Curriculum

THREE YEARS (SIX SEMESTERS)

Diploma Programme in

PULP AND PAPER TECHNOLOGY

==========

Semester System

==========

Prepared by:

==========

Curriculum Development Cell

==========

INSTITUTE OF RESEARCH DEVELOPMENT & TRAINING U. P., KANPUR-208002

To be
Approved and Implemented by B.T.E.
U.P.

CONTENTS

THIRD SEMESTER

FOURTH SEMESTER

FIFTH SEMESTER

SIXTH SEMESTER

PREFACE

An important issue generally debated amongst the planners and educators world over is how technical education can contribute to sustainable development of the societies struggling hard to come in the same bracket as that of the developed nations. The rapid industrialization and globalization has created an environment for free flow of information and technology through fast and efficient means. This has led to shrinking of the world, bringing people from different culture and environment together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the forgettable years of closed economy to knowledge based and open economy in the last few decades. In order to cope with the challenges of handling new technologies, materials and methods, we have to develop human resources having appropriate professional knowledge, skills and attitude. Technical education system is one of the significant components of the human resource development and has grown phenomenally during all these years. Now it is time to consolidate and infuse quality aspect through developing human resources, in the delivery system. Polytechnics play an important role in meeting the requirements of trained technical manpower for industries and field organizations.

In order to meet the requirements of future technical manpower, we will have to revamp our existing technical education system and one of the most important requirements is to develop outcome-based curricula of diploma programmes. The curricula for diploma programmes have been revised by adopting time-tested and nationally acclaimed scientific method, laying emphasis on the identification of learning outcomes of diploma programme.

The real success of the diploma programme depends upon its effective implementation. However best the curriculum document is designed, if that is not implemented properly, the output will not be as expected. In addition to acquisition of appropriate physical resources, the availability of motivated, competent and qualified faculty is essential for effective implementation of the curricula.

It is expected of the polytechnics to carry out job market research on a continuous basis to identify the new skill requirements, reduce or remove outdated and redundant courses, develop innovative methods of course offering and thereby infuse the much needed dynamism in the system.

K.Ram
Director
I.R.D.T. Kanpur

ACKNOWLEDGEMENTS

We gratefully acknowledge the guidance and contribution received from the following persons:

i) Sh. Subhas Chand Sharma, IAS Principal Secretary Technical Education Govt fo U.P. for his exemplary vision & approach.

ii) Sh. K Ram Director Technical Education UP and Director I.R.D.T. Kanpur for continually motivating, guiding and taking keen interest in the review of curriculum.

iii) Secretary Board of Technical Education U.P. for his support in this review of curriculum.

iv) All the participants from industry/field organizations, engineering colleges, polytechnics and other technical institutions for their professional inputs during curriculum workshops.

v) CDC Officer and other concerning staff of IRDT for their support and assistance in the conduct of curriculum workshops.

Ravindra Kumar
Research Assistant

Dr. A.P. Singh
Coordinator
I.R.D.T.

1. SALIENT FEATURES OF DIPLOMA PROGRAMME IN PULP AND PAPERTECHNOLOGY

1) Name of the Programme : Diploma Programme in Pulp And Paper Technology

2)	Duration of the Programme	:	Three years (Six Semesters)
3)	Entry Qualification	:	Matriculation or equivalent NSQF Level as Prescribed by State Board of Technical Education, UP
4)	Intake	:	60 (or as prescribed by the Board)
5)	Pattern of the Programme	:	Semester Pattern
6)	NSQF Level	:	Level - 5
7)	Ratio between theory and *Practice*	:	47 : 53 (Approx.)

8) Industrial Training:
Four weeks of industrial training is included after IV semester during summer vacation. Total marks allotted to industrial training will be 50.

9) Ecology and Environment :

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

10) Energy Conservation:

A subject on Energy Conservation has been incorporated in the curriculum.

11) Entrepreneurship Development:
A full subject on Industrial Management and Entrepreneurship Development has been incorporated in the curriculum.

12) Student Centred Activities:

A provision of 3-6 periods per week has been made for organizing Student Centred Activities for overall personality development of students. Such activities will comprise of co–curricular activities such as expert lectures, self-study, games, hobby classes like photography, painting, singing etc. seminars, declamation contests, educational field visits, NCC, NSS and other cultural activities, disaster management and safety etc.

13) Project work

A project work has been included in the curriculum to enable the student get familiarize with the practices and procedures being followed in the industries and provide an opportunity to work on some live projectsin the industry.

2. EMPLOYMENT OPPORTUNITIES FOR DIPLOMA HOLDERS IN PULP AND PAPER TECHNOLOGY

The following are the major employment opportunities for diploma holders in Pulp And Paper Technology:

1. Pulp and paper industries. (Govt. and public sector, Private sector companies)
2. Disposable crockery items industries.
3. Packaging industries.
4. Combustible cartridges manufacturing.
5. Printing industries like SPMCIL,Note press etc.
6. Corrugated sheets manufacturing.
7. Textile industries.
8. Paper tube industries.

3. LEARNING OUTCOMES OF DIPLOMA PROGRAMME IN PUPL AND PAPER TECHNOLOGY

After undergoing this programme, students will be able to:

Pulp & Paper Raw Materials

After completing this course, the students will have the knowledge on

- The history of paper making and different grades of paper.
- Different fibrous raw materials used in pulp & paper making.
- The composition/chemistry of the fibrous raw materials.
- The methods of raw material storage and its preparation for pulp making.

Students will have the ability to identify, analyse and characterize the fibrous raw materials.

Pulp Technology – I

After completing this course, the students will have the knowledge on

- Basic definitions and standard terms used in pulp & paper making.
- Different types of pulping processes and different types of pulping digesters & their operations.

Students will have the ability to

- Prepare and analyse pulping chemical solutions (white liquor and soda liquor etc.).
- Conduct different types of pulping experiments.
- Analyse the basic properties of the pulp.

Pulp Technology – II

After completing this course, the students will have knowledge on

- Pulp washing and different types of washing equipments used.
- Pulp screening & cleaning, their mechanisms and different types of screens and cleaners used.
- The pulp bleaching, different types of bleaching chemicals used and their reactions. The bleaching equipments and the bleach sequences used in multi-stage bleaching

Paper Technology – I

After completing this course, the students will have the knowledge on

- Stock preparation for paper making.
- Pulp refining, different types of refiners and refining requirements of different pulps to producedifferent types of papers.
- The internal sizing of paper, different sizing chemicals used.
- Different types of fillers used in paper and their effects on paper properties.
- Additives for paper strength, preparation and addition of additives.
- The dyes & pigments and the paper dyeing.

Paper Technology –II

After completing this course, the students will have the knowledge on

- Paper making machines, their different sections and operations.
- Various types of press designs for wet pressing to remove the water from wet paper sheet.
- Drying of paper, operations of dryers, surface sizing equipment and online coating of paperand boards.
- Different types of papers, specifically specialized papers.
- Various processes for paper conversions, equipments for sheet cutting, paper finishing andpacking.

Students will have the ability to

- Make laboratory hand-sheets of paper.
- Perform various analyses required for controlling the paper machine operations.
- Prepare bleaching chemicals and their analysis.
- Test the paper for various strength and performance characteristics.

Chemical Recovery and Recycling

After completing this course, the students will have the knowledge on

- The process and different equipments used for concentration of black liquor.
- Black liquor concentration & burning and recovery boiler to produce steam.
- Causticization process – reactions and conditions to recover the chemicals/ white liquor.

Students will have the ability to

- Analyse weak and concentrated black liquors and green liquor.
- Analyse lime, lime sludge, lime purity and regenerated white liquor.

4. DERIVING CURRICULUM AREAS FROM LEARNING OUTCOMES OF THE PROGRAMME

The following curriculum areas/subjects have been derived from learning outcomes:

Sr. No.	Learning Outcomes	Curriculum Areas/Subjects
1.	Prepare and interpret drawings of engineering components.	– Engineering Drawing
3.	Prepare simple jobs as per specifications.	– General Workshop Practice
4.	Operate conventional machine for machining of components as per specifications	– Workshop Technology
5.	Use cutting tools for machines and machine tools.	– General Workshop Practice – Design and Estimation
6.	Carry out casting and welding operation.	– Workshop Technology
8.	Carry out metal forming by rolling and forging processes to produce parts.	– Workshop Technology
9.	Difference b/w unit operation & unit process, characterization of solid particles, size reduction techniques i.e. crushing, grinding & milling etc. Crushing laws, screen analysis, tilt ration, sedimentation & classifiers.	– Mechanical Operations & Solid Handling
10.	History of pupl & paper making, Selection of raw materials for pulp & paper elemstry of fibrous raw materials, raw material preparation & storage recycled fiber.	– Pulp &Paper Raw Materials
11.	Introduction & properties of fluids, Manometers, fluid flow phenomena. Equation of continuity. Bernoulli's theorem, boundary layer theory.	– Fluid Mechanics
12.	Unit conversion, gas laws, Vander wall equation, average molecular weight of gas mixture. Material balance with & without chemical reaction. Energy balance & combustion process calculations, fuel analysis.	– Material Energy Balance
13.	Definition of pulp & paper industry, draw flowsheets for various pulping process, use of various equipment in pulp industry, digesters, waste paper pulping.	– Pulp Technology -I
14.	Basic laws of heat transfer, modes of heat transfer i.e. conduction, convection & radiation, heat exchanger types & calculations, boiling & condensation, evaporators & their capacity & economy.	– Heat Transfer Operations
15.	Chemical kinetics, rate of reaction concept, Arrhenius law, Collision & transition state theory, activation	– Chemical reaction engg. & Thermodynamics

	energy, reactor types, introduction to thermodynamics, first la, second law of thermodynamics, refrigeration cycles & liquefaction process.	
16.	Stock preparation by refining & beating, Fillers, sizing theory & process control of sizing, strength enhancing additives paper stock dyeing.	– Paper technology -I
17.	Apply materials balance & energy balance by using Ms excel & MAT Lab, Heat transfer problems, heat exchanger or evaporator design by Kern's method. Design of pulping digester, flow diagram of pulp paper processes & ETP.	– Computer Application in Pulp & Paper Technology
18.	Introduction to mass transfer operation, diffusion, gas absorption, Distillation methods, types of distillation columns, Liquid-liquid extraction, solid liquid extraction, Humidification, dehumidification & drying.	– Mass TransferOperations
19.	Introduction of various plant utilities as water, steam & electricity. Source of water & treatment techniques, Boiler fuels, properties of steam, types of boiler, boiler mountings & accessories, Boiler acts.	– Process Plant Utilities
20.	Pulp washing, brown stock washing, washing equipment, screening & cleaning of pulp, pulp beaching, modern bleaching processes, bleaching equipment & sequences.	– Pulp Technology-II
21.	Levels of paper making, paper making machines & function, press designing, drying & post drying operations, calendaring, specialized papers, paper conversions, development in pulp & paper making.	– Paper Technology-II
22.	Concept of automatic process control, elements of control system, process characteristics, elements of process dynamics, first order & second order system, modes of control action, closed loop in automatic control.	– Process Control
23.	Introduction to chemical recovery systems, pulping & washing, Black liquor concentration, incineration, causticizing operation & equipment, Alternate chemical recovery processes.	– Chemical Recovery & Recycling
24.	Use appropriate practices for conservation of energy and prevention of environment Pollution.	– Environmental Studies – Energy Conservation
25.	Interpret factory acts and laws.	– Industrial Management and Entrepreneurship Development

26.	Communicate effectively in English in oral and written form with others.	– Communication Skills – Student Centred Activities (SCA)
27.	Manage resources effectively at workplace.	– Industrial Management and Entrepreneurship Development
28.	Prepare detailed project proposal and report.	– Project Work
29.	Use computer and IT tools for creating document, making spread sheet and making presentation.	– Basics of Information Technology
30.	Solve real life problems by application of acquired knowledge and skills.	– Project Work – Repair and Maintenance
31.	Handle the customers effectively.	– Industrial Management and Entrepreneurship Development
32.	Apply concepts of Mechanics to solve engineering problems.	– Applied Mechanics – Mechanics of Solids
33.	Apply basic principles of Mathematics and Science to solve engineering problems.	– Applied Mathematics – Applied Physics – Applied Chemistry

5. ABSTRACT OF CURRICULUM AREAS

a) General Studies

1. Communication Skills
2. Environmental Studies
3. Energy Conservation

b) Applied Sciences

4. Applied Mathematics
5. Applied Physics
6. Applied Chemistry

c) Basic Courses in Engineering/Technology

7. Engineering Drawing
8. General Workshop Practice
9. Basics of Information Technology

d) Applied Courses in Engineering/Technology

1. Measuring Instruments & Measurements
2. Applied Mechanics
3. Mechanical Operations & Solid Handling
4. Pulp & Paper Raw Materials
5. Fluid Mechanics
6. Material Energy Balance
7. Pulp Technology –I
8. Basic of Information Technology
9. Heat Transfer Operations
10. Chemical Reaction Engg & Thermodynamics
11. Paper Technology –I
12. Basic of Electrical & Electronics Engg.
13. Computer Application in Pulp & Paper Technology
14. Mass Transfer Operation
15. Process Plant Utilities
16. Pulp Technology -II
17. Paper Technology –II
18. Process Control
19. Chemical Recovery & Recycling

e) Industrial Training

20. Project Work

6. GUIDELINES FOR ASSESSMENT OF STUDENT CENTRED ACTIVITIES (SCA)

It was discussed and decided that the maximum marks for SCA should be 30 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows:

i. 10 Marks for general behavior and discipline

(by HODs in consultation with all the teachers of the department)

ii. 5 Marks for attendance as per following:

(by HODs in consultation with all the teachers of the department)

a)	75 - 80%	2 Marks
b)	80 - 85%	4 Marks
c)	Above 85%	5 Marks

iii. 15 Marks maximum for Sports/NCC/Cultural/Co-curricular/ NSS activities as per following:

(by In-charge Sports/NCC/Cultural/Co-curricular/NSS)

a)	15	-	State/National Level participation
b)	10	-	Participation in two of above activities
c)	5	-	Inter-Polytechnic level participation

Note: There should be no marks for attendance in the internal sessional of different subjects.

7. STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN PULP AND PAPER TECHOLOGY

FIRST SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
1.1	*Communication Skills-I	4	-	2	4	20	10	30	50	2 ½	20	3	70	100
1.2	*Applied Mathematics-1	5	-	-	4	20	-	20	50	2 ½	-	-	50	70
1.3	*Applied Physics-1	5	-	2	5	20	10	30	50	2 ½	20	3	70	100
1.4	*Applied Chemistry	5	-	2	5	20	10	30	50	2 ½	20	3	70	100
1.5	*Engineering Drawing-I	-	-	8	3	-	40	40	60	3	-	-	60	100
1.6	Measuring Instruments & Measurements	4	-	2	4	20	10	30	50	2 ½	20	3	70	100
1.7	General Workshop Practice 1	-	-	8	3	-	40	40	-	-	60	4	60	100
#Student Centered Activities		-	-	1	1	-	30	30	-	-	-	-	-	30
Total		23	-	25	29	100	150	250	310	-	140	-	450	700

* Common with other diploma programme

Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

SECOND SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
2.1	*Applied Mathematics-II	5	-	-	4	20	-	20	50	2 ½	-	-	50	70
2.2	*Applied Physics-II	5	-	2	5	20	10	30	50	2 ½	20	3	70	100
2.3	+Applied Mechanics	5	-	2	5	20	10	30	50	2 ½	20	3	70	100
2.4	Mechanical Operations & Solid Handling	5	-	6	6	20	10	30	50	2 ½	20	3	70	100
2.5	Pulp and Paper Raw Materials	5	-	4	6	20	10	30	50	2	20	3	70	100
2.6	General Workshop Practice-II	-	-	8	3	-	40	40	-	-	60	4	60	100
#Student Centred Activities		-	-	1	1	-	30	30	-	-	-	-	-	30
Total		25	-	23	30	100	110	210	250	-	140	-	390	600

* Common with other diploma programs

+ Common with diploma in Mechanical Engineering and Civil Engg.

Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational fieldvisits, N.C.C., NSS, Cultural Activities and self-study etc.

THIRD SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
3.1	*Environmental Studies	3	-	2	3	20	10	30	50	2 ½	20	3	70	100
3.2	*Applied Mathematics -III	5	-	-	4	20	-	20	50	2 ½	-	-	50	70
3.3	Fluid Mechanics	5	-	4	6	20	30	50	50	2 ½	50	3	100	150
3.4	Material Energy Balance	6	-	-	5	20	-	20	50	2 ½	-	-	50	70
3.5	Pulp Technology-I	6	-	6	7	20	10	30	50	2 ½	40	3	90	120
3.6	*Basic of Information Technology	-	-	6	2	-	40	40	-	-	60	3	60	100
#Student Centred Activities		-	-	5	2	-	30	30	-	-	-	-	-	30
Total		25	-	23	29	100	120	220	250	-	170	-	420	640

* Common with other diploma Programs

\# Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

FOURTH SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
4.1	*Communication Skills-II	4	-	2	4	20	10	30	50	2 ½	20	3	70	100
4.2	Heat Transfer Operations	5	-	4	6	20	30	50	50	2 ½	50	3	100	150
4.3	Chemical Reaction Engg. & Thermodynamics	5	-	4	6	20	30	50	50	2 ½	50	3	100	150
4.4	Pulp Technology - II	5	-	-	4	20	-	20	50	2 ½	-	-	50	70
4.5	Basic of Electrical & Electronics Engineering	5	-	4	6	20	30	50	50	2 ½	50	3	100	150
4.6	Computer Application in Pulp & Paper Technology	-	-	4	2	-	20	20	-	-	40	3	40	60
4.7	*Universal Human Values	2	-	1	2	-	20	20	-		30	3	30	50
#Student Centred Activities		-	-	2	2	-	30	30	-	-	-	-	-	30
Total		26	-	21	32	100	170	270	250	-	240	-	490	760

Note: Industrial Training for 4 weeks after fourth semester during summer vacation.

* Common with other diploma Programs

** Common with diploma in Computer Science and Engineering

Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

FIFTH SEMESTER:

Sr. No.	*SUBJECTS*	*STUDY SCHEME Periods/Week*			*Credits*	*MARKS IN EVALUATION SCHEME*								*Total Marks of Internal & External*
						INTERNAL ASSESSMENT			*EXTERNAL ASSESSMENT*					
		L	*T*	*P*		*Th*	*Pr*	*Tot*	*Th*	*Hrs*	*Pr*	*Hrs*	*Tot*	
						-	-	-	-	-	-	-	-	
-	*Industrial Training*	-	-	-	*2*	-	-	-	-	-	*50*	*3*	*50*	*50*
5.1	*Mass Transfer Operations*	*5*	-	*4*	*6*	*20*	*30*	*50*	*50*	*2½*	*50*	*3*	*100*	*150*
5.2	*Pollution Control and Industrial Safety*	*5*	-	*4*	*6*	*20*	*30*	*50*	*50*	*2½*	*50*	*3*	*100*	*150*
5.3	*Process Plant Utilities*	*6*	-	-	*5*	*20*	-	*20*	*50*	*2½*	-	-	*50*	*70*
5.4	*Paper Technology - I*	*6*	-	-	*5*	*20*	-	*20*	*50*	*2½*	-	-	*50*	*70*
5.5	*Renewable Energy Sources*	*4*	-	-	*3*	*20*	-	*20*	*50*	*2½*	-	-	*50*	*70*
5.6	**Chemical Recovery and Recycling**	**6**	-	**6**	**7**	**20**	**30**	**50**	**50**	**2½**	**50**	**3**	**100**	**150**
#Student Centred Activities		-	-	*4*	*2*	-	*30*	*30*	-	-	-	-	-	*30*
Total		*32*	*0*	*18*	*36*	*120*	*120*	*240*	*300*	*0*	*200*	*12*	*500*	*740*

* Common with other diploma Programs

** Common with diploma in Computer Science and Engineering

Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

SIXTH SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
6.1	Process Control	6	-	4	6	20	30	50	50	2½	50	3	100	150
6.2	*Energy Conservation	3	-	2	3	20	10	30	50	2 ½	20	3	70	100
6.3	Paper Technology – II	*5*	-	*6*	*6*	*20*	*20*	*40*	*50*	*2½*	*40*	*3*	*90*	*130*
6.4	*Industrial Management and Entrepreneurship Development	5	-	-	4	20	-	20	50	2½	-	-	50	70
6.5	Project Work	-	-	12	5	-	50	50	-	-	100	3	100	150
#Student Centred Activities		-	-	4	2	-	30	30	-	-	-	-	-	30
Total		19	-	28	26	80	140	220	200	-	210	-	410	630

* Common with other diploma Programs

Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

1.1 COMMUNICATION SKILLS – I

L	T	P
4	-	2

RATIONALE

Knowledge of English Language plays an important role in career development. This subject aims at introducing basic concepts of communication besides laying emphasis on developing listening, speaking, reading and writing skills as parts of Communication Skill.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

.

- Understand the importance of effective communication
- Describe the process of communication
- Communicate effectively in different contexts
- Identify parts of speech
- Write correct sentences using appropriate vocabulary
- Reproduce and match words and sentences in a paragraph
- Write various types of paragraphs, notices for different purposes and composition onpicture with appropriate format
- Read unseen texts with comprehension

.

DETAILED CONTENTS

1	Basics of Communication	(13 periods)
1.1	Definition and process of communication	
1.2	Types of communication - formal and informal, oral and written, verbal andnon-verbal	
1.3	Communications barriers and how to overcome them	
1.4	Barriers to Communication, Tools of Communication	
2	Application of Grammar	(18 periods)
2.1	Parts of Speech (Noun, verb, adjective, adverb) and modals	
2.2	Sentences and its types	
2.3	Tenses	
2.4	Active and Passive Voce	

2.5 Punctuation
2.6 Direct and Indirect Speech

3 Reading Skill (10 periods)

Unseen passage for comprehension (one word substitution, prefixes, suffixes, antonyms, synonyms etc. based upon the passage to be covered under this topic)

4 Writing Skill (15 periods)

4.1 Picture composition
4.2 Writing paragraph
4.3 Notice writing

LIST OF PRACTICALS

Note: Teaching Learning Process should be focused on the use of the language in writing reports and making presentations.
Topics such as Effective listening, effective note taking, group discussions and regular presentations by the students need to be taught in a project oriented manner where the learning happens as a byproduct.

Listening and Speaking Exercises

1. Self and peer introduction
2. Newspaper reading
3. Just a minute session-Extempore
4. Greeting and starting a conversation
5. Leave taking
6. Thanking
7. Wishing well
8. Talking about likes and dislikes
9. Group Discussion
10. Listening Exercises.

INSTRUCTIONAL STRATEGY

Student should be encouraged to participate in role play and other student centered activities in class room and actively participate in listening exercises

MEANS OF ASSESSMENT

Assignments and quiz/class tests, mid-semester and end-semester written tests

- Actual practical work, exercises and viva-voce
- Presentation and viva-voce

RECOMMENDED BOOKS

1. Communicating Effectively in English, Book-I by Revathi Srinivas; AbhishekPublications, Chandigarh.
2. Communication Techniques and Skills by R. K. Chadha; Dhanpat Rai Publications, New Delhi.
3. High School English Grammar and Composition by Wren & Martin; S. Chand & Company Ltd., Delhi.
4. Excellent General English-R.B.Varshnay, R.K. Bansal, Mittal Book Depot, Malhotra
5. The Functional aspects of Communication Skills – Dr. P. Prsad, S.K. Katria & Sons, New Delhi
6. Q. Skills for success – Level & Margaret Books, Oxford University Press.
7. E-books/e-tools/relevant software to be used as recommended by AICTE/UPBTE /NITTTR.

Websites for Reference:

1. http://www.mindtools.com/page 8.html – 99k
2. http://www.letstalk.com.in
3. http://www.englishlearning.com
4. http://learnenglish.britishcouncil.org/en/
5. http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	13	24
2	18	32
3	10	16
4	15	28
Total	**56**	**100**

1.2 APPLIED MATHEMATICS - I

L	T	P
5	-	-

RATIONALE

Contents of this course provide fundamental base for understanding elementary mathematics and their uses in solving engineering problems. Contents of this course will enable students to use basic mathematical function like logarithms, partial fractions, matrices and basic 2D, curves in solving various engineering problems of all fields.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Apply Binomial theorem to solve engineering problems
- Apply determinants properties and Crammer's rule to solve engineering problems
- Apply dot & cross product of vectors to find the solution of engineering problems
- Use complex numbers in various engineering problems
- Apply differential calculus and higher order to solve engineering problems
- Find velocity, acceleration, errors and approximation in engineering problems with application of derivatives.

DETAILED CONTENTS

1. Algebra -I (12 Periods)

1.1 Series : AP and GP; Sum, nth term, Mean

1.2 Binomial theorem for positive, negative and fractional index (without proof). Application of Binomial theorem.

1.3 Determinants : Elementary properties of determinant of order 2 and 3, Multiplication system of algebraic equation, Consistency of equation, Cramer's rule

2. Algebra- II (12 Periods)

2.1 Vector algebra: Dot and Cross product, Scaler and vector triple product.

2.2 Complex number.
Complex numbers, Representation, Modulus and amplitude De-Moivre's theorem, its application in solving algebraic equations, Mod. function and its properties..

3. Trigonometry (10 Periods)

3.1 Relation between sides and angles of a triangle : Statement of various formulae showing relationship between sides and angle of a triangle.

3.2 Inverse circular functions: Simple case only

4. Differential Calculus – I (18 Periods)

4.1 Functions, limits, continuity, - functions and their graphs, range and domain, elementary methods of finding limits (right and left), elementary test for continuity and differentiability.

4.2 Methods of finding derivative, Trigonometric functions, exponential function, Function of a function, Log-arrhythmic differentiation, Differentiation of Inverse trigonometric function, Differentiation of implicit functions.

5. Differential Calculus – II (18 Periods)

5.1 Higher order derivatives, Leibnitz theorem (without proof). Simple applications.

5.2 Application - Finding Tangents, Normal, Points of Maxima/Minima, Increasing/Decreasing functions, Rate, Measure, velocity, Acceleration, Errors and approximation.

INSTRUCTONAL STRATEGY

The basic instructional strategy to teach basic mathematics, Binomial theorem, trigonometry, differential equations etc. should be conceptual with real world applications of relevant branch. More numerical and theory examples can be used for clear understanding of the content**.**

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests
- Model/Prototype Making

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
3 Applied Mathematics-I by Chauhan and Chauhan, Krishna Publications, Meerut**.**

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	12	20
2.	12	20
3.	10	12
4	18	24
5	18	24
Total	**70**	**100**

1.3 APPLIED PHYSICS – I

L	T	P
5	-	2

RATIONALE

Applied physics includes the study of a diversified topics related to the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects behave. Concrete knowledge of physical laws, analysis and applications in various fields of engineering and technology are given prominence in this course content.

Note: Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to learn and appreciate these concepts and principles. In all contents, SI units should be followed.

LEARNING OUTCOMES

After undergoing this course, the students must be able to:

- Identify the use of S.I. system of measurement with accuracy and how it is used in engineering
- Represent physical quantities as scalars and vectors, applying the physical laws and concepts of linear and circular motion in everyday life.
- Solve difficult problems (walking of man, horse and cart problem, flying of bird/ aircraft, etc.)
- Analyze and design banking of roads/railway tracks and apply conservation of momentum principle to Explain rocket propulsion, recoil of gun etc.
- Derive work, power and energy relationship and solve problems about work and power.
- Define work, energy and power and their units.
- Describe conservation of energy and its applications
- Understand the concept of rotational motion of a rigid body and its applications
- Apply the physical laws and concepts of gravity, its variation with longitude and latitude and its uses in space satellite etc. .
- Understand the concept of elasticity, surface tension, pressure and the laws governing movement of fluids.
- Express physical work in term of heat and temperature; Measure temperature in various processes on different scales (Celsius, Kelvin, Fahrenheit etc.)
- Distinguish between conduction, convection and radiation, identify the different methods for reducing heat losses
- Understand the laws of thermodynamics, Carnot cycle and their applications.

DETAILED CONTENTS

1. Units and Dimensions (10 Periods)

1.1 Need of Measurement in engineering and science, unit of a physical quantities - fundamental and derived units, systems of units (FPS, CGS and SI units)

1.2 Dimensions and dimensional formulae of physical quantities.

1.3 Principle of homogeneity of dimensions

1.4 Dimensional equations and their applications, conversion of numerical values of physical quantities from one system of units into another, checking the correctness of physical equations and deriving relations among various physical quantities

1.5 Limitations of dimensional analysis

1.6 Error in measurement, accuracy and precision of instruments, random and systematic errors, absolute error, relative error, and percentage error, Estimation of probable errors in the results of measurement (combination of errors in addition, subtraction, multiplication, division and powers), rules for representing significant figures in calculation.

1.7 Application of units and dimensions in measuring length, diameter, circumference, volume, surface area etc. of metallic and non-metallic blocks, wires, pipes etc. (at least two each).

