance certificate	20
2	Comprehensive report on Internship, Relevant Certificate from the concerned department.	30
3	Presentation by the student at the end of the Internship	30
4	Viva Voce	20
	Total	**100**

11. COMPARISION BETWEEN "F" SCHEME AND "G" SCHEME

THIRD TERM					
SL.NO	**F SCHEME**	**T/P**	**G SCHEME**	**T/P/PC**	**REMARKS**
1	Industrial Chemistry	**T**	Industrial Chemistry	**PC**	same as F SCHEME
2	Basic's Of Mechanical Engineering	**T**	Basic's Of Mechanical Engineering	**T**	same as F SCHEME
3	Pulp & Paper Technology I	**T**	Pulp & Paper Technology I	**T**	same as F SCHEME
4	Electrical & Electronics Engineering	**T**	Electrical & Electronics Engineering	**PC**	same as F SCHEME
5	Plant Engineering Management & Environmental Engineering	**T**			Shifted to V term
6	General Engineering practical	**P**	Fluid mechanics practical	**P**	Not Equivalent
7	Pulp Technology Laboratory	**P**	Pulp Technology Laboratory	**P**	same as F SCHEME
8	Physical Education		Physical Education		same as F SCHEME
9	Library		Library		same as F SCHEME
	NEW SUBJECT INTRODUCED				
10			Advanced Skill Certification		
11			Growth Lab		
12			Induction Program		
13			Club Activity		
14			Shop floor Immersion		
15			Emerging Technology Seminars		

FOURTH TERM					
SL.NO	**F SCHEME**	**T/P**	**G SCHEME**	**T/P/PC**	**REMARKS**
1	Pulping Operation Electrical and Mechanical Maintenance	**P**	Pulping Operation Electrical and Mechanical Maintenance	**PC**	same as F SCHEME
2	Chemical Recovery Operation and Maintenance	**P**	Chemical Recovery Operation and Maintenance	**PC**	same as F SCHEME
NEW SUBJECT INTRODUCED					
1			Club Activity		
2			Emerging Technology Seminars		
			Physical Education		

FIFTH TERM					
SL.NO	**F SCHEME**	**T/P**	**G SCHEME**	**T/P**	**REMARKS**
1	Pulp And Paper Technology II	**T**	Pulp And Paper Technology II	**T**	same as F SCHEME
2			Plant Engineering Management	**T**	Shifted from III term to V term
3	Process Instrumentation And Control	**T**	Process Instrumentation And Control	**PC**	same as F SCHEME
4	Unit Operations	**T**	Unit Operations in Pulp and Paper	**T**	same as F SCHEME
5	Environmental Engineering Laboratory	**P**	Environmental Management in Pulp and Paper	**PC**	Not Equivalent
6	Process instrumentation and control Lab	**P**		**P**	Merged to Process Instrumentation And Control
7	Entrepreneurship and Startups	**P**			Removed
8	Unit Operations Laboratory	**P**	Unit Operations Laboratory	**P**	same as F SCHEME
9	Physical Education				same as F SCHEME
10	Library				same as F SCHEME
	NEW SUBJECT INTRODUCED				
11			Advanced Skill Certification		
12			Induction Program II		
13			Placement Training		

SIXTH TERM					
SL.NO	**F SCHEME**	**T/P**	**G SCHEME**	**T/P/PC**	**REMARKS**
1	Pulp And Paper Technology III	**T**	Pulp And Paper Technology III	**T**	same as F SCHEME
2	Chemical Recovery	**T**	Chemical Recovery	**PC**	same as F SCHEME
3	Process Design Concept	**T**	Process Design Concept	**PC**	same as F SCHEME
4	Paper Technology Laboratory	**P**	Paper Technology Laboratory	**P**	same as F SCHEME
5	Chemical Recovery And Technical Analysis Laboratory	**P**			Merged to Chemical Recovery
6	Project Work & Entrepreneurship Management	**P**	Project Work	**PC**	same as F SCHEME
7	Process Design & Simulation Practical	**P**			Merged to Process Design Concept
NEW SUBJECT INTRODUCED					
8	NIL		NIL		NIL

SEVENTH TERM					
SL.NO	**F SCHEME**	**T/P**	**G SCHEME**	**T/P/PC**	**REMARKS**
1	Control Laboratory Utilities and Instrumentation	**P**	Control Laboratory Utilities and Instrumentation	**PC**	same as F SCHEME
2	Paper Making operation and Mechanical Maintenance	**P**	Paper Making operation and Mechanical Maintenance	**PC**	same as F SCHEME
NEW SUBJECT INTRODUCED					
3	NIL		NIL		NIL

12.DETAILS OF ADDITION AND DELETION OF SUBJECTS

THIRD TERM			
SUBJECT CODE	**G SCHEME**	**ADDITION**	**DELETION**
5G233110	Pulp & Paper Technology I	NA	NA
5G233210	Basic's Of Mechanical Engineering	NA	NA
5G233340	Electrical & Electronics Engineering	NA	Electrical Ac & Dc Machines Compressed To 1 Unit Electronic Devices & Measuring Instruments Compressed To 1 Unit
5G233440	Industrial Chemistry	Paper Sizing Chemicals	Carbohydrates ,Cellulose Chemistry, Structure & Reaction Of Lignin Compressed To 1 Unit Removed Basics Of Fatty Acids, Formaldehyde & Pigments
5G233520	Pulp Technology Laboratory	NA	
5G233620	Fluid mechanics practical	NA	NA

FOURTH TERM			
SUBJECT CODE	**G SCHEME**	**ADDITION**	**DELETION**
5G234120	Pulping Operation Electrical and Mechanical Maintenance	NA	NA
5G234220	Chemical Recovery Operation and Maintenance	NA	NA

FIFTH TERM			
SUBJECT CODE	**G SCHEME**	**ADDITION**	**DELETION**
5G235110	Pulp And Paper Technology II	NA	NA
5G235210	Plant Engineering Management	NA	NA
5G235310	Unit Operations in Pulp and Paper	NA	NA
5G235440	Process Instrumentation And Control	NA	Measurement Of Temperature & Pressure Compressed To 1 Unit Industrial Controllers & Automation Compressed To 1 Unit
5G235540	Environmental Management in Pulp and Paper	Air Pollution & Noise Pollution Water Pollution & Land Pollution	NA
5G233620	Unit Operations Laboratory	NA	NA

SIXTH TERM			
SUBJECT CODE	**G SCHEME**	**ADDITION**	**DELETION**
5G236110	Pulp And Paper Technology III	NA	NA
5G236240	Chemical Recovery	NA	Objective Of Chemical Recovery & Modern Chemical Recovery Unit Compressed To 1 Unit Smelt & Steam Boilers & Steam Turbines Causticizing Compressed To 1 Unit
5G236340	Process Design Concept	NA	Pulping Mill & Stock Preparation Compressed To 1 Unit Wet & Dry End, Production Calculation Compressed To 1 Unit
5G236420	Paper Technology Laboratory	NA	NA

SEVENTHTERM			
SUBJECT CODE	**G SCHEME**	**ADDITION**	**DELETION**
5G237120	Control Laboratory Utilities and Instrumentation	NA	NA
5G237220	Paper Making operation and Mechanical Maintenance	NA	NA

13.HORIZONTAL AND VERTICAL ORGANISATION OF THE SUBJECTS

S.No	Subjects	Distribution in Hours in Various Semesters				
		III	IV	V	VI	VII
1	Industrial Chemistry	5	-	-	-	-
2	Basis of Mechanical Engineering & Fluid Mechanics	3	-	-	-	-
3	Pulp & Paper Technology – I	4	-	-	-	-
4	Electrical & Electronics Engineering	5	-	-	-	-
5	Pulp Technology Laboratory	4	-	-	-	-
6	Fluid Mechanics Laboratory	4	-	-	-	-
8	Pulping Operation Electrical & Mechanical Maintenance	-	9	-	-	-
9	Chemical Recovery Operation & Maintenance	-	9	-	-	-
10	Process Instrumentation & Control	-	-	5	-	-
11	Plant Engineering & Management	-	-	3	-	-
12	Pulp & Paper Technology-II	-	-	3	-	-
13	Unit Operations in Pulp and Paper	-	-	3	-	-
14	Unit Operations Laboratory	-	-	4	-	-
16	Environmental Management in Pulp and Paper	-	-	5	-	-
17	Chemical Recovery	-	-	-	5	-
18	Pulp & Paper Technology-III	-	-	-	3	-
19	Process Design Concept	-	-	-	3	-
20	Paper Technology Laboratory	-	-	-	4	-
23	Project Work	-	-	-	12	-
24	Control Laboratory Utilities & Instrumentation	-	-	-	-	10
25	Paper Making Operation & Mechanical Maintenance	-	-	-	-	10
	Total	**25**	**18**	**23**	**27**	**20**

5G233110	PULP AND PAPER TECHNOLOGY I	L	T	P	C	End Exam
Theory		4	0	0	4	Theory

Course Introduction

This course provides foundational knowledge in **pulp and paper technology**, covering **historical developments, raw materials, pulping processes, stock preparation, and the role of non-fibrous materials**. Students will gain insights into **fibrous raw material selection, fiber morphology, chemical pulping, refining, and papermaking additives**. The course equips students with **technical skills to analyze and optimize pulp and paper manufacturing processes**, ensuring sustainable and efficient production.

Course Objectives

Upon completion of the course, students will be able to:

1. **Explain** the historical development of pulping and papermaking processes.
2. **Identify** different types of raw materials used in pulp and paper production.
3. **Analyze** fiber morphology and wood procurement techniques.
4. **Compare** different pulping processes and evaluate their advantages and limitations.
5. **Demonstrate** the principles of stock preparation and refining.
6. **Assess** the role of sizing and fillers in stock preparation.
7. **Apply** technical calculations for pulp mill operations.

Course Outcomes (COs)

After completion of this course, students will be able to:

CO Code	Course Outcome
CO1	**Explain** the evolution of pulping and papermaking and classify raw materials.
CO2	**Analyze** fiber morphology and wood preparation techniques.
CO3	**Compare** mechanical and chemical pulping processes and their efficiencies.
CO4	**Demonstrate** the operations involved in stock preparation and refining.
CO5	**Evaluate** the role of sizing, fillers, and their effects on paper properties.
CO6	**Apply** technical calculations related to pulp mill operations.

Programme Outcomes (POs)

After completing the program, graduates will be able to:

1. **Apply** mathematical, scientific, and engineering knowledge to solve paper technology problems.
2. **Identify** and **analyze** challenges in the pulp and paper industry.
3. **Design** and **evaluate** operations of paper processes.
4. **Troubleshoot** technical issues in plant operations.
5. **Use** modern engineering tools for paper industry applications.
6. **Demonstrate** awareness of professional and societal responsibilities.
7. **Assess** environmental and economic impacts of paper technology.
8. **Apply** ethical principles in professional practices.
9. **Work** effectively in teams and multidisciplinary environments.
10. **Communicate** technical information effectively.
11. **Incorporate** business practices for project and risk management.
12. **Engage** in lifelong learning to stay updated with technological advancements.

Programme Educational Objectives (PEOs)

Graduates will be able to:

1. **Lead** a successful career in the pulp and paper industry.
2. **Adapt** to industry advancements by **updating** knowledge and skills.
3. **Demonstrate** communication and leadership skills in professional settings.
4. **Work** effectively in **multidisciplinary and multicultural** environments.

Programme Specific Outcomes (PSOs)

Students completing this program will be able to:

1. **Apply** pulp and paper production techniques to **operate** and **control** industrial equipment.
2. **Analyze** and **optimize** manufacturing processes to enhance operational efficiency.

CO-PO & PSO Mapping

The following table shows the **correlation** between Course Outcomes (COs), Programme Outcomes (POs), and Programme Specific Outcomes (PSOs):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	-	1	-	-	2	1
CO2	3	3	2	1	1	-	-	-	1	2	-	-	3	2
CO3	2	3	3	3	2	1	-	-	2	2	1	-	3	3
CO4	2	3	3	3	3	1	-	1	2	2	1	-	3	3
CO5	2	3	3	3	3	1	2	1	1	2	2	1	3	3
CO6	3	2	3	3	3	1	2	1	2	3	3	2	3	3

- **3 - Strong correlation**, **2 - Moderate correlation**, **1 - Weak correlation**, **"-" - No correlation**

Instructional Strategy

- **Lecture sessions** with real-world industrial examples.
- **Case studies** and **interactive discussions**.
- **Video demonstrations** of pulping and paper manufacturing processes.
- **Practical assignments** on pulp and paper calculations.
- **Industry expert talks** and **guest lectures**.
- **Site visits** to paper mills for hands-on experience.

Assessment Methodology

Assessment Method	Assessment Marks		Converted Marks	Internal Marks	External Marks	Total Marks
Cycle Test - I (Unit - I & II) (2 Hours) (Written Test)	60 Marks	Best of CT-I & CT-II	10 Marks	40 Marks	60 Marks	100 Marks
Cycle Test - II (Unit - III &IV) (2 Hours) (Written Test)	60 Marks					
Model Theory Examinations (AllUnits) (3 Hours)	100 Marks		10 Marks			
* Assignment - 2 Nos.(2 Nos. x 10 Marks)	20 Marks		10 Marks			
MCQ	10 Marks		5 Marks			
Attendance	5 Marks		5 Marks			
END THEORY EXAMINATIONS (3 Hours)	100 Marks		60 Marks			
TOTAL						

Cycle Test Question Pattern

Part A - 6 Questions x 2 marks = 12 Marks

Part B - 6 Questions x 8 marks = 48 Marks

Total Marks = 60 Marks

In each Unit (4 Questions - Answer any 3) and Part - B (4 Questions - Answer any 3)

End Theory Examination Question Pattern

Part A - 10 Questions x 2 Marks = 20 Marks

Part B - 10 Questions x 8 Marks = 80 Marks

Total Marks = 100 Marks

In each Unit (3 Questions - Answer any 2) and Part - B (3 Questions - Answer any 2)

Assignment

2 Assignments covers all 5 Units. 20 Marks converted to 10 Marks

MCQ

Each Unit 10 Questions - 50 Questions. 50 Marks converted to 5 Marks

5G233110	PULP & PAPER TECHNOLOGY I	L	T	P	C	End Exam
Theory		4	0	0	4	Theory

UNIT	NAME OF THE TOPICS	PERIODS
I	**HISTORY OF PAPER MAKING & TYPES OF RAW MATERIAL** **Chapter 1.1** - Historical development of pulping and papermaking process. A simple Block diagram outlining the stage of process in integrated pulp and paper industry. Fibrous raw materials - Introduction - Selection Criteria of fibrous raw materials - A note on L/D ratio - Classification of fibrous raw materials including the classification of vegetable fibers with one example for each and a brief description of them - Chemistry of materials with special reference to wood.	12
II	**PROCESSING OF WOOD** **Chapter 2.1** - Fiber morphology with a simple sketch and a brief note an cell-walls - A note on Wood procurement, receiving and measurement- Debarking and its importance **Chapter 2.2** - Acceptable chip size - Rechipper Concept of oven dry and air dry raw materials including simple problems - Difference between hardwood and softwoods - Usage of these woods in different paper making - Wood Pulping line	12
III	**NON WOOD PLANT FIBERS & PULPING PROCESS** **Chapter 3.1** -The growth and fiber values of bamboo, bagasse, straws, grasses, jute coir, cotton, Kenaf and Banana- A short note on hemicelluloses in papermaking. **Chapter 3.2** - General principles of pulping - General classification of pulping processes - principles of mechanical and chemical pulping processes (an introductory treatment only) - Their merits and demerits - An introduction to soda and sulphate processes only - Sulphate process description in detail - RDH - Super Batch pulping process - OCC line	12
IV	**STOCK PREPARATION & IT'S EQUIPMENTS** **Chapter4.1** - Introduction - Basic principles of stock preparation systems - The concept of consistency and simple problems on consistency involving stock blending - Important operations of stock preparation - Theory of beating (a description with the sketch of cellulose fiber) - Refinig Vs strength properties - A simple sketch of conical and disc refiners and their functions in brief - Effect of refining on sheet properties **Chapter 4.2** - White water and its reclamation - Save-all - Cleaning of stock (ahead of paper machine) - Centrifugal separation - Pulpers **Chapter 4.3** - Introduction and principles - Method of sizing - Factors affecting sizing -Chemistry of sizing process - Alumina Theory and Co-ordinate valences theory - Description of chemicals with reference to rosin, alum, waxes and rosin. Alkaline sizing with ASA - Surface sizing.	12

V	**NON FIBROUS MATERIALS IN STOCK PREPARATION** **Chapter 5.1** - Principles - Fillers and paper properties- Paper fillers and their brief description - Production of fillers - Retention and effects of fillers - Theories of retention - Two sidedness of paper. **Chapter 5.2** - Method of adding dyes - Mechanism of paper dyeing - Factors affecting stock dye. **Chapter 5.3** - Technical calculation for pulp mill - O.D Weight - Tank capacity - Pipe size - Centri-cleaner calculation Screening calculation - Washing loss & Bleaching Calculation.	12
TOTAL PERIODS		60

Suggested Student Activities

- **Technical presentations** on recent innovations in pulp and paper.
- **Problem-solving sessions** on pulping efficiency calculations.
- **Mini projects** on stock preparation techniques.
- **Industry internships** or **research-based assignments**.
- **Participation in paper technology seminars/conferences**.

Reference Books

1. **"Pulp and Paper Manufacture Series"** – J.P. Casey
2. **"Handbook of Pulping and Papermaking"** – Christopher J. Biermann
3. **"Paper and Paperboard Manufacturing and Properties"** – James E. Kline
4. **"Paper Chemistry and Technology"** – Monica Ek

Web Links

1. **TAPPI (Technical Association of the Pulp and Paper Industry)** – www.tappi.org
2. **Pulp & Paper International (PPI)** – www.risiinfo.com
3. **Indian Paper Manufacturers Association (IPMA)** – www.ipma.co.in
4. **National Renewable Energy Laboratory (NREL) – Biomass & Paper** – www.nrel.gov

5G233210	BASICS OF MECHANICAL ENGINEERING	L	T	P	C	End Exam
Theory		3	0	0	3	Theory

Course Introduction

This course introduces students to the **fundamentals of mechanical engineering**, covering essential topics such as **material properties, fluid mechanics, thermodynamics, transmission systems, and steam power systems**. The course provides foundational knowledge required for **analyzing mechanical systems, selecting appropriate materials, understanding energy conversion, and ensuring effective motion transmission**.

Course Objectives

Upon completion of this course, students will be able to:

1. **Explain** the mechanical properties of materials and their relevance in engineering applications.
2. **Describe** the construction and working principles of various pumps, compressors, and valves.
3. **Analyze** different types of bearings, drives, and lubrication systems.
4. **Apply** fluid mechanics concepts such as fluid properties, manometry, and Bernoulli's theorem in engineering applications.
5. **Differentiate** between various types of fuels and combustion processes.
6. **Evaluate** the performance of boilers, turbines, and their components.

Course Outcomes (COs)

After completion of this course, students will be able to:

CO Code	Course Outcome
CO1	**Explain** the mechanical properties of materials and fluid machinery.
CO2	**Describe** different bearings, lubrication, and transmission systems.
CO3	**Analyze** the concepts of fluid statics and dynamics.
CO4	**Apply** thermodynamics concepts and fuel properties in energy conversion.
CO5	**Differentiate** between types of steam boilers and turbines.
CO6	**Evaluate** mechanical system performance using fundamental engineering principles.

