

Curriculum for
Diploma Programme in
CHEMICAL ENGINEERING
(PETROCHEMICAL)

For the State of Uttar Pradesh

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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. The initiatives being taken by the State Board of Technical Education, UP to revise the existing curricula of 6 diploma programmes as per the needs of the industry and making them NSQF compliant are laudable.

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.

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Coordinator
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1. SALIENT FEATURES OF DIPLOMA PROGRAMME IN CHEMICAL ENGINEERING

- 1) Name of the Programme : Diploma Programme in Chemical Engineering (Petrochemical)
- 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 : 45 : 55 (Approx.)

Practice

- 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 hrs 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 projects in the industry.

2. EMPLOYMENT OPPORTUNITIES

Employment opportunities for diploma holders in Petrochemical Engineering are visualized in following industries at various levels/positions:

i) Chemical and Allied Industries like

- Fertilizer industry
- Petroleum refinery and petrochemical industry
- Oil and natural gas corporation
- Cement plant
- Cosmetic industry
- Sugar industry
- Mineral industry
- Pulp and Paper industry
- Polymer industry
- Food industry
- Agro industry
- Pharmaceutical industry
- Distilleries
- Paint and dye industry
- Rubber industry
- Soap & detergent industry
- Textile industry etc.
- Pesticide industry
- General processing industries
- Glass industry
- Ceramics industry
- Automobile industry (paint shop and electroplating shop)\
- Test Equipment : Manufacturing and repairing

In various functional areas like erection and commissioning of plant, plant operation, energy conservation, plant utilities, production, water treatment, maintenance and safety, quality control, inspection and testing, marketing and sales, consultancy services and areas concerning environmental protection.

(ii) Research Organizations like CSIR laboratories, Defence laboratories, Atomic energy establishments etc.

(iii) Boards and Corporations.

- (iv) Entrepreneurs to small/tiny units especially food, agro and chemical industries such as paints, soap, detergents, equipment repairing etc.
- v) Academic Institutions (as technicians/instructors at all levels)
- vi) Startups and new inventions in the field of Petrochemical engineering.

3. **LEARNING OUTCOMES OF DIPLOMA PROGRAMME IN PETROCHEMICAL ENGINEERING**

Sr.	Learning Outcomes
After undergoing this programme, students will be able to:	
1	Prepare and interpret drawings of engineering components and plants
2	Read and interpret drawings related to plant layout, process equipment and components, process flow sheets and product manufacturing.
3	Apply concepts of mechanics to solve chemical engineering problems
4	Apply basic principles of mathematics, science and engineering to solve chemical engineering problems
5	Select various materials used in chemical processes, their properties and specifications
6	Understand various unit operations, unit processes and process instrumentation in process industry
7	Calculate the quantity of raw materials, energy inputs, manpower requirement and output from the process
8	Control the process and quality of the products commensurating with laid specifications
9	Recognise the need for and have the ability to engage in life long learning
10	Conduct experiments, analyse, interpret data and synthesise valid conclusions
11	Operate conventional machine for machining of components as per specifications as an aid to function effectively in the process industry.
12	Use electrical and electronic instruments to measure various engineering parameters
13	Use various measuring and gauging instruments
14	Select material as per desired application
15	Understand the general design of process equipments and testing

16	Operate different utility plants
17	Understand different renewable sources of energy and their applications.
18	Understand different plants utilities and their generation and maintenance
19	Use various software tools for automation and process development.
20	Interpret factory acts, laws and taxes
21	Develop communication and interpersonal skills for effective functioning in the world of work.
22	Communicate effectively in English and local language in oral and written form with others
23	Manage resources effectively at work place
24	Plan and execute given task/project as a team member or leader
25	Prepare detailed project proposal and report.
26	Use computer and IT tools for creating documents, making spread sheet and making presentation
27	Solve real life problems by application of acquired knowledge and skills
28	Use energy conservation methods to manage energy efficiency
29	Use appropriate practices for conservation and prevention of environment pollution and safety in process industries.
30	Learning about new systems that are used to create bio-energy which can greatly contribute to reducing greenhouse gases as they have the possibility of reducing the need to use fossil fuels.
31	Finding a new non-polluting energy source which is also renewable, by which the earth is being kept clean of harmful emissions.

**4. DERIVING CURRICULUM AREAS FROM LEARNING
OUTCOMES OF THE PROGRAMME**

The following curriculum area subjects have been derived from learning outcomes:

Sr. No.	Learning Outcomes	Curriculum Areas/Subjects
1.	Prepare and interpret drawings of engineering components and plants	-Engineering Drawing-I
2.	Read and interpret drawings related to plant layout, process equipment and components, process flow sheets and product Manufacturing.	- Chemical Technology - Petroleum Refining - Petrochemical Processing
3.	Apply concepts of mechanics to solve chemical engineering problems	- Applied Mechanics
4.	Apply basic principles of mathematics, science and engineering to solve chemical engineering problems	- Applied Mathematics - Applied Physics - Applied Chemistry - Basics of Mechanical and Civil Engineering - Chemical Engineering Thermodynamics
5.	Select various materials used in chemical processes, their properties and specifications	-Material Science
6.	Understand various unit operations, unit processes and process instrumentation in process industry	- Measuring Instruments and Measurements - Mechanical Operations and Solid Handling - Fluid Mechanics - Heat Transfer Operations - Mass Transfer Operations

7.	Calculate the quantity of raw materials, energy inputs, manpower requirement and output from the process	- Material and Energy Balance
8.	Control the process and quality of the products commensurating with laid Specifications.	- Process Control
9.	Recognise the need for and have the ability to engage in life long learning	- Student Centered Activities
10.	Conduct experiments, analyse, interpret data and synthesise valid conclusions	- Applied Chemistry - Chemical Reaction Engineering
11.	Operate conventional machine for machining of components as per specifications as an aid to function effectively in the process industry.	- General Workshop Practice
12.	Use electrical and electronic instruments to measure various engineering parameters	- Basics of Electrical and Electronics Engg.
13.	Use various measuring and gauging instruments	- Measuring Instruments & Measurements
14.	Select material as per desired application	- Material Science
15.	Understand the general design of process equipments and testing	- Process Control
16.	Operate different utility plants	- Process Plant Utilities - Process Control
17.	Understand different renewable sources of energy and their applications.	- Renewable Energy Sources
18.	Understand different plants utilities Understand plants generation and maintenance	- Process Plant Utilities
19.	Interpret factory acts, laws and taxes	- Industrial Management and Entrepreneurship Development

20.	Develop communication and interpersonal skills for effective functioning in the world of work.	- Communication Skills - Industrial Management and Entrepreneurship Development
21.	Communicate effectively in English and local language in oral and written form with others	- Communication Skills
22.	Manage resources effectively at work place	- Project Work
23.	Plan and execute given task/project as a team member or leader	- Project Work
24.	Prepare detailed project proposal and report.	- Project Work
25.	Use of computer and IT tools for creating documents, making spread sheet and making presentation	- Basics of Information Technology
26.	Solve real life problems by application of acquired knowledge and skills	- Project Work
27.	Use energy conservation methods to manage energy efficiency	- Energy Conservation
28.	Use appropriate practices for conservation and prevention of environment pollution and safety in process industries.	- Environmental Studies -Pollution Control and Industrial Safety
29.	Learning about new systems that are used to create bio-energy which can greatly contribute to reducing greenhouse gases as they have the possibility of reducing the need to use fossil fuels.	- Natural and Bio Gas Engineering
30.	Finding a new non-polluting energy source which is also renewable, by which the earth is being kept clean of harmful emissions.	- Natural and Bio Gas Engineering

5. ABSTRACT OF CURRICULUM AREAS

a) **General Studies** Communication

Skills Environmental Studies

Energy Conservation

Industrial Management and Entrepreneurship Development

b) **Applied Sciences**

Applied Mathematics

Applied Physics

Applied Chemistry

c) **Basic Courses in Engineering/Technology**

Engineering Drawing

General Workshop Practice

Basics of Mechanical and Civil Engineering

Basics of Information Technology

d) **Applied Courses in Engineering/Technology** Measuring

Instruments and Measurements

Applied Mechanics

Mechanical Operations and Solid Handling

Fluid Mechanics

Material Science

Basics of Electrical and Electronics Engineering

Chemical Technology

Chemical Engineering Thermodynamics

Process Plant Utilities

Heat Transfer Operations

Mass Transfer Operations

Pollution Control and Industrial Safety

Chemical Reaction Engineering

Process Control

Natural and Bio Gas Engineering

Process Equipment Design

Material and Energy Balance

Renewable Energy Sources

Petrochemical Processing

Industrial Training

Project Work

6. HORIZONTAL AND VERTICAL ORGANISATION OF THE SUBJECTS (FIRST YEAR)

Sr. No.	Subjects	Distribution in Periods per week in Various Semesters					
		I	II	III	IV	V	VI
1.	Communication Skills	6	-	-	6	-	-
2.	Applied Mathematics	5	5	5	-	-	-
3.	Applied Physics	7	7	-	-	-	-
4.	Applied Chemistry	7	-	-	-	-	-
5.	Engineering Drawing	8	-	-	-	-	-
6.	Measuring Instruments and Measurements	6	-	-	-	-	-
7.	General Workshop Practice	8	8	-	-	-	-
8.	Applied Mechanics	-	7	-	-	-	-
9.	Basics of Mechanical and Civil Engineering	-	7	-	-	-	-
10.	Mechanical Operations & Solid Handling	-	11	-	-	-	-
11.	Environmental Studies	-	-	5	-	-	-
12.	Fluid Mechanics	-	-	9	-	-	-
13.	Material and Energy Balance	-	-	6	-	-	-
14.	Basics of Electrical and Electronics Engg	-	-	-	9	-	-
15.	Basics of Information Technology	-	-	6	-	-	-
16.	Chemical Technology	-	-	8	-	-	-
17.	Chemical Engineering Thermodynamics	-	-	6	-	-	-
18.	Process Plant Utilities	-	-	-	-	6	-
19.	Material Science	-	-	-	-	4	-
20.	Natural and bio gas engineering	-	-	-	6	-	-
21.	Energy Conservation	-	-	-	-	-	5
22.	Industrial Management and Entrepreneurship Development	-	-	-	-	-	5
23.	Heat Transfer Operations	-	-	-	9	-	-
24.	Mass Transfer Operations	-	-	-	5	11	-
25.	Pollution Control and Industrial Safety	-	-	-	-	11	-
26.	Renewable energy sources	-	-	-	-	4	-
27.	Universal Human Values	-	-	-	-	3	-
29.	Chemical Reaction Engineering	-	-	-	9	-	-

APPROVED IN CDC COMMITTEE MEETING OF BTE,U.P,LKO DATED:26-09-2021

30.	Process Control	-	-	-	-	-	10
31.	Process Equipment Design	-	-	-	-	-	5
32.	Petroleum refining	-	-	-	-	6	-
33.	Petrochemical processing	-	-	-	-	-	12
34.	Project Work	-	-	-	-	-	8
35.	Student Centred Activities	1	3	3	2	3	3
	Total	48	48	48	48	48	48

**7. STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN
PETROCHEMICAL ENGINEERING**

FIRST SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME			Credits	MARKS IN EVALUATION SCHEME									Total Marks of
		Periods/Week				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	Internal & External	
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	2	-	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	2	-	40	40	-	-	60	4	60	100	
#Student Centred Activities		-	-	1	1	-	30	30	-	-	-	-	-	30	
Total		23	-	25	27	100	150	250	310	-	140	-	450	700	

* Common with other diploma programmes

Student Centred 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	**Basics of Mechanical & Civil Engg.	5	-	2	5	20	10	30	50	2 ½	20	3	70	100		
2.5	Mechanical Operations & Solid Handling	5	-	6	6	20	10	30	50	2 ½	20	3	70	100		
2.6	General Workshop Practice II	-	-	8	2	-	40	40	-	-	60	4	60	100		
#Student Centred Activities		-		3	2	-	30	30	-	-	-	-	-	30		
Total		25	-	23	29	100	110	210	250	-	140	-	390	600		

* Common with other diploma programmes

** Common with diploma in Electrical Engg.

+ Common with diploma in Mechanical Engineering and Civil Engg.