2. Force and Motion (10 periods)

2.1 Scalar and vector quantities – examples, representation of vector, types of vectors

2.2 Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statementonly), Scalar and Vector Product.

2.3 Resolution of Vectors and its application to lawn roller.

2.4 Force, Momentum, Statement and Derivation of Conservation of linear momentum, itsapplications such as recoil of gun.

2.5 Impulse and its Applications

2.6 Circular motion (Uniform and Non-uniform), definition of angular displacement, angular velocity, angular acceleration, frequency, time period.

2.7 Relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical)

2.8 Central force, Expression and Applications of Centripetal and centrifugal forces with examples such as banking of roads and bending of cyclist, Principle of centrifuge.

2.9 Application of various forces in lifts, cranes, large steam engines and turbines

3. Work, Power and Energy (10 periods)

3.1 Work: and its units, examples of zero work, positive work and negative work, conservative and non-conservative force,

3.2 Friction: modern concept, types, laws of limiting friction, Coefficient of friction and itsEngineering Applications.

3.3 Work done in moving an object on horizontal and inclined plane for rough and planesurfaces with its applications

3.4 Energy and its units: Kinetic energy and potential energy with examples and theirderivation, work energy theorem.

3.5 Principle of conservation of mechanical energy for freely falling bodies, examples of transformation of energy.

3.6 Power and its units, calculation of power in numerical problems

3.7 Application of Friction in brake system of moving vehicles, bicycle, scooter, car trainsetc.

4 Rotational Motion (10 periods)

4.1 Concept of translatory and rotatory motions with examples

4.2 Definition of torque with examples

4.3 Angular momentum, Conservation of angular momentum (quantitative) and its examples

4.4 Moment of inertia and its physical significance, radius of gyration for rigid body, Theorems of parallel and perpendicular axes (statements only), Moment of inertia of rod, disc, ring and sphere (hollow and solid) (Formulae only). Concept of Fly wheel.

4.5 Rotational kinetic energy, Rolling of sphere on the slant plane

4.6 Comparison of linear motion and rotational motion.

4.7 Application of rotational motions in transport vehicles, and machines.

5 Motion of planets and satellites (08 periods)

5.1 Gravitational force, Kepler's law of planetary motion

5.2 Acceleration due gravity and its variation

5.3 Gravitational Potential and Gravitational potential energy

5.4 Motion of satellite, orbital velocity and time period of satellite, Total energy and Bindingenergy of a satellite, Escape energy and escape velocity

5.5 Types of satellites, Geo-stationary satellite, semi-synchronous, polar satellite (conceptonly) and their uses in science and technology

5.6 Concept of Black Holes

6. Properties of Matter (12 periods)

6.1 Elasticity: definition of stress and strain, different types of moduli of elasticity, Hooke's law, significance of stress strain curve

6.2 Pressure: definition, its units, atmospheric pressure, gauge pressure, absolute pressure, Fortin's Barometer and its applications

6.3 Surface tension: concept, its units, angle of contact, Capillary action and determination of surface tension from capillary rise method, applications of surface tension, effect of temperature and impurity on surface tension

6.4 Viscosity and coefficient of viscosity: Terminal velocity, Stokes law and effect of temperature on viscosity, application in hydraulic systems.

6.5 Concept of fluid motion, stream line and turbulent flow, Reynold's number Equation of continuity, Bernoulli's Theorem and their applications.

7. Heat and Thermodynamics (10 periods)

7.1 Difference between heat and temperature

7.2 Modes of transfer of heat (Conduction, convection and radiation with examples)

7.3 Different scales of temperature and their relationship

7.4 Expansion of solids, liquids and gases, coefficient of linear, surface and cubicalexpansions and relation amongst them

7.5 Heat conduction in a metal rod, Temperature gradient, Concept of Co-efficient of thermalconductivity, Uses and effects of Heat conduction in Daily life.

7.6 Isothermal and Adiabatic process

7.7 Zeroth, First and second law of thermodynamics, Heat engine (concept Only),Carnot cycle.

7.8 Application of various systems of thermometry in refrigeration and air-conditioning etc.

LIST OF PRACTICALS

1 To find radius of wire and its volume and the maximum permissible error in these quantities by using both Vernier calipers and screw gauge.

2 To find the value of acceleration due to gravity on the surface of earth by using a simple pendulum.

3 To determine the Radius of curvature of (i) convex mirror, (ii) concave mirror by Spherometer

4 To verify parallelogram law of forces

5 To study conservation of energy of a ball or cylinder rolling down an inclined plane.

6 To find the Moment of Inertia of a flywheel about its axis of rotation

7 To determine the atmospheric pressure at a place using Fortin's Barometer

8 To determine the viscosity of glycerin by Stoke's method

9 To determine the coefficient of linear expansion of a metal rod

10 To determine force constant of spring using Hooks law

INSTRUCTIONAL STATREGY

Teacher may use various teaching aids like live models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. The teacher should explain about field applications before teaching the basics to develop proper understanding of the physical phenomenon. Use of demonstration and animations can make the subject interesting and may develop scientific temper in the students. Teacher must plan a tour of Science Park/planetarium available in nearby areas in order to enhance the interest in this course.

MEANS OF ASSEMENTS

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Model Making,
- Actual Lab & Practical Work,
- Viva Voce

RECOMMENDED BOOKS

1 Text Book of Physics for Class XI (Part-I, Part-II); N.C.E.R.T., Delhi
2 Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
3 Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi
4 B.Sc.Practical Physics by C L Arora, S. Chand Publication..
5 Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
6 Engineering Physics by DK Bhhatacharya & Poonam Tandan; Oxford University Press, New Delhi
7 Modern Engineering Physics by SL Gupta, Sanjeev Gupta, Dhanpat Rai Publications
8 V. Rajendran,physics-I, Tata McGraw-Hill raw Hill publication, New Delhi
9 Arthur Beiser, Applied Physics, Tata McGraw-Hill raw Hill publication, New Delhi
10 Physics Volume 1, 5th edition, Haliday Resnick and Krane, Wiley publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	10	15
2	10	15
3	10	15
4	10	15
5	08	10
6	12	16
7	10	14
Total	**70**	**100**

1.4 APPLIED CHEMISTRY

L	T	P
5	-	2

RATIONALE

The use of various chemicals and chemical products in diverse technical and engineering fields have repeatedly proved the importance of Applied Chemistry, which enhances its role to a new peak. On the other hand, ever increasing use of such materials will compel engineers, technocrats to acquire essential applied chemistry knowledge in order to select engineering materials, which not only suit them but also provide more environmental compatibility. This situation demands principles of Applied Chemistry in diploma- engineering courses. Principles of Applied Chemistry will enable budding engineers and technocrats to develop scientific temper and appreciate physical, chemical and engineering properties of materials. Hence the subject of Applied Chemistry.

LEARNING OUTCOMES

After undergoing this subject, the student will be able to:

- Classify various substances based on state of aggregation
- Substantiate the laws and principles on which structure of atom is established.
- Explain and predict properties of substances.
- Explain sources of water and various characteristics of water (quantitatively).
- Explain cause and factors which can adversely affecting natural water quality and remedial measures available for water purification
- Think critically, develop and adapt water conservation techniques.
- Explain corrosion of metal and their preventive measures.
- explain chemical nature and causes of corrosion
- Apply correct and efficient methods of corrosion prevention.
- Explain chemistry of fuels and their relative advantages.
- Select most efficient fuel for the engine and engineering applications.
- suggest how to subside air pollution caused by the use of fossil fuels
- explain the chemistry of various polymers and plastics
- Verify suitability and select polymer/rubber/plastic materials for engineering applications.

DETAILED CONTENTS

1. Atomic Structure, Periodic Table and Chemical Bonding (14 periods)

1.1 Fundamental particles- mass and charges of electrons, protons and neutrons withnames of the scientists who discovered these fundamental particles.

1.2 Bohr's model of atom and successes and limitations of atomic theory (qualitative treatment only).

1.3 Atomic number, atomic mass number isotopes and isobars.

1.4 Definition of orbit and orbitals, shapes of s and p orbitals only, quantum numbers and their significance,

1.5 Aufbau's principle, Pauli's exclusion principle and Hund's rule electronic configuration of elements with atomic number (Z) = 30 only. (Electronic configurations of elements with atomic number greater than 30 are excluded).

1.6 Modern periodic law and periodic table, groups and periods, classification of elements into s, p, d and f blocks (periodicity in properties - excluded)

1.7 Chemical bonding and cause of bonding and types such as ionic bond in NaCl sigma (σ) and pi (π) covalent bonds in H_2, HCl, Cl_2, elementary idea of hybridization in $BeCl_2$, BF_3, CH_4, NH_3 and H_2O, VSEPR, Molecular orbital Theory

1.8 States of Matter: Solid, Liquid & Gas, Metallic bonding- explanation with the help of electron gas (sea) model.

2. Fuels and Lubricants (18 periods)

2.1 Definition of fuel, classification of fuels, characteristics of good fuel, relative merits of gaseous, liquid and solid fuels

2.2 Calorific value-higher calorific value, lower calorific value, determination of calorific value of solid or liquid fuel using Bomb calorimeter and numerical examples.

2.3 Coal - types of coal and proximate analysis of coal

2.4 Fuel rating – Octane number and Cetane number, fuel-structural influence on Octaneand Cetane numbers

2.5 Gaseous fuels – chemical composition, calorific value and applications of natural gas(CNG), LPG, producer gas, water gas and biogas.

2.6 Elementary ideal on – hydrogen as future fuels, nuclear fuels.

2.7 Lubricants: Definition and properties, mechanism, industrial application and its function in bearings.

2.8 Synthetic lubricants and cutting fluids.

3. Water (14 periods)

3.1 Demonstration of water resources on Earth using pie chart.

3.2 Classification of water – soft water and hard water, action of soap on hard water, types of hardness, causes of hardness, units of hardness – mg per liter (mgL^{-1}) and part per million (ppm) and simple numerical, pH and buffer solutions and their applications.

3.3 Disadvantages caused by the use of hard water in domestic and boiler feed water. Priming and foaming and caustic embrittlement in boilers.

3.4 Removal of hardness -Permutit process and Ion-exchange process.

3.5 Physicochemical methods for Water Quality Testing

3.5.a) Determination of pH using pH meter, total dissolved solids (TDS)

3.5.b) Testing and Estimation of- alkalinity, indicator their types and application total hardness by EDTA method and O'Hener's Method. (Chemical reaction of EDTA method are excluded).

3.5.c) Understanding of Indian Water Quality standards as per WHO

3.6 Natural water sterilization by chlorine and UV radiation and reverse osmosis.

3.7 Municipality waste water treatment. Definition of B.O.D and C.O.D.

4. Electrochemistry (04 periods)

Redox Reaction, Electrode Potential, Nernst equation, Electrochemical cell (Galvanic and Electrolytes); Nernst equation.

5. Corrosion and its Control (10 periods)

5.1 Definition of corrosion and factors affecting corrosion rate.

5.2 Theories of:

5.2.a) Dry (chemical) corrosion- Pilling Bed-worth rule

5.2.b) Wet corrosion in acidic atmosphere by hydrogen evolution mechanism

5.3 Definition of passivity and galvanic series

5.4 Corrosion control:

5.4.a) Metal coatings – Cathodic protection, Cementation on Base Metal Steel –Application of Metal Zn (Sherardizing), Cr (Chromizing) and Al (Calorizing), Sacrificial protection and impressed current voltage

5.4.b) Inorganic coatings – Anodizing and phosphating,

5.4.c) Organic coatings - use of paints varnishes and enamels

5.4.d) Internal corrosion preventive measures- alloying (with reference to passivating, neutralizing and inhibition) and heat treatment (quenching, annealing)

6. Organic compounds, Polymers and Plastics (10 periods)

6.1 Classification of organic compounds and IUPAC Nomenclature
6.2 Definition of polymer, monomer and degree of polymerization
6.3 Brief introduction to addition and condensation polymers with suitable examples (PE, PS, PVC, Teflon, Nylon -66 and Bakelite)
6.4 Definition of plastics, thermoplastics and thermosetting plastics with suitable examples,distinctions between thermoplastics and thermosetting plastics
6.5 Applications of polymers in industry and daily life

LIST OF PRACTICALS

1. Estimation of total hardness of water using standard EDTA solution
2. Estimation of total alkalinity of given water sample by titrating it against standard Sulfuric acid solution
3. Proximate analysis of solid fuel)
4. Estimation of temporary hardness of water sample by O' Hener's Method.
5. Determination of flash and fire point of given lubricating oil using Able's flash point apparatus

INSTRUCTIONAL STRATEGY

Teachers may take help of various models and charts while imparting instructions to make the concept clear. More emphasis should be laid on discussing and explaining practical applications of various chemical process and reactions. In addition, students should be encouraged or motivated to study those processes in more details, which may find practical application in their future professional career.

MEANS OF ASSEMENTS

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Model Making,
- Actual Lab & Practical Work
- Viva Voce

RECOMMENDED BOOKS

1. Chemistry in Engineering by J.C. Kuricose & J. Rajaram, Tata McGraw Hill, Publishing Company Limited, New Delhi.
2. Engineering Chemistry by P.C. Jain & Monika Jain, Dhanapat Rai Publishing Company, New Delhi.
3. Eagle's Applied Chemistry - I by S. C. Ahuja & G. H. Hugar, Eagle Prakashan, Jalandhar.
4. Engineering Chemistry – A Text Book by H. K. Chopra & A. Parmar, Narosa Publishing House, New Delhi.
5. Applied Chemistry - I by Dr. P. K Vij & Shiksha Vij, Lords Publications, Jalandhar.
6. Engineering Chemistry by Dr. Himanshu Pandey, Goel Publishing House, Meerut,India

SUGGESTED DISTRIBUTION OF MARKS

Topics	Time Allotted (hrs)	Marks Allotted (%)
1.	14	20
2.	18	24
3.	14	20
4.	04	06
5.	10	15
6.	10	15
Total	**70**	**100**

1.5 ENGINEERING DRAWING - I

L	T	P
-	-	8

RATIONALE

Drawing is the language of engineers and technicians. Reading and interpreting engineering drawing is their day to day responsibility. The subject is aimed at developing basic graphic skills in the students so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation. The emphasis, while imparting instructions, should be to develop conceptual skills in the students following BIS SP 46 – 1988.

Note:

i) First angle projection is to be followed

ii) Minimum of 18 sheets to be prepared and at least 2 sheets on AutoCAD

iii) Instructions relevant to various drawings may be given along with appropriate demonstrations, before assigning drawing practice to students

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Identify and use of different grades of pencils and other drafting instruments which are used in engineering field
- Draw free hand sketches of various kinds of objects.
- Utilize various types of lines used in engineering drawing.
- Read and apply different dimensioning methods on drawing of objects.
- Use different types of scales and their utilization in reading and reproducing drawings of objects and maps.
- Draw 2 - dimensional view of different objects viewed from different angles (orthographic views)
- Draw and interpret complete inner hidden details of an object which are otherwise not visible in normal view
- To make projections of Solid
- Generate isometric (3D) drawing from different 2D (orthographic) views/sketches
- Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances
- Use basic commands of AutoCAD.

DETAILED CONTENTS

1. Introduction to Engineering Drawing (03 sheets)

    1.1 Introduction to drawing instruments, materials, layout and sizes of drawing sheets and drawing boards.
    1.2 Different types of lines in Engineering drawing as per BIS specifications
    1.3 Practice of vertical, horizontal and inclined lines, geometrical figures such as triangles, rectangles, circles, ellipses and curves, hexagonal, pentagon with the help of drawing instruments.
    1.4 Free hand and instrumental lettering (Alphabet and numerals) – upper case (Capital Letter), single stroke, vertical and inclined at 75 degree, series of 5,8,12 mm of free hand and instrumental lettering of height 25 to 35 mm in the ratio of 7:4

2. Dimensioning Technique (01 sheet)

    2.1 Necessity of dimensioning, method and principles of dimensioning (mainly theoretical instructions)
    2.2 Dimensioning of overall sizes, circles, threaded holes, chamfered surfaces, angles, tapered surfaces, holes, equally spaced on P.C.D., counter sunk holes, counter bored holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches

3. Scales (02 sheets)

    3.1 Scales –their needs and importance (theoretical instructions), type of scales, definition of R.F. and length of scale
    3.2 Drawing of plain and diagonal scales

4. Orthographic Projections (06 sheets)

    4.1 Theory of orthographic projections (Elaborate theoretical instructions)
    4.2 Projection of Points in different quadrant
    4.3 Projection of Straight Line (1^{st} and 3^{rd} angle)
        4.3.1. Line parallel to both the planes
        4.3.2. Line perpendicular to any one of the reference plane
        4.3.3. Line inclined to any one of the reference plane.
    4.4 Projection of Plane – Different lamina like square, rectangular, triangular and circle inclined to one plane, parallel and perpendicular to another plane in 1^{st} angle only
    4.5 Three views of orthographic projection of different objects. (At least one sheet in 3^{rd} angle)
    4.6 Identification of surfaces

5 Projection of Solid (02 sheets)

5.1. Definition and salient features of Solid
5.2. Types of Solid (Polyhedron and Solid of revolution)
5.3 To make projections, sources, Top view, Front view and Side view of various types of Solid.

6. Sections (02 sheets)

6.1 Importance and salient features
6.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections.
6.3 Convention sectional representation of various materials, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections
6.4 Orthographic sectional views of different objects.

7. Isometric Views (02 sheets)

7.1 Fundamentals of isometric projections and isometric scale.
7.2 Isometric views of combination of regular solids like cylinder, cone, cube and prism.

8. Common Symbols and Conventions used in Engineering (02 sheets)

8.1 Civil Engineering sanitary fitting symbols
8.2 Electrical fitting symbols for domestic interior installations

*9. Introduction to Auto CAD (02 sheets)

Basic introduction and operational instructions of various commands in AutoCAD. At least two sheets on AutoCAD of cube, cuboid, cone, pyramid, truncated cone and pyramid, sphere and combination of above solids.

*** Auto CAD drawing will be evaluated internally by sessional marks and not by final theory paper.**

INSTRUCTIONAL STRATEGY

Teacher should show model and Realia of the component/part whose drawing is to be made. Emphasis should be given on cleanliness, dimensioning and layout of sheet. Focus should be on proper selection of drawing instruments and their proper use. The institute should procure AutoCAD or other engineering graphics software for practice in engineering drawings.

Teachers should undergo training in AutoCAD/Engineering Graphic. Separate labs for practice on AutoCAD should be established.

MEANS OF ASSESSMENT

- Sketches
- Drawing
- Use of software

RECOMMENDED BOOKS

1. A Text Book of Engineering Drawing by Surjit Singh; Dhanpat Rai & Co., Delhi
2. Engineering Drawing by PS Gill; SK Kataria & Sons, New Delhi
3. Elementary Engineering Drawing in First Angle Projection by ND Bhatt; Charotar Publishing House Pvt. Ltd., Anand
4. Engineering Drawing I & II by JS Layall; Eagle Parkashan, Jalandhar
5. Engineering Drawing I by DK Goel, GBD Publication.

1.6 MEASURING INSTRUMENTS AND MEASUREMENTS

L	T	P
4	-	2

RATIONALE

The subject of Measuring Instruments and Measurements provides the students necessary knowledge about calibrating, conducting experiments or handling various measuring instruments like Pressure Gauges, Thermometers, Pyrometers, Level Indicators etc.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Understand various process instrumentation in process industry
- Operate various measuring instruments like pressure gauge, thermometer, etc.
- Find errors and test various instruments and justify their use in systems and improve productivity.
- Select instruments for various applications.

DETAILED CONTENTS

1. Introduction and Classification of Instruments (12 Periods)

   Importance of instruments in chemical process industries, General classification of industrial instruments, Functional elements of instruments, Indicating and recording type instruments, Static and dynamic characteristics of instruments, Description and constructional details, working principle, Ranges and applications of Strip chart recorder, Circular chart recorder, Thermal conductivity measuring instrument.

2. Pressure Measurements (12 Periods)

   Absolute, Gauge and Vacuum pressure, Liquid column gauge, Bourdon tube gauge, McLeod gauge, Ionization gauge.

3. Temperature Measurement (12 Periods)

   Temperature scales, Bimetallic thermometer, Liquid expansion thermometer, Thermocouples, Resistance thermometer, Optical and radiation pyrometers, Thermistor.

4. Liquid-Level Meters (12 Periods)

   Visual indicators, Float actuated instrument, the-bubbler system, diaphragm box and air trap systems, electrical contact type liquid level indicators. Hydrostatic head density compensator level meter, hydro step, Radar or microwave level indicator, Ultrasonic or sonic level indicator.

5. Mass and Weight Measurement (08 periods)

Two-pan balance and single pan mechanical balances, Single pan electronic balance.

LIST OF PRACTICALS

1. Calibration of Pressure Gauge
2. Calibration of Thermistor
3. Calibration of Thermocouple for temperature measurement
4. Calibration of McLeod Gauge for low pressure
5. Calibration of Optical pyrometer.
6. Sketch of single pan electronic balance.
7. Measurement of pressure using bourdon tube.
8. Sketch of diaphragm and air trap system.

INSTRUCTONAL STRATEGY

This subject gives the knowledge of various instruments used to measure various process parameters. So the theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. The teacher should use audio-visual aids to show the working of these instruments.

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- End-term Written Tests
- Laboratory Work
- Viva-Voce

RECOMMENDED BOOKS

1. Industrial Instrumentation by Donald.P. Eckmann; CBS., 2004
2. Industrial instrumentation and Control by S.K. Singh; Tata McGraw , 20016
3. Industrial instrumentation, K. Krishnaswamy; New Age International.

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	12	22
2.	12	22
3.	12	22
4	12	22
5	08	12
Total	**56**	**100**

1.7 GENERAL WORKSHOP PRACTICE – I

L	T	P
-	-	8

RATIONALE

In order to have a balanced overall development of diploma engineers, it is necessary to integrate theory with practice. General workshop practices are included in the curriculum in order to provide hands-on experience about use of different tools and basic manufacturing practices. This subject aims at developing general manual and machining skills in the students. In addition, the development of dignity of Labour, safety at work place, team working and development of right attitude are the other objectives.

LEARNING OUTCOMES

After completing the course, the students will be able to:

- Identify tools and equipment used and their respective functions.
- Identify different types of materials and their basic properties.
- Use and take measurements with the help of basic measuring tools/equipment.
- Select proper tools for a particular operation.
- Select materials, tools, and sequence of operations to make a job as per given specification/drawing.
- Prepare simple jobs independently and inspect the same.
- Follow safety procedures and precautionary measures.
- Use safety equipment and Personal Protection Equipment.

DETAILED CONTENTS

Note: The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

The following shops are included in the syllabus:

1. Carpentry Shop
2. Painting and Polishing Shop
3. Electrical Shop
4. Welding Shop
5. Plumbing Shop

1. CARPENTRY SHOP

1.1 General Shop Talk

1.1.1 Name and use of raw materials used in carpentry shop : wood & alternative materials

1.1.2 Names, uses, care and maintenance of hand tools such as different types of Saws, C-Clamp, Chisels, Mallets, Carpenter's vices, Marking gauges, Try-squares, Rulers and other commonly used tools and materials used in carpentry shop by segregating as cutting tools, supporting tools, holding tools , measuring tools etc.

1.1.3 Specification of tools used in carpentry shop.

1.1.4 Different types of Timbers, their properties, uses & defects.

1.1.5 Seasoning of wood.

1.2. Practice

1.2.1 Practices for Basic Carpentry Work

1.2.2 Sawing practice using different types of saws

1.2.3 Assembling jack plane — Planning practice including sharpening of jack plane cutter

1.2.4 Chiseling practice using different types of chisels including sharpeningof chisel

1.2.5 Making of different types of wooden pin and fixing methods. Marking measuring and inspection of jobs.

1.3 Job Practice

Job 1 Marking, sawing, planning and chiseling and their practice

Job II Half Lap Joint (cross, L or T – any one)

Job III Mortise and Tenon joint (T-Joint)

Job IV Dove tail Joint (Lap or Bridle Joint)

1.4. Demonstration of job showing use of Rip Saw, Bow saw and Tenon saw, method of sharpening various saws.

2. PAINTING AND POLISHING SHOP

2.1. Introduction of paints, varnishes, Reason for surface preparation, Advantages of Painting, other method of surface coating i.e. Electroplating etc.

2.2. Job Practice

Job 1: To prepare a wooden surface for painting apply primer on one side and to paint the same side. To prepare French polish for wooden surface and polish the other side.

Job II: To prepare metal surface for painting, apply primer and paint the same.
Job III: To prepare a metal surface for spray painting, first spray primer and paint the same by spray painting gun and compressor system.

The sequence of polishing will be as follows:

i) Abrasive cutting by leather wheel
ii) Polishing with hard cotton wheel and with polishing material
iii) Buffing with cotton wheel or buff wheel.

3. ELECTRICAL SHOP

3.1 Study, demonstration and identification of common electrical materials with standard ratings and specifications such as wires, cables, switches, fuses, cleats, clamps and allied items, tools and accessories.

3.2 Study of electrical safety measures and protective devices.

Job I Identification of phase, Neutral and Earth wires for connection to domestic electrical appliances and their connections to three pin plugs.

Job II Carrying out house wiring circuits using fuse, switches, sockets, ceiling rose etc. in batten or P.V.C. casing-capping.

3.3 Study of common electrical appliances such as auto electric iron, electric kettle, ceiling/table fan, desert cooler etc.

3.4 Introduction to the construction of lead acid battery and its working.

Job III Installation of battery and connecting two or three batteries in series and parallel.

3.5 Introduction to battery charger and its functioning.

Job IV Charging a battery and testing with hydrometer and cell tester

4. WELDING SHOP

4.1 Introduction and importance of welding as compared to other material joining processes. Specifications and type of welding machines, classification and coding of electrodes, welding parameters, welding joints and welding positions. Materials to be welded, safety precautions.

4.2 Job Practice

Job I Practice of striking arc (Minimum 4 beads on 100 mm long M.S. flat).

5. PLUMBING SHOP

Use of personal protective equipments, safety precautions while working and cleaning of shop.

Introduction and demonstration of tools, equipment and machines used in plumbing shop.

Introduction of various pipes and pipe fittings of elbow, nipple, socket, union etc.

Job Practice

Job 1 : Preparation of job using elbow, bend and nipple

Job II: Preparation of job using Union, Tap, Plug and Socket.

Job III: Threading practice on pipe with die

MEANS OF ASSESSMENT

- Workshop jobs
- Report writing, presentation and viva voce

RECOMMENDED BOOKS

1. Workshop Technology I,II,III, by SK Hajra, Choudhary and AK Choudhary; Media Promoters and Publishers Pvt. Ltd. Mumbai.
2. Workshop Technology Vol. I, II, III by Manchanda; India Publishing House, Jalandhar.
3. Workshop Training Manual Vol. I, II by S.S. Ubhi; Katson Publishers, Ludhiana.
4. Manual on Workshop Practice by K Venkata Reddy; MacMillan India Ltd., New Delhi
5. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd.,New Delhi
6. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Co., New Delhi
7. Workshop Technology by HS Bawa; Tata McGraw Hill Publishers, New Delhi.

2.1 APPLIED MATHEMATICS - II

L	T	P
5	-	-

RATIONALE

Basic elements of integral calculus, differential calculus, numerical methods, differential m equations included in this course will play a vital role in understanding engineering problem mathematically. This will also develop analytical as well as conceptual abilities amongstudents.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Calculate simple integration by methods of integration
- Evaluate the area under curves, surface by using definite integrals.
- Calculate the area and volume under a curve along areas
- Solve the engineering problems with numerical methods.
- Understand the geometric shapes used in engineering problems by co-ordinate geometry.

DETAILED CONTENTS

1. Integral Calculus – I (20 Periods)

Methods of Indefinite Integration

1.1 Integration by substitution.
1.2 Integration by rational function.
1.3 Integration by partial fraction.
1.4 Integration by parts.
1.5 Integration of special function

2. Integral Calculus – II (20 Periods)

2.1 Meaning and properties of definite integrals, Evaluation of definite integrals.
2.2 Application : Length of simple curves, Finding areas bounded by simple curves Volume of solids of revolution, center of mean of plane areas.
2.3 Simpsons 1/3rd and Simposns3/8th rule and Trapezoidal Rule: their application in simple cases. Numerical solutions of algebraic equations; Bisections method, Regula falsi method, Newton-Raphson's method(without proof), Numerical solutions of simultaneous equations; Gauss elimination method(without proof)

3. Co-ordinate Geometry (2 Dimension) (18 Periods)

3.1 Circle

Equation of circle in standard form. Centre - Radius form, Diameter form, two intercept form.

4. Co-ordinate Geometry (3 Dimension) (12 Periods)

4.1 Straight lines and planes in space

Distance between two points in space, direction cosine and direction ratios, finding equation of a straight line (without proof)

INSTRUCTONAL STRATEGY

Basic elements of Differential Calculus, Integral Calculus and differential equations can be taught conceptually along with real engineering applications in which particular algorithm and theory can be applied. Numerical examples will be helpful in understanding the content of the subject.