Programme Outcomes (POs)

After completing the program, graduates will be able to:

1. **Apply** knowledge of mathematics, science, and engineering to solve mechanical problems.
2. **Identify** and **analyze** complex engineering problems.
3. **Design** and **develop** solutions for engineering applications.
4. **Investigate** problems and provide conclusions using mechanical engineering principles.
5. **Use** modern tools for solving mechanical problems.
6. **Assess** the impact of mechanical engineering solutions on society.
7. **Understand** sustainability and environmental considerations in mechanical applications.
8. **Apply** ethical principles in professional mechanical engineering practices.
9. **Work** effectively in teams and multidisciplinary environments.
10. **Communicate** effectively through reports, drawings, and presentations.
11. **Demonstrate** project management and financial knowledge in engineering projects.
12. **Engage** in lifelong learning for professional development.

Programme Educational Objectives (PEOs)

Graduates will be able to:

1. **Develop** a strong foundation in mechanical engineering principles.
2. **Apply** engineering knowledge to solve real-world mechanical problems.
3. **Communicate** and **collaborate** effectively in professional and research settings.
4. **Engage** in **continuous learning** to keep up with evolving technologies.

Programme Specific Outcomes (PSOs)

Students completing this program will be able to:

1. **Analyze** and **design** mechanical components and systems.
2. **Apply** energy conversion principles to optimize mechanical operations.

CO-PO & PSO Mapping

The following table shows the **correlation** between Course Outcomes (COs), Programme Outcomes (POs), and Programme Specific Outcomes (PSOs):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	-	1	-	-	2	1
CO2	3	3	2	1	1	-	-	-	1	2	-	-	3	2
CO3	2	3	3	3	2	1	-	-	2	2	1	-	3	3
CO4	2	3	3	3	3	1	-	1	2	2	1	-	3	3
CO5	2	3	3	3	3	1	2	1	1	2	2	1	3	3
CO6	3	2	3	3	3	1	2	1	2	3	3	2	3	3

- **3 - Strong correlation**, **2 - Moderate correlation**, **1 - Weak correlation**, **"-" - No correlation**

Instructional Strategy

- **Lecture sessions** with real-world industrial examples.
- **Case studies** and **interactive discussions**.
- **Video demonstrations** of fluid mechanics, thermodynamics, and material testing.
- **Practical assignments** on mechanical system calculations.
- **Industry expert talks** and **guest lectures**.
- **Site visits** to manufacturing plants and thermal power plants.

Assessment Methodology

Assessment Method	AssessmentMarks		Converted Marks	Internal Marks	External Marks	Total Marks
Cycle Test - I (Unit - I & II) (2 Hours) (Written Test)	60 Marks	Best of CT-I & CT-II	10 Marks	40 Marks	60 Marks	100 Marks
Cycle Test - II (Unit - III &IV) (2 Hours) (Written Test)	60 Marks					
Model Theory Examinations (AllUnits) (3 Hours)	100 Marks		10 Marks			
* Assignment - 2 Nos.(2 Nos. x 10 Marks)	20 Marks		10 Marks			
MCQ	10 Marks		5 Marks			
Attendance	5 Marks		5 Marks			
END THEORY EXAMINATIONS (3 Hours)	100 Marks		60 Marks			
TOTAL						

Cycle Test Question Pattern

Part A - 6 Questions x 2 marks = 12 Marks

Part B - 6 Questions x 8 marks = 48 Marks

Total Marks = 60 Marks

In Each Unit (4 Questions answer any 3) and Part - B (4 Questions answer any 3)

End Theory Examination Question Pattern

Part A - 10 Questions x 2 Marks = 20 Marks

Part B - 10 Questions x 8 Marks = 80 Marks

Total Marks = 100 Marks

In Each Unit (3 Questions - Answer any 2) and Part - B (3 Questions - Answer any 2)

Assignment

2 Assignments covers all 5 Units. 20 Marks converted to 10 Marks

MCQ

Each Unit 10 Questions - 50 Questions. 50 Marks converted to 5 Marks

5G233210	BASICS OF MECHANICAL ENGINEERING	L	T	P	C	End Exam
Theory		3	0	0	3	Theory

UNIT	NAME OF THE TOPICS	PERIODS
I	**PROPERTIES OF MATERIALS & FLUID MOVING MACHINERY USED IN INDUSTRY** **Chapter 1.1** - Definition of Elasticity - Plasticity - Ductility -Malleability -Toughness- Hardness -Stiffness, Tensile, Compressive and Shear Stress , Hooke's law, Stress strain curve **Chapter 1.2** - Valves & Types - Gate valve, Globe valve and Check valves - Fans, Blowers, Compressors & Pumps - Construction and working of Reciprocating pumps - Screw pump - External and internal Gear pump - Diaphragm pump - centrifugal pump - Multistage centrifuge pumps- self priming pumps - Water Ring pumps	9
II	**BEARINGS & TRANSMISSION OF MOTION** **Chapter 2.1** - Bearing- Types - Journal - Ball - Roller - Tapper Roller - Needle Bearings -Comparison of Journal And Ball Bearings - Linear Motion Bearings & Applications - Lubricant - Types - Solid, Semisolid And Liquid Lubricants - Properties Of Lubricants. **Chapter 2.2** - Drives - Types - Belt, Chain, Gear Drives -Applications - Merits And Demerits. Cams & followers	9
III	**FLUID STATICS & FLUID DYNAMICS** **Chapter 3.1** - Definitions of Compressible and incompressible fluids- Newtonian and non Newtonian fluids- Properties of fluids - Density, specific gravity, specific weight, viscosity, surface tension, capillarity - Turbulent flow - laminar flow - Boundary layer formation. **Chapter 3.2** - Manometers - U- tube, single column manometers inclined tube manometers - Simple numerical on simple U tube & differential U tube manometers **Chapter 3.3** -Fluid Dynamics: Continuity equation -Bernoulli's equation - Application of Bernoulli's Theorem	9
IV	**THERMODYNAMICS, FUELS AND COMBUSTION** **Chapter4.1** - Terminologies in Thermodynamics (definition only) - System and surroundings- open system, closed system, and isolated system- Thermodynamic equilibrium - Laws of Thermodynamics - First law - Second law - Zeroth law **Chapter 4.2** - Classification of fuels- Solid, liquid and gaseous fuels - merits and demerits - Fossil fuels and non-fossil fuels - Requirements of a good fuel - combustion of fuels- Excess air - products of combustion - Calorific value of fuels (definition only) - LCV and HCV - Orsat analysis for flue gas analysis.	9

V	**STEAM BOILERS & STEAM TURBINES** **Chapter 5.1** - Properties of steam (Sensible, Latent heat & Dryness fraction) - Classification of boiler - Working principles of high pressure boiler-advantages of high pressure boilers -- Boiler mountings and Accessories - Boiler draught - Safety precaution in boiler operation. **Chapter 5.2** - Steam turbine - classification -Construction and working of impulse and reaction steam turbines - Advantages & Disadvantages Comparison of impulse and reaction turbines.	9
TOTAL PERIODS		45

Suggested Student Activities

- **Technical presentations** on recent developments in mechanical engineering.
- **Problem-solving sessions** on fluid mechanics and thermodynamic calculations.
- **Mini projects** on mechanical components and system design.
- **Industrial internships** or **research-based assignments**.
- **Participation in mechanical engineering seminars/conferences**.

Reference Books

1. **"Strength of Materials"** – R.K. Bansal
2. **"Fluid Mechanics and Machinery"** – R.K. Rajput
3. **"Thermodynamics: An Engineering Approach"** – Yunus A. Çengel
4. **"Engineering Mechanics"** – S.S. Bhavikatti

Web Links

1. **MIT OpenCourseWare – Mechanical Engineering** – ocw.mit.edu
2. **NPTEL – Fluid Mechanics and Mechanical Engineering** – nptel.ac.in
3. **ASME (American Society of Mechanical Engineers)** – www.asme.org
4. **IIT Bombay – Mechanical Engineering Tutorials** – www.iitb.ac.in

5G233340	ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C	End Exam
Practicum		1	0	4	3	Practical

Course Introduction

This course provides practical exposure to **fundamental electrical and electronics engineering concepts**, covering **electrical systems, machines, power measurement, electronic circuits, and logic gates**. It aims to equip students with **hands-on skills** required to work with **electric motors, transformers, rectifiers, and digital circuits**, enabling them to apply electrical and electronics knowledge in real-world engineering applications.

Course Objectives

Upon completion of this course, students will be able to:

1. **Understand** the basic principles of electrical circuits, machines, and power transmission.
2. **Operate** and **analyze** different types of electrical machines such as **DC motors, induction motors, and transformers**.
3. **Measure** power, voltage, current, and energy using appropriate instruments.
4. **Construct** and **test** electronic circuits, including **diodes, rectifiers, and voltage regulators**.
5. **Apply** the principles of logic gates in **digital circuits** and **programmable logic controllers (PLCs)**.
6. **Demonstrate** safe handling practices in electrical and electronic applications.

Course Outcomes (COs)

After completing this course, students will be able to:

CO Code	Course Outcome
CO1	**Explain** the fundamentals of electrical systems and power transmission.
CO2	**Operate** and **test** DC and AC motors, transformers, and motor control circuits.
CO3	**Measure** electrical parameters such as voltage, current, power, and energy.
CO4	**Construct** and **analyze** rectifiers, voltage regulators, and SMPS circuits.
CO5	**Apply** logic gates and PLCs for basic automation and digital control.
CO6	**Demonstrate** electrical safety procedures and earthing techniques.

Programme Outcomes (POs)

After completing the program, graduates will be able to:

1. **Apply** basic knowledge of electrical and electronics engineering to solve real-world problems.
2. **Identify** and **analyze** electrical and electronic circuits for various applications.
3. **Design** simple electrical and electronic systems.
4. **Use** modern tools and techniques for electrical and electronic applications.
5. **Work** effectively in multidisciplinary teams.
6. **Apply** ethical principles and adhere to professional responsibilities.
7. **Understand** environmental and sustainability aspects in electrical engineering.
8. **Communicate** effectively in both verbal and written forms.
9. **Demonstrate** leadership and project management skills.
10. **Engage** in lifelong learning to keep pace with emerging technologies.

Programme Educational Objectives (PEOs)

Graduates will be able to:

1. **Develop** strong fundamentals in electrical and electronics engineering.
2. **Apply** knowledge in industrial automation and energy systems.
3. **Work** effectively in teams and contribute to technological innovations.
4. **Engage** in lifelong learning for career advancement.

Programme Specific Outcomes (PSOs)

Students completing this program will be able to:

1. **Analyze** and **design** basic electrical and electronic circuits.
2. **Apply** automation concepts using PLCs and microcontrollers.

CO-PO & PSO Mapping

The following table shows the **correlation** between Course Outcomes (COs), Programme Outcomes (POs), and Programme Specific Outcomes (PSOs):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	-	1	2	1
CO2	3	3	2	1	1	-	-	-	1	2	3	2
CO3	2	3	3	3	2	1	-	-	2	2	3	3
CO4	2	3	3	3	3	1	-	1	2	2	3	3
CO5	2	3	3	3	3	1	2	1	1	2	3	3
CO6	3	2	3	3	3	1	2	1	2	3	3	3

- **3 - Strong correlation**, **2 - Moderate correlation**, **1 - Weak correlation**, **"-" - No correlation**

Assessment Methodology

<table>
<tr><th>Assessment Method</th><th colspan="2">Assessment Marks</th><th>Converted Marks</th><th>Internal Marks</th><th>External Marks</th><th>Total Marks</th></tr>
<tr><td>Cycle Test - I Practical Examinations PART A Exercises (2 Hours)</td><td>50 Marks</td><td rowspan="2">Best of CY-I & CY-II</td><td rowspan="2">10 Marks</td><td rowspan="8">40 Marks</td><td rowspan="8">60 Marks</td><td rowspan="9">100 Marks</td></tr>
<tr><td>Cycle Test - II Practical Examinations PART B Exercises (2 Hours)</td><td>50 Marks</td></tr>
<tr><td>Model Theory Examinations (3 Hours)</td><td>100 Marks</td><td>15 Marks</td><td rowspan="2">15 Marks</td></tr>
<tr><td>Model Practical Examinations (3 Hours)</td><td>100 Marks</td><td>15 Marks</td></tr>
<tr><td>Practical Document/ Drawing Plate submission (Each Exercise / Experiment / Drawing plate should be evaluated to 10 Marks.</td><td colspan="2">10 Marks</td><td>10 Marks</td></tr>
<tr><td>Attendance</td><td colspan="2">5 Marks</td><td>5 Marks</td><td></td></tr>
<tr><td>END PRACTICAL EXAMINATIONS (3 Hours)</td><td colspan="2">100 Marks</td><td>60 Marks</td><td></td></tr>
<tr><td colspan="6">TOTAL</td></tr>
</table>

SCHEME OF EVALUATION
CYCLE TEST I & II

PART	DESCRIPTION	MARKS
1	Aim & Procedure	35
2	Execution and Result	15
	Total	**50**

SCHEME OF EVALUATION
Model Theory Examination

Part A - 10 Questions x 2 Marks = 20 Marks
Part B - 10 Questions x 8 Marks = 80 Marks
Total Marks= 100 Marks

In Each Unit Part - A (3 Questions answer any 2)
Part - B (3 Questions answer any 2)

SCHEME OF EVALUATION
Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
1	Aim (05) ,Program from Part - A (30)	35
2	Aim (05) ,Program from Part - B (30)	35
3	Executing any one program (Part A or Part -B)	15
4	Output	10
5	Viva Voce	05
	Total	**100**

5G233340	ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C	End Exam
Practicum		1	0	4	3	Practical

Unit I	ELECTRICAL SYSTEMS AND MACHINES	
Electricity - Definition of terms and their Units: Current, Voltage, Power, Energy - Types of Supply- AC & DC - Comparison of AC & DC - Single Phase & 3 Phase AC - Advantages - A.C Circuits -Definition of frequency, Average, Maximum and RMS values, Inductance, Capacitance, Reactance and Impedance - Basic Structure of Power Generation, Transmission and Distribution System (elementary treatment only)- Construction, working principle and applications of D.C motors- Difference between DC motor and DC generator- 3 Point Starter - Induction Motors - Single Phase & 3 Phase - Types - D.O.L. & Star/Delta Starters - Electric Drives - Types of Drives - Types of Transmission of Drives - VFD - Transformers- Construction and working principle - Motor Control Centers (MCC) - Fuses- Relays - Circuit breakers. (Functions of the above with brief description).		8
Ex.No	**Name of the Experiment**	
1	Study of DC & AC Motor Starters	30
2	Load test on DC Motor	
3	Load test on single phase Induction Motor	
4	Load test on single phase transformer.	
5	Speed Control of Induction Motor by Variable Frequency Drive	
Unit II	**MEASUREMENTS & ELECTRONICS**	
Use of Ammeter, Voltmeter, Wattmeter, Energy Meter- Electrical Safety - Purpose of grounding the motors and equipment - Measurement of Earth Resistance - Measurement of Power - Measurement of Energy - Diode - forward biasing and reverse biasing - use of diode in rectifiers - Half wave, full wave & Bridge rectifiers - Regulated power supplies: IC voltage regulators - SMPS, UPS and inverters - General description and their applications - LED, 7 segment LED, LCD - Logic gates - Positive and negative logic, definition, symbol, truth table, Boolean expression for OR, AND, NOT, NOR, NAND, EX- OR and EX-NOR gates - Programmable Logic Controllers - Definition- Block Diagram- Applications only		7

Ex.No	Name of the Experiment	
6	Measurement of Earth Resistance	**30**
7	Power & Energy measurement in a single phase circuit using Resistive load.	
8	VI Characteristics of PN Junction Diode	
9	Construction of Bridge Rectifier	
10	Verification of Logic Gates	
TOTAL HOURS		**75**

Instructional Strategy

- **Hands-on lab sessions** with electrical and electronic components.
- **Simulation-based learning** using electrical circuit simulation software.
- **Industrial visits** to power stations or automation industries.
- **Interactive lectures** with real-life case studies.
- **Mini projects** on motor control and digital circuits.
- **Group discussions** on emerging trends in electrical and electronics engineering.

Suggested Student Activities

- **Building small electrical circuits** such as rectifiers and power supplies.
- **Measurement of power and energy** using different instruments.
- **Hands-on troubleshooting** of electrical faults in motors and transformers.
- **Implementing logic gates** using Arduino or PLCs.
- **Industry internships** focusing on automation and power distribution.
- **Participation in technical events and hackathons.**

Reference Books

1. **"Electrical Technology"** – B.L. Theraja
2. **"Basic Electrical and Electronics Engineering"** – M.S. Sukhija & T.K. Nagsarkar
3. **"Industrial Electronics"** – James A. Rehg
4. **"Digital Electronics"** – R.P. Jain

Web Links

1. **MIT OpenCourseWare – Electrical Engineering** – ocw.mit.edu
2. **NPTEL – Electrical and Electronics Engineering** – nptel.ac.in
3. **IEEE Xplore Digital Library** – ieeexplore.ieee.org

- **PLC Basics and Industrial Automation** –

5G233440	INDUSTRIAL CHEMISTRY	L	T	P	C	End Exam
Practicum		1	0	4	3	Practical

COURSE INTRODUCTION Industrial Chemistry plays a crucial role in pulp and paper manufacturing by providing insights into the chemistry behind pulping, additives, and dyes. This course equips students with the fundamental knowledge required for chemical processing and quality control in the paper industry.

COURSE OBJECTIVES

To understand the chemical principles behind pulping and papermaking.

1. To study the chemistry of lignin, cellulose, and various industrial additives.
2. To analyze different chemical formulations used in the paper industry.
3. To perform laboratory experiments related to industrial chemistry.
4. To evaluate the effectiveness of dyes, defoamers, and sizing agents.

COURSE OUTCOMES (COs)

Upon successful completion of this course, students will be able to:

1. Explain the fundamental chemistry behind pulping and papermaking.
2. Analyze the chemical properties of cellulose, lignin, and starch.
3. Evaluate various chemical additives and dyes used in the paper industry.
4. Demonstrate the working principles of sizing agents and defoamers.
5. Conduct laboratory analysis of industrial chemicals.

PROGRAMME OUTCOMES (POs)

1. Engineering knowledge
2. Problem analysis
3. Design/development of solutions
4. Conduct investigations of complex problems
5. Modern tool usage
6. The engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and teamwork
10. Communication skills

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. To develop expertise in industrial chemistry applications in the paper industry.
2. To equip students with problem-solving and analytical skills.
3. To promote sustainable and environmentally friendly chemical processes.
4. To prepare students for successful careers in industrial chemistry.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Ability to analyze and apply industrial chemistry principles to the paper industry.
2. Proficiency in conducting experiments and evaluating chemical properties.

CO-PO-PSO MAPPING TABLE

COs/POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	-	1	3	2
CO2	3	3	2	1	1	-	-	-	1	2	3	3
CO3	2	3	3	3	2	1	-	-	2	2	3	3
CO4	2	3	3	3	3	1	-	1	2	2	3	3
CO5	2	3	3	3	3	1	2	1	1	2	3	3

INSTRUCTIONAL STRATEGY

- **Lectures & Tutorials**: Concept explanation with real-world industrial applications.
- **Laboratory Experiments**: Hands-on practical sessions for chemical analysis.
- **Industry Visits**: Exposure to chemical processing in pulp and paper industries.
- **Case Studies**: Discussions on challenges in industrial chemistry.