Student Centred 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.

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	5	20	30	50	50	2 ½	50	3	100	150	
3.4	Material and Energy Balance	6	-	-	5	20	-	20	50	2 ½	-	-	50	70	
3.5	Chemical Engineering Thermodynamics	6	-	-	5	20	-	20	50	2½	-	-	50	70	
3.6	Chemical Technology	4	-	4	5	20	10	30	50	2 ½	20	3	70	100	
3.7	Basics of Information Technology	-	-	6	2	-	40	40	-	-	60	3	60	100	
#Student Centred Activities		-	-	3	2	-	30	30	-	-	-	-	-	30	
Total		29	-	19	31	120	120	240	300	-	150	-	450	690	

* Common with other diploma Programmes

Student Centred 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			Credits	MARKS IN EVALUATION SCHEME									Total Marks of Internal & External
		SCHEME				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
		Periods/Week													
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
4.1	*Communication Skills-II	4	-	2	4	20	10	30	50	2½	20	3	70	100	
4.2	Heat Transfer Operations	5	-	4	5	20	30	50	50	2½	50	3	100	150	
4.3	Chemical Reaction Engineering	5	-	4	5	20	30	50	50	2½	50	3	100	150	
4.4	Natural And Bio Gas Engineering	6	-	-	5	30	-	30	70	2½	-	-	70	100	
4.5	Mass Transfer Operations I	5	-	-	4	20	-	20	50	2½	-	-	50	70	
4.6	**Basic of Electrical and Electronics Engineering	5	-	4	6	20	30	50	50	2½	50	3	100	150	
#Student Centred Activities		-	-	2	2	-	30	30	-	-	-	-	-	30	
Total		30	-	16	31	130	130	260	320	-	170	-	490	750	

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

* Common with other diploma Programmes

** Common with diploma in Computer Science and Engineering

Student Centred 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			Cred its	MARKS IN EVALUATION SCHEME									Total Marks of Internal & External
		Periods/ Week				INTERNAL ASSESSMENT			EXTERN AL ASSESSMENT						
		L	T	P		Th -	Pr -	Tot -	Th -	Hrs -	Pr 50	Hrs -	Tot 50		
-	Industrial Training	-	-	-	2	-	-	-	-	-	50	3	50	50	
5.1	Mass Transfer Operations-II	5	-	6	6	20	30	50	50	2½	50	3	100	150	
5.2	Pollution Control and Industrial Safety	5	-	6	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	Material Science	4	-	-	3	20	-	20	50	2½	-	-	50	70	
5.5	Renewable Energy Sources	4	-	-	3	20	-	20	50	2½	-	-	50	70	
5.6	Petroleum Refining	6	-	-	4	30	-	30	70	2½	-	-	70	100	
5.7	Universal Human Values	2	-	1	1	-	20	20	-	-	30	3	30	50	
#Student Centred Activities		-	-	3	1	-	30	30	-	-	-	-	-	30	
Total		32	-	16	31	130	110	240	320	-	180	-	500	740	

Student Centred 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 Equipment Design	5	-	-	4	20	-	20	50	2½	-	-	50	70
6.2	Process Control	6	-	4	5	20	30	50	50	2½	50	3	100	150
6.3	Energy Conservation	3	-	2	4	20	10	30	50	2½	20	3	70	100
6.4	Petrochemical Processing	6	-	6	7	20	30	50	50	2½	50	3	100	150
6.5	Industrial Management and Entrepreneurship Development	5	-	-	4	20	-	20	50	2½	-	-	50	70
6.6	Project Work	-	-	8	5	-	50	50	-	-	100	3	100	150
#Student Centred Activities		-	-	3	2	-	30	30	-	-	-	-	-	30
Total		25	-	23	31	100	150	250	250	-	220	-	470	720

* Common with other diploma Programmes

Student Centred 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.

8. 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.

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 on picture 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 and non-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 Voice	
	2.5 Punctuation	
	2.6 Direct and Indirect Speech	

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

- 4.1 Picture composition
- 4.2 Writing paragraph
- 4.3 Notice writing

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.

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.

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

- 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 RevathiSrinivas; Abhishek Publications, Chandigarh.
2. Communication Techniques and Skills by R. K. Chadha; DhanpatRai 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. Prasad, 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](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 Cramer'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 Demoivre 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, Logarithmic 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.

INSTRUCTIONAL 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.
4. Applied Mathematics-I (A) by Kailash Sinha and Varun Kumar; Aarti Publication, 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

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.)
- ☐ Analyse 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 (Statement only), 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, its applications 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 its Engineering Applications.
- 3.3 Work done in moving an object on horizontal and inclined plane for rough and plane surfaces with its applications
- 3.4 Energy and its units: Kinetic energy and potential energy with examples and their derivation, 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 trains etc.

- 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 Binding energy of a satellite, Escape energy and escape velocity
 - 5.5 Types of satellites, Geo-stationary satellite, semi-synchronous, polar satellite (concept only) 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, Stoke's 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 cubical expansions and relation amongst them
 - 7.5 Heat conduction in a metal rod, Temperature gradient, Concept of Co-efficient of thermal conductivity, 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,

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- Mid-Term and End-Term written test, –
Model Making,
- Actual Lab & Practical Work, –
VivaVoice

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 Bhattacharya & Poonam Tandan; Oxford University Press,
- 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	Marks Allotted
	(Periods)	(%)
1	10	15
2	10	15
3	10	15
4	10	15
5	8	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 with names 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.

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- 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 Octane and 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 Physico-Chemical methods for Water Quality Testing
 - a) Determination of pH using pH meter, total dissolved solids (TDS)

- 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).
 - 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 (4 periods)

Redox Reaction, Electrode Potential, Nernst equation, Electrochemical cell (Galvanic and Electrolytic); Nernst equation.
- 5. Corrosion and its Control (10 periods)
 - 5.1 Definition of corrosion and factors affecting corrosion rate.
 - 5.2 Theories of
 - a) Dry (chemical) corrosion- Pilling Bedworth rule
 - b) Wet corrosion in acidic atmosphere by hydrogen evolution mechanism
 - 5.3 Definition of passivity and galvanic series
 - 5.4 Corrosion control:
 - a) Metal coatings – Cathodic protection, Cementation on Base Metal Steel –Application of Metal Zn (Sheradizing),Cr (Chromozing) and Al (Calorizing), Sacrificial protection and impressed current voltage
 - b) Inorganic coatings – Anodizing and phosphating,
 - c) Organic coatings - use of paints varnishes and enamels
 - 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, thermo plastics and thermo setting plastics with suitable examples, distinctions between thermo and thermo setting 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
Estimation of total alkalinity of given water sample by titrating it against standard sulphuric acid solution
- 3. Proximate analysis of solid fuel)
- 4. Estimation of temporary hardness of water sample by O' Hener's Method.

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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,
- VivaVoice

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.	4	6
5.	10	15
6.	10	15
Total	70	100

1.5 ENGINEERING DRAWING - I

L T P

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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 atleast 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 (1st and 3rd 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 1st angle only
 - 4.5 Three views of orthographic projection of different objects. (At least one sheet in 3rd 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 AutoCAD (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 of 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, Bourden 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 Thermister
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 Bourden tube.
8. Sketch of diaphragm and air trap system.

INSTRUCTIONAL 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	20
4	12	22
5	08	14
Total	56	100

1.7 GENERAL WORKSHOP PRACTICE – I

(Common for Civil Engineering, Electrical Engineering and Chemical Engineering)

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 Chiselling practice using different types of chisels including sharpening of 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 I | Marking, sawing, planning and chiselling 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 ie. 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-caping.
- 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).
 - Job II Practice of depositing beads on plate at different current levels. (Minimum 4 beads on M.S. plate at four setting of current level).
 - Job III Preparation of lap joint using arc welding process.

Job IV Preparation of T-joint using gas welding or arc welding on
100 mm x 6 mm MS Flat

5. PLUMBING SHOP

- 5.1. Use of personal protective equipments, safety precautions while working and cleaning of shop.
- 5.2. Introduction and demonstration of tools, equipment and machines used in plumbing shop.
- 5.3. Introduction of various pipes and pipe fittings of elbow, nipple, socket, union etc.
- 5.4. Job Practice
 - Job I : 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 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 among students.

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, centre of mean of plane areas.
- 2.3 Simposns 1/3rd and Simposns 3/8th 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)

INSTRUCTIONAL 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.
4. Applied Mathematics-I (B) by Kailash Sinha and Varun Kumar; Aarti Publication, 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

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 Ultrasonics.
- ☐ 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 fibre 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, Accoustics of building defects and remedy.
 - 1.6 Ultrasonics –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's 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 polaroids.
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 (numericals), 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 tapped),
 - 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 Fibre 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 fibre 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's 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 STRATEGY

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-Voice

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, centre 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/centre 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 BASICS OF MECHANICAL AND CIVIL ENGINEERING

L T P
5 - 2

RATIONALE

Apart from the common core subjects, some engineering subjects are included in the diploma course of electrical engineering. One of these subjects is Elementary Mech. Engg. to impart some necessary knowledge and skill about mechanical nature. Inclusion of the subject is further justified by the fact that in practical field, any job of electrical and civil technician is intermingled with either civil or mechanical engineering. As such the relevant basic topics of these disciplines are included in the content of the subject.