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests
- Model/Prototype Making

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
3 Applied Mathematics-II by Chauhan and Chauhan, Krishna Publications, Meerut**.**

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	20	28
2.	20	28
3.	18	24
4	12	20
Total	**70**	**100**

2.2 APPLIED PHYSICS – II

L	T	P
5	-	2

RATIONALE

Applied physics includes the study of a diversified topics related to the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects behave. Concrete knowledge of physical laws, analysis and applications in various fields of engineering and technology are given prominence in this course content.

Note: Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to learn and appreciate these concepts and principles. In all contents, SI units should be followed.

LEARNING OUTCOMES

After undergoing this subject, the student will be able to;

- Define wave motion its types (Transverse and Longitudinal), Periodic and Simple Harmonic Motion, solve simple problems.
- Define the terms: frequency, amplitude, wavelength, velocity of a wave.
- Explain various Engineering, Medical and Industrial applications of Ultrasonic.
- Apply acoustics principles to various types of buildings to get best sound effect
- Explain diffraction, interference, polarization.
- Define capacitance and its unit. They will be able to explain the function of capacitors in simple circuits, solve simple problems using C=Q/V
- Explain the role of free electrons in insulators, conductors and semiconductors, qualitatively the terms: potential, potential difference, electromotive force.
- Explain the concept of electric current, resistance and its measurement.
- List the effects of an electric current and their common applications, State and apply Ohm's law, calculate the equivalent resistance of a variety of resistor combinations, determine the energy consumed by an appliance, distinguish between AC and DC electricity
- Explain Biot-Savart Law, Ampere’s law, Lorenz Force.
- State the laws of electromagnetic induction, describe the effect on a current-carrying conductor when placed in a magnetic field
- Explain operation of moving coil galvanometer, simple DC motor
- Apply the knowledge of diodes in rectifiers, adapters IC’s and various electronic circuits. Apply the concept of light amplification in designing of various LASER based instruments and optical sources.
- Explain total internal reflection and apply this concept for optical fiber and its uses in Medical field and Communication.

DETAILED CONTENTS

1. Wave motion and its applications (12 periods)

1.1 Wave motion, transverse and longitudinal wave motion with examples, sound and light waves, relationship among wave velocity, frequency and wave length and its application

1.2 Wave equation y = r sin wt, phase, phase difference, principle of superposition of waves

1.3 Simple Harmonic Motion (SHM): definition and characteristic, expression for displacement, velocity, acceleration, time period, frequency in S.H.M., Energy of a body executing S. H. M., simple pendulum, concept of simple harmonic progressive wave,

1.4 Free, Damped and forced oscillations, Resonance with examples, Q-factor

1.5 Definition of pitch, loudness, quality and intensity of sound waves, intensity level, Echo and reverberation, Sabine formula for reverberation time(without derivation), coefficient of absorption of sound, methods to control reverberation time and their applications, Acoustics of building defects and remedy.

1.6 Ultrasonic –production, detection, properties and applications in engineering and medical applications.

2. Wave Optics (6 periods)

2.1 Dual nature of light, wave theory of light, laws of reflection and refraction, Snell's law, Power of lens, magnification.

2.2 Two-Source Interference, Double-Slit interference, Interference due to thin films, Fresnel Biprism.

2.3 Use of interference making highly efficient solar panel.

2.4 Diffraction, Single Slit diffraction, Intensity calculation etc.

2.5 Polarization of electromagnetic waves, polarizing sheets, polarizing by Reflection (Brewster's law), Malus law, use of Polaroid's.

3. Electrostatics (12 periods)

3.1 Concept of charge, Coulombs law, Electric field of point charges, Electric lines of force and their properties, Electric flux, Electric potential and potential difference.

3.2 Gauss law of electrostatics: Application of Gauss law to find electric field intensity of straight charged conductor, plane charged sheet and charged sphere.

3.3 Capacitor and its working principle, Capacitance and its units. Capacitance of parallel plate capacitor. Series and parallel combination of capacitors (numerical), charging and discharging of a capacitor.

3.4 Dielectric and its effect on capacitance, dielectric break down.

3.5 Application of electrostatics in electrostatic precipitation of microbes and moisture separation from air and gases in industry for pollution control (Brief explanation only)

4. Current Electricity (12 periods)

4.1 Electric Current, Resistance, Specific Resistance, Conductance, Specific Conductance, Series and Parallel combination of Resistances. Factors affecting Resistance, Colour coding of carbon Resistances, Ohm's law. Superconductivity.

4.2 Kirchhoff's laws, Wheatstone bridge and its applications (meter bridge and slide wire bridge)

4.3 Concept of terminal potential difference and Electro motive force (EMF), potentiometer.

4.4 Heating effect of current, Electric power, Electric energy and its units (related numerical problems), Advantages of Electric Energy over other forms of energy

4.5 Examples of application of DC circuits in various electrical and electronics equipment such as C.R.O, T.V., Audio-Video System, Computers etc.

5. Magneto Statics and Electromagnetism (12 periods)

5.1 Magnetic poles, force on a moving charge, circulating charges, force on a current carrying wire, Hall effect, torque on a current loop.

5.2 Magnetic field due to moving charge (Biot-Savart Law), due to current (Biot-Savart Law), parallel currents, field of a solenoid, Ampere's law.

5.3 Faraday's law, Lenz' law, motional emf, induced electric fields.

5.4 Magnetic dipole and force on a magnetic dipole in a non-uniform field, Magnetization, Gauss' law for magnetism.

5.5 Types of magnetic materials. Dia, para and ferromagnetic materials with their properties,

5.6 Application of electromagnetism in ac/dc motors and generators.

6. Semiconductor physics (8 periods)

6.1 Types of materials (insulator, semi-conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction diode and its V-I characteristics

6.2 Diode as rectifier – half wave and full wave rectifier (Centre taped),

6.3 Semiconductor transistor, pnp and npn (concepts only)

6.4 Application of semiconductor diodes (Zener, LED) and that of transistor as amplifier and oscillator.

7. Modern Physics (8 Periods)

7.1 Lasers: concept of energy levels, ionizations and excitation potentials; spontaneous and stimulated emission; laser and its characteristics, population inversion, Types of lasers; Ruby and He-Ne lasers, engineering and medical applications of lasers.

7.2 Fiber optics: Total internal reflection and its applications, Critical angle and conditions for total internal reflection, introduction to optical fibers, light propagation, types, acceptance angle and numerical aperture, types and applications of optical fiber in communication.

7.3 Introduction to nanotechnology, nanoparticles and Nano materials,

LIST OF PRACTICALS (To perform minimum six experiments)

1. To determine the velocity of sound with the help of resonance tube.
2. To find the focal length of convex lens by displacement method.
3. To find the refractive index of the material of given prism using spectrometer.
4. To find the wavelength of sodium light using Fresnel Biprism.
5. To verify laws of resistances in series and parallel combination
6. To verify ohm's laws by drawing a graph between voltage and current.
7. To measure very low resistance and very high resistances using Slide Wire bridge
8. Conversion of Galvanometer into an Ammeter and Voltmeter of given range.
9. To draw hysteresis curve of a ferromagnetic material.
10. To draw characteristics of a PN junction diode and determine knee and break down voltages.
11. To find wave length of the laser beam.
12. To find numerical aperture of an optical fiber.

INSTRUCTIONAL STATREGY

Teacher may use various teaching aids like live models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. The teacher should explain about field applications before teaching the basics to develop proper understanding of the physical phenomenon. Use of demonstration and animations can make the subject interesting and may develop scientific temper in the students. Teacher must plan a tour of Science Park/planetarium available in nearby areas in order to enhance the interest in this course.

MEANS OF ASSESSMENT

- Assignment & Quiz
- Mid-Term and End-Term written test
- Model Making
- Actual Lab & Practical Work
- Viva-Voce

RECOMMENDED BOOKS

1. Text Book of Physics (Part-I, Part-II); N.C.E.R.T., Delhi
2. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
3. A Text Book of Optics, Subramanian and Brij Lal, S Chand & Co., New Delhi
4. Practical Physics, by C. L. Arora, S Chand publications
5. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
6. Modern Engineering Physics by SL Gupta, Sanjeev Gupta, Dhanpat Rai Publications.
7. Physics Volume 2, 5th edition, Haliday Resnick and Krane, Wiley publication
8. Fundamentals of Physics by Haliday, Resnick & Walker 7th edition, Wiley publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	12	18
2	6	8
3	12	18
4	12	16
5	12	16
6	8	12
7	8	12
Total	**70**	**100**

2.3 APPLIED MECHANICS

L	T	P
5	-	2

RATIONALE

The subject Applied Mechanics deals with basic concepts of mechanics like laws of forces, moments, friction, center of gravity, laws of motion and simple machines which are required by the students for further understanding of other allied subjects. The subject enhances the analytical ability of the students.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Interpret various types of units and their conversion from one to another.
- Analyze different types of forces acting on a body and draw free body diagrams.
- Determine the resultant of coplanar concurrent forces.
- Calculate the co-efficient of friction for different types of surfaces.
- Calculate the least force required to maintain equilibrium on an inclined plane.
- Determine the centroid/center of gravity of plain and composite laminar and solid bodies.
- Determine velocity ratio, mechanical advantage and efficiency of simple machines

DETAILED CONTENTS

1. Introduction (06 periods)

   1.1 Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields. Definition of Applied Mechanics.

   1.2 Definition, basic quantities and derived quantities of basic units and derived units

   1.3 Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another for density, force, pressure, work, power, velocity, acceleration

   1.4 Concept of rigid body, scalar and vector quantities

2. Laws of forces (12 periods)

   2.1 Definition of force, measurement of force in SI units, its representation, types of force: Point force/concentrated force & Uniformly distributed force, effects of force, characteristics of a force

   2.2 Different force systems (coplanar and non-coplanar), principle of

Transmissibility of forces, law of superposition

2.3 Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces, resolving a force into two rectangular components

2.4 Free body diagram

2.5 Equilibrant force and its determination

2.6 Lami's theorem (concept only)

[Simple problems on above topics]

2.7 Type of Load, supports, Beams- analysis for simply supported, cantilever beams

3. Moment (14 periods)

3.1 Concept of moment

3.2 Moment of a force and units of moment

3.3 Varignon's theorem (definition only)

3.4 Principle of moment and its applications (Levers – simple and compound, steel yard, safety valve, reaction at support)

3.5 Parallel forces (like and unlike parallel force), calculating their resultant

3.6 Concept of couple, its properties and effects

3.7 General conditions of equilibrium of bodies under coplanar forces

3.8 Position of resultant force by moment

[Simple problems on the above topics]

4. Friction (14 periods)

4.1 Definition and concept of friction, types of friction, force of friction

4.2 Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction

4.3 Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane.

4.4 Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force:

a) Acting along the inclined plane Horizontally
b) At some angle with the inclined plane

5. Centre of Gravity (10 periods)

5.1 Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies

5.2 Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion

5.3 Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed
[Simple problems on the above topics]

6. Simple Machines (14 periods)

6.1. Definition of effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines

6.2. Simple and compound machine (Examples)

6.3. Definition of ideal machine, reversible and self-locking machine

6.4. Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency

6.5. System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency

6.6. Working principle and application of wheel and axle, Weston's Differential Pulley Block, simple screw jack, worm and worm wheel, single and double winch crab. Expression for their velocity ratio and field of their application
[Simple problems on the above topics]

LIST OF PRACTICALS

1. Verification of the polygon law of forces using Gravesend apparatus.
2. To verify the forces in different members of jib crane.
3. To verify the reaction at the supports of a simply supported beam.
4. To find the mechanical advantage, velocity ratio and efficiency in case of an inclined plane.
5. To find the mechanical advantage, velocity ratio and efficiency of a screw jack.
6. To find the mechanical advantage, velocity ratio and efficiency of worm and worm wheel.

7. To find mechanical advantage, velocity ratio and efficiency of single purchase crab.
8. To find out center of gravity of regular lamina.
9. To find out center of gravity of irregular lamina.
10. To determine coefficient of friction between three pairs of given surface.

INSTRUCTIONAL STRATEGY

Applied Mechanics being a fundamental subject, the teacher are expected to emphasize on the application of "Applied Mechanics" in various subjects so that students are able to appreciate the importance of the subject. Students should also be made conversant with the use of scientific calculator to solve numerical problems

MEANS OF ASSESSMENT

Assignments and quiz/class tests, mid and end-term written tests, model/prototype making.

RECOMMENDED BOOKS

1. A Text Book of Applied Mechanics by S Ramamurtham, Dhanpat Rai Publishing Co.Ltd.
2. A Text Book of Engineering Mechanics (Applied Mechanics) by RK Khurmi; S Chand and Co. Ltd., New Delhi.
3. A Text Book of Applied Mechanics by RK Rajput; Laxmi Publications, New Delhi..
4. Text Book of Applied Mechanics by Birinder Singh, Kaption Publishing House, New Delhi.
5. Test Book of Applied Mechanics by AK Upadhyay, SK Kataria & Sons, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	8
2	12	18
3	14	20
4	14	20
5	10	14
6	14	20
Total	**70**	**100**

2.4 MECHANICAL OPERATIONS AND SOLID HANDLING

L T P
5 - 6

RATIONALE

The subject gives the students the knowledge of working of individual mechanical operations and handling of solids and their significance in chemical industries. With this information, students will be able to control the operation of equipment and regulate production.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Understand different properties of particulate solids and carry out their analysis.
- Select specific size reduction equipment based on their final application in various chemical industries like paint, pharmaceuticals etc.
- Select specific conveyor for transportation of solid particles
- Utilize theoretical knowledge for fundamental design of suitable solid- liquid separation operation.
- Identify technical errors that influence the productivity.

DETAILED CONTENTS

1. Concepts and role of unit operation in process industries (02 periods)

2. Characterization of Solid Particles (08 periods)
   Particle shape, particle size, mixed particle sizes and size analysis, expressions for specific surface of mixture, average particle size, number of particles in mixture (expression and meaning of terms only, no derivation)

3. Size Reduction (20 periods)
   - 3.1. Energy and power requirements in crushing, mechanical efficiency, expression for power required by machine.
   - 3.2. Crushing laws: Rittinger's law, Bond's law and Kick's law, Cru shing efficiency.
   - 3.3. Size reduction equipment: classification and names; study of machines: Gyratory Crusher, Jaw crusher, Grinding rolls, Single roll toothed crusher, Impact or Attrition mill, Ball mill, Fluid energy mill, Colloid mill, Rotary knife cutter, Flow sheet for closed circuit grinding.

4. Mechanical Separation (24 periods)

4.1. Screen analysis, Tyler standard screen series, screen effectiveness, Types of screening equipment i.e. gyrating screens, stationary screens and vibrating screens, Screen efficiency, Screen capacity.

4.2. Filtrations: Classification of filtrations, filter media, filter aids, mechanisms of filtrations, discontinuous Pressure filters, Filter press, Continuous: Vacuum filters, Rotary drum filters, Centrifugal filters; Suspended batch centrifuges.

4.3. Separation based on the motion of particles through fluids, Gravity classifiers, Sorting classifiers, Thickeners, Batch sedimentation, rate of sedimentation, centrifugal settling process, Tubular centrifuge, Disk centrifuge.

4.4 Cyclone Separators, Hydro cyclones.

5. Conveying of Solid Particles: Classification of conveying equipment, Belt conveyor, Screw conveyor, Chain conveyor and their applications. (08periods)

6 Mixing of Solids (08 periods)

6.1 Types of mixers, Ribbon blenders, Double cone mixer, Twin- shell blender.

6.2 Fluidization, Fluidized bed

LIST OF PRACTICALS

1. To find the sieve analysis of a given sample of solid particles by sieve shaker
2. To determine the grind ability of solids by ball-mill
3. To determine the crushing efficiency by a roll crusher using a sample of solidparticles
4. To find the rate of filtration with the help of filter press
5. To perform an experiment on rotary vacuum filter and find rate of filtration
6. To perform an experiment on a cyclone separator and find collection efficiency
7. To perform an experiment on mixer for solid-liquid mixing and find rate of mixing
8. To perform on experiment on Jaw crusher and find its crushing efficiency

INSTRUCTIONAL STRATEGY

Mechanical operations has significant importance in the area of chemical engineering. Adequate competency needs to be developed by giving sufficient practical knowledge to mechanical operation (characterization of solid particles, size reduction, energy requirement and mechanical separation). A field visit may be conducted to expose the working of various conveyers and filtration equipment in industries.

MEANS OF ASSESSMENT

- Assignments
- Class Tests
- Practical Work
- End Semester Exam
- Viva-Voce

RECOMMENDED BOOKS

1 Mechanical Operations by Swain Palra, G.K. Roy, Tata McGraw Hill Publication
2 Mechanical Operations by Kiran D. Patil, Nirali Publication
3 Chemical Engineering, Vol. I and II by Coulson and Richardson, Pergamon Press Publication
4 Unit Operation of Chemical Engineering by McCabe and Smith; McGraw Hill Publication
5 Introduction to Chemical Technology by Badger and Banchero, McGraw Hill Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	02	04
2.	08	12
3.	20	28
4	24	32
5	08	12
6	08	12
Total	**70**	**100**

2.5 PULP & PAPER RAW MATERIALS

L	T	P
5	-	4

RATIONALE

The overall course objective is to give students increased confidence in understanding the pulp & paper processes to interact more knowledge with process engineers and operators. The subject also involve in increase their ability to contribute to improving mill operations by Gaining a comprehensive overview of pulp & paper industry, mill operations, products, process variables, equipment, and terminology and to increase awareness of the importance of thinking on a mill wide basis. Increasing knowledge of how the P&P processes affect product properties, in order to improve product quality and troubleshooting the variations in quality.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Gain a more complete understanding of papermaking terms, equipment, process technology, science, and engineering fundamentals, operations, and variables. Use of various energy sources.
- Learn how one part of the mill affects other operations.
- Understand process – product relationships, and troubleshooting product quality problems.

DETAILED CONTENTS

1 Paper Making Raw Materials:

1.1 Definition and History of Pulp and Paper Making, Status of Indian Paper industry, handmade papermaking – A brief description. raw materials, Paper making raw materials, (06 periods)

1.2 Selection of pulp and paper making raw materials (a) Wood based raw materials (b) Non-woody raw materials (c) Recycled fibers (d) Synthetics fibers. (06 periods)

1.3 Brief description of pulp and paper making process (Introduction), Description of various grades of pulp and paper, Properties of paper. (06 periods)

2. Chemistry of Fibrous Raw Materials:

2.1 Chemical composition of fibrous raw materials, Cellulose – Isolation, structure and

Chemical properties, (08 periods)

2.2 Cellulose derivatives-Preparation and end use, Hemicelluloses –Isolation, Importance in paper making , reaction during pulping, lignin – Isolation, structure linkage, physical & Chemical properties, extractives – isolation and significance in pulp & Paper making. (10 periods)

3. Raw Material Preparation:

3.1 Introduction, wood handling, debarking, wood chips preparation & handling at the pulp mill, chip screening, chip storage & conveying, equipment's used for raw material preparation, chipping, chip screening & conveying, wood chip measurement, effect of chip size on pulping properties. (08 Periods)

Raw material preparation using straws, grasses and bagasse, cutters & screens for straws and grasses.

Bagasse depithing – dry and wet depithing, effect of depithing on pulping and paper making properties, disposal of pith. (08 Periods)

4. Raw Material Storage:

4.1 Storage of conventional non-woody raw materials like bamboo, storage of non-conventional raw materials like straws, grasses and bagasse

(06 periods)

4.2 Preparation, chipping, chip screening and conveying, Effect of chip size on pulping Properties. Storage of conventional (non-woody) raw materials like Bamboo, Chip preparation.

(06 periods)

5. Recycled Fiber:

Introduction to fiber from recycled paper, statistics recycled fiber recovery, recycled fiber preparation, uses of recovered paper other than paper making. (06 Periods)

LIST OF PRACTICALS

1. Wood Anatomy – Identification.
2. Fiber identification and tissue analysis (proportion of fibers, Vessels, rays, parenchyma) and determination of dimensions.
3. Proximate chemical analysis.

4. Determination of Alpha, Beta and Gama cellulose
5. Silica in raw material.
6. Raw materials preparation chipping, chip classification, measurement

a. Of dimensions, chip density, bulk density.

7. Depicting of bagasse.

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies like expert lectures, seminars, visits to green house, effluent treatment plant of any industry, rain water harvesting plant etc. may also be organized.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests,
- Mid-term and end-term written tests

BOOKS RECOMMENDED

1. G.A. Smook, Handbook of Pulp and Paper technologists, 4th Edition, Tappi Press, 2016
2. J.P. Casey (Editor), Pulp & Paper Chemistry and Technology, 3rd Edition, Vol. I, Wiley 1980
3. P. Bajpai, Biermann's Handbook of Pulp and Paper, 3rd Edition, Vol. I, Elsevier 2018

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	18	25
2.	18	25
3.	16	20
4	12	20
5	06	10
Total	**70**	**100**

2.6 GENERAL WORKSHOP PRACTICE –II

L	T	P
		-- 8

RATIONALE

In order to have a balanced overall development of diploma engineers, it is necessary to integrate theory with practice. General workshop practices are included in the curriculum in order to provide hands-on experience about use of different tools and basic manufacturing practices. This subject aims at developing general manual and machining skills in the students. In addition, the development of dignity of labour, safety at work place, team working and development of right attitude are the other objectives.

LEARNING OUTCOMES

After completing the course, the students will be able to:

- Identify tools and equipment used and their respective functions.
- Identify different types of materials and their basic properties.
- Use and take measurements with the help of basic measuring tools/equipment.
- Select proper tools for a particular operation.
- Select materials, tools, and sequence of operations to make a job as per given specification/drawing.
- Prepare simple jobs independently and inspect the same.
- Follow safety procedures and precautionary measures.
- Use safety equipment and Personal Protection Equipment.

DETAILED CONTENTS (PRACTICAL EXERCISES)

Note: The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

The following shops are included in the syllabus:

1 Fitting Shop
2 Sheet Metal Shop
3 Mason Shop
4 Machine Shop

1. FITTING SHOP

1.1 Use of personal protective equipment and safety precautions while working.
1.2 Basic deburring processes.
1.3 Introduction to fitting shop tools, marking and measuring devices/equipment.
1.4 Identification of materials. (Iron, Copper, Stainless Steel, Aluminum etc.)
1.5 Identification of various steel sections (flat, angle, channel, bar etc.).
1.6 Introduction to various fitting shop operations/processes (Hacksawing, Drilling, Chipping and Filing).
1.7 Job Practice

Job I Marking of job, use of marking tools, filing and use of measuring instruments. (Vernier caliper, Micrometer and Vernier height gauge).
Job II Filing a rectangular/square piece to maintain dimensions within an accuracy of ±.25 mm.
Job III Making a cut-out from a square piece of MS flat using hand hacksaw and chipping
Job IV Drilling and tapping practice on MS Flat.

2. SHEET METAL SHOP

2.1. Introduction to sheet metal shop, use of hand tools and accessories e.g. different types of hammers, hard and soft mallet, sheet and wire gauge, necessary allowance required during job fabrication, selection of material.
2.2 Introduction and demonstration of hand tools used in sheet metal shop.
2.3 Introduction and demonstration of various machines and equipment used in sheet metal shop e.g. Shearing Machine, Bar Folder, Burring Machine,
2.4 Introduction and demonstration of various raw materials used in sheet metal shop e.g. black-plain sheet, galvanized-iron plain sheet, galvanized corrugated sheet, aluminum sheet etc.
2.5 Study of various types of nuts, bolts, rivets, screws etc.
2.6 Job Practice
Job I: Shearing practice on a sheet using hand shears.
Job II: Practice on making Single riveted lap joint/Double riveted lap Joint.
Job III: Practice on making Single cover plate chain type, zig-zag type and single riveted Butt Joint.

4.3 MASON SHOP

4.3.1. Introduction and importance of Mason shop
4.3.2. Introduction of tools, equipment and machines used in Mason shop

4.3.3. Job Practice

Job I : Preparation of simple bond Job II :
Preparation of Arched bond
Job III: Preparation of RCC structure (column and beam)

4.4 MACHINE SHOP

4.1 Study and sketch of lathe machine

4.2 Study and Sketch of grinders, milling machine, drilling machine and CNC machine.

4.3 Plain and step turning and knurling practice.

4.4 Study and sketch of planning/shaping machine and to plane a rectangleof castiron.

MEANS OF ASSESSMENT

- Workshop jobs
- Report writing, presentation and viva voce

RECOMMENDED BOOKS

1. Workshop Technology I,II,III, by SK Hajra, Choudhary and AK Choudhary; MediaPromoters and Publishers Pvt. Ltd. Mumbai.
2. Workshop Technology Vol. I, II, III by Manchanda; India Publishing House,Jalandhar.
3. Workshop Training Manual Vol. I, II by S.S. Ubhi; Katson Publishers, Ludhiana.
4. Manual on Workshop Practice by K Venkata Reddy; MacMillan India Ltd., NewDelhi
5. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd.,New Delhi
6. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Co., New Delhi
7. Workshop Technology by HS Bawa; Tata McGraw Hill Publishers, New Delhi

3.1 ENVIRONMENTAL STUDIES

L	T	P
3	-	2

RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industries and constructional activities so that he may help in balancing the ecosystem and controlling pollution by various control measures. He should also be aware of environmental laws related to the control of pollution. He should know how to manage the waste. Energy conservation is the need of hour. He should know the concept of energy management and its conservation.

LEARNING OUTCOMES

After undergoing the subject, the student will be able to:

- Comprehend the importance of ecosystem and sustainable
- Demonstrate interdisciplinary nature of environmental issues
- Identify different types of environmental pollution and control measures.
- Take corrective measures for the abatement of pollution.
- Explain environmental legislation acts.
- Define energy management, energy conservation and energy efficiency
- Demonstrate positive attitude towards judicious use of energy and environmental protection
- Practice energy efficient techniques in day-to-day life and industrial processes.
- Adopt cleaner productive technologies
- Identify the role of non-conventional energy resources in environmental protection.
- Analyze the impact of human activities on the environment

DETAILED CONTENTS

1. Introduction (04 Periods)

1.1 Basics of ecology, eco system- concept, and sustainable development, Resources renewable and non-renewable. Air Pollution (04 Periods)

1.2 Source of air pollution. Effect of air pollution on human health, economy, plant, animals. Air pollution control methods.

2. Water Pollution (08 Periods)

2.1 Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of dissolved O_2, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

3. Soil Pollution (06 Periods)

3.1 Sources of soil pollution
3.2 Types of Solid waste- House hold, Hospital, From Agriculture, Biomedical, Animal and human, excreta, sediments and E-waste
3.3 Effect of Solid waste
3.4 Disposal of Solid Waste- Solid Waste Management

4. Noise pollution (06 Periods)

Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimize noise pollution.

5. Environmental Legislation (08 Periods)

Introduction to Water (Prevention and Control of Pollution) Act 1974, Introduction to Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board and National Green Tribunal (NGT), Environmental Impact Assessment (EIA).

6. Impact of Energy Usage on Environment (06 Periods)

Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings.

LIST OF PRACTICALS

1. Determination of TDS in drinking water
2. Determination of pH of drinking water
3. Determination of TSS in drinking water
4. Determination of hardness in drinking water
5. Determination of oil & grease in drinking water
6. Determination of alkalinity in drinking water
7. Determination of acidity in drinking water
8. Determination of organic/inorganic solid in drinking water
9. Determination of pH of soil
10. Determination of N&P (Nitrogen & Phosphorus) of soil
11. To measure the noise level in classroom and industry.
12. To segregate the various types of solid waste in a locality.
13. To study the waste management plan of different solid waste
14. To study the effect of melting of floating ice in water due to global warming

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies like expert lectures, seminars, visits to green house, effluent treatment plant of any industry, rain water harvesting plant etc. may also be organized.

MEANS OF ASSESSMENT

– Assignments and quiz/class tests,
– Mid-term and end-term written tests

RECOMMENDED BOOKS

1. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
2. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and DeepPublications, New Delhi.
3. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi
4. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
5. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.
6. Environmental Studies by Erach Bharucha; University Press (India) Private Ltd., Hyderabad.
7. Environmental Engineering and Management by Suresh K Dhamija; S K Katariaand Sons, NewDelhi.
8. E-books/e-tools/relevant software to be used as recommended by AICTE/ NITTTR,Chandigarh.

Websites for Reference:
http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	04	10
2	04	10
3	08	20
4	06	14
5	06	14
6	08	20
7	06	12
Total	**42**	**100**

3.2 APPLIED MATHEMATICS –III

L	T	P
5	-	-

RATIONALE

Contents of this course provide understanding of some elementary and advanced mathematics algorithms and their applications of solving engineering problems. Content of this course will enable students to use some advanced techniques like Beta-Gamma function, Fourier series, Laplace transform and probability distributions in solving complex engineering problems.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Understand matrix operations and uses of matrix in different problems.
- Apply elementary row and column operations in finding inverse of a matrix.
- Find Eigen values, Eigen vectors of a matrix and their different properties.
- Understand degree/order of differential equations and their solution techniques.
- Use differential equations in engineering problems of different areas.
- Find Fourier series expansion of a function
- Apply Laplace transform and their applications in solving engineering problems.
- Understand concept of probability distribution and their applications.