Assessment Methodology

Assessment Method	Assessment Marks		Converted Marks	Internal Marks	External Marks	Total Marks
Cycle Test - I Practical Examinations PART A Exercises (2 Hours)	50 Marks	Best of CY-I & CY-II	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Cycle Test - II Practical Examinations PART B Exercises (2 Hours)	50 Marks					
Model Theory Examinations (3 Hours)	100 Marks	15 Marks	15 Marks			
Model Practical Examinations (3 Hours)	100 Marks	15 Marks				
Practical Document/ Drawing Plate submission (Each Exercise / Experiment / Drawing plate should be evaluated to 10 Marks.	10 Marks		10 Marks			
Attendance	5 Marks		5 Marks			
END PRACTICAL EXAMINATIONS (3 Hours)	100 Marks		60 Marks			
TOTAL						

SCHEME OF EVALUATION
CYCLE TEST I & II

PART	DESCRIPTION	MARKS
1	Aim & Procedure	35
2	Execution and Result	15
	Total	**50**

SCHEME OF EVALUATION
Model Theory Examination

Part A - 10 Questions x 2 Marks = 20 Marks
Part B - 10 Questions x 8 Marks = 80 Marks
Total Marks= 100 Marks

In Each Unit Part - A (3 Questions answer any 2)
Part - B (3 Questions answer any 2)

SCHEME OF EVALUATION
Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
1	Aim (05) ,Program from Part - A (30)	35
2	Aim (05) ,Program from Part - B (30)	35
3	Executing any one program (Part A or Part -B)	15
4	Output	10
5	Viva Voce	05
	Total	**100**

5G233440	INDUSTRIAL CHEMISTRY	L	T	P	C	End Exam
Practicum		1	0	4	3	Practical
Unit I	CHEMISTRY BEHIND PULPING					
Chapter 1.1 -Introduction to Organic chemistry - Fuctional group - Classification of organic compounds on the basis of functional groups **Chapter 1.2 - Carbohydrates & Cellulose:**Definition-Nomenclature-Classification-Monosaccharides, Disaccharides &Polysaccharides. Chemical structure of Cellulose - Reason for Fibrous structure - Sorption property - Swelling property - Degradation reaction with alkali (peeling off reaction) and decomposition reaction with chlorine & Chlorine dioxide. **Chapter 1.3 STRUCTURE & REACTION OF LIGNIN:**Elementary composition-Functional groups-Structure of lignin fragments. Cellulose & lignin comparison. Sulphonation - Mercaptation- Condensation-Oxidation reaction such as Hypochlorite Oxidation, Chlorite Oxidation, peroxide Oxidation and permanganate Oxidation-Halogenation. Short notes on uses of polymeric products from lignin in various fields. **Chapter 1.4 -** Starch and its two fractions -Alpha amylose and Beta amylose-Native starch, oxidised starch, cationic starch - preparation - properties & applications - integrated & nonintegrated process-Chemical formula of sodium sulphate and its proerties-Optical Brightening agent & applications						8
Ex.No	**Name of the Experiment**					
1	Analysis of Soap stone Powder					30
2	Evaluation of Starch					
3	Analysis of Sodium Sulphate					
4	Testing of Whitening Agent					

Unit II	MANUFACTURING OF CHEMICAL ADDITIVES & DYES FOR PAPER INDUSTRY	
Chapter 2.1 - Chemical additives used in industry-Manufacture of caustic soda-simple description with diagrams.Manufacture of chlorine dioxide and oxygen-physical and chemical properties of chlorine dioxide and oxygen -Uses of Chlorine dioxide and Oxygen with respect to a paper mill. **Chapter 2.2 -** Various Aluminium Compounds used in paper Making — Chemical formula -Manufacture of Alum, Sodium Aluminate and PAC and its uses. Common Fillers used in paper manufacture - Talcum, Calcium carbonate, Calcined clay and Titanium di oxide. **Chapter 2.3** - Paper sizing chemicals - Chemical formula -Rosin, Fortified rosin, Alkyl Ketene Dimer(AKD), Alkenyl Succinic Anhydride(ASA) - properties & applications-Defoamers and its types. **Chapter 2.4 -Dyes**:Definition-Characteristics-Relationship between color and constitution- The concept of auxochrome and chromophore - Classification according to application-Acid dyes, Direct dyes, Basic dyes, Pigment dyes -One example for each.		7

Ex.No	Name of the Experiment	
5	Analysis of Alum	30
6	Analysis of Defoamer	
7	Testing of Dyes	
8	Analysis of Fortified Rosin	
	TOTAL HOURS	**75**

SUGGESTED STUDENT ACTIVITIES

- Conduct chemical analysis of industrial additives.
- Prepare project reports on chemical processes in paper manufacturing.
- Participate in seminars on emerging trends in industrial chemistry.
- Work on mini-projects related to green chemistry in the paper industry.

REFERENCE BOOKS

Shreve's Chemical Process Industries - George T. Austin

1. Industrial Chemistry - B. K. Sharma
2. Handbook of Pulp and Paper Chemistry - Christopher J. Biermann
3. Elements of Industrial Chemistry - R. Norris Shreve

WEB LINKS

1. https://www.sciencedirect.com/topics/chemical-engineering/pulp-and-paper-industry
2. https://nptel.ac.in/courses/103103029/
3. https://www.tappi.org/
4. https://www.researchgate.net/publication/332876217_Industrial_Chemistry_in_Paper_Production

5G233520	PULP TECHNOLOGY LABORATORY	L	T	P	C	End Exam
Practical		0	0	4	2	Practical

INTRODUCTION

Students will be given the idea of various processes to convert raw material to pulp. The status of Indian industries in relation to papermaking should be imparted to them. The use of pulp for various types of papermaking is emphasized.

Course Objective:

- To provide students with hands-on experience in the analysis of various aspects of pulping processes, including cooking liquors, freeness of pulps, ash and moisture content, and effluent analysis.
- To enable students to understand the key parameters in pulp technology, such as the Kappa number, bleach liquor analysis, and residual alkali in washed pulp.
- To equip students with the practical skills necessary to conduct standard laboratory tests for evaluating pulp quality and the environmental impact of pulping processes.

Course Outcomes (CO):

By the end of the course, students will be able to:

1. **CO1**: Analyze cooking liquors and determine their properties and composition.
2. **CO2**: Measure the freeness of pulps using the CSF method and interpret the results.
3. **CO3**: Evaluate the ash and moisture content of pulp to assess its quality.
4. **CO4**: Determine the Kappa number of pulps and assess their bleachability and chemical properties.
5. **CO5**: Analyze bleach liquor composition and understand its impact on the pulping process.
6. **CO6**: Prepare hand sheets and measure the brightness of pulp to evaluate its quality.
7. **CO7**: Assess residual alkali in washed pulp and understand washing loss during the pulping process.
8. **CO8**: Analyze effluent from pulp mills and understand its environmental implications.

Program Outcomes (PO) and Program-Specific Outcomes (PSO) Mapping:

COs / POs / PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1: Analyze cooking liquors	✓	✓		✓			✓	
CO2: Measure freeness of pulps	✓	✓	✓				✓	✓
CO3: Evaluate ash and moisture content of pulp	✓	✓	✓				✓	✓
CO4: Determine Kappa number of pulps	✓	✓	✓	✓			✓	✓
CO5: Analyze bleach liquor composition	✓	✓		✓	✓		✓	✓
CO6: Prepare hand sheets and measure brightness	✓	✓	✓			✓	✓	✓
CO7: Assess residual alkali in washed pulp	✓	✓		✓		✓	✓	
CO8: Analyze effluent from pulp mills	✓	✓	✓	✓		✓	✓	✓

Instructional Strategy:

- **Practical Sessions**: Students will perform hands-on experiments in the laboratory to familiarize themselves with various analytical techniques used in pulp technology.
- **Demonstrations**: Faculty will demonstrate the correct use of laboratory equipment and the procedures for each experiment.
- **Case Studies**: Case studies from real-world pulp mills will be analyzed to understand the industrial applications of various laboratory tests.
- **Discussions**: Post-laboratory discussions will encourage students to interpret results and understand the implications of their findings in the context of pulp and paper technology.
- **Assignments**: Assignments related to the analysis of effluents, bleach liquor, and cooking liquors will enhance theoretical understanding of industrial processes.

Assessment Methodology

Assessment Method	Assessment Marks		Converted Marks	Internal Marks	External Marks	Total Marks
Cycle Test - I Practical Examinations PART A Exercises (2 Hours)	50 Marks	Best of CT-I and CT-II	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Cycle Test - II Practical Examinations PART B Exercises (2 Hours)	50 Marks					
Model Practical Examinations All Exercises (3 Hours)	100 Marks		15 Marks			
Practical Document submission (Each Exercise / Experiment Drawing plate should be evaluated to 10 Marks	10 Marks		10 Marks			
Attendance	5 Marks		5 Marks			
END PRACTICAL EXAMINATIONS (3 Hours)	100 Marks		60 Marks			
TOTAL						

SCHEME OF EVALUATION

Cycle Test I & II

PART	DESCRIPTION	MARKS
1	Aim & Procedure	35
2	Execution and Result	15
	Total	50

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
1	Aim (05) ,Program from Part - A (30)	35
2	Aim (05) ,Program from Part - B (30)	35
3	Executing any one program (Part A or Part -B)	15
4	Output	10
5	Viva Voce	05
	Total	100

5G233520	PULP TECHNOLOGY LABORATORY	L	T	P	C	End Exam
Practical		0	0	4	2	Practical
Ex. No	**Name of the Experiment**					**Period**
1	Analysis of cooking liquors					60
2	Freeness of pulps (CSF)					
3	Ash and moisture content of pulp					
4	Permanganate number / Kappa number of pulps					
5	Analysis of Bleach liquor					
6	Hand sheet making and brightness of pulp					
7	Residual alkali in washed pulp (washing loss)					
8	Effluent analysis from Pulp mill outlet					
Total Hours						60

Glassware:

1. **Beakers** (50 mL, 100 mL, 250 mL, 500 mL, and 1 L)
2. **Flasks**:
   - **Conical Flasks** (250 mL, 500 mL)
   - **Volumetric Flasks** (100 mL, 500 mL, 1 L)
3. **Burettes** (50 mL)
4. **Pipettes** (10 mL, 25 mL, 50 mL)
5. **Graduated Cylinders** (10 mL, 50 mL, 100 mL)
6. **Measuring Cylinders** (10 mL, 50 mL)
7. **Funnels** (Glass, various sizes)
8. **Watch Glasses** (for evaporation or covering beakers)
9. **Test Tubes** (various sizes)
10. **Test Tube Rack**
11. **Reagents Bottles** (250 mL, 500 mL, 1 L)
12. **Desiccator** (for drying and storing moisture-sensitive chemicals)
13. **Cuvettes** (for spectrophotometric analysis)

Other Laboratory Glassware/Materials:

1. **Titration Equipment** (Burettes, Conical Flasks, Pipettes)
2. **Crucibles** (for ash content determination)
3. **Glass Rods** (for stirring)
4. **Filter Paper** (various grades, including Whatman)
5. **Glass Stirrers** (for mixing solutions)
6. **Petri Dishes** (for small-scale sample analysis)
7. **Graduated Pipette** (to measure liquids accurately)
8. **Thermometer** (for temperature measurements)

Laboratory Equipment:

1. **Freeness Tester (CSF Tester)** – Used to measure the freeness of pulp.
2. **Moisture Analyzer** – To measure the moisture content of pulp samples.
3. **Kappa Number Testing Apparatus** – For determining the Kappa number (a measure of lignin content in the pulp).
4. **Hot Plate** (with magnetic stirrer) – For heating solutions and mixing samples.
5. **Muffle Furnace** – Used for ash content determination and high-temperature analysis.
6. **Soxhlet Extraction Apparatus** – For extracting chemicals or solvents from pulp samples.
7. **Hand Sheet Forming Machine** – For preparing hand sheets from pulp.
8. **pH Meter** – To measure the pH of cooking liquors, bleach liquor, and effluent.
9. **Rotary Evaporator** – For evaporating solvents during chemical tests (e.g., bleach liquor analysis).
10. **Spectrophotometer** – Used for measuring the brightness or color of the pulp (particularly for bleach liquor and hand sheet brightness).
11. **Filtration Setup** (Buchner Funnel, Filter Flask) – For filtration during various experiments.
12. **Conductivity Meter** – To measure the conductivity of the effluent and other liquid samples.
13. **BOD Incubator** – For assessing the biochemical oxygen demand in effluents.
14. **Heated Water Bath** – For temperature-controlled processing of certain samples.
15. **Vacuum Pump** – For filtering and drying samples, especially during effluent analysis.

Other Supplies:

1. **Reagents**:
    - Sodium Hydroxide (NaOH)
    - Hydrochloric Acid (HCl)
    - Potassium Permanganate ($KMnO_4$)
    - Acetic Acid
    - Bleaching Agents (e.g., chlorine dioxide)
    - Calcium Carbonate
    - Sulfuric Acid (H_2SO_4)
    - Hydrogen Peroxide (H_2O_2)
    - Starch Solutions
    - Phosphoric Acid (H_3PO_4)
    - Methyl Red, Phenolphthalein (indicators)
2. **Paper and Filter Media** (Whatman filter papers, blotting paper)
3. **Weighing Scale** (Analytical balance)

Safety Equipment:

1. **Safety Goggles**
2. **Lab Coats**
3. **Gloves** (Rubber/Plastic)
4. **Fume Hood** (for experiments involving volatile chemicals)
5. **Fire Extinguisher**
6. **First Aid Kit**

Additional Tools for Specific Experiments:

- **Hand Sheet Press** – Used for pressing hand sheets made from pulp.
- **Freeness Tester (CSF)** – Used specifically for measuring the freeness of pulps.
- **Effluent Collection System** – For collecting and analyzing effluent during the effluent analysis experiment.

Suggested Student Activities:

1. **Group Project**: Analyze and present a report on the environmental impacts of pulping processes, focusing on effluent treatment and sustainable practices.
2. **Experiment Reports**: Write detailed reports for each laboratory experiment, including methods, results, and discussions on the significance of the findings.
3. **Field Visit**: Organize a visit to a local pulp mill to observe industrial processes, particularly effluent treatment and pulp quality control.
4. **Quiz or Test**: Participate in quizzes related to the pulping process, chemical reactions, and laboratory analysis methods.
5. **Group Presentation**: Present findings on the effects of various bleaching agents and the process of hand sheet making.

Reference Books:

1. **"Pulp and Paper Chemistry and Technology" by James P. Casey** – Comprehensive coverage of the chemistry and technology behind pulping and paper production.
2. **"Pulp and Paper Manufacture, Vol 1: The Kraft Process" by M. K. Bansal** – Focuses on the Kraft process and includes important aspects of chemical pulping.
3. **"Fundamentals of Pulping and Papermaking" by C. G. Dence and D. W. Reeve** – Detailed exploration of the pulp and paper industry and laboratory procedures.
4. **"Handbook of Pulping and Papermaking" by Robert A. Young** – Reference guide for pulp analysis, chemical treatment, and paper-making processes.
5. **"The Chemistry of Pulp and Paper Making" by H.A. Jansen** – A thorough text on the chemical processes involved in pulp production and bleaching.

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1. **TAPPI (Technical Association of the Pulp and Paper Industry)**
   Link: https://www.tappi.org/
   - TAPPI provides industry standards, research, and technical resources for the pulp and paper industry.
2. **Pulp and Paper Research Institute of Canada (Paprican)**
   Link: https://www.fpinnovations.ca/
   - FPInnovations is a leader in applied research for the forest products industry, including pulping processes.
3. **ResearchGate - Pulp and Paper Technology**
   Link: https://www.researchgate.net/
   - ResearchGate is a network where you can find research papers and publications on pulp and paper technologies.
4. **Pulp and Paper Wiki**
   Link: https://www.pulpandpaperwiki.com/
   - This wiki provides information on various pulping processes, chemical treatments, and technologies used in the paper industry.
5. **Papermaking Research Center - University of Washington**
   Link: https://www.pugetsound.edu/academics/academic-resources/papermaking-research-center/
   - University of Washington's Papermaking Research Center offers research and resources related to the paper industry and pulp technology.

5G233620	FLUID MECHANICS LABORATORY	L	T	P	C	End Exam
Practical		0	0	4	2	Practical

Course Introduction: The Fluid Mechanics Laboratory course provides hands-on experience in understanding the principles of fluid mechanics. Through a series of experiments, students will analyze fluid properties, flow characteristics, and performance of various hydraulic machines. This practical exposure enhances theoretical learning and develops essential engineering skills.

Course Objectives:

1. To familiarize students with fluid flow measurement techniques.
2. To analyze the performance of pumps and compressors.
3. To evaluate frictional losses in pipes and fittings.
4. To understand flow behavior through different measuring devices.
5. To enhance problem-solving skills related to fluid mechanics applications.

Course Outcomes (CO) with Verbs:

1. **CO1**: Conduct experiments to determine the coefficients of orifices and venturi meters. *(Apply, Analyze)*
2. **CO2**: Measure and analyze pipe friction losses. *(Evaluate)*
3. **CO3**: Calibrate flow measuring devices like V-notches and rotameters. *(Apply, Analyze)*
4. **CO4**: Study the characteristics of centrifugal and reciprocating pumps. *(Analyze, Evaluate)*
5. **CO5**: Operate and assess the performance of a compressor test rig. *(Apply, Evaluate)*

Programme Outcomes (PO):

1. Engineering Knowledge
2. Problem Analysis
3. Design/Development of Solutions
4. Conduct Investigations of Complex Problems
5. Modern Tool Usage
6. Engineer and Society
7. Environment and Sustainability
8. Ethics
9. Individual and Team Work
10. Communication
11. Project Management
12. Life-Long Learning

Programme Educational Objectives (PEO):

1. To equip students with fundamental knowledge and practical exposure in fluid mechanics.

2. To develop analytical and experimental skills required for industry and research.
3. To enable students to solve real-world fluid flow problems effectively.

Programme Specific Outcomes (PSO):

1. Apply the knowledge of fluid mechanics in the design and analysis of hydraulic systems.
2. Utilize experimental data to enhance the performance of fluid flow systems.

CO-PO-PSO Mapping:

CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	3	3	2	2	2	-	-	-	1	1	-	2	3	2
CO2	3	3	2	3	2	-	-	-	1	1	-	2	3	2
CO3	3	2	2	2	2	-	-	-	1	1	-	2	3	3
CO4	3	3	3	3	3	-	-	-	1	1	-	2	3	3
CO5	3	3	3	3	3	-	-	-	1	1	-	2	3	3
(3: Strong, 2: Moderate, 1: Slight, - : No Mapping)														

Instructional Strategy:

- Hands-on demonstration of each experiment before student execution.
- Encouraging teamwork and collaborative learning.
- Real-time data analysis and comparison with theoretical values.
- Assignments and lab reports to enhance analytical and documentation skills.

Assessment Methodology

Assessment Method	Assessment Marks		Converted Marks	Internal Marks	External Marks	Total Marks
Cycle Test - I Practical Examinations PART A Exercises (2 Hours)	50 Marks	Best of CT-I and CT-II	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Cycle Test - II Practical Examinations PART B Exercises (2 Hours)	50 Marks					
Model Practical Examinations All Exercises (3 Hours)	100 Marks		15 Marks			
Practical Document submission (Each Exercise / Experiment Drawing plate should be evaluated to 10 Marks	10 Marks		10 Marks			
Attendance	5 Marks		5 Marks			
END PRACTICAL EXAMINATIONS (3 Hours)	100 Marks		60 Marks			
TOTAL						

SCHEME OF EVALUATION

Cycle Test I & II

PART	DESCRIPTION	MARKS
1	Aim & Procedure	35
2	Execution and Result	15
	Total	50

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
1	Aim (05) ,Program from Part - A (30)	35
2	Aim (05) ,Program from Part - B (30)	35
3	Executing any one program (Part A or Part -B)	15
4	Output	10
5	Viva Voce	05
	Total	100

5G233620	FLUID MECHANICS LABORATORY	L	T	P	C	End Exam
Practical		0	0	4	2	Practical

Ex. No	Name of the Experiment	Period
1	Determination of Orifice Co-Efficient.	60
2	Determination of Venturi Co-Efficient.	
3	Determination of Pipe Friction	
4	Flow Through V-Notch	
5	Rotameter calibration	
6	Centrifugal Pump Characteristics	
7	Compressor Test Rig.	
8	Study Of Pipes, Pipe Fittings	
9	Study Of Centrifugal Pump	
10	Reciprocating Pump Characteristics	
Total Hours		60

LIST OF EQUIPMENTS

- Orifice meter
- Venturimeter
- Pipe friction setup
- V notch setup
- Rotameter
- Centrifugal pump
- Air compressor
- Reciprocating pump

Suggested Student Activities:

- Conduct additional experiments beyond the syllabus.
- Prepare case studies on real-world fluid mechanics applications.
- Develop computational models for fluid flow analysis.
- Participate in technical presentations and competitions related to fluid mechanics.

