SYLLABUS

FOR

DIPLOMA IN

POLYMER TECHNOLOGY

(DIPLOMA COURSES IN ENGINEERING / TECHNOLOGY)

C23 REGULATION

TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE

(AUTONOMOUS), MADURAI – 625 011

Regular Curriculum 2023	2023

GOVERNMENT OF TAMIL NADU

DEPARTMENT OF TECHNICAL EDUCATION

DIPLOMA IN
POLYMER TECHNOLOGY (SWC) SYLLABUS

C23 - SCHEME

2023 – 2024onwards

TAMIL NADU GOVERNMENT POLYTECHNIC COLLEGE (AUTONOMOUS)

MADURAI – 625 011.

PREFACE

Polymers are present in every facet of life and it has become impossible to live without them. Hence it is not exaggerated that to say we are living in "Polymer Age".

The diploma holders in polymer technology play a vital role in the polymer industries. They are recruited for either supervisory level or as semi-technical personnel on the floor job. So, framing of syllabus assumes a special significance for its importance and relevance to meet the technological advancements taking place around the globe and to cope up with the modernization-taking place in the field of polymer engineering. The course in Polymer Technology (sandwich) provides an understanding of polymer materials, their properties, manufacturing processes, testing and applications.

Salient features of 'C23' Scheme: This C23-Scheme Polymer Technology syllabus for the Department of Polymer Technology (sandwich), Tamilnadu Government Polytechnic Autonomous College, Madurai is designed and framed in tune with the international standard, under new guidelines and policy prescribed by the Directorate of Technical Education to meet the industry needs on behalf of the Government of Tamilnadu and AICTE's outcome based Model Curriculum for the Diploma Program in Engineering & Technology.

C23 scheme syllabus encompassing of basic sciences and engineering sciences (31%), core polymer engineering subjects (49%) having focus on fundamentals, significant discipline level courses and ample electives (8%) both from the polymer/cross disciplines and Entrepreneurship and startups, project work and internship in polymer industry (12%).

Removal of obsolete portions from N20 Scheme and addition of topics covering of new technology in C23 Scheme like green polymer chemistry, biomedical applications of polymers, waste management, nano technology, composites technology, polymer mould engineering will allow students to meet the expectations of polymer industries.

The new curriculum with entrepreneurship and startups subject will also let the students face academically challenging environment, develop industrial problem solving skills and enrich them to make them self-enablers and / or match job requirements of polymer industries, which include, packaging, automotive, music, clothing, medical, information technology, aerospace, building and construction industries. Internship is mandatory in the new curriculum, which will equip the students with practical understanding and training about industry practices in a polymer industry or organization. To make education holistic, sports, physical activities, social science courses have been embedded in the curriculum.

A sound knowledge of fundamentals is included. The skill and knowledge expected from a Diploma holder to suit the needs of an industry are incorporated.

CONVENER BOARD OF STUDIES

. Er.R.DHANASEKAR, HOD, i/c,
Department of Polymer Technology,
Tamilnadu Government Polytechnic College,
Madurai - 625 011

APPROVED COMMITTEE MEMBERS

CHAIR PERSON	**Er.V.THENMOZHI M.E** PRINCIPAL Tamilnadu Government Polytechnic College, Madurai-625011
CONVENOR	**THIRU. R.DHANASEKAR** HOD i/c /Polymer Tamilnadu Government Polytechnic College, Madurai-625011
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ACADEMIC EXPERT:2	**DR. E.KRISHNPRABAKARAN** Lecturer / Polymer Institute of Chemical Technology, Tharamani;Chennai-600113
ACADEMIC EXPERT:3	**DR. V.SELVI** Lecturer / Polymer Institute of Chemical Technology, Tharamani;Chennai-600113
ACADEMIC EXPERT:4	**Dr. S.GANDHI** CONTROLLER OF EXAMINATION KCET , Virudhunagar
INDUSTRIAL EXPERT:1	**Mr.A.LAKSHMI NARASHIMAN** Managing Director Bhargavi rubber private ltd 342,melakkal main road Kochadai; madurai-625016
INDUSTRIAL EXPERT:2	**SATHISH VEEAIAH** Managing partner;Veera industries 23,visalabagam 2nd street; Subramaniya puram;Madurai-625011

INDUSTRIAL EXPERT:3	**Mr.C.SOMAN** Managing partner Janatha rubber industry Salem
ALUMNI FROM INDUSTRY	**Mr.A.VIJAYAKUMAR** Managing partner Madura rubber industry Ambathur; Chennai
INTERNAL MEMBER-1	**Thiru. G.KALIRAJ** Lecturer /Polymer Tamilnadu Government Polytechnic College, Madurai-625011
INTERNAL MEMBER-2	**Tmt. E.HEMA MEENAKSHI** Lecturer /Polymer Tamilnadu Government Polytechnic College, Madurai-625011
INTERNAL MEMBER-3	**Dr.E.BABU** Lecturer /Polymer Tamilnadu Government Polytechnic College, Madurai-625011

Regulation 2023
Program Structure

Diploma Polymer Technology (Sandwich)

Program Outcomes (PO's)

POs are statements that describe what students are expected to know and be able to do upon graduating from the program. These relate to the skills, knowledge, analytical ability attitude, and behavior that students acquire through the program.

The POs essentially indicate what the students can do from subject-wise knowledge acquired by them during the program. As such, POs define the professional profile of an engineering diploma graduate.

NBA has defined the following seven POs for an Engineering diploma graduate:

P01: Basic and Discipline-specific knowledge: Apply knowledge of basic mathematics, science and engineering fundamentals and an engineering specialization to solve the engineering problems.

PO2: Problem analysis: Identify and analyze well-defined engineering problems using codified standard methods.

PO3: Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

P04: Engineering Tools, Experimentation, and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

P05: Engineering practices for society, sustainability and environment: Apply appropriate technology in the context of society, sustainability, environment and ethical practices.

PO6: Project Management: Use engineering management principles individually, as a team member or as a leader to manage projects and effectively communicate about well-defined engineeringactivities.

PO7: Life-longlearning: Abilitytoanalyzeindividualneedsandengageinupdatinginthecontext of technological changes.

Credit Distribution

Semester	No of Courses	Periods	Credits
Semester I	9	640	20
Semester II	9	640	20
Semester III	8	640	20
Semester IV	7	640	20
Semester V	8	640	20
Semester VI	3	640	20
Semester VII	1	-	12
		Total	132

DIPLOMA IN POLYMER TECHNOLOGY; REGULATION 2023; SEMESTER – III

##	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	74310	Basic Organic Chemistry	3-0-0	45	3	Theory
2	Program Core	Theory	74320	Basics of Polymer Science	3-0-0	45	3	Theory
3	Program Core	Practicum	74330	Rubber Materials	1-0-4	75	3	Practical
4	Program Core	Practicum	74340	Plastics Materials	1-0-4	75	3	Practical
5	Program Core	Practical/Lab	74350	Polymer Science Practical	0-0-4	60	2	Practical
6	Program Core	Practical/Lab	74360	Polymer engineering practical	0-0-6	90	3	Practical
7	Open Elective	Advanced Skill Certification	74370	Advanced Skills Certification – 3	1-0-2	60	2	NA
8	Humanities & Social Science	Integrated Learning Experience	74380	Growth Lab	0-0-2	30	1	NA
9	Audit Course	Integrated Learning Experience	74390	Induction Program – II	-	16	0	-
10	Audit Course	Integrated Learning Experience	743A0	I&E/ Club Activity/ Community Initiatives	-	16	0	-
11	Audit Course	Integrated Learning Experience	743B0	Emerging Technology Seminars	-	8	0	-
12	Audit Course	Integrated Learning Experience	743C0	Shop floor Immersion	-	6	0	-
13	Audit Course	Integrated Learning Experience	743D0	Health & Wellness	-	30	1	-
14	Audit Course	Integrated Learning Experience	743E0	Student-Led Initiative	-	24	0	-
TOTAL					565	**580**	**20**	

Note: Test & Revisions: 45 Periods | Library Hours: 15 Periods

DIPLOMA IN POLYMER TECHNOLOGY; REGULATION 2023; SEMESTER – IV

##	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	74410	Basics of Chemical Engineering	3-0-0	45	3	Theory
2	Program Core	Theory	74420	Rubber Processing	3-0-0	45	3	Theory
3	Program Core	Practicum	74430	Plastic Processing	2-0-2	60	3	Practical
4	Program Core	Practicum	74440	Polymer additives & compounding	2-0-2	60	3	Practical
5	Program Core	Practical/Lab	74450	Chemical Engineering Practical	0-0-6	90	3	Practical
6	Program Core	Practical/Lab	74460	Rubber Processing Practical	0-0-6	90	3	Practical
7	Open Elective	Advanced Skill Certification	74470	Advanced Skills Certification - 4	1-0-2	60	2	NA
8	Audit Course	Integrated Learning Experience	74480	I&E/ Club Activity/ Community Initiatives	-	30	0	-
9	Audit Course	Integrated Learning Experience	74490	Special Interest Groups *(Placement Training)*	-	30	0	-
10	Audit Course	Integrated Learning Experience	744A0	Emerging Technology Seminars	-	8	0	-
11	Audit Course	Integrated Learning Experience	744B0	Shop floor Immersion	-	8	0	-
12	Audit Course	Integrated Learning Experience	744C0	Health & Wellness	-	30	0	-
13	Audit Course	Integrated Learning Experience	744D0	Student-Led Initiative	-	24	0	-
TOTAL						**580**	**20**	

Note: Test & Revisions: 45 Periods | Library Hours: 15 Periods

DIPLOMA IN POLYMER TECHNOLOGY; REGULATION 2023; SEMESTER – V

##	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Elective	Theory	*	Elective-1	3-0-0	45	3	Theory
2	Program Elective	Theory	**	Elective-2	3-0-0	45	3	Theory
3	Program Core	Practicum	74530	Polymer mould design	1-0-4	75	3	Practical
4	Program Core	Practicum	74540	Chemical Process Instrumentation and Control	1-0-4	75	3	Practical
5	Program Core	Practical/Lab	74550	Polymer testing practical	2-0-4	90	4	Practical
6	Humanities & Social Science	Project/Internship	74560	Innovation & Startup	1-0-2	60	2	Practical
7	Open Elective	Advanced Skill Certification	74570	Advanced Skills Certification – 5	1-0-2	60	2	NA
8	Audit Course	Integrated Learning Experience	74580	Induction program III		40	0	-
9	Audit Course	Integrated Learning Experience	74590	Special Interest Groups (Placement Training)		40	0	-
10	Audit Course	Integrated Learning Experience	745A0	Health & Wellness		30	0	-
11	Audit Course	Integrated Learning Experience	745B0	Student-Led Initiative		30	0	-
TOTAL						**590**	**20**	

Note: Test & Revisions: 35 Periods | Library Hours: 15 Periods

*	1	Program Elective-1	Theory	74511	Rubber product manufacturing technology
	2	Program Elective-1	Theory	74512	Polymer Packaging Technology
	3	Program Elective-1	Theory	74513	Footwear Technology

**	1	Program Elective-2	Theory	74521	Polymer testing
	2	Program Elective-2	Theory	74522	Polymer Blends and Alloys
	3	Program Elective-2	Theory	74523	Bio Polymers

DIPLOMA IN POLYMER TECHNOLOGY; REGULATION 2023; SEMESTER – VI

##	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Elective	Theory	*	Electives-3 (Pathway)	4-0-0	60	4	Theory
2	Program Elective	Practicum	**	Elective-4 (Specialization)	2-0-4	90	4	Practical
3	Project report and work	Project	74630	In-house Project / Fellowship	0-0-24	475	12	Project
TOTAL						**620**	**20**	

Note: Test & Revisions: 10 Periods | Library Hours: 10 Periods

*	1	Program Elective-3 |Pathway| Higher Education	Theory	74611	Advanced Elastomeric Technology
	2	Program Elective-3 |Pathway| Entrepreneurship	Theory	74612	Entrepreneurship and Business Management
	3	Program Elective-3 |Pathway| Technocrats	Theory	74613	Industrial Management
	4	Program Elective-3 |Pathway| Technologists	Theory	74614	Advanced polymer processing

**	1	Program Elective-4 | Specialization	Practicum	74621	Polymer Recycling and waste management
	2	Program Elective-4 | Specialization	Practicum	74622	Adhesive Technology
	3	Program Elective-4 | Specialization	Practicum	74623	Latex technology

DIPLOMA IN POLYMER TECHNOLOGY; REGULATION 2023; SEMESTER – VII

##	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Industrial Training	Internship/Training	74710	Industrial Training Report and Viva-voce	-	-	12	Viva-voce
TOTAL						**-**	**12**	

74310	BASIC ORGANIC CHEMSTRY	L	T	P	C
Theory		3	0	0	3

Introduction

Organic chemistry is the branch of chemistry that deals with the structure, properties, and reactions of compounds that contain carbon. It is a highly creative science. Chemists in general and organic chemists in particular can create new molecules never before proposed which, if carefully designed, may have important properties for the betterment of the human experience.