DETAILED CONTENTS

1. Matrices (16 Periods)

1.1 Algebra of Matrices, Inverse
Addition, Multiplication of matrices, Null matrix and a unit matrix, Square matrix, Symmetric, Skew symmetric, Hermitian, Skew herniation, Orthogonal, Unitary, diagonal and Triangular matrix, Determinant of a matrix. Definition and Computation of inverse of a matrix.

1.2 Elementary Row/Column Transformation Meaning and use in computing inverse and rank of a mat

1.3 Linear Dependence, Rank of a Matrix Linear dependence/independence of vectors, Definition and computation of rank of matrix. Computing rank through determinants, Elementary row transformation and through the concept of a set of independent vectors, Consistency of equations.

1.4 Eigen Pairs, Cayley-Hamilton Theorem Definition and evaluation of eign values and eign vectors of a matrix of order two and three, Cayley-Hamilton theorem (without Proof)and its verification, Use in finding inverse and powers of a matrix.

2. Differential Calculus (15 Periods)

2.1 Function of two variables, identification of surfaces in space, coincides

2.2 Partial Differentiation

Directional derivative, Gradient, Use of gradient f, Partial derivatives, Chain rule, higher order derivatives, Euler's theorem for homogeneous functions, Jacobians.

2.3 Vector Calculus

Vector function, Introduction to double and triple integral, differentiation and integration of vector functions, gradient, divergence and curl, differential derivatives.

3. Differential Equation (15 Periods)

3.1 Formation, Order, Degree, Types, Solution

Formation of differential equations through physical, geometrical, mechanical and electrical considerations, Order, Degree of a differential equation, Linear, nonlinear equation.

3.2 First Order Equations

Variable separable, equations reducible to separable forms, Homogeneous equations, equations reducible to homogeneous forms, Linear and Bernoulli form exact equation and their solutions.

3.3 Higher Order Linear Equation :

Property of solution, linear differential equation with constant coefficients (PI for $X= e^{ax}$ Sinax, Cosax, X^n, $e^{ax}V$, XV

3.4 Simple Applications

LCR circuit, Motion under gravity, Newton's law of cooling, radioactive decay, Population growth, Force vibration of a mass point attached to spring with and without damping effect. Equivalence of electrical and mechanical system

4. Integral Calculus-II (12 Periods)

4.1 Beta and Gamma Functions

Definition, Use, Relation between the two, their use in evaluating integrals.

4.2 Fourier Series

Fourier series of f(x),-n<x<n, Odd and even function, Half range series.

4.3 Laplace Transform

Definition, Basic theorem and properties, Unit step and Periodic functions, Inverse Laplace transform, Solution of ordinary differential equations

5. Probability and Statistics (12Periods)

5.1 Probability

Introduction, Addition and Multiplication theorem and simple problem.

5.2 Distribution

Discrete and continuous distribution, Binomial Distribution, Poisson distribution, Normal Distribution.

INSTRUCTONAL STRATEGY

The content of this course is to be taught on conceptual basis with plenty of real world examples. The basic elements of Laplace transform, Differential equations and Applications of differential equations can be taught with engineering applications of relevant branch.

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests
- Model/Prototype Making

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
3. Applied Mathematics-III by Chauhan and Chauhan, Krishna Publications, Meerut..
4. E-books/e-tools/relevant software to be used as recommended by AICTE/ NITTTR, Chandigarh.

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	16	24
2.	15	20
3.	15	20
4	12	18
5	12	18
Total	**70**	**100**

3.3 FLUID MECHANICS

L	T	P
5	-	4

RATIONALE

The subject gives the knowledge of measurement of fluid flow and various fluid transportation machinery. The knowledge gained by this subject is directly used in different subjects studied in Chemical Engineering. The knowledge of this subject helps in installation of different fluid flow and transportation machinery.

LEARNING OUTCOMES

After studying this subject, the students will be able to:

- Distinguish between different types of fluids.
- Understand the concept of viscosity.
- Calculate flow rates.
- Calculate the power of pump required to do a certain pumping job.
- Understand the principles behind different flow meters.
- Install and calculate the flow rate of fluid with different flow meters in closed pipe line.
- Understand different flow control devices and to gain the knowledge of using different valves for different types of fluids and different flow situations.
- Understand the principle and working of different fluid flow machinery.
- Install the fluid flow machinery in closed pipe lines.

DETAILED CONTENTS

1. Introduction to fluids (16 Periods)

1.1 Properties of fluids- Density and viscosity (absolute and kinematic), Vapor pressure and surface tension, cohesion and adhesion, Principle of Hydrostatic Equilibrium

1.2 Manometers- Types of Manometers (U, Inclined, Differential), Equations, Uses

1.3 Types of Fluids- Ideal and Actual fluids, Compressible and Incompressible Fluids, Newtonian and Non-Newtonian fluids including time dependent and time independent fluids.

1.4 Fluid flow phenomena : Laminar flow, shear rate, shear stress, rheological properties of fluid and turbulence

2. Flow of Fluids (Incompressible) (20 Periods)

2.1 Fluid flow, stream line flow, steady and unsteady state flow, uniform and non-uniform flow, rotational and irrational flow.
2.2 Equation of continuity, Calculation of mass flow rate, volumetric flow rate, average velocity and mass velocity.
2.3 Bernoulli's Theorem by Euler's equation and its application, Bernoulli's equation for ideal fluid, actual fluid and with pump work done. Correction in Bernoulli's equation.
2.4 Reynolds experiment and its significance in determining turbulent, laminar and transition regime.
2.5 Concept of Boundary layer, Boundary layer formation in straight tubes
2.6 Form friction and skin friction- Relationship between pressure drop, wall shear and shear stress
2.7 Laminar flow in circular pipe, Relation between maximum and average velocity in laminar flow, Hagen poiseuille's equation.
2.8 Friction in pipe, Fanning's friction factor. Friction losses due to sudden expansion/reduction of pipe and in pipefittings. Definition equivalent of length of pipe fittings.
2.9 Measurement of fluid flow with the help of flow meters- venture meter Construction Principle, Working, Coefficient of discharge, Calibration, Derivation, Orifice meter: Construction, principle, Working, Coefficient of discharge, Calibration, Derivation for calculating the flow rates, Rota meter: construction, principle working and Calibration, Pitot tube: Construction, Principle and Working. Nozzle meter: construction, principal working, derivation for calculating flow rates.
2.10 Relation between Cd, Cc and Cv
2.11 Measurement of flow in open channels with help of notches (V-notch, square- notch)

3. Pipe, fitting and valves (12 Periods)

3.1 Standard sizes of pipes, wall thickness, Schedule number, BWG Number
3.2 Joints and fittings, Gate valve, Globe valve, Ball valve, Needle valve, Non return value, Butterfly valve, Diaphragm valve

4. Transportation of Fluids (22 Periods)

4.1 Pumps-Centrifugal Pump: Parts of centrifugal pump, working of Centrifugal pump, Performance of centrifugal pump (Characteristics of centrifugal pump),Characteristics curves, priming, Developed Head, Cavitation, Net Positive Suction Head (NPSH) Priming. Positive displacement reciprocating pumps based on pressure component and based on action of piston/plunger, their construction & working, Gear pump, its construction and working, Diaphragm pump, its utility, construction and working, Screw pump, characteristic curve of pump.

4.2 Introduction to Fan, blower and compressor- Reciprocating & centrifugal compressor,

Vacuum Pump, jet ejector - its working and application.

LIST OF PRACTICALS

1. Determination of coefficient of discharge of venture meter and plot a calibration curve
2. Determination of coefficient of discharge of orifice meter & plot a calibration curve
3. To calibrate a rotameter for different liquids and plot the calibration curve.
4. To perform experiment on Bernoulli's Theorem and prove that the summation of pressurehead, kinetic head and potential head is constant.
5. To perform Reynolds Experiment and determine Reynolds number at the end of laminar region and beginning of turbulent region.
6. Determination of equivalent length of pipe fittings
7. To plot characteristics curves of centrifugal pump
8. To determine the relationship between Fanning's friction factor & Reynolds Number
9. To measure the viscosity of different liquids (Ostwald's Viscometer or Redwood Viscometer)
10. To measure the flow rate of gases using flow meter.
11. To measure the major and minor loses in pipes.

INSTRUCTIONAL STRATEGY

Teacher should give small assignments to the student. Give industrial based practical problems for material and energy calculations.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

RECOMMENDED BOOKS

1. Unit Operations of Chemical Engineering by McCabe, Smith; McGraw Hill
2. Introduction to Chemical Engineering by Badger & Banchero; McGraw Hill
3. Chemical Engineering Volume-1 by Richardson & Coulson; Pergamon Press

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	16	22
2	20	28
3	12	20
4	22	30
Total	**70**	**100**

3.4 MATERIAL AND ENERGY BALANCE

L	T	P
6	-	-

RATIONALE

This subject equips the students with basic chemical engineering calculations. It is one of the core subjects. In this subject, students learn the fundamental concepts on which chemical engineering design is based. This subject helps the student to prepare the material and enthalpy balance of a process. It also helps them to calculate the quantity of material input and output of a process plant.

LEARNING OUTCOMES

After studying this course, the students will be able to:

- Have understanding of scope of material and balance in chemical industries.
- Carry out conversions of units and equations.
- Have knowledge of the solution concentrations, specific gravity, density, molarity, normality, molality in the chemical industries.
- Find the contents and properties of given analyzed gas.
- Find out quantity of material input and outputs of various unit operations.
- Calculate material input and outputs of chemical reactions to identify excess and limitingreactants.
- Calculate the enthalpy associated with a reaction.
- Calculate the quantities of utility required.
- Carry out combustion calculations, proximate analysis and ultimate analysis

DETAILED CONTENTS

1. Scope (04 Periods)
   Scope of material and energy balance in chemical industries.

2. Unit conversion (08 Periods)
   Unit conversion of units, conversions of equations, S.I. system, M.K.S. system, C.G.S. system.

3. Gases and Gas Mixture (12Periods)

   3.1 Ideal gas law, Boyle's law, Charle's law, value of universal gas constant, Amagats Law,partial pressure
   3.2 Vander Waal's equation.
   3.3 Average molecular weight, density and composition (by weight and by mole) of gas mixture.
   3.4 Transform of material from one measure of concentration to another, including mass/volume,PPM, molality, normality and molarity.

4. Material Balance without Chemical Reaction (15Periods)

4.1 Steps for solving material balance problems.
4.2 Solving problems on various unit operations like drying, evaporation, crystallization,distillation, mixing, blending, absorption, extraction.
4.3 By pass, streams, recycle and purge simple problems.

5. Material Balance with Chemical reaction (15 Periods)

5.1 Limiting component, excess component, percent conversion, percent yield, percent excess

5.2 By pass, recycle and purge stream related simple problems.

6. Energy Balance (15 Periods)

6.1 Units of heat, sensible heat, latent heat calculations.
6.2 Heat of formation by Hess's law, problems on the same.
6.3 Heat of reaction from specific heat data, heat of combustion, heat of formation data problems.
6.4 Adiabatic reaction and adiabatic reaction temperature
6.5 Net and gross heating value and its problems.

7. Combustion Process (15 Periods)

7.1 Analysis of products of combustion: proximate and ultimate analysis.

7.2 Problems of fuel analysis, air fuel ratio, and theoretical oxygen/air required.

7.3 Problems of fuel analysis

7.4 Oxidation of Sulphur and its compounds

INSTRUCTIONAL STRATEGY

Teacher should give small assignments to the student. Give industrial based practical problems for material and energy calculations.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

RECOMMENDED BOOKS

1. Stoichiometry by B. I. Bhatt &S. M. Vora; McGraw Hill Publication
2. Chemical Process Principles Part-1 by O.A. Hougen and K.M. Watson.
3. Chemical Process Principles Part-1 by R.A. Rastogi
4. Solved Examples in Chemical Engineering by G.K. Ray

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	04	05
2.	08	10
3.	12	15
4.	15	20
5.	15	20
6.	15	15
7.	15	15
Total	**84**	**100**

3.5 PULP TECHNOLGY - 1

L	T	P
6	-	6

RATIONALE

Making of pulp from wood or other lingo cellulosic materials is an important & essential process step for paper making. In this process, the raw material is broken down physically and/or chemically such that discrete fibers are liberated that can be dispersed in water and reformed into a paper web. The first part deals mainly with the different types of pulping processes for various types of raw materials like woody, non-woody, agro-residue based and recycled/recovered papers.

LEARNING OUTCOMES

After studying this course, the students will be able to:

- State basic terms and definition of pulp and paper industry.
- Understand various processes used for manufacturing of different pulp.
- Draw flowsheets for various pulping process.
- Understand use of various equipment/ Instruments for different operations in pulp industry.
- Apply different segregation and treatment processes for recycling and processes to achieve cleaner environment.

DETAILED CONTENTS

1. INTRODUCTION : (10 periods)

   Basic definition and standard terms used in pulp and paper industry, Active alkali, Total alkali, Total titrable alkali, Effective alkali, White liquor, Black liquor and Green liquor, Sulphidity, Causticity and causticizing efficiency.

2. CHEMICAL PULPING : (18 periods)

2.1 ALKALINE PULPING : Introduction to standard terms used, Characteristics of alkaline pulps, Batch and continuous pulping process, Chemical composition of cooking liquor, Blow heat recovery systems, Odour emissions and its reasons, Process variable.

2.2 SULPHITE PULPING: Introduction to standard terms used, Characteristics of sulfite pulping, Process variables, Factors affecting sulfite pulping, chemical composition and preparation of cooking liquor.

2.3 PULPING PROCESS FOR DISSOVING GRADE PULP: Prehydrolysis of raw material – water prehydrolysis, acid prehydrolysis, Variables affecting the prehydrolysis, Characteristics of prehydrlysate, Kraft/sulfite pulping of prehydrolysed material, Yield calculations. Determination of moisture in pulp and raw material.

3. MECHANICAL PULPING : (12 periods)

Mechanical pulping processes, Process of fibre separation, Stone ground wood process, Pulping quality, characteristics and end use of pulp, Refiner - mechanical and chemical refiner, mechanical pulping process, Theory of refining, Process variables, Pulp quality, Thermo-mechanical and chemi-thermo-mechanical pulping processes, General principle of RMP, CRMP, TMP and CTMP processes.

4. SEMI-CHEMICAL AND CHEMI-MECHANICAL PULPING : (10 periods)

   Types of processes, Process variables, pulp characteristics and uses, Composition of cooking liquor and chemical reaction during treatment, chemical treatments employed.

5. WASTE PAPER PULPING : (10 periods)

   Fiber separation of waste paper (in Hydrapulper), Deinking of waste paper, various deinking systems including enzymatic deinking, Quality of deinked pulp, Production of unbleached pulps, Process variables, Advantages of recycling of waste paper.

6. DIFFERENT TYPES OF DIGESTERS: (10 periods)
   Batch digester – Rotary & Stationary, Continuous digesters - Kamyar & Pandia. Heating methods: Direct and Indirect Methods, Digester room operations like Chip filling, liquor charging, digester relief and blow down operations. Outlines of secondary fibre pulping. Simple calculations based on yield, Consistency and other properties. High density storage towers for brown stock.

LIST OF PRACTICALS

1. Preparation and analysis of white liquor.
2. Preparation and analysis of caustic soda liquor.
3. Chemical pulping of agri-residues (soda process)
4. Pre-hydrolysis and Kraft pulping of wood and bamboo.
5. Alkaline Sulphite pulping.
6. Pulp Analysis – Kappa/Permanganate number, Copper number, viscosity and lignin.
7. Refiner mechanical pulping.
8. Semi-chemical and chemi-mechanical pulping.
9. Fibre classification.
10. Waste paper processing/deinking and evaluation.
11. Determination of pulp consistency
12. Determination of pulp freeness – CSF and extent of refining - ^{0}SR.
13. Beating and refining in different laboratory beaters and refiners.
14. Drainage time of pulp
15. Stock sizing and evaluation of paper properties.
16. Analysis of rosin and alum.
17. % of solid in sizing chemical.
18. Drainability of pulp by Schopper - Riegler method.

INSTRUCTIONAL STRATEGY

Teacher should explain each process techniques and use of each and every equipment used. Industrial visit can be organized in pulp and paper industries. Audio-visuals should be used to teach.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

BOOKS RECOMMENDED

1. S.A. Rydholm, Pulping Processes, Interscience Publishers 1965
2. G.A. Smook, Handbook of Pulp and Paper Technologists, 4th Edition, Tappi Press, 2016
3. J.P. Casey (Editor), Pulp & Paper Chemistry and Technology, 3rd Edition, Vol. I, Wiley 1980
4. P. Bajpai, Biermann's Handbook of Pulp and Paper, 3rd Edition, Vol. I, Elsevier 2018

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted	Marks Allotted (%)
1	10	14
2	18	25
3	12	18
4	10	14
5	10	14
6	10	15
Total	**70**	**100**

3.6 BASICS OF INFORMATION TECHNOLOGY

L	T	P
-	-	6

RATIONALE

Information technology has great influence on all aspects of life. Primary purpose of using computer is to make the life easier. Almost all work places and living environment are being computerized. The subject introduces the fundamentals of computer system for using various hardware and software components. In order to prepare diploma holders to work in these environments, it is essential that they are exposed to various aspects of information technology such as understanding the concept of information technology and its scope; operating a computer; use of various tools using MS Office/Open Office/Libre Office using internet etc., form the broad competency profile of diploma holders. This exposure will enable the students to enter their professions with confidence, live in a harmonious way and contribute to the productivity.

Note:

Explanation of Introductory part should be demonstrated with practical work. Following topics may be explained in the laboratory along with the practical exercises. There will not be any theory examination.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Identify Computer Hardware Components, Network Components and Peripherals.
- Explain the role of an Operating System.
- Install System and Application Software.
- Explain the function of the system components including Processor, Motherboard and Input-output devices.
- Use Word Processing Software to prepare document.
- Use Spreadsheet Software to create workbooks and automate calculation.
- Use Presentation Software to create interactive presentation.
- Perform fundamental tasks common to most application software including print, scan, save, edit, cut, copy, paste, format, spell and grammar check.
- Find and evaluate information on the Web.
- Install Antivirus.
- Safeguard against Online Frauds, threats and crimes.
- Use online office tools(Google suits)

TOPICS TO BE EXPLAINED THROUGH DEMONSTRATION

1. Introduction to Computers and Peripherals.

   Components of Computer, Types of Computer, CPU, RAM, ROM, Hard disk, USB, Flash drive, CD, DVD, Blue ray, Keyboard, Mouse, Monitor, LCD, Printer, Plotter, Scanner, Modem, Sound Cards, Speakers, CMOS battery, Sharing of Printers.

2. Operation System and Application Software

   System Software, Application Software, Virtualization Software, Utility Software, MS Office/Open Office/Libre Office, Working with window, Desktop components, Menu bars, creating shortcut of program. Installation of Application software, Antivirus and Drivers.

3. Word Processing, Spreadsheet and Presentation

   Usage and creation of word document, spreadsheets and presentation, Google Suits (Google drive, google sheet, google doc. Google presentation)

.

4. Internet

   Basics of Networking – LAN, WAN, Wi-Fi technologies, Concept of IP Addresses, DNS, Search Engines, e-mail, Browsing and cyber laws.

LIST OF PRACTICAL EXERCISES

1. Identify various components, peripherals of computer and list their functions.
2. Installation of various application software and peripheral drivers
3. Installation of operating system (windows/linux/others)
4. Creation and Management (Rename, delete, search of file and folders)
5. Installation of Antivirus and remove viruses

6. Scanning and printing documents
7. Browsing, Downloading, Information using Internet
8. E-Mail ID creation, comparing, sending and receiving e-mail. Attaching a file with e-mail message.
9. Word Processing (MS Office/Open Office)

9.a) File Management

- Opening, creating and saving a document, locating files, copying contents in some different file(s), protecting files, giving password protection for a file

9.b) Page set up

- Setting margins, tab setting, ruler, indenting

9.c) Editing a document

- Entering text, cut, copy, paste using tool- bars

9.d) Formatting a document

- Using different fonts, changing font size and colour, changing the appearance through bold/italic/underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods
- Aligning of text in a document, justification of document, inserting bullets and numbering
- Formatting paragraph, inserting page breaks and column breaks, line spacing
- Use of headers, footers: Inserting footnote, end note, use of comments, auto text
- Inserting date, time, special symbols, importing graphic images, drawing tools

9.e) Tables and Borders

- Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table
- Print preview, zoom, page set up, printing options
- Using find, replace options

9.f) Using Tools like

- Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printing envelops and lables
- Using shapes and drawing toolbar,
- Working with more than one window.

10. Spread Sheet Processing (MS Office/Open Office/Libre Office)

10.a) Starting excel, open worksheet, enter, edit, data, formulae to calculate values, format data, save worksheet, switching between different spread sheets

10.b) Menu commands:
Create, format charts, organize, manage data, solving problem by analyzing data. Programming with Excel Work Sheet, getting information while working

10.c) Work books:
Managing workbooks (create, open, close, save), working in work books, selecting the cells, choosing commands, data entry techniques, formula creation and links, controlling calculations

Editing a worksheet, copying, moving cells, pasting, inserting, deletion cells, rows, columns, find and replace text, numbers of cells, formatting worksheet, conditional formatting

10.d) Creating a chart:
Working with chart types, changing data in chart, formatting a chart, use chart to analyze data

Using a list to organize data, sorting and filtering data in list

10.e) Retrieve data with query:
Create a pivot table, customizing a pivot table. Statistical analysis of data

10.f) Exchange data with other application:
Embedding objects, linking to other applications, import, export document.

11. Power Point Presentation (MS Office/Open Office/Libre office)

11.a) Introduction to PowerPoint

- How to start PowerPoint
- Working environment: concept of toolbars, slide layout &templates.
- Opening a new/existing presentation
- Different views for viewing slides in a presentation: normal, slide sorter.

11.b) Addition, deletion and saving of slides

11.c) Insertion of multimedia elements

- Adding text boxes
- Adding/importing pictures
- Adding movies and sound

- Adding tables and charts etc.
- Adding organizational chart
- Editing objects
- Working with Clip Art

11.d) Formatting slides

- Using slide master
- Text formatting
- Changing slide layout
- Changing slide colour scheme
- Changing background
- Applying design template

12. Google Suits

Using Google drive, Google shut, Google docs, Google slides.

INSTRUCTIONAL STRATEGY

Since this subject is practice oriented, the teacher should demonstrate the capabilities of computers to students while doing practical exercises. The students should be made familiar with computer parts, peripherals, connections and proficient in making use of MS Office/Open Office/Libre office/Google Suit in addition to working on internet. The student should be made capable of working on computers independently.

MEANS OF ASSESSMENT

- Class Tests/Quiz
- Software Installation and Use
- Viva-Voce
- Presentation

RECOMMENDED BOOKS

1. Fundamentals of Computer by V Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi
2. Information Technology for Management by Henery Lucas, Tata McGraw Hills, New Delhi
3. Computers Fundamentals Architecture and Organisation by B Ram, revised Edition, New AgeInternational Publishers, New Delhi
4. Computers Today by SK Basandara, Galgotia publication Pvt Ltd. Daryaganj, New Delhi.
5. Internet for Every One by Alexis Leon and Mathews Leon; Vikas Publishing House Pvt. Ltd.,Jungpura, New Delhi
6. A First Course in Computer by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., Jungpura,New Delhi
7. Computer Fundamentals by PK Sinha; BPB Publication, New Delhi
8. Fundamentals of Information Technology by Leon and Leon; Vikas Publishing House Pvt. Ltd.,Jungpura, New Delhi
9. On Your Marks - Net…Set…Go… Surviving in an e-world by Anushka Wirasinha, Prentice Hallof India Pvt. Ltd., New Delhi
10. Fundamentals of Information Technology by Vipin Arora, Eagle Parkashan, Jalandhar

Reference websites

1. www. tutorialspoint..com
2. www.sf.net
3. Gsuite.google.com
4. Spoken-tutorial.org
5. Swayam.gov.in

4.1 COMMUNICATION SKILLS – II

L	T	P
4	-	2

RATIONALE

Knowledge of English Language plays an important role in career development. This subject aims at introducing basic concepts of communication besides laying emphasis on developing listening, speaking, reading and writing skills as parts of Communication Skill.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Frame correct sentences with illustrations
- Comprehend the language correctly
- Interpret the language correctly
- Use given material in new situations.
- Correspond effectively using various types of writings like letters, memos etc.
- Communicate effectively in English with appropriate body language making use of correct and appropriate vocabulary and grammar in an organized set up and social context.

DETAILED CONTENTS

1. Functional Grammar (16 periods)

   1.1 Prepositions

   1.2 Framing Questions

   1.3 Conjunctions

   1.4 Tenses

2 Reading (16 periods)

   2.1 Unseen Passage for Comprehension (Vocabulary enhancement - Prefixes, Suffixes, one word substitution, Synonym and Antonym) based upon the passage should be covered under this topic.

3 Writing Skill (24 periods)

   3.1. Correspondence

      3.1.a) Business Letters- Floating Quotations, Placing Orders, Complaint Letters.

3.1.b) Official Letters- Letters to Government and other Offices

3.2. Memos, Circular, Office Orders

3.3. Agenda & Minutes of Meeting

3.4. Report Writing

LIST OF PRACTICALS

Note: Teaching Learning Process should be focused on the use of the language in writing report sand making presentations.

Topics such as Effective listening, effective note taking, group discussions and regular presentations by the students need to be taught in a project oriented manner where the learning happens as a byproduct.

Speaking and Listening Skills

1. Debate
2. Telephonic Conversation: general etiquette for making and receiving calls
3. Offering- Responding to offers.
4. Requesting – Responding to requests
5. Congratulating
6. Exploring sympathy and condolences
7. Asking Questions- Polite Responses
8. Apologizing, forgiving
9. Complaining
10. Warning
11. Asking and giving information
12. Getting and giving permission
13. Asking for and giving opinions

INSTRUCTIONAL STRATEGY

Students should be encouraged to participate in role play and other student-centered activities in class rooms and actively participate in listening exercises

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-semester and end-semester written tests
- Actual practical work, exercises and viva-voce
- Presentation and viva-voce

RECOMMENDED BOOKS

1. Communicating Effectively in English, Book-I by Revathi Srinivas; Abhishek Publications, Chandigarh.

2 Communication Techniques and Skills by R. K. Chadha; Dhanpat Rai Publications, New Delhi.

3 High School English Grammar and Composition by Wren & Martin; S. Chand & Company Ltd.,Delhi.

4. e-books/e-tools/relevant software to be used as recommended by AICTE/NITTTR, Chandigarh.

Websites for Reference:

1. http://www.mindtools.com/ page 8.html – 99k
2. http://www.letstalk.com.in
3. http://www.englishlearning.com
4. http://learnenglish.britishcouncil.org/en/
5. http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	16	28
2	16	28
3	24	44
Total	**56**	**100**

4.2 HEAT TRANSFER OPERATIONS

L	T	P
5	-	4

RATIONALE

Most of the Chemical Engineering operations will involve either heat addition or heat removal in one way or the other. It is, therefore, extremely necessary to have good understanding about the heat transfer mechanisms. This subject enables the students to apply this knowledge for understanding the performances of various heat transfer equipment such as heat exchangers, condensers, evaporators etc. used in almost all chemical and related industries

LEARNING OUTCOMES

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

- Understand basic laws of heat transfer
- Analyze problems involving steady heat conduction in simple geometries.
- Understand the concept of convective heat transfer and to analyze the problems involving heattransfer coefficients for natural and forced convection
- Analyze heat exchanger performance using LMTD and use it for parallel or counter flow
- Recognizer various type of heat exchanger working principle, and basic geometries of heatexchanger.
- Determine the overall heat transfer coefficient for a heat exchanger.
- Understand the concept of boiling and condenser
- Analyze the performance of evaporator

DETAILED CONTENTS

1. Modes of Heat Transfer (2 Periods)

   Conduction, Convection, Radiation, concept of steady state and unsteady state heat transfer.

2. Conduction (12 Periods)

   Fourier's law of heat conduction, thermal conductivity of materials – solids, liquids and gases and effect of temperature on thermal conductivity, one dimensional steady state heat conduction through a plane wall, composite wall and cylinder, multi-layer cylinder. Steady state heat conduction through a variable area in solid cylinder and sphere.

   Insulation and insulating materials, critical thickness of insulation, physical properties of insulating materials

3. Convection (12 Periods)

Natural and forced convection, dimensional analysis and significance of various dimensional groups such as Reynolds number, Prandtl number, Nusselt number, Grasshof number., Stanton number. Peclet number, empirical correlations for free and forced convection.

