Curriculum for

Diploma Programme in

CHEMICAL TECHNOLOGY (RUBBER & PLASTIC)

For the State of Uttar Pradesh

Prepared by:

Curriculum Development Centre

Institute of Research Development & Training

U. P. Kanpur

APPROVED IN CDC COMMITTEE MEETING OF BTE,UP,LKO DATED 26-09-2021

CONTENTS

Sr. No	Particulars	Page No.
-	Preface	(i)
-	Acknowledgement	(ii)
	Salient Features of the Diploma Programme	1
	Employment Opportunities	3
	Learning Outcomes of the Programme	4
	Deriving Curriculum Areas from Learning Outcomes of the Programme	6
	Abstract of Curriculum Areas	8
	Horizontal and Vertical Organization of the Subjects	10
	Study and Evaluation Scheme	11
	Guidelines (for Assessment of Student Centered Activities and Internal Assessment)	17
	Detailed Contents of various Subjects	18-153

FIRST SEMESTER

1.1	Communication Skills-I	18
1.2	Applied Mathematics-1	21
1.3	Applied Physics-1	24
1.4	Applied Chemistry	29
1.5	Measuring Instruments & Measurements	33
1.6	General Workshop Practice-I	36
1.7	Universal Human Values	40

SECOND SEMESTER

2.1	Applied Mathematics-II	44
2.2	Applied Physics-II	46
2.3	Applied Mechanics	51
2.4	Polymer Chemistry	55
2.5	Technology of Plastic Material	60
2.6	Engineering Drawing	62

THIRD SEMESTER

3.1	Environmental Studies	66
3.2	Applied Mathematics-III	69
3.3	Fluid Mechanics & Solid Handling	72
3.4	Material and Energy Balance	76
3.5	Chemical Reaction Engineering & Thermodynamics	79

3.6	Basics of Information Technology	82
3.7	Renewable Energy Resources	87

FOURTH SEMESTER

4.1	Communication Skills-II	90
4.2	Plastic & Rubber Processing -I	93
4.3	Quality Control & Testing of Polymer	97
4.4	Plastic & Rubber Compounding	100
4.5	Basics of Electrical and Electronics Engg.	102
4.6	Technology of Natural & Synthetic Rubber	105

FIFTH SEMESTER

-	Industrial Training	107
5.1	Heat & Mass Transfer	108
5.2	Pollution Control and Industrial Safety	112
5.3	Process Plant Utilities	115
5.4	Plastic & Rubber Processing - II	118
5.5	Plastic & Rubber Waist Management	122
5.6.1	Foam & Adhesive Technology.	126
5.6.2	Plastic in Building Service	128
5.6.3	Polymer Blends & Alloys	130

SIXTH SEMESTER

6.1	Polymer Composites	132
6.2	Plastic & Rubber Mould Die Design & Construction	135
6.3	Industrial Management and Entrepreneurship Development	138
6.4	Energy Conservation	142
6.5	Process Control	146
6.6	Project Work	149
	Resource Requirement	152
	Evaluation Strategy	166
	Recommendations for Effective Implementation of Curriculum	169
	List of Participants	172

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 Technical Education, UP to revise the existing curricula of 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.

Manoj Kumar
Director
Institute of Research Development &Training,U. P.
Kanpur

ACKNOWLEDGEMENTS

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

1. Sh. Alok Kumar-III, IAS, Secretary, Technical Education Department, U.P. Govt.

2. Sh. Sunil Kumar Chaudhary, Special Secretary, Technical Education Department, U.P. Govt.

3. Sh. Manoj Kumar, Director, Technical Education, UP & I.R.D.T., Kanpur, for taking keen interest in the review of this curriculum.

4. Secretary, Board of Technical Education, UP for initiating this project of review of curriculum.

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

6. Faculty/Subject Experts from U.P. Government polytechnics

Coordinator
Institute of Research Development & Training,
Kanpur, U.P.

1. SALIENT FEATURES OF DIPLOMA PROGRAMME IN CHEMICAL TECHNOLOGY (RUBBER AND PLASTIC)

1)	Name of the Programme	:	Diploma Programme in Chemical Technology (Rubber and Plastic)
2)	Duration of the Programme	:	Three years (Six Semesters)
3)	Entry Qualification	:	Matriculation or equivalent NSQF Level as Prescribed by State Board of Technical Education, UP
4)	Intake	:	60 (or as prescribed by the Board)
5)	Pattern of the Programme	:	Semester Pattern
6)	NSQF Level	:	Level - 5
7)	Ratio between theory and Practice	:	45 : 55 (Approx.)

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

9) Ecology and Environment :

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

10) Energy Conservation:

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

11) Entrepreneurship Development:

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

12) Student Centered 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 Chemical Technology (Rubber Plastic) are visualized in following industries at various levels/positions:

i) Chemical and Allied Industries like

- Polymer Processing
- 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 Production 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
- Packaging industries
- Testing & Quality Control
- 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, Defense 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)

3. LEARNING OUTCOMES OF DIPLOMA PROGRAMME IN CHEMICAL 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.

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
2.	Read and interpret drawings related to plant layout, process equipment and components, process flow sheets and product manufacturing.	- Technology of Plastic Material - Technology of Natural & Synthetic Rubber Material - Processing of plastic & Rubber
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 - Chemical Reaction Engineering & Thermodynamics
5.	Understand various unit operations, unit processes and process instrumentation in process industry	- Measuring Instruments and Measurements - Fluid Mechanics and Solid Handling - Heat & Mass Transfer
6.	Calculate the quantity of raw materials, energy inputs, manpower requirement and output from the process	- Material and Energy Balance
7.	Control the process and quality of the products commensurating with laid specifications	- Process Control
8.	Recognize the need for and have the ability to engage in lifelong learning	- Student Centered Activities
9.	Conduct experiments, analyze, interpret data and synthesize valid conclusions	- Applied Chemistry, polymer Chemistry - Chemical Reaction Engineering
10.	Operate conventional machine for machining of components as per specifications as an aid to function effectively in the process industry.	- General Workshop Practice
11.	Use electrical and electronic instruments to measure various engineering parameters	- Basics of Electrical and Electronics Engg.

12.	Use various measuring and gauging instruments	- Measuring Instruments & Measurements
13.	Select material as per desired application	- Technology of Plastic Material - Technology of Natural & Synthetic Rubber Material
14.	Understand the general design of process equipments and testing	- Process Control - Quality Control & Testing of Polymer - Plastic Rubber Mold Die Design & Construction
15.	Operate different utility plants	- Process Plant Utilities - Process Control
16.	Understand different renewable sources of energy and their applications.	- Renewable Energy Sources
17.	Understand different plants utilities and their generation and maintenance	- Process Plant Utilities
18.	Use various software tools for automation and process development.	- Computer Applications in Engineering/ Technology
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 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

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 Information Technology

d) Applied Courses in Engineering/Technology

Measuring Instruments and Measurement

Applied Mechanics

Fluid Mechanics and Solid Handling

Basics of Electrical and Electronics Engineering

Polymer Chemistry

Chemical Reaction Engineering & Thermodynamics

Process Plant Utilities

Heat & Mass Transfer

Pollution Control and Industrial Safety

Process Control

Plastic Rubber Mold Die Design & Construction

Material and Energy Balance

Renewable Energy Sources

Plastic & Rubber Compounding

Plastic & Rubber Processing-I & II

Quality Control & Testing of polymer

Polymeric Composites

Technology of Plastic Material

Technology of Natural & Synthetic Rubber

Plastic & Rubber Waste Management

Industrial Training

Project Work

Elective

Foam & Adhesive Technology

Polymer Blend & Alloy

Plastics in Building Services

6. HORIZONTAL AND VERTICAL ORGANISATION OF THE SUBJECTS

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		12	-	-	-	-
6.	Measuring Instruments and Measurements	6	-	-	-	-	-
7.	Polymer Chemistry	8	9	-	-	-	-
8.	Universal Human Values	3					
9.	Applied Mechanics	-	7	-	-	-	-
10.	Technology of Plastic Material	-	5	-	-	-	-
11.	Environmental Studies	-	-	5	-	-	-
12.	Fluid Mechanics & Solid handling	-	-	11	-	-	-
13.	Material and Energy Balance	-	-	6	-	-	-
14.	Basics of Electrical and Electronics Engg	-	-	-	9	-	-
15.	Basics of Information Technology	-	-	6	-	-	-
16.	Renewable Energy Sources	-	-	4		-	-
17.	Chemical Reaction Engineering & Thermody.	-	-	9		-	-
18.	Process Plant Utilities	-	-	-	-	8	-
19.	Heat & Mass Transfer	-	-	-	-	10	-
20.	Fuel and Material Technology	-	-	-	-	-	-
21.	Energy Conservation	-	-	-	-	-	5
22.	Industrial Management and Entrep.Development	-	-	-	-	-	5
23.	Plastic & Rubber Processing	-	-	-	9	10	-
24.	Plastic & Rubber Compounding	-	-	-	5		-
25.	Pollution Control and Industrial Safety	-	-	-	-	11	-
26.	Plastic & Rubber Waist Management	-	-	-	-	4	-
27.	Elective	-	-	-	-	4	-
28.	Quality Control & Testing of Polymer	-	-	-	9	-	-
29.	Technology of Natural & Synthetic	-	-	-	5	-	-
30.	Process Control	-	-	-	-	-	10
31.	Polymer Composits	-	-	-	-	-	9
32.	Plastic & Rubber Mould Die Design & Const.	-	-	-	-	-	6
33.	Project Work	-	-	-	-	-	8
34.	Student Centred Activities	6	3	2	5	1	5
Total		**48**	**48**	**48**	**48**	**48**	**48**

STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN CHEMICAL TECHNOLOGY (RUBBER & PLASTIC)

FIRST SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
1.1	*Communication Skills-I	4	-	2	4	20	10	30	50	2 ½	20	3	70	100
1.2	*Applied Mathematics-1	5	-	-	4	20	-	20	50	2 ½	-	-	50	70
1.3	*Applied Physics-1	5	-	2	5	20	10	30	50	2 ½	20	3	70	100
1.4	*Applied Chemistry	5	-	2	5	20	10	30	50	2 ½	20	3	70	100
1.5	Measuring Instruments & Measurements	4	-	2	4	20	10	30	50	2 ½	20	3	70	100
1.6	General Workshop Practice 1	-	-	8	3	-	40	40	-	-	60	4	60	100
1.7	Universal Human Values	2	-	1	2	-	20	20	-	-	30	3	30	50
#Student Centred Activities		-	-	6	2	-	30	30	-	-	-	-	-	30
Total		**25**		**23**	**29**	**100**	**130**	**230**	**250**		**170**		**420**	**650**

* 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	Polymer Chemistry	5		4	6	20	10	30	50	2 ½	20	3	70	100
2.5	Technology of Plastic Material	5			4	20	-	20	50	2 ½	-	-	50	70
2.6	Engineering Drawing	2		10	4	20	-	20	50	3.0	-	-	50	70
#Student Centred Activities		-		3	1	-	30	30	-	-	-	-	-	30
Total		**27**		**21**	**29**	**120**	**60**	**180**	**300**		**60**		**360**	**540**

* 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 & Solid Handling	6		5	7	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 Reaction Engineering & Thermodynamics	5	-	4	6	20	-	20	50	2 ½	-	-	50	70
3.6	Basics of Information Technology	-	-	6	2	-	40	40	-	-	60	3	60	100
3.7	Renewable Energy Sources	4	-	-	3	20		20	50	2 ½	-	-	50	70
#Student Centred Activities		-	-	2	1	-	30	30	-	-	-	-	-	30
Total		29	-	19	31	120	110	230	300		130		430	660

* 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 SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
4.1	*Communication Skills-II	4	-	2	4	20	10	30	50	2½	20	3	70	100
4.2	Plastic & Rubber Processing -I	5		4	6	20	10	30	50	2½	20	3	70	100
4.3	Quality Control & Testing of Polymer	5		4	6	20	10	30	50	2½	20	3	70	100
4.4	Plastic & Rubber Compounding	5			4	20	-	20	50	2½	-	-	50	70
4.5	*Basic of Electrical and Electronics Engineering	5	-	4	5	20	30	50	50	2 ½	50	3	100	150
4.6	Technology of Natural & Synthetic Rubber	5		-	5	20	10	30	50	2½	20	3	70	100
#Student Centred Activities		-	-	5	1	-	30	30	-	-	-	-	-	30
Total		29	-	19	31	120	100	220	300	-	130	-	430	650

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 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 50	Hrs -	Tot 50	
-	Industrial Training	-	-	-	2	-	-	-	-	-	50	3	50	50
5.1	Heat & Mass Transfer	6		4	6	20	30	50	50	2½	50	3	100	150
5.2	Pollution Control and Industrial Safety	5	-	6	5	20	30	50	50	2½	50	3	100	150
5.3	Process Plant Utilities	6	-	2	5	20	30	50	50	2½	50	3	100	150
5.4	Plastic & Rubber Processing -II	6		4	6	20	30	50	50	2½	50	3	100	150
5.5	Plastic & Rubber Waist Management	4			3	20	-	20	50	2½	-	-	50	70
5.6	**Elective (Any One)	4			3	20	-	20	50	2½	-	-	50	70
#Student Centred Activities		-	-	1	1	-	30	30	-	-	-	-	-	30
Total		31		17	31	120	120	240	300		200		500	820

**Elective (Any One)

1.0 Foam & Adhesive Technology
2.0 Plastic in Building Service
3.0 Polymer Blends & Alloys

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	Polymer Composites	5		4	6	20	30	50	50	2½	50	3	100	150
6.2	Plastic & Rubber Mould Die Design & Construction	6	-	-	5	20		20	50	2½			50	70
6.3	*Industrial Management and Entrepreneurship Development	5	-	-	4	20	-	20	50	2½	-	-	50	70
6.4	Energy Conservation	3		2	3	20	30	50	50	2½	50	3	100	150
6.5	Process Control	6		4	6	20	30	50	50	2½	50	3	100	150
6.6	Project Work	-	-	8	3	-	50	50	-	-	100	3	100	150
#Student Centred Activities		-	-	5	2	-	30	30	-	-	-	-	-	30
Total		25		23	29	100	170	270	250		250		500	770

* 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)

8.1 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

8.2 Guidelines for Internal Assessment

- The distribution of marks for Internal Assessment in theory subjects shall be made as per the following guidelines:
  i. 60% of internal assessment shall be based on the performance in the house tests. At least three such tests shall be conducted during the semester out of which best two shall be counted for assessment.
  ii. 20% marks shall be given based on performance in seminar, group discussion etc. by assessing the technical and communication skills of the student.
  iii. 20% marks shall be given for attendance/punctuality in the subject concerned and for assignments, in equal proportion.
- The distribution of marks for Internal Assessment in practical subjects shall be made as per the following guidelines:
  i. 60% marks shall be awarded for performance in practical
  ii. 20% marks shall be given for Report/Practical book and punctuality in equal proportion.
  iii. 20% marks shall be for Viva-voce conducted during the practical.