Organic compounds play a major role in the manufacture of Polymeric materials. Organic compounds are all around us and in industries such as the rubber, plastics, fuel, pharmaceutical, cosmetics, and detergent, coatings, dyestuffs, and agrichemicals industries. Organic chemistry is critically important to our high standard of living.

Course Objectives

The objective of this course is to enable the students,

- To learn about the IUPAC nomenclature of the organic compounds.
- To understand the different methods of purification of the organic compound
- To understand the types of Isomerism and polymerization
- To know about the methods of preparation properties and uses of Alcohols, carbonyl compounds and Amines
- To learn about the fractional distillation of coal tar and the various fractions

Course Outcomes

After successful completion of this course, the students should be able to

CO1	To narrate about the IUPAC nomenclature and different methods of purification of the organic compounds.
CO2	To explain the different types of isomerism and different types of reactions.
CO3	To describe about the methods of preparation properties and uses of ethylene, acetylene methanol, ethanol, ethylene glycol and glycerol.
CO4	To explain the different methods of preparation properties and uses of formaldehyde, acetone, acetic acid and amines.
CO5	To discuss about the fractional distillation of coal tar and the various fractions. To study about the methods of preparation of properties and uses of Benzene, nitrobenzene, aniline and phenol

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	1	2	2	2	3
CO2	3	-	1	2	2	2	3
CO3	3	-	1	2	2	2	3
CO4	3	-	1	2	2	2	3
CO5	3	-	1	2	2	2	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.
- Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6^{th} Week	12^{th} Week	$13\text{-}14^{th}$ Week	16^{th} Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of **EIGHT** questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

  Each question may have subdivisions. Maximum two subdivisions shall be permitted.
- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.
- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74310	BASIC ORGANIC CHEMSTRY	L	T	P	C
Theory		3	0	0	3

Unit I	**CLASSIFICATION, NOMENCLATURE AND TYPES OF BOND**	
Classification of organic compounds – Functional Group - IUPAC nomenclature of Alkane, Alkene, Alkyne, alcohol (Monohydric, dihydric and trihydric), ether, Aldehyde, ketone, carboxylic acid (mono and di), and amines (Primary, secondary and tertiary). Types of Bond – Ionic Bond , Covalent Bond and Hydrogen Bond (Definition with example) - Homolytic and Hetrolytic fission of Covalent Bond. Free Radical, Carbocations and Carbanions (Defnition with example).		**9**
Unit II	**PURIFICATION OF ORGANIC COMPOUNDS AND ISOMERISM.**	
Purification of organic compounds - crystallization, sublimation, simple distillation and Column Chromatography. Isomerism chain isomerism, position isomerism, functional isomerism, metamerism, and tautomerism (Keto-enol tautomerism only). Stereoisomerism.- optical isomerism (Lactic acid only)-Geometrical isomerism (Maleic acidand Fumaric acid only).		**9**
Unit III	**TYPES OF ORGANIC REACTIONS AND HYDROCARBONS**	
Types of organic reactions - Substitution reactions and Addition reaction (Definition with example) - Markonikaff's Rule - Peroxide effect, Elimination reaction and Polymerisation reactions. Methods of preparation, properties and uses of Methane, Ethylene and Acetylene.		**9**
Unit IV	**ALCOHOLS , CARBONYL COMPOUNDS AND AMINES**	
Methods of preparation, properties and uses of Methanol (Preparation from water gas and by oxidation of CH_4). Ethylene glycol (Preparation from ethylene and ethylene diamine), Glycerol (Preparation from propylene). Methods of preparation, properties and uses of Formaldehyde, Acetone, Acetic acid and Amines (Primary, Secondary and Tertiary amines)- Separation of amines by Hoffmann's method.		**9**
Unit V	**AROMATIC COMPOUNDS**	
Coal tar - Fractional distillation of coal tar - Different products and their uses Commercial preparation of benzene (from (i) coal tar and (ii) Petroleum) - Properties of benzene. Methods of preparation, properties and uses of Nitrobenzene, Aniline and Phenol.		**9**
TOTAL HOURS		**45**

Text Books:

1. V.R.Gowarikar, N.V.Viswanathan & Jayadev Sridhar - Polymer Science - New age international publishers - 1986.
2. Fred W.Billmeyer - Text Book of Polymer Science - Wiley Interscience - 1971.

References:

1. Anilkumar & S.K.Gupta -Fundamentals of Polymer Science - Tata McGraw Hill Pub. Co. 1978.
2. Odian.G - Principles of Polymerisation – McGraw-Hill, New York – 1970

74320	Basics of Polymer Science	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the manufacture of various automotive and non-automotive rubber products. After doing this course student will be confident about the different manufacturing processes of rubber industry. It will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students

1. To know the different polymerisation kinetics
2. To know the various polymerisation techniques
3. To determine molecular weight and its distribution
4. To relate the effect of crystallinity and Tg on polymer properties
5. To understand the fundamentals polymer reaction

Course Outcomes

After successful completion of this course, the students should be able to

CO1	Differentiate various polymerisation kinetics
CO2	Understand various polymerisation techniques
CO3	Determine molecular weight and its distribution
CO4	Relate the effect of crystallinity and Tg on polymer properties
CO5	Understand the fundamentals polymer reaction

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	1	2	2	2	3
CO2	3	-	1	2	2	2	3
CO3	3	-	1	2	2	2	3
CO4	3	-	1	2	2	2	3
CO5	3	-	1	2	2	2	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide

examples from daily life, realistic situations and real- world engineering and technological applications.The demonstration can make the subject exciting and foster the student's scientific mindset.

- Activities for student should be planned on feasible topics.Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology:

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6^{th} Week	12^{th} Week	$13\text{-}14^{th}$ Week	16^{th} Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of **EIGHT** questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

Each question may have subdivisions. Maximum two subdivisions shall be permitted.

- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.
- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74320	Basics of Polymer Science	L	T	P	C
Theory		3	0	0	3

Unit I	**CHEMISTRY OF POLYMERISATION AND CHAIN POLYMERISATION**	
Definition of Monomer - Functionality of monomers - Definition of Polymer, Polymerisation and Degree of polymerisation – Classification of polymers - Chemistry of polymerisation - Chain polymerisation - Free Radical polymerisation - Initiation - Chain transfer agents – Propagation - Inhibitors – termination - Ionic polymerisation - Cationic polymerisation - Anionic polymerisation - Living polymesr - coordination polymerization –stereo regular & Ziegler-Natta catalysts.		**9**
Unit II	**MISCELLENEOUS POLYMERISATION AND CO-POLYMERISATION**	
Step Polymerisation: Polycondensation polymerisation - Polyaddition polymerisation - Ring opening polymerization – Group transfer polymerization – Co-polymers – definion and examples - Free Radical co-polymerisation – Co-polycondensation.		**9**
Unit III	**POLYMERISATION TECHNIQUES**	
Bulk polymerization- Solution polymerisation - Suspension polymerisation- Emulsion polymerisation – Melt Polycondensation – Solution Polycondensation – Interfacial Polycondensation		**9**
Unit IV	**POLYMER MOLECULAR WEIGHT DETERMINATION**	
Average molecular weight concept - Number average molecular weight - Weight average Molecular weight – Molecular weight and degree of polymerisation - Molecular weight determination: Cryoscopy – Viscometry: Ostwald Viscometry – Light scattering method - Polymer fractionation: Gel permeation Chromatography		**9**
Unit V	**POLYMER CRYSTALLISATION, Tg AND POLYMER REACTIONS**	
Degree of crystallinity - Effect of crystallinity on the properties of polymers – Amorphous Vs Crystalline Polymers - Glass transition temperature - factors influencing the glass transition temperature - Polymer reactions (Definition and example only) - Hydrolysis - Acidolysis - Hydrogenation - Cross linking reactions of rubber and thermoset plastic (one example each)-Polymer degradation (principle only).		**9**
TOTAL HOURS		**45**

Text Books:

1. V.R.Gowarikar, N.V.Viswanathan & Jayadev Sridhar - Polymer Science - New age international publishers - 1986.
2. Fred W.Billmeyer - Text Book of Polymer Science - Wiley Interscience - 1971.

References:

3. Anilkumar & S.K.Gupta -Fundamentals of Polymer Science - Tata McGraw Hill Pub. Co. 1978.
4. Odian.G - Principles of Polymerisation – McGraw-Hill, New York – 1970

74330	Rubber Materials	L	T	P	C
Practicum		1	0	4	3

Introduction

To study the manufacturing technology, properties and applications of various elastomers. The concepts of flexible polymer chains and its influence in properties of rubber. Appreciate the influence of chemical structure on various properties of elastomer. Acquire basic knowledge on Natural Rubber, properties and its applications. Familiar with preparation, properties and application of various synthetic rubbers.

Course Objectives

The objective of this course is to enable the students

1. To know the structure and property relationship of various rubbers
2. To select a rubber for a given application based on its properties
3. To differentiate the various categories of rubber
4. To understand the applications of various rubbers
5. To identify different rubbers by chemical method

Course Outcomes

After successful completion of this course, the students should be able to

CO1	Identify a rubber by chemical method
CO2	Select a rubber for a given application based on its properties
CO3	Differentiate the various categories of rubber
CO4	Understand the applications of various rubbers
CO5	Identify different rubbers by chemical method

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	1	2	-	3
CO2	3	2	2	1	2	-	3
CO3	3	2	2	1	2	-	3
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Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

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- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)			**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	
Mode	Practical & Written Test	Practical & Written Test	Practical Test	Practical Examination
Portion	PART A/Cycle 1 Exercises & Two units	PART B/Cycle 2 Exercises & another two units	All Exercises	All Exercises
Duration	3 Periods	3 Periods	3 Hours	3 hours
Exam Marks	60	60	100	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7^{th} Week	14^{th} Week	16^{th} Week	

Note:

- **CA1 and CA2:**.The practical and written test should be conducted as per the portion above and the scheme of evaluation can be decided by the departments. Assessment written & Practical test should be conducted for 60 Marks. The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.

- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted and the scheme of evaluation can be decided by the departments. The marks awarded should be converted to 10 Marks for the internal assessment.