Dittus-Boelter equation, Sieder-Tate Equation, simple numerical problems using Dittus-Boelter equation, Sieder-Tate equation and convective heat coefficient. Convective heat transfer and concept of heat transfer coefficient

4. Radiation (10 Periods)

Reflection, absorption and transmission of thermal radiation, Emissive power, Wein's displacement law, Stefan Boltzmann Law, Planck's law, Kirchhoff's law, Concept of black body, Grey body. Heat transfer by radiation exchange of energy between two parallel planes of different emissivity, view factor, radiation shield, solar radiation.

5 Heat Exchanger (16 Periods)

Introduction, classification, individual and overall heat transfer coefficient, fouling factor, roughness of surfaces and their effect, LMTD for parallel and counter current heat exchangers, construction and description of:- Concentric double pipe, Shell and tube (1-1 heat exchanger and 1-2 heat exchanger), Plate type heat exchanger, Efficiency of extended surface equipment, compact heat exchanger, finned tube heat exchanger.

6. Boiling and condensation (8 Periods)

Interface, bubble and film boiling, boiling regime, Concept of condensation, types of condensation i.e. drop wise and film wise condensation

7. Evaporators (10 Periods)

Evaporation Capacity, Evaporation Economy, construction and description of open pan, long type vertical evaporator, falling film evaporator and agitated thin film evaporator, multiple effect evaporator, feeding arrangements- forward, backward, mixed and parallel feed.

LIST OF PRACTICALS (at least 8 experiments to be performed)

1. To find the thermal conductivity of (material at different temperature) metal rod.
2. To calculate the rate of heat loss through composite wall.
3. To determine experimentally the k value of insulating powder.
4. To calculate the heat transfer co-efficient for natural convection.
5. To calculate the heat transfer co-efficient for forced convection.

6. To determine overall heat transfer co-efficient for an open pan evaporator.
7. To study dropwise and film wise condensation.
8. To study Stefan Boltzmann law.
9. To determine the heat transfer coefficient with the help of double pipe heat exchanger using parallel flow
10. To determine the H.T coefficient with the help of double pipe heat exchanger using counter flow
11. To determine heat transfer coefficient in shell and tube heat exchanger using counter flow
12. To determine heat transfer coefficient in shell and tube heat exchanger using parallel flow
13. To determine the rate of evaporation in a jacketed bottle (open pan evaporation)
14. Experiment on a single effect evaporator and determination of steam economy
15. To determine heat transfer rate in finned tube heat exchanger

INSTRUCTIONAL STRATEGY

A field visit may be conducted to expose the students to various types of heat transfer equipment. Practical should be conducted to give an idea about modes of heat transfer, effect of insulation on heat transfer.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-semester and end-semester written tests
- Actual practical work, exercises and viva-voce
- Presentation and viva-voce

RECOMMENDED BOOKS

1. Heat Transfer by Chapman, MacMillan Publication.
2. Principles of Heat Transfer by Kreith, Harper and Row Publication.
3. Process Heat Transfer by Kern, McGraw Hill Publication.
4. Heat Transfer by McAdams, McGraw Hill Publication.
5. Heat Transfer by KA Gavahane, Nirali Publications.
6. Process Heat Transfer by Kern DQ, McGraw Hill Book, New York
7. Heat Transfer 7th Ed. By Holman JP; McGraw Hill, New York
8. Applied Process Design for Chemical and Petrochemical Plants, Volume III by Ludwig, E; Gulf Publishing Co., Houston, Texas
9. Heat Transfer Principles and Applications by K Dutta; Prentice Hall, India.
10. Unit Operation of Chemical Engineering by McCabe and Smith.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1.	02	04
2.	12	16
3.	12	16
4.	10	15
5.	16	22
6.	08	12
7.	10	15
Total	**70**	**100**

4.3 CHEMICAL REACTION ENGINEERING & THERMODYNAMICS

L	T	P
5	-	4

RATIONALE

This subject outline the basic principles of Kinetics. These principles which are useful in developing new concept and operating the plant. It enables the students to have an idea about the different types of rectors and it's design also gives knowledge about the importance of catalyst in various chemical processes in the industries.
Understanding basic concepts, thermodynamic properties of fluid and performance of thermal systems used in industry.

LEARNING OUTCOMES

After Studying this subject, the students will be able to:

- Know about rate of chemical reaction.
- Understand various types of reactors.
- Know the fundamentals of reactor design.
- Know about basic concepts of thermodynamics.
- Understands laws of thermodynamics.
- Understand the application of laws of thermodynamics.

DETAILED CONTENTS

Part-A

CHEMICAL REACTION ENGINEERING

1. Introduction to Chemical Kinetics (10 Periods)

1.1 Concept of rate of reaction, rate equation, rate constant, order of reaction, Molecularity of reaction.

1.2 Single reaction multiple reaction, non-elementary reaction.

1.3 Theories of reaction (Collision & Transition State Theory) rates constant- Arrhenius law and problems based on it.

1.4 Activation Energy.

1.5 Definition, Important Classification and desired properties of catalysts.

2. Interpretation of batch reactor data. (10 Periods)

2.1 Concept of batch &semi Batch reactor.

2.2 Integral and Differential method of analysis of batch reactor data.

2.3 Half-life concept for the overall order of irreversible reactions and problem based on that.

3. Introduction to Reactor Design (08 Periods)

3.1. Type of reactor (Batch reactor, Continuous reactor, Plug flow reactor, mixed flow reactor, Biological reactor, Fixed (packed) bed reactor, fluidized bed reactor.

3.2. Concept of space-time, space velocity and holding time.

PART-B
CHEMICAL ENGINEERING THERMODYNAMICS

1. Introduction and Basic Concepts (10 Periods)

Systems, Scope & importance of Thermodynamics, surroundings & Processes open, closed and isolated systems intensive and extensive properties, state and path functions/ Concept of internal energy, enthalpy, entropy, free energy and equilibrium equation of state, ideal gas law, Vander Waals equation. Amagat's law, Dalton's law, Henry's law, Zeroth law of thermodynamics.

2. First Law of Thermodynamics for Open and Closed System (10 Periods)

Statement of first law of thermodynamics, calculation of internal energy, enthalpy, heat and work for ideal gas undergoing reversible, isothermal, Isobaric, adiabatic and polytrophic process. T-V, P-V and P-T diagrams.

3. Second Law of Thermodynamics (14 Periods)

Statement of second law of thermodynamics: Kelvin Plank statement and Classius statement, Carnot cycle and its efficiency, concept of entropy and entropy change for closed and open system.
Heat pump and heat engine (coefficient of performance and efficiency).

4. Applications of Second law of Thermodynamics (08 Periods)

Refrigeration, The Carnot Refrigeration cycle, vapor compression and absorption refrigeration cycle, air refrigeration cycle, coefficient of performance(COP), liquefaction process, latest refrigerants - their qualities and applications

LIST OF PRACTICALS

1. Study and operation of batch reactor
2. Saponification reaction through batch reactor
3. Study the kinetics of reaction for all the combination for given PFR and CSTR in series
4. To find the Arrhenius equation from isothermal batch reactor.
5. To study the performance of a fluidized bed reactor
6. Study the performance of mixed flow reactor
7. Study the performance of plug flow reactor
8. Find out rate constant and in a CSTR

INSTRUCTIONAL STRATEGY

Stress should be given on interpretation and designing of the different reactors. Industrial visit during the semester should be planned and audio-visual aids should be used for making student understand. This will make subject interesting and improve student's performance in the subject.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid semester and end semester written tests

RECOMMENDED BOOKS

1. Chemical Reaction Engineering by Octave Levenspiel; Wiley Eastern Ltd.
2. Chemical Engineering Kinetics by J.M Smith; McGraw Hill Publication
3. Chemical Engineering Thermodynamics by J.M Smith, H.C. Vanness; McGraw Hill
4. Chemical Engineering Thermodynamics by K.V. Narayanan; Prentice Hall India.
5. Chemical Engineering Thermodynamics by YVC Rao
6. Engineering Thermodynamics by PK Nag
7. Chemical Engineering Thermodynamics by K.A. Gavhane, Nirali Publication.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	10	15
2.	10	15
3.	08	12
4.	10	15
5.	10	15
6.	14	18
7.	08	10
Total	**70**	**100**

4.4 PULP TECHNOLOGY –II

L T P

5 - -

RATIONAL

After the pulp is prepared from the raw material, it has to be thoroughly washed and screened for removing the uncooked raw material. This pulp is brown in color. For producing white paper, the pulp has to be bleached in multi-stage bleaching systems using different processes and bleaching agents. This subject deals with the pulp washing, screening and bleaching processes.

LEARNING OUTCOMES

- After studying this course, the students will be able to:
- Describe pulp washing with special reference to brown stock washing.
- Use different washing equipment for pulp washing.
- Draw flowsheets for various bleaching sequences.
- Analyze techniques for screening and cleaning of pulp.
- Understand the pulp bleaching and its processes.

DETAILED CONTENTS

1. Brown Stock Washing (20 period)

   Objectives of pulp washing, Study of pulp washing on multi-stage rotary vacuum filters. Counter-current washing of brown stock washer. Construction and working of a rotary vacuum filter, operating procedure, including startup and shutdown. Generation and maintenance of vacuum. Concept of dilution factor and elementary calculations. Washing losses, process variables affecting the washing efficiency.

2. Washing Equipment's (15 periods)

   Washing equipment other than rotary vacuum filters like horizontal belt washers and diffusion washers – working principles and operational aspects. Factors affecting brown stock washing and displacement efficiency, construction, working of 3-stage dilution/extraction pulp washing system.

3. Screening And Cleaning Of Pulp (15 periods)
   Screening and cleaning of pulps, reasons for pulp screening and cleaning, undersized constituents in unscreened pulp, Objectives and mechanisms of screening and cleaning. Variable affecting screening efficiency. Type of screens and their process design. Use of centrifugal cleaners (centric leaners), variables affecting centrifugal cleaning. Types of centrifugal cleaners. Theory and operation of centrifugal cleaners.

4. Pulp Bleaching (20 periods)

   4.1. Objectives and fundamentals of pulp bleaching. Important bleaching agents, their advantages and disadvantages. Brightness as a measure of pulp bleaching, Storage, handling and safety of chlorine and chlorine dioxide based bleached agents, introduction to chlorine free bleaching. Bleaching processes for chemical, mechanical, semi-chemical and waste paper pulps. Single and multi-stage bleaching

system for chemical pulps. Chlorine water system, chlorination, alkali extraction, use of hypochlorite and chlorine dioxide in bleaching operation. Chemical reactions and process parameters.

4.2. Recent bleaching process – use of hydrogen peroxide, oxygen, ozone, per acids, bio-bleaching. Non-wood fibre bleaching systems. Preparation of various bleaching chemicals.

5. Bleaching Equipment And Sequences (14 periods)

Introduction of common bleaching sequences. Flow sheets for important bleaching sequences like CE, CEHH, CEHD, CEHP, CEHDED, OCEDED, CED with emphasis on operational measures and equipment used.

INSTRUCTIONAL STRATEGY

Teacher should explain each process techniques and use of each and every equipment used. Industrial visit can be organized in pulp and paper industries. Audio-visuals should be used to teach.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

RECOMMENDED BOOKS

1. S.A. Rydholm, Pulping Processes, Interscience Publishers 1965
2. G.A. Smook, Handbook of Pulp and Paper Technologists, 4th Edition, Tappi Press, 2016
3. J.P. Casey (Editor), Pulp & Paper Chemistry and Technology, 3rd Edition, Vol. I, Wiley 1980
4. P. Bajpai, Biermann's Handbook of Pulp and Paper, 3rd Edition, Vol. I, Elsevier 2018
5. R.P. Singh, Bleaching of Pulp, TAPPI Press 1979

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted	Marks Allotted (%)
1	20	23
2	15	18
3	15	18
4	20	23
5	14	18
Total	**84**	**100**

4.5 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

L T P
5 - 4

RATIONALE

The objective of the course is to impart basic knowledge and skills regarding basic electrical engineering, which diploma holders will come across in their professional life. This course will provide the students to understand the basic concepts and principles of d.c. and a.c. fundamentals, electromagnetic induction, batteries, transformers, motors distribution system, domestic installation, electrical safety etc. The students will also learn basic electronics including diodes and transistors and their applications.

LEARNING OUTCOME

After undergoing the subject, the students will be able to

- Understand the meaning of basic electrical quantities such as voltage, current, power etc.
- Use working principle of transformer.
- Use basic Network Theorem and Kirchhoff's laws.
- Understand the concept of Junction Diode, transistor and field effect transistor.

DETAILED CONTENTS

1. Application and Advantages of Electricity (03 periods)

   Difference between ac and dc, various applications of electricity, advantages of electrical energy over other types of energy.

2. Basic Electrical Quantities (06 periods)

   Definition of voltage, current, power and energy with their units, name of instruments used for measuring above quantities, connection of these instruments in an electric circuit

3. AC Fundamentals (08 periods)

   Electromagnetic induction-Faraday's Laws, Lenz's Law; Fleming's rules, Principles of a.c. circuits; Alternating emf, Definition of cycle, frequency, amplitude and time period. Instantaneous, average, r.m.s and maximum value of sinusoidal wave; form factor and Peak Factor. Concept of phase and phase difference. Concept of resistance, inductance and capacitance in simple a.c. circuit. Power factor and improvement of power factor by use of capacitors. Concept of three phase system; star and delta connections; voltage and current relationship (no derivation)

4. Transformers (06 periods)

Working, principle and construction of single phase transformer, transformer ratio, emf equation, losses and efficiency, cooling of transformers, isolation transformer, CVT, auto transformer (brief idea), applications.

5. D.C. Circuits (10 periods)

5.1 Ohm/s law, resistivity, effect of temperature on resistance, heating effect of electric current, conversion of mechanical units into electrical units.

5.2 Kirchhoff's laws, application of Kirchhoff's laws to solve, simple d.c. circuits

5.3 Thevenin's theorem, maximum power transfer theorem, Norton's theorem and super position theorem, simple numerical problems.

6. Basic Electronics (22 periods)

6.1 Basic idea of semiconductors – P and N type; diodes, Zener diodes and their applications,

6.2 Introduction to BJT : NPN and PnP transistors, other symbols and mechanism of current flow, explanation of fundamental current relations. Comparison of CB, CE and CC configuration transistor as amplifier in CE configuration.

6.3 Field Effect Transistor (FET) : Construction, Operation and Characteristics of Junction FET, Comparison of SFET, MOSFET & CMOS.

LIST OF PRACTICALS

1. Identification of Resistor, Capacitor, Inductor, Transformer, LBD etc.
2. Familiarization with multimeter /CPO etc.
3. Measurement of wave shapes of half wave rectifier and full wave rectifier.
4. Plot the P&T characteristics and determination of its parameter from this characteristics.
5. Connection and reading of an electric energy meter
6. Use of ammeter, voltmeter, wattmeter, and multi-meter
7. Study of different types of fuses, MCBs and ELCBs
8. Study of Zener diode as a constant voltage source and to draw its V-I characteristics
9. To draw V-I characteristics of PN junction diode
10. Verify Thevenin and Norton theorem

INSTRUCTIONAL STRATEGY

The teacher should give emphasis on understanding of concept and various terms used in the subject. Practical exercises will reinforce various concepts.

MEANS OF ASSESSMENT

- Class Test
- Home Assignment
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Basic Electrical Engineering by PS Dhongal; Tata McGraw Hill Publishers, New Delhi
2. A Text Book of Electrical Technology, Vol. I and II by BL Thareja; S Chand and Co., New Delhi
3. Basic Electricity by BR Sharma; Satya Prakashan, New Delhi
4. Basic Electrical Engineering by JB Gupta, S Kataria and Sons, Delhi
5. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International Publishers Ltd., New Delhi
6. Basic Electronics by VK Mehta; S Chand and Co., New Delhi
7. Electrical Machines by SK Bhattacharya; Tata McGraw Hill, New Delhi
8. Basic Electronics and Linear Circuits by NN Bhargava and Kulshreshta, Tata McGraw Hill New Delhi.
9. Electronic principles by SK Sachdev, Dhanpat Rai and Sons, New Delhi.
10. Electronic Devices and circuits by Rama Raddy Narora Publishing House Pvt. Ltd. NewDelhi.
11. Principles of electrical and electronics Engineering by VK Mehta; S Chand and Co. New Delhi
12. Digital Electronics by Malvino

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	03	05
2	06	10
3	09	15
4	06	10
5	10	18
6	22	42
Total	**56**	**100**

4.6 COMPUTER APPLICATIONS IN PULP & PAPER TECHNOLOGY

L	T	P
-	-	4

RATIONALE

Most of the chemical process industries these days are operated and controlled through computers. It is necessary to train students with the use of computers in Chemical Engineering. Hence this subject.

LEARNING OUTCOMES

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

- Understand the use and significance of software in chemical process industry.
- Solve basic chemical engineering problems using MS-Excel and MATLAB

LIST OF PRACTICALS

Experiments to be done using MS-Excel and MATLAB

1. To apply material balance on any chemical engineering unit operation.
2. To apply energy balance on any chemical engineering unit operation.
3. To work on heat transfer problems.
4. To work on a heat exchanger or evaporator design using Kern's method
5. To find out effect on conversion and time of operation in a batch reactor.
6. Design of pulping Digester
7. Process Flow Diagram of Pulp & Paper Processes
8. Process Flow Diagram of Eflluent Treatment Plant of Pulp & Paper industry

INSTRUCTIONAL STRATEGY

There will be no theory classes in this subject. The instructor should prepare problems sheets with solution guidelines for each experiment. The instructors should discuss the problem in lab itself. It is strongly recommended to allot single computer system to each student instead of group activity.

4.7 Universal Human Values

L - T- P
2 - 0 -1

Course Objectives

This introductory course input is intended

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature

Thus, this course is intended to provide a much needed orientational input in value education to the young enquiring minds.

Course Methodology

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. It is free from any dogma or value prescriptions.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.
5. This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.

The syllabus for the lectures is given below:

- After every two lectures of one hour each, there is one hour practice session.
- The assessment for this subject is as follows:
- Sessions Marks (Internal): 20
- Practical Marks (External): 30
- Total Marks: 50

UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self-Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario

6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material the Body'
2. Understanding the needs of Self ('I') and 'Body' - *Sukh* and *Suvidha*
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure *Sanyam* and *Swasthya*

-Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. *Understanding Harmony in the family – the basic unit of human interaction*
2. Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*;
3. Trust (*Vishwas)* and Respect (*Samman)* as the foundational values of relationship
4. Understanding the meaning of *Vishwas*; Difference between intention and competence
5. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
6. Understanding the harmony in the society (society being an extension of family): *Samadhan, Samridhi, Abhay, Sah-astitva* as comprehensive Human Goals
7. Visualizing a universal harmonious order in society- Undivided Society (*Akhand Samaj),* Universal Order (*Sarvabhaum Vyawastha)*- from family to world family!

-Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature
3. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence

-Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics:

a) Ability to utilize the professional competence for augmenting universal human order

b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,
c) Ability to identify and develop appropriate technologies and management patterns for above production systems.

5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:

a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers
b) At the level of society: as mutually enriching institutions and organizations

7. To inculcate Human Values among Students: The Role of self ,Parents and Teachers

-Practice Exercises and Case Studies will be taken up in Practice Sessions.

Practical Session also Includes Different Yogic Exercises and Meditation Session

INSTRUCTONAL STRATEGY

The content of this course is to be taught on conceptual basis with plenty of real world examples.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests,
- Mid-term and end-term written tests
- Practical assessment

Reference Material

The primary resource material for teaching this course consists of

a. The text book (Latest Edition)

R.R Gaur, R Asthana, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi.

b. The teacher's manual (Latest Edition)

R.R Gaur, R Asthana, G P Bagaria, A foundation course in Human Values and professional Ethics – Teachers Manual, Excel books, New Delhi.

In addition, the following reference books may be found useful for supplementary reading in connection with different parts of the course:

1. B L Bajpai, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, *Science and Humanism*, Commonwealth Publishers.
3. Sussan George, 1976, *How the Other Half Dies*, Penguin Press. Reprinted 1986, 1991
4. Ivan Illich, 1974, *Energy & Equity*, The Trinity Press, Worcester, and HarperCollins, USA
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.
6. Subhas Palekar, 2000, *How to practice Natural Farming*, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagraj, 1998, *Jeevan Vidya ek Parichay*, Divya Path Sansthan, Amarkantak.
8. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, *Human Values*, New Age International Publishers.

Relevant websites, movies and documentaries

1. Value Education websites, http://uhv.ac.in, *http://www.aktu.ac.in*
2. Story of Stuff, *http://www.storyofstuff.com*
3. Al Gore, *An Inconvenient Truth*, Paramount Classics, USA
4. Charlie Chaplin, *Modern Times*, United Artists, USA
5. IIT Delhi, *Modern Technology – the Untold Story*
6. Case study Hevade Bazar Movie
7. RC Shekhar , Ethical Contradiction ,Trident New Delhi
8. *Gandhi A., Right Here Right Now, Cyclewala Production*

SUGGESTED DISTRIBUTION OF MARKS

Unit	Time Allotted (Periods)	Marks Allotted (%)
1	08	20
2	08	20
3	08	20
4	08	20
5	10	20
Total	**42**	**100**

5.1 MASS TRANSFER OPERATIONS

L	T	P
5	-	4

RATIONALE

It is the further step of Unit Operation deals with the gas absorption, distillation, boiling point diagrams, extraction operation, humidification and drying processes in chemical industry. The subject have experiments as well, to be aware of the facts involved in actual process.

LEARNING OUTCOMES

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

- Understands Separation Techniques of Components from gaseous mixtures.
- Understands Separation Techniques of Liquid- Liquid mixtures & Solid -Liquid mixtures.
- Understands cooling towers and use of humidity chart.
- Understands different types of dryers and dryers and drying behaviors.

DETAILED CONTENTS

1. Diffusion (10 Periods)

   Definition of diffusion, Rate of diffusion in Mass Transfer, Fick's law, diffusion in the gas phase-Equimolecular counter diffusion, diffusion through a stationary gas (Stefan's Law), Mass. Transfer Coefficient. Film theory and penetration theory of Mass Transfer, Diffusion in solids. Derivation of the following relations.

2. Gas Absorption (12 Periods)

   Introduction, importance, tower packings, channeling, Limiting flow rates– Loading & Flooding, Mechanism of absorption - two film theory, Diffusion of gases through a stagnant gas, Diffusion in liquid phase, Rate of absorption,

   I. $1/K_G.a = 1/.a + m/k_L.a$
   II. $1/K_L.a = 1/.a + 1/mk_G.a$

   Derivation of Relation between film and overall coefficient, Factors influencing the transfer coefficient. Gas absorption equipment – packed column, Choice of solvent for absorption, Height of Transfer Unit (HTU), Number of Transfer Unit (NTU), Meaning and their relationship (Simple Numerical Problems).

3. Distillation (16 Periods)

   Various distillation methods:-
   3.1. Equilibrium or flash distillation.
   3.2. Differential distillation
   3.3. Batch distillation.

3.4. Vacuum and Steam distillation.
3.5. Azeotropic and Extractive distillation.

Types of distillation columns:-

3.5.1. Perforated plate or sieve plate column

3.5.2. Bubble cap plate column Vapor liquid equilibrium diagram, Raoult's law; Relative volatility, constant boiling mixtures, equilibrium diagram and construction of equilibrium diagram, Fractionating column calculation- Heat & material balance, Reflux ratio, equilibrium plate, Location of feed plate. Sub cooled reflux; effect of reflux ratio, Total reflux, Minimum reflux ratio Entrainment; Mc-Cable Thiele diagram-section above and below feed plate; Intersection of operating line. Location of q-line, optimum reflux ratio, calculation of no. of equilibrium plate by Mc-Cable Thiele diagram. Overall plate efficiency.

4. Extraction (12 Periods)

4.1. Applications of this operation.
4.2. Choice of solvent.
4.3. Steps of extraction operation
4.4. Solid Liquid extraction, construction and description of
  4.4.1. Moving Bed type oil seed extractor or Bollman extractor.
  4.4.2. Rotocel extractor.
4.5. Liquid extractor; description and construction of
  4.5.1. Mixer settler extraction system.
  4.5.2. Perforated plate and baffle towers.

5. Humidification (10 Periods)

Definition and calculation of
5.1. Humidity
5.2. Percentage humidity
5.3. Relative humidity
5.4. Humid volume.
5.5. Humid heat.
5.6. Enthalpy and its calculation.
5.7. Dry bulb and wet bulb-temp.
5.8. Adiabatic saturation temperature.
5.9. Use of humidity chart. Dew point, simple numerical problem using humidity chart, construction and description of cooling towers. (Natural and induced draft)

6. Drying (10 Periods)

General drying behavior-Critical moisture content, equilibrium moisture content: Description and construction of dryer.
6.1. Tray dryer.
6.2. Screen conveyor dryer.
6.3. Rotary dryer.

NOTE:

1. At Least One Question from Each Topic.

LIST OF PRACTICALS

1. To find out diffusion coefficient in liquid
2. To find out diffusion coefficient in solid
3. To study on packed bed absorption tower
4. To study time of batch drying in tray tower
5. To separate given solution mixture with the help of a sieve plate distillation
6. To study and determine the efficiency of solid-liquid extraction
7. To separate a mixture of two liquid using liquid extraction and calculate separation efficiency
8. To verify Ray-Leigh equation using batch distillation set-up
9. To determine the efficiency of Cooling Tower (Natural/Induced Draft)

INSTRUCTIONAL STRATEGY

Field visit will make the students familiar with different types of column (packed / tray), different types of packing used in the column, different types of extractors and membrane separation techniques. This will also make the students aware of auxiliary equipment / model / supports for different equipment. Emphasis should also be given to problem solving and practices especially for distillation column and extraction.

MEANS OF ASSESSMENT

- Class Test
- Home Assignment
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Mass Transfer Operations by Treybal, Kogakusha Publication
2. Introduction to Chemical Engineering by Badger and Banchero; McGraw Hill Publication
3. Unit Operations of Chemical Engineering by Mc Cabe and Smith; McGraw Hill Publication
4. Mass Transfer by Sherwood Pigford and Wilke; McGraw Hill Publication
5. Chemical Engineering Handbook by Perry and Chilton; McGraw Hill Publication
6. Mass Transfer by K.A Gavhane, Nirali Publication
7. Chemical Engineering Vol. II by Richardson & Coulson
8. Introduction To Chemical Engineering by Badger & Bancher

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted %
1	10	12
2	12	15
3	16	25
4	12	18
5	10	15
6	10	15
Total	**70**	**100**

5.2 POLLUTION CONTROL AND INDUSTRIAL SAFETY

L	T	P
5	-	4

RATIONALE

A Chemical Engineering technician must have the knowledge of different types of pollution caused due to industrialization so that he may help in balancing the eco-system and control the pollution by means of control devices. The technician must know various types of accidents which occur in chemical plants and how to safeguard them to avoid injury to men and material. Hence this subject.

LEARNING OUTCOMES

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

- Understand different types of pollution caused due to industrialization.
- Balance pollutants to save the ecosystem
- Control pollution by means of control devices
- Have knowledge of different Acts and rules about the environmental protection.
- Manage solid wastes to reduce the pollution.
- Have Knowledge of various types of accidents which occur in chemical plants

DETAILED CONTENTS

1. Introduction (06 Periods)

   Environment and Pollution, Classification of pollution e.g. Land, Water, Air, Noise. Environment Impact assessment Studies, Character and origin of industrial wastes.

2. Air Pollution (06 Periods)

   2.1. Definition of air pollution, Types of Air pollutants and their sources like SPM, SOX, NOX, NH3, F, C1, CFC, CO2 etc.

   2.2. Air Pollution control equipment in industries.

   - 2.2.1. Settling chamber
   - 2.2.2. Cyclone
   - 2.2.3. Scrubber (dry & wet)
   - 2.2.4. Multicyclone
   - 2.2.5. Electrostatic precipitator
   - 2.2.6. Bag Filter

   2.3. Ambient air quality measurement & their standards

   2.4. Vehicular Pollution and its control

2.5. Noise Pollution and its control mechanism

3. Water Pollution (06 Periods)

Water pollution, standards for drinking water, domestic waste water and industrial waste water. Methods of measurement of various parameter like BOD, SS, pH, COD, TDS etc. Methods of treatment of industrial waste water like

3.1. Chemical treatment
3.2. Physio-Chemical treatment
3.3. Bio-chemical treatment
3.4. Any other advance treatment

4. Environment Protection (10 Periods)
4.1. Environmental protection from hazardous chemicals waste:

4.2. Terminology relating to chemical hazards and air pollution, classification of chemical hazards and hazardous chemicals, codes of safety for operational hazards in laboratories, industries etc. (Reference should be made of I.S. Codes)

5. Radio Active Pollution (06 Periods)

Sources and effect on human, animal, plant and material. Measurement, means to control, preventive measures.