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

3 Reading Skill (10 periods)

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

4 Writing Skill (15 periods)

4.1 Picture composition
4.2 Writing paragraph
4.3 Notice writing

LIST OF PRACTICALS

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

Listening and Speaking Exercises

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. Communicating Effectively in English, Book-I by 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. Prsad, S.K. Katria & Sons, New Delhi
6. Q. Skills for success – Level & Margaret Books, Oxford University Press.
7. E-books/e-tools/relevant software to be used as recommended by AICTE/UPBTE/NITTTR.

Websites for Reference:

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

SUGGESTED DISTRIBUTION OF MARKS

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

1.2 APPLIED MATHEMATICS - I

L	T	P
5	-	-

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Algebra -I (12 Periods)

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

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

   1.3 Determinants : Elementary properties of determinant of order 2 and 3, Multiplication system of algebraic equation, Consistency of equation, Crammer'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, Logaritimic differentiation, Differentiation of Inverse trigonometric function, Differentiation of implicit functions.

5. Differential Calculus - II (18 Periods)

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

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

INSTRUCTONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

1.3 APPLIED PHYSICS – I

L	T	P
5	-	2

RATIONALE

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

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

LEARNING OUTCOMES

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

- Identify the use of S.I. system of measurement with accuracy and how it is used in engineering
- Represent physical quantities as scalars and vectors, applying the physical laws and concepts of linear and circular motion in everyday life.
- Solve difficult problems (walking of man, horse and cart problem, flying of bird/ aircraft, etc.)
- 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 modulii 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 Adibatic process

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

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

LIST OF PRACTICALS

1 To find radius of wire and its volume and the maximum permissible error in these quantities by using both vernier calipers and screw gauge.
2 To find the value of acceleration due to gravity on the surface of earth by using a simple pendulum.
3 To determine the Radius of curvature of (i) convex mirror, (ii) concave mirror by spherometer
4 To verify parallelogram law of forces
5 To study conservation of energy of a ball or cylinder rolling down an inclined plane.
6 To find the Moment of Inertia of a flywheel about its axis of rotation
7 To determine the atmospheric pressure at a place using Fortin's Barometer
8 To determine the viscosity of glycerin by Stoke's method
9 To determine the coefficient of linear expansion of a metal rod
10 To determine force constant of spring using Hooks law

INSTRUCTIONAL STATREGY

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

MEANS OF ASSEMENTS

– Assignment & Quiz,

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

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

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

1.4 APPLIED CHEMISTRY

L	T	P
5	-	2

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

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

1.1 Fundamental particles- mass and charges of electrons, protons and neutrons 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.
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. Primming 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 Electrobytes); 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.
5. Determination of flash and fire point of given lubricating oil using Able's flash point apparatus

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSEMENTS

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

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 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.

INSTRUCTONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	12	22
2.	12	22
3.	12	20
4	12	22
5	08	14
Total	**56**	**100**

1.6 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 1	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 1 : Preparation of job using elbow, bend and nipple

Job II: Preparation of job using Union, Tap, Plug and Socket.
Job III: Threading practice on pipe with die

MEANS OF ASSESSMENT

- Workshop jobs
- Report writing, presentation and viva voce

RECOMMENDED BOOKS

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

1.7 Universal Human Values

L	T	P
2	-	1

Course Objectives

This introductory course input is intended

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

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

Course Methodology

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

The syllabus for the lectures is given below:

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

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

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

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

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

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

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

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

1. Understanding Harmony in the family – the basic unit of human interaction
2. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti;
    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-astitva as comprehensive Human Goals
6. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family!

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

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

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

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

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

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

a) Ability to utilize the professional competence for augmenting universal human order
b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,
c) Ability to identify and develop appropriate technologies and management patterns for above production systems.

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

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

7. To inculcate Human Values among Students: The Role of self ,Parents and Teachers -Practice Exercises and Case Studies will be taken up in Practice Sessions.

INSTRUCTONAL STRATEGY

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

MEANS OF ASSESSMENT

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

Reference Material

The primary resource material for teaching this course consists of

a. The text book (Latest Edition)

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

b. The teacher's manual (Latest Edition)

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

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

1. B L Bajpai, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, *Science and Humanism*, Commonwealth Purblishers.
3. Sussan George, 1976, *How the Other Half Dies,* Penguin Press. Reprinted 1986, 1991
4. Ivan Illich, 1974, *Energy & Equity,* The Trinity Press, Worcester, and HarperCollins,

USA

5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III,

1972, limits to Growth, Club of Rome's Report, Universe Books.

6. Subhas Palekar, 2000, *How to practice Natural Farming,* Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagraj, 1998, *Jeevan Vidya ek Parichay,* Divya Path Sansthan, Amarkantak.
8. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, *Human Values*, New Age International Publishers.

Relevant websites, movies and documentaries

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

SUGGESTED DISTRIBUTION OF MARKS

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

2.1 APPLIED MATHEMATICS - II

L	T	P
5	-	-

RATIONALE

Basic elements of integral calculus, differential calculus, numerical methods, differential m equations included in this course will play a vital role in understanding engineering problem mathematically. This will also develop analytical as well as conceptual abilities 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 Simposns3/8th rule and Trapezoidal Rule : their application in simple cases. Numerical solutions of algebraic equations; Bisections method, Regula-Falsi method, Newton-Raphson's method(without proof), Numerical solutions of simultaneous equations; Gauss elimination method(without proof)

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

3.1 Circle

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

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

4.1 Straight lines and planes in space

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

INSTRUCTONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

2.2 APPLIED PHYSICS – II

L	T	P
5	-	2

RATIONALE

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

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

LEARNING OUTCOMES

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

- Define wave motion its types (Transverse and Longitudinal), Periodic and Simple Harmonic Motion, solve simple problems.
- Define the terms: frequency, amplitude, wavelength, velocity of a wave.
- Explain various Engineering, Medical and Industrial applications of 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 (Brewser's law), Malus law, use of polariods.

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 taped),

6.3 Semiconductor transistor, pnp and npn (concepts only)

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

7. Modern Physics (8 Periods)

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

7.2 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 STATREGY

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

MEANS OF ASSESSMENT

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

L	T	P
5	-	4

RATIONALE

The Purpose of this Paper is to acquaint the students with Polymers and their Reactions, Polymerization Techniques, Classification, Molecular weight, Distribution of Molecular weight, Degradation and Scope of Plastic and Elastomers which will be useful in Practical working conditions.

LEARNING OUTCOMES

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

- Understand the fundamentals types and properties of polymers.
- Understand and apply the chain growth polymerization and it's kinetics.
- Understand and apply the step growth polymerization, its kinetics, and crosslinking.
- Analyse polymerization components for determination of molecular weight and molecular weight distribution of polymers, copolymers, etc.
- Understand and Analyse Co-polymerization and its types, ring opening polymerization.
- Apply knowledge of chemistry for analysing polymerization components.

DETAILED CONTENTS

UNIT -I

A. INTRODUCTION:

- Introduction & historical background macromolecular concept
- monomer & polymers
- Nomenclature of polymers
- Characteristic features of a polymer
- Definition of polymerization
- Polymerization and functionality,
- High polymers and oligopolymers.
- Scope of elastomeric, Fabre forming and plastic materials.

B. CLASSIFICATION OF POLYMERS (Brief Study):

Classification of polymers on the basis of

A. Origin - natural, semisynthetic & synthetic.
B. Thermal response - Thermoplastic & Thermosetting.
C. Mode of formation - Addition & Condensation.
D. Line structure - Linear, branched, Cross linked.
E. Application & Physical Properties - Rubber, Plastic and fibers.
F. Tacticity - Isotactic, syndiotactic and atactic.
G. Crystallinity - Non crystalline (amorphous), Semi-crystalline and crystalline.

UNIT -II

A. TYPES OF POLYMERISATION:

- Addition (chain) polymerization,
- Condensation polymerization,
- Comparison between addition and condensation polymerization,
- Copolymerization,
- Types of co-polymer - Random, Alternate and Block.

B. CHEMISTRY OF POLYMERISATION:

Mechanism of addition polymerization - Initiation step, propagation step and termination step, chain transfer, Rate of polymerization, Average degree of polymerization Types of initiations, inhibitors, types of polymerization reactions as - free radical polymerization, anionic and cant ionic polymerization reactions co-ordination polymerization or Ziegler - Natta polymerization, polycondensation polyaddition polymerization, ring opening polymerization, miscellaneous polymerization reactions.

UNIT -III

POLYMERISATION TECHNIQUES:

Suspension, Bulk and Emulsion & Solution polymerization, Mini Emulsion and Mini Suspension polymerization. Interfacial Polymerization.

UNIT -IV

POLYMER STRUCTURE & PROPERTIES

A. CHEMICAL & GEOMETRIAL STRUCTIRE OF POLYMER MOLECULES:

General remarks on polymer microstructure, microstructure based on chemical structure
(a) Organic and inorganic polymers
(b) homochain and hetero chain polymers
(c) homopolymers and copolymers. Microstructure based on the geometrical structure i.e. linear, branched and cross-linked polymers, random, alternating, block and graft copolymers, stereo regular polymers.

B. POLYMER PROPERTIES & EFFECT OF POLYMER STRUCTURE ON PROPERTIES:

I. Molecular Weight of a Polymer:

Determination of molecular weight of a polymer average molecular weight, number average molecular weight (Mn), weight - average molecular weight (Mw), viscosity average molecular weight (Mv) molecular weight and degree of polymerization, polydispersity index and molecular weight distribution in polymers, the practical significance of polymer molecular weight, size of polymer molecules.

II. Crystallinity in Polymers :

Degree of crystallinity crystallizable polymer crystallization, effect of crystallinity on the properties of polymers.

III. Glass Transition Temperature:

What is glass transition temperature, glassy solids and glass transition, transition and associated properties factors influencing the glass transition temperature and molecular weight, Glass transition temperature and plasticisers. Glass transition temperature of co-polymers, Glass transition temperature and melting point. Importance of glass transition temperature, Heat distortion temperature.

IV. Effect of Polymer Structure on Properties :

1. Strength
2. Plastic deformation
3. Physical state of polymer
4. Chemical resistance
5. Crystallinity
6. Mechanical behavior of polymers

UNIT -V

POLYMER REACTIONS:

A- Hydrolysis, Acidolysis, Aminolysis, Hydrogenation, addition and substitution reactions of various specific groups, cyclisation reaction, cross linking reaction, miscellaneous reactions.

B- Polymer Degradation:

What is polymer degradation, types of degradation?

UNIT -VI

I-Experimental

Determination of refractive index of organic compounds, purification, determination of yield and refractive index of monomers and solvents, determination of density of plastic sample, identification of known and unknown polymer (simple physical method of identification like visual examination, heating, burning, solubility, elements detection and confirmatory chemical test for unprocessed and processed) samples

LIST OF PRACTICALS.

1. Determination of refractive index of organic compounds.
2. Purification of monomers and determining the yield and refractive index of the purified monomer.
3. Purification of monomer/solvent by washing and determination of yield.
4. Determination of percentage purity of initiators, viz. benzoyl peroxde, AIBN, etc.
5. Determination of density of given polymer sample that sinks in water.
6. Determination of specific gravity of given molded sample of plastic.
7. Preparation of Phenol Formaldehyde moulding powder.
8. Polymerisation of Styrene/monomer by emulsion polymerisation
9. Polymerisation of styrene by suspension/solution polymerization
10. Polymerisation of Methyl Methacrylate monomer by bulk polymerization.
11. Determination of melting point of Plastics/Rubber samples
12. Identification of known and unknown Plastic samples (unprocessed and processed) samples.