Some study exercises along with some field work have been suggested to give feel of jobs and equipments involved.

LEARNING OUTCOMES

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

- ☐ Apply Thermodynamics Laws.
- ☐ Use of various energy sources.
- ☐ Solve basic problems related to fuel and combustion.
- ☐ Have an idea of loading on machine components.
- ☐ Explain the application of different types of bearings.
- ☐ Explain the uses of different types of gears and springs.
- ☐ Explain the working principle of different lubrication systems.

SECTION A - MECHANICAL ENGINEERING

DETAILED CONTENTS

1. Thermal Engineering (14 periods)

1.1 Sources of Energy

Definition, Concept of thermodynamic system and surroundings, Closed system, Open system, Isolated system, Thermodynamics definition of work. Zeroth law of thermodynamics Basic ideas, conventional and nonconventional forms- Thermal, wind, Solar, Biomass and Nuclear and their uses. Hydel, Tidal,

1.2 Fuels & Combustion:

Combustion of fuels- their higher and lower calorific values. Combustion equations for carbon, sulphur, hydrogen and their simple compounds. Calculation of minimum amount of air required for complete combustion. Combustion analysis on mass basis and on volume basis. Concept of excess air in a

boiler furnace combustion. Heat carried away by flue gases. Analysis of flue gases by Orsat apparatus. Simple numerical problems
Idea of specific properties of liquid fuels such as detonation, knock resistance (cetane and octane numbers), viscosity, solidification point, flash point and flame point.

2. Machine Components

(20 periods)

Brief idea of loading on machine components.

- (i) Pins, Cottor and Knuckle Joints.
- (ii) Keys, Key ways and spline on the shaft.
- (iii) Shafts, Collars, Cranks, Eccentrics.
- (iv) Couplings and Clutches.
- (v) Bearings-Plane, Bushed, Split-step, ball, Roller bearing, Journal bearing, Foot step bearing, thrust bearing, collar bearing and Special type bearings and their applications.
- (vi) Gears
Different types of gears, gear trains and their use for transmission of motion.
Determination of velocity ratio for spur gear trains; spur gear, single and double helical gears, Bevel gears, Mitre wheel, worms, Rack and Pinion. Simple and compound and epicyclic gear trains and their use. Definition of pitch and pitch circle & module.
- (vii) Springs
Compression, Tension, Helical springs, Torsion springs, Leaf and Laminated springs.
Their use and material.

(08 periods)

3. Lubrication

Different lubrication system for lubricating the components of machines.

Principle of working of wet sump and dry sump system of lubrication. (Explain with simple line diagram). Selection of lubricant based on different application (Requirement with the help of manufacturer catalogue).

SECTION B : CIVIL ENGINEERING

4. Construction Materials

(06 periods)

Properties and uses of various construction materials such as stones, bricks, lime, content and timber with their properties, physical/field testing, elements of brick masonry.

5. Foundations (08 periods)

- 5.1 Bearing capacity of soil and its importance
- 5.2 Types of various foundations and their salient features, suitability of various foundations for heavy, light and vibrating machines.

6. Concrete (08 periods)

Various ingredients of concrete, different grades of concrete, water cement ratio, workability, physical/field testing of concrete, mixing of concrete, placing and curing of concrete..

7. RCC (06 periods)

Basics of reinforced cement concrete and its use (elementary knowledge), introduction to various structural elements of a building.

Note: While imparting instructions, teachers are expected to lay more emphasis on concepts and principles. It will be better if the classes for general engineering are conducted by organized demonstrations for explaining various concepts and principles.

LIST OF PRACTICALS

1. Study and Sketch of Pins and Cottor
2. Study and Sketch of Keys and Key ways
3. Study and sketch of Couplings and Clutches
4. Study and Sketch of Bearings
5. Study and Sketch of Springs
6. Study of green energy
- 7 Testing of bricks
 - a) Shape and size
 - b) Soundness test
 - c) Water absorption
 - d) Crushing strength
- 8 Testing of concrete
 - a) Slump test
 - b) Compressive Strength of concrete cube
- 9 The students should be taken to different construction sites to show them various construction materials, concreting process and construction of RCC structural elements, foundations and other civil works.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on basic principles and use charts in class, visits to labs and industry may be arranged to demonstrate certain materials and practices.

MEANS OF ASSESSMENT

- Sessional Tests
- End term Tests
- Practicals
- Viva-Voce

RECOMMENDED BOOKS

1. Textbook of Concrete Technology 2nd Edition, by Kulkarni, PD Ghosh TK and Phull, YR; New Age International(P) Ltd, Publishers, New Delhi
2. Materials of Construction by Ghosh; Tata McGraw Hill Publishing Co. Ltd., New Delhi
3. Civil Engineering Materials by TTTI, Chandigarh; Tata McGraw Hill Publishing Co. Ltd., New Delhi
4. Concrete Technology by J.Jha and Sinha; Khanna Publishers, Delhi
5. Building Construction by Jha and Sinha; Khanna Publishers, Delhi
6. Building Construction by Vairani and Chandola; Khanna Publishers, Delhi
7. Civil Engineering Materials by SV Deodhar and Singhai; Khanna Publishers, New Delhi
8. Soil Mechanics and Foundation Engineering by SK Garg; Khanna Publishers, New

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	14	20
2.	20	28
3.	08	12
4	06	08
5	08	12
6	08	12
7	06	08
Total	70	100

2.5 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.
- ☐ 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, Crushing 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.

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- 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. (08 periods)
- 6 Mixing of Solids (08 periods)
 - 6.1 Types of mixers, Ribbon blenders, Doubleconemixer, 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 solid particles
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

1. Assignments
2. Class Tests
3. Practical Work
4. End Semester Exam
5. 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

2.6 GENERAL WORKSHOP PRACTICE –II

(Common for Civil Engineering, Electrical Engineering and Chemical Engineering)

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, Aluminium 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 ± 0.25 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, galvanised corrugated sheet, aluminium 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 rivetted Butt Joint.

3 MASON SHOP

- 3.1. Introduction and importance of Mason shop
- 3.2. Introduction of tools, equipment and machines used in Mason shop
- 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 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 planing/shaping machine and to plane a rectangle of cast iron.

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.

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.
2. Air Pollution (04 Periods)
 - 2.1 Source of air pollution. Effect of air pollution on human health, economy, plant, animals. Air pollution control methods.
3. Water Pollution (08 Periods)
 - 3.1 Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of dissolved O₂, BOD, COD. Prevention

of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

4. Soil Pollution (06 Periods)

- 4.1 Sources of soil pollution
- 4.2 Types of Solid waste- House hold, Hospital, From Agriculture, Biomedical, Animal and human, excreta, sediments and E-waste
- 4.3 Effect of Solid waste
- 4.4 Disposal of Solid Waste- Solid Waste Management

5. Noise pollution (06 Periods)

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

6. 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).

7. 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 pH of drinking water
- 2. Determination of TDS in 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 Deep Publications, 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 ErachBharucha; University Press (India) Private Ltd., Hyderabad.
7. Environmental Engineering and Management by Suresh K Dhamija; S K Katariaand Sons, New Delhi.
6. 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 hermitian, 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 matrix.

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 eigen values and eigen 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, conicoids
 - 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 $X=e^{ax}$, $\sin ax$, $\cos ax$, 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.

INSTRUCTIONAL 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. Applied Mathematics-II by Kailash Sinha and Varun Kumar; Aarti Publication, Meerut.
5. 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), Vapour 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 irrotational 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 equation.
- 2.8 Friction in pipe, Fanning's friction factor. Friction losses due to sudden expansion/reduction of pipe and in pipe fittings. Definition equivalent of length of pipe fittings.
- 2.9 Measurement of fluid flow with the help of flow meters- Venturimeter: 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 C_d , C_c and C_v
- 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 valve, 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

APPROVED IN CDC COMMITTEE MEETING OF BTE,U.P,LKO DATED:26-09-2021

1. Determination of coefficient of discharge of venturimeter 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 pressure head, 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 losses 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
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3.4 MATERIAL AND ENERGY BALANCE

LTP
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 limiting reactants.
- 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

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

(12 Periods)

Unit conversion of units, conversions of equations, S.I. system, M.K.S. system, C.G.S. system.

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)

Analysis of products of combustion: proximate and ultimate

7.1 analysis.

7.2 Problems of fuel analysis, air fuel ratio, 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 CHEMICAL ENGINEERING THERMODYNAMICS

L T P

6 - -

RATIONALE

It is a core subject of Chemical Engineering and is essential for understanding basic concepts, thermodynamic properties of fluid and performance of thermal systems used in industry.

LEARNING OUTCOMES

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

- Know about basic concepts of thermodynamics.
- Understands laws of thermodynamics.
- Understand the application of laws of thermodynamics
- Know about the phase equilibrium

DETAILED CONTENTS

1. Introduction and Basic Concepts (14 Periods)
Systems, processes and surroundings, homogenous and heterogeneous systems, closed, open and isolated, 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 (14 Periods)
Statement of first law of thermodynamics, use of steam tables, calculation of internal energy, enthalpy, heat and work for ideal gas undergoing reversible, isothermal, Isobaric, adiabatic and polytropic process. T-V, P-V and P-T diagrams.
3. Second Law of Thermodynamics (20 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).
Reversible and irreversible process. Thermodynamic temperature scale.
Thermal thermodynamic equation, Maxwell relation
4. Third Law of Thermodynamics (Statement only) (02 Periods)
5. Entropy (10 Periods)
Inequality of Classius, entropy-a property of a system entropy change in reversible process, entropy change for an open system, principle of increase of entropy, efficiency, irreversibility.

6. Applications of Second law of Thermodynamics (12 Periods)

Refrigeration, vapor compression and absorption refrigeration cycle, air refrigeration cycle, types of compressors, reciprocating air compressor, single stage compressor, and isentropic efficiency of compressor, coefficient of performance(COP), liquefaction process, latest refrigerants-their qualities and applications

7. Chemical Reaction Equilibrium and Vapor Liquid Equilibrium (12 Periods)

Concept of chemical potential, Gibb's Duhem Equation, Raoul's law, Gibb's phase rule, vapor liquid equilibrium, dew point and bubble point, calculations for two component systems, fugacity, fugacity coefficient, activity and activity coefficient.

INSTRUCTIONAL STRATEGY

Lot of emphasis on use of model as well as audio-video presentation should be given. Lot of stress should be given to numerical aspect to give in-depth knowledge of the subject. This will make the subject interesting and improve students' involvement in the subject.