74330	Rubber Materials	L	T	P	C
Practicum		1	0	4	3

Unit I	**GENERAL PURPOSE RUBBER – I**	
Natural Rubber: NR Latex – Composition – Conversion of NR Latex into Ribbed Smoked Sheet, Pale crepe and Brown crepe - Properties of dry rubber and Applications- Vulcanization. BR: Structure – Types – Manufacture of BR - Properties and Applications- Vulcanization **List of experiments:** 1. Identification of NR 2. Identification of BR		**15**
Unit II	**GENERAL PURPOSE RUBBER – II**	
SBR: Structure - Types – Manufacture of emulsion SBR and solution SBR - Properties and applications-Vulcanization EPDM: Structure – Dienes – Manufacture of EPDM - Properties and Applications-Vulcanization. **List of experiments:** 3. Identification of SBR 4. Identification of EPDM		**15**
Unit III	**SPECIALITY RUBBERS – I**	
IIR:Butyl rubber – Structure – Manufacture - Properties and Applications-Vulcanization. Chloroprene rubber – Structure – Manufacture – Properties and Applications - Vulcanization. **List of experiments:** 5. Identification of IIR 6. Identification of CR		**15**
Unit IV	**SPECIALITY RUBBERS – II**	
NBR:Nitrile Rubber – Structure – types – Manufacture - Properties and Applications- - Vulcanization. Silicone - Structure – Liquid silicone rubbers – Properties - silicones in medical applications—Vulcanization. **List of experiments:** 7. Identification of NBR 8. Identification of Silicone		**15**
Unit V	**HIGH PERFORMANCE RUBBER**	
Structure, Properties and Applications of Fluoro rubbers - Ethylene–Vinyl Acetate (EVA) copolymers- Polysulphide rubbers and Polyurethanes. Introduction to Thermoplastic elastomers –Rubber Blends. **List of experiments:** 9. Identification of halogenated rubber 10. Identification of NBR/PVC blend.		**15**
TOTAL HOURS		**75**

List of Equipment / Instruments, Material, Manuals Required (For A Batch of 30 Students):

S.No.	Name of Equipment / Instrument	Quantity
1.	Tripod stand	10
2.	Mortar and pestal	5
3.	Tongs	10
4.	Test tube	25
5.	Beaker	10
6.	Bunsen burner	10

Text Books:

1. Kothandaraman B, Rubber Materials, Ane Books, 2008.
2. Brydson J, Rubber Chemistry, Butterworths, 1978

References:

1. Morton, M.; Rubber Technology, Chapman Hall, 1995.
2. C.M.Blow - Rubber Technology and Manufacture - Butterworths Publication-1971.
3. G.Alliger - Vulcanization of Elastomers - Reinhold Publishing co. 1965.
4. Franta, I; Elastomers and Rubber Compounding materials, Elsevier, 1989.
5. Dick. J.S., Rubber Technology Compounding and testing for Performance, Hanser Publisher, 2001
6. Analysis of rubbers – Lab manual

4340	Plastics Materials	L	T	P	C
Practicum		1	0	4	3

Introduction

To study the manufacturing technology, properties and applications of various plastics. Appreciate the influence of chemical structure on various properties of plastics. Acquire basic knowledge on thermoplastic and thermoset plastics properties and its applications. Familiar with preparation, properties and application of various plastics materials.

Course Objectives

The objective of this course is to enable the students

1. To know the structure and property relationship of various plastics
2. To select a plastic for a given application based on its properties
3. To differentiate the various categories of plastics
4. To understand the applications of various plastics
5. To identify different rubbers by chemical method

Course Outcomes

After successful completion of this course, the students should be able to

CO1	Identify a rubber by chemical method
CO2	Select a rubber for a given application based on its properties
CO3	Differentiate the various categories of rubber
CO4	Understand the applications of various rubbers
CO5	Identify different rubbers by chemical method

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	2	3	3
CO2	3	2	-	1	2	3	3
CO3	3	2	-	1	2	3	3
CO4	3	2	-	1	2	3	3
CO5	3	2	-	1	2	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.
- Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)			**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	
Mode	Practical & Written Test	Practical & Written Test	Practical Test	Practical Examination
Portion	PART A/Cycle 1 Exercises & Two units	PART B/Cycle 2 Exercises & another two units	All Exercises	All Exercises
Duration	1+2 Periods	3 Periods	3 Hours	3 hours
Exam Marks	60	60	100	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7^{th} Week	14^{th} Week	16^{th} Week	

Note:

- **CA1 and CA2:**.The practical and written test should be conducted as per the portion above and the scheme of evaluation can be decided by the departments. Assessment written & Practical test should be conducted for 60 Marks. The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.

- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted and the scheme of evaluation can be decided by the departments. The marks awarded should be converted to 10 Marks for the internal assessment.

74340	Plastics Materials	L	T	P	C
Practicum		1	0	4	3

Unit I	COMMODITY PLASTICS – I	
Plastics – Definition and Classifications – Abbreviations. Polyolefins: Polyethylene – Types: LDPE, HDPE, LLDPE – Structure – Manufacture of High-Density Polyethylene by Zeigler process - Properties and applications of PE – Polypropylene – Types: Isotactic, Syndiotacic and Atactic – Structure – Properties and applications of PP. **List of experiments:** 1. Identification of (I) LDPE (ii) HDPE 2. Identification of PP		**15**

Unit II	COMMODITY PLASTICS – II	
Polystyrene and copolymers(SAN, ABS ,HIPS and EPS)- Structure, Properties and applications.Polyvinyl chloride: Manufacture of PVC - Structure – Property – Difference between rigid and flexible PVC - Applications. **List of experiments:** **3.** Identification of (I) PS (ii) ABS **4.** Identification of PVC		**15**

Unit III	ENGINEERING PLASTICS – I	
Polyamides (Nylon 6 & Nylon 6,6 (only)): Structure, Preparation, Properties and applications.Polyesters – PET: Structure, Preparation, Properties and applications PMMA: Structure, Preparation, Properties and applications **List of experiments:** 5. Identification of (i) Nylon 6 and 6,6 6. Identification of (ii) PET and PMMA		**15**

Unit IV	ENGINEERING PLASTICS – II	
Polyacetals: Structure, Preparation, Properties and applications Poly Carbonate: Structure, Preparation, Properties and applications.Fluorine containing Plastics: Structure, Preparation, properties & applications of PTFE. **List of experiments:** 7. Identification of PC and POM 8. Identification of PTFE		**15**

Unit V	HIGH PERFORMANCE AND THERMOSETTING PLASTICS	
Structure, Properties and applications of PPO, PPS, Polysulphones, PEEK, and Kevlar. Structure, Properties and Applications of PF, UF, MF, Epoxy and Unsaturated Polyester resin. **List of experiments:** 9. Identification of PF 10. Identification of UF		**15**
TOTAL HOURS		**75**

List of Equipment / Instruments, Material, Manuals Required (For A Batch of 30 Students):

S.No.	Name of Equipment / Instrument	Quantity
1.	Tripod stand	10
2.	Mortar and pestal	5
3.	Tongs	10
4.	Test tube	25
5.	Beaker	10
6.	Bunsen burner	10

Text Books:

1. Brydson.J.A., Plastics Materials, 7th edition Elsevier Publication, 1999
2. Irvin.I. Rubin, “Hand Book of Plastic Materials and Technology”, Wiley Interscience, NY,1990.
3. Engineering. Plastics, Vol.2, ASM International 1988.

References:

1. R.W. Dyson “Specialty Plastics” 2nd edition, Blackie Academic & Professional 1988.
2. Athalye & Prakash Trivedi, PVC Tech, Multitech Publishing Co, Bombay,1994.
3. Geoffrey Pritchard, “Plastics Additives”, Rapra Technology Ltd, UK, 2005.
4. OlagokeOlabisi, “Hand Book of Thermoplastics”, Marcel Decker, inc., 1997
5. James M. Margolis “Engineering. Plastics Handbook” McGraw – Hill, 2006.
6. G.Gordon Cameron - Ellis Hand Book of Analysis of Synthetic Polymers-Honwood Ltd., - 1977
7. Analysis of plastics – Lab manual

74350	Polymer Science Practical	L	T	P	C
Practical		0	0	4	2

Introduction

In Diploma level engineering education, skill development plays a vital role. This can be achieved by gaining the hands-on training with various equipment relevant to their field of study. This is accomplished by doing polymer related experiments in practical classes.

Course Objectives

The objective of this course is to enable the students to find and prepare

1. To determine the Viscosity average molecular weight of polymers
2. To find the swelling and dissolution characteristics of Polymers
3. To prepare thermoplastic polymers using bulk, solution polymerisation techniques
4. To prepare copolymers using condensation polymerisation techniques
5. To prepare thermoplastic polymers using ring opening and interfacial polymerisation techniques

Course Outcomes

After successful completion of this course, the students should be able to

CO1	To determine the Viscosity average molecular weight of polymers
CO2	To find the swelling and dissolution characteristics of Polymers
CO3	To prepare thermoplastic polymers using bulk, solution polymerisation techniques
CO4	To prepare copolymers using condensation polymerisation techniques
CO5	To prepare thermoplastic polymers using ring opening and interfacial polymerisation techniques

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	-	2	2	3
CO2	3	2	1	-	2	2	3
CO3	3	2	1	-	2	2	3
CO4	3	2	1	-	2	2	3
CO5	3	2	1	-	2	2	3

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

Assessment Methodology

	Continuous Assessment (40 marks)			End Semester Examination (60 marks)
	CA1	**CA2**	**CA3**	
Mode	Practical Test	Practical Test	Practical Document	Practical Examination
Portion	Part A/ Cycle 1 Exercises	Part B/ Cycle 2 Exercises	All Exercises	All Exercises
Duration	3 Periods	3 Periods	Regularly	3 Hours
Exam Marks	60	60	Each Practical 10 Marks	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7th Week	14th Week	15th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the pattern to be decided by the departments.

  The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.

  CA 3: Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate.

74350	Polymer Science Practical	L	T	P	C
Practical		0	0	4	2

List of Experiments		
1	Preparation of poly Styrene by Bulk polymerisation .	
2	Preparation of nylon 6,6 by poly condensation technique	
3	Interfacial polymerisation of Nylon 6 6	
4.	Preparation of poly acrylonitrile by solution polymerisation .	
5	Preparation of PF Resin	
6	Preparation of UF Resin	
7	Viscosity average molecular weight by Ostwald Viscometer	
8	Determination of hydrolytic degradation of polymers.	
9	Determination of Chemical degradation of polymers.	
10	Swelling and dissolution characteristics of Polymers (Any one rubber and plastic)	
	TOTAL HOURS	**60**

List of Equipment / Instruments, Material, Manuals Required (For A Batch of 30 Students):

S.No.	Name of Equipment / Instrument	Quantity
1.	Electronic weighing balance	1
2.	Burette	5
3.	Ostwald Viscometer	5
4.	Magnetic Stirrer	5
5.	Conical flask	5
6.	Heating Mantle	5
7.	Round bottom flask	5
8.	Liebig condenser	5
9	Water bath	1

Reference:

1. Experimental Polymer science by V.R.Gowrikar et.al.,
2. Polymer science Lab Manual

74360	Polymer Engineering Drawing Practical	L	T	P	C
Practical		0	0	6	3

Introduction

In today's scenario metals, wood, ceramics, glass, etc., are replaced polymeric materials. But to manufacture any product the part drawing plays the fundamental role. Hence, converting the finer and accurate details of a polymer part into a drawing is very essential. This subject helps the students to represent the product detail as a drawing. Moreover, this fundamental knowledge helps the students to understand about polymer mould design concept in the higher semester in a better way.