INSTRUCTIONAL STRATEGY

Polymer Chemistry being a fundamental subject, the teacher are expected to give knowledge of Polymer chemistry and importance of the subject. Students should also be do Experiment on the Concept of Polymer Chemistry.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. F. W. Billmeyer, "Text Book of Polymer Science ", John. Wiley & Sons, 1990.
2. Vasant R. Gowariker, "Polymer Science", New Age International, 1986. .
3. Premamoy Ghosh, " Polymer Science and Technology ", Tata McGraw-Hill Education,1990.
4. George Odian, " Principles of Polymerization ", Wiley, 1981.
5. Paul J. Flory, " Principles of Polymer Chemistry ", Cornell University Press, 1953.
6. Robert W. Lenz, " Organic Chemistry of Synthetic High Polymers ", John Wiley & Sons Inc, 1967.
7. D. Margerison, " An Introduction to Polymer Chemistry ", Pergamon,

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	14
2	14	18
3	08	12
4	14	20
5	12	16
6	14	20
Total	**70**	**100**

2.5 TECHNOLOGY OF PLASTIC MATERIAL

L	T	P
5	-	-

RATIONALE

The knowledge of this paper will equip the student with the knowledge of plastic material, raw material i.e. Vinyl Polymers, Flurocarbon Polymers etc. which will prove useful in practical atmosphere.

LEARNING OUTCOMES

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

- Understand industrial methods of polymerization, different aspects of a polymerization plant, reactors, safety and plant automation.
- Understand stereo specific catalyst and polymerizations.
- Understand and apply the production process for commodity thermoplastics.
- Understand and apply the production process for common thermoset polymers.
- Understand and analyze production technology, properties and applications of polymers and their copolymers.
- Apply techniques of polymerization for synthesis of polymers at lab scale.

DETAILED CONTENTS

I. Introduction of General parts of polymerization plants. Batch & continuous production processes.

II. Industrial Manufacturing processes of common thermo- plastic such as polyethylene's polypropylenes and polystyrenes and its co-polymers i.e.: ABS & SAN polyvinylchloride acrylic polymers along with their properties and applications. Introduction to new polymers such as polycarbonates, polypsulphones, polyimide, PET (Polyethylene terephthalate, PTFE (Poly Tetra Fluro Ethylene). Chemistry and Production of nylon 6 and nylon 6.6

III. Manufacturing process, properties and application of synthetic condensation polymers (Themro-setting Plastic of synthetic such as phenol formaldehyde, urea formaldehyde, melamine formaldehyde polyester (saturated and unsaturated) epoxy resins, vinyl esters)

IV. Advance polymer material such as Liquid crystal polymer, Conducting polymer, High energy absorbing material, Smart material, Nano polymer, etc.

INSTRUCTIONAL STRATEGY

Technology of Plastic Material is a fundamental subject of Plastic Material, the teacher are expected give Knowledge in such manner so students are able to appreciate the importance of the subject.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. J. A. Brydson, " Polymer Materials ", Butterworth-Heinemann, 1990.
2. Mark &Overberger, " Encyclopedia of Polymer Science & Tech. " Wiley-Interscience, 1986.
3. J. Scheries& W. Kaminsky, " Metallocene based Polymers ", Wiley, 2000.
4. Vasant R. Gowariker, "Polymer Science ", New Age International, 1986.
5. Christopher C. Ibeh, " Thermoplastic Materials: Properties, Manufacturing Methods, and Applications ", Taylor and Francis Group, 2011.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	20
2	30	50
3	14	20
4	12	10
Total	**70**	**100**

2.6 ENGINEERING DRAWING

L	T	P
2	-	10

RATIONALE

Drawing, which is known as the language of engineers, is a widely used means of communication among the designers, engineers, technicians, draftsmen and craftsmen in the industry. The translation of ideas into practice without the use of this graphic language is really beyond imagination. Thus, for the effective and efficient communication among all those involved in an industrial system, it becomes necessary that the personnel working in different capacities acquire appropriate skills in the use of this graphic language in varying degrees of proficiency in accordance with their job requirements. Generally speaking, an engineering technician working at the middle level of the three-tier technical manpower spectrum, is required to read and interpret the designs and drawings, provided to him by technologists and subsequently to translate them to the craftsmen for actual execution of the job. This course in Engineering Drawing has been designed, keeping in view, the above referred job functions of a technician in the industry. This preliminary course aims at building a foundation for the further courses in drawing and other allied subjects. The contents of the course have been selected as to form a core for the various diversified fields of engineering. It is expected that at the end of this session, the students acquire sufficient skill drafting and some ability in spatial visualization of simple objects.

LEARNING OUTCOMES

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

- Understand the Basic Concepts of Engineering Drawing.
- Apply Different Drawing Instruments
- Apply Different Lettering Techniques
- 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

NOTE : Latest Indian Standards Code of Practice to be followed.

1. Drawing, instruments and their uses. 1 Sheet

1.1 Introduction to various drawing, instruments. 1

1.2 Correct use and care of Instruments.
1.3 Sizes of drawing sheets and their layouts.

2. (a) Lettering Techniques 2 Sheet
Printing of vertical and inclined, normal single stroke capital letters.
Printing of vertical and inclined normal single stroke numbers.
Stencils and their use.

(b) Introduction to Scales 2 Sheet
Necessity and use, R F Types of scales used in general engineering drawing.
Plane, diagonal and chord scales.

3. Conventional Presentation: 1 Sheet

Thread (Internal and External), Welded joint, Types of lines, Conventional representation of materials, Conventional representation of machine parts.

4. (a) Principles of Projection 1 Sheet

Orthographic, Pictorial and perspective.

Concept of horizontal and vertical planes.

Difference between I and III angle projections.

Dimensioning techniques.

(b) Projections of points, lines and planes. 1 Sheet

5 (a) Orthographic Projections of Simple 2 Sheet

Geometrical Solids

Edge and axis making given angles with the reference planes. Face making given angles with reference planes. Face and its edge making given angles with reference planes.

(b) Orthographic views of simple composite solids from their isometric views.

(c) Exercises on missing surfaces and views

6. Section of Solids 2 Sheet

Concept of sectioning

Cases involving cutting plane parallel to one of the reference planes and perpendicular to the others.

Cases involving cutting plane perpendicular to one of the reference planes and inclined to the others plane, true shape of the section

7. Isometric Projection. 2 Sheet

Isometric scale

Isometric projection of solids.

8. Free hand sketching 1 Sheet

Use of squared paper

Orthographic views of simple solids

Isometric views of simple job like

carpentry joints

9. Development of Surfaces 2 Sheet

Parallel line and radial line methods of developments.

Development of simple and truncated surfaces (Cube, prism, cylinder, cone and pyramid).

10. ORTHOGRAPHIC PROJECTION OF MACHINE PARTS: 2 Sheet

Nut and Bolt, Locking device, Wall bracket

11. PRACTICE ON AUTO CAD : 2 Sheet

Concept of AutoCAD, Tool bars in AutoCAD, Coordinate System, Snap, Grid and Ortho mode. Drawing Command - Point, Line, Arc, Circle, Ellipse. Editing Commands - Scale, Erase, Copy, Stretch, Lengthen and Explode. Dimensioning and Placing text in drawing area. Sectioning and hatching. Inquiry for different parameters of drawing.

NOTE :

A. The drawing should include dimension with tolerance wherever necessary, material list according to I.S. code. 25% of the drawing sheet should be drawn in first angle projection and rest 75% drawing sheet should be in third angle figure

B. Practice on AutoCAD latest software is to be done in AutoCAD lab of Mechanical Engineering Department of the Institute.

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.

3.1 ENVIRONMENTALSTUDIES

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 tha/t 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 O_2, 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.
8. E-books/e-tools/relevant software to be used as recommended by AICTE/ NITTTR, Chandigarh.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

3.2 APPLIED MATHEMATICS –III

L	T	P
5	-	-

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Matrices (16 Periods)

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

1.2 Elementry 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 eign values and eign vectors of a matrix of order two and three, Cayley-Hamilton theorem (without Proof)and its verification, Use in finding inverse and powers of a matrix.

2. Differential Calculus (15 Periods)

2.1 Function of two variables, identification of surfaces in space, 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 todouble 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 seperable, equations reducible to seperable forms, Homogeneous eqution, equations reducible to homogeneous forms, Linear and Bernoulli form exact equation and their solutions.

3.3 Higher Order Linear Equation :

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

3.4 Simple Applications

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

4. Integral Calculus-II (12 Periods)

4.1 Beta and Gamma Functions

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

4.2 Fourier Series

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

4.3 Laplace Transform

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

5. Probability and Statistics (12Periods)

5.1 Probability

Introduction, Addition and Multiplication theorem and simple problem.

5.2 Distribution

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

INSTRUCTONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

L	T	P
6	-	5

RATIONALE

The subject will enhance the knowledge of students about fluids and their properties like shear, laminar, turbulent, continuity equation, friction losses and other properties of incompressible fluids. Time of emptying a tank, transportation of fluids and measurement of flowing liquids. Solid handling is the fundamental of different machine and equipments used in the chemical industries such as grinding, crushing, ball mills etc. chain belts and screw conveyor, filtration & mixing equipments. Theoretical and experimental work will inculcate their interest in learning and teaching among the students and teachers.

LEARNING OUTCOMES

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

- Understand the need of fluid mechanics for chemical engineers.
- Understand the basic terms and their concepts of fluid flow
- Apply the knowledge to develop a dimensional number for the fluid flow.
- Understand the fundamentals in characterization and classification of solids.
- Understand the sieving performances using different sieve size.
- Calculate the crushing efficiency of different size reduction equipment using crushing laws.

DETAILED CONTENTS

PART - A

1. FLUIDS (8 periods)
   (i) Properties
   (ii) Classification of Fluids.
   (iii) Fluid manometers, description and simple numerical problems.

2. FLOW OF INCOMPRESSIBLE FLUIDS: (12 periods)

   (i) Shear stress distribution in a cylindrical tube, velocity distribution for Newtonion fluid.

   (ii) Reynold No. Elementary knowledge of laminar and turbulent flow, Reynold experiment.

   (iii) Continuity equations, Bernoulli's theorem, fluid heads and power requirement calculation.

   (iv) Friction factor, Fanning equation and Hagen Poiseuille equation friction losses in pipes, calculation of friction loss due to enlargement, contraction, fittings and valves.

(v) N.P.S.H., cavitation, pipes, tubing, fittings & (Valves numerical problems)

3. MEASUREMENT OF FLOWING FLUIDS: (14 periods)

Orifice meter, venturimeter, pitot tube, rotameter, weirs and notches (Their construction and derivation of formulae simple numerical problems, Definition:-Cofficient of contraction, Coefficient of velocity, coefficient of discharge (Simple numerical problems).

4. TRANSPORTATION OF FLUIDS: (8 periods)

Classification of pumps, construction and operation of Air lift, reciprocating, rotary, and centrifugal and gear pumps.

PART - B

1. INTRODUCTION: (4 periods)

Concept and role of unit operation in Industries.

2. CHARACTERISATION OF SOLID PARTICLES: (8 periods)

Characterization of solid particles, screening equipments, standard screens, screen analysis, Grizzles, trommels.

3. SIZE REDUCTION: (10 periods)

Theory of crushing, Rittinger's law, Kick's law, Bond's Law Crushing and grinding machinery; their classification, general description of jaw crusher, gyratory crusher, roll crusher, hammer mills, ball mills, open circuit and closed circuit Systems.

4. HANDLING OF SOLIDS: (8 periods)

Conveying equipments, their classification general construction and industrial application, Belt conveyors, chain conveyors and screw conveyors.

5. MECHANICAL SEPARATIONS: (8 periods)

(i) Types of filtration equipment, their application and operation, sand filters, filter press, leaf filters, rotary filters, filter aids. Centrifugal filtration.

(ii) Classifiers.

(iii) Thickener

(iv) Cyclones.

6. MIXING EQUIPMENTS: (4 periods)

Mixing equipments used for liquid-liquid, liquid-solid and liquid-gas system.

LIST OF PRACTICALS

1. To determine the co-efficient of discharge of orifice-meter.

2. To determine the co-efficient of discharge of venturimeter.

3. To determine the co-efficient of discharge of V-Notches.

4. To determine the co-efficient of discharge of Rectangular Notches.

5. To determine coefficient of velocity (Cv), coefficient of discharge (Cd),coefficient of contraction (Cc) and verify the relation between them.

6. To determine friction losses in pipes and fittings.

7. To verify loss of head due to

   (a) Sudden Enlargement.

   (b) Sudden Contraction.

8. To verify Bernoullie'sTheorem .

9. To perform Reynold's experiments.

10. To determine the efficiency of a centrifugal pump.

11. Study the following.

   (a) Reciprocating Pump.
   (b) Pressure Gauge/Water Meter/Mechanical Flow Meter/Pitot Tube.

12. To study and draw a sketch of Chemical Engineering lab.
13. To analyse the given sample on a set of screens and report the analysis.
14. To determine the critical speed of a ball mill.
15. To determine the efficiency of disintegrator.
16. To determinefilteration constant by a plate and frame filter press.
17. To determine the rate of settling of slurries of various concentration draw a height VS time curve.
18. To determine the efficiency of Jaw crusher.
19. To study and sketch a Rotary filter.

RECOMMENDED BOOKS

1. McCabe and Smith, Unit Operations of Chemical Engineering: McGraw Hill
2. Coulson &Richardson , Chemical Engineering Vol. I: Pergamon, 1979 McGraw hill
3. Gupta, Vijay and S. K. Gupta, “Fluid Mechanics and its Applications”, Wiley Eastern, New Delhi (1984).
4. W.L.Badger and J.T.Banchero, Introduction to Chemical Engineering, TMH (1979)

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	8	8
2	12	15
3	14	18
4	8	8
5	4	5
6	8	8
7	10	15
8	8	8
9	8	10
10	4	5
Total	**84**	**100**

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

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

3. Gases and Gas Mixture (12Periods)

   3.1 Ideal gas law, Boyle's law, Charle's law, value of universal gas constant, Amagats Law, partial pressure
   3.2 Vander Waal's equation.