Reference Books:

1. R.K. Bansal, "Fluid Mechanics and Hydraulic Machines," Laxmi Publications.
2. P.N. Modi & S.M. Seth, "Hydraulics and Fluid Mechanics," Standard Book House.
3. S.K. Som, Gautam Biswas, & S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines," McGraw Hill Education.

Web Links:

1. https://nptel.ac.in/courses/112/105/112105268/
2. https://www.mechengg.net/fluid-mechanics-lab-experiments/
3. https://www.sciencedirect.com/journal/experimental-thermal-and-fluid-science

5G234173	PULPING OPERATION, ELECTRICAL & MECHANICAL MAINTENANCE	L	T	P	C	End Exam
Industrial Training		0	0	0	9	Project

Course Introduction: This course on Pulping Operation, Electrical & Mechanical Maintenance provides students with an in-depth understanding of pulping processes, washing, screening, bleaching operations, and maintenance aspects of unit operations. The focus is on reducing pollution, optimizing energy and chemical recovery, and improving the quality of pulp production. Emphasis is placed on industrial training to equip students with hands-on experience in the field.

Course Outcomes (COs):

1. Explain various pulping operations.
2. Demonstrate conversion of raw materials into pulp
3. Analyze cooking operations and conditions for different raw materials.
4. Understand electrical and mechanical maintenance in unit operations
5. Evaluate various washing and bleaching methods and their parameters.

Programme Outcomes (POs):

1. Engineering knowledge
2. Problem analysis
3. Design and development of solutions
4. Conduct investigations of complex problems
5. Modern tool usage
6. Engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and teamwork
10. Communication
11. Project management and finance
12. Life-long learning

Programme Educational Objectives (PEOs):

1. Provide comprehensive knowledge of pulping, screening, and washing techniques.
2. Develop skills in maintaining industrial electrical and mechanical systems.
3. Foster an understanding of pollution reduction and sustainability in pulp industries.
4. Enhance hands-on industrial training experience for real-world applications.
5. Encourage lifelong learning and professional development in pulp technology.

Programme Specific Outcomes (PSOs):

1. Apply knowledge of pulping and washing processes for industrial applications.
2. Develop problem-solving skills for electrical and mechanical maintenance in pulp operations.
3. Evaluate environmental and operational efficiency in pulp manufacturing.

CO-PO-PSO Mapping:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	3	2	2	2	1	2	3	2	2
CO2	3	3	2	3	3	2	3	2	2	2	1	2	3	3	3
CO3	3	3	3	3	3	2	3	2	2	2	1	2	3	3	3
CO4	3	2	3	3	3	3	3	2	2	2	1	2	3	3	3
CO5	3	3	3	3	3	3	3	3	2	2	1	2	3	3	3

Instructional Strategy:

1. Industry-based training for real-world exposure.
2. Hands-on sessions on pulping, washing, and bleaching techniques.
3. Demonstrations of electrical and mechanical maintenance procedures.
4. Case studies on sustainability and pollution reduction in pulp industries.
5. Group discussions and technical presentations on modern pulp processing techniques.

COURSE TYPE PROJECT/INTERNSHIP END EXAM PROJECT

Assessment Method	Assessment Marks	Converted Marks	Internal Marks	External Marks	Total Marks
Punctuality and regularity. (Attendance)	10 Marks	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Level/proficiency of practical skills acquired. Initiative in learning / working at site	10 Marks	10 Marks			
Self-expression / communication skills. Interpersonal skills / Human Relation.	10 Marks	10 Marks			
Report and Presentation.	10 Marks	10 Marks			
END PROJECT EXAMINATIONS	100 Marks	60 Marks			
TOTAL					

SCHEME OF EVALUATION
END SEMESTER EXAMINATION- PROJECT

PART	DESCRIPTION	MARKS
1	Daily Activity Report snd Attendance certificate	20
2	Comprehensive report on Internship, Relevant Certificate from the concerned department.	30
3	Presentation by the student at the end of the Internship	30
4	Viva Voce	20
	Total	**100**

Suggested Student Activities:

1. Industrial visits to pulp manufacturing plants.
2. Research on advanced pulping and bleaching technologies.
3. Hands-on troubleshooting of electrical and mechanical maintenance issues.
4. Group projects on optimizing pulp washing and bleaching efficiency.
5. Participation in technical seminars and workshops.

Reference Books:

1. G.A. Smook, "Handbook for Pulp & Paper Technologists," Angus Wilde Publications.
2. J.P. Casey, "Pulp and Paper: Chemistry and Chemical Technology," Wiley.
3. M.J. Kocurek, "Pulp and Paper Manufacture Series," TAPPI Press.
4. C. Biermann, "Handbook of Pulping and Papermaking," Elsevier.
5. E. Sjöström, "Wood Chemistry: Fundamentals and Applications," Academic Press.

Web Links:

1. https://www.tappi.org/
2. https://www.pulpandpaper.org/

5G234273	CHEMICAL RECOVERY OPERATION AND MAINTENANCE	L	T	P	C	End Exam
Industrial Training		0	0	0	9	Project

Course Introduction

Chemical recovery is an essential part of any modern paper mill, significantly aiding in pollution control and resource conservation. The process focuses on recovering and reusing cooking chemicals, minimizing emissions, and improving energy efficiency. This course provides in-depth knowledge of chemical recovery operations, including black liquor conversion, evaporator functions, heat recovery, and causticizing processes. The course also emphasizes the maintenance of recovery boilers and Electrostatic Precipitators (ESP).

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

- **CO1:** Explain the conversion process of black liquor to white liquor.
- **CO2:** Analyze the different process steps involved in evaporators.
- **CO3:** Demonstrate the recovery of heat and white liquor chemicals in the recovery boiler.
- **CO4:** Describe the process and key parameters of causticizing and lime kiln operations
- **CO5:** Apply knowledge of unit operations and mechanical maintenance in the recovery process.

Programme Outcomes (POs)

1. Engineering knowledge
2. Problem analysis
3. Design and development of solutions
4. Conduct investigations of complex problems
5. Modern tool usage
6. Engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and teamwork
10. Communication
11. Project management and finance
12. Life-long learning

Programme Educational Objectives (PEOs)

1. Develop a strong foundation in chemical recovery processes for industrial applications.
2. Enhance problem-solving skills for effective process optimization.
3. Promote sustainable and eco-friendly practices in chemical recovery.
4. Encourage teamwork and effective communication for industrial operations.
5. Prepare students for lifelong learning and adaptation to technological advancements.

Programme Specific Outcomes (PSOs)

1. Apply knowledge of chemical recovery and environmental sustainability in pulp and paper industries.
2. Develop skills in optimizing chemical recovery processes and minimizing emissions.
3. Understand and apply mechanical and electrical maintenance principles in recovery operations.

CO-PO-PSO Mapping

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	2	2	3	2	3
CO2	3	3	2	3	2	2	2	3	2	3
CO3	3	3	2	3	2	2	2	3	3	3
CO4	3	3	2	3	2	2	2	3	3	3
CO5	3	3	2	3	2	2	2	3	3	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- **Engage and Motivate:** Actively involve students to enhance confidence and learning.
- **Real-World Relevance:** Incorporate industry examples and case studies to link theory with practice.
- **Interactive Learning:** Use demonstrations and discussions to enhance engagement.
- **Application-Based Learning:** Implement a *theory-demonstrate-practice-activity* model for hands-on experience.
- **Critical Thinking:** Encourage students to analyze and troubleshoot chemical recovery processes.

COURSE TYPE PROJECT/INTERNSHIP END EXAM PROJECT

Assessment Method	Assessment Marks	Converted Marks	Internal Marks	External Marks	Total Marks
Punctuality and regularity. (Attendance)	10 Marks	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Level/proficiency of practical skills acquired. Initiative in learning / working at site	10 Marks	10 Marks			
Self-expression / communication skills. Interpersonal skills / Human Relation.	10 Marks	10 Marks			
Report and Presentation.	10 Marks	10 Marks			
END PROJECT EXAMINATIONS	100 Marks	60 Marks			
TOTAL					

SCHEME OF EVALUATION
END SEMESTER EXAMINATION- PROJECT

PART	DESCRIPTION	MARKS
1	Daily Activity Report and Attendance certificate	20
2	Comprehensive report on Internship, Relevant Certificate from the concerned department.	30
3	Presentation by the student at the end of the Internship	30
4	Viva Voce	20
	Total	**100**

Suggested Student Activities

1. Industrial visits to chemical recovery plants.
2. Group projects on pollution control and sustainability in chemical recovery.
3. Case studies on process optimization in the recovery boiler.
4. Hands-on simulation exercises for evaporator and causticizer operations.
5. Technical presentations on chemical recovery advancements.

Reference Books

1. G. Hough, *Chemical Recovery in the Alkaline Pulping Processes*, TAPPI Press.
2. J. P. Casey, *Pulp and Paper: Chemistry and Chemical Technology*, Wiley.
3. E. Sjöström, *Wood Chemistry: Fundamentals and Applications*, Academic Press.
4. M. Biermann, *Handbook of Pulping and Papermaking*, Elsevier.
5. W. Smook, *Handbook for Pulp & Paper Technologists*, Angus Wilde Publications.

Web Links

1. TAPPI - Pulp and Paper Technical Association
2. Pulp and Paper Research
3. ScienceDirect - Pulp and Paper Journal
4. Cellulose Chemistry and Technology
5. ResearchGate - Pulp and Paper Technology

5G235110	PULP AND PAPER TECHNOLOGY II	L	T	P	C	End Exam
Theory		3	0	0	3	Theory

Course Introduction

This course provides an in-depth understanding of pulping and bleaching processes in the pulp and paper industry. It covers different pulping methods, including sulphate, sulphite, mechanical, semi-chemical, and deinking processes. Students will learn about washing, screening, cleaning, and bleaching techniques essential for producing high-quality pulp. The course also emphasizes the environmental impact of these processes and strategies for pollution control.

Course Objectives

By the end of this course, students will be able to:

- Understand different pulping methods and their industrial applications.
- Learn the principles of washing, screening, and centri-cleaning in pulp processing.
- Gain knowledge of deinking, rag pulping, and pretreatment processes.
- Analyze the chemical reactions and process variables involved in pulping and bleaching.
- Evaluate modern bleaching techniques and their environmental impact.

Course Outcomes (Cos):

Upon successful completion of the course, students will be able to:

- **CO1:** Explain the sulphate pulping process and its process variables.
- **CO2:** Compare different pulping techniques such as sulphite, mechanical, and semi-chemical pulping.
- **CO3:** Describe the deinking process, rag pulping, and their industrial significance.
- **CO4:** Evaluate washing, screening, and centri-cleaning methods for efficient pulp processing.
- **CO5:** Analyze bleaching processes, including ECF and enzyme bleaching, and assess their environmental impact

Programme Outcomes (POs)

1. Engineering knowledge
2. Problem analysis
3. Design and development of solutions
4. Conduct investigations of complex problems
5. Modern tool usage
6. Engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and teamwork
10. Communication
11. Project management and finance
12. Life-long learning

Programme Educational Objectives (PEOs)

1. Develop a strong foundation in pulping and bleaching processes.
2. Enhance analytical and problem-solving skills in pulp and paper technology.
3. Promote environmentally sustainable practices in the paper industry.
4. Encourage teamwork and effective communication in industrial settings.
5. Foster continuous learning and adaptation to new technologies.

Programme Specific Outcomes (PSOs)

1. Apply knowledge of pulping and bleaching processes in industrial applications.
2. Optimize pulp quality and process efficiency through advanced techniques.
3. Implement environmentally friendly and sustainable practices in pulp production.

CO-PO-PSO Mapping

CO/PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	3	2	2	2	3	2	2
CO2	3	3	2	3	3	2	2	3	2	3
CO3	3	3	3	3	3	2	2	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- **Concept-Based Learning:** Deliver interactive lectures with real-world examples.
- **Industrial Relevance:** Incorporate case studies and practical insights from the pulp and paper industry.
- **Hands-On Activities:** Engage students in problem-solving exercises and process simulations.
- **Group Discussions:** Encourage discussions on environmental impact and sustainable practices.
- **Technical Presentations:** Assign research topics for student presentations on modern pulping technologies.

Assessment Methodology

<table>
<tr><th>Assessment Method</th><th colspan="2">AssessmentMarks</th><th>Converted Marks</th><th>Internal Marks</th><th>External Marks</th><th>Total Marks</th></tr>
<tr><td>Cycle Test - I (Unit - I & II)
(2 Hours) (Written Test)</td><td>60 Marks</td><td rowspan="2">Best of CT-I
&
CT-II</td><td rowspan="2">10 Marks</td><td rowspan="7">40 Marks</td><td rowspan="7">60 Marks</td><td rowspan="8">100 Marks</td></tr>
<tr><td>Cycle Test - II (Unit - III &IV) (2 Hours)
(Written Test)</td><td>60 Marks</td></tr>
<tr><td>Model Theory Examinations
(AllUnits) (3 Hours)</td><td colspan="2">100 Marks</td><td>10 Marks</td></tr>
<tr><td>* Assignment - 2 Nos.(2 Nos. x 10 Marks)</td><td colspan="2">20 Marks</td><td>10 Marks</td></tr>
<tr><td>MCQ</td><td colspan="2">10 Marks</td><td>5 Marks</td></tr>
<tr><td>Attendance</td><td colspan="2">5 Marks</td><td>5 Marks</td></tr>
<tr><td>END THEORY EXAMINATIONS
(3 Hours)</td><td colspan="2">100 Marks</td><td>60 Marks</td></tr>
<tr><td colspan="6">TOTAL</td></tr>
</table>

Cycle Test Question Pattern

Part A - 6 Questions x 2 marks = 12 Marks

Part B - 6 Questions x 8 marks = 48 Marks

Total Marks = 60 Marks

In each Unit (4 Questions - Answer any 3) and Part - B (4 Questions - Answer any 3)

End Theory Examination Question Pattern

Part A - 10 Questions x 2 Marks = 20 Marks

Part B - 10 Questions x 8 Marks = 80 Marks

Total Marks = 100 Marks

In each Unit (3 Questions - Answer any 2) and Part - B (3 Questions - Answer any 2)

Assignment

2 Assignments covers all 5 Units 20. Marks converted to 10 Marks

MCQ

Each Unit 10 Questions - 50 Questions 50. Marks converted to 5 Marks

5G235110	PULP & PAPER TECHNOLOGY II	L	T	P	C	End Exam
Theory		3	0	0	3	Theory

UNIT	NAME OF THE TOPICS	PERIODS
I	**SULPHATE PULPING** **Chapter 1.1** - Introduction to chemical pulping - Introduction to sulphate pulping process - Advantages and disadvantage of sulphate pulping Standard terms (Applicable only to pulping process) - Complete cooking cycle of batch digester wit reference to stationary vertical digester - Illustration of RDH/Super Batch process. - Uses of black liquor - Air pollution - Problems to calculate the volumes of WL and BL using bath ratio of a stationary digester - Chemical reactions in alkaline pulping-Process variables in sulphate cooking i) Amount of alkali (as effective alkali) ii) Alkali Concentration iii) Sulphidity iv) Time and Temperature - H- factor (a short note with definition only) - Equipments details : Digester - Below tank - Preheater - Regenerators - Recuperators.	9
II	**SULPHITE PULPING, MECHANICAL PULPING & SEMI CHEMICAL PULPING** **Chapter 2.1** - Outline of the process with block diagram - Sulphite pulping - Raw material suitability - A table of difference between sulphate and sulphite pulping - A qualitative treatment only on dissolving grade pulping **Chapter 2.2** - Introduction to the types of mechanical pulping- A block diagram and simple description of ground wood pulping process - Description of grinding with a neat diagram - Limitations of ground wood pulps **Chapter 2.3** - Principle and scope - Advantages of SC process - Properties of SC pulps - A note on pulp yield -Types of SC process - NSSC (bath process and typical cooking conditions) A note on α β and r celluloses.	9

III	**PUPLING AND PRETREATMENT OF RAGS & DEINKING** **Chapter 3.1** - Properties and uses of rag pulps- A note on pulping of cotton linters **Chapter 3.2** - Process description with plant Diagram, Deinking(wastepaper treatment)- Advantages and disadvantages of deinked stock- A brief note on deinking chemicals-A qualitative account on deinking plant- Shrinkage and yield of Deinking- Properties and uses of Deinked pulps.	9
IV	**WASHING & SCREENING AND CENTRICLEANING** **Chapter4.1** - Reasons for washing - Chemical losses substances removed during washing - Washing efficiency - Dilution factor and displacement ratio (Qualitative treatment only) - Types of washing equipment - Diagram and description of diffusion washer and rotary drum washer - A complete diagram of a typical three stage countercurrent washing system - Twin roll press - Operational factors affecting washing efficiency - A note on knotter - Unit operations in washing **Chapter 4.2** - Introduction-Screening and principles - Nature of impurities - Important variables in screening - Cascading principle of centricleaner - A typical flow diagram of modern screening plant and its description.	9
V	**BLEACHING** **Chapter 5.1** - Introduction and aims of bleaching - Bleaching chemicals - Principles of their chemical analysis - Bleach ability of pulps - Single stage and multistage bleaching - Chlorine water system and its significances in bleaching - Peroxide and Hydrosulphite bleaching- Chlorine-di-oxide treatment - Bleaching with a reducing agent - Introduction to Elemental chlorine-free bleaching process - Introduction to enzyme bleaching process - Chemical reactions in bleaching - Variables in bleaching - Bleaching equipments - Safety - Materials of construction. **Chapter 5.2** - Auxiliary equipments - Oxygen bleaching of mechanical pulps - A flow diagram with description of CEH/CEHH sequence only	9
TOTAL PERIODS		45

5G235210	PLANT ENGINEERING MANAGEMENT	L	T	P	C	End Exam
Theory		3	0	0	3	Theory

Course Introduction

This course provides an understanding of the principles of management, plant layout, production planning, quality control, industrial relations, and the working principles of steam boilers and turbines. It is designed to equip students with the necessary skills for effective plant engineering and management in an industrial environment.

Course Objectives

By the end of this course, students will be able to:

- Understand the fundamentals of industrial management and entrepreneurship.
- Learn organizational structures, leadership, and production planning techniques.
- Gain knowledge of quality control systems, including ISO standards.
- Analyze marketing functions and industrial relations.
- Understand steam boilers, steam turbines, and their working principles.

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

- **CO1:** Explain the principles of management, entrepreneurship, and plant layout. **CO2:** Analyze leadership, decision-making, and inventory control methods. *(Analyze, Evaluate)*
- **CO3:** Apply quality control techniques and understand certification schemes. *(Apply, Understand)*
- **CO4:** Evaluate marketing strategies, industrial relations, and employee rights. *(Evaluate, Assess)*
- **CO5:** Describe the working principles of steam boilers and turbines. *(Describe, Explain)*

Programme Outcomes (POs)

1. Engineering knowledge
2. Problem analysis
3. Design and development of solutions
4. Conduct investigations of complex problems
5. Modern tool usage
6. Engineer and society
7. Environment and sustainability
8. Ethics

9. Individual and teamwork
10. Communication
11. Project management and finance
12. Life-long learning

Programme Educational Objectives (PEOs)

1. Develop managerial skills essential for industrial plant operations.
2. Enhance problem-solving abilities in production and quality management.
3. Promote ethical and responsible industrial practices.
4. Strengthen communication and teamwork in plant engineering.
5. Encourage continuous learning and professional growth in industrial engineering.