Course Objectives

The objective of this course is to enable the students

1. To understand the different types of views and projections
2. To capture the dimensional details of a polymer product
3. To draw the sectional view of polymer test specimens, moulds and products
4. To understand different views of a part
5. To Draw different views of a plastic parts

Course Outcomes

After successful completion of this course, the students should be able to

CO1	Differentiate various views and projections
CO2	Capture the dimensional details of a polymer product
CO3	Draw the sectional view of polymer test specimens, moulds and products
CO4	Understand different views of a part
CO5	Draw different views of a plastic parts

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	2	2	3
CO2	3	2	-	1	2	2	3
CO3	3	2	-	1	2	2	3
CO4	3	2	-	1	2	2	3
CO5	3	2	-	1	2	2	3

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

Assessment Methodology

	Continuous Assessment (40 marks)			End Semester Examination (60 marks)
	CA1	**CA2**	**CA3**	
Mode	Practical Test	Practical Test	Practical Document	Practical Examination
Portion	Part A/ Cycle 1 Exercises	Part B/ Cycle 2 Exercises	All Exercises	All Exercises
Duration	3 Periods	3 Periods	Regularly	3 Hours
Exam Marks	60	60	Each Practical 10 Marks	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7th Week	14th Week	15th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the pattern to be decided by the departments.

  The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.

CA 3: Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate.

74360	Polymer Engineering Drawing Practical	L	T	P	C
Practical		0	0	6	3

List of Experiments		
1	Top, Front and Side view of Compression Button specimen	
2	Top, Front and Side view of Flexural/Tear Specimen	
3	Top, Front and Side view of Notched Charpy Specimen	
4	Top, Front and Side view of Dumbbell specimen	
5	Front and top view of guide pin and guide bush	
6	Full Sectional view of Single cavity mould	
7	Full Sectional view of Multi cavity mould	
8	Full Sectional view of Tensile slab mould	
9	Full Sectional view of Simple Rubber Ball	
10	Full Sectional view of Plastic bottle	
TOTAL HOURS		**90**

Reference:

1. Engineering Drawing, N.D.Bhatt, Charotar Publishing House Pvt. Ltd., 53rd edition, 2014.

List of Equipment / Instruments, Material, Manuals Required (For A Batch of 30 Students):

S.No.	Name of Equipment / Instrument	Quantity
1.	Drawing specimens and moulds	5 sets
2.	Drawing Table	30 Nos.

74410	Basics of Chemical Engineering	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the importance of polymer recycling and various methods to recycle polymers. Since, it is the need essential to solve environmental related issues this course will play a vital role. It will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students to

1. Explain the properties of the fluid and its behavior, working principle of flow meters
2. Familiarize about the working principle of pumps and its types along with hydraulic fluids
3. Select the required method to reduce the size of the material and various laws
4. Understand the principle behind the heat transfer process/equipment's and mechanism of drying
5. Know about the principle of mixing, agitation, settling and its equipment's

Course Outcomes

After successful completion of this course, the students should be able

CO1	To explain the properties of the fluid and its behavior, working principle of flow meters
CO2	To familiarize about the working principle of pumps and its types along with hydraulic fluids
CO3	To select the required method to reduce the size of the material and various laws
CO4	To understand the principle behind the heat transfer process /equipment's and mechanism of drying
CO5	To know about the principle of mixing, agitation, settling and its equipment's

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	2	3	3
CO2	3	2	-	1	2	3	3
CO3	3	2	-	1	2	3	3
CO4	3	2	-	1	2	3	3
CO5	3	2	-	1	2	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.
- Activities for student should be planned on feasible topics.Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of **EIGHT** questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

  Each question may have subdivisions. Maximum two subdivisions shall be permitted.
- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.
- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74410	Basics of Chemical Engineering	L	T	P	C
Theory		3	0	0	3

Unit I	HYDROSTATICS AND FLUID MECHANICS	
Properties of fluids- density- specific weight- specific volume- specific gravity- surface Tension and capillarity -vapour pressure. Pressure - fluid pressure - Laws of liquid pressure - Pascal's law of Transmissibility - Intensity of pressure - Atmospheric pressure - Gauge pressure - Absolute pressure. Flow of fluids- Laminar flow- Newtonian and Non-Newtonian fluids - viscosity - Kinematic viscosity - Turbulent flow- Reynolds experiment - Reynolds number - dimensionless number - continuity equation- Energy of fluid- Potential energy-kinetic energy- pressure energy- Bernoulli's Theorum- **Definition only** - Principle , construction and working of Venturi meter and orifice meter - Difference between venturi and orifice meter – Principle, construction and working of Rotameter.		**09**

Unit II	PUMPS AND HYDRAULIC APPLIANCES	
Reciprocating pump - single acting reciprocating pump - double acting reciprocating pump - Principle of centrifugal pump - working of a centrifugal pump - priming of centrifugal pump. Major properties and types of hydraulic fluids the construction and operation of hydraulic press and hydraulic lift – The construction and operation of weight loaded accumulators, single acting intensifier, the advantages and disadvantages of each type.		**09**

Unit III	HEAT TANSFER	
Conduction - Fourier's law - thermal conductivity - conduction through plane wall, convection - natural convection - forced convection - radiation - Kirchoff's law - black body - Stefan Boltzmann law - emissivity - grey body - heat transfer equipment - 1 - 2 shell and tube heat exchanger only - construction details - thermal insulation. Drying – drying definitions – Construction and operation of tray driers, spray drier.		**09**

Unit IV	SIZE REDUCTION, SCREENING AND CONVEYING	
Principles - applications - size reduction machines - crushers - jaw crusher - roll crushers - angle of nip - grinders - ball mills - load - operations - critical speed - operating speed - ultrafine grinders - fluid energy mill. Screening - sieve standards - motions of screens - actual screen and ideal screen. Conveying types - belt conveyor - bucket elevator - screw conveyor - pneumatic conveyor.		**09**

Unit V	MIXING, AGITATION, SETTLING AND SEDIMENTATION	
Purposes of agitation - Agitation of liquids - equipment's - propellers - paddles - turbines - Vortex and Swirling prevention. Mixing of pastes - change can mixers - kneaders - two arm kneader - Banbury mill - Mixers for dry powders- ribbon blenders - tumbling mixers. Settling – stokes law - batch settling - hindered settling and free settling - equipment - Dorr thickner.		**09**
TOTAL HOURS		**45**

Text Books:

1. W.L.Mc Cabe & J.C.Smith - Unit Operations of Chemical Engg. - McGraw Hill Book Co. 1985.
2. W.L.Badger & J.T.Banchero - Introduction to Chemical Engg. - McGraw Hill Book Co. 1988.
3. R.S.Khurmi - Hydraulics and Hydraulic appliances.

References:

1. Robert H.Perry - Perry's Chemical Engg. Hand Book - McGraw Hill Book Co.
2. A.S.Foust Etal - Principles of Unit Operations - Wiley International Edition.

74420	Rubber Processing	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the importance of Rubber Processing. Since, it is the need essential to solve environmental related issues. Rubber products are made from various formulations by any one of the processing methods. Therefore ,highly necessary to have good understanding about the principles of processing and also different problems encountered during processing and to rectify the same to get good products. This subject enables the students to apply the understanding of various rubber processing techniques used in rubber industries. this course will play a vital role. It will be useful for them during the professional career.

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Course Objectives

The objective of this course is to enable the students to

1. Explain the properties of the fluid and its behaviour, working principle of flow meters
2. Familiarize about the working principle of pumps and its types along with hydraulic fluids
3. Select the required method to reduce the size of the material and various laws
4. Understand the principle behind the heat transfer process/equipment's and mechanism of drying
5. Know about the principle of mixing, agitation, settling and its equipment's

Course Outcomes

After successful completion of this course, the students should be able

CO1	To explain the properties of the fluid and its behavior, working principle of flow meters
CO2	To familiarize about the working principle of pumps and its types along with hydraulic fluids
CO3	To select the required method to reduce the size of the material and various laws
CO4	To understand the principle behind the heat transfer process /equipment's and mechanism of drying
CO5	To know about the principle of mixing, agitation, settling and its equipment's

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	2	3	3
CO2	3	2	-	1	2	3	3
CO3	3	2	-	1	2	3	3
CO4	3	2	-	1	2	3	3
CO5	3	2	-	1	2	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of **EIGHT** questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

  Each question may have subdivisions. Maximum two subdivisions shall be permitted.
- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.
- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74420	Rubber Processing	L	T	P	C
Theory		3	0	0	3

Unit I	**MIXING**	
Mastication- Basic Principles of Mixing; distributive and dispersive mixing-Mixing machinery for rubber –construction and operations- open Two-roll Mills - Internal Batch Mixers – kneader, inter mix- Banbury Mixer – Continuous Mixing- Master batch Mixing- Final Mixing- post-mixing-operations, handling and storage- safety and common problems in mixing -factors affecting the mixing process.		**9**
Unit II	**EXTRUSION**	
Extruders- Types- Basic principles involved types of Extruders- construction and operations of single screw type-L/D ratio and its influences - construction and operations - Die Swell -Recent Extruder Design- layout of ancillary equipment- safety and common problems in extrusion- factors affecting the process		**9**
Unit III	**CALENDERING**	
Calender-Types- Basic principles involved types of Calendering- Feeding the Calender -construction and operations of three roll vertical calendar machine-–calendering operations-sheeting- skim coating- frictioning- topping- lamination, profiling- roll configuration-control of thickness- roll bending-roll crossing -Material Thickness Control-layout of ancillary equipment- safety and common problems in Calendering - factors affecting the process ..		**9**
Unit IV	**FORMING**	
Forming -Basic principles involved –forming machines-Forming of hand built products-with and without reinforcement-- Forming of machine built products- with and without reinforcement - layout of ancillary equipment - safety and common problems in forming process-factors affecting the process.		**9**
Unit V	**CURING**	
curing - Basic principles involved –Molding: construction and operations of Compression Molding and Transfer Molding machine –Rubber injection moulding machine- Backrind- safety and common problems in curing process-factors affecting the process. Autoclave Curing-Continuous vulcanization-Fluidized bed curing-Liquid Curing Medium, Microwave curing- radiation curing- Roto cure and hot air oven curing. Various Trimming and Finishing methods.		**9**
TOTAL HOURS		**45**

Text Books:

1. An Introduction to Rubber Technology ;Andrew Ciesielski First Published 1999 by Rapra Technology Limited.
2. The Complete Book on Rubber Processing and Compounding Technology ;Author: NIIR Board of Consultants and Engineers Format: Paperback ISBN: 8178330059 . Published: 2006 Publisher: Asia Pacific Business Press Inc

References:

1. Rubber Technology Compounding and Testing for Performance John S. Dick
2. Morton, M.; Rubber Technology, Chapman Hall, 1995.
3. C.M.Blow - Rubber Technology and Manufacture - Butterworths Publication-1971.

74430	Plastics Processing	L	T	P	C
Practicum		2	0	2	3

Introduction

In today's scenario metals, wood, ceramics, glass, etc., are replace plastic materials. Hence the application of plastic material is much wider and has many more futuristic applications. Thereby, it is significant to know the processing of such plastic material into various products using suitable techniques. By doing this course, the students will explore the optimization of various process parameters involved and gain confidence in knowing the functioning of each components of the processing machineries. The theoretical and corresponding practical knowledge will pave way for gaining confidence in plastics processing techniques.