3.3 Average molecular weight, density and composition (by weight and by mole) of gas mixture.
3.4 Transform of material from one measure of concentration to another, including mass/volume, PPM, molality, normality and molarity.

4. Material Balance without Chemical Reaction (15Periods)

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

5. Material Balance with Chemical reaction (15 Periods)

5.1 Limiting component, excess component, percent conversion, percent yield, percent excess
5.2 By pass, recycle and purge stream related simple problems.

6. Energy Balance (15 Periods)

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

7. Combustion Process (15 Periods)
7.1 Analysis of products of combustion: proximate and ultimate analysis.
7.2 Problems of fuel analysis, air fuel ratio, 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 REACTION ENGINEERING & THERMODYNAMICS

L	T	P
5	-	4

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

Part-A

CHEMICAL REACTION ENGINEERING

1. Introduction to Chemical Kinetics (10 Periods)
   - 1.1 Concept of rate of reaction, rate equation, rate constant, order of reaction, Molecularity of reaction.
   - 1.2 Single reaction multiple reaction, non-elementary reaction.
   - 1.3 Theories of reaction (Collision & Transition State Theory) rates constant-Arrhenius law and problems based on it.
   - 1.4 Activation Energy.
   - 1.5 Definition, Important Classification and desired properties of catalysts.

2. Interpretation of batch reactor data. (10 Periods)
   - 2.1 Concept of batch & semi Batch reactor.
   - 2.2 Integral and Differential method of analysis of batch reactor data.
   - 2.3 Half-life concept for the overall order of irreversible reactions and problem based on that.

3. Introduction to Reactor Design (08 Periods)

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

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

PART-B
CHEMICAL ENGINEERING THERMODYNAMICS

1. Introduction and Basic Concepts (10 Periods)

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

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

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

3. Second Law of Thermodynamics (14 Periods)

Statement of second law of thermodynamics: Kelvin Plank statement and Classius statement, Carnot cycle and its efficiency, concept of entropy and entropy change for closed and open system.

Heat pump and heat engine (coefficient of performance and efficiency).

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

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

LIST OF PRACTICALS

1. Study and operation of batch reactor
2. Saponification reaction through batch reactor
3. Study the kinetics of reaction for all the combination for given PFR and CSTR in series

4. To find the Arrhenius equation from isothermal batch reactor.
5. To study the performance of a fluidized bed reactor
6. Study the performance of mixed flow reactor
7. Study the performance of plug flow reactor
8. Find out rate constant and in a CSTR

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

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

3.6 BASICS OF INFORMATION TECHNOLOGY

L	T	P
-	-	6

RATIONALE

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

Note:

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

LEARNING OUTCOMES

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

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

TOPICS TO BE EXPLAINED THROUGH DEMONSTRATION

1. Introduction to Computers and Peripherals.

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

2. Operation System and Application Software

   System Software, Application Software, Virtualization Software, Utility Software, MS Office/Open Office/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 envelops and lables
- 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

3.7 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)

    1.1. Introduction to wind energy
    1.2. Site selection of wind mill
    1.3. 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)

1.1. Introduction to solar energy, solar spectral and greenhouse effect
1.2. Classification of solar thermal collectors- flat type, focusing type and central tower receivers, their construction and working
1.3. Application of solar energy like solar cooker, solar water heater, solar crop dryers and solar pond
1.4. Solar photo voltaic- construction and working principle
1.5. 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)

1.1. Methods for hydrogen production
1.2. Storage of Hydrogen
1.3. 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 equipmentis 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 McGraw Hill 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**

4.1 COMMUNICATION SKILLS – II

L	T	P
4	-	2

RATIONALE

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

LEARNING OUTCOMES

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

- Frame correct sentences with illustrations
- Comprehend the language correctly
- Interpret the language correctly
- Use given material in new situations.
- Correspond effectively using various types of writings like letters, memos etc.
- Communicate effectively in English with appropriate body language making use of correct and appropriate vocabulary and grammar in an 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 RevathiSrinivas; Abhishek Publications, Chandigarh.
2. Communication Techniques and Skills by R. K. Chadha; Dhanpat Rai Publications, New Delhi.
3. High School English Grammar and Composition by Wren & Martin; S. Chand & Company Ltd., Delhi.
4. e-books/e-tools/relevant software to be used as recommended by AICTE/NITTTR, Chandigarh.

Websites for Reference:

1. http://www.mindtools.com/ page 8.html – 99k
2. http://www.letstalk.com.in
3. http://www.englishlearning.com

4. http://learnenglish.britishcouncil.org/en/
5. http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

4.2 PLASTIC & RUBER PROCESSING - I

L	T	P
5	-	4

RATIONALE

The purpose of this paper is to make the students aware of Plastic and Rubber processing i.e. different types of molding, mixing and casting techniques which will prove to be a powerful tool in the world of work.

LEARNING OUTCOMES

- Understand the concepts of Extrusion process of plastic & rubber materials.
- Understand and apply the utility of the single screw and multiple screw extruder systems.
- Knowledge of extrusion process for manufacturing of different extruded plastic products.
- Understand the concepts of Injection molding process of plastic & rubber materials.
- Understand the concepts of Blow molding process of plastic materials.
- Understand the concepts of compression /transfer process of plastic & Rubber materials.

DETAILED CONTENTS

PLASTIC PROCESSING

1. Concept and Introduction of plastic processing and short description of different processing techniques.

2. **EXTRUSION**:

Basic principle of Extrusion, Extrusion process, Single screw extruder and multiple screw extruder. Different zones of extruders. Design of screw for different types of plastics. Extruder components such as Barrel, Screw, hopper, Die, L/D ratio and Compression ratio of screw. Advantage and disadvantage of single screw extruder over multiple screw and vice-versa. Extruder performance and extruder die and screw characteristics curves, Flow in extruder, barrels statics, drag pressure and pressure flow. Heat and temperature control in extruders cooling and take off system. Extrusion Process for production of plastic film. Extrusion process for production of plastic pipe. Extrusion Process for production of plastic profiles. Extrusion Process for production for wire coating. Importance and utility of co-extrusion process Faults & their remedies in extruder. Introduction to Reactive extrusion processing.

3 **CALENDERING:**

Basic principles of calendaring processes, types of Roll arrangement. Heating and cooling system, Calendaring variables, Faults and Remedies.

4. **INJECTION MOULDING**:

Basic process and materials, Elements of Injection molding, i.e. Injection unit, clamping unit, Mould and machine controls. Classification of Injection Molding Machine, Hand operated and Power operated Plunger and Screw type. Advantages of screw type and plunder type machine. Injection molding cycle, Nozzle, Mould Temperature control, Specification of Injection Molding machine, Molding defects and their remedies, Application of injection molding, Elementary knowledge of Reaction Injection Molding- Gas Injection Molding, Plastic Over Molding, Insert Injection Moulding, Thermoset Injection Molding.

5. **BLOW MOULDING:**

Basic Process and Materials, Types of Blow moulding i.e. Hand operated and Power operated, Extrusion blow moulding, Injection blow moulding machine, Stretch blow moulding, Finishing operation, Moulding defects and their remedies. Application of blow moulding.

6. **COMPRESSION MOULDING & TRANSFER MOULDING**::

Basic Process and materials, Moulding cycles, Advantages and limitations for compression moulding, Application of compression moulding, Defects and their remedies in compression molding . Basic processes and materials, Types of transfer moulding, Advantage and limitation of Transfer moulding, Defects and their remedies Transfer moulding.

EQUIPMENTS FOR THE COMPRESSION AND TRANSFER MOULDING:

Hard Press, Manually operated hydraulic press, Automatic hydraulic press, Preheaters, Performers, Heating system, Cleaning and finishing devices.

7 <u>RUBBER PROCESSING.</u>

1. EXTRUSION:

Screw extrusion, Ram extrusion and Extrusion Technology.

2. Hand Molding and forming.

3. Vulcanization by methods other than moulding Batch curing methods, Continuous vulcanizing methods.

4. Finishing of Rubber components, Flash and spot removal, Punching grinding, Shaft blasting, Painting and lacquering chemical surface treatment. Types of take off system.

List of Practical
PLASTICS PROCESSING SHOP

1. To study the effect of change in temperature of melt pressure, mould temperature on shrinkage in injection molding machine.

2. To study the effect of change in temperature of melt, pressure mould temperature on quality of product in injection molding machine.

3. Study and operation of compression molding machine (Semi automatic).

4. To produce two components of Thermosetting plastic by compression molding press and to prepare a quality record.

5. To develop formulation for a given colour shade and to produce a sample by dry mixing and to make granular of it by granulator.

6. To produce components by hand operated injection molding machine.

7. Study and operation of Automatic injection moulding machine and to produce 10 components by the same machine.

8. To produce components by hand operated blow molding machine.

9. Study and operation of Extruder.

10 To Produce rigid PVC pipe by Extruder.

11. To Produce Blown film by Blown Film Extruder.

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. Plastics Extrusion, by Allen Grief
2. Plastic Engineering Handbook (SPI), by Frados
3. Screw extrusion of Plastics, by Jacobi
4. Plastic materials and processes (a concise encyclopedia), by Charles Harper
5. Polymer Mixing and Extrusion Technology, by Nicholas Cheremisinoff
6. Plastics Extrusion Technology, Hanser SPE, 1996
7. Injection and Compression Moulding Fundamentals, by Isayev.
8. Encyclopedia of Polymer Science and Technology Vol. 1-23, by Mark &Overberger.

9. HandBook of Injection Moulding, by Rosato&Rosato.
10. Practical Thermoforming Principles & Applications, by J. Florian

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	02	5
2	14	20
3	08	10
4	14	20
5	12	15
6	12	15
7	08	15
Total	**70**	**100**

4.3 QUALITY CONTROL & TESTING OF POLYMERS

L	T	P
5	-	4

RATIONALE

For checking quality of the manufactured material its physical properties as well as chemical methods of analysis are required. The student having knowledge of Rheology andTesting will prove useful in the industrial atmosphere.

LEARNING OUTCOMES

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

- Understand the fundamentals of polymer rheology
- Apply mathematical models to interpret the flow behaviour of polymer melts
- Understand and apply the concept of measurement of viscosity and apply knowledge in handling rheological instruments
- Understand and apply testing of plastics materials for its mechanical, electrical, optical, and thermal properties.
- Apply characterization techniques viz. FTIR, NMR, TGA & DSC to elucidate the properties of polymers.
- Analyze testing of plastic materials on different testing equipments.

DETAILED CONTENTS

1. QUALITY CONTROL:

Introduction to quality control for plastic products, Need of quality control, General methods of quality control and introduction to various standards like IS, BS and ASTM etc. ISO 9000/Awareness

2. STRUCTURAL & PHYSICAL PROPERTIES:

Structural and physical properties such as mechanical, electrical, thermal and optical properties.

3. CHARACTERIZATION OF POLYMERS:

Elementary knowledge of physico-chemical methods of analysis such as I.R., D.T.A., T.G.A., D.S.C.& U.V. chromatography, FTIR etc.

4. MECHNAICAL PROPERTIES:

Testing of polymers according to standard methods like A.S.T.M. Or B.I.S.Impact strength like Izod, Charpy, Falling Dart and Tensile strength & Flexural strength .

5. RHEOLOGICAL PROPERTIES:

Introduction to polymer rheology, types of deformation. Newtonion and Non-newtonion flow, Classification of Non-newtonion fluid, Time dependent and time independent fluids, Visco-clestics fluids.

6. ELECTRICAL PROPERTIES:

Introduction to dielectric strength, arc resistance, volume and surface resistivity. Their physical significance & importance in polymer processing industries.

7. THERMAL PROPERTIES:

Introduction to melt-flow index, Vicat softening point, Heat distortion temperature. Their physical significance & importance in polymer processing industries.

8. OPTICAL PROPERTIES:
Introduction to transmittance and haze & gloss, Colour Testing, Weathering Properties. Their physical significance & importance in polymer processing industries.

LIST OF PRACTICALS.

1. Study and sketch of the Universal Testing M/c.
2. Determination of Tensile Strength and Percent Elongation of polymer film/sheet
3 Determination of the Vicat Softening point of given plastic sample on Vicat Softening Point apparatus
4. Determination of the Izod/Charpy Impact Strength of given specimen
5. Determination of the Melt Flow Index of polymer raw material by MFI tester
6. Determination of the Shore A Hardness of Rubber Sheet
7. Determination of the Falling Dart Impact Strength of polyethylene film using Falling Dart Impact Tester
9. To find out the impact strength of PVC rigid pipe as per IS 4985.
10. To determine the gloss of plastic Film.
11. To determine the haze of the Plastic Film.
12. To determine the flexural strength of Rubber and Plastic material.
13. To determine the resilience of the polymer sample.