6. Solid Waste Management (08 Periods)

6.1. Municipal solid waste, biomedical waste, Plastic waste and its management, solid waste disposal methods such as open dumping, sanitary landfilling composting, incineration.
6.2. Importance of development of green area

7. Pollution Acts (08 Periods)

A water pollution prevention control Act 1974, Air Pollution Act 1981, Environment protection Act 1986, Hazardous chemical manufacturing, storage and impact rules 1989 and hazardous waste and management and handling rules 1989, Regulation and control Rules 2000.

8. Safety in Chemical Industry (20 Periods)

Receiving and storing chemicals- transporting and moving chemicals- Safety in chemical reactions, pipe-lines with color coding in chemical factories. Precautions in the case of processes in operations involving explosive or inflammable dusts, gases, vapors etc. Maintenance of chemical plants-corrosion health hazards in common chemical processes, Fire hazards and their prevention. Codes of practice and specification for safety equipment (Reference should be made from I.S. Codes), case study of major chemical process industries disasters/accidents.

LIST OF PRACTICALS

1. Determination of pH value.
2. Determination of turbidity
3. Determination of total solids, suspended solids and total dissolved solids.
4. Determination of dissolved oxygen (DO)
5. Determination of BOD.
6. Determination of COD
7. Determination of Sulphate in water
8. Determination of chloride in water
9. Prepare chart for treatments of different solid waste.
10. Removal of suspended impurities from air using fabric filter.
11. Removal of suspended solids by coagulation

INSTRUCTIONAL STRATEGY

- Case study of any disaster should be undertaken. Study should be data based Field visit to the industries should be planned.
- Student should encouraged to undertake project work related to environmental problems.

MEANS OF ASSESSMENT

- Class Test
- Home Assignment
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Safety in Process Plant Design by Wells
2. Safety and Accident Prevention in Chemical Operation by H. H, Tanacatte and W. S. Wood
3. Engineering Chemistry by P.C. Jain

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1.	6	8
2.	6	8
3.	6	8
4.	10	14
5.	6	8
6.	8	12
7.	8	12
8.	20	30
Total	**70**	**100**

5.3 PROCESS PLANT UTILITIES

L	T	P
6	-	-

RATIONALE

The objective of this subject is to teach the students about requirement of different utilities for the process plant and effective utilization. Main utilities required for process plants are water, steam, airand refrigerants. Steam and non-steam heating media is used for conversion of raw material to products in reactors and to elevate the temperature in the chemical processes. Similarly, refrigeration is important to maintain the temperature in the process plant. Compressed air and process air is used in processes and instrument air is used in pneumatic devices and controls.

LEARNING OUTCOMES

After studying this course, the students will be able to:

- Acquire the knowledge for selection of different utilities.
- Understand basic calculations involved in steam generation, psychometric operation and refrigeration.
- Describe the different equipment used to run the process plant with different utilities.
- State the principals involved during water treatment
- Know different fuels used in boilers

DETAILED CONTENTS

1. Importance of Water (14 Periods)

    1.1. Sources of water, storage, quality parameters like hardness, suspended solids (SS), turbidity and alkalinity etc., hard and soft water.
    1.2. Requisites of industrial water and its uses.
    1.3. Methods of water treatment –flow diagram, coagulation by iron compounds like alum, sedimentation, filtration, chemical softening and demineralization (Ion Exchange Process)
    1.4. Resins used for water softening
    1.5. Reverse osmosis and membrane separation
    1.6. Effects of impure boiler feed water - scale and sludge formation, corrosion, priming and foaming, caustic embrittlement

2. Fuels used in boilers (08 Periods)

    Types of fuels used in boilers, coal, fuel oil, rice husk, natural and biogas etc.

3. Steam and Steam Generation: (12 Periods)

    3.1. Properties of steam

3.2. Problems based on enthalpy calculation for wet steam, dry saturated steam, superheated steam
3.3. Types of steam generators/boilers: water tube & fire tube, Solid fuel fired boiler, waste gas fired boiler, Waste heat boiler, Fluidized bed boiler.
3.4. Scaling, trouble shooting, blow down preparing boiler for inspection
3.5. Steam traps, pressure reducing valves (PRV), steam ejectors, boiler mountings and accessories: feed water pump, injector, economizer, air preheater, super heater, pressure gauge, water level indicator, safety valve etc.
3.6. Boiler Act

4. Humidification and Cooling Towers (12 Periods)

Equipment used for humidification, dehumidification evaporative cooling, spray ponds, cooling towers- principle, details and problems like scaling, use of inhibitors like sodium and chromates etc.

5. Refrigeration: (12 Periods)

5.1. Refrigeration cycles
5.2. Different methods of refrigeration used in industry - Vapour compression, Vapor absorption: Lithium bromide (Eco-Friendly)
5.3. Different refrigerants–Monochloro difluoro methane (R-22), Chlorofluorocarbons (CFC), Secondary refrigerants: Brines
5.4. Simple calculation of C.O.P., Refrigerating effects.

6. Air Supply and Drying Unit (10 Periods)

6.1. Use of compressed air, process air and instrument air
6.2. Process of getting instrument air and process air
6.3. Drying unit and regeneration of drying unit

7. Non steam heating system (10 Periods)

Principle, construction and working of Thermic fluid heater

8. Inert gases (06 Periods)
Nitrogen generation, nitrogen drying and supply.

INSTRUCTIONAL STRATEGY

Teacher should focus on conceptual clarity.
An industrial visit can be organized in relevant industries. Audio-visuals aids should be used toteach.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

RECOMMENDED BOOKS

2. Thermal Engineering by P.L. Ballaney; Khanna Publisher New Delhi
3. Industrial water treatment by S.T. Powel; McGraw Hill New York
4. Boiler Operations by Chattopadhyay; Tata McGraw Hill, New Delhi
5. Perry's chemical Engineer's Handbook by Perry R.H. Green D.W; McGraw Hill,New York
6. Elements of Heat Engines Vol. II,III by R.C. Patel C.J. Karm chandani; Acharya Book Depot Vadodara
7. Refrigeration & Air conditioning by P.N. Ananthanarayan; Tata McGraw Hill
8. Industrial chemistry by Jain & Jain; Tata McGraw Hill

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1.	14	16
2.	8	10
3.	12	14
4.	12	14
5.	12	14
6.	10	12
7.	10	12
8.	6	08
Total	**84**	**100**

5.4 PAPER TECHNOLOGY -I

L	T	P
6	-	-

RATIONALE

This subject deals with the important process steps to prepare the pulp, obtained from different raw materials, for paper making (called stock preparation). In addition to some physical treatments, it also involves addition of different non-fibrous materials to get the desired properties of different types of papers.

LEARNING OUTCOMES

After going through this subject, the students will be able to

- Perform stock preparation with carrying out refining and beating
- Gain a broad perspective by exploring the various type of pulp refining mechanism influenced by external factors and refined pulp characterizations.
- Analyze the refining process affecting factors and influence of refining process on paper qualities
- Select the types of fillers considering the required properties of paper according to end use
- Become familiar with general sizing theory of paper including variable and process control of sizing.
- Use the strength enhancing additives and their retention in paper fabrication with the knowledge and shortcomings associated with fibre flocculation
- Develop technical competency of paper stock dyeing including process control and colour matching

DETAILED CONTENTS

1. STOCK PREPARATION :

   Introduction to stock preparation and its importance. Pulp chests. Beating and refining, mechanism of refining, types of refiners. Pulp characterization, refining of different types of pulp fibers, refining of pulp mixtures. Factors affecting refining, Effect of refining on paper properties. Refining requirements of different types of paper. Blending of pulp.

   (18 Periods)

2. INTERNAL SIZING:
   Internal sizing of paper, theory of sizing, different types of sizing. Use of rosin sizing, alkyl ketene dimer (AKD) sizing, alkyl succinic anhydride (ASA) sizing. Effect of pH on sizing, variables and process control in sizing. Method of addition of sizing chemicals.

   (14 Periods)

3. ROLES OF FILLERS:
   Roles of fillers in paper making, types of fillers, selection criteria. Addition of fillers and their retention. Effect of fillers on optical, surface and strength properties of paper. Methods of addition

of fillers. Retention of additives during paper making, theory of retention, Zeta potential and its effect on retention of additives, common retention aids, fiber flocculation.

(16 Periods)

4. STRENGTH ENHANCING ADDITIVES:
   Introduction to strength enhancing additives. Use of starch, CMC and other gums. Wet strength enhancing additives, mechanism of wet strength development, Preparation and method of addition.

   (12 Periods)

5. DYEING OF PAPER :

   Reason of dyeing, Role of dyes and pigments, types of dyes, factors associated with dyeing of paper stock. Two sidedness and reasons for the same, colour matching and process control.

   (10 Periods)

INSTRUCTIONAL STRATEGY

While imparting instructions, teacher should show various types of raw materials of paper manufacturing to the students. Students should be asked to collect various types of available pulp fibers, fillers, dyes etc. in the market. Visits to industry should be planned todemonstrate making process and use of dyes.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Small Projects
- Viva-voce

BOOKS RECOMMENDED

1. G.A. Smook, Handbook of Pulp and Paper technologists, 4th Edition, Tappi Press, 2016
2. J.P. Casey (Editor), Pulp & Paper Chemistry and Technology, 3rd Edition, Vol. II & III, Wiley1980
3. P. Bajpai, Biermann's Handbook of Pulp and Paper, 3rd Edition, Vol. II, Elsevier 2018

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1	18	25
2	14	20
3	16	22
4	12	15
5	10	18
Total	**70**	**100**

5.5 RENEWABLE ENERGY SOURCES

L T P
4 - -

RATIONALE

Energy is an important input in all sectors of country's economy. Standard of living of a country can be directly judged by per capita consumption of energy. In light of energy crises and environmental concerns, renewable energy is the only solution to save our planet. Hence this subject.

LEARNING OUTCOMES

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

- Understand the importance and applications of various renewable sources of energy
- Understand the types of biogas plants and electricity generation from biomass
- Identify usage of different types of wind turbines
- Understand the working of various types of collectors and applications of solar energy
- Understand different geothermal power plants
- Understand the usage of tidal and wave energy
- Understand the importance of hydrogen energy

DETAILED CONTENTS

1. Renewable and Non-Renewable Sources of Energy (06 Periods)

    1.1. Introduction
    1.2. Need of renewable sources of energy
    1.3. Renewable sources of energy such as biomass, wind, solar, geothermal, and tidal and wave, hydrogen energy.

2. Biomass Energy (08 Periods)

    2.1. Introduction to biomass energy
    2.2. Resources of biomass energy
    2.3. Types of biogas plants-fixed dome and floating type
    2.4. Electricity generation from biomass
    2.5. Other useful products from biomass

3. Wind Energy (06 Periods)

    3.1. Introduction to wind energy
    3.2. Site selection of wind mill
    3.3. Types of Wind Turbines-Horizontal axis wind turbine (HWAT) and vertical axis wind turbine (VAWT), their construction, working, advantages and disadvantages

4. Solar Energy (20 Periods)

    4.1. Introduction to solar energy, solar spectral and greenhouse effect

4.2. Classification of solar thermal collectors- flat type, focusing type and central tower receivers, their construction and working
4.3. Application of solar energy like solar cooker, solar water heater, solar crop dryers and solar pond
4.4. Solar photo voltaic- construction and working principle
4.5. Solar energy storage methods

5. Geothermal Energy (06 Periods)

5.1. Introduction and its significance
5.2. Geothermal Power Plants-dry stream, flash steam and binary cycle

6. Tidal and Wave Energy (06 Periods)

6.1. Generation of Tidal and Wave Energy
6.2. Tidal Power Plant
6.3. Wave Power Plant

7. Hydrogen Energy (04 Periods)

7.1. Methods for hydrogen production
7.2. Storage of Hydrogen
7.3. Transportation of Hydrogen-through pipelines and containers

INSTRUCTION STRATEGY

This subject is of great importance, therefore the teachers are expected to lay considerable stress on renewable sources, their importance, production, utilization and storage system. As far as possible, the teaching of the subject must be supplemented by showing the videos on working principle of various renewable energy equipment and also visits to nearby places where such equipment is installed.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

RECOMMENDED BOOKS

1. Non-Conventional Energy Sources by G.D. Rai; Khanna Publishers, New Delhi.
2. Renewable and Conventional Energy by S. Rao; Khanna Publisher, New Delhi
3. Non-Conventional Sources of Energy by Umesh Chandra Sharma; Studium Press, Texas, USA
4. Solar Energy by S.P. Sukhatme; Tata McGrawHill Publishing Co. Ltd., New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	06	10
2	08	14
3	06	10
4	20	38
5	06	10
6	06	10
7	04	08
Total	**56**	**100**

L	T	P
6	-	6

RATIONAL

Paper industry is one of the most water consuming industry, where a large amount of water is needed for production and outlet as waste, which requires proper treatment for further recycling and use. The subject ‘’Chemical Recovery and Recycling’’ introduces chemical recovery processes for different types of effluents obtained from pulp and paper manufacturing process. It involves properties and treatment of black liquor, green liquor and white liquor by the methods of evaporation, roasting & causticizing. The equipment’s used during these treatment techniques such as evaporators, furnaces, boilers and smelters are described too in addition to design, chemical reactions and heat & chemical balance involved in treatment equipment’s.
Due to modern scenario of pulp and paper industry environmental impacts, the term agro base pulping recovery is also being involved for non-wood pulp making industries.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to

- Understand about Chemical recovery systems, chemical recovery process, impact of pulping and washing on chemical recovery.
- Properties and evaporation of black liquor, evaporator types and its design aspects. Energy (Heat) and Chemical (Mass) balance inside evaporators.
- Development and evolution of recovery furnace, chemical reactions in recovery furnaces.
- Roaster and smelter, vertical stationary type furnaces.
- Equipment of furnace operation techniques, steam production by boiler, boiler mountings and accessories.
- Properties of green liquor, white liquor clarification, causticizing, lime sludge re-burning.
- Agro base pulp recovery.

DETAILED CONTENTS

1. Introduction (10 Periods)

   Introduction to conventional chemical recovery systems, various terms associated with chemical recovery process, Impact of pulping and washing on chemical recovery, Properties of black liquor.

2. Black Liquor Concentration (20 Periods)

   Evaporation of black liquor, Classification of evaporators and their objectives in chemical recovery process, Introduction to multiple effect evaporations of black liquor, Types of evaporators, Condensate systems, Vacuum devices, Feeding arrangement, Operation of evaporators and operational troubles, Introduction to direct contact evaporators, Description of Kraft recovery process, Design aspects of evaporator, Heat and chemical balance

3. Black Liquor Incineration (18 Periods)

Historical development and evolution of recovery furnace, Roaster and smelter, Vertical stationary type furnace, Chemical reactions in recovery furnaces, Recovery furnace: description of various equipment, Operating techniques, Problem and troubleshooting, Properties of green liquor, Boiler mounting and steam production

4. Causticizing Operations (12 Periods)

The causticizing reactions, Operation of slackers, Causticizer, mud (lime sludge) washers and mud filters, Problems and troubleshooting, White liquor clarification, Lime sludge reburning

5. Alternate Chemical Recovery Processes (10 Periods)

Alternate technologies-gasification processes, Non-conventional causticization technologies- direct causticization, Partial borate auto-causticization, Borate auto-causticization with black liquor gasification

LIST OF PRACTICALS

1. Black liquor analysis – General (organic & inorganic, TTA, silica, sulphate)
2. Total solids in black liquor.
3. Residual alkali or free alkali in black liquor.
4. Estimation of mixed oxides (R2O3) in black liquor.
5. Swelling volume ratio of black liquor.
6. Viscosity measurements of black liquor by using Brookfield viscometer.
7. Analysis of green liquor
8. Analysis of lime, lime sludge and lime purity.
9. Analysis of regenerated white liquor.

INSTRUCTIONAL STRATEGY

The teacher should give emphasis on understanding of concept and various terms used in the subject. Practical exercises will reinforce various concepts.

MEANS OF ASSESSMENT

- Class Test
- Home Assignment
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. P.W. Hart (Editor), Chemical Recovery in the Alkaline Pulping Process, 4th Edition, Tappi Press, USA.
2. M. Ek, G. Gellerstedt, G. Henriksson, Pulp and Paper Chemistry and Technology - Vol

2: Pulping Chemistry and Technology, De Gruyter 2009
3. G.A. Smook, Handbook of Pulp and Paper Technologists, 4th Edition, Tappi Press, 2016 USA
4. J.P. Casey (Editor), Pulp & Paper Chemistry and Technology, 3rd Edition, Vol. I & II, Wiley 1980
5. P. Bajpai, Biermann's Handbook of Pulp and Paper, 3rd Edition, Vol. I, Elsevier 2018

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	10	15
2	20	30
3	18	25
4	12	15
5	10	15
Total	**70**	**100**

6.1 PROCESS CONTROL

L T P
6 – 4

RATIONALE

The subject Automatic Process Control deals with the different types of controls in processes in chemical industries including automatic control systems. Process characteristics is of first order (i.e. time constant element) and second order (i.e. oscillatory type element). Different modes of control action and closed loop in automatic control are well known. The student will be well conversant with these process control systems.

LEARNING OUTCOMES

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

- Explain the importance of automation and its applications in chemical industries.
- Explain the basic principles of process control in industrial processes.
- Determine the time and response of first order and second order systems for step, ramp, impulse and sinusoidal inputs.
- Handle chemical processes by framing it in block diagrams.
- Identify open and closed loop systems.
- Implement different controllers to various industrial processes.

DETAILED CONTENTS

1. Introduction (05 Periods)

Concept of automatic control, Advantages of automatic control, manual and automatic control, physical and block diagrams.

2. Elements of control system (10 Periods)

Definition- input means, controlling means, actuating means, measuring means, final control elements.

3. Process Characteristics (15 Periods)

Process variables, process degree of freedom, forcing function, step function, ramp, impulse, sinusoidal function and Laplace transformation.

4. Elements of process dynamics (22 Periods)

Time constant and oscillatory element, determination of system function or transfer function of the following- sketch physical diagram and block diagram

4.1. I^{st} order system or time constant element- Naked bulb thermometer, Stirred tank heater, Mixing process, R.C. Circuit, Liquid levels, Two time constant type liquid vessel cascaded i.e. non interacting and non-cascaded, i.e. interacting.

4.2. II^{nd} Order system or oscillatory type element- Bulb in thermowell, Mechanical damper. Response of I^{st} order system to step, ramp, impulse and sinusoidal inputs. Response of II^{nd} order system to step change (transient response).

5. Controller Characteristic or Modes of Control Action (15 Periods)

Block diagram of a control system, negative and positive feedback system, servo and regulatory problem, control valve mechanism and its transfer function, elements of Controller, proportional control, integral control, proportional-integral control, Proportional derivative control proportional-integral-derivative control, two positions control.

6. Closed Loop in Automation Control (14 Periods)

Standard block diagram symbol, overall transfer function for a single loop system, overall transfer function for change in set point and for change in load, overall transfer function in multi loop control system, unit step response of the following:

6.1. Proportional control at stirred tank heater for set point change and for load change.
6.2. Proportional integral control of stirred tank heater for set point change and load change

7. Introduction to Programmable Logic Controller (PLC) and Distributed Control System (DCS) (03 Periods)

LIST OF PRACTICALS

1. To calibrate pressure gauge with the help of dead weight pressure gauge
2. To calibrate bimetallic thermometer, resistance thermometer, thermocouple
3. To determine the characteristics of a flapper nozzle system.
4. To study on-off controller for temperature control.
5. To study constructional details of strip chart recorder.
6. To study constructional details of circular chart recorder.
7. To calibrate the pneumatic valve.
8. To calibrate the given manometer for level measurement.
9. To measure time constant of a single capacity thermal process (water bath and heater)
10. To study the transient response of first order system (thermocouple) and find out time constant.
11. To study the response of two tank in non-interacting liquid level system.
12. To study the response of two tank in interacting liquid level system.
13. To study the response of bimetallic thermometer for a step input and find outs its time constant.

INSTRUCTIONAL STRATEGY

The subject gives the knowledge of various process, instruments and controls to measure process parameters. So the theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. Each topic should be supplemented with

examples.

MEANS OF ASSESSMENT

- Class Test
- Home Assignment
- Sessional Test
- Practical work

RECOMMENDED BOOKS

1. Industrial Instrumentation by Donald P. Eckman, Wiley Eastern Publications.
2. Process System Analysis and Control by Coughanowr and Steven LeBlanc, McGraw Hill publications.
3. Industrial Instrumentation by SK Singh, Tata McGraw Hill Publications.
4. Principles of Industrial Instrumentation by D. Patranabis; Tata McGraw Hill Company

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	05	05
2	10	12
3	15	18
4	22	25
5	15	20
6	14	16
7	03	04
Total	**84**	**100**

6.2 ENERGY CONSERVATION

L	T	P
3	-	2

RATIONALE

The requirement of energy has increased manifolds in last two decades due to rapid urbanization and growth in industrial/service sector. It has become challenging task to meet ever increasing energy demands with limited conventional fuels and natural resources. Due to fast depletion of fossil fuels and a tremendous gap between supply and demand of energy,it is essential to adopt energy conservation techniques in almost every field like industries, commercial and residential sectors etc. Energy conservation has attained priority as it is regarded as additional energy resource. Energy saved is energy produced. This course covers the concepts of energy management and its conservation. It gives the insight to energy conservation opportunities in general industry and details out energy audit methodology and energy audit instruments.

LEARNING OUTCOMES

- After undergoing this subject, the students will be able to:
- Define principles and objectives of energy management and energy audit.
- Understand Energy Conservation Act 2001 and its features.
- Understand various forms & elements of energy.
- Identify electrical and thermal utilities. Understand their basic principle of operation and assess performance of various equipment.
- Identify areas of energy conservation and adopt conservation methods in various systems.
- Evaluate the techno economic feasibility of the energy conservation technique adopted.

DETAILED CONTENTS

1. Basics of Energy

    1.1. Classification of energy- primary and secondary energy, commercial and non-commercial energy, non-renewable and renewable energy with special reference to solar energy, Capacity factor of solar and wind power generators.
    1.2. Global fuel reserve
    1.3. Energy scenario in India and state of U.P. Sector-wise energy consumption (domestic, industrial, agricultural and other sectors)
    1.4. Impact of energy usage on climate

2. Energy Conservation and EC Act 2001

    2.1. Introduction to energy management, energy conservation, energy efficiency and its need
    2.2. Salient features of Energy Conservation Act 2001 & The Energy Conservation (Amendment) Act, 2010 and its importance. Prominent organizations at Centre and State level responsible for its implementation.

2.3. Standards and Labeling: Concept of star rating and its importance, Types of product available for star rating

3. Electrical Supply System and Motors

3.1. Types of electrical supply system
3.2. Single line diagram
3.3. Losses in electrical power distribution system
3.4. Understanding Electricity Bill: Transformers Tariff structure, Components of power (kW, kVA and kVAR) and power factor, improvement of power factor, Concept of sanctioned load, maximum demand, contract demand and monthly minimum charges (MMC)
3.5. Transformers: Introduction, Losses in transformer, transformer Loading, Tips for energy savings in transformers
3.6. Electric Motors: Types of motors, Losses in induction motors Features and characteristics of energy efficient motors, Estimation of motor loading, Variation in efficiency and power factor with loading, Tips for energy savings in motors.

4. Energy Efficiency in Electrical Utilities

4.1. Pumps: Introduction to pump and its applications, efficient pumping system operation, Energy efficiency in agriculture pumps, Tips for energy saving in pumps.
4.2. Compressed Air System: Types of air compressor and its applications, Leakage test, Energy saving opportunities in compressors.
4.3. Energy Conservation in HVAC and Refrigeration System: Introduction, Concept of Energy Efficiency Ratio (EER), Energy saving opportunities in Heating, Ventilation and Air Conditioning (HVAC) and Refrigeration Systems.

5. Lighting and DG Systems

5.1. Lighting Systems: Basic definitions- Lux, lumen and efficacy, Types of different lamps and their features, Energy efficient practices in lighting.
5.2. DG Systems: Introduction, Energy efficiency opportunities in DG systems, loading estimation.

6. Energy Efficiency in Thermal Utilities

6.1. Thermal Basics: Thermal energy, Energy content in fuels, Energy Units and its conversions in terms of Metric Ton of Oil Equivalent (MTOE)
6.2. Energy Conservation in boilers and furnaces : Introduction and types of boilers, Energy performance assessment of boilers, Concept of stoichiometric air and excess air for combustion, Energy conservation in boilers and furnaces, Do's and Don'ts for efficient use of boilers and furnaces
6.3. Cooling Towers: Basic concept of cooling towers, Tips for energy savings in cooling towers
6.4. Efficient Steam Utilization

7. Energy Conservation Building Code (ECBC)

7.1. ECBC and its salient features
7.2. Tips for energy savings in buildings: New buildings, Existing buildings

8. Waste Heat Recovery and Co-Generation

8.1. Concept, classification and benefits of waste heat recovery
8.2. Concept and types of co-generation system

9. General Energy Saving Tips Energy saving tips in

9.1. Lighting
9.2. Room Air Conditioner
9.3. Refrigerator
9.4. Water Heater
9.5. Computer
9.6. Fan, Heater, Blower and Washing Machin
9.7. Color Television
9.8. Water Pump
9.9. Cooking
9.10. Transport

10. Energy Audit

10.1. Types and methodology
10.2. Energy audit instruments
10.3. Energy auditing reporting format

LIST OF PRACTICALS

1. To conduct load survey and power consumption calculations of small building.
2. To check efficacy of different lamps by measuring power consumption and lumens using lux meter.
3. To measure energy efficiency ratio (EER) of an air conditioner.
4. To measure effect of valve throttling and variable frequency drive (VFD) on energy consumption by centrifugal pump.
5. To measure and calculate energy saving by arresting air leakages in compressor.
6. To measure the effect of blower speed on energy consumed by it.

STUDENT ACTIVITIES ON ENERGY CONSERVATION/ENERGY EFFICIENCY

- Presentations of Case Studies
- Debate competitions
- Poster competitions
- Industrial visits
- Visual Aids

INSTRUCTIONAL STRATEGY

1. Teachers are expected to lay considerable stress on understanding the basic concepts in energy conservation, principles and their applications.

2. For this purpose, teachers are expected to give simple problems in the class room so as to develop necessary knowledge for comprehending the basic concepts and principles. As far as possible, the teaching of the subject must be supplemented by demonstrations and practical work in the laboratory. Visits to industries must be carried out. Expert from industry must be invited to deliver talks on energy conservation to students and faculty.

RECOMMENDED BOOKS

1. Guide book on General Aspects of Energy Management and Energy Audit by Bureau of Energy Efficiency, Government of India. Edition 2015
2. Guide book on Energy Efficiency in Electrical Utilities, by Bureau of Energy Efficiency, Government of India. Edition 2015
3. Guide book on Energy Efficiency in Thermal Utilities, by Bureau of Energy Efficiency, Government of India. Edition 2015
4. Handbook on Energy Audit & Environmental Management by Y P Abbi & Shashank Jain published by TERI. Latest Edition

WEBSITES FOR REFERENCE

2. Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India. www.beeindia.gov.in.
3. Ministry of New and Renewable Energy (MNRE), Government of India. www.mnre.gov.in.
4. Uttar Pradesh New and Renewable Energy Agency (UPNEDA), Government of Uttar Pradesh. www.upneda.org.in.
5. Central Pollution Control Board (CPCB), Ministry of Environment, Forest and Climate Change, Government of India. www.cpcb.nic.in.
6. Energy Efficiency Services Limited (EESL). www.eeslindia.org.
7. Electrical India, Magazine on power and electrical products industry. www.electricalindia.in.

6.3 PAPER TECHNOLOGY-II

L	T	P
5	-	6

RATIONAL

The well dispersed pulp fibre and after mixing with other additives has to be formed a web of fibres (from aqueous slurry). This is called wet end operation where different types & grades of papers are produced by changing the stock and operating parameters. This subject deals with the wet-end processes and drying, reeling, cutting into paper sheets.

LEARNING OUTCOMES

- After undergoing this course, the students will be able to: Explain the different levels of papermaking, paper making machines and their function.
- Distinguish between various types of sheets and understand the operation of wire plants.
- Classify press designs and explain role of press fabrics & press parts.
- Analyze the effect of various things on drying and post drying operations.
- Explain the modern paper making techniques and use of paper in different industries.
- Perform different processes of using paper like box making etc. and can describe the different equipments.
- Understand the effect of papermaking process on environment and use of computer in pulp & paper technology.

DETAILED CONTENT

1. Wet End Operation (20 periods)

   1.1. History and developments of papermaking. Types of paper making machines. Role of screening and cleaning operation before sheet formation, Role and control of consistency in papermaking. Flow approach system & its significance. Head Box designs and development, Modern head boxes for high speed machines, Function of type of slice, its adjustment, Control of cross directional profile of paper.