Course Objectives

The objective of this course is to enable the students to

1. Select a suitable processing method to manufacture a plastics product as per the requirement
2. Differentiate the various processing methods
3. Identify the various components and the functions of the plastics processing machinery
4. Define the function of various components of the plastics processing machinery
5. Choose a suitable method to join the various plastics parts

Course Outcomes

After successful completion of this course, the students should be able

CO1	To select a suitable processing method to manufacture a plastics product as per the requirement
CO2	To differentiate the various processing methods
CO3	To identify the various components and the functions of the plastics processing machinery
CO4	To define the function of various components of the plastics processing machinery
CO5	To choose a suitable method to join the various plastics parts

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	2	3	3
CO2	3	2	-	1	2	3	3
CO3	3	2	-	1	2	3	3
CO4	3	2	-	1	2	3	3
CO5	3	2	-	1	2	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)			**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	
Mode	Practical & Written Test	Practical & Written Test	Practical Test	Practical Examination
Portion	PART A/Cycle 1 Exercises & Two units	PART B/Cycle 2 Exercises & another two units	All Exercises	All Exercises
Duration	3 Periods	3 Periods	3 Hours	3 hours
Exam Marks	60	60	100	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7^{th} Week	14^{th} Week	16^{th} Week	

Note:

- **CA1 and CA2:**.The practical and written test should be conducted as per the portion above and the scheme of evaluation can be decided by the departments. Assessment written & Practical test should be conducted for 60 Marks. The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.
- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted and the scheme of evaluation can be decided by the departments. The marks awarded should be converted to 10 Marks for the internal assessment.

74430	Plastics Processing	L	T	P	C
Practicum		2	0	2	3

Unit I	**COMPRESSION AND TRANSFER MOULDING**	
Compression moulding process - moulding cycle - types of compression press - Bulk factor - Trouble shooting. Transfer moulding process - moulding cycle - pot vs plunger type - comparison of compression moulding process and transfer moulding process. **List of experiments:** 1. Manufacture of plastic product by compression moulding 2. Calculation of bulk factor		**12**
Unit II	**INJECTION MOULDING**	
Injection moulding process- types – Parts of injection moulding and their function –- cycle time – Types of clamping system – Thermoset injection moulding process - Troubleshooting **List of experiments:** 3. Manufacture of plastic product by injection moulding. 4. Calculation of clamping force		**12**
Unit III	**BLOW MOULDING**	
blow moulding process – types- extrusion blow moulding process – Injection blow moulding process - Injection stretch blow moulding process – Parison programming for convergent and divergent die - Blow up ratio - Troubleshooting. **List of experiments:** 5. Manufacture of plastic product by blow moulding 6. Calculation of blow up ratio		**12**
Unit IV	**EXTRUSION AND THERMOFORMING**	
Extrusion process –types- Extruder parts and functions . Thermoforming process – Heating sources - vacuum forming techniques – Pressure forming techniques -Plug assist forming - Bubble or blister forming - Draw ratio of sheet **List of experiments:** 7. Manufacture of plastic product by thermoforming process 8. Calculation of draw ratio		**12**
Unit V	**ROTATIONAL MOULDING , POLYMER COMPOSITES AND JOINING**	
Rotational moulding process: Types of rotational moulding - Batch type machine process - Straight line (Shuttle) machine process - Carousel type machine process . Basic concept of fabrication of moulds for fiber reinforced plastics - Processing method of fiber reinforced plastics – Hand lay up – Spray up –Vacuum bag – Pressure bag – Filament winding –Pultrusion– Matched die moulding and resin transfer moulding. Joining of plastics: Adhesive bonding - Ultrasonic welding - Vibration welding – hermal sealing. **List of experiments:** 9. Manufacture of plastic product by rotational moulding 10. Preparation of FRP by handlay-uptechnique		**12**
TOTAL HOURS		**60**

List of Equipment / Instruments, Material, Manuals Required (For A Batch of 30 Students):

S.No.	Name of Equipment / Instrument	Quantity
1.	Compression/Hydraulic press with mould	1
2.	Blow moulding machine with mould	1
3.	Thermoforming machine with mould	1
4.	Injection moulding machine with mould	1
5.	Bulk density apparatus set	1
6.	Rotational moulding machine with mould	1
7.	Electronic weighing balance	1
8.	Heat sealing machine	1
9.	Air Compressor	1
10.	Hot air oven	1
12.	Stirrer set	2

Text Books:

1. D.H.Marton, Jones - Polymer Processing – Chapman and Hall(1989)
2. Irvin Rubin - Injection Moulding: Theory and Practice – Wiely, (1972).

References:

1. E.C.Bernhardt – Processing of Thermoplastics Materials – Reinhold, New York.
2. J.S.Walker & E.R.Martin - Injection Moulding of Plastics Butterworths, London.
3. Bown,J - Injection Moulding of Plastics Components – McGraw-Hill (1979).
4. Holmes–Walker,W.A – Polymer Conversion, Applied Science Publishers-(1975)
5. John D. Beadle – Plastics Forming – Macmillan, London (1981)
6. Fisher, E.G - Blow Moulding of Plastics – Iliffe, London (1991)
7. Elden,R.A. and Swann,A.D - Calendering of Plastics – Iliffe, London (1991)
8. James E.S., Margolis - Decorative of Plastics – Hanser Publishers (1986)
9. Gleann L Beall – Rotational Moulding – Hanser Publishers (1998)
10. Polymer processing – Lab manual

74440	Polymer additives & compounding	L	T	P	C
practicum		2	0	2	3

Introduction

All the rubber product performance requirement cannot be fit in a single formulation. Hence, the formulation have to be tailor made as per the customer's requirement. Preparing the rubber compound is a skill based task. Rubber compounding using two roll mill is essential in any rubber industry. Moreover, preparing a rubber compound as per the formulation is equally important as that of the designing of formulation. Quality of the rubber compound plays a vital role in determining the quality of the product. Hence, this course paly a very vital role in the professional career of the polymer students.

Course Objectives

The objective of this course is to enable the students to

1. Operate the two roll mil.
2. Prepare the given rubber compound as per the formulation.
3. Demonstrate the skill to compound using two roll mill as per the formulation.
4. Apply the order of addition during mixing.
5. Optimize the mixing parameter.

Course Outcomes

After successful completion of this course, the students should be able

CO1	To operate the two roll mil.
CO2	To prepare the given rubber compound as per the formulation.
CO3	To demonstrate their skill using two roll mill as per the formulation.
CO4	To apply the order of addition during mixing.
CO5	To analyse the rubber compound to ensure its quality.

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	2	3	3
CO2	3	2	-	1	2	3	3
CO3	3	2	-	1	2	3	3
CO4	3	2	-	1	2	3	3
CO5	3	2	-	1	2	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.

- Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)			**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	
Mode	Practical & Written Test	Practical & Written Test	Practical Test	Practical Examination
Portion	PART A/Cycle 1 Exercises & Two units	PART B/Cycle 2 Exercises & another two units	All Exercises	All Exercises
Duration	3 Periods	3 Periods	3 Hours	3 hours
Exam Marks	60	60	100	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7th Week	14th Week	16th Week	

Note:

- **CA1 and CA2:**.The practical and written test should be conducted as per the portion above and the scheme of evaluation can be decided by the departments. Assessment written & Practical test should be conducted for 60 Marks. The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.
- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted and the scheme of evaluation can be decided by the departments. The marks awarded should be converted to 10 Marks for the internal assessment.

74440	Polymer additives & compounding	L	T	P	C
practicum		2	0	2	3

Unit I	**POLYMER DEGRADATION**	
Polymer degradation - Types of degradation: Thermal degradation - Thermal degradation of PVC - Mechanical degradation – Mastication of NR, Photo degradation - Photo degradation of PMMA, Oxidative degradation – Oxidative degradation of PP - Hydrolytic degradation.		**12**
Unit II	**ANTI DEGRADANTS**	
Importance of compounding additives – Requirement of additives – Classification of additives (Functional, Process, Modifier and Miscellaneous) – Antioxidants – Antiozonants – UV absorber – UV stabiliser – Heat stabiliser and its classification.		**12**
Unit III	**FILLERS AND REINFORCEMENTS**	
Types of fillers: Based on source – Based on reinforcement – Based of colour – Types of carbon black - Fibers – Types of fibers: Based on source – Glass fiber and its types – Carbon fibre and its types – Aramid fibre and its types – Nano filler vs conventional filler. 1.Preparation of carbon black filled NR compound 2.Preparation of carbon black filled PVC compound 3.Preparation of non-black filled NR compound 4.Preparation of non-black filled synthetic rubber compound		**12**
Unit IV	**PROCESSING AIDS, CURING AGENTS AND MISCELLANEOUS ADDITIVES**	
Plasticizer and its role – Types of plasticizer - Lubricants and its types – Miscellaneous additives (Definition and example only): Flame retardant – Blowing agents - Impact modifier – Antistatic agent – Colourants. Curing system: Definition of Crosslinking – Vulcanising agents for rubbers – Accelerators and its types – Activator for rubbers. 5.Preparation of rubber compound based on sulphur cure system. 6. Preparation of rubber compound based on peroxide cure system. 7. Preparation of rubber compound based on metal oxide cure system.		**12**
Unit V	**COMPOUNDING**	
Principle of compounding– Order of addition - Definition with one formulation of Master batch, Gum compound, Green compound – typical formulation based on NR,SBR,EPDM,IIR,NBR and CR. 8. Preparation of rubber compound based on conventional cure system. 9.Preparation of rubber compound based on semi efficient cure system. 10. Preparation of rubber compound based on efficient cure system.		**12**
TOTAL HOURS		**60**

Text Books:

1. Holloway - Composite materials – Elsevier, Amsterdam, 1966.

References:

1. Brian Parkyn – Glass Reinforced Plastics , 1970.
2. Gibbs & Cox – Marine Design Manual for FRP- McGraw Hill Book Co. –1960.
3. P.Ghosh – Fiber science and technology – Tata McGraw Hill, New Delhi,2004
4. Geoffery Pritchard – Reinforced Plastics Durability – Wood head Publishing –2000
5. R.H.Sonneborn - Fiberglass Reinforced Plastics – Reinhold, New York, 1954

List of Equipment / Instruments, Material, Manuals Required (For A Batch of 30 Students):

S.No.	Name of Equipment / Instrument	Quantity
1.	Two roll mill	1
2.	Two roll mill knife	2
3.	Electronic weighing balance	1
4.	Rubber bale cutter	1

Reference:

1. Rubber Compounding manual

74450	Chemical Engineering Practical	L	T	P	C
Practical		0	0	6	3

Introduction

In Diploma level engineering education skill development plays a vital role. These can be achieved gaining the hands-on training with various equipment relevant to their field of study.

This is accomplished by doing engineering related experiments in practical classes.

Course Objectives

The objective of this course is to enable the students to

1. Operate the various flow meters
2. Familiarize with the operation of centrifugal pump.
3. Demonstrate the skill to operate the size reduction machineries.
4. Gaining knowledge about the working of drier.
5. Analyze the operation of industrial mixer and settling.

Course Outcomes

After successful completion of this course, the students should be able

CO1	To Operate the various flow meters
CO2	To Familiarize with the operation of centrifugal pump.
CO3	To Demonstrate the skill to operate the size reduction machineries.
CO4	To Gaining knowledge about the working of drier.
CO5	To Analyze the operation of industrial mixer and settling.