INSTRUCTIONAL STRATEGY

Stress should be given on interpretation and designing of the different reactors. Industrial visit during the semester should be planned and audio-visualaids 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. J. D. Ferry, " Visco-elastic properties of polymers ", Wiley, 1980.
2. J. Ferguson and Z. Kemblowski, " Applied fluid rheology ", Springer Netherlands, 1991.
3. R.B. Brown, " Handbook of Plastics Test Method ", CRC Press, 1999.
4. Brown and Vishnu Shah, " Handbook of Plastic Testing Technology ", Wiley-Blackwell, 1998.
5. John M. Dealy, Kurt F. Wissburn, " Melt Rheology & its Role in Plastics processing theory & applications ", Springer Netherlands, 1998.
6. Brydson, JA, " Flow Properties of Polymer Melts ", CBLS, 1970.
7. Christopher W. Macosko, " Rheology, Principles, measurements and applications ", Wiley-VCH, 1994.

SUGGESTED DISTRIBUTION OF MARKS

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

4.4 PLASTICS & RUBBER COMPOUNDING

LTP
5 - -

RATIONALE

The students will be required to :

Formulation of Plastics and rubber needs basic knowledge of common ingredients used in the processes. A student having practical knowledge of these ingredients and their application in right manner is of great importance to practical fields.

(a) have knowledge about manufacturing outline of major rubber products involving the material, components, their functions, building and curing.

(b) be familiar on design construction and comparative advantages/disadvantages.

LEARNING OUTCOMES

- After studying this course, the students will be able to:
- Compounding of Polymers
- Importance of compounding in RUBBER & plastics
- Compounding additives and their functions
- Effect of compounding additives on performance and processing of plastics & rubber.
- Compounding equipments like Ban bury mixer, etc.

DETAILED CONTENTS

1- INTRODUCTION: (05 Periods)

Meaning of formulation, their purpose and industrial importance.

2- COMMON APPLICATION OF VINYL & ITS PROPERTIES: (10 Periods)

Application of polyvinyl chloride in different fields, Properties and their uses.

3- COMMON INGREDIENTS FOR FORMULATION OF PLASTICS & RUBBER COMPOUNDS: (20 Periods)

Common ingredients such as plasticizers, fillers, extenders, anti ozonoate, antioxidants, antistatic agents, stabilizers, colorants, flame retardants blowing agents, lubricants, curing agents. Their function and properties.

4- COMPOUNDING OF PVC: (08 Periods)

Compounding, Need of compounding, Compounding Equipment such as two roll mill, extruder, high speed mixture etc.

. 5-FORMULATION OF SOME OF THE PLASTIC AND RUBBER COMPONENTS:

(27 Periods)

(A) For clear PVC film, general purpose insulating compounds, transparent calendaring compound for PVC, house by extrusion rigid PVC pipes, fitting and conduits, blow molded PVC clear bottles and containers, for PVC leather cloth - for spreading techniques as -well as for calendaring for flooring compounds and for gramophone record, PVC compounds for cables.

(B) Rubber, Hosepipes, Belts, Cycle tubes and tires, footwear.

(C) Miscellaneous Rubber Products FORMULATION

(i)Coated Fabrics and calendared sheeting.

(ii) Molded items like seals, gaskets, auto components etc.

(iii) Rubber to Metal bonded components -- engine mounting, rubber roller.

(iv) Extruded items like tubing, weather strip etc.

(v) Adhesives -- solvent based and aqueous systems.

INSTRUCTIONAL STRATEGY

Teacher should explain each process industry and use of each and every equipment used.
An industrial visit can be organized in various chemical and process industries.
Audio-visuals should be used to teach.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	05	10
2.	10	12
3.	20	25
4.	08	15
5.	27	38
Total	**70**	**100**

4.5 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P
5	-	4

RATIONALE

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

LEARNING OUTCOME

After undergoing the subject, the students will be able to

- Understand the meaning of basic electrical quantities such as voltage, current, power etc.
- Use working principle of transformer.
- Use basic Network Theorem and 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 Kirchoff's laws, application of Kirchoff'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. Basic Electrical Engineering by PS Dhongal; Tata McGraw Hill Publishers, New Delhi
2. A Text Book of Electrical Technology, Vol. I and II by BL Thareja; S Chand and Co., New Delhi
3. Basic Electricity by BR Sharma; Satya Prakashan, New Delhi
4. Basic Electrical Engineering by JB Gupta, S Kataria and Sons, Delhi
5. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International Publishers Ltd., New Delhi
6. Basic Electronics by VK Mehta; S Chand and Co., New Delhi
7. Electrical Machines by SK Bhattacharya; Tata McGraw Hill, New Delhi
8. Basic Electronics and Linear Circuits by NN Bhargava and Kulshreshta, Tata McGraw Hill New Delhi.
9. Electronic principles by SK Sachdev, Dhanpat Rai and Sons, New Delhi.
10. Electronic Devices and circuits by Rama 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**

4.6 TECHNOLOGY OF NATURAL & SYNTHETIC RUBBER

L	T	P
5	-	-

RATIONALE

The Purpose of this paper is to make the students aware of manufacturing processes of natural and synthetic rubber, mastication, vulcanizing etc. which is considered be useful in practical life.

LEARNING OUTCOME

- To understand the production of Natural Rubber
- To understand Mastication Process and the equipment used in Mastication Process
- To understand the Production of different synthetic Rubber
- To understand the Vulcanization Process
- To understand the Processing of different Rubber Products

DETAILED CONTENTS

I. (10 Periods)

Sources and History of natural and Synthetic Rubber. Definition of Synthetic Rubber, Advantages and Disadvantages of Natural Rubber, Difference between Heavea and Gutta Percha Rubber, synthetic rubber, Significance of structure of natural rubber in contrast to the Synthetic Rubber, Aging of rubber.

II. (20 Periods)

Production of different grades of natural rubber from latex such as pale crepe and smoke sheet rubber and different grades use of latex. Latex NR latex types and grades; preservation, concentration, stability, gelatin, coacervation (**Coacervation** is a chemical method for producing polymer droplets in suspension based on the separation of two liquid phases into one concentrated colloidal phase.) Gradation system, processing characteristics & curing systems. Processing characteristics & curing systems.

III. (08 Periods)

MASTICATION, Machinery of mastication, Chemistry of mastication. Compounding of natural and synthetic rubber compounding ingredients and methods of compounding.

IV. (06 Periods)

Vulcanization, Sulphur Vulcanization and Non sulphur, Vulcanization, Reclaiming of Rubber.

V. (12 Periods)

Manufacturing process, Properties and application of SBR, Nitrile Rubber, Butyl, Neoprene and Polysulphide . Synthetic Rubbers such as SBR, PBR, NBR, CR, IIR,

EPDM -their grades, comparative properties and applications including high performance synthetic rubbers such as FKM, ACM, ECO, CSPE, Silicon rubber.

VI. (14 Periods)

Some Major rubber products I.e. synthetic rubber, Hyplone, Polyurethane, Silicones, and their application i.e. Industrial fabrication of few rubber articles such as conveyer belt, House pipes (Types and Tube of cycles). Polymer Blends-their importance and sulphide & XIIR applications, concept of miscibility/ compatibility; useful blends – rubber-plastic, rubber-rubber e.g. NBR/PVC blends, NR/SBR, NR/PBR etc. Thermoplastic Rubber (TPR) and Thermoplastic Elastomers (TPE) - their concept and applications of SBS and EVA.

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	10	10
2	20	25
3	08	15
4	06	10
5	12	15
6	14	25
Total	**70**	**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 HEAT AND MASS TRANSFER

L	T	P
6	-	4

RATIONALE

The purpose of this paper is to acquaint the students with the tools needed in Unit Operation like Modes of heat transfer, Conduction, Convection, Radiation, Heat exchanger, Distillation, Dryer, Extractor, Absorber andEvaporator, to meet the challenges of industrial atmosphere

LEARNING OUTCOMES

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

- To Understand Different Modes of Heat Transfer
- To Understand The Flow Patterns in Heat Exchangers
- To Understand the Construction and working of different types of Heat Exchangers
- To Understand the Details of Distillation Column , Dryer ,Extractors , Absorbers and Evaporators

DETAILED CONTENTS

PART-'A'

1. MODE OF HEAT TRANSFER: (02 Periods)

Conduction, Convection and Radiation.

2. CONDUCTION: (08 Periods)

Fourier's Law, Thermal conductivity, Conductance wall, Multilayer flat wall, Hollow cylinder, Multilayer cylinder, Logmean Area, Geometric mean area and Arithmetic mean area. Simple Numerical Problems in S. I. Units.

3. CONVECTION: (08 Periods)

Natural and Forced convection, dimensional analysis, Pi theorem, Physical significance of dimension less number, Reynold number, Prandtl number, Nusselt number, Stanton number, Peclet number, Grashof number, Dittus-Boelter's equation - Simple Numerical Problems using Dittus-Boelter's equation. Individual heat transfer coefficients and overall heat transfer coefficients.

4. RADIATION: (06 Periods)

Reflection, absorption and transmission of radiation, Kirchhoff's law, Emissive power, Wein's displacement law. The Stefan Boltzmann law, Heat transfer by radiation, Exchange of energy between two parallel planes of different emissivity, Radiant heat transfer coefficient, Solar radiation gray surface or gray body.

5. HEAT EXCHANGERS: (12 Periods)

Log mean temperature difference (L.M.T.D.) for parallel or Co-current flow, Counter current flow, Cross flow, Construction and description of (i) Double pipe heat exchangers, (ii) shell and tube heat exchangers. Wilson plot calculation of individual and over all heat transfer coefficients.

6. EVAPORATORS: (08 Periods)

Construction and Description of (1) Basket type (2) Horizontal tube types (3) Vertical tube or Long tube type. Boiling point rise (B.P.R.) and its effect, Steam economy for single effect evaporator.

PART 'B'

7. GAS ABSORPTION: (06 Periods)

Properties of tower packing. Types of tower packing and Stone ware towerconstruction.

8. DISTILLATION: (12 Periods)

Various distillation methods (1) Equilibrium or Flash distillation (2) Differential distillation (3) Batch distillation (4) Vacuum and Steam distillation (5) Azeotropic and extractive distillation. Types of distillation columns : (1) Perforated plate or sieve plate column (2) Bubble plate column (3) Packed column.

Fractional column accessories.

Boiling point diagrams, Raoult's law, Henry's law, Relative volatility, Constant boiling mixture, Equilibrium diagram and constant of equilibrium diagram. Fractionating column calculations - Heat and material balance Reflux ratio equilibrium plate, Enthalpy composition diagram, Graphic solution - Selection of column above and below feed plate, Location of feed plate, Subcooled reflex effect on reflux ratio, entrainment McCabe-thiele diagram - Section above and below feed plate. Intersection of operating line, Location of 'q' line, Optimum reflux ratio, Calculation of number of equilibrium plate by McCabe-thielediagram, over all plate efficiency. The murphree plate efficiency. The murphy point efficiency.

9. EXTRACTION: (06 Periods)

(1) Choice of Solvent (2) Steps of Extraction operation (3) Solid liquid Extraction construction and description of (a) stationery solid bed extractor, moving bed-basket type oil seed extractor or Bollman extractor (c) Rotocell extractor (d) liquid extraction.

10. HUMIDIFICATION: (08 Periods)

Determination of (1) Humidity (2) Percentage humidity (3) Relative humidity (4) Humid volume (5) Humid heat (6) Dry bulb and wet bulb temperature (7) Adiabalic saturation temperature (8) Use of Humidity chart (9) Dew point temperature. Simple numerical problems using humidity chart construction and description of cooling towers.

11. DRYING: (08 Periods)

General drying behavior - Critical moisture content equilibrium moisture content, Description and construction of dryers.

1. Tray Dryer
2. Rotary Dryer
3. Screw Conveyor.

LIST OF PRACTICALS

1. To determine over all heat transfer coefficient for an open pan evaporator in steady state condition.

2. To determine over all heat transfer confinements for an open pan evaporator in a unsteady state condition.

3. To determine 'U' for a double pipe heat exchanger in steady state condition and also to determine efficiency of heat utilization.

4. To determine shell and tube heat exchanger in steady state conditions and also to determine efficiency of heat utilization.

5. To study a sieve plate distillation column operation and to calculate over all efficiency of the distillation column.

6. To determine steam economy of a open pan evaporator.

7. To study the construction and working of various chemical equipment.

8. To study the rate of drying in vacuum dryer.

9. To determine the pounds of volatile compound distilled per unit pounds of steam distilled in a steam distillation operation.

10. To determine rate of settling.

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. Heat Transfer by Chapman, MacMillan Publication.
2. Principles of Heat Transfer by Kreith, Harper and Row Publication.
3. Process Heat Transfer by Kern, McGraw Hill Publication.
4. Heat Transfer by McAdams, McGraw Hill Publication.
5. Heat Transfer by KA Gavahane, Nirali Publications.
6. Process Heat Transfer by Kern DQ, McGraw Hill Book, New York
7. Heat Transfer 7th Ed. By Holman JP; McGraw Hill, New York
8. Applied Process Design for Chemical and Petrochemical Plants, Volume III by Ludwig, E; Gulf Publishing Co., Houston, Texas
9. Heat Transfer Principles and Applications by K Dutta; Prentice Hall, India.
10. Unit Operation of Chemical Engineering by McCabe and Smith.
11. Mass Transfer Operations by Treybal, Kogakusha Publication
12. Introduction to Chemical Engineering by Badger and Banchero, McGraw Hill Publication
13. Unit Operation of Chemical Engineering by McCabe and Smith; McGraw Hill Publication
14. Mass Transfer by Sherwood Pigford and Wilke, McGraw Hill Publication
15. Chemical Engineers Handbook by Perry and Chilton, McGraw Hill Publication
16. Mass Transfer Operations by Kiran D. Patil, Nirali Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	02	02
2	08	12
3	08	10
4	06	06
5	12	15
6	08	10
7	06	05
8	12	15
9	06	05
10	08	10
11	08	10
Total	**84**	**100**

5.2 POLLUTION CONTROL AND INDUSTRIAL SAFETY

L T P
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 CONTENTS

2 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, NH_3, F, C1, CFC, CO_2 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

2. Safety in Process Plant Design by Wells
3. Safety and Accident Prevention in Chemical Operation by H. H, Tanacatte and W. S. Wood
4. 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	-	2

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 (08 Periods)

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

3. Steam and Steam Generation: (12 Periods)

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

4. Humidification and Cooling Towers (12 Periods)

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

5. Refrigeration: (12 Periods)

5.1 Refrigeration cycles
5.2 Different methods of refrigeration used in industry – Vapour compression, 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 workingof 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 PLASTIC AND RUBBER PROCESSING-II

L	T	P
6	-	4

RATIONALE

The purpose of this paper is to equip the student with the knowledge of equipment and processes utilised in Plastic and Rubber processing and finishing of Rubber Components. These equipment and processes are common almost in all Plastic and Rubber plants.