Programme Specific Outcomes (PSOs)

1. Apply engineering management principles in plant operations.
2. Optimize industrial processes through quality control and planning techniques.
3. Implement safe and efficient steam boiler and turbine operations.

CO-PO-PSO Mapping

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	3	2	2
CO2	3	3	2	3	3	2	2	3	3	2
CO3	3	3	3	3	3	2	2	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- **Case-Based Learning:** Incorporate real-life industrial management cases for better understanding.
- **Interactive Learning:** Use group discussions, role plays, and decision-making exercises.
- **Hands-On Activities:** Introduce practical examples related to quality control and production planning.
- **Process Simulations:** Implement software tools to simulate plant operations and management.
- **Industrial Exposure:** Encourage industrial visits and guest lectures from industry professionals.

Assessment Method

Assessment Method	Assessment Marks		Converted Marks	Internal Marks	External Marks	Total Marks
Cycle Test - I (Unit - I & II) (2 Hours) (Written Test)	60 Marks	Best of CT-I & CT-II	10 Marks	40 Marks	60 Marks	100 Marks
Cycle Test - II (Unit - III &IV) (2 Hours) (Written Test)	60 Marks					
Model Theory Examinations (AllUnits) (3 Hours)	100 Marks		10 Marks			
* Assignment - 2 Nos.(2 Nos. x 10 Marks)	20 Marks		10 Marks			
MCQ	10 Marks		5 Marks			
Attendance	5 Marks		5 Marks			
END THEORY EXAMINATIONS (3 Hours)	100 Marks		60 Marks			
TOTAL						

Cycle Test Question Pattern

Part A - 6 Questions x 2 marks = 12 Marks
Part B - 6 Questions x 8 marks = 48 Marks
Total Marks = 60 Marks
In each Unit (4 Questions - Answer any 3) and Part - B (4 Questions - Answer any 3)

End Theory Examination Question Pattern

Part A - 10 Questions x 2 Marks = 20 Marks
Part B - 10 Questions x 8 Marks = 80 Marks
Total Marks = 100 Marks
In Each Unit (3 Questions - Answer any 2) and Part - B (3 Questions - Answer any 2)

Assignment

2 Assignments covers all 5 Units. 20 Marks converted to 10 Marks

MCQ

Each Unit 10 Questions - 50 Questions. 50 Marks converted to 5 Marks

5G235210	**PLANT ENGINEERING MANAGEMENT**	L	T	P	C	End Exam
Theory		3	0	0	3	Theory

UNIT	NAME OF THE TOPICS	PERIODS
I	**PRINCIPLES OF MANAGEMENT** **Chapter 1.1** - Role of industry -Types of ownership-Proprietorship, partnership-Private limited -Public limited -Industrial co- operatives - Scientific management -Functions of management -Types of organization -line-staff-functional organization -concept and Definition -Importance of Entrepreneurship -Promotion of self employment - Government policies -Advantages and limitations of entrepreneurship. Product selection -Site selection - Principles of plant layout - Factors influencing plant location.	9
II	**ORGANISATION** **Chapter 2.1** - Leadership in organization -Decision making - Communication -Motivation -Group dynamics - Production planning and control -Need for planning - Routing -Scheduling - Dispatching - PERT -CPM - Inventory control -ABC analysis of safety stock -EOQ method - Purchasing procedures -Records -Bin cards.	9
III	**QUALITY CONTROL** **Chapter 3.1** - Quality control -Basic concepts -Definition -Terminology - Presentation of data -Indian standards on quality control technique - Quality certification schemes -ISO 9000, ISO 14000 etc. OSHAS.	9
IV	**MARKETING FUNCTIONS, INDUSTRIAL RELATIONS** **Chapter4.1** - Marketing -Definition -Information -Functions -Pricing policy -Pricing techniques Sales -Definition -Personal selling - Promotion mix - Advertising -Sales packaging -Promotion techniques Trade unions -Disputes -Settlement -Collective bargaining -Welfare concepts - Rights and responsibilities of employer and employee	9
V	**STEAM BOILERS & STEAM TURBINES** **Chapter 5.1** - Properties of steam (Sensible, Latent heat & Dryness fraction) - Classification of boiler - Working principles of high pressure boiler-advantages of high pressure boilers -- Boiler mountings and Accessories - Boiler draught - Safety precaution in boiler operation. **Chapter 5.2** - Steam turbine - classification -Construction and working of impulse and reaction steam turbines - Advantages & Disadvantages Comparison of impulse and reaction turbines.	9
TOTAL PERIODS		**45**

Suggested Student Activities

1. Conduct case studies on plant management and layout optimization.
2. Analyze industrial quality control systems and present findings.
3. Participate in leadership and decision-making role-playing activities.
4. Visit industries to observe boiler and turbine operations.
5. Research and present on modern industrial management practices.

Reference Books

1. Koontz & Weihrich, *Essentials of Management*, Tata McGraw Hill.
2. S. P. Robbins & M. Coulter, *Management*, Pearson Education.
3. Juran & Gryna, *Quality Planning and Analysis*, Tata McGraw Hill.
4. O. P. Khanna, *Industrial Engineering and Management*, Dhanpat Rai & Sons.
5. P. N. Rao, *Manufacturing Technology*, Tata McGraw Hill.

Web Links

1. National Productivity Council
2. ISO Standards
3. MIT OpenCourseWare - Engineering Management
4. Harvard Business Review - Management
5. National Institute of Industrial Engineering (NITIE)

5G235310	**UNIT OPERATION IN PULP & PAPER**	L	T	P	C	End Exam
Theory		3	0	0	3	Theory

Course Introduction

This course provides fundamental knowledge of various unit operations involved in the pulp and paper industry. It covers size reduction, screening, conveying, separation, heat transfer, heat exchangers, absorption, humidification, and drying. Students will learn about industrial equipment and their operational principles, enabling them to understand and optimize pulp and paper manufacturing processes.

Course Objectives

By the end of this course, students will be able to:

- Understand the principles and applications of size reduction and screening.
- Learn material conveying, separation, and filtration techniques.
- Gain knowledge of heat transfer and heat exchanger operations.
- Analyze absorption, humidification, and drying processes in industrial applications.
- Solve basic numerical problems related to heat and mass transfer in the pulp and paper industry.

Course Outcomes (COs) with Action Verbs

Upon successful completion of the course, students will be able to:

- **CO1:** Explain size reduction techniques and perform basic sieve analysis. *(Understand, Explain)*
- **CO2:** Analyze different material conveying and separation methods. *(Analyze, Compare)*
- **CO3:** Apply heat transfer concepts to industrial heat exchange processes. *(Apply, Demonstrate)*
- **CO4:** Evaluate evaporation processes and material balances in pulp and paper industries. *(Evaluate, Calculate)*
- **CO5:** Describe and compare absorption, humidification, and drying techniques. *(Describe, Compare)*

Programme Outcomes (POs)

1. Engineering knowledge
2. Problem analysis
3. Design and development of solutions

4. Conduct investigations of complex problems
5. Modern tool usage
6. Engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and teamwork
10. Communication
11. Project management and finance
12. Life-long learning

Programme Educational Objectives (PEOs)

1. Develop expertise in unit operations relevant to the pulp and paper industry.
2. Enhance problem-solving and analytical skills in industrial processes.
3. Promote sustainable and efficient industrial operations.
4. Strengthen teamwork and communication skills in an industrial setting.
5. Encourage continuous learning and technological adaptation.

Programme Specific Outcomes (PSOs)

1. Apply engineering principles to unit operations in the pulp and paper industry.
2. Analyze and optimize industrial heat and mass transfer processes.
3. Implement best practices in absorption, humidification, and drying techniques.

CO-PO-PSO Mapping

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	3	2	2
CO2	3	3	2	3	3	2	2	3	3	2
CO3	3	3	3	3	3	2	2	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- **Case-Based Learning:** Include case studies from pulp and paper industries.
- **Interactive Learning:** Use real-life industrial examples and site visits.
- **Process Simulations:** Utilize simulation tools to demonstrate unit operations.
- **Hands-On Activities:** Organize lab demonstrations for filtration, heat transfer, and drying.
- **Problem-Solving Approach:** Engage students with numerical problems related to heat and mass transfer.

Assessment Methodology

Assessment Method	AssessmentMarks		Converted Marks	Internal Marks	External Marks	Total Marks
Cycle Test - I (Unit - I & II) (2 Hours) (Written Test)	60 Marks	Best of CT-I & CT-II	10 Marks	40 Marks	60 Marks	100 Marks
Cycle Test - II (Unit - III &IV) (2 Hours) (Written Test)	60 Marks					
Model Theory Examinations (AllUnits) (3 Hours)	100 Marks		10 Marks			
* Assignment - 2 Nos.(2 Nos. x 10 Marks)	20 Marks		10 Marks			
MCQ	10 Marks		5 Marks			
Attendance	5 Marks		5 Marks			
END THEORY EXAMINATIONS (3 Hours)	100 Marks		60 Marks			
TOTAL						

Cycle Test Question Pattern

Part A - 6 Questions x 2 marks = 12 Marks
Part B - 6 Questions x 8 marks = 48 Marks
Total Marks = 60 Marks

In each Unit (4 Questions - Answer any 3) and Part - B (4 Questions - Answer any 3)

End Theory Examination Question Pattern

Part A - 10 Questions x 2 Marks = 20 Marks
Part B - 10 Questions x 8 Marks = 80 Marks
Total Marks = 100 Marks

In Each Unit (3 Questions - Answer any 2) and Part - B (3 Questions - Answer any 2)

Assignment

2 Assignments covers all 5 Units. 20 Marks converted to 10 Marks

MCQ

Each Unit 10 Questions - 50 Questions. 50 Marks converted to 5 Marks

5G235310	**UNIT OPERATION IN PULP & PAPER**	L	T	P	C	End Exam
Theory		3	0	0	3	Theory

Unit	Name of the Topics	Hours
I	**SIZE REDUCTION & SCREENING** **Chapter 1.1 -** units of temperature, pressure, and simple numerical of their inter conversion **Chapter 1.2 -** Advantages – Important methods of size reduction – Classification of size reduction equipments namely Blake jaw crusher, Ball mill and Rotary Knife cutter **Chapter 1.3 -**Average particles size– Screening – Notes on differential and cumulative sieve analysis (basic qualitative treatment only)	9
II	**CONVEYING & SEPERATION OF MATRIALS** **Chapter 2.1 -** Belt conveyor – Bucket elevator – Screw conveyor and Pneumatic conveyors **Chapter 2.2 -** Clarification and classification flocculation – Free and hindered setting – Sink and float methods sedimentation –Setting equipment namely Gravity thickener. (all heating describe treatment only) **Chapter 2.3 -** Principle – Construction and operation of filtration equipment namely continuous Rotary drum vacuum filter. **Chapter 2.4 -** Principle of a Centrifuge and construction and operation of Simple basket centrifuge	9
III	**FUNDAMENTALS OF HEAT TRANSFER** **Chapter 3.1 -** Modes of heat transfer – Conduction, convection and radiation – Examples Conduction:- Fourier's law – Heat flow through a flat wall Thermal conductivity – Analogy between heat conduction and electricity simple numerical on heat flow through a flat wall. **Chapter 3.2 -** Natural and forced convection – Example – Heat flux Surface(individual heat transfer) coefficients – Overall coefficient Fouling factors – Simplification of overall coefficient – Simple numerical involving surface and overall coefficients on simplified overall coefficient formulae Mention of four dimensionless numbers namely Length to Diameter ratio, Reynolds's no,prantl's no Nusselt no, (formulae only)	9

IV	**FUNDAMENTALS OF HEAT EXCHANGERS** **Chapter 4.1 -** Concept of LMTD – Parallel and counter current flow –Applications – Simple numerical on LMTD for parallel and counter flows Equipments :- Double pipe heat exchanger – Simple 1-1Shell and tube heat exchanger with sketches **Chapter 4.2 -** Wavelengths of thermal radiation – Thermal radiation – Blackbody Greybody, Absorptivity, emmisivity – Comparison of conduction-convection-radiation. **Chapter 4.3 -** Evaporation – Liquid characteristics – Evaporator types namely falling film evaporators – Single effect and multiple effect evaporation Material balance ofsingle effect evaporator – Material balance for a triple effect evaporator – capacity, steam economy and elevation in boiling point. (Definition and description only) – Simple numerical on material balance of single effect evaporators – Simple numerical on material balance of triple effect evaporators	9
V	**ABSORPTION, HUMIDIFICATION & DRYING** **Chapter 5.1 -** Gas absorption – construction and operation of packed tower for absorption – Important tower packing characteristics of tower packing. **Chapter 5.2 -** Humidification – dehumidification - definition of humidity Industrial water cooling using Natural draft and Mechanical draft cooling towers. **Chapter 5.3 -** Drying – Definition - moisture – Bound and unbound moisture – Free moisture – Drying equipment –Tray drier – cylinder drier.	9
	TOTAL HOURS	45

Suggested Student Activities

1. Conduct sieve analysis experiments to understand size reduction techniques.
2. Analyze different types of material conveyors and their applications.
3. Solve numerical problems related to heat transfer and LMTD calculations.
4. Visit an industry to study heat exchangers, evaporators, and drying units.
5. Prepare technical reports on industrial separation and drying processes.

Reference Books

1. McCabe & Smith, *Unit Operations of Chemical Engineering*, McGraw-Hill.
2. Badger & Banchero, *Introduction to Chemical Engineering*, McGraw-Hill.
3. Coulson & Richardson, *Chemical Engineering – Volume I & II*, Elsevier.
4. Perry & Green, *Chemical Engineers' Handbook*, McGraw-Hill.
5. Ghosh, *Pulp & Paper Technology*, Tata McGraw-Hill.

Web Links

1. Pulp and Paper Technical Association
2. National Renewable Energy Laboratory
3. MIT OpenCourseWare - Heat Transfer
4. American Institute of Chemical Engineers
5. Pulp and Paper Canada

5G235440	PROCESS INSTRUMENTATION AND CONTROL	L	T	P	C	End Exam
Practicum		1	0	4	3	Practical

Course Introduction

This course provides fundamental knowledge of process instrumentation and control systems used in industrial applications, particularly in pulp and paper industries. The course covers temperature, pressure, level, flow measurement, industrial controllers, and automation techniques. Through hands-on experiments and real-time case studies, students will gain practical experience in monitoring, measuring, and controlling process variables effectively.

Course Objectives

By the end of this course, students will be able to:

- Understand the principles of temperature and pressure measurement.
- Learn various flow and level measurement techniques.
- Study industrial controllers and automation systems.
- Analyze process control loops and their applications.
- Gain hands-on experience in instrumentation and control techniques.

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

- **CO1:** Explain the working principles of temperature and pressure measurement devices.
- **CO2:** Demonstrate the working of flow and level measurement instruments.
- **CO3:** Implement process control strategies using industrial controllers.
- **CO4:** Analyze feedback and feedforward control systems in industrial processes.
- **CO5:** Apply automation techniques like PLC and DCS in process control.

Programme Outcomes (POs)

1. Engineering knowledge
2. Problem analysis
3. Design and development of solutions
4. Conduct investigations of complex problems
5. Modern tool usage
6. Engineer and society
7. Environment and sustainability
8. Ethics

9. Individual and teamwork
10. Communication
11. Project management and finance
12. Life-long learning

Programme Educational Objectives (PEOs)

1. Equip students with technical knowledge in instrumentation and process control.
2. Develop problem-solving skills for industrial automation challenges.
3. Promote sustainable process control techniques for industrial applications.
4. Enhance teamwork and leadership skills in a multidisciplinary environment.
5. Encourage lifelong learning and professional development in automation.

Programme Specific Outcomes (PSOs)

1. Apply process instrumentation and control techniques in industrial settings.
2. Analyze and optimize process control loops for improved efficiency.
3. Implement modern automation technologies for industrial control systems.

CO-PO-PSO Mapping

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	3	2	2
CO2	3	3	2	3	3	2	2	3	3	2
CO3	3	3	3	3	3	2	2	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- **Case-Based Learning:** Use real-world case studies to explain instrumentation concepts.
- **Hands-on Experiments:** Conduct practical lab sessions for measuring process variables.
- **Interactive Simulations:** Use process control simulation software for visualization.
- **Industry Collaboration:** Organize industrial visits to process plants.
- **Problem-Solving Approach:** Engage students with control loop troubleshooting exercises.

Assessment Methodology

Assessment Method	Assessment Marks		Converte dMarks	Internal Marks	External Marks	Total Marks
Cycle Test - I Practical Examinations PART A Exercises (2 Hours)	50 Marks	Best of CY-I & CY-II	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Cycle Test - II Practical Examinations PART B Exercises (2 Hours)	50 Marks					
Model Theory Examinations (3 Hours)	100 Marks	15 Marks	15 Marks			
Model Practical Examinations (3 Hours)	100 Marks	15 Marks				
Practical Document/ Drawing Plate submission (Each Exercise / Experiment / Drawing plate should be evaluated to 10 Marks.	10 Marks		10 Marks			
Attendance	5 Marks		5 Marks			
END PRACTICAL EXAMINATIONS (3 Hours)	100 Marks		60 Marks			
TOTAL						

SCHEME OF EVALUATION
CYCLE TEST I & II

PART	DESCRIPTION	MARKS
1	Aim & Procedure	35
2	Execution and Result	15
	Total	**50**

SCHEME OF EVALUATION
Model Theory Examination

Part A - 10 Questions x 2 Marks = 20 Marks
Part B - 10 Questions x 8 Marks = 80 Marks
Total Marks= 100 Marks

In Each Unit Part - A (3 Questions answer any 2)
Part - B (3 Questions answer any 2)

SCHEME OF EVALUATION
Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
1	Aim (05) ,Program from Part - A (30)	35
2	Aim (05) ,Program from Part - B (30)	35
3	Executing any one program (Part A or Part -B)	15
4	Output	10
5	Viva Voce	05
	Total	**100**

5G235440	PROCESS INSTRUMENTATION AND CONTROL	L	T	P	C	End Exam
Practicum		1	0	4	3	Practical

Unit I	MEASUREMENT OF TEMPERATURE & PRESSURE	
Chapter 1.1 - Units - General purpose of instrumentation - Instruments for measuring temperature - Liquid and gas filled thermometers, Bimetallic thermometers, Electrical resistance thermometers, Thermocouples - Principles, different types and their application -Thermopiles, Thermistors, Radiation pyrometer and Optical pyrometer. **Chapter 1.2** - Units - different types of pressure & measurements - Mc Leod gauge-Bourdon gauge-Principle, Different types of bourdon tubes, application, Bellows type and diaphragm type pressure sensors - Vacuum measurement - Ionisation vacuum gauge, Pirani gauge. **Chapter 1.3** - LVDT, Strain gauge sensor, Piezo resistive pressure sensor **Chapter 1.4** - Units - Head flow meters: Orifice and Venturi - Pitot tube, Ultrasonic flow measurement, vortex flow measurement, Area flow meters - Rotameter - Metering pumps, Notating disc meter, Magnetic flow meter. Level measurement: Visual indicator methods - Float level indicator - Bubbler type - Displacement type level indicator - Capacitance and conductivity type level sensors - Nuclenic level gauge.		8
Ex.No	**Name of the Experiment**	
1	Measurement of Temperature using Thermocouple and RTD module's	30
2	Measurement of Pressure using Strain Gauge type Transducer	
3	Measurement of Pressure using Bourdon pressure transducer	
4	Liquid level ON-OFF Control	

Unit II	INDUSTRIAL CONTROLLERS & AUTOMATION	
	Chapter 2.1 - PH & Conductivity, definition, significance-Method of measuring. Humidity - definition of absolute and relative humidity - Measurement of humidity - Dry and wet bulb thermometer - Hair hygrometer, Sling psychomotor. Viscosity - Absolute and kinematic viscosity - Viscosity measurement - Say bolt and Redwood viscometer - Falling- ball viscometer. **Chapter2.2** - Process Control Open loop & closed loop Systems - Principles and purpose of Feed Back Control - Feed Forward Control - Ratio Control - Cascade control **Chapter2.3** - controllers- classification - based on control action such as P,I,PI,PD,PID based on actuating medium such as Pneumatic Controllers-concept and application only in Pneumatic system. Block Diagrams - Sources of Process lag - Control applications in (i) Reactor Temperature (ii) Reactor Pressure (iii)Heat exchanger - Temperature, Flow (iv)Distillations Column-Temperature, Flow, Process. **Chapter 2.4** - Analog Signal from processes - conversion of analog signal to digital signal in computers computer programmes- conversion of digital signal to analog signal - PLC - Difference between PLC & DCS	7

Suggested Student Activities

1. Conduct experiments using RTDs, thermocouples, and pressure transducers.
2. Analyze industrial controllers' response to various process conditions.
3. Program PLC for automation tasks and study DCS integration.
4. Develop a mini-project on automated process control applications.
5. Prepare reports on real-world applications of process instrumentation.