CO/PO Mapping

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	3	2	-	1	2	3	3
CO2	3	2	-	1	2	3	3
CO3	3	2	-	1	2	3	3
CO4	3	2	-	1	2	3	3
CO5	3	2	-	1	2	3	3

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

Assessment Methodology

	Continuous Assessment (40 marks)			End Semester Examination (60 marks)
	CA1	**CA2**	**CA3**	
Mode	Practical Test	Practical Test	Practical Document	Practical Examination
Portion	Part A/ Cycle 1 Exercises	Part B/ Cycle 2 Exercises	All Exercises	All Exercises
Duration	3 Periods	3 Periods	Regularly	3 Hours
Exam Marks	60	60	Each Practical 10 Marks	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7^{th} Week	14^{th} Week	15^{th} Week	

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the pattern to be decided by the departments.

  The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.

CA 3: Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate.

74450	Chemical Engineering Practical	L	T	P	C
Practical		0	0	6	3

List of Experiments		
1	Determination of Pipe friction	
2	Study and operation on Orifice meter	
3	Study and operation on Venturi meter	
4	Study and operation on Rotameter	
5	Study and operation on Centrifugal pump	
6	Study and operation on Jaw crusher	
7	Study and operation on Ball mill	
8	Experiment on Batch settling	
9	Study and operation on Industrial mixer	
10	Study and operation on Drier	
TOTAL HOURS		**90**

List of Equipment / Instruments, Material, Manuals Required (For A Batch of 30 Students):

S.No.	Name of Equipment / Instrument	Quantity
1	Pipe friction equipment	
2.	Orifice meter	1
3.	Venturi meter	1
4.	Rotameter	1
5.	Centrifugal pump	1
6.	Jaw crusher	1
7.	Ball mill	1
8.	Batch settling equipment	1
9.	Industrial mixer	1
10.	Drier	1

Reference:

1. Chemical Engineering Manual by W.L.Mc Cabe & J.C.Smith

2. Chemical Engineering Manual by W.L.Badger &J.T.Banchero

74460	Rubber Processing Practical	L	T	P	C
Practical		0	0	6	3

Introduction

In today's scenario metals, wood, ceramics, glass, etc., are replace polymeric materials. Hence the application of polymer material is much wider and has many more futuristic applications. Thereby, it is significant to know the processing of such material into various products using suitable techniques. By doing this course, the students will explore the optimization of various process parameters involved and gain confidence in knowing the functioning of each components of the processing machineries. The theoretical and corresponding practical knowledge will pave way for gaining confidence in Rubber processing techniques.

Course Objectives

The objective of this course is to enable the students to

1. Operate the various Rubber processing machineries.
2. Select the suitable processing machineries as per the requirement.
3. Demonstrate the skill to operate the Rubber processing machineries.
4. Optimize the processing parameters.
5. Analyse the defect and rectify the same.

Course Outcomes

After successful completion of this course, the students should be able

CO1	To operate the various polymer processing machineries.
CO2	To select the suitable processing machineries as per the requirement.
CO3	To demonstrate the skill to operate the polymer processing machineries.
CO4	To optimize the processing parameters.
CO5	To analyse the defect and rectify the same.

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	2	3	3
CO2	3	2	-	1	2	3	3
CO3	3	2	-	1	2	3	3
CO4	3	2	-	1	2	3	3
CO5	3	2	-	1	2	3	3

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

Assessment Methodology

	Continuous Assessment (40 marks)			End Semester Examination (60 marks)
	CA1	**CA2**	**CA3**	
Mode	Practical Test	Practical Test	Practical Document	Practical Examination
Portion	Part A/ Cycle 1 Exercises	Part B/ Cycle 2 Exercises	All Exercises	All Exercises
Duration	3 Periods	3 Periods	Regularly	3 Hours
Exam Marks	60	60	Each Practical 10 Marks	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7th Week	14th Week	15th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the pattern to be decided by the departments.

  The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.

CA 3: Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate.

74460	Rubber Processing Practical	L	T	P	C
Practical		0	0	6	3

List of Experiments		
1	Mastication of rubber by adding peptiser on a two roll mill.	
2	Preparation of master batch	
3	Preparation of final batch	
4	Processing of rubber using extruder machine	
5	Study about the die swell characteristics of rubber in extruder machine.	
6	Processing of rubber using calendering machine.	
7	Study about the calendaring processes in calendering machine.	
8	Preparation of preform of moulded goods article.	
9	Processing of rubber using Compression moulding machine with tensile slab mould	
10	Processing of rubber using Compression moulding machine with hardness button mould.	
TOTAL HOURS		**90**

List **o**f Equipment / Instruments, Material, Manuals Required (For A Batch **o**f 30 Students):

S.No.	Name of Equipment / Instrument	Quantity
1.	Two roll mill	1
2.	Two roll mill knife	2
3.	Extrusion machine	1
4.	Electronic weighing balance	1
5.	Rubber bale cutter	1
6.	Calendaring machine	1
7.	Compression moulding machine	1

Reference:

1. Morton, M.; Rubber Technology, Chapman Hall, 1995.
2. C.M.Blow - Rubber Technology and Manufacture - Butterworths Publication-1971.

74511	Rubber Products Manufacturing Technology	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the manufacture of various automotive and non-automotive rubber products. After doing this course student will be confident about the different manufacturing processes of rubber industry. It will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students to

1. Know the important terminologies in Rubber compounding.
2. Analyse the mechanism behind curing
3. Explain the manufacture process of tyres.
4. Describe the manufacture process of tubes, hoses and oil seal.
5. Distinguish various types of automotive and non-automotive rubber products.

Course Outcomes

After successful completion of this course, the students should be able

CO1	To Know the important terminologies in Rubber compounding.
CO2	To analyse the mechanism behind curing
CO3	To explain the manufacture process of tyres.
CO4	To describe the manufacture process of tubes, hoses and oil seal.
CO5	To distinguish various types of automotive and non-automotive rubber products.

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	2	3	3
CO2	3	2	-	1	2	3	3
CO3	3	2	-	1	2	3	3
CO4	3	2	-	1	2	3	3
CO5	3	2	-	1	2	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.

- Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of **EIGHT** questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

  Each question may have subdivisions. Maximum two subdivisions shall be permitted.
- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.
- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74511 Theory	Rubber Products Manufacturing Technology	L	T	P	C
		3	0	0	3

Unit I	**TYRES**	
Tyres: Definition – Types – Specification of a tyre - Function o f a tyre, Components of a bias, belted bias and radial tyre and its function - Tubed v s Tubeless tyres – Bias vs Radial tyre. **PneumaticTyres:**– Manufacture of pneumatic tyres: Tyre building - Vulcanization: P ress curing, Bag-o-matic curing, Autoclave curing **Solid Tyres:** Manufacture of solid tyre – Applications.		**9**
Unit II	**TUBES,HOSES AND CABLES**	
Tubes: Manufacture of Automotive tube **Hoses:** Types – Components and its function – Manufacture of hose – Autoclave curing. **Cable:** Manufacture of cable		**9**
Unit III	**COATED FABRICS AND BELTS**	
Coated fabrics: Formulations – manufacturing of coated fabrics –applications of coated fabrics..**Belts:** Conveyor belt vs Transmission belt - Conveyor belting – components and its function – Manufacture of conveyor belt - Transmission belting – Components and its function – Manufacture of V-belt – Timing belt - Cogged belt – Vulcanization - Rotocuring and Pot curing		**9**
Unit IV	**RUBBER TO METAL BONDED COMPONENTS**	
Rubber to metal bonded components:Bonding methods-Metal cleaning-surface preparation Compound spreparation for bonding,application of bonding medium, molding - Rubber rollers: formulation for general purpose, textile roll, paper mill roll and hard rubber roll–curing,Applications of rubber rolls.		**9**
Unit V	**MOULDED RUBBER PRODUCTS**	
Formulations and manufacture of Diaphragms, oilseals, Bellows, O-rings, play balls: Hard rubber: formulation, manufacture, properties and applications. - Manufacture of footwear.		**9**
	TOTAL HOURS	**45**

Text Books:

1. Rubber Tech., and Manufacture by C.M.Blow-Plastic and Rubber Institute, ButterWorths - 1982
2. Plastics Materials and Product Testing Vol.I & II CIPET, Chennai
3. Rubber Engineering - Indian Rubber Institute - Tata McGraw Hill Publishing Co. Ltd. New Delhi – 1998
4. F.J. Kovac, —Tire Technologyll, 4th edition, Good year Tire and Rubber Company, Akron, 1978.

References:

1. Plastics by JJ.Harry Dubois and Frederick W.John -Van Nostrand Reinhold Co.
2. Plastics Technology by Robert V.Milby -McGraw Hill BookCo.-1973
3. Technology of Rubber Products byG.P.Mayurya-S.B.P.Publication
4. Complete Manufacturing Details and Know-how on Tyres Tubes Hoses and Belts by R.S.Gupta - SIRI Publications.
5. Hand Book of Rubber and Rubber Goods Industries by K.E.Dhingra - SIRI Publications

74512	Polymer Packaging Technology	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the importance of polymer recycling and various methods to recycle polymers. Since, it is the need essential to solve environmental related issues this course will play a vital role. It will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students to

1. Know the various requirements of packaging
2. Understand the different processing methods
3. Describe the various flexible packaging methods
4. Explain different rigid and semi rigid packaging methods
5. Analyse the testing to be performed for packaging

Course Outcomes

After successful completion of this course, the students should be able

CO1	To know the various requirements of packaging
CO2	To understand the different processing methods
CO3	To describe the various flexible packaging methods
CO4	To explain different rigid and semi rigid packaging methods
CO5	To analyse the testing to be performed for packaging

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	2	1	3	2	3
CO2	3	-	2	1	3	2	3
CO3	3	-	2	1	3	2	3
CO4	3	-	2	1	3	2	3
CO5	3	-	2	1	3	2	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide

examples from daily life, realistic situations and real- world engineering and technological applications.

- The demonstration can make the subject exciting and foster the student's scientific mindset.
- Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of **EIGHT** questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

  Each question may have subdivisions. Maximum two subdivisions shall be permitted.

- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.
- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74512	Polymer Packaging Technology	L	T	P	C
Theory		3	0	0	3

Unit I	**INTRODUCTION TO PLASTICS PACKAGING**	
Scope and functions of packaging – advantages of plastics packaging over conventional packaging materials – Major forms of plastics materials used in packaging - distribution hazards – special requirements of food and medical packaging – packaging regulations and legislation.		**9**
Unit II	**COVERSION PROCESSES**	
Different types of closures: Friction closures - Snap fit closures - Threaded closures – Plastics bottles production by blow moulding – extrusion blow moulding – injection blow moulding – stretch blow moulding - Metalizing – Barrier coatings.		**9**
Unit III	**FLEXIBLE PACKAGING**	
Sheet extrusion process – Blown film extrusion process – Multi layer film manufacture – Pouches: Pillow pouches - Three side seal pouches - Four side seal pouches - Stand up pouches - Forming pouches – Bulk and heavy duty bags - Advantages of flexible packaging		**9**
Unit IV	**RIGID AND SEMI RIGID PACKAGING**	
Thermoforming techniques in packaging: Wrap forming – B lister packaging – Skin packaging – Foam moulding process: Injection - Compression – Applications: Expanded polystyrene, Rigid foam and flexible foam in packaging.		**9**
Unit V	**TESTING OF PLASTICS PACKAGING**	
Testing of plastic packages – Barrier properties – Oxygen permeability – Carbon dioxide permeability – Water vapour transmission rate (WVTR) - Migration properties – Compatibility property.		**9**
TOTAL HOURS		**45**

Text Books:

1. John Scheirs., - “Polymer Recycling” John Wiley and Sons,1998
2. Nabil Mustafa – “Plastics Waste Management” John Wiley and Sons,1998

References:

1. Aaron L Brody Kenneth S Marsh, “Encyclopedia of Packaging Technology”, Wiley, 1997.
2. A.S. Athayle, “Handbook of Packaging Plastics”, Multi Tech publishing Co, First edition, 1999
3. Selke, S. E. M., Culter, J. D. and Hernandez, R. J., “Plastics Packaging: Properties, Processing, Applications and Regulations”, Carl Hanser Verlag, USA, 2004

74513	Footwear technology	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the importance of Footwear technology and various methods to fabricate Footwear technology based on polymers. Since, it is the need essential to solve environmental related issues this course will play a vital role. It will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students to

1. Know the various requirements of packaging
2. Understand the different processing methods
3. Describe the various flexible packaging methods
4. Explain different rigid and semi rigid packaging methods
5. Analyse the testing to be performed for packaging

Course Outcomes

After successful completion of this course, the students should be able

CO1	To know the various requirements of packaging
CO2	To understand the different processing methods
CO3	To describe the various flexible packaging methods
CO4	To explain different rigid and semi rigid packaging methods
CO5	To analyse the testing to be performed for packaging

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	2	1	3	2	3
CO2	3	-	2	1	3	2	3
CO3	3	-	2	1	3	2	3
CO4	3	-	2	1	3	2	3
CO5	3	-	2	1	3	2	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological

applications.The demonstration can make the subject exciting and foster the student's scientific mindset.Activities for student should be planned on feasible topics.

- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6^{th} Week	12^{th} Week	$13\text{-}14^{th}$ Week	16^{th} Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of **EIGHT** questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

  Each question may have subdivisions. Maximum two subdivisions shall be permitted.
- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74513	Footwear Technology	L	T	P	C
Theory		3	0	0	3

Unit I	FOOT ANATOMY	
Foot anatomy – Arches of foot -Foot parameters-Foot injury-foot deformity-Last for footwear making–sizing systems-English sizing system-European Sizing system –Basic styles of footwear- Basic concepts of Design and Patterns for footwear- Mean former extraction from last -Extraction of upper standards – Style Line marking –Pattern extraction-Pattern Grading – CAD for footwear design.		9
Unit II	**Pre closing operations**	
Pre closing operations- clicking - Splitting, Skiving, cementing, Folding, Edge treatments, etc.-Various treatment of upper closing-closing operation-Types of seams- selection of leather for footwear making-footwear components Reinforcement materials-Insoles-Shanks-Soling materials.		9
Unit III	**Types of footwear**	
Types of footwear-Various components of open footwear- Various unit operations involved in men's chapel making-Unit operations involved in Ladies Chapel Making.		9
Unit IV	**Principle and process of drafting**	
Principle and process of drafting-Types of lasting- Types of footwear construction viz. Cemented, Good year welted, Veldschotan, stoble, Moccasin and moulded shoes etc-Process and sequence of operations in cementing construction –Basic footwear machines-Lasting machines, .		9
Unit V	**Finishing techniques**	
Finishing techniques –-Finishing techniques involved in open footwear fabrication – Bottoming finishing-shoe Dressing-Materials used in finishing department –Packing – Quality control aspects in footwear making.		9
TOTAL HOURS		**45**

Text Books:

3. Text Book of Footwear Manufacture by J.H. Thornton - The National Trade Press Ltd., London, 1970.
4. Manual of Shoe making by R.G. Miller - Clarks Ltd., Publications, 1989.

References:

1. "Know Your Footwear" by B. Venkatappaiah _NICLAI Publications.
2.. The Complete Hand Book of footwear making – Ganguly,

74521	Polymer Testing	L	T	P	C
THEORY		3	0	0	3

Introduction

Any polymer product should tested as per the standards to meet the customer specification. Even if the formulation is perfect and processing method is appropriate, the wrongly performed test method will end up to an erroneous path. So, selecting the right test method, performing them as per the procedure and appropriate test specimen preparation is crucial in any product development and routine production to meet the customer specification and to maintain the quality. Hence, this course paly a very vital role in the professional career of the polymer students.

Course Objectives

The objective of this course is to enable the students to

1. Select the suitable test method to measure the necessary parameter.
2. Determine the properties required as per the standard.
3. Apply the procedure as per the standard.
4. Analyse the values obtained from the test.
5. Interpret the test result.

Course Outcomes

After successful completion of this course, the students should be able

CO1	To select the suitable test method to measure the necessary parameter.
CO2	To determine the properties required as per the standard.
CO3	To apply the procedure as per the standard.
CO4	To analyse the values obtained from the test.
CO5	To interpret the test result.

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	2	3	3
CO2	3	2	-	1	2	3	3
CO3	3	2	-	1	2	3	3
CO4	3	2	-	1	2	3	3
CO5	3	2	-	1	2	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.
- Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of

EIGHT questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

Each question may have subdivisions. Maximum two subdivisions shall be permitted.

- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.
- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74521	Polymer Testing	L	T	P	C
Theory		3	0	0	3

Unit I	**MECHANICAL PROPERITES OF POLYMER**	
Tensile strength - Stress curve - Equipment and procedure - Tear resistance – Equipment and procedure - Angular specimen - Impact strength - Izod – Charpy – Falling dart - Equipment and procedure – Abrasion resistance (DIN method) - Equipment and procedure – Rebound resilience - Equipment and procedure		**09**
Unit II	**THERMAL PROPERTIES OF POLYMER**	
Thermal properties: Heat distortion Temperature (HDT) - Equipment and procedure - TGA – equipment and procedure - Determination of Glass transition temperature by DSC- equipment and procedure **Flammability tests**: - Limiting oxygen index – Horizontal burning method.		**09**
Unit III	**RHEOLOGICAL PROPERTIES OF POLYMER**	
Rheological Properties: Melt Flow Index – equipment and procedure – Mooney Viscometer - Oscillating Disc Rheometer - equipment and procedure.		**09**
Unit IV	**ELECTRICAL AND OPTICAL PROPERITES OF POLYMER**	
Electrical properties: Requirements of an insulator – Di-electric strength (Step by step method) – equipment and procedure – Factors affecting Di-electric strength. – Arc resistance – equipment and procedure. **Optical properties**: Light Transmittance and Haze – equipment and procedure – Gloss – equipment and procedure.		**09**
Unit V	**WEATHERING, CHEMICAL PROPERTIES AND NON-DESTRUCTIVE TEST**	
Weathering properties: Accelerated weathering test (Weather-O-meter) – equipment and procedure **Chemical properties:** Solvent stress cracking resistance – equipment and procedure – Environmental Stress Cracking Resistance (ESCR) – equipment and procedure **Nondestructive testing:** Importance of non-destructive testing – Various NDT methods available (List only)		**09**
	TOTAL HOURS	**45**

Text Books:

1. R.P.Brown, —Physical Testingof Rubbers‖, 3rd edition, Smither Rapra Publishing, 1992.
2. Vishu Shah, —Handbook of Plastic Testing Technology - Wiley Inter-science Publications, 1998.
3. J.Haslam and H.A.Willis, —Identification and Analysis of Polymer, ILIFFE, London, 1972.
4. Polymer Testing Lab Manual

References:

1. G.Gordon Cameron - Ellis Hand Book of Analysis of Synthetic Polymers- Honwood Ltd., - 1977
2. Maurice Morton - Rubber Technology - Robert E.KriegerPub.Co.1973.
3. A.S. Athalye–Identification and testing of plastics - Multitech publishers -1992.

4. How to identify plastics - CIPET Publication-2003.
5. Paul Kluckow-Rubber and Plastics Testing – Chapman & Hall, London –1963.
6. Murugan.N - Basics of Testing of Plastics – Study Material.
7. L.E.Nielsen -Mechanical properties of Plastics – Reinhold, New York – 1962.
8. J.H.Collins -Testing and Analysis of Plastics – Plastics Institute – 1955.
9. R. P. Brown - Handbook of plastic testing methods - 1971
10. K.J.Saunders-Identification of Plastics & Rubbers–Chapman & Hall –1966.
11. M.E.Baird - Electrical Properties of polymeric materials – Plastics and Rubber Institute, London – 1973.

74522	Polymer Blends and Alloys	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the various polymer blends and alloys to make a customized polymer product as per the application requirement. Also, the synergetic effect of properties exhibited by lends paves way for wide range of application. After doing this course student will be confident about the different blends preparation, processing and their applications which will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students to

1. Differentiate the various polymer blends
2. Prepare various polymer blends
3. Process polymer blends in batches
4. Process polymer blends continuously
5. Carry out the testing of polymer blends.

Course Outcomes

After successful completion of this course, the students should be able

CO1	To differentiate the various polymer blends
CO2	To prepare various polymer blends
CO3	To process polymer blends in batches
CO4	To process polymer blends continuously
CO5	To carry out the testing of polymer blends

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	-	2	3	3
CO2	3	2	1	-	2	3	3
CO3	3	2	1	-	2	3	3
CO4	3	2	1	-	2	3	3
CO5	3	2	1	-	2	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.

- Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of **EIGHT** questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

  Each question may have subdivisions. Maximum two subdivisions shall be permitted.
- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.
- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74522	Polymer Blends and Alloys	L	T	P	C
Theory		3	0	0	3
Unit I	**INTRODUCTION**				
Definition of blend and alloy – Difference between blend and alloy – Phases in blend: Matrix phase – Dispersed phase - Types of blends: Miscible – Compatiblised – Immiscible - Methods of blending: Polymerisation – Co-polymerisation – Mixing – Gibb's free energy.					9
Unit II	**POLYMER BLEND PREPARATION**				
Mixing – Dry – Melt – Solution – Mixing mechanism – Dispersion vs Distribution – Mixing nature: Macroscopic level – Microscopic level – Molecular level – Reynolds number and flow behavior.					9
Unit III	**BATCH PROCESSING MACHINERIES**				
Tumbler – Ribbon blender – High speed mixer – Z- blade mixer – Ball mill – Banbury - Kneader - Two roll mill					9
Unit IV	**CONTINUOUS PROCESSING MACHINERIES**				
Twin screw extruder – Co-rotating – Counter rotating – Inter meshing – Non-inter meshing – Conical screw extruder.					9
Unit V	**TESTING OF POLYMER BLEND**				
Specimen preparation, equipment and procedure of Differential scanning calorimetry – Scanning electron microscopy – Transmission electron microscopy.					9
TOTAL HOURS					**45**

Text Books:

1. Utracki, L.A., "Polymer Blends Handbook", Volumes I and II, Kluwer Academic Publishers, 2002.

References:

1. Paul, D.R. and Bucknall, C.B., "Polymer Blends", Volumes I and II, Wiley Interscience, 2000.
2. Riew, C.K. and Kinloch, A.J., "Toughened Plastics I – Science and Engineering", ACS, Advance in Chemistry Series 233, 1993
3.L.H.Sperling, "Introduction to Physical Polymer Science", Wiley Interscience, 2006

74523	Biopolymers	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the various biopolymer, their properties and applications. Biopolymers are widely used in agriculture, pharmaceutical, medical and packaging industry. Biopolymer helps the sustainability of polymer applications by being environmental friendly. After doing this course student will be confident about the advancements in the field of polymers and kindle their mind towards higher education.

The objective of this course is to enable the students to

1. Understand the need for biopolymers
2. Know the various sources for biopolymers
3. Select and process biopolymers based on customer requirements.
4. Explore the applications of biopolymers in packaging.
5. Discover the applications of biopolymers in agriculture.

Course Outcomes

After successful completion of this course, the students should be able

CO1	To understand the need for biopolymers
CO2	To know the various sources for biopolymers
CO3	To select and process biopolymers based on customer requirements.
CO4	To explore the applications of biopolymers in packaging
CO5	To discover the applications of biopolymers in agriculture.