LEARNING OUTCOMES

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

- Casting of Rubber & plastics
- Basic concepts of Casting process
  Description of process for making Casting products
- Understand formation of low cost plastic products by thermoforming process and analyze utility of process for different applications
- Understand formation of hollow plastic products and analyze utility of various techniques, for production of hollow products.
- Understand the different machining and finishing process & equipment
- Understand the different welding and sealingprocess & equipment
- Different parameters related to processing machines for formation of plastic products.
- Understand the fibre spinning process and their types.
- Understand the rubber processing parameters.

DETAILED CONTENTS

PLASTIC PROCESSING

1. CASTING:(10 Periods)

History, Basic process, Different Casting Processes, Sheet casting of M.M.A. Rotational casting and typical applications.

2. ROTATION AL MOULDING: (10 Periods)

The basic principal of rotational molding process and material, Types of rotation molding machines, Single spindle, Multiple spindle, Straight spindle and Jacketed molding rational machine, Application of rotational molding. Faults & Their Remedies in rotational molding process.

3. THERMOFORMING & FOAMING: (10 Periods)

The basic principle of thermoforming process. Sheet forming, different processes for thermoforming by using heating and air pressure or vacuum. Vacuum forming machines

methods of heating, economics of heating, thinning of sheets in relation to forming process, effect of tool shape size on thinning, economics of sheet forming and comparison other methods of fabrication. Analysis of faults and their remedies in thermoforming process. Foaming process and types of foaming. Application of foaming process. Analysis of faults and their remedies in foaming process.

4. MACHINING & FINISHING OF PLASTICS: (08Periods)

Machining of plastics in the form of sheets, rods and bulks. Finishing operations; Filing, tumbling, grinding and sanding, buffing and polishing, Machining of plastics; Drilling, Tapering, Threading, Sanding, Grinding.

5. WELDING AND SEALING OF PLASTICS: (08 Periods)

Characteristics of cemented and welded joints with the major thermoplastics materials, strength of joints, aging of joints processes of welding heated tool sealing and welding, hot gas welding dielectric sealing, Induction welding, frictional welding equipment used, rate of production economics of the processes. Methods of Plastic Welding-Ultra-sonic welding and vibration welding.

6. **FIBRE SPINNING:** (04Periods)

Basic principle of spinning, types of spinning, fiber after treatment, finishing of fiber.

RUBBER PROCESSING:

1. Introduction to Rubber Processing. (04Periods)
2. MOULDING: (10 Periods)

Compression and Transfer molding of rubber, Injection molding of rubber components, Molding shrinkage, Mould lubrication, Mould cleaning.

3. **Manufacturing of Rubber Products:**(16 Periods)

3.1. Tires and Tubes –cycle tires, passenger car tires and truck tires; tire sizing and marking;

Different types of tyre constructions – bias, radial & tubeless tires – their basic feature and characteristics; different components of tires and their functioning; selection criteria of different reinforcement materials; method of tire building & curing; post curing treatments.

3.2. Industrial Rubber Products

(a) Belting – Conveyor, Transmission, V-Belt & Timing Belt – types, grades functions, construction, selection of materials, mix design, building and curing.

(b) Hose --Types and grades; construction – hand-made, circular woven, braided and spiral; their advantages; disadvantage and applicability; design features, neutral angle and bursting pressure calculation; selection of reinforcing materials and mix design, production flow chart and curing methods.

(c) Footwear -- Sole manufacturing – microcellular, Unit Sole and Resin Rubber Sole; hand-built footwear & DVP/DIP.

(d) Cables -- Types/grades -- Construction, insulation and sheath, materials selection, mix design, building and curing.

3.3. Latex Products: Dipped Goods – balloons, prophylactics and gloves; latex Thread and Foam and Carpet Backing.

6. COATING OF TEXTILE FIBRES: (04 Periods)
   Adhesion of rubber to Textile substances.

PLASTIC AND RUBBER PROCESSING LAB

1. Study and Operation of Compression moulding m/c and to produce a Rubber product.
2. Study and operation of vacuum forming machine.
3. Study and operation of induction welding machine.
4. To visit works of a plastics molding workshop and observe molding and to prepare a report.
5. Study and operation of Grinder.
6. Study and operation of Rotational Molding m/c
7. Compounding of rubbers by two roll mill to study the curing characteristics.
8. Study & Operation of ball mill.

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. Plastic Engineering Handbook (SPI), by Frados
2. Plastic materials and processes (a concise encyclopedia), by Charles Harper
3. Injection and Compression Moulding Fundamentals, by Isayev.
4. Encyclopedia of Polymer Science and Technology Vol. 1-23, by Mark &Overberger.
5. Practical Thermoforming Principles & Applications, by J. Florian
6. Rubber processing and compounding technology ,by NIIR Board of consultant and engineers
7 Rubber Processing an Introduction , by Peter S . Johnson

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	10	12
2	10	12
3	10	12
4	08	10
5	08	08
6	04	04
7	04	04
8	10	14
9	16	20
10	04	04
Total	**84**	**100**

5.5 PLASTIC AND RUBBER WASTE MANAGEMENT

L	T	P
4	-	-

RATIONALE

The purpose of this paper is to equip the student with the knowledge of plastic & rubber waste management. The students should have the knowledge of different aspects of polymers, the issue raised due to irresponsible handling of polymer in the environment. The students should have the knowledge of waste generation, different standard for environmental pollution control.

LEARNING OUTCOMES

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

- Understand the source of rubber & plastic waste generation.
- Waste treatment of various plastic plants, estimation of power requirement and efficiency of size reduction operation of plastics.
- Biodegradable programs for various applications viz. food packaging, agriculture.
- Understand how rubber & plastic waste is value addition for society.
- The impact of the rubber & plastic waste on environment.
- Global policies and regulations.
- Plastic waste management.
- Recycling and recovery of various plastics items/materials.
- Various modification techniques/latest developments in polymers to improve waste management.

DETAILED CONTENTS
PLASTIC WASTE MANAGEMENT

UNIT – I Plastics Wastes and its Separation (04Periods)

Introduction – Sources of Plastics Waste – Collection of Plastics Waste – Sorting and segregation methods viz. simple identification techniques, Density Separation, Solvent Separation, floatation technique, Air classification, Melt filtration and Equipment based sorting techniques.

UNIT – II Plastics Waste Management Techniques (08 Periods)

Plastics Recycling – 4 R & I approach – code of Practice – types of Recycling viz. Primary, Secondary, Tertiary and quaternary techniques with examples – Fuel from Plastics Waste - Energy recovery from Plastic Waste – Co-processing in cement kiln – Plastic Waste in Road Construction.

UNIT – III Machinery and Value addition(06 Periods)

Process flow chart by mechanical route - Basic Mechanical recycling Plant – Additives for improving quality of recycled products – value addition in Plastics recycling viz., PP/HDPE woven sacks to Pots, PE/PE multilayer film waste to moulded products.

UNIT – IV Plastics Waste and Environment (04 Periods)

Environmental issues and Guidelines for Recycling of Plastics Wastes – Environmental legislation in India.

Rubber Waste Management

UNIT-I Processing of Industrial Wastes:(04 Periods)

Types and specification of the Wastes: Wastes from tyre Manufacture, Wastes from tyre-rebuilding industry, Wastes from reclaim production, Wastes from the rubber-mechanical goods industry and rubber footwear production.

Waste re-use in main production practice: Rubber mix and cord wastes, Vulcanized wastes.The manufacture of other materials and articles from wastes Production of corrugated asbestos boards, roofing's, and tie plates, Production of Rezdor slab and floor slabs for stock farms, Other trends and directions in the use of production wastes

UNIT-II(08 Periods)

Production of reclaim from scrap tyres and its employment in rubber compounds: Production of reclaim: The physical and chemical principles of the rubber reclaiming process, Raw materials and compounding ingredients in obtaining reclaimed rubbers, Grinding of Scrap tires and inner tubes, Methods of devulcanizing'(reclaiming) cured rubbers, Mechanical treatment of devulcanizates, The properties of commodity reclaim, The effect of structure of a reclaim on the properties of reclaimed rubber and vulcanizates.

Applications of reclaim: The effect of reclaim on the properties of rubber compounds and their vulcanizates, Fields of reclaimed rubber use, Technical and economic effectiveness of employing reclaim in rubber compounds, Current situation and future prospects for reclaim manufacture and consumption.

UNIT-III (04 Periods)

Fine-dispersed materials from scrap tyres: The properties of compositions and rubbers based on polymer blends.

The properties of cured rubbers incorporating ground vulcanizate: Influences due to the loading and particle size of the ground vulcanizate, The effect of the degree of cross-linking in polymeric phases, The effect of raw rubber types involved in polymeric phases, The effect of diffusion processes, The effect accelerator type, The effect of premodifying a ground vulcanizate, Various technological procedures using ground vulcanizates.

Preparation of finely- dispersed cured rubbers: Cryogenic grinding of cured rubbers, Grinding of cured rubbers at temperatures above freezing point. Preparation, Properties, and use of aqueous dispersions of cured rubber.

UNIT-IV (08 Periods)

USE of ground rubbers in road construction and in the manufacture of building and industrial materials: Road construction: Preparation of binder, Manufacture of asphaltic concretes, Other ways of using crushed vulcanizates in road construction. Production of building and industrial materials.

UNIT-V (04 Periods)

Processing of rubbers by pyrolysis : Pyrolytic process engineering, Use of pyrolysis products.

UNIT-VI (06 Periods)

other trends in the utilization of scrap tyres.

Waste Disposal: Introduction, RCRA, SARA, General Compliance Rules, Waste tyre Disposal, Physical waste reduction

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-Recycling from the Rubber Products Industry, by Vladimir M. Makarov•&ValerijF.Drozdovski.

2-Rubber Products Manufacturing Technology By: Anil K. Bhowmick.•

3- Rubber Technology•& Manufacture by Blow & Hepburn.

4. Technical Manual on Plastics Processing –

5. Recycling & Plastics Waste Management – Dr. J S Anand

6. Environmental Engineering & Management – Suresh k. Dameja

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	04	10
2	08	15
3	06	15
4	04	10
5	04	06
6	08	12
7	04	10
8	08	06
9	04	06
10	06	10
Total	**56**	**100**

5.6.1 FOAM & ADHESSIVE TECHNOLOGY

LTP
4 --

RATIONALE

Foam and Adhesive are now a days becoming much popularin every day use in public as well as in private sectors. Many kinds of adhesives are available with different trade names for specific and general applications. Infact, we can not imagine modern life withoutadhesives. The student is supposed to have some idea about these adhesives.

LEARNING OUTCOMES

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

- Understand the concept of foaming,
- Understand the foam manufacturing techniques and application.
- Understands the different gradients used in the manufacturing of foam.
- Understand the chemistry of foaming
- Understand the types of adhesive.
- Understand the mechanism of adhesive
- Understand the application of adhesive

DETAILED CONTENTS

(A) FOAM:

1. INTRODUCTION: (10 Periods)

Introduction to Foam- Meaning, Application, Types of foam flexible and Rigid foam chemistry of physics of foam formation, Foaming in greadients such as Blowing agents etc., Their effects on foam morphology and physical properties of cellular plastics.

2. PROPERTIES: (18 Periods)

Chemistry, formulation and manufacturing processes and properties of the following foams, Pelythylene foams, Polyurethene(rigid & flexible) foams, Polyethylene foam LD & HD epoxy resin foams etc.

(B) ADHESSIVES: (28 Periods)

Multipurpose adhesives - Resins and anaerobic compounds for sealing, jointing, fitting, fixing, locking and filling etc. A few popular commerical names to mention such as Araldits, Stellon compounds Fevicols, Specfit, Specinstabond, Loctites, Silastics, M-seal, etc., their properties and usage.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

LIST OF REFERENCE BOOKS

LIST OF REFERENCE BOOKS

1.Handbook Of Polymer Foams Paperback By D. Eaves (Editor)

2. Polymer Foams Structure –Properties- Performance By Bernard E. Obi.

3. Handbook Of Foaming & Blowing Agents By George Wypych

4. Practical Guide To Flexible Polyurethane Foams By ChrishDefonseka

5.Hand Book Of Adhesive Formulations : Adhesive Technology By By Shrikant P. Athavale

6-Adhesive Technology & Formulations Hand Book (Hand Book Of Adhesives) By By Eiri Board

7-Handbook Of Pressure Sensitive Adhesive Technology By D. Satas

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1	10	20
2	18	30
3	28	50
Total	**56**	**100**

5.6.2 PLASTICS IN BUILDING SERVICE

LTP
4--

RATIONALE

Plastics now a days are getting application in almost every field of life i.e. Agriculture, Civil Engineering and Industries, etc. Student Should be aware of General Features and Properties and there response to environment.