MEANS OF ASSESSMENT

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

LIST OF RECOMMENDED BOOKS

1. Introduction to Chemical Engineering Thermodynamics by Smith and Vanness; McGraw Hill.
2. Chemical Engineering Thermodynamics by K.V. Narayanan; Prentice Hall India.
3. Chemical Engineering Thermodynamics by Dodge; McGraw Hill.
4. Chemical Engineering Thermodynamics by YVC Rao
5. Engineering Thermodynamics by PK Nag
6. Thermal Engineering by Ballaney
7. Chemical Engineering Thermodynamics by K.A. Gavhane, Nirali Publication.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	14	18
2.	14	18
3.	20	24
4.	02	2
5.	10	12
6.	12	14
7.	12	12
Total	84	100

3.6 CHEMICAL TECHNOLOGY

LTP

4 - 4

RATIONALE

A comprehensive knowledge of various chemical industries involving process technology, availability of raw materials, production trend, preparation of flow sheet, engineering problems involving material of construction and uses, is required for diploma holders in Chemical Engineering. Hence this subject.

LEARNING OUTCOMES

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

- State basic principles of chemical process industry.
- Understand various processes used for manufacturing different compounds.
- Draw different types of flow sheet used in process industry.
- Describe engineering problems of various chemical industries.
- Understand use of various equipment/instruments used in process industry.

TOPIC WISE DISTRIBUTION OF PERIODS

Sl.No.	Units	Coverage Time
L		
T		
P		
1.	Industrial Gases	
2.	Fertilizer Industries	
3.	Chlor-Alkali Industries	
4.	Sulphur Industries	
5.	Cement Industries	
6.	Insecticides, Pesticides and	Hertricides
7.	Process Industries	
A.	Petroleum Refining	
B.	Suger Industries	
C.	Fermentation Industries	
D.	Soap & Detergent Industries	
E.	Pulp & Paper	
F.	Polymer Industry	

DETAILED CONTENTS

1. INDUSTRIAL GASES : (08 periods)
Manufacture and uses of Oxygen, Hydrogen, Nitrogen, Carbon Dioxide.
2. FERTILIZER INDUSTRIES : (08 periods)

Ammonia, Nitric acid, Ammonium Sulphate, Urea, Ammonium Nitrat
Phosphorus, Phosphoric Acid, Calcium Phosphates- Super Phosphates,
Triple Super Phosphate, Nitro Phosphate, N-P-K fertilizer.
3. CHLOR-ALKALI INDUSTRIES : (08 periods)
Common Salt, Caustic Soda, Chlorine, Hydrochloric
Acid, Soda-Ash, Bleaching Powder.
4. SULPHUR INDUSTRIES : (04 periods)
Manufacture of Sulphuric acid, Oleum.
5. CEMENT INDUSTRIES : (04 periods)

Manufacture of Portland Cement.
6. INSECTISIDES, PESTICIDES & HERBICIDES : (04 periods)

Definition, types of insecticides, pesticides and herbicides,
Uses and Quantity and variety, benefits.
7. PROCESS INDUSTRIES (20 periods)
 - A. Petroleum Refining :

Constituent of petroleum including petroleum gases, products of refining,
distillation- atmospheric distillation unit and vacuum distillation unit.
Sugar Industry : Manufacture of cane sugar.
 - B. FERMENTATION INDUSTRY :

Introduction, Types of fermentation processes, Production of ethyl alcohol
by fermentation, Industrial alcohol, manufacture of industrial alcohol-
Beers, Wines & Liquors.
 - C. SOAP & DETERGENTS INDUSTRY :
Manufacturing of soap, glycerine as by products from soap
manufacturing Detergents, Detergents raw material and manufacturing of
detergents. House disinfectant (Phenyl).
 - D. PULP AND PAPER INDUSTRY:
Sulfite & ground wood pulp for paper manufacture of paper, specially
paper.

E. POLYMER INDUSTRY :

8. Types of polymer, Polymerization Process, Manufacture of Polyethylene, Styrene Nylon 6, Nylon 66

REFERENCE BOOKS

1. Outline of Chemicals Technology by M. Gopala Rao.
2. Chemical Process Industry by Shreve and Austin
3. Chemical Technology Vol I & II by G. N. Pandey
4. Industrial chemicals by Faith, Keyes and Clark
Industrial Chemistry by Dr. B. K. Sharma

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	06	10
2.	06	10
3.	10	18
4.	10	18
5.	08	15
6.	08	15
7.	08	14
Total	56	100

3.7 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/Libreoffice, Working with window, Desktop components, Menu bars, creating shortcut of program. Installation of Application softwares, 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 Addrsses, 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)
 - 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
 - b) Page set up
Setting margins, tab setting, ruler, indenting
 - c) Editing a document
Entering text, cut, copy, paste using tool- bars
 - 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, autotext Inserting date, time, special symbols, importing graphic images, drawing tools

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

f) Using Tools like

Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printing envelopes and labels

Using shapes and drawing toolbar,

Working with more than one window .

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

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

b) Menu commands:

Create, format charts, organise, manage data, solving problem by analyzing data. Programming with Excel Work Sheet, getting information while working

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

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

e) Retrieve data with query:

Create a pivot table, customizing a pivot table. Statistical analysis of data

f) Exchange data with other application:

Embedding objects, linking to other applications, import, export document.

11. PowerPoint Presentation (MS Office/Open Office/Libre office)

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.

b) Addition, deletion and saving of slides

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

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 Age International 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 Hall of 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

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

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/NITT TR, Chandigarh.

Websites for Reference:

1. [http://www.mindtools.com/ page 8.html](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 heat transfer coefficients for natural and forced convection
- Analyze heat exchanger performance using LMTD and use it for parallel or counter flow
- Recognize various type of heat exchanger working principle, and basic geometries of heat exchanger.
- 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 (2Periods)
Conduction, Convection, Radiation, concept of steady state and unsteady state heat transfer
2. Conduction (12Periods)
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 (12Periods)
 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's 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 (10Periods)
 Reflection, absorption and transmission of thermal radiation, Emmissive 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 (16Periods)
 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 (10Periods)
 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 filmwise condensation.
8. To study Stefan Boltzman 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, NiraliPublications.
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

RATIONALE

This subject outlines 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 reactors and its design also gives knowledge about the importance of catalyst in various chemical processes in the industries.

LEARNING OUTCOMES

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

- Know about rate of chemical reaction.
- Understand various types of reactors.
- Know the fundamentals of reactor design.
- Know the fundamentals of heterogeneous reacting system
- Understand the concept of catalysis

DETAILED CONTENTS

1. Introduction to Chemical Kinetics (12 Periods)
 - 1.1 Concept of rate of reaction, rate equation, rate constant, order of reaction, Molecularity of reaction, Chain reaction, Non chain reaction.
 - 1.2 Type of intermediate form in non-chain reaction.
 - 1.3 Single reaction multiple reaction, non-elementary reaction.
 - 1.4 Theories of reaction rates constant- Arrhenius law and problems based on it, from Thermodynamic, from Collision theory, from Transition state theory.
 - 1.5 Activation Energy.
2. Interpretation of batch reactor data. (20 Periods)
 - 2.1 Concept of batch reactor, semi Batch reactor, constant and variable volume reactions. Type of intermediate form in non-chain reaction.
 - 2.2 Integral and Differential method of analysis of batch reactor data.
 - 2.3 Integral method of analysis of irreversible unimolecular first order reaction, bimolecular second order reaction, n^{th} order, zero order and auto catalytic reaction. Problem based on zero order, first order and second order reactions.
 - 2.4 Half-life concept for the overall order of irreversible reactions and problem based on that.

3. Introduction to Reactor Design

(20 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.
- 3.3. Performance equation for ideal batch reactor, mixed flow reactor and plug flow reactor for constant volume and variable volume irreversible first order reaction. Problems based on the above topic.
- 3.4. Size comparison of the reactor-Batch reactors vs PFR (For first order reactions), PFR vs MFR (For first order irreversible reactions) and problems based on the above topics.

4. Introduction to Heterogeneous Reacting System

(06 Periods)

- 4.1. Rate Equation for Heterogeneous Reaction
- 4.2. Contacting pattern for two phase system
- 4.3. Factor affecting heterogeneous reaction

5. Catalysis

(12 Periods)

- 5.1. Definition, types and classification of catalyst
- 5.2. Preparation of catalyst, ingredients (Promoter, inhibitor, accelerator)
- 5.3. Catalyst Poisoning, regenerator.
- 5.4. Theories of catalysis-Adsorption, Intermediate compound formation theory.
- 5.5. Desired properties of catalyst.

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. Thermodynamics for Chemists by Samuel Glasstone; Krieger Publication Company.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	12	20
2.	20	26
3.	20	26
4.	06	08
5.	12	20
Total	70	100

4.4 NATURAL AND BIOGAS ENGINEERING

L T P
6 - -

RATIONALE

The field of Natural and Biogas Engineering is very much important for Petrochemical Students this subject outline the basic and essential concepts of Natural and Biogas Industries. The subject gives ideas about Natural Gas Production Processing and Transportation. This course will also provide the knowledge to students to understand the basic concepts and principles of biogas including its applications and utilization in various fields.

LEARNING OUTCOMES

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

- Learning New Systems that are used to create bio-energy which can greatly contribute to reducing green house effect.
- Finding a new non-polluting energy resource which is also renewable.
- Finding different alternative application and uses of natural and bio-fuels.

DETAILED CONTENTS

1. **INTRODUCTION AND BASIC CONCEPTS**
Introduction to Natural Gas, properties of Natural Gas, Gas Production, Phase Behavior.
Introduction to Biogas, Characteristics of Biogas and necessary condition for its formation. Benefits of Biogas, Biogas potential.

NATURAL GAS

2. **PROPERTIES OF NATURAL GAS**
Formation volume factor, Gas Reservoir, Deliverability, Skin Factor, Productivity Index.
3. **NATURAL GAS PRODUCTION**
Gas Production, Upstream, Downstream, Surface Facilities, Principle of Separator, Design of Separator : Vertical, Horizontal, Two Phase Separation and Three Phase Separation.
4. **DEHYDRATION OF NATURAL GAS**
Basic Concept of dehydration, Design of dehydration, Sweetening Process, Compressor Design and Energy Calculation, Transportation and Measurement.

BIO GAS

5. **BIOGAS AND BIOGAS SYSTEM**
Production of Biogas : Composition, application, Anaerobic Digestion, Applications, Power Generation, Grid Injection, Aerobic Digestion, Comparison of Anaerobic and Aerobic Digestion, Components of Biogas.
6. **APPLICATION AND UTILIZATION OF BIOGAS**
Biogas as Transportation fuel, Biogas Vehicles, Biogas Problems and Safety Measures, Benefits of Biogas, Utilization in Social Research, Future Research and Development of Biogas field.