Reference Books

1. Curtis D. Johnson, *Process Control Instrumentation Technology*, Pearson.
2. E. A. Parr, *Industrial Process Automation Systems*, Elsevier.
3. P. Harriott, *Process Control*, McGraw-Hill.
4. B. G. Lipták, *Instrumentation Engineers' Handbook*, CRC Press.
5. Stephanopoulos, *Chemical Process Control*, Pearson.

Web Links

1. ISA - International Society of Automation
2. MIT OpenCourseWare - Process Control
3. NI - National Instruments
4. Industrial Automation & Control
5. Process Control & Instrumentation Online

5G235540	ENVIRONMENTAL MANAGEMENT IN PULP & PAPER	L	T	P	C	End Exam
Practicum		1	0	4	3	Practical

Course Introduction

This course provides comprehensive knowledge of environmental management practices in the pulp and paper industry. It covers air, water, noise, and land pollution, their effects, and various control measures. The course also includes laboratory experiments to analyze pollution levels and apply suitable treatment techniques. Through hands-on training and industrial case studies, students will develop practical skills to manage and minimize environmental impacts in the pulp and paper sector.

Course Objectives

By the end of this course, students will be able to:

1. Understand the sources and effects of air, water, noise, and land pollution.
2. Analyze pollution measurement techniques and treatment processes.
3. Study environmental regulations and pollution control standards.
4. Implement pollution prevention techniques in the pulp and paper industry.
5. Develop sustainable waste management strategies.

Course Outcomes (COs) with Action Verbs

Upon successful completion of the course, students will be able to:

- **CO1:** Explain the causes and effects of air, water, noise, and land pollution. *(Explain, Describe)*
- **CO2:** Demonstrate pollution measurement techniques for industrial waste. *(Demonstrate, Analyze)*
- **CO3:** Implement pollution control strategies in industrial settings. *(Implement, Apply)*
- **CO4:** Assess environmental regulations and their impact on the pulp and paper industry. *(Assess, Evaluate)*
- **CO5:** Design sustainable waste management and pollution prevention methods. *(Design, Develop)*

Programme Outcomes (POs)

1. Engineering knowledge
2. Problem analysis
3. Design and development of solutions
4. Conduct investigations of complex problems
5. Modern tool usage
6. Engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and teamwork
10. Communication
11. Project management and finance
12. Life-long learning

Programme Educational Objectives (PEOs)

1. Equip students with knowledge of environmental pollution and control methods.
2. Develop analytical skills to assess and manage industrial pollution.
3. Promote sustainable and eco-friendly practices in process industries.
4. Enhance teamwork and leadership abilities in environmental management.
5. Encourage continuous learning and adherence to environmental regulations.

Programme Specific Outcomes (PSOs)

1. Apply pollution control techniques in industrial processes.
2. Analyze and optimize environmental management strategies.
3. Implement sustainable solutions for industrial waste treatment.

CO-PO-PSO Mapping

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	3	3	3	2	2
CO2	3	3	2	3	3	3	3	3	3	2
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- **Case-Based Learning:** Use real-world case studies on environmental issues in the pulp and paper industry.
- **Hands-on Experiments:** Conduct practical lab sessions for pollution analysis and treatment.
- **Interactive Simulations:** Use environmental modeling tools to predict pollution impact.
- **Industry Collaboration:** Arrange visits to industrial wastewater treatment plants.
- **Problem-Solving Approach:** Engage students in troubleshooting real-time pollution control issues.

Assessment Methodology

Assessment Method	Assessment Marks		Converte dMarks	Internal Marks	External Marks	Total Marks
Cycle Test - I Practical Examinations PART A Exercises (2 Hours)	50 Marks	Best of CY-I & CY-II	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Cycle Test - II Practical Examinations PART B Exercises (2 Hours)	50 Marks					
Model Theory Examinations (3 Hours)	100 Marks	15 Marks	15 Marks			
Model Practical Examinations (3 Hours)	100 Marks	15 Marks				
Practical Document/ Drawing Plate submission (Each Exercise / Experiment / Drawing plate should be evaluated to 10 Marks.	10 Marks		10 Marks			
Attendance	5 Marks		5 Marks			
END PRACTICAL EXAMINATIONS (3 Hours)	100 Marks		60 Marks			
TOTAL						

SCHEME OF EVALUATION
CYCLE TEST I & II

PART	DESCRIPTION	MARKS
1	Aim & Procedure	35
2	Execution and Result	15
	Total	**50**

SCHEME OF EVALUATION
Model Theory Examination

Part A - 10 Questions x 2 Marks = 20 Marks
Part B - 10 Questions x 8 Marks = 80 Marks
Total Marks= 100 Marks

In Each Unit Part - A (3 Questions answer any 2)
Part - B (3 Questions answer any 2)

SCHEME OF EVALUATION
Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
1	Aim (05) ,Program from Part - A (30)	35
2	Aim (05) ,Program from Part - B (30)	35
3	Executing any one program (Part A or Part -B)	15
4	Output	10
5	Viva Voce	05
	Total	**100**

5G235540	ENVIRONMENTAL MANAGEMENT IN PULP & PAPER	L	T	P	C	End Exam
Practicum		1	0	4	3	Practical

Unit I	AIR POLLUTION & NOISE POLLUTION	
Chapter 1.1: Pollution control Standards for air Sources of air pollution- Effects of air pollution on Environment, materials, human health and animals- Analytical methods of air pollution measurement(Names and brief notes on the methods only)- Measurement of important air pollutants namely Carbon monoxide. SO_X and NO_X. **Chapter 1.2:**Equipments for control of air pollutants as applicable to pulp and paper industries namely Dust collectors, Cyclone separators, Venturi scrubbers, Impingement separators, Electrical precipitators and Fabric filters(brief description with schematic sketch of the equipment only).Sources of water- Hardness of water- raw water clarification Filtration – Water treatment by lime-soda process and ion-exchange process- Ultra filtration and reverse osmosis **Chapter 1.3:**Definition of Noise pollution – Sources of noise pollution – Noise control criteria – Noise exposure index – Control of noise pollution – Source of odour as applied to paper mill and its control. Ozone layer depletion, Acid rain , Global warming and Greenhouse gas effect.		8
Ex.No	**Name of the Experiment**	
1	Determination of chemical oxygen demand (COD).	30
2	Determination of solids (TSS & TDS) & dissolved oxygen (D.O)	
3	Determination of biological oxygen demand (BOD)	
4	Estimation of optimum coagulant dosage	

Unit II	WATER POLLUTION & LAND POLLUTION	
Chapter 2.1 Definition of water – pollution – pollution control standards for water Sources of water pollution – Their effects on environment and materials, human health and animals. Industrial waste treatment as applied to paper industry – Neutralizations ponds – Anaerobic oxidation – Aerobic oxidation – Clarification – Filtration – Recycle and reuse – Water conservation methods –BOD and COD – Their measurement – Norms and standards – Simple numerical on determination of BOD. AOX levels prevailing and permitted for treated effluent in a paper mill. **Chapter 2.2** Definition of Land pollution – Sources and classification of solid wastes Solid wastes generated from various units of paper mill –Their disposal and treatment.		7
Ex.No	**Name of the Experiment**	
5	Determination of the Turbidity, Electrical Conductivity and pH of the given sample	30
6	Determination of acidity in process water.	
7	Determination of alkalinity in process water.	
8	Analysis of ions: copper, chlorides and sulfate.	
TOTAL HOURS		75

Suggested Student Activities

1. Conduct experiments to measure COD, BOD, and TDS in industrial effluents.
2. Analyze air and noise pollution levels using industrial sensors.
3. Develop a mini-project on sustainable waste management in pulp and paper industries.
4. Prepare a report on environmental regulations and compliance in industries.
5. Organize group discussions on climate change and global sustainability.

Reference Books

1. Metcalf & Eddy, *Wastewater Engineering: Treatment and Reuse*, McGraw-Hill.
2. P. Aarne Vesilind, *Introduction to Environmental Engineering*, Cengage Learning.
3. Rao C. S., *Environmental Pollution Control Engineering*, New Age International.
4. B. K. Sharma, *Environmental Chemistry*, Krishna Prakashan Media.
5. S. P. Mahajan, *Pollution Control in Process Industries*, Tata McGraw-Hill.

Web Links

1. Central Pollution Control Board (CPCB), India
2. Environmental Protection Agency (EPA)
3. National Institute of Environmental Health Sciences (NIEHS)
4. MIT OpenCourseWare - Environmental Engineering

- World Health Organization (WHO) - Air Quality Guidelines

5G235620	UNIT OPERATIONS LABORATORY	L	T	P	C	End Exam
Practical		0	0	4	2	Practical

Course Introduction: This course focuses on essential unit operations in process industries, emphasizing solid-liquid separation, particle size analysis, heat transfer, mass transfer, and fluid flow characteristics. Through hands-on experiments, students will develop practical skills required for industrial applications.

Course Objectives:

1. To analyze the particle size distribution of solid materials using sieving techniques.
2. To evaluate the efficiency of comminution equipment such as ball mills.
3. To study the settling characteristics of suspensions and interpret the results.
4. To investigate filtration operations using vacuum leaf filters.
5. To determine fluid viscosity using capillary and Ostwald viscometers.
6. To analyze heat transfer efficiency in evaporators and heat exchangers.
7. To assess drying characteristics of solid materials.
8. To evaluate steam requirements for distillation operations.

Course Outcomes (COs): Upon successful completion of the course, students will be able to:

1. **Analyze** particle size distribution through sieving techniques.
2. **Evaluate** the operational efficiency of a ball mill.
3. **Examine** settling characteristics of slurries and infer results.
4. **Investigate** filtration characteristics under different pressure conditions.
5. **Determine** viscosity of liquids using standard viscometers.
6. **Analyze** heat transfer efficiency and LMTD in heat exchangers.
7. **Assess** steam requirements in distillation processes.
8. **Interpret** drying characteristics and establish drying kinetics.

Programme Outcomes (POs):

1. Engineering knowledge
2. Problem analysis
3. Design/development of solutions
4. Conduct investigations of complex problems
5. Modern tool usage
6. The engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and team work

10. Communication
11. Project management and finance
12. Lifelong learning

Programme Educational Objectives (PEOs):

1. Graduates will establish themselves as professionals in the field of Paper Technology and allied sectors.
2. Graduates will engage in life-long learning through higher education, research, and professional development.
3. Graduates will contribute to sustainable and ethical industrial practices.
4. Graduates will demonstrate leadership, teamwork, and innovation in their careers.

Programme Specific Outcomes (PSOs):

1. Apply principles of chemical engineering to paper manufacturing and related industries.
2. Develop solutions for process optimization, sustainability, and environmental compliance in paper technology.
3. Demonstrate expertise in modern analytical tools and equipment used in paper processing industries.

CO-PO & CO-PSO Mapping Table:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	2	2	1	2	3	2	2
CO2	3	3	3	2	2	1	1	1	2	2	2	2	3	2	2
CO3	3	3	2	3	3	1	1	1	2	2	2	3	3	3	2
CO4	3	3	3	3	3	2	2	2	2	3	2	3	3	3	3
CO5	3	2	2	3	3	2	2	2	2	3	2	3	3	3	3
CO6	3	3	2	3	3	2	2	2	2	3	2	3	3	3	3
CO7	3	3	2	3	3	2	2	2	2	3	2	3	3	3	3
CO8	3	3	2	3	3	2	2	2	2	3	2	3	3	3	3

(Note: 3 – Strong Correlation, 2 – Moderate Correlation, 1 – Low Correlation)

Instructional Strategy:

- Lectures with real-world case studies
- Laboratory experiments with data analysis
- Group discussions and problem-solving sessions
- Industry visits and guest lectures

Assessment Methodology

Assessment Method	Assessment Marks		Converted Marks	Internal Marks	External Marks	Total Marks
Cycle Test - I Practical Examinations PART A Exercises (2 Hours)	50 Marks	Best of CT-I and CT-II	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Cycle Test - II Practical Examinations PART B Exercises (2 Hours)	50 Marks					
Model Practical Examinations All Exercises (3 Hours)	100 Marks		15 Marks			
Practical Document submission (Each Exercise / Experiment Drawing plate should be evaluated to 10 Marks	10 Marks		10 Marks			
Attendance	5 Marks		5 Marks			
END PRACTICAL EXAMINATIONS (3 Hours)	100 Marks		60 Marks			
TOTAL						

SCHEME OF EVALUATION

Cycle Test I & II

PART	DESCRIPTION	MARKS
1	Aim & Procedure	35
2	Execution and Result	15
	Total	50

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
1	Aim (05) ,Program from Part - A (30)	35
2	Aim (05) ,Program from Part - B (30)	35
3	Executing any one program (Part A or Part -B)	15
4	Output	10
5	Viva Voce	05
	Total	100

5G235620	UNIT OPERATIONS LABORATORY	L	T	P	C	End Exam
Practical		0	0	4	2	Practical

Ex. No	Name of the Experiment	Period
1	Analyze a feed by separating it into different sized solid particles using a set of sieve	60
2	Ball Mill and operation efficiency	
3	To study the settling characteristics of calcium carbonate slurries of two different concentrations and plot graphs and make inferences	
4	To study the Filtration characteristics of calcium carbonate slurry (using a vacuum leaf filter) by low & high pressure filtration and plot graphs and make inferences.	
5	Determination of viscosity of water by making it flow through a capillary tube of known length and diameter	
6	Determination of viscosities of different free flowing liquid samples using an Ostwald's viscometer	
7	Determination of Overall heat transfer coefficient 'U' of an open pan evaporator set-up with continuous stirring of the bath liquid.	
8	Determination of LMTD and Overall heat transfer coefficient of water - air system.	
9	Determination of steam required to distilled unit samples of Aniline sample	
10	To study the drying characteristics of a wet solid by drying it in a current of air inside a drying chamber, and plot graphs and make interfaces.	
Total Hours		60

Suggested Student Activities:

- Conducting mini-projects on unit operations
- Writing technical reports on experimental findings
- Participating in technical quizzes and paper presentations

Reference Books:

1. McCabe, W.L., Smith, J.C., & Harriott, P. "Unit Operations of Chemical Engineering," McGraw-Hill.
2. Coulson, J.M., & Richardson, J.F. "Chemical Engineering Vol 1 & 2," Butterworth-Heinemann.
3. Geankoplis, C.J. "Transport Processes and Separation Process Principles," Prentice Hall.

Web Links:

1. https://nptel.ac.in/courses/103103033/
2. https://www.sciencedirect.com/journal/chemical-engineering-science
3. https://www.aiche.org/resources/publications/cep

5G236110	PULP & PAPER TECHNOLOGY III	L	T	P	C	End Exam
Theory		3	0	0	3	Theory

Course Introduction: This course, "Pulp and Paper Technology III," is designed to provide in-depth knowledge of the sheet formation process, modern advancements in paper machinery, pulping, pressing, drying, calendaring, and coating techniques. It covers both theoretical and practical aspects, preparing students for careers in the paper manufacturing industry.

Course Objectives:

1. To understand the fundamental principles of sheet formation and headbox operations.
2. To explore modern developments in paper machine technology.
3. To study various pressing and drying techniques in paper production.
4. To analyze calendaring and coating processes used in paper finishing.
5. To introduce Industry 4.0 applications in the paper industry.

Course Outcomes (COs) (with action verbs):

CO1: Explain the principles of sheet formation and headbox functions.

CO2: Analyze modern advancements in paper machine design and performance.

CO3: Evaluate the effects of pressing on paper quality and production efficiency.

CO4: Assess different drying techniques and their impact on paper properties.

CO5: Demonstrate knowledge of calendaring, coating, and finishing processes..

Programme Outcomes (POs):

1. Engineering knowledge
2. Problem analysis
3. Design and development of solutions
4. Conduct investigations of complex problems
5. Modern tool usage
6. The engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and team work
10. Communication
11. Project management and finance
12. Life-long learning

Programme Educational Objectives (PEOs): PEO1: To provide graduates with strong technical knowledge in pulp and paper technology. PEO2: To equip students with problem-solving and analytical skills in industrial applications. PEO3: To encourage continuous learning and adaptation to technological advancements. PEO4: To promote ethical and sustainable practices in the paper manufacturing sector.

Programme Specific Outcomes (PSOs): PSO1: Apply knowledge of raw materials, processes, and machinery in pulp and paper technology. PSO2: Develop solutions for efficiency improvement and waste minimization in the paper industry.

CO-PO-PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	-	1	1	-	2	3	2
CO2	3	3	2	2	3	2	-	-	2	2	-	2	3	3
CO3	3	3	3	3	3	2	1	1	2	2	1	3	3	3
CO4	3	3	2	2	3	2	1	1	2	2	1	3	3	3
CO5	3	2	2	2	3	2	1	1	2	2	1	3	3	3

Instructional Strategy:

1. Lectures with visual aids and industrial case studies.
2. Hands-on training in paper machine operations.
3. Group discussions and problem-solving activities.
4. Industry visits and expert lectures.
5. Assignments and mini-projects.