LEARNING OUTCOMES

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

- Understand the Scope of Plastic in Building Services
- Understand the advantages of Plastic in Building Services
- Understand the Specific Plastic and there properties to be used in Building Services
- Understand the Different application areas in Building Services

DETAILED CONTENTS

1. INTRODUCTION: (04 Periods)

Increasing use of Plastics in Building, their advantage as a building materials, Review and types of plastics, Thermoplastic and thermo sets. Their engineering and allied properties. Behavior of different plastics in fire.

2. APPLICATION OF PLASTICS IN BUILDING: (10 Periods)

General use as flooring, Hand rails, curtain rails and Window stages, Wall titles, Roof lights, Steel and Partition panels, False ceiling, PVC sheets, Insulation materials, Electrical fitting and fixture, Tubing, Basins and Furniture etc.

3. POLYTHELENE FILM FOR WATER PROOFING: (10 Periods)

Properties, Advantages of polyethylene film, Damp proofing at ground level at roof.Arrangement for laying film on ground, road and roof and detail of construction.

4. THERMAL AND SOUND INSULATION BY PLASTICS: (10 Periods)

Purpose, Material Selection, Insulation of theater, Roof, Air conditioned building walls, Sandwich construction.

5. PLASTICS ROOFING AND CLADDING AND FLOORING: (12 Periods)

Material selection, Roofing and Cladding of external walls, Advantage of plastics, Flooring in comparison to concrete, wooden and other general types of flooring, selection of material of flooring.

6. MISCELLANEOUS: (10 Periods)

Plastics tape and valves, Plastics in sanitary wares, Plastics conduit and fitting, Plastics cables in Electrical wiring, Decorative laminates in building, Plastic in surface coating, Plastics door, window and fixtures. Their different types material selection with causes, Advantages and application.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

LIST OF REFERENCE BOOKS

- **P**lastic in Architecture and constructions, By- Stephan Engelsmann
- Building Design and Construction Handbook , Publisher TMH
- Construction and Building Materials By- Michael C. Forde

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1	04	10
2	10	15
3	10	20
4	10	15
5	12	20
6	10	20
Total	**56**	**100**

5.6.3 POLYMER BLENDS AND ALLOYS

LTP
4 --

RATIONALE

The purpose of this paper is to equip the student with the knowledge of polymer blend & alloy. The students should have the knowledge of different types of polymers; their properties and relevant application to understand the blend theory. This subject gives the broad no of polymer generation with a combination of only two or more than two polymer together.

LEARNING OUTCOMES

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

1- Understand the source of combination principle of polymer.
2- Understand the properties addition of polymer.
3- Understand how a few no of polymer is generation a lot of number of polymer blends with slight change in the composition of the polymers.
4- Understand the economy of polymer blending.
5- Understand the blending equipments.
6- Understand the area of application of polymer blend & alloy.

DETAILED CONTENTS

CHAPTER-1 (12 Periods)

Introduction to polymer blends & Alloys – Definitions and a nomenclature reasons for making polymer blend- how to select blend components preparation of alloys & blends – economy of blending. Compatibilization and reactive blending. Introduction- Compatibilization, mechanisms–compatibilization methods- compatibilization by addition of copolymer reactive blending – future trends

CHAPTER-2 (16 Periods)

Rheology of polymer blends – Introduction– Miscibility and flow behavior of polymer blends – Immiscible blends– Flow behavior of immiscible and miscible polymer blends. Complex flow- processing of polymer blends – flow through a contraction. Techniques for studying blends and alloys–light microscopy–the microscope, micro structure – scanning electron microscopy

CHAPTER-3 (16 Periods)

BLEND PREPARATION EQUIPMENTS

Mixers' and their various types like ban bury, hot and cold mixers,twin screw compounders, and two- roll mills, etc. Design features of these equipments

like rotor types, screws and their various types; flow behavior of the plastic material in the mixing equipments, theory of mixing etc.

CHAPTER-4 (12 Periods)

COMMERCIAL POLYMER ALLOYS AND BLENDS: blends of engineering and commodity plastics like PVC/ABS, PVC/SAN,PVC/NBR, PC/PET, PC/PBT, PC/ABS; PPO/HIPS etc. study in detail along with properties and applications.

LIST OF PRACTICALS

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

LIST OF REFERENCE BOOKS

1. L.A. Utracki, Commercial Polymer Blends, Chapman & Hall, London, 1998.

2. RP. Singh, C.K. Das, S.K. Mustafi, Polymer Blends and Alloys an overview, Asian Books Pvt. Ltd. , New Delhi- 2002.

3. D.R. Paul & Seymour Newman, Polymer Blends, Vol. 1 & 2, Academic Press, New York, 1978.

4. Chris Rauwendaal, Polymer Mixing A self- Study Guide, Hanser Publishers, Munich

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1	12	20
2	16	30
3	16	30
4	12	20
Total	**56**	**100**

6.1 POLYMER COMPOSITS

L	T	P
5	-	4

RATIONALE

In certain engineering applications plastics of greater strength are needed. Therefore, efforts have been made to reinforce the plastic with fibers. The process and technology will certainly prove very useful for students of this field in practical applications.

LEARNING OUTCOMES

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

- Understand the concept of composite materials and reinforcement.
- Understand the types and forms of reinforcement materials used in composites.
- Understand various thermoset and thermoplastic materials used in composites.
- Understand different production techniques for composite structures like hand-layup, bag molding etc.
- Apply knowledge of production technique for making different structure like hybrid structure and sandwich structure.

DETAILED CONTENTS

1. INTRODUCTION: (04 Periods)

   Definition, Properties of composites and fiber reinforced plastic, History and development of fibers reinforced plastics.

2. COMMERICAL APPLICATION OF COMPOSITES: (12 Periods)

   Application of composites in chemical industry, Aerospace, Electrical Application, Marine Application, Automobile Industry and Miscellaneous Applications.

3. PREPARATION AND PROPERTIES OF PLASTICS TO BE REINFORCED: (14 Periods)

   Preparation of unsaturated polyester resin and their varieties and properties. Preparation of epoxy resin and polypropylene for reinforcement and their properties.

4. REINFORCING METERIALS (FIBRES): (12 Periods)

   Glass fibers & their varieties and specific applications. Carbon fiber, asbestos, cotton, Nylon, Rayon, Graphite fibre their properties and applications.

5. ADDITIVES: (10 Periods)

Additives for Reinforced Plastics excludingresins& Reinforcing Materials with Special: Reference to glass reinforced Polyester resin. Binder, Catalyst, Accelerators, Fillers, Pigments, Monomers,& Mould Release Agents.

6. TECHNIQUES OF FABRICATING REINFORCED PLASTICS: (18 Periods)

(a) Hand lay-up or contact moulding.

(b) Spray up.

(c) Encapsulation.

(d) Filament winding

(e) Centrifugal Casting.

(f) Continuous pultrusion.

(g) Match die molding.

(h) Continuous Laminating.

(i) Pultrusion

(j) PREPARATION AND FINISHING OF MOULDS FOR FRT PRODUCTS

POLYMER COMPOSITS LAB

List of Practical's

1. Preparation of unsaturated polyester resin.

2. Surface treatment of glass fiber for molding.

3. To prepare a compound of glass fiber and polyester resins for pipe production and to make pipe of it.

4. To produce a sample of a given component using reinforcing materials other than glass fiber.

5. To produce sink of glass fiber reinforced polyester resin by hand lay-up techniques.

6. To produce a laminate of glass fiber reinforced plastics by hand lay-up method and to determine its tensile strength and impact strength.

7. To study the effect of cross linking monomer on the mechanical properties (tensile strength and impact of the composites.)

8. To complete the tensile strength and impact strength of two different composites made of same resin and different reinforcing materials.

9. To determine the strength to weight ratio composites and steel and to prepare comparative chart.

10. Study & Operation of plastic lamination machine.

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**

6.2 PLASTIC AND RUBBER MOULD DIE DESIGN AND CONSTRUCTION

L	T	P
6	--	

RATIONALE

The objective of this paper is to equip the student with the knowledge of different kinds of moulds, making of moulds and design of molded articles. The skill and knowledge of die design and construction is of utmost importance in world of work

.**LEARNING OUTCOMES**

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

- Understand the Product Design
- Understand the Different Features of Plastic / Rubber Product
- Understand the Mold Material required for Mold making
- Understand the Mold Design
- Understand the Mechanical Operations used in Mold Fabrication
- Understand the computer Aided Design of Mold & Die.

DETAILED CONTENTS

1. DESIGN OF MOULDED ARTICLES: (20 Periods)

Basic principles, Shrinkage, Flash lines, Under cuts, Wall thickness, Taner and drafts, Raddi fillets, Ribs and Bosses, Moulded holes, Moulded threads, Moulded letters, Inserts, Selection of metal for inserts, Problems in moulding with inserts, Types of inserts.

2. PRINCIPLES OF OPERATION AND DESIGN: (24 Periods)

Design of the following types of moulds and dies.

a. COMPRESSION MOULDS:

Positive, Semi Positive and Flash Type.

b. TRANSFER MOULDS:

Plunger Transfer Mould and Pot Type Mould.

c. INJECTION MOULDS:

Design of two plates and three plates mould with splits and side cores, method of colliding, Feed system sprue, runner, gates and methods of injection.

d. EXTRUSION DIE:

Design and construction, die design for tubes, pipes, sheets rod, slits, flat film and wire coating.

3. Free Hand Drawing of the Following – (20 Periods)

I. Bending Die
II. Shallow Drawing Die
III. Deep Drawing
IV. Simple and Progressive Die.
V. Blanking Die
Vi. Piercing Die

4. MOULD MAKING: (20 Periods)

Selection of steels and mould materials, types of mould making machinery, copy milling and die sinking, machines, spark erosion machines, holding, finishing processes, heat treatment, fitting and mould polishing.

5. COMPUTER AIDED MOULD DESIGN (10 Periods)

INTRODUCTION of CAD in product design of mold & die for plastic. In this Chapter, the students are required to learn the basics of software such as: Mechanical Desktop, Mould Creator, Mould Flow etc. and further to design at least 2 moulds for given components using these software.

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. Computer based tools for design of mold & die should be introduced to the students.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

- Fundamentals of Plastic Mold Design , By – Nayak S. K
- Plastic Product Design By- Paul F. Mastro
- Plastic Product Design By- Beck. Ronald D
- Industrial Design of Plastic Product By- M.Josheph , Gordon J R
- Robust Plastic Product Design A Holistic Approach By- Vikram Bhargav

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	18	18
2	22	28
3	18	22
4	16	22
5	10	10
Total	**84**	**100**

6.3INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

L	T	P
5	-	-

RATIONALE

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

LEARNING OUTCOMES

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

- Know about various schemes of assistance by entrepreneurial support agencies
- Conduct market survey
- Prepare project report
- Explain the principles of management including its functions in an 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)

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

6.4 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.
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 Sevices Limited (EESL). www.eeslindia.org.

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

6.5 PROCESS CONTROL

L	T	P
6	-	4

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Introduction (05 Periods)
   Concept of automatic control, Advantages of automatic control, manual and automatic control, physical and block diagrams.

2. Elements of control System (10 Periods)
   Definition- input means, controlling means, actuating means, measuring means, final control elements.

3. Process Characteristics (15 Periods)
   Process variables, process degree of freedom, forcing function, step function, ramp, impulse, sinusoidal function and Laplace transformation.

4. Elements of process dynamics (22 Periods)
   Time constant and oscillatory element, determination of system function or transfer function of the following- sketch physical diagram and block diagram

7.1 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.

7.2 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).

1. 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.

2. 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:
   .1 Proportional control at stirred tank heater for set point change and for load change.
   .2 Proportional integral control of stirred tank heater for set point change and load change

- 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 outs its time constant.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

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

6.6 PROJECT WORK

L	T	P
-	-	8

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 Objective of the diploma project is to give practice to the students to make an effective literature survey as well as to utilise the knowledge acquired.

The part of the project may include following points as given below:-

1) General introduction of the problem.

2) History of the project including raw materials and finished product,present capacity of production of the raw materials in World and India.

3) Raw materials- Imported/exported. Demand in the country for future and measure/steps taken by the Government.

4) Physical and chemical properties of the raw materials and final product.

5) Discussion of diffrent schemes, and processes and selection of the process and detailed description of the selected process with neat flow diagrams.

6) The selected process has to be discussed with instrumentation schemes.

7) Discussion of the equipment required in the project scheme.

8) Detailed discussion of the main equipment required in the scheme and detailed drawings of the equipment.

9) Discussion of the accessories used in the process for the production including dies, moulds, motors, blowers, mixer,etc.

10) Finished product- quality control, evaluation which is required for the product, inspection and application.

11) Marketing of the products.

12) Plant organisation and Management.

13) Plant location and plant layout.

14) Estimation of the capital cost-fixed cost, recurring cost, total investment required, depreciation, break even point profitability of the product.

15) Future expansion of the plant/fature planning.

16) Actual design of the mould/dies and drawing to the scale for the specific product

B. LIST OF PROJECT (Guide Lines)

1. Extrusion

- Manufacture of cables. - Manufacture of pipes (Rigid).

–Manufacture of woven sacks. - Manufacture of films (PVC).