RECOMMENDED BOOKS

1. Natural Gas Engineering Handbook by Ali Ghalambor and Boyun Guo
2. Natural Gas Production Engineering by Mohan Kelkar
3. The Biogas Handbook By Wellinger Jerry Murphy David Baxter
4. Biogas from Waste and Renewable Resources: An Introduction Hardcover – Illustrated By Dieter Deublein, Angelika Steinhauser

REFERENCE WEBSITES

1. <https://bue.libguides.com>
2. <https://www.oilandgaseng.com>
3. <https://biogaseng.com>
4. <https://biogasengineering.it/en/>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	14	20
2.	14	10
3.	14	20
4.	14	20
5.	14	20
6.	14	10
Total	84	100

4.5 MASS TRANSFER OPERATIONS- I

L T P

5 - -

RATIONALE

In this subject the basic concepts of mass transfer are covered to enable the students to understand working of various mass transfer equipment like distillation column, gas absorption columns, dryers, cooling towers and extraction columns etc. which are used in industries for purification of products

LEARNING OUTCOMES

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

- Understand the fundamentals of mass transfer operations
- Estimate the diffusivity for molecular diffusion in gases and liquids.
- Find out local and overall mass transfer coefficient for interphase mass transfer.
- Understand various mass transfer processes like diffusion, adsorption, stripping, humidification and drying.

DETAILED CONTENTS

1. Introduction to Mass Transfer Operations and Classification (02periods)
2. Diffusion (20periods)
Definition of diffusion and its classification viz diffusion under concentration, pressure and thermal gradient, forced diffusion and eddy diffusion.
Role of diffusion in mass transfer, Fick's law, diffusion in the gas phase equimolecular counter diffusion, diffusion through stationary gas. Mass transfer coefficient, film theory and penetration theory, surface renewal theory of mass transfer, diffusion in solids, interface mass transfer, relation between film and overall mass transfer coefficient, Knudsen diffusion.
Simple numerical problems based on Fick's law
3. Gas Absorption and Desorption (20periods)
Condition of equilibrium between gas and liquid, mechanism of absorption, material balance and design equation of operating line. Absorption factor, concept of transfer unit (HTU and NTU) height of column based on condition-gas film, based on condition-liquid film, height of column based on overall coefficient, HETP for packed column of distillation, types of tower packing, properties of tower packing, problems encountered like flooding, channeling, and weeping, loading, choice of solvent, Raoult's law and Henry's law.
4. Humidification and Dehumidification (14periods)
Definition of humidity, saturated gas, relative humidity, percentage humidity, humid heat, humid volume, dew point, total enthalpy, phase equilibria – relation between equilibrium, mole fraction and saturation humidity, use of humidity chart.

Dry bulb and wet bulb temperature, Adiabatic saturation temperature. Gas liquid contact operation: names of adiabatic and non-adiabatic equipment – natural draft cooling tower, humidifier and dehumidifier, different cooling tower arrangements, spray chambers, spray ponds.

5. Drying (14periods)

General Definition – moisture content (wet and dry basis), equilibrium moisture content, bound moisture content, unbound moisture content, free and critical moisture content, rate of drying curve, time of drying, constant and falling rate periods, drying equipment – tray dryer, rotary dryer, spray dryer, fluidized bed dryer and application.

INSTRUCTIONAL STRATEGY

Field visit will make the students familiar with different types of column (packed/tray) and different types of packings/trays used in the column. This will also make the students aware of auxiliary equipment/models/supports used for the columns. Along with the theoretical part, emphasis should be given to problem solving and practices especially for distillation column, absorption and humidification.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. Mass Transfer Operations by Treybal, Kogakusha Publication
2. Introduction to Chemical Engineering by Badger and Banchero, McGraw Hill Publication
3. Unit Operation of Chemical Engineering by McCabe and Smith; McGraw Hill Publication
4. Mass Transfer by Sherwood Pigford and Wilke, McGraw Hill Publication
5. Chemical Engineers Handbook by Perry and Chilton, McGraw Hill Publication
6. Mass Transfer Operations by Kiran D. Patil, Nirali Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	02	04
2	20	28
3	20	28
4	14	20
5	14	20
Total	70	100

4.6 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

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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 Kirchoff'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 superposition 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.
2. Basic Electrical Engineering by PS Dhongal; Tata McGraw Hill Publishers, New Delhi
3. A Text Book of Electrical Technology, Vol. I and II by BL Thareja; S Chand and Co., New Delhi
4. 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 RaddyNarora Publishing House Pvt. Ltd. New Delhi.
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

INDUSTRIAL TRAINING OF STUDENTS

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of 4 weeks duration to be organized during the semester break starting after second year i.e. after 4th semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An external assessment of 50 marks has been provided in the study and evaluation scheme of 5th Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.

Teachers and students are requested to see the footnote below the study and evaluation scheme of 4th semester for further details.

The teacher along with field supervisors will conduct performance assessment of students.

The components of evaluation will include the following:

- | | |
|--------------------------------------|-----|
| a) Punctuality and regularity | 15% |
| b) Initiative in learning new things | 15% |
| c) Presentation and VIVA | 15% |
| d) Industrial training report | 55% |

5.1 MASS TRANSFER OPERATIONS– II

L T P

5 - 6

RATIONALE

In this subject, the basic concepts of mass transfer are covered to enable the students to understand working of various mass transfer equipment like distillation columns, crystallizers and extractors which are used in industries.

LEARNING OUTCOMES

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

- Understand the concept of distillation.
- Analyze problems involving calculation of trays required for desired separation in binary distillation column
- Understand and evaluate the performance of various mass transfer operations like extraction, leaching, adsorption, crystallization and membrane separation

DETAILED CONTENTS

1. Distillation (25 periods)
 - Concept of Distillation, Vapour Liquid Equilibria, Raoult's Law, Dalton's Law Volatility: Relative Volatility, Derivation to calculate Vapour composition and liquid composition.
 - Methods of Distillation: Differential or simple Distillation, Rayleigh's equation. Flash or Equilibrium Distillation. Material Balance over stripping and enriching section, McCabe Thiele Method (only procedure) Feed plate, feed line, q-line, effect of feed condition, reflux ratio, total reflux ratio, Minimum reflux ratio, optimum reflux ratio.
 - Batch Distillation, Azeotropic Distillation, Extractive Distillation, steam Distillation.
 - Equipment for distillation – plate column, packed column. Concept of flooding, foaming, dumping/Weeping, Entrainment in distillation columns.
2. Extraction (12 periods)

Definition and application of extraction, (final expression and physical meaning of terms therein, no derivation) equipment: mixer settler, spray and packed extraction towers, perforated plate extraction tower, agitated tower extractor.
3. Leaching (08 periods)

Definition and application of leaching, equipment: leaching through stationary solid beds, moving beds, ideal stages in counter current leaching.
4. Adsorption (10 periods)

Concept of Adsorption operation, types of adsorption and nature of adsorbent, effect of temperature on adsorption and industrial application, adsorption isotherms, Freundlich adsorption isotherm

5. Membrane Separation and Crystallization (15 periods)

- Introduction to Membrane Separation, Types of Membrane, Membrane Separation Processes, Brief Introduction: reverse osmosis, microfiltration, ultra filtration, nano filtration, dialysis.
- Concept of crystallization, saturation and super saturation and solubility curve, mechanism of crystallization/crystal formation, method of super saturation – Miers super saturation theory.
- Classification of crystallizers – construction and working of agitated tank crystallizer, draft tube baffle crystallizer, Swenson walker crystallizer, vacuum crystallizer.

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 find out overall mass transfer coefficient wetted wall column
6. To separate given solution mixture with the help of a sieve plate distillation
7. To draw calibration curve for a given mixture using refractive index and to find out the unknown concentration from this calibration curve using abbe's refractometer
8. To study and determine the efficiency of solid-liquid extraction
9. To study the performance of crystallizer
10. To separate a mixture of two liquid using liquid extraction and calculate separation efficiency.
11. To verify Raoult's equation using batch distillation set-up

MEANS OF ASSESSMENT

- Class Test
- Home Assignment – Attendance
- Sessional Test

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.

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	25	30
2	12	20
3	08	15
4	10	15
5	15	20
Total	70	100

5.2 POLLUTION CONTROL AND INDUSTRIAL SAFETY

LTP

5 - 6

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 CONTENT

1 Introduction (10 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 (10 Periods)

- i) Definition of air pollution, Types of Air pollutants and their sources like SPM, SOX, NOX, NH₃, F, Cl, CFC, CO₂ etc.
- ii) Air Pollution control equipment in industries.
 - a) Settling chamber
 - b) Cyclone
 - c) Scrubber (dry & wet)
 - d) Multicyclone
 - e) Electrostatic precipitator
 - f) Bag Filter
- iii) Ambient air quality measurement & their standards
- iv) Vehicular Pollution and its control
- v) Noise Pollution and its control mechanism

3. Water Pollution (10 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
- a) Chemical treatment
 - b) Physio-Chemical treatment
 - c) Bio-chemical treatment
 - d) Any other advance treatment
4. Environment Protection (15 Periods)
Environmental protection from hazardous chemicals waste:
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 (10 Periods)

Sources and effect on human, animal, plant and material. Measurement, means to control, preventive measures.
6. Solid Waste Management (10 Periods)

Municipal solid waste, biomedical waste, Plastic waste and its management, solid waste disposal methods such as open dumping, sanitary landfilling composting, incineration.
Importance of development of green area
7. Pollution Acts
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 (25 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, vapours 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	28
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, air and 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 principles 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

(08Periods)

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

3. Steam and Steam Generation:

(12Periods)

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, Vaporabsorption: Lithium bromide (Eco-Friendly)
 - 5.3 Different refrigerants – Monochlorodifluoro 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 to teach.

MEANS OF ASSESSMENT

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

LIST OF PRACTICALS

1. To determine the alkalinity of water
2. To determine the hardness of water
3. To determine the variation in PH with ion exchange bed
4. Determination of humidity and use of humidity chart
5. Boiler simulator
6. Determination of outgoing temperature of water from any cooling tower
7. Observing starting procedure of thermopack or boiler
8. Draw & prepare the report of steam traps
9. Observation of use of instrument air in pneumatic control valve

RECOMMENDED BOOKS

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

L T P

4 - -

RATIONALE

Lot of developments have taken place in the field of materials. New materials are being developed and it has become possible to change the properties of materials to suit the requirements. Diploma holders in this course are required to make use of different materials for various applications. For this purpose, it is necessary to teach them basics of metal structure, properties, usage and testing of various ferrous and non ferrous materials and various heat treatment processes. This subject aims at developing knowledge about the characteristics, testing and usage of various types of materials used in industries.

LEARNING OUTCOMES

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

- Understand different types of bonding in materials
- Select and characterize engineering materials
- Understand different properties of materials used in industries
- Distinguish between various engineering materials on the basis of mechanical, magnetic and electrical properties.
- Identify materials for applications in chemical process industry.