   1.2. Introduction to sheet formation - single wire Fourdrinier machines, twin & multi-layer wire systems, Forming fabrics and their role, Operation of wire part, various sections on wire part, water drainage and sheet formation on forming fabric. Energy conservation measures on Fourdrinier forming machines using low vacuum, high vacuum. Hydrofoil and table rolls. Role of suction boxes, various designs of foils and suction boxes, Need of vacuum and its control. Construction of wire table and various supporting rolls, operation and control of wire plant.

2. Press Section (10 periods)

   Water removal by wet pressing. Sheet consolidation. Various press designs. Role of press fabric. Theory of pressing, felt /fabric conditioning and cleaning. Operation and control of press parts.

3. Dry End Operation (15 periods)

3.1. Description of dryer parts, Theory of drying advances in dryer run ability, Single cylinder and multi cylinder dryer. Steam heating and condensate removal system, Role of fabric on drying, Design of dryer hood, Description of various parts in dryer section.
3.2. Paper reeling, rewinding, Need of drive control of various sections, Type of drive and control functions, line shaft and sectional drives.
3.3. Paper making common problems and troubleshooting, operational parameters and controls, Quality control on paper machine.
3.4. Post drying operations: Need for surface sizing, chemicals used in surface sizing, Improvement in surface properties, Construction of size press.
3.5. Reason for Calendaring of paper. Hard nip and soft nip calendars, process parameters during calendaring, Construction of calendar section, Online coating of paper and board.

4. Specialized Papers (10 periods)

Specialized papers used in packaging, printing, manufacturing, electronics, etc. Capacitor, cigarette, Bible, glassine and grease proof papers. Multi layered board machines, their principal and operation, Modern concept of papermaking.

5. Paper Conversions (10 periods)

Introduction to various conversion processes. Sheet cutting equipment, paper finishing and packing practices like offline coating, corrugating, box making. Printing, laminating etc. Short description of processes and equipment.

6. Recent Developments In Pulp And Paper Making Technology (05 periods)

Introduction to recent development in various areas of pulping and paper making. Environmental considerations. Introduction to basic training of computer application in relation to pulp & paper technology.

LIST OF PRACTICALS

1. Laboratory sheet making
2. Back water analysis, first pass retention and first pass ash retention
3. Fibre loss analysis
4. Determination of moisture in paper sheet
5. Determination of % ash in paper.
6. Testing of pulp hand sheet - General
7. Testing of paper for optical (brightness, whiteness, color, reverted brightness, gloss) properties
8. Testing of thickness and bulk of paper and paper board.
9. Testing of paper for strength (tensile, tear, bending, busting, folding) properties
10. Determination of Cobb value (60 sec) water absorptiveness of sized paper.

INSTRUCTIONAL STRATEGY

While imparting instructions, teacher should show various types of raw materials of paper manufacturing to the students. Students should be asked to collect various types of available papers in the market. Visits to industry should be planned to demonstrateuse of various types of papers in different process industries.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Actual Practical Performance.
- Small Projects
- Viva-voce

RECOMMENDED BOOKS

2. G.A. Smook, Handbook of Pulp and Paper technologists, 4th Edition, Tappi Press, 2016
3. J.P. Casey (Editor), Pulp & Paper Chemistry and Technology, 3rd Edition, Vol. III & IV, Wiley 1980
4. P. Bajpai, Biermann's Handbook of Pulp and Paper, 3rd Edition, Vol. II, Elsevier 2018

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1.	20	30
2.	10	15
3.	15	17
4.	10	15
5.	10	15
6.	05	8
Total	**70**	**100**

6.4 INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

L	T	P
5	-	-

RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. It may be further added that an entrepreneurial mind set with managerial skills helps the student in the job market. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

LEARNING OUTCOMES

After undergoing this course, the students will be able to

- Know about various schemes of assistance by entrepreneurial support agencies
- Conduct market survey
- Prepare project report
- Explain the principles of management including its functions in an organization
- Have insight into different types of organizations and their structures
- Inculcate leadership qualities to motivate self and others
- Manage human resources at the shop-floor
- Maintain and be a part of healthy work culture in an organization
- Use marketing skills for the benefit of the organization
- Maintain books of accounts and take financial decisions
- Undertake store management
- Use modern concepts like TQM, JIT and CRM

DETAILED CONTENTS

SECTION – A

ENTREPRENEURSHIP

1. Introduction (04 Periods)

    1.1. Concept /Meaning and its need
    1.2. Qualities and functions of entrepreneur and barriers in entrepreneurship
    1.3. Sole proprietorship and partnership forms and other forms of business organizations
    1.4. Schemes of assistance by entrepreneurial support agencies at National, State, District – level, organization: NSIC, NRDC, DC, MSME, SIDBI, NABARD, NIESBUD, HARDICON Ltd., Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubators (TBI) and Science and Technology Entrepreneur Parks

2. Market Survey and Opportunity Identification/Ideation (04 Periods)

    2.1. Scanning of the business environment

2.2. Salient features of National and Haryana State industrial policies and resultant business opportunities
2.3. Types and conduct of market survey
2.4. Assessment of demand and supply in potential areas of growth
2.5. Identifying business opportunity
2.6. Considerations in product selection
2.7. Converting an idea into a business opportunity

3. Project report Preparation (06 Periods)

3.1. Preliminary project report
3.2. Detailed project report including technical, economic and market feasibility
3.3. Common errors in project report preparations
3.4. Exercises on preparation of project report
3.5. Sample project report

SECTION –B

MANAGEMENT

4. Introduction to Management (06 Periods)

4.1. Definitions and importance of management
4.2. Functions of management: Importance and process of planning, organizing, staffing, directing and controlling
4.3. Principles of management (Henri Fayol, F.W. Taylor)
4.4. Concept and structure of an organization
4.5. Types of industrial organizations and their advantages
4.6. Line organization, staff organization
4.7. Line and staff organization
4.8. Functional organization

5. Leadership and Motivation (08 Periods)

5.1. Leadership: Definition and Need, Qualities and functions of a leader, Manager Vs leader, Types of leadership, Case studies of great leaders
5.2. Motivation: Definition and characteristics, Importance of self-motivation, Factors affecting motivation, Theories of motivation (Maslow, Herzberg, Douglas, McGregor)

6. Management Scope in Different Areas (14 Periods)

6.1. Human Resource Management: Introduction and objective, Introduction to Man power planning, recruitment and selection, Introduction to performance appraisal methods
6.2. Material and Store Management: Introduction functions, and objectives, ABC Analysis and EOQ
6.3. Marketing and sales: Introduction, importance, and its functions, Physical distribution, Introduction to promotion mix, Sales promotion
6.4. Financial Management: Introductions, importance and its functions, knowledge of income tax, sales tax, excise duty, custom duty, VAT, GST

7. Work Culture (08 Periods)

7.1. Introduction and importance of Healthy Work Culture in organization
7.2. Components of Culture
7.3. Importance of attitude, values and behavior
7.4. Behavioral Science – Individual and group behavior.
7.5. Professional ethics - Concept and need of professional ethics and human values.

8. Basic of Accounting and Finance (10 Periods)

8.1. Basic of Accounting: Meaning and definition of accounting, Double entry system of book keeping, Trading account, PLA account and balance sheet of a company
8.2. Objectives of Financial Management: Profit Maximization v/s Wealth Maximization

9. Miscellaneous Topics (10 Periods)

9.1. Total Quality Management (TQM): Statistical process control, Total employees Involvement, Just in time (JIT)
9.2. Intellectual Property Right (IPR): Introduction, definition and its importance, Infringement related to patents, copy right, trade mark

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment, seminar or case study method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organizations on visit. Approach extracted reading and handouts may be provided.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Model/Prototype making.

RECOMMENDED BOOKS

1. A Handbook of Entrepreneurship, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)
2. Entrepreneurship Development and Management by J.S.Narang; Dhanpat Rai & Sons, Delhi.
3. Entrepreneurship Development by CB Gupta and P Srinivasan, Sultan Chand and Sons, New Delhi
4. Handbook of Small Scale Industry by PM Bhandari
5. Entrepreneurship Development and Management by MK Garg
6. E-books/e-tools/relevant software to be used as recommended by AICTE/ NITTTR, Chandigarh.

WEBSITES FOR REFERENCE

1. http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	04	06
2	04	06
3	06	08
4	06	08
5	08	12
6	14	20
7	08	12
8	10	14
9	10	14
Total	**70**	**100**

6.5 PROJECT WORK

L	T	P
-	-	12

RATIONALE

Project Work aims at developing innovative skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place students for project oriented practical training in actual work situation for the stipulated period.

LEARNING OUTCOMES

After undergoing the project work, the students will be able to

- Apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project.
- Develop understanding regarding the size and scale of operations and nature of field-work in which students are going to play their role after completing the courses of study
- Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.
- Develop firsthand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems related to the world of work.
- Develop abilities like interpersonal skills, communication skills, positive attitudes and values etc.
- Assemble/fabricate and test an electronics gadget.

GENERAL GUIDELINES

The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. The activity of problem identification should begin well in advance (say at the end of second year). Students should be allotted a problem of interest to him/her as a major project work. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The project work identified in collaboration with industry should be preferred.

This practical training cum project work should not be considered as merely conventional industrial training in which students are sent at work places with either minimal or no -supervision. This experience is required to be planned in advance and supervised on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant organization for providing such an experience to students. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such that it matches with the curricular interest to students and of professional value to industrial/ field

Organizations. Each teacher is expected to supervise and guide 5-6 students.The project assignments may consist of

1. Development of prototypes

2. Study of different types of
   2.1. Heat exchangers
   2.2. Distillation columns
   2.3. Evaporators
   2.4. Reactors
   2.5. Drying unit etc.

3. Study of different types of vessels, heads and joints (can be done through factory visit)

4. Study of pumps and valves used in process industries

5. Fabrication of components / equipment's

6. Fault diagnosis and rectification experiences

7. Bringing improvements in the existing system/equipment

8. Audits of industry- energy audit, water audit, material audit etc.

9. Case Studies

NOTE:

1. The list is only the guideline for selecting a project; however a student is at liberty to select any other related project of his choice independently under guidance of his teacher.

A suggestive criterion for assessing student performance by the external (person from industry) and internal (teacher) examiner is given in Table below:

Sr.No.	Performance Criteria	Max.** Marks	Rating Scale				
			Excellent	Very Good	Good	Fair	Poor
1.	Selection of project assignment	10%	10	8	6	4	2
2.	Planning and execution of considerations	10%	10	8	6	4	2
3.	Quality of performance	20%	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20%	20	16	12	8	4
5.	Sense of responsibility	10%	10	8	6	4	2
6.	Self-expression/ communication skills	5%	5	4	3	2	1
7.	Interpersonal skills/human relations	5%	5	4	3	2	1
8.	Report writing skills	10%	10	8	6	4	2
9.	Viva voce	10%	10	8	6	4	2
10.	**Total Marks**	**100**	**80**	**60**	**40**	**20**	**10**

The overall grading of the practical training shall be made as per above Table.

In order to qualify for the diploma, students must get "Overall Good grade" failing which the students may be given one more chance to improve and re-evaluate before being disqualified and declared "not eligible to receive diploma". It is also important to note that the students must get more than six "goods" or above "good" grade in different performance criteria items in order to get "Overall Good" grade.

IMPORTANT NOTES

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.

2. The criteria for evaluation of the students have been worked out for 200 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.

3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students' performance as per the above criteria.

4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

The teachers are free to evolve other criteria of assessment, depending upon the type of project work. It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organizations in such an exhibition.

LIST OF INDUSTRIES

1. Karnal Coopretive Sugar Mills Ltd., Karnal
2. JCT, Hissar
3. Ruchire Paper Mills Ltd., Kala amb
4. Max GB. Ropar
5. Shreyans Paper Mill, Ropar
6. PCPL Derabassi
7. SIEL Complex, Rajpura
8. Rana Sugar Mill, Bulter
9. Trident, Barnala
10. IAL, Saugrur
11. Barnala Paper Mill
12. Paper Mill, Jagadhari
13. Sukhjit Starch and Chemicals, Phagwara
14. Horlicks, Nabha
15. NESTLE, Ferozpur Road, Moga
16. K.B.R.L., Dhrui-Malerkotla Road, Bhasaur, Dist Sarangrur
17. Oswald Oils and Fats, Raikot
18. A.P Solvex Ltd. Dhuri
19. Shreyans Paper Mills, Ahmedgarh
20. Ind Swift- Barwala road, Chandigarh
21. Panecea BioTech – Lalroo
22. Morpen Pharmaceuticals, Parwanoo
23. Sanchez Pharmaceuticals, Tohana, Tricrossing Tohana, Distt. Fatehabad
24. Wochert, Ambala-Chandigarh. Road, Lalroo
25. Amrit Vanaspati, Rajpura
26. Diplast Industries, Mohali

27. Mount Shivalik Breweries, Derabassi
28. PCPL Chemicals, Derabassi
29. YASH Papers, Darshan Nagar Faizabad

6.6 INDUSTRIAL TRAINING / FIELD EXPOSURE

Student have to go for a industrial training of 4 weeks in a Pulp and paper industry under the guidance of their H.O.D. The student will submit a industrial training report which will be scrutinized and examined by the external examiner appointed by the B.T.E.. There will be viva voce of 100 marks and sessional marks of 50.

TRAINING SCHEDULE

04 weeks structured supervised branch specific, task oriented Industrial Training to be organized during summer vacation after IV Semester examination. The student during
The industrial training must undertake training in at least any one of the following and submit the training report in the format given at Annexure-I & II.

1. Operation of Pulp and Paper Plant

   Operation of plant, Process control, Management of labor, Material and utility, Safety of workers and equipment's

2. Analysis

   Analysis of sample, Interpretation of results of analysis

3. Erection & Commissioning of Plant

   Reading and interpreting the sketches, drawings, layout, planning etc. Erection of plants, Commissioning of plants

4. Inspection & Testing of Equipment

   Inspection, testing and performance of individual equipment, Fault finding or trouble shooting and its rectification

RESOURCE REQUIREMENT: As per AICTE norms

EQUIPMENT REQUIRED FOR CHEMICAL ENGINEERING

COMMUNICATION LABORATORY			
Sl.No	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Stools	40	10,000
2.	Display Board/Screen	02	6,000
3.	Sound recording and playing system	01	6,000
4.	Audio cassettes	60	2,000
5.	Overhead Projector	01	5,000
6.	Transparencies slides	100	500
7.	TV, VCR and camera for video recording	01 Each	20,000
8.	English spoken course	01	2,000
9.	A Quiz room equipped with two way audio system, back projection system and slide projector	01	30,000
10.	Miscellaneous	LS	1,500

APPLIED PHYSICS LABORATORY			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Vernier calipers Working length 160 mm, Internal and external dia with locking arrangement	12	2,000
2.	Screw Gauges Working length 15 mm, pitch 0.5 mm, least count .005 mm	12	2,000
3.	Spherometers Distance between legs 2.5 mm, pitch 0.5 mm, least count .005 mm.	12	2,000
4.	Mirrors (convex, concave)	5 Each	1,500
5.	Pendulum Setup	02	4,000
6.	Gravesend's Apparatus	02	3,000
7.	Inclined Plane Setup	02	2,000
8.	Flywheel Setup	02	4,000
9.	Prism	05	1,500
10.	Spectrometer	02	25,000
11.	DC Ammeters Moving coil Weston-type ammeter with ebonite stand	10	3,500
12.	DC Milli ammeter	02	1,000
13.	DC Micro ammeters	02	700
14.	DC voltmeters	10	700
15.	DC Millivolt meters	10	2,000
16.	Sensitivity Galvanometer	02	800
17.	Student Galvanometers	10	4,000
18.	Demonstration type DC Ammeters Range; 0 to 1 Amp.	02	1,000
19.	D type DC Voltmeter Range : 0 to 1 Volt	02	1,000
20.	D type Galvanometers Sensitivity : 20 microamperes per scale division,	08	8,000

21.	Resistance boxes (dial type) assorted	08	8,000
22.	Rheostats	10	4.000
23.	Miscellaneous items (Spring, Pan, Glycerin, Optic fibre, Ferromagnetic material)	LS	2,000
24.	Fortin's Barometer (Wall type)	02	20,000
25.	Stoke's Apparatus	02	10,000
26.	Gumther's Apparatus	02	16,000
27.	Resonance Tube Apparatus with accessories and Tuning fork set	02	14,000
28.	Sodium Lamp setup with Bi-prism	02	10,000
29.	Ohmic resistance coil	10	5,00
30.	Slide wire bridge	02	8,000
31.	PN Junction diode Apparatus	02	10,000
32.	Laser (as per requirement)	01	1,00,000
33.	Numerical aperture setup	01	25,000
34.	Miscellaneous	LS	3,000

APPLIED CHEMISTRY LABORATORY			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Digital Balance	01	80,000
2.	Burette 50ml	30	3,000
3.	Pipette 25ml	60	4,000
4.	Beakers 100ml	60	4,000
5.	Burette stand	30	30,000
6.	Glazed tile	30	1,000
7.	Conical flask 50ml (Titration flask)	60	4,000
8.	Standard (Measuring) flask (to prepare standard solution) 250ml/100ml	30	6,000
9.	Able's Flash Point apparatus	02	10,000
10.	(1/10)°C thermometer	06	6,000
11.	Candles	20	100
12.	Crucible with lid	06	2,000
13.	Muffle furnace	01	18,000
14.	Desiccator	06	8,000
15.	Pair of tongue (small and big)	24 (Small) 2 (Big)	2,000
16.	Chemicals • EDTA-1 kg • Eriochrome Black-T(Solochrome black T)- 200g • Buffer solution (NH3 - 2.5 Ltr, NH4Cl – 1 kg) • Zinc sulphate- 500g • H2SO4- 2.5 Ltr • Phenolphthalein indicator (as per requirement) • Methyl orange indicator (as per requirement) • Charcoal (as per requirement) • Kerosene- 1 Ltr	LS	20,000
17.	Miscellaneous	LS	2,000

ENGINEERING DRAWING			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Drawing Boards (700 x 500mm)	60	25,000
2.	Draughtsman Tables	60	1,80,000
3.	Draughtsman Stools	60	40,000
4.	Computer Aided Drawing (CAD) Software	30 User	5,00,000
5.	Model of different wooden joints	01	1,000
6.	Model of different screw threads	01	1,000
7.	Model of various locking devices	01	1,000
8.	Model of various joints	01	1,000
9.	Cut section Model of various couplings	01	3,000
10.	Miscellaneous	LS	5,000

ELECTRICAL AND ELECTRONICS ENGINEERING LABORTORY			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Voltmeter	05	7,500
2.	Ammeter	05	10,000
3.	CRO	01	15,000
4.	Wattmeter	05	10,000
5.	Multimeter	01	4,000
6.	Resistive load	01	4,000
7.	Regulated supply	01	8,000
8.	Signal generator	01	5,000
9.	Rheostat	02	2,500
10.	Lead acid battery	01	4,000
11.	Cables, Coils, Lamp (as per requirements)	LS	1,500
12.	Resistance, Inductor, Capacitor (as per requirements)	LS	1,500
13.	Miscellaneous/Electronics Components	LS	2,500

BASICS OF IT LABORATORY/COMPUTER APPLICATIONS LABORATORY			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Computer System with latest configuration	30	8,00,000
2.	Printer (MFP)	01	25,000
3.	Printer (Laser)	01	35,000
4.	Plotter	01	75,000
5.	Digitizer	01	50,000
6.	Antivirus Software	LS	10,000
7.	Internet Facility on Computers	LS	2,00,000
8.	LCD Projector	01	35,000
9.	UPS	60	1,20,000
10.	Software (latest windows, latest MS Office)	01	1,00,000
11.	Scanner	01	10,000
12.	Software MATLAB	01	2,00,000
13.	Miscellaneous	LS	5,000

CARPENTRY SHOP			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Work benches fitted with carpenter vices	05	20,000
2.	Circular saw grinder	01	6,000
3.	Wood cutting band saw-vertical	01	10,000
4.	Bench grinder	01	5,000
5.	Drilling machine	01	8,000
6.	Wood turning lathe	01	40,000
7.	Wood Planner	01	20,000
8.	Tool accessories measuring and marking Instruments	25	25,000
9.	Band saw blade brazing unit	01	10,000
10.	Miscellaneous	LS	1,500

PAINTING AND POLISHING SHOP			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Spray gun with hose pipe	01	1,000
2.	Paint brushes	20	2,000
3.	Paint/Varnish	LS	2,000
4.	Air Compressor with 2 HP motor	1 Set	10,000
5.	Miscellaneous	LS	2,000

ELECTRICAL SHOP			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Tool kit (Plier, Screw driver, Knife, Steel rule, hammer, scriber, pincer steel tape etc.)	20	20,000
2.	Fuses, Switches, Plugs, Sockets, Ceiling rose, Wires, cleats, Clamps, Test lamp, Tester.(as per requirement)		8,000
3.	Electric Iron	01	1,500
4.	Electric kettle	01	1,500
5.	Ceiling fan/table fan	01	2,500
6.	Desert cooler	01	5,000
7.	Lead acid battery	02	8,000
8.	Battery Charger	01	6,000
9.	Miscellaneous		3,000

WELDING SHOP			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Electrical welding transformer set with accessories	03	30,000
2.	Gas Cutting Unit	01	3,000
3.	Work benches with vices	03	5,000
4.	Welding generator set	01	10,000
5.	Oxy acetylene welding set with accessories	01	7,000
6.	Acetylene generating set	01	6,000
7.	Electric welder tool kit	10	10,000
8.	Projection welding machine	01	15,000
9.	Brazing equipment with accessories	01	10,000
10.	Soldering irons	03	1,000
11.	Pedestal grinder	01	10,000
12.	Metal spraying gun	01	10,000
13.	Spot welder	01	25,000
14.	TIG welding set	01	1,00,000
15.	MIG welding set	01	1,00,000
16.	Welding Partition Screen	05	2,500
17.	Miscellaneous	LS	3,000

SHEET METAL SHOP			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Hammers	08	3,000
2.	Mallets (Hard & Soft)	05	2,000
3.	Sheet and wire Ganges	LS	8,00
4.	Shearing Machine	01	20,000
5.	Bar folding Machine	01	20,000
6.	Burring machine	01	10,000
7.	Various sheet (black plain, galvanized iron, corrugated, Aluminum)	01 Each	1,000
8.	Hand Shears/Snippers	04	2,000
9.	Nuts, Bolts, Rivets, Screw	LS	500
10.	Miscellaneous	LS	1,000

FITTING AND PLUMBING SHOP			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Work benches with vices (4 vices on each bench)	05	30,000
2.	Marking tables with scribers	04	24,000
3.	Surface plates	05	20,000
4.	Accessories like calipers, V blocks, height, gauges steel rules and scribers	25	50,000
5.	Tool kits - taps, dies, drills	25	40,000
6.	Tool kits - chisels, hammers, files, hacksaw	25	25,000
7.	Drilling machine	02	12,000
8.	Pipe vice	04	1,000
9.	Chain wrenches	05	1,250
10.	Ring spanner set	05	600
11.	Pipe die set 2”	02 Set	1,000
12.	Pipe bending device	01	5,000
13.	Various plumbing fittings	LS	2,000
14.	Miscellaneous	LS	1,500

MACHINE SHOP			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Centre lathes	10	6,00,000
2.	Grinder	01	10,000
3.	Universal milling machine	01	1,25,000
4.	Shaper	02	1,20,000
5.	Plainer	02	1,20,000
6.	Work bench	03	10,000
7.	Precision instruments	01	10,000
8.	Hand tools and accessories	02	8,000
9.	CNC trainer lathe	01	4,00,000
10.	Miscellaneous	LS	5,000

MECHANICAL OPERATIONS AND SOLID HANDLING/ FLUID MECHANICSLABORATORY			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Centrifuge	01	8,425
2.	Ball Mill	01	6,00,000
3.	Mixer – Liquid Mixer and Solid Liquid Mixer	02	3,96,256
4.	Roller mill	01	2,90,000
5.	Compressor, Wet Gas Meter, Blower	01	21,500/each
6.	Jaw Crusher	01	50,000
7.	Cyclone Separator	01	1.5 lakh
8.	Plate and frame filter press	01	55,000
9.	Sieve shaker	01	7,000
10.	Bernoulli's Theorem Apparatus	01	15,000
11.	Vacuum pump	01	7,199
12.	Particle settling in fluids (Drag coefficient)	01	Equation used
13.	Determination of Friction loss through pipe	01	Equation used
14.	Weirs, V-notch, Rectangular Notch	01	34,000/each
15.	Centrifugal pumps, reciprocating pump	01	15,000/each
16.	Redwood Viscometer	01	30,500
17.	Rotameter, Venturimeter, Orificemeter, pitot tube	01	900,3500,47750 and 6000
18.	Globe valve, check valves, Butterfly valve, Needle valve	01	1,407/ each
19.	Gate Valve, Diaphragm Valve	01	1,407/ each
20.	Reynolds number determination apparatus	01	36,500
21.	Rotary Disc Filter, Vacuum Rotary Drum Filter	01	80,000

HEAT AND MASS TRANSFER LABORATORY			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Equipment to measure thermal conductivity of metal rod.	01	49,000
2.	Heat transfer through compound wall equipment.	01	20,900
3.	Thermal conductivity (Insulating powder) Apparatus90-	01	70,000
4.	Forced convection apparatus	01	38,000
5.	Natural convection apparatus	01	22,000
6.	Open pen evaporator	01	52,000
7.	Drop and film wise condensation apparatus	01	33,000
8.	Parallel and counter flow apparatus for heat exchanger	01	44,000
9.	Shell and tube heat exchanger	01	15,000
10.	Double pipe heat exchanger for heat transfer coefficient	01	10,000
11.	Single effect evaporator	01	72,000
12.	Finned tube heat exchanger	01	75,000
13.	Batch Distillation Apparatus		10,0000
14.	Oven	01	24,000
15.	Liquid-Liquid Extractor Setup	01	10,000, 00
16.	Packed Column	01	2700/piece
17.	Tray Dryer	01	44,000
18.	Bubble Cap Distillation Column	01	50,000
19.	Refractometer	01	3,300
20.	Liquid Diffusion Apparatus	01	4,00,000
21.	Solid Diffusion Apparatus	01	7,000

22.	Wetted Wall Column Apparatus	01	25,000
23.	Cooling Tower	01	25,000
24.	Crystallizer	01	80,000
25.	Reverse Osmosis set up	01	2,500

MASON SHOP			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Mason Trowel	10	1,000
2.	Concrete Finishing Trowel	10	1,000
3.	Gauging Trowel	10	1,000
4.	Margin Trowel	10	1,000
5.	Pointing Trowel	10	1,000
6.	Round Trowel	10	1,000
7.	Mason/Brick Hammer	10	3,000
8.	Comb hammer	10	3,000
9.	Blocking chisel	10	1,000
10.	Plumb bob	10	500
11.	Spirit level	10	1,000
12.	Straight Edge	10	1,000
13.	Jointer	10	1,000
14.	Masonry Pan	10	1,500
15.	Steel Measuring Tape	10	500
16.	Miscellaneous (Bricks, Blocks, Stones, Sand, Cement)	10	3,000

ENVIRONMENT ENGINEERING LABORATORY			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Ph meter	01	699
2.	Turbidity meter	01	188
3.	Oven with temperature controller and forced air circulation type	01	24,000
4.	B.o.d. Incubator	01	25,550
5.	Water analysis kit	01	3,099
6.	High volume sampler	01	75,000
7.	Electrical balance for weighing up to 1/10 of milligram (capacity)	01	12,000

PROCESS CONTROL			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Apparatus for celebration of pressure gauge	01	4,974
2.	Bimetallic Thermometer	01	525
3.	Energy Meter	01	365
4.	Watt Meter	01	2,600
5.	Manometers	01	2000
6.	Flapper nozzle system apparatus	01	
7.	On-off Controller	01	2500/each
8.	Thermopiles/Thermocouple	01	590/each
9.	Resistance thermometer	01	13,750
10.	Strip chart recorder	01	60,000
11.	Circular chart recorder	01	
12.	Pneumatic value	01	942,55
13.	Set up for study response of two tank in non-introductory and interacting system	01	66,000
14.	P controller, PD controller PID controller	01 Each	3000/ each

ENERGY CONSERVATION LABORATORY			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Clamp meter	02	4000
2.	Multimeter	02	2000
3.	Power Analyzer	01	4799
4.	Different types of lamps (LS) i. 60 W lamp, 230 V, 100 V ii. 200 W lamp, 230 V, 100 V iii. 500 W lamp, 230 V, 100 V iv. 100 W lamp, 110 V, 150 V	10	25/each
5.	Lux meter	02	4,000/each
6.	Standard window A.C.	01	28,000
7.	Anemometer	02	2000/each
8.	Thermometer	03	950/each
9.	Flow meter	02	49,500/ each
10.	Pumping set with at least two pumps of different capacity	1 Set	
11.	Pressure gauge fitted on discharge lines	1 Set	690/each
12.	Variable Frequency Drive	02	8999/each
13.	A small compressor with a small network of pipeline, gauge, safety valve and loading / unloading pressure switch	01	10,0000
14.	Stop watch	02	1000/each
15.	Small blower (1.5 kW motor) with inlet and outlet ducts of approximately one meter length on both sides	01	40000/unit