– Production of granules from waste materials (Recyling).

- Production of bags . - Production of nylone ropes.

- Production of plastic canes.

- Production of Tube (Flexible).

2. Blow Moulding

- Manufacture of bottles.

- Manufacture of garrycans.

- Different types of containers of various materials.

- Extrusion blow stretch and injection blow stretch.

3. Injection moulding

- Manufacture of polyethylene switches.

- Manufacture of Household items.

- Manufacture of Industrial items.

- Manufacture of T.V., Transistors and Radio-Cabinets.

- Manufacture of Automobile components.

- Manufacture of items such as Lamp, shades, fan blades.

4. Fiber Glass Products

- Manufacture of solar Cooker.

- Manufacture of latrin seats.

- Manufacture of Bio-gas holders.

- Manufacture of corrugated seats.

- Lining of industrial Vessels.

- Manufacture OF Tank.

5. Compression/Transfer Moulding

- Manufacture of electrical items.

- Manufacture of industrial items.

- Manufacture of machine parts by IMC (Dough Moulding Compound) and SMC (Sheet Moulding Compound).

- Manufacture of

a) Sign board

b) Name plates

c) Pen stand etc.

6. Fabrication project

1. Fabrication of plastic testing machine for Impact testing of pipe.

2. Fabrication of plastic testing machine for Impact testing of pipe.

3. Fabrication of Hand operated injection moulding machine.

4. Fabrication of hand operated blow moulding machine.

5. Fabrication of Glass Reinforced Plastic Products such as chairs and tables.

7. Fabrication of Dies & Moulds

- Fabrication of mould for hand operated injection moulding machine.

- Fabrication of mould for hand operated blow moulding machine.

- Fabrication of mould for semiautomatic injection moulding machine.

- Fabrication of moulds for semi-automatic blow moulding machine.

- Fabrication of mouldsfor vaccum forming machine (Comparison of wooden mould and Al.moulds).

- Fabrication of Dies for the manufacture of cables/pipes/sheets.

8. Printing & Decorations

- Screen printing of plastic.

- Spray painting and In foil Moulding Electro Plating Vaccum Metalising.

9. Thermoforming

- Fabrication of egg trays, refrigeration lining and disposable products.

10. Lamination

- Production of industrial Laminates, decorative laminates (Table top) etc The project assignments may consist of:

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				
			Excellent	Very Good	Good	Fair	Poor
1.	Selection of project assignment	10%	10	8	6	4	2
2.	Planning and execution of considerations	10%	10	8	6	4	2
3.	Quality of performance	20%	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20%	20	16	12	8	4
5.	Sense of responsibility	10%	10	8	6	4	2
6.	Self expression/ communication skills	5%	5	4	3	2	1
7.	Interpersonal skills/human relations	5%	5	4	3	2	1
8.	Report writing skills	10%	10	8	6	4	2
9	Viva voce	10%	10	8	6	4	2
Total marks		**100**	**100**	**80**	**60**	**40**	**20**

The overall grading of the practical training shall be made as per following table.
In order to qualify for the diploma, students must get "Overall Good grade" failing which the students may be given one more chance to improve and re-evaluate before being disqualified and declared "not eligible to receive diploma ". It is also important to note that the students must get more than six "goods" or above "good" grade in different performance criteria items in order to get "Overall Good" grade.

	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

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.

2. The criteria for evaluation of the students have been worked out for 200 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.

3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.

4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

The teachers are free to evolve other criteria of assessment, depending upon the type of project work.
It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial 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
- Basics of IT/Computer Applications \Laboratory
- Carpentry Shop
- Painting and Polishing Shop
- Basics of Electrical and Electronic Engg.
- **Polymer chemistry lab**
- 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
- **Plastic & Rubber Processing Laboratory**
- **Quality Control & Testing of polymer Laboratory**
- Chemical Reaction Engg. Lab.
- Process Control
- Energy Conservation Lab.
- Pollution Control and Industrial Safety
- **Polymer composite lab**
- **CAD lab** for plastic mold design

EQUIPMENT REQUIRED FOR CHEMICAL TECHNOLOGY (RUBBER & PLASTIC)

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

Sr. No.	Description	Qty	Total Price (Rs)
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

Sr. No.	Description	Qty	Total Price (Rs)
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 - EDTA-1 kg - Eriochrome Black-T(solochrome black T)-200g - Buffer solution (NH_3 - 2.5 ltr, NH_4Cl – 1 kg) - Zinc sulphate- 500g - H_2SO_4- 2.5 ltr - Phenolphthalein indicator (as per requirement) - Methyl orange indicator (as per requirement) - Charcoal (as per requirement) - Kerosene- 1 ltr	LS	20,000
17.	**Miscellaneous**	**LS**	**2,000**
ENGINEERING DRAWING			
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

Sr. No.	Description	Qty	Total Price (Rs)
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**
CARPENTRY SHOP			
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**

Sr. No.	Description	Qty	Total Price (Rs)
FITTING AND PLUMBING SHOP			
1.	Work benches with vices (4 vices on each bench)	5	30,000
2.	Marking tables with scribers	4	24,000
3.	Surface plates	5	20,000
4.	Accessories like calipers, V blocks, height, gauges steel rules and scribers	25	50,000
5.	Tool kits – taps, dies, drills	25	40,000
6.	Tool kits – chiesels, 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
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

Sr. No.	Description	Qty	Total Price (Rs)
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
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**

Sr. No.	Particulars	Unit
FLUID MECHANICS & SOLID HANDLING LABORATORY		
1.	Centrifuge	01
2.	Ball Mill	01
3.	Mixer – Liquid Liquid Mixer and Solid Liquid Mixer	02
4.	Roll 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
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	

Sr. No.	**Particulars**	**Unit**
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
Sr. No.	**Particulars**	**Unit**
CHEMICAL REACTION ENGINEERING & THERMODYNAMICS LAB		
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
6	PFR and CSTR in series	01
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 value	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) – 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
Sr. **No.**	**Particulars**	**Unit**
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
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

QUALITY CONTROL & TESTING OF POLYMER LAB				
S.NO.	**EQUIPMENT DESCRIPTION**	**QUANTITY REQUIRED**	**PRICE/UNIT (Rs) Aprox**	**TOTAL AMOUNT Aproximate (Rs)**
1	ABRASION TESTER	1	250000	250000
2	AIR COMPRESSOR	1	120000	120000
3	ANALYTICAL BALANCES	2	45000	90000
4	CHARPY IMPACT TESTING M/C	1	250000	250000
5	CHEMICAL BALANCES	2	40000	80000
6	CONDITIONING CHAMBER	1	90000	90000
7	DIAL MICRO METER	3	2000	6000
8	FALLING DART IMPACT TESTER FOR FILM	1	100000	100000
9	FALLING DART IMPACT TESTER FOR RIGID PVC PIPE	1	150000	150000
10	FLEXURAL STRENGTH TESTER	1	150000	150000
11	GLOSS METER	1	45000	45000
12	HAZE METER	1	45000	45000
13	IZOD IMPACT TESTING M/C	1	100000	100000
14	MELT FLOW INDEX TESTER	1	750000	750000
15	PHYSICAL BALANCES	2	40000	80000
16	RESILIENCE TESTER	1	50000	50000
17	ROCKWELL HARDNESS TESTER	1	60000	60000
18	SHORE A HARDNESS TESTER	1	10000	10000
19	SPECIFIC GRAVITY APPARATUS	1	5000	5000
20	SPECIFIC GRAVITY BOTTLES	2	5000	10000
21	STEEL SCALE, SCISSOR, TAPE ETC	1	100000	100000

22	STOP WATCH	2	1000	2000
23	TENSILE STRENGTH TESTING MACHINE	1	300000	300000
24	THERMOMETER	10	1000	10000
25	UNIVERSAL TESTING MACHINETM (2TON)	1	800000	800000
26	VICAT SOFTENING APPARATUS	1	80000	80000

PLASIC & RUBBER PROCESSING LABORATORY				
S.NO.	EQUIPMENT DESCRIPTION	QUANTITY REQUIRED	**PRICE/UNIT (Rs) Aprox**	**TOTAL AMOUNT Aproximate (Rs)**
1	AUTOMATIC INJECTION MOLDING MACHINE	1	2500000	2500000
2	BALL MILL	1	20000	20000
3	BLOW MOLDING MACHINE	1	2500000	2500000
4	BLOWN FILM EXTRUDER	1	1500000	1500000
5	COMPRESSION MOLDING MACHINE	1	800000	800000
6	EXTRUDER (35MM) FOR PVC PIPE	1	1000000	1000000
7	HAND OPERATED BLOW MOLDING MACHINE	3	150000	450000
8	HAND OPERATED INJECTION MOLDING MACHINE	3	150000	450000
9	PLASTIC INDUCTION WELDING M/C	1	1000000	1000000
10	ROTATIONAL MOLDING MACHINE	1	1000000	1000000
11	THERMOFORMING MACHINE	1	600000	600000
12	TRANSFER MOULDING PRESS (100 T)	1	1000000	1000000
13	TWO ROLL MILL	1	250000	250000

POLYMER CHEMISTRY LABORATORY				
S.NO.	**EQUIPMENT DESCRIPTION**	**QUANTITY REQUIRED**	**PRICE/UNIT (Rs) Aprox**	**TOTAL AMOUNT Aproximate (Rs)**
1	ABBE'S REFRACTOMETER	2	150000	300000
2	ANALYTICAL BALANCES	1	90000	90000
3	BROOKFIELD VISCOMETER	1	75000	75000
4	CENTRIFUGE (LAB MODEL)	1	45000	45000
5	HEATING MENTLES CAP 500 ML	10	20000	200000
6	HOT AIR OVEN	2	25000	50000
7	OSTWALD VISCOMETER	2	10000	20000
8	P. H. METER	5	2000	10000
9	PHYSICAL BALANCES	2	20000	40000

10	TEMPERATURE REGULATORS	10	5000	50000
11	THERMOSTATIC BATHS	2	10000	20000
12	WATER BATHS	10	10000	100000
13	WATER DISTILLATION UNIT	10	10000	100000

POLYMER COMPOSITE LABORATORY				
S.NO.	**EQUIPMENT DESCRIPTION**	**QUANTITY REQUIRED**	**PRICE/UNIT (Rs) Aprox**	**TOTAL AMOUNT Aproximate (Rs)**
1	BENCH GRINDER	1	20000	20000
2	CONSUMABLES	1	100000	100000
3	FILAMENT WINDING M/C	1	1500000	1500000
4	PLASTIC LAMINATING MACHINE FOR FILM	1	100000	100000
5	PULTRUSION MACHINE	1	100000	100000
6	SPRAY MACHINE	1	150000	150000
CAD LABORATORY				
S.NO.	**EQUIPMENT DESCRIPTION**	**QUANTITY REQUIRED**	**PRICE/UNIT (Rs) Aprox**	**TOTAL AMOUNT Aproximate (Rs)**
1	SOFTWARE FOR INJECTION MOLD DESIGN	1	100000	100000
2	SOFTWARE FOR EXTRUDER DIE DESIGN	1	100000	100000

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 students ability to apply, in an integrated manner, learnt knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The formative and summative evaluation may comprise of weightage to nature of project, quality of product, quality of report and quality of presentation followed by viva-voce.

D. Professional Industrial Training

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of materials, industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. The formative and summative evaluation may comprise of weightages to performance in testing, general 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.

The following experts participated in workshop for diploma course in Chemical Engineering for UP State at NITTTR, Chandigarh:

1. Sh. VK Sagar, Punjab Chemical and Crop Protection Ltd., Dera Bassi (Punjab)
2. Mrs. Seema Kapoor, Professor, Dr. SSBUICET, Punjab University Chandigarh
3. Dr. Sushil Kumar Kanal, Dr. SSBUICET, Punjab University Chandigarh
4. Sh. Ashok Kushwaha, CDC Officer, IRDT, Kanpur
5. Sh. Lal Ji Patel, Head of Department, Chemical Engineering, Government Polytechnic Rath, Hamirpur (UP)
6. Sh. Padmesh Pankaj, Head of Department, Chemical Engineering, Government Polytechnic, Lakhimpur, Kheri (UP)
7. Dr. Umesh Chandra, Assistant Professor, Chemical Engineering, CSJM University, Kanpur.
8. Sh. Faizan Ahemad, Lecturer, Chemical Engineering, Sanjay Gandhi Government Polytechnic, Jagdishpur, Amethi (UP)
9. Sh. Arvind Kumar, Lecturer, Chemical Engineering Government Polytechnic Mankera, Agra (UP)
10. Ms. Huma Siddiqui, Lecturer, Government Polytechnic, Lakhimpur
11. Sh. Abhinav Jain, Lecturer, Chemical Engineering, Government Polytechnic, Sutawali, Amroha

The following experts participated in workshop for Developing the Curricula Structure and Contents of Chemical Technology (Rubber & Plastic) :

1. Dr Deepak Srivastava , Prof & Head ,Plastic Technology, HBTU, Kanpur
2. Sh. Lal Ji Patel, HOD Chemical , Government Polytechnic Sarsai , Rath (Hamirpur), UP
3. Sr. Rakesh Kumar , HOD Chemical , G.P.Kanpur
4. Sh. S.P.Pal , HOD , Chemical (Ruber & Plastic), G.P.Badau
5. Sh. Prabhu Nath , Lecturer Chemical , G.P.Kanpur
6. Sh Ashok Kushwaha , Text Book Officer / CDC officer IRDT, Kanpur