DETAILED CONTENTS

1. Introduction (12 Periods)
Introduction: Importance of materials, Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bonding.
Crystallography and imperfections: Concept of unit cell, space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices. X-ray crystallography techniques, imperfections, Defects & Dislocations in solids.
2. Properties of Materials (14 Periods)
 - 2.1. Mechanical Properties and Testing: Stress strain diagram, Ductile and brittle materials, stress vs strength, toughness, hardness, fracture, fatigue and creep. Testing, such as Strength testing, Hardness testing, Impact testing, Fatigue testing, Creep testing, Non-destructive testing (NDT)
 - 2.2. Magnetic Properties: Concept of magnetism-Dia, para, ferro magnetic materials, Hysteresis, Soft and hard magnetic materials.
 - 2.3. Electric Properties: Energy band, concept of conductor, insulator and semi conductor. Intrinsic and extrinsic semi-conductors, p-n junction and transistors, Basic devices and their applications, diffusion of Solid, Super conductivity and its applications, Messier effect. Type I & II superconductors. High Temp. superconductors.

3. Phase Diagram and Equilibrium Diagram (08 Periods)
Unitary and Binary diagrams, Phase rules, Types of equilibrium diagrams: solid solution type, eutectic type and combination type, Iron-carbon equilibrium diagram.
4. Ferrous and Non-ferrous Materials and Alloys (14 Periods)
 - 4.1. Ferrous materials: Iron and steel manufacture, various types of carbon steels, alloy steels and cast irons, its properties and uses.
 - 4.2. Heat Treatment: various types of heat treatment, such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams
 - 4.3. Non-Ferrous Materials and Alloys: Non-ferrous metals, such as Cu, Al, Zn, Cr, Ni etc. and its applications. Various types of brass, bronze bearing materials-their properties and uses. Aluminum alloys such as Duralumin, Other advanced materials/alloys.
5. Ceramics and Other Materials (14 Periods)
 - 5.1. Ceramics: Structure, types, properties and applications of ceramics. Mechanical/Electrical behavior and processing of ceramics.
 - 5.2. Other Materials: Brief description of other materials, such as optical and thermal materials, concrete, composite materials and their uses.

INSTRUCTIONAL STRATEGY

Audio-visuals can be used as teaching aid. Processes of Heat-treatment can be shown to students in workshop.

MEANS OF ASSESSMENT

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

LIST OF REFERENCEBOOKS

1. Material Science & Engineering by William D. Callister Jr.; John Wiley and Sons Inc
2. Elements of Material Science & Engineering by Van Vlack; John Wiley & Sons.
3. Material Science by V. Raghvan; Prentice Hall of India.
4. Material Science by Narula; Tata McGrawHill.
5. Science of Materials Engineering by Srivastava, Srinivasan; New Age International

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	12	20
2	14	25
3	08	15
4	14	25
5	08	15
Total	56	100

5.5 RENEWABLE ENERGY SOURCES

LTP
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, 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

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- 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 equipments are installed.

MEANS OF ASSESSMENT

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

LIST OF REFERENCE 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

5.6 PETROLEUM REFINING

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5	1	-

RATIONALE:

Crude oil is the raw material for a refinery. Various processes are involved in the production of petroleum products. A student having knowledge of Distillation, thermal Cracking, Catalytic Cracking for producing Lubricating oil, Bitumen and many other products will be useful for petroleum refining industry.

LEARNING OUTCOMES

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

- have introductory information about petroleum and refinery.
- learn the refinery products, test methods and petroleum properties.
- recognize the characteristics of petroleum refinery process.
- recognize the distillation processes.
- learn solvent treating and extraction processes.
- learn Thermal cracking.

DETAILED CONTENTS

1. INTRODUCTION:
Origin of petroleum and theories. India and global status of petroleum and natural gas, future prospects and availability of processing technology.
2. CRUDE OIL :
Bench mark of crude oil , crude oil hash point, fire point, cloud point, aniline point, freeze point, refractive index . sweet and sour crude oil. Chemistry and Composition, crude oil evaluation, Laboratory distillation (ASTM, TBP, EFV).
3. PETROLEUM PRODUCT :
Composition, uses and Indian specification of LPG, Naptha, MS, Kerosine, ATF, HSD, LDO, Bitumen, Waxes, Petroleum Cokes, Lubricating oil.
4. DISTILLATION :

Distillation of crude oil, Atmospheric distillation, Vacuum distillation.
5. THERMAL CRACKING :

Coking process, Fluid coking, Delayed coking, Visbreaking.

6. CATALYTIC CRACKING PROCESS :

Catalytic reforming, Hydrocracking, Alkalization isomerisation, Polymerization.

7. MANUFACTURE OF LUBE OIL BASE STOCK :

Solvent Deasphalting, Solvent extraction, Solvent dewaxing, Hydrofinishing, Manufacture of waxes (Paraffin and Microcrystalline).

8. BITUMENT :

Manufacturing of Bitumen.

LIST OF REFERENCE BOOKS

1. Petroleum Refining by William L. Leffler
2. Handbook of Petroleum Refining by James Speight
3. Modern Petroleum Refining Processes by Rao
4. Refining Processes Handbook by Surinder Parkash

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted
1	09	15
2	09	15
3	09	20
4	09	10
5	09	10
6	09	15
7	08	10
8	08	5
Total	70	100

5.7 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 complementarity 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*;
a. Trust (Vishwas) and Respect (Samman) as the foundational values of relationship
3. Understanding the meaning of *Vishwas*; Difference between intention and competence
4. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
5. Understanding the harmony in the society (society being an extension of family): *Samadhan, Samridhi, Abhay, Sah-astitvaas* comprehensive Human Goals
6. Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*SarvabhaumVyawastha*)- 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

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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

INSTRUCTIONAL 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 ekParichay*, 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

6.1 PROCESS EQUIPMENT DESIGN

L T P
5 - -

RATIONALE

A diploma holder in Chemical Engineering is expected to have knowledge of design procedure of pressure vessels, heat exchangers and distillation column. He should also be conversant with various fabrication and testing methods. Hence this subject.

LEARNING OUTCOMES

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

- Understand the general design method of process equipment.
- Design pressure vessels, heat exchangers and distillation column.
- Design various parts of vessels like head, support etc.
- Understand fabrication and testing methods.

DETAILED CONTENTS

1. Basic Considerations in Process Equipment Design (04 Periods)

- 1.1 Introduction
- 1.2 The general design procedure
- 1.3 Fabrication Techniques
- 1.4 Equipment classification

2. Stress and Stress Analysis (12 Periods)

- 2.1 Introduction
- 2.2 Definition & types of stresses
- 2.3 Stresses due to static loads
- 2.4 Strains
- 2.5 Elastic constants
- 2.6 Thermal stresses
- 2.7 Stresses caused by bending
- 2.8 Deflection
- 2.9 Stresses caused by torsion
- 2.10 Stresses in flat plates

- 2.11 Stresses in cylinders and spheres
- 2.12 Stress concentration
- 2.13 Dynamic stresses
- 2.14 Impact stresses
- 2.15 Compound stresses
- 2.16 Stresses created due to static and dynamic loads
- 2.17 Combined stresses and theories of failure
- 2.18 Effects of fabrication methods Economic considerations
- 3. Pressure Vessels (14 Periods)
 - 3.1 Introduction
 - 3.2 Operating conditions -Normal conditions, Transient conditions
 - 3.3 Pressure vessel code
 - 3.4 Design stress and design criteria
 - 3.5 Corrosion allowance
 - 3.6 Joint efficiency
 - 3.7 Shell thickness for spherical and cylindrical vessels
 - 3.8 Head or covers- crown and knuckle radius
 - 3.9 Thickness of head subjected to internal pressure
- 4. Heat Exchanger (12 Periods)
 - 4.1 Introduction
 - 4.2 Codes and standards for heat exchangers
 - 4.3 Overall heat transfer co efficient
 - 4.4 Shell and tube heat exchangers:Tubes, Shell, Tube sheet layout. (Tube count), Shell types (Passes), Baffles, tie rods , tube joining methods
 - 4.5 Flow patterns
 - 4.6 Kern's Methods
 - 4.7 U tube and floating and heat exchanger
- 5. Supports for Vessels (10 Periods)
 - 5.1 Introduction
 - 5.2 Bracket or lug supports
 - 5.3 Leg supports
 - 5.4 Skirt supports
 - 5.5 Saddle supports
 - 5.6 Flanges
 - 5.7 Nozzles
 - 5.8 Design of Jackets (IS 2825)
 - 5.9 Coils for pressure vessels
- 6. Distillation Column (18 Periods)
 - 6.1 Introduction
 - 6.2 Columns internals
 - 6.3 Selection of Key component for multicomponent distillation
 - 6.4 Advantages and limitation of vacuum distillation

- 6.5 Determination of number of theoretical stages of binary distillation
- 6.6 Using McCabe Thiele Method
- 6.7 Selection of trays
- 6.8 Checking of conditions for weeping, down comer flooding and liquid entrainment

INSTRUCTION STRATEGY

As far as possible, the teaching of the subject must be supplemented by showing the videos on designing of various parts.

MEANS OF ASSESSMENT

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

LIST OF RECOMMENDED BOOKS

1. Process equipment design by M.V. Joshi and V.V.Mahajan; McMillan India
2. Chemical Engineering by J.M. Coulson and J.F. Richardson; Pergamon Press, New York
3. Engineering Mechanics by R.S.Khurmi, S. Chand and Company Ltd., New Delhi
4. Process Equipment Design by B.E. Brownell and E.M. Young; John Wiley & Sons

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	04	04
2	12	16
3	14	22
4	12	18
5	10	15
6	18	25
Total	70	100

6.2PROCESS 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:

1. Explain the importance of automation and its applications in chemical industries.
2. Explain the basic principles of process control in industrial processes.
3. Determine the time and response of first order and second order systems for step, ramp, impulse and sinusoidal inputs.
4. Handle chemical processes by framing it in block diagrams.
5. Identify open and closed loop systems.
6. 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 Ist 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 IInd order system or oscillatory type element- Bulb in themowell, Mechanical damper.

Response of Ist order system to step, ramp, impulse and sinusoidal inputs.
Response of IInd 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(at least 8 experiments to be performed)

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 (thermo couple) 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 out 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

6.3 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 equipments.
- 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 Tonne 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 Machine
 - 9.7 Colour 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

PRACTICAL EXERCISES

1. To conduct load survey and power consumption calculations of small building.

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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

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

Important Links:

- (i) Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India.
www.beeindia.gov.in.
- (ii) Ministry of New and Renewable Energy (MNRE), Government of India.
www.mnre.gov.in.
- (iii) Uttar Pradesh New and Renewable Energy Agency (UPNEDA), Government of Uttar Pradesh. www.upneda.org.in.
- (iv) Central Pollution Control Board (CPCB), Ministry of Environment, Forest and Climate Change, Government of India. www.cpcb.nic.in.
- (v) Energy Efficiency Services Limited (EESL). www.eeslindia.org.