Assessment Methodology

<table>
<tr><th>Assessment Method</th><th colspan="2">AssessmentMarks</th><th>Converted Marks</th><th>Internal Marks</th><th>External Marks</th><th>Total Marks</th></tr>
<tr><td>Cycle Test - I (Unit - I & II)
(2 Hours) (Written Test)</td><td>60 Marks</td><td rowspan="2">Best of CT-I & CT-II</td><td rowspan="2">10 Marks</td><td rowspan="8">40 Marks</td><td rowspan="8">60 Marks</td><td rowspan="9">100 Marks</td></tr>
<tr><td>Cycle Test - II (Unit - III &IV) (2 Hours) (Written Test)</td><td>60 Marks</td></tr>
<tr><td>Model Theory Examinations (AllUnits) (3 Hours)</td><td colspan="2">100 Marks</td><td>10 Marks</td></tr>
<tr><td>* Assignment - 2 Nos.(2 Nos. x 10 Marks)</td><td colspan="2">20 Marks</td><td>10 Marks</td></tr>
<tr><td>MCQ</td><td colspan="2">10 Marks</td><td>5 Marks</td></tr>
<tr><td>Attendance</td><td colspan="2">5 Marks</td><td>5 Marks</td></tr>
<tr><td>END THEORY EXAMINATIONS
(3 Hours)</td><td colspan="2">100 Marks</td><td>60 Marks</td></tr>
<tr><td colspan="6">TOTAL</td></tr>
</table>

Cycle Test Question Pattern

Part A - 6 Questions x 2 marks = 12 Marks

Part B - 6 Questions x 8 marks = 48 Marks

Total Marks = 60 Marks

In Each Unit (4 Questions answer any 3) and Part - B (4 Questions answer any 3)

End Theory Examination Question Pattern

Part A - 10 Questions x 2 Marks = 20 Marks

Part B - 10 Questions x 8 Marks = 80 Marks

Total Marks = 100 Marks

In Each Unit (3 Questions answer any 2) and Part - B (3 Questions answer any 2)

Assignment

2 Assignments covers all 5 Units 20 Marks converted to 10 Marks

MCQ

Each Unit 10 Questions - 50 Questions 50 Marks converted to 5 Marks

5G236110	PULP AND PAPER TECHNOLOGY III	L	T	P	C	End Exam
Theory		3	0	0	3	Theory

UNIT	NAME OF THE TOPICS	PERIODS
I	**SHEET FORMATION** **Chapter 1.1** - Definition of sheet formation and paper- Head box and it functions and important types- The three sections of Head box with simple sketch- Types of distributors (simple type, tapered duct type wit flow eveners. With fan pump,cross flow type, and multiple branc manifold- A simple sketch and description on each)- Middle section Types and functions of slices- Evaluation of pressure head in head box Dilution control system - CFD formers. **Chapter 1.2 -** A complete description with a neat diagram of four driner wire part- Placement of stock on the wire sagging- Jet wire speed ratio and its significance- Dewatering at table rolls- Grooved table rolls- Couch and its types- The three types of transfer of web from couch to press part- Drainage at wire part VS hydraulic press part gradient (Qualitative treatment only) - Shower water system	9
II	**MODERN DEVELOPMENTS IN SHEET FORMATION & CYLINDER MACHINES** **Chapter 2.1** - High speed machines – Twin Wire former – Topfomer& shaker – Inver form machines – Stevence former – Roto former - Hybrid former. A note on stretch in paper. **Chapter 2.2** - Principle of cylinder machines–Speed limitations – Disadvantages and advantages of cylinder machines - Factor affecting drainage – Diagram and description of the two types of vat flows with piping system - Primary press part of cylinder machines - Common troubles of cylinder mould machines.	9
III	**PUPLING AND PRETREATMENT OF RAGS & PRESSING** **Chapter 3.1 -** The effect of pressing on sheet- Necessity of pressing- construction of press part- crowning of press(solid and suction presses)- A note on swimming roll with a neat diagram- theory of pressing (Wahistrom's theory only)- Factors affecting dewatering in pressing- Felt- Functions, constructions - Extended NIP press (Woven and needle types only) and cleaning of press-felts - some special types of presses(Brief notes on) Smoothening press, Air bleed press, Reverse or return press, Fabric press , Unipress and Shoe Press	9

IV	**DRYING** **Chapter 4.1 -** Introduction principles of drying - Cylinder drying its principles - A graphical sketch of drying for critical moisture content- Description of multi cylinders and Yankee cylinder Factor affecting drying - Drying efficiency in relation to mass and heat transfer- (A qualitative treatment only) - A note on too dry and too wet papers of drying process - Drying with blowers - Ventilation hoods - Steam and condensate systems - Dryer felts - Vacuum systems of paper machines. Syphonic systems for condensate and removal - advantages of Unirun dryers problems involving production of paper with quantity of water removal at wire part, press part and drying parts – Metering size press.	9
V	**CALENDARING & COATING** **Chapter 5.1** - Machine and super calendaring - Effect of calendaring on paper – Common terms – Spreader roll(a simple diagram and a note) - Crowing with reference to hot or cold air blowing anti deflection roll, bottom roll bending and swimming rolls – Construction of super calendar and its description – Creep-humidity during calendaring – Common calendar troubles – A short note on embossing and its two types (gear and slip embossing) - Paper machine reels and its common troubles. A qualitative treatment on paper machine drives – Broke handling system. **Chapter 5.2** - Aims of coating - coating chemicals and typical formulation – Starch preparation system - Coating color system – online & offline coating system - Air knife coater - Flexible blade coaters – A simple sketch and description of these coaters –Rod/metering coater - its application and advantages curtain coater. **Chapter 5.3 -** Winding and slitting - Rewinding - Sheet cutting and guillotines - Roll wrapping & Pallet Wrapping - Counting - Packing and dispatching Standard sizes of paper - Common and special qualities and their characteristics of paper including industrial papers and electrical grade papers. **Chapter 5.4 -** Introduction to Industry 4.0 - Machine learning & Artificial intelligence	9
TOTAL PERIODS		**45**

Suggested Student Activities

- Mini project on evaluating the effectiveness of various pressing techniques.
- Visit to a pulp and paper industry and submit a report.
- Group presentation on Industry 4.0 in paper production.
- Create a working model/simulation of a Fourdrinier system.
- Design a flowchart for coating and drying stages.

Reference Books

1. G.A. Smook, *Handbook for Pulp & Paper Technologists*
2. R. W. J. McDonald, *Pulp and Paper Manufacture*
3. Peter A. N. *Introduction to Paper Production*
4. Biermann C.J., *Handbook of Pulping and Papermaking*

Web Links

- https://www.tappi.org – Technical Association of Pulp and Paper Industry
- https://www.paperonweb.com – Paper manufacturing tutorials and resources
- https://www.fpl.fs.fed.us – U.S. Forest Products Laboratory
- https://www.researchgate.net – Research articles on paper technology
- https://www.sciencedirect.com – Journal articles on pulp and paper

5G236240	CHEMICAL RECOVERY	L	T	P	C	End Exam
Practicum		1	0	4	3	Practical

Course Introduction

This course focuses on the processes and technologies involved in the chemical recovery cycle of Kraft pulp mills. Emphasis is laid on black liquor evaporation, causticizing, smelt dissolution, lime recovery, and related analytical techniques. Students will also gain hands-on experience through laboratory-based practicum for key chemical recovery parameters and learn modern methods for efficiency enhancement, emissions control, and safety in recovery plants.

Course Objectives

The students will:

1. Understand the purpose and steps of chemical recovery in Kraft pulping.
2. Study evaporation, incineration, and recovery boiler operations.
3. Learn black liquor and green liquor treatment techniques.
4. Understand causticizing and lime recovery processes.
5. Analyze chemical recovery parameters through hands-on laboratory experiments.
6. Learn modern systems and safety measures in chemical recovery plants.

Course Outcomes (COs)

CO No.	Course Outcome Description
CO1	Describe the process of chemical recovery and black liquor evaporation.
CO2	Explain the working of evaporators and recovery boiler components.
CO3	Analyze the operations of causticizing and lime kiln systems.
CO4	Calculate efficiency parameters like causticizing and reduction.
CO5	Conduct experiments to determine chemical characteristics and efficiency.
CO6	Apply knowledge of modern safety and emission control systems.

Program Outcomes (POs)

Aligned with NBA graduate attributes:

- **PO1**: Engineering Knowledge
- **PO2**: Problem Analysis
- **PO3**: Design/Development of Solutions

- **PO4**: Investigation of Complex Problems
- **PO5**: Modern Tool Usage
- **PO6**: Engineer & Society
- **PO7**: Environment and Sustainability
- **PO8**: Ethics
- **PO9**: Individual and Teamwork
- **PO10**: Communication
- **PO11**: Project Management and Finance
- **PO12**: Life-Long Learning

Program Educational Objectives (PEOs)

1. Graduates will succeed in industrial or research roles in chemical recovery and pulp processes.
2. Graduates will continuously improve through professional learning and certification.
3. Graduates will demonstrate ethical responsibility and sustainability in engineering practices.

Program Specific Outcomes (PSOs)

- **PSO1**: Apply chemical engineering concepts for efficient pulp and chemical recovery.
- **PSO2**: Use modern analytical tools and safety systems in chemical recovery operations.

CO-PO-PSO Mapping Table

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	1	-	-	-	1	-	2	3	2
CO2	3	2	2	2	2	-	-	-	-	1	-	2	3	3
CO3	3	3	2	2	2	1	2	-	-	-	-	2	3	2
CO4	3	3	2	2	2	-	-	-	-	1	-	2	3	3
CO5	2	2	3	3	3	-	-	-	1	2	1	2	3	3
CO6	2	2	2	2	3	2	2	1	2	2	1	3	3	3

(3: Strongly related, 2: Moderately related, 1: Slightly related, - : Not related)

Instructional Strategy

- **Demonstrations** of chemical analysis techniques in lab.
- **Multimedia presentations** for understanding recovery systems and equipment.
- **Simulations/Case studies** for process safety, emissions, and energy efficiency.
- **Problem-solving sessions** with real industrial data for efficiency calculations.
- **Guest lectures** from industry experts in Kraft recovery systems.

Assessment Methodology

Assessment Method	Assessment Marks		Converted Marks	Internal Marks	External Marks	Total Marks
Cycle Test - I Practical Examinations PART A Exercises (2 Hours)	50 Marks	Best of CY-I & CY-II	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Cycle Test - II Practical Examinations PART B Exercises (2 Hours)	50 Marks					
Model Theory Examinations (3 Hours)	100 Marks	15 Marks	15 Marks			
Model Practical Examinations (3 Hours)	100 Marks	15 Marks				
Practical Document/ Drawing Plate submission (Each Exercise / Experiment / Drawing plate should be evaluated to 10 Marks.	10 Marks		10 Marks			
Attendance	5 Marks		5 Marks			
END PRACTICAL EXAMINATIONS (3 Hours)	100 Marks		60 Marks			
TOTAL						

SCHEME OF EVALUATION
CYCLE TEST I & II

PART	DESCRIPTION	MARKS
1	Aim & Procedure	35
2	Execution and Result	15
	Total	**50**

SCHEME OF EVALUATION
Model Theory Examination

Part A - 10 Questions x 2 Marks = 20 Marks
Part B - 10 Questions x 8 Marks = 80 Marks
Total Marks= 100 Marks

In Each Unit Part - A (3 Questions answer any 2)
Part - B (3 Questions answer any 2)

SCHEME OF EVALUATION
Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
1	Aim (05) ,Program from Part - A (30)	35
2	Aim (05) ,Program from Part - B (30)	35
3	Executing any one program (Part A or Part -B)	15
4	Output	10
5	Viva Voce	05
	Total	**100**

5G236240	CHEMICAL RECOVERY	L	T	P	C	End Exam
Practicum		1	0	4	3	Practical

UNIT	OBJECTIVE OF CHEMICAL RECOVERY & MODERN CHEMICAL RECOVERY UNIT	PERIODS
	Chapter 1.1 - Objectives of Chemical recovery in a Kraft pulp mill – Various steps involved of Kraft liquor recovery and reuse – Black liquor – Properties of black liquor-Multiple effect evaporation of black liquor – Falling film and Forced circulation evaporators (brief description of each with schematic sketches) – Simple numerical on material balance relating to black liquor evaporation in multiple effect evaporator plant. (formulae for material balance to be stated. No derivations required). **Chapter 1.2** - Standard terms used in a Kraft recovery plant and simple numerical based on them – Direct contact evaporation of semi concentrated black liquor-Cascade evaporator, Cyclone evaporator and Venturi evaporator cum scrubber. **Chapter 2.1 -** Electro Static Precipitation Of Fume In Kraft Recovery Plant – Its Principle Of Working And Operation Silica removal methods practiced in Kraft mill from black liquor and green liquor- Advantages of silica removal -Chemical equations and operations involved in silica removal. **Chapter 2.2 -** Oxidation of black liquor – Advantages – Chemical equations involved - Oxidation equipment namely Spiral oxidizer. **Chapter 3.1 -** Recovery boiler-Super heater Economizer – Air heater- Saltcake mix tank-Smelt dissolving tank-Air fan-Soot blowers and their working. **Chapter 3.2 -** Black liquor incineration – Different zones inside the furnace - functions and changes taking place inside the furnace- Explosion Hazards and common troubles associated with the Recovery furnace and allied equipments – Chemistry involved at the various stages of recovery and reuse of kraft spent liquor – Stack emission control	8
1	Determination of available calcium oxide in lime	30
2	Analysis of salt cake	
3	Analysis of soda ash	
4	Determination of purity of caustic soda	
5	Analysis of Green liquor	

UNIT II	SMELT & STEAM BOILERS & STEAM TURBINES CAUSTICIZING	
Chapter 4.1 - Smelt dissolution – Raw Green liquor – Clarification of raw green liquor – Dregs and its washing – Slaking of green liquor- Stationary slaker cum classifier – Rotary slaker and classifier – Grits and its washing-Causticising tanks-Raw white liquor-Clarification of whit liquor – Unit type -Lime mud washing – Unit type and Balanced compartmental tray type mud washers-Lime mud dewatering - Rotary drum vacuum filter and Belt filters. **Chapter 4.2 -** Make up lime and lime stone- -Desilication of lime sludge- Partial Causticising - Rotary lime kiln - Construction and Operation - Burning of lime mud – Different zones and their functions and temperatures inside the kiln. Fluidised bed calcinations system. **Chapter 5.1 -** Chemistry of Causticising – Causticising efficiency – Factors influencing it – Reasons for incomplete Causticising – simple numerical on Causticising efficiency – Sodium, Sulphur and Calcium losses - Reduction efficiency in furnace - Available calcium oxide from kiln. Trouble shooting in Causticising plant.		7
6	Analysis of White liquor and determination of Causticizing efficiency	30
7	Total hardness of water	
8	Total solids, chlorides and total alkalinity of water	
9	Analysis of smelt to determine reduction efficiency	
10	P^H, Total Solids, Residual Active alkali determination in Black liquor	
TOTAL PERIODS		75

Suggested Student Activities

- Mini-project: Design a model of a Kraft recovery boiler system.
- Lab report submission and viva on chemical analyses.
- Presentation on recovery furnace emission control systems.
- Field visit to a chemical recovery plant and prepare an observation report.
- Numerical assignment on material balance in multiple effect evaporators.

Reference Books

1. G. A. Smook, *Handbook of Pulp and Paper Technology*, Angus Wilde Publications.
2. Biermann C. J., *Handbook of Pulping and Papermaking*, Academic Press.
3. MacDonald R. W., *Chemical Recovery in the Pulp and Paper Industry*.
4. TAPPI Press Manuals on Kraft Recovery Operations.

Web Links

- https://www.tappi.org – Technical resources for pulp and paper engineers.
- https://www.paperonweb.com – Pulp and paper industry knowledge base.
- https://www.researchgate.net – Access research papers on chemical recovery.
- https://www.sciencedirect.com – Journals and articles on process engineering.
- https://www.fpl.fs.fed.us – US Forest Products Laboratory data and research.

5G236340	PROCESS DESIGN CONCEPT	L	T	P	C	End Exam
Practicum		1	0	2	2	Practical

Course Introduction: Process Design Concept focuses on the fundamental principles of designing and analyzing industrial processes, particularly in the pulp and paper industry. This course emphasizes material balance, process efficiency, and equipment optimization to improve production.

Course Objectives:

1. Understand the material balance in the pulp and paper industry.
2. Learn the operational principles of digestors, washers, bleaching units, and pulping machines.
3. Analyze stock preparation techniques, including refining, screening, and deinking.
4. Study the drying process and production calculations.
5. Develop problem-solving skills through practical applications.

Course Outcomes (CO) with Verbs:

1. CO1 - Analyze material balance in pulp mill operations. (Analyze)
2. CO2 - Explain the working principles of key process units. (Explain)
3. CO3 - Perform production calculations for stock preparation and paper machines. (Perform)
4. CO4 - Evaluate drying section parameters and their impact on efficiency. (Evaluate)
5. CO5 - Apply knowledge of process optimization in real-time industrial scenarios. (Apply)

Programme Outcomes (PO):

1. Engineering knowledge
2. Problem analysis
3. Design and development of solutions
4. Conduct investigations
5. Modern tool usage
6. Engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and teamwork
10. Communication
11. Project management
12. Life-long learning

Programme Educational Objectives (PEO):

1. PEO1 - Develop fundamental knowledge in process design and industrial applications.
2. PEO2 - Foster problem-solving skills for complex engineering challenges.
3. PEO3 - Promote lifelong learning and adaptability in evolving technologies.

Programme Specific Outcomes (PSO):

1. PSO1 - Apply engineering principles to optimize paper manufacturing processes.
2. PSO2 - Utilize modern tools and techniques for efficiency enhancement.

CO-PO-PSO Mapping Table:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	1	2	1	2	2	1	2	3	2
CO2	3	2	2	2	2	1	1	1	2	2	2	3	2	3
CO3	3	3	3	3	3	2	2	1	2	3	2	3	3	3
CO4	3	3	3	3	3	2	2	2	2	3	2	3	3	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3	3	3

(*3 - Strong, 2 - Moderate, 1 - Weak Contribution*)

Instructional Strategy:

1. Lectures and presentations
2. Laboratory experiments
3. Case studies and industry visits
4. Group discussions and problem-solving sessions
5. Assignments and project-based learning

Assessment Methodology

Assessment Method	Assessment Marks		Converted Marks	Internal Marks	External Marks	Total Marks
Cycle Test - I Practical Examinations PART A Exercises (2 Hours)	50 Marks	Best of CY-I & CY-II	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Cycle Test - II Practical Examinations PART B Exercises (2 Hours)	50 Marks					
Model Theory Examinations (3 Hours)	100 Marks	15 Marks	15 Marks			
Model Practical Examinations (3 Hours)	100 Marks	15 Marks				
Practical Document/ Drawing Plate submission (Each Exercise / Experiment / Drawing plate should be evaluated to 10 Marks.	10 Marks		10 Marks			
Attendance	5 Marks		5 Marks			
END PRACTICAL EXAMINATIONS (3 Hours)	100 Marks		60 Marks			
TOTAL						

SCHEME OF EVALUATION
CYCLE TEST I & II

PART	DESCRIPTION	MARKS
1	Aim & Procedure	35
2	Execution and Result	15
	Total	**50**

SCHEME OF EVALUATION
Model Theory Examination

Part A - 10 Questions x 2 Marks = 20 Marks
Part B - 10 Questions x 8 Marks = 80 Marks
Total Marks= 100 Marks

In Each Unit Part - A (3 Questions answer any 2)
Part - B (3 Questions answer any 2)

SCHEME OF EVALUATION
Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
1	Aim (05) ,Program from Part - A (30)	35
2	Aim (05) ,Program from Part - B (30)	35
3	Executing any one program (Part A or Part -B)	15
4	Output	10
5	Viva Voce	05
	Total	**100**

5G236340	PROCESS DESIGN CONCEPT	L	T	P	C	End Exam
Practicum		1	0	2	2	Practical

Unit I	**PULPING MILL & STOCK PREPARATION**	
Chapter 1.1 - Material Balance - Pulp mill **Chapter 1.2 -** Digestor, Brown stock washer, Bleaching **Chapter 1.3 -** Deinking (Flotation cell) & Low consistency Pulper **Chapter 1.4 -** Material Balance - Paper machine, Stock preparation **Chapter 1.5 -** Headbox - Capacity, Fanpump, pipe size **Chapter 1.6 -** Disc refiner, Centri - cleaner & Screening		07
Ex.No	**Name of the Experiment**	
1	Material Balance - Pulp mill	15
2	Digestor, Brown stock washer, Bleaching	
3	Deinking (Flotation cell) & Low consistency Pulper	
4	Disc refiner, Centri - cleaner & Screening	
5	Headbox - Capacity, Fanpump, pipe size	
Unit II	**WET & DRY END, PRODUCTION CALCULATION**	
Chapter 2.1 - Drying section, No of Dryers, Area of contact, Angle of wrap Chapter 2.2 - Consistency of Pulp at various stages in Wire part and there effects. Chapter 2.3 - Wire length &width, Dandy roll Chapter 2.4 - Production calculation for paper mill		08
Ex.No	**Name of the Experiment**	
6	Wire length &width, Dandy roll	15
7	Material Balance - Paper machine, Stock preparation	
8	Drying section, No of Dryers, Area of contact, Angle of wrap	
9	Consistency of Pulp at various stages in Wire part and there effects	
10	Production calculation	
TOTAL HOURS		45

Suggested Student Activities:

1. Research and present case studies on paper manufacturing processes.
2. Conduct small-scale material balance calculations.
3. Industry visits to paper mills.
4. Develop reports on process improvements.
5. Group discussions on process efficiency enhancement.