POLLUTION CONTROL AND INDUSTRIAL SAFETY			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	BOD incubator ($5^0C - 50^0C$) with digital temperature indicator	01	25,550
2.	COD Heater	01	62675
3.	Refrigerator, 280 Ltr.	01	27,740
4.	Laboratory oven $2' \times 2' \times 2$	01	24,000
5.	Turbidity meter (0 - 4000 NTU)	01	188
6.	TDS portable meter	01	699
7.	Electronic balance (0.001 grams)	01	14,500
8.	Beakers	01	124/each
9.	Conical flask, round bottom flasks	01	180/each
10.	Condenser, reflux condenser	01	110/each
11.	BOD bottles, rubber pipe, burette, pipette etc.	LS	1050/total

INTRODUCTION TO COMPUTER

(Common to all Trades)

COMPUTER CENTRE			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Core-2 Quad Processor, 4GB RAM, 1 GB SATA HDD, 19" TFT Monitor/ Server of Latest Specification OS-Windows 2007/2008/Latest Version	02 Server	1,20,000
2.	General Desktop Computer-Intel i5 or Higher(with latest Specification Pre-loaded latest Anti-Virus with Life time Subscription, License Media and Manual with UPS 660 VA with latest window OS Including license OR Computer of latest Specification With latest Window OS including license	60 node	36,00,000
3.	Software : (Latest Version) i. MS OFFICE 2010/Latest Version ii. COMPILER 'C', C++, JAVA-7	LS	LS
4.	Hardware i. Switch-32 Port ii. Router iii. Hub iv. Ext. Modem v. Wireless N/W Adaptor vi. Series Access Point vii. LAN Cable Meter viii. LAN Cable Analyzer ix. Crimping Tool and all other accessories related to Networking	LS 02 02 04(8 Port) 02 02 02 05 05 15	4,50,000
5.	Scanner- Flat Bed A4/Auto Lighter (Bit depth 48)	02	20,000
6.	132 Column 600 CPS or faster 9 Pin dot matrix printer with 500 million character head life	02	50,000

7.	Laser Jet-A4 All In one 20 page per min (2 Each)	04	50,000
8.	Desk Jet-A4 Photo Smart (2 Each)	04	40,000
9.	5 KVA online UPS with minimum 30 minute battery backup along with sealed maintenance free batteries. Provision for connecting external batteries with network connectivity (For 2 Labs)	04	8,00000
10.	Split Air Conditioner 1.5 tones capacity with ISI mark along with electronic voltage stabilizer with over voltage and time delay circuit	08	35,0000
11.	Room preparation and furniture	LS	-
12.	19" rack, 24-port switch. connector RJ-45 Cat-6 cabling for network	LS	10,0000
13.	2 KVA Inverter Cum UPS	02	6,0000
14.	Fire Extinguisher (2 Kg)	04	15,000
15.	Fire Extinguisher (5 Kg)	04	25,000
16.	Vacuum Cleaner	02	25,000
17.	LCD Projector 3000 Lumen with all Accessories	02	3,50,000
18.	Pen Drive 16 GB	10	10,000
19.	DVD Writer External	02	10,000
20.	HDD External 500 GB	02	15,000
21.	PAD (Latest Configuration)	02	15,000
22.	Broadband For Internet(Speed Min. 8mbps)	04	LS
23.	USB Modem	02	8,000
24.	Generator 15 KVA Water Coolant	01	4,50,000

UNIT OPERATION LAB			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Apparatus to verify Bernoulli's Theorem	01 Set	15,000
2.	Apparatus for conducting experiments on Venturimeter with collecting and supplying tank	01 Set	15,000
3.	Reynold's apparatus with storage tank and flow steadying arrangement with 1/2 HP pump and accessories	01 Set	10,000
4.	Apparatus for determining Cc, Cv and Cd (with set & micrometer gauge)	01 Set	15,000
5.	Apparatus for determining various head losses in pipes (Fitted with all valves & Orifice meter along with storage tank)	01 Set	25,000
6.	Notch apparatus with set of notches with v-type, square-type notch	01 Set	13,000
7.	Model of Reciprocating pump-1.4"	01	5,000
8.	Model of Centrifugal pump	01	5,000
9.	Pressure gauge Borden's type Max. 4 Kg/ Cm2/1/4" connection Nipple	01	5,000
10.	In place of item no. 1,2,4,5 & 8 Hydraulic bench may be purchased with all accessories or such institution if already have above items may purchase one unit, Otherwise 6 units	06	20,000
11.	Misc. for tools, Manometer Pitot's tube, Differential manometer and minor equipment	01	20,000
12.	Orifice Meter (Orifice Diameter 25mm)	01	20,000
13.	Rota Meter 40 - 400 lit. per. min. with all parts	01	10,000
14.	Stop Watch (1/10 racer)	03	3,600
15.	Centrifugal Pump with Motor 230 V, 1HP Single Phase	01	15,000
16.	Plate & Frame filter Press 240X240 mm, 6 No. of Filter Plate / 5 Nos. of frame with stand, tray, tighten arrangement, filter cloth & motorized pump & tank	01	55,000
17.	Sieve Shaker with Motor & Time Switch/stop watch	01	7,000

18.	Test Sieve with FHP Motor through a reduction gear Suitable to carry up to 7 sieve of 50 cm. or 20 cm. Diameter	01 Set	15,000
19.	Sieve Plate(S.S.) Distillation Column dia 6-8" test size 200mm dia with Reboiler and condenser	01	75,000
20.	U Tube Double Pipe Heat Exchanger 1800 mm length inside pipe 30mm OD 25 mm, welded leak proof with inlet and outlet valves & steam trip, all fitted on M.S. structure	01	55,000
21.	Stainless Steel Spherical Jacketed Open Pan Evaporator. 1X4' with jacket for cooling stirrer	01	50,000
22.	Stainless Steel Crystallizer 500 Lit. with stirrer motor and Gear Box	01	40,000
23.	Rotatory Dryer Drying Shell : Material Stain steel 1.5 M Dia 110 mm, Feed Hopper, Product receiver, Heating Chamber, Heater, Temperature Sensors, Standard make on/off switch, Main indicator, etc.	01	1,00,000
24.	M.S. Thickener	01	45,000
25.	S.S. Spherical Jacketed Open Pan Evaporator With Stirrer. 500 liter with Stirrer motor and gear box	01	50,000
26.	Shell & Tube Heat Exchanger System water RO water (1-2 shell & tube type) Shell : Material Stainless Steel dia 220 mm, length 500 mm (Approx.), Tube: OD 16 mm (Approx.), Length 500mm (24 Nos.)	01	50,000
27.	Tray Dryer Drying Chamber : Stainless Steel Material, Heater, Temperature Sensors, Digital Temperature Controller with standard make on/off switch	01	70,000
28.	Rotary Vacuum Filter Drum Dia 1'-1.5 slurry through vacuum/suction pump	01	50,000
29.	Electric Boiler with temperature control recorder & pressure gauge (100-800hp, 15-300 psig)	01	80,000
30.	Disintegrator Along with Wattmeter and voltmeter fitted with Motor and stand, hammer type Common gauge plate input hopper and discharge element (1 Horse Power)	01	25,000
31.	Jaw Crusher along with Wattmeter and voltmeter 4"X4" 40 kg. per hour with 3 HP motor made of heavy steel body with magnetic steel jaws and stand	01	50,000

32.	Ball Mill Moc : MS Chamber Size : 300(D) * 350 (L) mm Speed : 65 RPM with step pulley arrangement Elevation : Centre line of the shell @ 50 cm high from the ground level 2 HP ac motor, 1440 rpm, single phase, 230V & 50 Hz with step pulleys to give Three different speed of drum. Accessories : Set of Step pulleys & Suitable belt 50 nos. 25 mm dia porcelain Ball/MS balls 1 no. or product collection Tray of suitable size of MS with painted	01	6,00,000
33.	Vacuum Pump Water Ring Type	01	18,000
34.	Vacuum Pump Oil Ring Type	01	6,500
35.	Valves (Gate, Gloves, Cock, Check, Butterfly, Steam Trap, Safety valve, Ball valve)	01 Each	1,407/ each
36.	Fittings (Flange, Socket, Union, Nipple, Elbow, Reducer, T, Plug)	01 Each	350/each
37.	Thermal Conductivity Meter (For Asbestos Powder)	01	10,499

AUTOMATIC PROCESS CONTROL LAB			
Sl.No.	**Name of Equipment**	**No.**	**Amount**
1.	Electronic Microprocessors Based Balance 300/310 Gm. Accuracy 0.001 gm., reproducibility 0.001gm, stabilization +3ppm/oC Sample pan size 135mm dia, min. Input weight reading 1gm. Operating Temperature range 0oC-40oC RH-85%, Power supply AC Adopter 220V or other +10% - 15%, 50-60 Hz supplied Acrylic wind shunt	01	35,000
2.	Strip Chart Recorder	01	35,000
3.	Automatic Rapid Moisture Tester.	01	32,000
4.	Air Compressor (Single Stage) Single Phase	01	12,000
5.	Air compressor With Automatic Control Switch.	01	8,000
6.	Bimetallic Thermometer		1
7.	Stop Watch 1/10 sec. Magnetic 7 jewels	02	1,500
8.	Platinum Resistance Thermometer	01	1,500
9.	Thermocouple With Indicator and Control Recorder	01	10,000
10.	Recording Type Gas/Vapor Filled Thermometer (Single Pen)	01	9,000
11.	Pressure Transducer With Indicator	01	16,000
12.	Rate Meter 40-400 lit./min with all parts	01	10,000
13.	Pneumatic Control Valve 1" two-way max, pressure 5kh. on/off (Diaphragm Type)	01	8,000
14.	Float & Tape Type Liquid Level Measuring Depth.	01	1,500
15.	Flap or Nozzle Arrangement For Demonstration.	01	1,000
16.	Pressure Regulator with Air Filter Needle. (Max. Pressure 5 Bar 25 connector 1/4)	01	3,000
17.	M.S. Tanks 1.5x1x0.7 M.	03	15,000

18.	M.S. Tank Cylindrical With Inlet & Outlet type.	06	18,000
19.	Bourdon Pressure Gauge	03	45,00
20.	Tullu Pump of Minimum Capacity 1/4 HP	03	15,000
21.	Auto Transformer 2 amp	03	6,000
22.	Voltage Stabilizer , Input 80-280 V/Output 230 V	02	3,000
23.	Mili voltmeter, Milliameter, Micrometer Each 0-100 Amp.	03	24,000
24.	Hot Plate Heater/Water Heater	02	6,000

CHEMICAL RECOVERY LAB			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Electronic Balance for weighing up to 1/10 milligrams (capacity up to 300 gm)	02	40,000
2.	Sp. Gravity Meter at Constant Temperature (i.e. at 4^0C) along with cooling device	01	330/piece
3.	Automatic Black Liquor Burning Furnace Sample Capacity (5ml) Temperature $1200^o\ C$	01	78,000
4.	Orsat Apparatus	01	16,000
5.	ASTM Distillation Apparatus for Black Liquor	01	10,0000
6.	Kjeldahl flask (300 C.C.) Connecting Kjeldahl flask Distillation unit, receiver Heater connecting piping's and suitable holding fixtures	06	60,000
7.	Reflux Condenser with k-jacketed flask & fixture	01	3,000
8.	COD Heater Portable Pen Type	01	45,000
9.	Rubber Tube	10 Meter	800
10.	Condenser 1.5' to 2'	01	700
11.	Round Bottom Flask with Joint B-24, 500 ml	01	600
12.	BOD Incubator Temperature range $5-50^0C$ uniform cooling temperature uniformity $+1^0C$ operating at 20^0C, $+1^0C$ Digital temperature indicator And controller graduated in 1^0C	01	60,000
13.	BOD Bottle 300ml	01	699/each
14.	Refrigerator 280 Ltr,180V-230V, 50 cycle	01	27,740
15.	Laboratory Oven Max $2' \times 2' \times 2'$ thermometer temperature 140^0C	01	24,000
16.	Laboratory Incubator $+1^0C$ Temperature range $5-50^0C$ uniform cooling temperature uniformity $+1^0C$ operating at 20^0C Digital temperature indicator And controller graduated in 1^0C	01	12,000

17.	Turbidity Meter (Portable pen type with a wide range of 0-4000 NTUs)	01	188
18.	TDS Portable Meter (Portable pen type with suitable Probe)	01	179
19.	pH Meter (Portable pen type with suitable Probe)	01	699/each
20.	Membrane Type Water, Purifier	01	4,600

ELECTRICAL TECHNOLOGY & ELECTRONICS LAB			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	D.C. Shunt Motor 3 Kw. 1500 RPM with 3 Point Starter.	02	20,000
2.	D.C. Compound Motor 3 Kw. 1500 RPM	02	20,000
3.	Single Phase Transformer 1 KVA 50 Hz. Primary Voltage 230 with tapping at 50%, 86.6 % Facility	02	12,000
4.	3 Phase Induction Motor 415 V., 50 Hz, 440 RPM, 3 KVA Star/Delta/Autotransformer Starter.	02	10,000
5.	Loading Drum Spring Balance & Belt Arrangement.	02 Set	
6.	Tachometer (Analog/Digital)	01	2,000
7.	3 Phase Inductive Loading of Variable Nature	01	8,000
8.	Single Phase Inductive Loading Variable 0-10 Amp., 50 Hz.	01	8,000
9.	Moving Coil Ammeter 0-10 Amp.	08	1,000
10.	Moving Coil Voltmeter 0-300 V.	08	8,000
11.	Moving Iron Ammeter 0-10 Amp.	08	8,000
12.	Moving Iron Voltmeter 0-300 V.	08	8,000
13.	Wattmeter Single Phase Dynamo Type 75/300/600 V. 2.5/5 Amp.	04	10,000
14.	Three Phase Variable Inductive Loading.	01	8,000
15.	Single Phase Variable Inductive Loading with Rheostat.	01	8,000
16.	Megger 0-20 Mega Ohm, 500 RPM		
17.	Fluorescent Tube With Choke.	01	100
18.	SCR Bread Board	01	1,000
19.	Power Supply 230 V.	01	1,000

20.	Moving Coil Ammeter 0-500 M.A.	01	1,000
21.	Moving Coil Voltmeter 0-250 V.	01	1,000
22.	Energy Meter Single Phase 230 V., 5 Amp	01	2,000
23.	Misc.	LS	1,500

PULP AND PAPER TECHNOLOGY LAB			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Electronics Balance	02	12,000
2.	Oven	02	40,000
3.	Quadrant Scale Apparatus	01	6,000
4.	Template for Quadrant Scale Apparatus	02	1,000
5.	Stop Watch	02	300
6.	Cobb Testing Apparatus	02	8,000
7.	Paper Thickness Tester Dead Weight Type (as per TAPPI standard)	01	20,000
8.	pH Meter	01	5,000
9.	Paper Cutter/Template	01	500
10.	Paper Tensile Tester as per TAPPI standard), Automatically operated	01	1,50,000
11.	Paper Strip Cutter for Tensile Testing	01	2,000
12.	Mullen Paper Bursting Strength Tester	02	1,60,000
13.	Paper folding Endurance Tester for Paper	01	50,000
14.	Elmendorf Tear Tester for Paper	01	30,000
15.	Template/Cutter for Tear Tester	01	500
16.	Paper Stiffness Tester	01	
17.	Infrared and Ultra-violet Lamp	01	10,000
18.	Gurley Paper Porosity Tester	02	30,000
19.	Bendtsen Smoothness Tester	01	3,00,000

20.	Oil Absorption Tester for Paper	01	85,000
21.	Photovoltaic Brightness Tester along with Opacity and Gloss	01	2,00,000
22.	Color Touch Method Instrument for Measuring Opacity, Fluorescence, CIE Brightness	01	
23.	Board/corrugated box crush tester	01	30,000
24.	Ink printability tester	01	
25.	Air knife coater	01	
26.	Paper sheet calendaring equipment	01	
27.	Temperature and humidity control system for paper testing laboratory as per TAPPI standard	01	20,000
28.	Fluff Tester	01	
29.	Quick moisture determination apparatus (electronic type)	01	9,999
30.	Forced Air Circulator Large Size with temperature controller	02	
31.	Electric Operated Muffle Furnace Large Size Temperature Range up to 1200^0C	02	15,000
32.	Laboratory Digester for Wood chips, Pulping along with ¾ Autoclave (Rotary Design)	01	3,00,000
33.	Constant Temperature Water Bath along with Agitator and Temperature Controller	01	
34.	Brook Field Viscometer DV-III Model	01	452700
35.	Plate Form Type Electronic Balance (5 Kg Capacity)	01	5,000
36.	Pulp Defibrator and Screener (Electric Operated)	01	
37.	Microscope with 400, 600, 800, 1000 Magnification Power with Photo Camera Attachments	01	3,00,000
38.	Fuming Chamber for Bleaching of Pulp with Chlorine Dioxide/ Chlorine	01	
39.	Deep Freezer for Storage of Cooked Pulp	01	15,000
40.	Water Distillation Plant	01	50,000
41.	Vacuum Pump for Pulp Filtration and Washing of Unbleached and Bleached Pulps	01	10,000

42.	Disintegrator for Pulp	01	20,000
43.	Valley Beater	01	1,00,000
44.	British Sheet Former	02	1,60,000
45.	Fiber Classifier	01	80,000
46.	Double Disc Refiner	01	1,00,000
47.	Degree Shopper Reigler Tester	02	1,00,000
48.	Canadian Standard Freeness tester	02	
49.	Hydrapulper	01	
50.	Drying Rings for BSF Paper Sheet Drying	100	
51.	Forced Air Drying Chamber for BSF Sheet Drying	01	

ENERGY CONSERVATION			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	Multimeter	01	17,000
2.	Power Analyzer	01	20,000
3.	Lux meter	01	5,000
4.	Black Box (for checking lamp efficacy including stand and lux meter)	01	25,000
5.	Centrifugal pump, 1 kW	01	15,000
6.	Variable Frequency drive	02	50,000
7.	Water Flow meter	01	10,000
8.	Pressure Gauge	01	2,000
9.	Experimental Set up for Valve Throttling vs VFD	01	50,000
10.	Compressor, 20 cfm, single-stage	01	50,000
11.	Air leakage meter	01	18,000
12.	Blower (2 HP)	01	8,000

LEARNING RESOURCE MATERIALS			
Sl.No.	**Name of Equipment**	**No.**	**Amount (₹)**
1.	LCD Projector with Screen	01	20000
2.	Handycam	01	30000
3.	Cutting, Binding & Stitching equipment	01	30000
4.	Desk Top Computer with Internet Core i5/i7- 760, Processor, Genuine Window 7, Professional 18 inch HD, Flat Panel Monitor Optical Mouse, Key Board & all related media or latest version	01	40000
5.	Home Theater Support Disc type CD. CDR/CDRW DVDR/DVDRW, VCD Supported with USB Port Support-DIVX/JPEG/MP3	01	25000
6.	Commercial P A System 16 W-220W output, AC & 24V DC Operated, 5 Mic. & 2 Auxiliary input, Speaker output 4 Ohm, 8 Ohm, 17 V & 100 V	01	20000
7.	Interactive Board	01	50000

NOTE:

1. This center will be only one at the institute level irrespective of all branches.

Note:

1. The specifications and price of equipment mentioned above used as broad guidelines for purchase of equipment.
2. Any other items not mentioned in the lit of equipment can be purchased as provision has been made for purchase under the item miscellaneous for each lab/shop.
3. Any additional equipment, already available in the institute, may be used for demonstration to the students.

NOTE:

In addition to the above, laboratories in respect of physics, chemistry, Computer Centre etc. will be required for effective implementation of the course. Provision for photocopiers, PC facilities along with LCD Projection System etc. has also to be made.

(A) Furniture Requirement

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

Human Resources Development:

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

EVALUATION STRATEGY

INTRODUCTION

Evaluation plays an important role in the teaching-learning process. The major objective of any teaching- learning endeavor isto ensure the quality of the product which can be assessed through learner's evaluation.

The purpose of student evaluation is to determine the extent to which the general andthe specific objectives of curriculum have been achieved. Student evaluation is also important from the point of view of ascertaining the quality of instructional processesand to get feedback for curriculum improvement. It helps the teachers in determining

the level of appropriateness of teaching experiences provided to learners to meet their individual and professional needs. Evaluation also helps in diagnosing learning difficulties of the students. Evaluation is of two types: Formative and Summative (Internal and External Evaluation)

Formative Evaluation

It is an on-going evaluation process. Its purpose is to provide continuous and comprehensive feedback to students and teachers concerning teaching-learning process. It provides corrective steps to be taken to account for curricular as well as co-curricular aspects.

Summative Evaluation

It is carried out at the end of a unit of instruction like topic, subject, semester or year. The main purpose of summative evaluation is to measure achievement for assigning course grades, certification of students and ascertaining accountability of instructional process. The student evaluation has to be done in a comprehensive and systematic manner since any mistake or lacuna is likely to affect the future of students.

In the present educational scenario in India, where summative evaluation plays an important role in educational process, there is a need to improve the standard of summative evaluation with a view to bring validity and reliability in the end-term examination system for achieving objectivity and efficiency in evaluation.

STUDENTS' EVALUATION AREAS

The student evaluation is carried out for the following areas:

- Theory
- Practical Work (Laboratory, Workshop, Field Exercises)
- Project Work
- Professional Industrial Training

A. Theory

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems. The formative evaluation for theory subjects may be caused through sessional /class-tests, home-assignments, tutorial-work, seminars, and group discussions etc. For end-term evaluation of theory, the question paper may comprise of three sections.

Section-I

It should contain objective type items e.g. multiple choice, matching and completion type. Total weightage to Section-1 should be of the order of 20 percent of the total marks and no choice should be given in this section. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.

Section-II

It should contain short answer/completion items. The weightage to this section should be of the order of 40 percent of the total marks. Again, no choice should be given in section-II

Section-III

It may contain two to three essay type questions. Total weightage to this section should be of the order of 40 percent of the total marks. Some built-in, internal choice of about 50 percent of the questions set, can be given in this section

Table II : Suggested Weightage to be given to different ability levels

Abilities	Weightage to be assigned
Knowledge	10-30 percent
Comprehension	40-60 percent
Application	20-30 percent
Higher than application i.e. Analysis, Synthesis and Evaluation	Upto 10 percent

B. Practical Work

Evaluation of students performance in practical work (Laboratory experiments, Workshop practicals /field exercises) aims at assessing students ability to apply or practice learnt concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work related attitudes. Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behavior and it should be followed by viva-voce.

C. Project Work

The purpose of evaluation of project work is to assess students ability to apply, in an integrated manner, learnt knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and

communication skills. The formative and summative evaluation may comprise of weightage to nature of project, quality of product, quality of report and quality of presentation followed by viva-voce.

D. Professional Industrial Training

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of materials, industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. The formative and summative evaluation may comprise of weightages to performance in testing, general behavior, quality of report and presentation during viva-voce.

RECOMMENDATIONS FOR EFFECTIVE CURRICULUM IMPLEMENTATION

This curriculum document is a Plan of Action and has been prepared based on exhaustive exercise of curriculum planning and design. The representative sample comprising selected senior personnel (lecturers and HODs) from various institutions and experts from industry/field have been involved in curriculum design process.

The document so prepared is now ready for its implementation. It is the faculty of polytechnics who have to play a vital role in planning instructional experiences for the courses in four different environments viz. class-room, laboratory, library and field and execute them in right perspective. It is emphasized that a proper mix of different teaching methods in all these places of instruction only can bring the changes in stipulated students behavior as in the curriculum document. It is important for the teachers to understand curriculum document holistically and further be aware of intricacies of teaching-learning process (T-L) for achieving curriculum objectives. Given below are certain suggestions which may help the teachers in planning and designing learning experiences effectively. These are indicative in nature and teachers using their creativity can further develop/refine them. The designers of the programme suggest every teacher to read them carefully, comprehend and start using them.

(A) Broad Suggestions:

1. Curriculum implementation takes place at programme, course and class-room level respectively and synchronization among them is required for its success.The first step towards achieving synchronization is to read curriculum document holistically and understand its rationale and philosophy.

2. An academic plan needs to be prepared and made available to all polytechnics

well in advance. The Principals have a great role to play in its dissemination and, percolation up to grass-root level. Polytechnics, in turn are supposed to prepare institutional academic plan.

3. HOD of every Programme Department along with HODs and in charges of other departments are required to prepare academic plan at department level referring to institutional academic plan.

4. All lecturers/Senior lecturers are required to prepare course level and class level lesson plans referring departmental academic plan.

(B) Course Level Suggestions

Teachers are educational managers at class room level and their success in achieving course level objectives lies in using course plan and their judicious execution which is very important for the success of programme by achieving its objectives.

Polytechnic teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/workshop practicals, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practicals and field experiences. Teachers are also required to do all these activities within a stipulated period of time. It is essential for them to use the given time judiciously by planning all above activities properly and ensure execution of the plan effectively.

Following is the gist of suggestions for subject teachers to carry out T-L process effectively:

1. Teachers are required to prepare a course plan, taking into account departmental academic plan, number of weeks available and courses to be taught.

2. Teachers are required to prepare lesson plan for every theory class. This plan may comprise of contents to be covered, learning material for execution of a lesson plan. They may follow steps for preparing lesson plan e.g. drawing attention, state instructional objectives, help in recalling pre-requisite knowledge, deliver planned subject content, check desired learning outcomes and reinforce learning etc.

3. Teachers are required to plan for expert lectures from field/industry. Necessary steps are to plan in advance, identify field experts, make correspondence to invite them, take necessary budgetary approval etc.

4. Teachers are required to plan for guided library exercises by identification of course specific experience requirement, setting time, assessment, etc. The assignments and seminars can be thought of as terminal outcome of library

experiences.

5. Concept and content based field visits may be planned and executed for such content of course which is abstract in nature and no other requisite resources are readily available in institute to impart them effectively.

6. There is a dire need for planning practical experiences in right perspective. These slots ina course are the avenues to use problem based learning/activity learning/ experiential learning approach effectively. The development of lab instruction sheets for the course isa good beginning to provide lab experiences effectively.

7. Planning of progressive assessment encompasses periodical assessment in a semester, preparation of proper quality question paper, assessment of answer sheets
Immediately and giving constructive feedback to every student

8. The student centered activities may be used to develop generic skills liketask management, problem solving, managing self, collaborating with others etc.

9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time.

10. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.

11. Students be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.

12. Students may be given relevant and well thought out project assignments, which are purposeful and develop practical skills. This will help students in developing creativity and confidence for their gainful employment.

13. A Project bank may be developed by the concerned department of the polytechnics in consultation with related Industry, research institutes and other relevant field organizations in the state.

LIST OF PARTICIPANTS

The following experts participated in workshop for Developing the Curricula Structure and Contents of PUPL AND PAPER TECHNOLOGY on 13th December 2022 at I.R.D.T. Kanpur

1. Professor P.K. Bajpai Ex. Distinguish Prof. & Dean T.I.E.T. Patiyala
2. Shri Rakesh Gangvar Head Chemical Engg. Govt. Polytechnic Kanpur
3. Shri Dugesh Chandra Head Chemical Engg. Govt. Polytechnic Firozabad
4. Smt. Namrta Pal Lecturer Chemical Engg. Govt. Polytechnic Kotwan Mathura
5. Faizan Ahamed Lecturer Chemical Engg. Govt. Polytechnic Jagdishpur Amethi
6. Shri Samprati Katyayan Lecturer Chemical Engg. Govt. Polytechnic Kanpur
7. Smt. Dr. Shashi Bala Gautam Lecturer Chemical Engg. Govt. Polytechnic Kanpur
8. Shri Dr. A.P. Singh Deputy Director I.R.D.T. Kanpur
9. Shri Ravindra Kumar Research Assistant I.R.D.T. Kanpur

The following experts participated in workshop for Developing the Curricula Structure and Contents of PUPL AND PAPER TECHNOLOGY on 02nd March 2023 at I.R.D.T. Kanpur

1. Professor P.K. Bajpai Ex. Distinguish Prof. & Dean T.I.E.T. Patiyala
2. Shri Rakesh Gangvar Head Chemical Engg. Govt. Polytechnic Kanpur
3. Shri Dugesh Chandra Head Chemical Engg. Govt. Polytechnic Firozabad
4. Shri Dr. Dharmans Lecturer Paint Technology Govt. Polytechnic Kotwan Mathura
5. Faizan Ahamed Lecturer Chemical Engg. Govt. Polytechnic Jagdishpur Amethi
6. Shri Samprati Katyayan Lecturer Chemical Engg. Govt. Polytechnic Kanpur
7. Smt. Dr. Shashi Bala Gautam Lecturer Chemical Engg. Govt. Polytechnic Kanpur
8. Shri Dr. A.P. Singh Deputy Director I.R.D.T. Kanpur
9. Shri Ravindra Kumar Research Assistant I.R.D.T. Kanpur