APPROVED IN CDC COMMITTEE MEETING OF BTE,U.P,LKO DATED:26-09-2021

- (vi) Electrical India, Magazine on power and electrical products industry.
www.electricalindia.in.

6.4. PETROCHEMICAL PROCESSING

L T P

6 - 6

RATIONALE

Petroleum industry is one among core chemical industries and it has large employment potential. In this subject, the students will be imparted detailed knowledge of petroleum refining and petroleum products along with major petrochemicals.

LEARNING OUTCOMES

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

- Get familiar with different petroleum refining processes.
- Test petroleum product

DETAILED CONTENTS

1. INTRODUCTION:
Growth and prospects of petrochemical industry in India. Introduction to technology of Dehydrogenation, Oxidation, Hydration, Sulphonation, Alkylation, etc.
2. SYNTHESIS OF GENERATION :
Synthesis gas generation through steam reforming and partial oxidation of liquid and gaseous feedstock. Manufacture of Menthyl, Oxalcohol.
3. MANUFACTURE OF OLEFINS :
Naphtha pyrolysis and Gas cracking, Manufacture of Acetylene, Ethylene, Propylene, Butanes and their derivatives such as vinyls, Ethylene oxide, Propylene oxide, Isopropyl Alcohol and Acetone, Acrylonitrile and Buta-diene.
4. MANUFACTURE OF AROMATICS :
Products of benzene, Toluene and xylenes from liquid and Gaseous feed stock.
5. CHEMICALS USED IN DETERGENT INDUSTRY : Manufacture of Linear Alkyl Benzene.
6. MANUFACTURE OF CHEMICALS FOR USE IN FIBRE MAKING :
Caprolactum, dimethyl phthalate, polyester, phthalic anhydride.
7. MANUFACTURE OF POLYMERS :
Polyethylene (Low and High density), Polypropylene, Polymethyl Methacrylate, Polystyrene, teflon, etc.

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8. MANUFACTURE OF CHEMICALS :
Dyes, Pharmaceutical, Intermediates and Textile auxiliaries.

PETROCHEMICAL & POLLUTION CONTROL LAB

1. Determination of Kinematic Viscosity by Engler Viscometer
2. Determination of Smoke point.
3. Determination of Penetration Number.
4. Laboratory distillation (ASTM, TBT, EFV).
5. Determination of Carbon residue-conradson and remsbottom method
6. Determination of Cloud and Pour Points.
7. Determination of Sulphur.
8. Determination of water content by Dean and Stark method.
9. Determination of softening point by ring and ball apparatus.
10. Determination of pH-value.
11. Determination of Turbidity.
12. Determination of Total Dissolved Solid (TDS).
13. Determination of Dissolved Oxygen (DO).
14. Determination of Chemical Oxygen Demand (COD).
15. Determination of Biochemical Oxygen Demand(BOD)

RECOMMENDED BOOKS

1. Handbook Of Petroleum Refining Processes by Naitik Verma, Scitus
2. SPRINGER HANDBOOK OF PETROLEUM TECHNOLOGY 2ED (HB 2017) by HSU C S, SPRINGER
3. Handbook of Petroleum Refining Processes By Meyers Robert
4. Modern Petroleum Refining Processes by Bhaskara Rao B, Oxford & Ibh Publishing

REFERENCE WEBSITES

1. <https://www.hydrocarbonprocessing.com/>
2. <https://chemicals.nic.in/petrochemicals>
3. <https://www.digitalrefining.com/>
4. <https://en.wikipedia.org/wiki/Petrochemical>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	10	15
2	10	15
3	10	20
4	10	10
5	11	10
6	11	10
7	11	15
8	11	5
Total	84	100

6.5 INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

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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 organisation.
- 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 organisation.
- 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 organisations
 - 1.4 Schemes of assistance by entrepreneurial support agencies at National, State, District –level, organisation: 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)
- 4.2 Definitions and importance of management
 - 4.3 Functions of management: Importance and process of planning, organising, staffing, directing and controlling
 - 4.4 Principles of management (Henri Fayol, F.W. Taylor)
 - 4.5 Concept and structure of an organisation
 - 4.6 Types of industrial organisations and their advantages
 - 4.7 Line organisation, staff organisation
 - 4.8 Line and staff organisation
 - 4.9 Functional Organisation
5. Leadership and Motivation (08 Periods)
- 5.2 Leadership: Definition and Need, Qualities and functions of a leader, Manager Vs leader, Types of leadership, Case studies of great leaders
 - 5.3 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 Behavioural 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 organisations 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:

<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

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:

Development of prototypes

Study of different types of :

- heat exchangers
- distillation columns
- evaporators
- reactors
- drying unit etc.

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

Study of pumps and valves used in process industries

Fabrication of components/equipments

Fault diagnosis and rectification experiences

Bringing improvements in the existing system/equipment

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

Case Studies

NOTE:

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				
			Excel lent	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
Total marks		100	100	80	60	40	20

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General Guidelines

The overall grading of the practical training shall be made as per following table.

1. 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.

Range of maximum marks		Overall grade
i)	More than 80	Excellent
ii)	79 < 65	Very good
iii)	64 < 50	Good
iv)	49 < 40	Fair
v)	Less than 40	Poor

Important Notes

- These 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.
- 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.
- 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.
- 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 organisations in such an exhibition.

10. RESOURCE REQUIREMENT

10.1 PHYSICAL RESOURCES

(A) Space requirement

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

(B) Equipment requirement:

Following Laboratories are required for diploma programme in Chemical Engineering:

- Communication Laboratory –
- Applied Physics Laboratory –
- Applied Chemistry Laboratory –
- Engineering Drawing
- Electrical Engineering Laboratory
- Basics of IT/Computer Applications \Laboratory
- Carpentry Shop
- Painting and Polishing Shop
- Basics of Electrical and Electronic Engg.
- Welding Shop
- Fitting and Plumbing Shop
- Sheet Metal Shop
- Mason Shop –
- Machine Shop
- Mechanical Operations and Solid Handling/Fluid Mechanics Laboratory
- Heat and Mass Transfer Laboratory
- Environment Engineering Laboratory
- Petroleum Processing Laboratory
- Chemical Technology Laboratory
- Chemical Reaction Engg. Lab.
- Process Control
- Energy Conservation Lab.
- Pollution Control and Industrial Safety
- Fertilizer Technology

EQUIPMENT REQUIRED FOR CHEMICAL ENGINEERING

Sr. No.	Description	Qty	Total Price (Rs)
COMMUNICATION LABORATORY			
1.	Stools	40	10,000
2.	Display Board/Screen	2	6,000
3.	Sound recording and playing system	1	6,000
4.	Audio cassettes	60	2,000
5.	Overhead Projector	1	5,000
6.	Transparencies slides	100	500
7.	TV, VCR and camera for video recording	1 each	20,000
8.	English spoken course	1	2,000
9.	A Quiz room equipped with two way audio system, back projection system and slide projector	1	30,000
10.	Miscellaneous	LS	1,500
APPLIED PHYSICS LABORATORY			
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.	Gravesand'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 Miliammeters	2	1,000
13.	DC Microammeters	2	700
14.	DC voltmeters	10	700
15.	DC Millivoltmeters	10	2,000
16.	Sensitivity Galvanometer	2	800
17.	Student Galvanometers	10	4,000
18.	Demonstration type DC Ammeters Range; 0 to 1 Amp.	2	1,000
19.	D type DC Voltmeter Range : 0 to 1 Volt	2	1,000
20.	D type Galvanometers Sensitivity : 20 microamperes per scale division,	8	8,000
21.	Resistance boxes (dial type) assorted	8	8,000
22.	Rheostats	10	4,000
23.	Miscellaneous items (Spring, Pan, Glycerine, Optic fibre, Ferromagnetic material)	LS	2,000
24.	Fortin's Barometer (Wall type)	2	20,000
25.	Stoke's Apparatus	2	10,000
26.	Gumther's Apparatus	2	16,000
27.	Resonance Tube Apparatus with accessories and Tuning fork set	2	14,000
28.	Sodium Lamp setup with Biprism	2	10,000
29.	Ohmic resistance coil	10	5,00

30.	Slide wire bridge	2	8,000
31.	PN Junction diode Apparatus	2	10,000
32.	Laser (as per requirement)	1	1,00,000
33.	Numerical aperture setup	1	25,000
34.	Miscellaneous	LS	3,000
APPLIED CHEMISTRY LABORATORY			
1.	Digital Balance	1	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	2	10,000
10.	(1/10)°C thermometer	06	6,000
11.	Candles	20	100
12.	Crucible with lid	06	2,000
13.	Muffle furnace	1	18,000
14.	Decicators	06	8,000
15.	Pair of tongue (small and big)	24 (small) 2 (big)	2,000
16.	Chemicals		
	<ul style="list-style-type: none"> - 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) 	LS	20,000

	<ul style="list-style-type: none"> - Methyl orange indicator (as per requirement) - Charcoal (as per requirement) - Kerosene- 1 ltr 		
17.	Miscellaneous	LS	2,000

ENGINEERING DRAWING			
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 wooder joints	1	1,000
6.	Model of different screw threads	1	1,000
7.	Model of various locking devices	1	1,000
8.	Model of various joints	1	1,000
9.	Cut section Model of various couplings	1	3,000
10.	Miscellaneous	LS	5,000
ELECTRICAL AND ELECTRONICS ENGINEERING LABORTORY			
1.	Voltmeter	5	7,500
2.	Ammeter	5	10,000
3.	CRO	1	15,000
4.	Wattmeter	5	10,000
5.	Multimeter	1	4,000
6.	Resistive load	1	4,000
7.	Regulated supply	1	8,000
8.	Signal generator	1	5,000
9.	Rheostat	2	2,500
10.	Lead acid battery	1	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**

1.	Computer System with latest configuration	30	8,00,000
2.	Printer (MFP)	1	25,000
3.	Printer (Laser)	1	35,000
4.	Plotter	1	75,000
5.	Digitiser	1	50,000
6.	Antivirus Software	LS	10,000
7.	Internet Facility on Computers	LS	2,00,000
8.	LCD Projector	1	35,000
9.	UPS	60	1,20,000
10.	Software (latest windows, latest MS Office)	1	1,00,000
11.	Scanner	1	10,000
12.	Software MATLAB	1	2,00,000
13.	Miscellaneous	LS	5,000
<i>CARPENTRY SHOP</i>			
1	Work benches fitted with carpenter vices	5	20,000
2.	Circular saw grinder	1	6,000
3.	Wood cutting band saw-vertical	1	10,000
4.	Bench grinder	1	5,000
5.	Drilling machine	1	8,000
6.	Wood turning lathe	1	40,000
7.	Wood Planner	1	20,000
8.	Tool accessories measuring and marking Instruments	25	25,000
9.	Band saw blade brazing unit	1	10,000
10.	Miscellaneous	LS	1,500