Reference Books:

1. Biermann, C. J. (1996). *Handbook of Pulping and Papermaking*. Academic Press.
2. Smook, G. A. (2002). *Handbook for Pulp & Paper Technologists*. TAPPI Press.
3. Gullichsen, J., & Fogelholm, C. J. (2000). *Chemical Pulping*. Fapet Oy.

Web Links:

1. www.tappi.org (Technical Association of the Pulp and Paper Industry)
2. www.pulpandpaper.net (Industry News and Resources)
3. www.paperonweb.com (Pulp and Paper Technical Resources)

5G236420	PAPER TECHNOLOGY LABORATORY	L	T	P	C	End Exam
Practical		0	0	4	2	Practical

Course Introduction: Paper Technology Laboratory provides hands-on experience in evaluating the physical and mechanical properties of paper. This course enables students to perform standardized tests and understand the significance of various paper properties in industrial applications.

Course Objectives:

1. Develop skills in measuring paper properties such as basis weight, thickness, and density.
2. Understand the importance of mechanical properties like bursting, tearing, and tensile strength.
3. Analyze optical properties, surface characteristics, and water absorbency.
4. Perform quality control tests relevant to the paper industry.
5. Correlate experimental results with industrial applications and standards.

Course Outcomes (CO) with Verbs:

1. CO1 - Conduct tests to determine basis weight, thickness, and density. (Conduct)
2. CO2 - Measure and evaluate the mechanical strength of paper. (Measure)
3. CO3 - Analyze the brightness, opacity, and surface properties of paper. (Analyze)
4. CO4 - Perform Cobb's test for water absorbency and sizing degree assessment. (Perform)
5. CO5 - Interpret ply bond and smoothness test results for quality assessment. (Interpret)

Programme Outcomes (PO):

1. Engineering knowledge
2. Problem analysis
3. Design and development of solutions
4. Conduct investigations
5. Modern tool usage
6. Engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and teamwork
10. Communication
11. Project management
12. Life-long learning

Programme Educational Objectives (PEO):

1. PEO1 - Provide students with in-depth knowledge of paper testing techniques.
2. PEO2 - Develop analytical and problem-solving skills relevant to the paper industry.
3. PEO3 - Promote lifelong learning and adherence to industrial standards.

Programme Specific Outcomes (PSO):

1. PSO1 - Apply standard testing methodologies to assess paper quality.
2. PSO2 - Utilize experimental data for process optimization in paper manufacturing.

CO-PO-PSO Mapping Table:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	1	1	1	2	2	1	2	3	2
CO2	3	3	2	3	3	1	2	1	2	3	2	2	3	3
CO3	3	3	3	3	3	2	2	1	2	3	2	3	3	3
CO4	3	3	3	3	3	2	2	2	2	3	2	3	3	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3	3	3

3 - Strong, 2 - Moderate, 1 - Weak Contribution)

Instructional Strategy:

1. Practical laboratory sessions
2. Demonstrations of testing procedures
3. Hands-on experiments with industrial testing equipment
4. Data analysis and result interpretation
5. Report writing and documentation of findings

Assessment Methodology

Assessment Method	Assessment Marks		Converted Marks	Internal Marks	External Marks	Total Marks
Cycle Test - I Practical Examinations PART A Exercises (2 Hours)	50 Marks	Best of CT-I and CT-II	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Cycle Test - II Practical Examinations PART B Exercises (2 Hours)	50 Marks					
Model Practical Examinations All Exercises (3 Hours)	100 Marks		15 Marks			
Practical Document submission (Each Exercise / Experiment Drawing plate should be evaluated to 10 Marks	10 Marks		10 Marks			
Attendance	5 Marks		5 Marks			
END PRACTICAL EXAMINATIONS (3 Hours)	100 Marks		60 Marks			
TOTAL						

SCHEME OF EVALUATION

Cycle Test I & II

PART	DESCRIPTION	MARKS
1	Aim & Procedure	35
2	Execution and Result	15
	Total	50

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
1	Aim (05) ,Program from Part - A (30)	35
2	Aim (05) ,Program from Part - B (30)	35
3	Executing any one program (Part A or Part -B)	15
4	Output	10
5	Viva Voce	05
	Total	**100**

5G236420	PAPER TECHNOLOGY LABORATORY	L	T	P	C	End Exam
Practical				4	2	Practical

Ex. No	Name of the Experiment	Period
1	Basis weight, thickness, density and bulk	60
2	Bursting strength and burst factor	
3	Tearing strength and tear factor	
4	Tensile strength and breaking length	
5	Brightness and Opacity of paper	
6	Surface strength of paper(Wax pick)	
7	Water absorbency - Cobb's method	
8	Smoothness, softness and porosity	
9	Degree of sizing	
10	Determination of ply bond.	
Total Hours		**60**

Suggested Student Activities:

1. Conduct and document standard paper tests.
2. Compare test results with industrial standards.
3. Visit paper testing laboratories in industries.
4. Present findings in a structured lab report.
5. Group discussions on the significance of various paper properties.

Reference Books:

1. Smook, G. A. (2002). *Handbook for Pulp & Paper Technologists*. TAPPI Press.
2. Casey, J. P. (1990). *Pulp and Paper: Chemistry and Chemical Technology*. Wiley-Interscience.
3. Biermann, C. J. (1996). *Handbook of Pulping and Papermaking*. Academic Press.

Web Links:

1. www.tappi.org (Technical Association of the Pulp and Paper Industry)
2. www.pulpandpaper.net (Industry News and Resources)
3. www.paperonweb.com (Pulp and Paper Technical Resources)

5G23674	PROJECT WORK	L	T	P	C	End Exam
Project		0	0	0	12	Project

Course Introduction: The Project Work course allows students to undertake an industry-oriented or research-based project in consultation with faculty members and industry personnel. The students will gather literature, conduct experiments if required, analyze data, and present their findings. This experience prepares them for real-world industrial challenges and research applications.

Course Objectives:

1. Provide hands-on experience in real-world industrial and research settings.
2. Enable students to apply theoretical knowledge to practical engineering problems.
3. Develop essential technical, analytical, and problem-solving skills.
4. Enhance communication, teamwork, and time management abilities.
5. Familiarize students with industry standards, safety practices, and quality control measures.

Course Outcomes (CO) with Verbs:

1. CO1 - Apply theoretical knowledge acquired in paper technology studies. (Apply)
2. CO2 - Utilize practical knowledge gained from in-plant training. (Utilize)
3. CO3 - Analyze industrial problems and identify bottlenecks. (Analyze)
4. CO4 - Design solutions based on research and industrial data. (Design)
5. CO5 - Present findings effectively in written and oral formats. (Present)

Programme Outcomes (PO):

1. Engineering knowledge
2. Problem analysis
3. Design and development of solutions
4. Conduct investigations
5. Modern tool usage
6. Engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and teamwork
10. Communication
11. Project management

12. Life-long learning

Programme Educational Objectives (PEO):

1. PEO1 - Develop in-depth technical knowledge in project management and research.
2. PEO2 - Enhance problem-solving and analytical skills for industrial applications.
3. PEO3 - Promote continuous learning and professional development.

Programme Specific Outcomes (PSO):

1. PSO1 - Apply research methodologies and engineering tools to optimize paper technology processes.
2. PSO2 - Develop innovative solutions and contribute to industrial advancements.

CO-PO-PSO Mapping Table:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	1	1	2	3	2	2	3	2
CO2	3	3	3	3	2	2	1	1	2	3	2	3	3	3
CO3	3	3	3	3	2	2	2	1	2	3	2	3	3	3
CO4	3	3	3	3	3	2	2	2	2	3	3	3	3	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3	3	3

3 - Strong, 2 - Moderate, 1 - Weak Contribution

Instructional Strategy:

1. Regular meetings with faculty advisors for guidance.
2. Effective time management and task planning for project completion.
3. Hands-on participation in in-house or industrial projects.
4. Development of professional skills such as communication, teamwork, and leadership.
5. Engagement in networking opportunities and industry collaborations.
6. Submission of project documentation, analysis reports, and a final presentation.

Documents to be submitted by the student for an in-house project.

Submit a printed report of your in-house project work along with the fabrication model /analysis report for the End Semester Examination.

Rubrics for In-House Project Work

Sl. No.	Topics	Description
1	Objectives	Clearly defined and specific objectives outlined. Objectives align with the project's scope and purpose.
2	LiteratureReview	Thorough review of relevant literature. Identification of gaps and justification for the project's contribution.
3	Research Design and Methodology	Clear explanation of the research design. Appropriateness and justification of chosen research methods.
4	Project Management	Adherence to project timeline and milestones. Effective organization and planning evident in the project execution.
5	Documentation	Comprehensive documentation of project details. Clarity and completeness in recording methods, results, andchallenges.
6	Presentation Skills	Clear and articulate communication of project findings. Effective use of visuals, if applicable.
7	Analysis and Interpretation	In-depth analysis of data. Clear interpretation of results in the context of researchquestions.
8	Problem-Solving	Demonstrated ability to identify and address challenges encountered during the project. Innovative solutions considered where applicable.
9	Professionalism and Compliance	Adherence to ethical standards in research. Compliance with project guidelines and requirements.
10	Quality of Work	Overall quality and contribution of the project to the field. Demonstrated effort to produce high-quality work.

COURSE TYPE PROJECT/INTERNSHIP END EXAM PROJECT

Assessment Method	Assessment Marks	Converted Marks	Internal Marks	External Marks	Total Marks
Punctuality and regularity. (Attendance)	10 Marks	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Level/proficiency of practical skills acquired. Initiative in learning / working at site	10 Marks	10 Marks			
Self-expression / communication skills. Interpersonal skills / Human Relation.	10 Marks	10 Marks			
Report and Presentation.	10 Marks	10 Marks			
END PROJECT EXAMINATIONS	100 Marks	60 Marks			
TOTAL					

SCHEME OF EVALUATION

END SEMESTER EXAMINATION- PROJECT

PART	DESCRIPTION	MARKS
1	Daily Activity Report snd Attendance certificate	20
2	Comprehensive report on Internship, Relevant Certificate from the concerned department.	30
3	Presentation by the student at the end of the Internship	30
4	Viva Voce	20
	Total	**100**

Suggested Student Activities:

1. Conduct literature reviews and industry research.
2. Design and execute experimental or case-study-based projects.
3. Analyze collected data and propose innovative solutions.
4. Prepare comprehensive project reports and presentations.
5. Participate in project discussions and review sessions.

Reference Books:

1. Montgomery, D. C. (2017). *Design and Analysis of Experiments*. Wiley.
2. Kothari, C. R. (2004). *Research Methodology: Methods and Techniques*. New Age International.
3. Creswell, J. W. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications.

Web Links:

1. www.sciencedirect.com (Engineering Research Database)
2. www.tappi.org (Technical Association of the Pulp and Paper Industry)
3. www.researchgate.net (Research Articles and Papers)

5G237173	CONTROL LABORATORY UTILITIES AND INSTRUMENTATION	L	T	P	C	End Exam
Industrial Training		0	0	0	10	Project

Course Introduction: Control Laboratory Utilities and Instrumentation is essential for understanding the mechanical and electrical operations in pulp and paper mills. This course focuses on process instrumentation, control equipment, and their role in maintaining product quality and operational efficiency.

Course Objectives:

1. Understand and measure key process parameters such as temperature, pressure, liquid level, and flow rate.
2. Gain hands-on experience with process instrumentation and control equipment.
3. Analyze water and energy consumption in paper mills.
4. Learn about industrial boilers and their significance in paper production.
5. Study automatic control valves and distributed control systems.

Course Outcomes (CO) with Verbs:

1. CO1 - Explain the physical parameters and equipment used in the laboratory. (Explain)
2. CO2 - Demonstrate computer control of process variables and identify instrument failures. (Demonstrate)
3. CO3 - Evaluate water and energy consumption in paper mills. (Evaluate)
4. CO4 - Analyze automatic control valves and distributed control system operations. (Analyze)
5. CO5 - Interpret laboratory results and assess equipment performance. (Interpret)

Programme Outcomes (PO):

1. Engineering knowledge
2. Problem analysis
3. Design and development of solutions
4. Conduct investigations
5. Modern tool usage
6. Engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and teamwork
10. Communication
11. Project management
12. Life-long learning

Programme Educational Objectives (PEO):

1. PEO1 - Equip students with knowledge of process instrumentation and control.
2. PEO2 - Develop problem-solving skills for industrial applications.
3. PEO3 - Encourage lifelong learning and professional competency.

Programme Specific Outcomes (PSO):

1. PSO1 - Apply instrumentation techniques for process control.
2. PSO2 - Utilize analytical tools for optimizing industrial operations.

CO-PO-PSO Mapping Table:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	1	1	0	1	2	2	1	2	3	2
CO2	3	3	2	3	0	1	1	1	2	3	2	2	3	3
CO3	3	2	1	3	1	0	0	1	2	3	2	3	3	3
CO4	3	3	2	3	0	1	1	2	2	3	2	3	3	3
CO5	3	2	1	2	1	1	0	2	3	3	3	3	3	3

3 - Strong, 2 - Moderate, 1 - Weak Contribution

Instructional Strategy:

1. Engage students through interactive learning sessions.
2. Use real-world industrial case studies for better understanding.
3. Demonstrate instrumentation and control techniques in practical sessions.
4. Implement application-based learning approaches.
5. Foster critical thinking and problem-solving discussions.

Suggested Student Activities:

1. Conduct and document process parameter measurements.
2. Visit industries to observe real-world control systems.
3. Analyze and troubleshoot common instrument failures.
4. Prepare reports on water and energy consumption in mills.
5. Engage in group discussions on process optimization.

Reference Books:

1. Eckman, D. P. (1990). *Industrial Instrumentation*. Wiley.
2. Lipták, B. G. (2003). *Instrument Engineers' Handbook: Process Measurement and Analysis*. CRC Press.
3. Johnson, C. D. (2015). *Process Control Instrumentation Technology*. Pearson.

Web Links:

1. www.tappi.org (Technical Association of the Pulp and Paper Industry)

2. www.instrumentationtools.com (Instrumentation and Control Engineering Resources)

3. www.controlglobal.com (Process Control and Automation)

COURSE TYPE PROJECT/INTERNSHIP END EXAM PROJECT

Assessment Method	Assessment Marks	Converted Marks	Internal Marks	External Marks	Total Marks
Punctuality and regularity. (Attendance)	10 Marks	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Level/proficiency of practical skills acquired. Initiative in learning / working at site	10 Marks	10 Marks			
Self-expression / communication skills. Interpersonal skills / Human Relation.	10 Marks	10 Marks			
Report and Presentation.	10 Marks	10 Marks			
END PROJECT EXAMINATIONS	100 Marks	60 Marks			
TOTAL					

SCHEME OF EVALUATION

END SEMESTER EXAMINATION- PROJECT

PART	DESCRIPTION	MARKS
1	Daily Activity Report snd Attendance certificate	20
2	Comprehensive report on Internship, Relevant Certificate from the concerned department.	30
3	Presentation by the student at the end of the Internship	30
4	Viva Voce	20
	Total	**100**

5G237273	PAPER MAKING OPERATION & MECHANICAL MAINTENANCE	L	T	P	C	End Exam
Industrial Training		0	0	0	10	Project

Course Introduction: Paper Making Operation & Mechanical Maintenance provides students with comprehensive knowledge of how paper is manufactured from raw materials. The course covers essential paper-making processes, including sheet forming, pressing, drying, and calendaring, while also focusing on mechanical maintenance to ensure smooth production.

Course Objectives:

1. Understand the process of paper manufacturing.
2. Learn procedures to operate equipment and handling techniques.
3. Analyze operating procedures, including start-up and shutdown methods.
4. Evaluate variables affecting efficiency and production rates.
5. Gain knowledge of unit operations and their mechanical and electrical maintenance.
6. Identify common issues in paper-making and their troubleshooting solutions.
7. Obtain hands-on experience with paper-making machinery.
8. Understand paper machine runnability and quality control.
9. Study moisture control in various stages of production.
10. Develop troubleshooting techniques for paper production.

Course Outcomes (CO) with Verbs:

1. CO1 - Describe the procedures to operate equipment and handling techniques. (Describe)
2. CO2 - Analyze variables affecting efficiency and production rate. (Analyze)
3. CO3 - Identify common problems, troubleshooting, and operational parameters. (Identify)
4. CO4 - Apply quality control techniques in paper production. (Apply)
5. CO5 - Demonstrate hands-on experience with paper-making machinery. (Demonstrate)

Programme Outcomes (PO):

1. Engineering knowledge
2. Problem analysis
3. Design and development of solutions
4. Conduct investigations
5. Modern tool usage
6. Engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and teamwork
10. Communication
11. Project management
12. Life-long learning

Programme Educational Objectives (PEO):

1. PEO1 - Develop expertise in paper-making operations and mechanical maintenance.
2. PEO2 - Enhance problem-solving skills for industrial applications.
3. PEO3 - Promote lifelong learning and professional development.

Programme Specific Outcomes (PSO):

1. PSO1 - Apply mechanical maintenance techniques in paper production.
2. PSO2 - Optimize paper-making processes for improved efficiency.

CO-PO-PSO Mapping Table:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	0	1	1	1	2	2	1	2	3	2
CO2	2	2	1	2	1	1	0	1	2	3	2	2	3	3
CO3	2	2	1	2	1	0	0	1	2	3	2	3	3	3
CO4	2	2	1	2	0	0	1	2	2	3	2	3	3	3
CO5	2	2	1	2	1	1	0	2	3	3	3	3	3	3

3 - Strong, 2 - Moderate, 1 - Weak Contribution)

Instructional Strategy:

1. Organize field trips to pulp mills for practical exposure.
2. Conduct guest lectures with industry professionals.
3. Engage students in problem-solving activities through case studies.
4. Implement project-based learning on paper-making technology.
5. Utilize interactive discussions to address troubleshooting techniques.

COURSE TYPE PROJECT/INTERNSHIP END EXAM PROJECT

Assessment Method	Assessment Marks	Converted Marks	Internal Marks	External Marks	Total Marks
Punctuality and regularity. (Attendance)	10 Marks	10 Marks	**40 Marks**	**60 Marks**	**100 Marks**
Level/proficiency of practical skills acquired. Initiative in learning / working at site	10 Marks	10 Marks			
Self-expression / communication skills. Interpersonal skills / Human Relation.	10 Marks	10 Marks			
Report and Presentation.	10 Marks	10 Marks			
END PROJECT EXAMINATIONS	100 Marks	60 Marks			
TOTAL					

SCHEME OF EVALUATION

END SEMESTER EXAMINATION- PROJECT

PART	DESCRIPTION	MARKS
1	Daily Activity Report snd Attendance certificate	20
2	Comprehensive report on Internship, Relevant Certificate from the concerned department.	30
3	Presentation by the student at the end of the Internship	30
4	Viva Voce	20
	Total	**100**

Suggested Student Activities:

1. Perform hands-on activities in a paper production lab.
2. Visit paper mills to observe industrial operations.
3. Analyze machine efficiency and suggest optimizations.
4. Conduct research on quality control measures in paper manufacturing.
5. Participate in group discussions on industry challenges.

Reference Books:

1. Smook, G. A. (2002). *Handbook for Pulp & Paper Technologists*. TAPPI Press.
2. Casey, J. P. (1990). *Pulp and Paper Chemistry and Technology*. Wiley.
3. Biermann, C. J. (1996). *Handbook of Pulping and Papermaking*. Academic Press.

Web Links:

1. www.tappi.org (Technical Association of the Pulp and Paper Industry)
2. www.paperonweb.com (Paper Manufacturing Resources)
3. www.pulpandpaper.org (Pulp and Paper Technology Updates)