Sr. No.	Description	Qty	Total Price (Rs)
PAINTING AND POLISHING SHOP			
1.	Spray gun with hose pipe	1	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			
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	1	1,500
4.	Electric kettle	1	1,500
5.	Ceiling fan/table fan	1	2,500
6.	Desert cooler	1	5,000
7.	Lead acid battery	2	8,000
8.	Battery Charger	1	6,000
9.	Miscellaneous		3,000
WELDING SHOP			
1.	Electrical welding transformer set with accessories	3	30,000
2.	Gas Cutting Unit	1	3,000
3.	Work benches with vices	3	5,000
4.	Welding generator set	1	10,000
5.	Oxy acetylene welding set with accessories	1	7,000
6.	Acetylene generating set	1	6,000
7.	Electric welder tool kit	10	10,000
8.	Projection welding machine	1	15,000
9.	Brazing equipment with accessories	1	10,000

10.	Soldering irons	3	1,000
11.	Pedestal grinder	1	10,000
12.	Metal spraying gun	1	10,000
13.	Spot welder	1	25,000
14.	TIG welding set	1	1,00,000
15.	MIG welding set	1	1,00,000
16.	Welding Partition Screen	5	2,500
17.	Miscellaneous	LS	3,000

FITTING AND PLUMBING SHOP

1.	Work benches with vices (4 vices on each bench)	5	30,000
2.	Marking tables with scribes	4	24,000
3.	Surface plates	5	20,000
4.	Accessories like calipers, V blocks, height, gauges steel rules and scribes	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	2	12,000
8.	Pipe vice	4	1,000
9.	Chain wrenches	5	1,250
10.	Ring spanner set	5	600
11.	Pipe die set 2"	2 set	1,000
12.	Pipe bending device	1	5,000
13.	Various plumbing fittings	LS	2,000
14.	Miscellaneous	LS	1,500

SHEET METAL SHOP

1.	Hammers	8	3,000
2.	Mallets (Hard & Soft)	5	2,000

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3.	Sheet and wire Ganges	LS	8,00
4.	Shearing Machine	1	20,000
5.	Bar folding Machine	1	20,000
6.	Burring machine	1	10,000
7.	Various sheet (black plain, galvanized iron, corrugated, Aluminium)	1 Each	1,000
8.	Hand Shears/Snippers	4	2,000
9.	Nuts, Bolts, Rivets, Screw	LS	5,00
10.	Miscellaneous	LS	1,000
MASON SHOP			
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
MACHINE SHOP			
1.	Centre lathes	10	6,00,000
2.	Grinder	1	10,000
3.	Universal milling machine	1	1,25,000
4.	Shaper	2	1,20,000

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5.	Plainer	2	1,20,000
6.	Work bench	3	10,000
7.	Precision instruments	1	10,000
8.	Hand tools and accessories	2	8,000
9.	CNC trainer lathe	1	4,00,000
10.	Miscellaneous	LS	5,000

MECHANICAL OPERATIONS AND SOLID HANDLING/FLUID MECHANICS LABORATORY		
Sr.	Particulars	Unit
1.	Ball Mill	01
2.	Centrifuge	01
3.	Mixer – Liquid Liquid Mixer and Solid Liquid Mixer	02
4.	Roller mill	01
5.	Compressor, Wet Gas Meter, Blower	01
6.	Jaw Crusher	01
7.	Cyclone Separator	01
8.	Plate and frame filter press	01
9.	Sieve shaker	01
10.	Bernoulli's Theorem Apparatus	01
11.	Vacuum pump	01
12.	Particle settling in fluids (Drag coefficient)	01
13.	Determination of Friction loss through pipe	01
14.	Weirs, V-notch, Rectangular Notch	01
15.	Centrifugal pumps, reciprocating pump	01
16.	Redwood Viscometer	01
17.	Rotameter, Venturimeter, Orificemeter, pitot tube	01
18.	Globe valve, check valves, Butterfly valve, Needle valve	01
19.	Gate Valve, Diaphragm Valve	01
20.	Reynolds number determination apparatus	01
21.	Rotary Disc Filter, Vacuum Rotary Drum Filter	01
HEAT AND MASS TRANSFER LABORATORY		
1.	Equipment to measure thermal conductivity of metal rod.	01
2.	Heat transfer through compound wall equipment.	01
3.	Thermal conductivity (Insulating powder) Apparatus90-	01
4.	Forced convection apparatus	01

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5.	Natural convection apparatus	01
6.	Open pen evaporator	01
7.	Drop and film wise condensation apparatus	01
8.	Parallel and counter flow apparatus for heat exchanger	01
9.	Shell and tube heat exchanger	01
10.	Double pipe heat exchanger for heat transfer coefficient	01
11.	Single effect evaporator	01
12.	Finned tube heat exchanger	01
13	Batch Distillation Apparatus	01
14	Oven	01
15	Liquid-Liquid Extractor Setup	01
16	Packed Column	01
17	Tray Dryer	01
18	Bubble Cap Distillation Column	01
19	Refractormeter	01
20	Liquid Diffusion Apparatus	01
21	Solid Diffusion Apparatus	01
22	Wetted Wall Column Apparatus	01
23	Cooling Tower	01
24	Crystallizer	01
25	Reverse Osmosis Set Up	01
ENVIRONMENT ENGINEERING LABORATORY		
1.	pH Meter	01
2.	Turbidity Meter	01
3.	Oven with Temperature Controller and Forced Air Circulation Type	01
4.	B.O.D. Incubator	01

5.	Water Analysis Kit	01	
6.	High Volume Sampler	01	
7.	Electrical Balance for weighing upto 1/10 of milligram (capacity)	01	
PETROLEUM PROCESSING LABORATORY			
1.	Cleave land flash and fire point apparatus	01	
2.	ASTM D-92 open cup types with thermometers	01	
3.	Cloud and pour point apparatus	01	
4.	Redwood viscometer with stop watch, measuring flask, thermometers	01	
5.	Pensky –Martens flash point apparatus	01	
6.	Smoke point apparatus	01	
7.	Aniline point apparatus	01	
8.	ASTM distillation of Petroleum product apparatus	01	
CHEMICAL TECHNOLOGY LABORATORY			
1.	Distillation Apparatus (Glass) Sieve and Plate type	01	
2.	Heating Mantle (2” – 3”)	03	
3.	Beakers (100 ml, 200 ml, 500 ml)	05 each	
4.	Round bottom flasks	05	
5.	Raw Material (Coconut Oil, Mustard Oil, Phenol Formaldehyde, NaOH, HCl, NaCl, Lead Chromate, Lead dichromate, Filter paper	As per need	

CHEMICAL REACTION ENGINEERING

1	Batch Reactor	01	
2	Isothermal Plug Flow Reactor	01	
3	Isothermal Mixed Flow Reactor/Continuous Stirred Tank Reactor	01	
4	Fluidized Bed Reactor	01	
5	Refrigerator	01	

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6	PFR and CSTR in series	01
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PROCESS CONTROL

1	Apparatus for celebration of pressure gauge	01
2	Bimetallic Thermometer	01
3	Energy Meter	
4	Watt Meter	
5	Manometers	
6	Flapper nozzle system apparatus	01
7	On-off Controller	01
8	Thermopiles/Thermo couple	01
9	Resistance thermometer	01
10	Strip chart recorder	01
11	Circular chart recorder	01
12	Pneumatic valve	01
13	Set up for study response of two tank in non-introductory and interacting system	01
14	P controller, PD controller PID controller	01 each

ENERGY CONSERVATION LABORATORY

1	Clamp meter	02
2	Multimeter	02
3	Power Analyser	01
4	Different types of lamps (LS) <ul style="list-style-type: none"> – 60 W lamp, 230 V , 100 V – 200 W lamp – 500 W lamp – 100 W lamp, 110 V, 150 V 	10
5	Lux meter	02
6	Standard window A.C.	01
7	Anemometer	02
8	Thermometer	03
9	Flow meter	02
10	Pumping set with at least two pumps of different capacity.	1 set
11	Pressure gauge fitted on discharge lines	1 set
12	Variable Frequency Drive	02
13	A small compressor with a small network of pipe line fitted with suitable pipeline, pressure gauge, safety valve and loading / unloading pressure switch.	1
14	Stop watch	2
15	Small blower (1.5 kW motor) with inlet and outlet ducts of approximately one meter length on both sides	1

POLLUTION CONTROL AND INDUSTRIAL SAFETY

1	BOD incubator (5 C- 50C) with digital temperature indicator	1
2	COD Heater	1
3	Refrigerator, 280 ltrs.	1
4	Laboratory oven 2'x2'x2'	1
5	Turbidity meter (0-4000 NTU)	1
6	TDS portable meter	1

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7	Electronic balance (0.001 grams)	1
8	Beakers	1
9	Conical flask, round bottom flasks	1
10	Condenser, reflux condenser	1
11	BOD bottles, rubber pipe, burette, pipette etc.	LS
FERTILIZER TECHNOLOGY		
1	Carbon dioxide generator	1
2	Combustion assembly	1
3	K-Jeldahl flask (300.CC), connecting kjeldal flask, Distillation unit, receiver, Heater connecting pipings and suitable holding fixtures	6
4	Electric Oven	2
5	Electronics Balance 200-300 gm, 0.001 gm, back light LED with glass enclosure and lab weight for calibration	1
6	Reflux Condenser with k-jacketed flask & fixture	1
7	Round Bottom Flask with Joint B-24, 500ml	1
8	CNH Analyzer	1

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.

(C) Furniture Requirement

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

10.2 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 staff be worked out as per norms and standards laid down by the AICTE.

11. EVALUATION STRATEGY

11.1 INTRODUCTION

Evaluation plays an important role in the teaching-learning process. The major objective of any teaching-learning endeavor is to 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 and the specific objectives of curriculum have been achieved. Student evaluation is also important from the point of view of ascertaining the quality of instructional processes and 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.

11.2 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 behaviour and it should be followed by viva-voce.

C. Project Work

The purpose of evaluation of project work is to assess student's 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 behaviour, quality of report and presentation during viva-voce.

12. 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 behaviour 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 upto grass-root level. Polytechnics, in turn are supposed to prepare institutional academic plan.
3. HOD of every Programme Department along with HODs and incharges 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 in a course are the avenues to use problem based learning/activity learning/ experiential learning approach effectively. The development of lab instruction sheets for the course is a 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 feed back to every student.
8. The student centred activities may be used to develop generic skills like task 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 Diploma Programme in Chemical Engineering (Petrochemical) for UP State at HBTU, Kanpur:

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