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	-	2	1	3
CO2	3	2	3	-	2	1	3
CO3	3	2	3	-	2	1	3
CO4	3	2	3	-	2	1	3
CO5	3	2	3	-	2	1	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.

- Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of **EIGHT** questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

  Each question may have subdivisions. Maximum two subdivisions shall be permitted.
- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.
- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74523	Biopolymers	L	T	P	C
Theory		3	0	0	3
Unit I	**INTRODUCTION**				
Sources for Polymers – Sustainability of Petroleum resources - Need for Alternate – Polymer Recycling and Environmental Issues – Bio derived Polymers - Biodegradation and its Evaluation techniques - Introduction to Life Cycle Assessment		**9**			
Unit II	**BIOPOLYMER RESOURCES**				
Polysaccharide based polymers – Gelatinization – Starch based blends - Biodegradation of Starch based Polymers - Production of Lactic acid and Polylactide - Properties and applications of Polylactide – Chitin & Chitosan and its derivatives as biopolymers.		**9**			
Unit III	**CELLULOSE BASED BIOPOLYMRES**				
Plant and animal based Proteins – Solution casting of proteins – Processing of proteins as plastics – Preparation and properties of hemicellulose – Cellulose based Composites – Surface and Chemical modifications of Cellulose fibers		**9**			
Unit IV	**PACKAGING APPLICATIONS OF BIOPOLYMERS**				
Food Packaging – Functional Properties – Safety and Environmental aspects – Shelf life – Films and coatings in Food Applications – Materials for edible films and coatings – Biopolymer coatings for paper and paperboard – Bio-nanocomposite films and coatings		**9**			
Unit V	**BIOPOLYMER APPLICATIONS IN AGRICULTURE**				
Biopolymer Films – Biodegradable mulching – Advantages and Disadvantages – Chemical sensors – Biosensors - Functionalized Biopolymer Coatings and Films – Applications of biopolymers in horticulture		**9**			
TOTAL HOURS		**45**			

Text Books:

1. David Plackett, “Biopolymers – New Materials for Sustainable films and Coatings”, John Wiley & Sons Ltd, 2011

References:

1. David Kaplan, “Biopolymers from Renewable resources”, Springer, 1998
2. Carmen Scholz, Richard A Gross, “Polymers from Renewable Resources: Biopolymers and Biocatalysis”, American Chemical Society, 2001.

74530	Polymer Mould Design	L	T	P	C
Practicum		1	0	4	3

Introduction

Polymer product design is an emerging field. Expertise people in this area is very limited as the designing of polymer product and the behavior of polymeric materials are entirely different from that of metals. This course needs the fundamental understanding about the properties of various polymeric materials and their processing characteristics. This course will help the polymer students to enter into the emerging filed as their profession. Hence, this course paly a very vital role in the professional career of the polymer students.

Course Objectives

The objective of this course is to enable the students to

1. Define the terminologies in mould design
2. Design and draw single cavity mould
3. Design and draw multi cavity mould
4. Design and draw split mould
5. Design and draw compression mould, transfer mould and extrusion die

Course Outcomes

After successful completion of this course, the students should be able

CO1	To define the terminologies in mould design
CO2	To design and draw single cavity mould
CO3	To design and draw multi cavity mould
CO4	To design and draw split mould
CO5	To design and draw compression mould, transfer mould and extrusion die

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	2	3	3
CO2	3	2	-	1	2	3	3
CO3	3	2	-	1	2	3	3
CO4	3	2	-	1	2	3	3
CO5	3	2	-	1	2	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.

- Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)			**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	
Mode	Practical & Written Test	Practical & Written Test	Practical Test	Practical Examination
Portion	PART A/Cycle 1 Exercises & Two units	PART B/Cycle 2 Exercises & another two units	All Exercises	All Exercises
Duration	3 Periods	3 Periods	3 Hours	3 hours
Exam Marks	60	60	100	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7^{th} Week	14^{th} Week	16^{th} Week	

Note:

- **CA1 and CA2:**.The practical and written test should be conducted as per the portion above and the scheme of evaluation can be decided by the departments. Assessment written & Practical test should be conducted for 60 Marks. The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.
- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted and the scheme of evaluation can be decided by the departments. The marks awarded should be converted to 10 Marks for the internal assessment.

74530	Polymer Mould Design	L	T	P	C
Practicum		1	0	4	3

Unit I	INTRODUCTION	
Introduction to product design – Types of moulds – Parts of a mould and its function - Positioning of gates, runners, venting, weld lines – Definition and role of Ribs, Bosses , Rim, Gussets ,Radii , Fillets, Cavity and core (integer, insert) - Bolster - Sprue bush - Register ring - Guide pillar - Guide bush and Parting line - Types of undercuts **List of experiments:** 1. Draw the sectional view of a basic mould 2. Draw the sectional view of feed system		**15**
Unit II	**FEED, EJECTION & COOLING SYSTEM**	
Parting line construction - Stepped parting line - Irregular parting surface - Local stepped and profile parting line. Feed system - sprue - runners –hot runner - Balancing of runner. Types of gating system - Winkle gate - Diaphragm gate - Sprue gate - Edge gate - Fan gate - Ring gate - Submarine gate - Pin point gate - Types of ejection – Pin - Stepped pin - Blade – Sleeve – Stripper – Air - Double ejection. Cavity cooling techniques - Core cooling techniques - Bolster cooling techniques - Sprue cooling - Ejection cooling. **List of experiments:** 3. Draw the section view of balancing of runner 4. Draw the sectional view of any 4 gate system		**15**
Unit III	**INJECTION MOULD DESIGN**	
Types of injection moulds - General arrangement of 2 plate, 3 plate mould - Single, multi impression moulds - Single daylight, multi daylight moulds - Split mould - Actuation techniques - Cam actuation, finger cam, dog leg. **List of experiments:** 5. Draw the sectional view of single impression injection mould 6. Draw the sectional view of multi impression injection mould		**15**
Unit IV	**COMPRESSION AND TRANSFER MOULD DESIGN**	
Compression mould types - flash, semi-positive, positive moulds – Advantages, limitations - Transfer moulds - Pot type moulds, Plunger type moulds. **List of experiments:** 7. Draw the sectional view of compression mould 8. Draw the sectional view of transfer mould		**15**
Unit V	**BLOW MOULD & EXTRUSION DIE DESIGN**	
Die head - Side feed - Spider or axial flow head - Accumulator head - Parison programming – Convergent and Divergent - Parting line - Pinch off - Neck pinch off - Base pinch off - Extrusion Die geometry – Torpedo – mandrel. **List of experiments:** 9. Draw the sectional view of a blow mould 10. Draw the sectional view of a die head		**15**
	TOTAL HOURS	**75**

List of Equipment / Instruments, Material, Manuals Required (For A Batch of 30 Students):

S.No.	Name of Equipment / Instrument	Quantity
1.	AutoCad Software	1
2.	System (above P3 configuration)	30
3.	Single cavity mould	1
4.	Multi cavity mould	1
5.	Compression mould	1
6.	Transfer mould	1
7.	Extruder die head	1
8.	Blow mould	1

Text Books:

1. Ronald D. Beck - Product Design - Van Nostrand-Reinhold Co. (1970)
2. R.G.W.Pye - Injection mould design -4th Ed- Longman scientific & Technical (2000)
3. R.H.Bebb - Plastic Mould Design - (Compression & Transfer mould)
4. Rosato - Blow Mould Design – Hanser Publications (1972)
5. M.V. Joshi - Extrusion Die Design –Macmillan India ltd (1992)

References:

1. J. Harry Dubois &Waying I. Prible - Plastic mould engineering hand book (1982)
2. Laszlosors – Plastic Mould Engineering – Pergamon press (1967)
3. Robert A Malloy – Plastic part design for injection Moulding – Hanser (1994)
4. Chereminishroff -.Product Design and Testing of Polymeric Material – Hanser (1992)
5. Levy - Plastics Product Design Hand Book – Van nostrand reinhold Co. (1977)
6. Dominick V Rosato and Donald V Rosato - Injection Moulding Handbook (1985)
7. Ralph.E.Wright – Moulded Thermosets – Hanser Publishers (1991)
8. Klaus stoeckhert – Mould making Handbook for Plastic Engineers – Hanser (1983)
9. Pauk.A.Tres – Designing Plastic parts for assembly – Hanser (1994)
10. Walter Michaeli – Extrusion Dies - 2nd Ed- Hanser(1992)
11. CIPET Design data book
12. Polymer Mould Design – Lab manual

74540	Chemical Process Measurement and Control	L	T	P	C
Practicum		1	0	4	3

Introduction

This course makes the student to know about the various control parameters in processing and testing machineries. This subject gives the knowledge of various instruments used to measure various processes parameters. This course will impart knowledge on working principle, construction, repair, and use of these instruments. The diploma holder should be in a position to deal with all these kinds of equipment's in the plastic processing industry.

Course Objectives

The objective of this course is to enable the students to

1. Measure the process variables of the plastic processing equipment
2. Select a suitable instrument to measure the temperature
3. Select a suitable instrument to measure the pressure
4. Explain the principle behind the process control
5. Distinguish the various modes of control actions

Course Outcomes

After successful completion of this course, the students should be able

CO1	To measure the process variables of the polymer processing equipment
CO2	To select a suitable instrument to measure the temperature
CO3	To select a suitable instrument to measure the pressure
CO4	To explain the principle behind the process control
CO5	To distinguish the various modes of control actions

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	2	3	3
CO2	3	2	-	1	2	3	3
CO3	3	2	-	1	2	3	3
CO4	3	2	-	1	2	3	3
CO5	3	2	-	1	2	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications. The demonstration can make the subject exciting and foster the student's scientific mindset.
- Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology:

	Continuous Assessment (40 marks)			**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	
Mode	Practical & Written Test	Practical & Written Test	Practical Test	Practical Examination
Portion	PART A/Cycle 1 Exercises & Two units	PART B/Cycle 2 Exercises & another two units	All Exercises	All Exercises
Duration	3 Periods	3 Periods	3 Hours	3 hours
Exam Marks	60	60	100	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7^{th} Week	14^{th} Week	16^{th} Week	

Note:

- **CA1 and CA2:**.The practical and written test should be conducted as per the portion above and the scheme of evaluation can be decided by the departments. Assessment written & Practical test should be conducted for 60 Marks. The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.
- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted and the scheme of evaluation can be decided by the departments. The marks awarded should be converted to 10 Marks for the internal assessment.

74540 Practicum	Chemical Process Measurement and Control (PRACTICUM)	L	T	P	C
		1	0	4	3

Unit I	BASIC CONCEPT OF MEASUREMENT	
	Purpose of Instrumentation– measurement- Functional elements of Instruments – Static and Dynamic characteristics of Instruments	15

Unit II	MEASUREMENT OF TEMPERATURE	
	Temperature measuring Instruments- Liquid and Gas filled Thermometer- Bimetallic Thermometer- Resistance Thermometer - Thermocouples – Thermistor. **List of Experiments** 1. Measurement of temperature using Thermocouple module 2. Measurement of temperature using RTD module 3. Measurement of temperature using Thermistor module	15

Unit III	MEASUREMENT OF PRESSURE	
	Pressure measuring Instruments – Bourdon gauge - Bellow and Diaphragm pressure sensors- Electrical pressure Transducers - Strain gauge pressure Transducers – Potentiometric pressure Transducers **List of Experiments** 4. Measurement of Pressure using Strain Gauge type Transducer **5.** Measurement of Pressure using Bourdon Pressure Transducer	15

Unit IV	PROCESS CONTROL	
	Automatic control system – significance – Terminology used in control system: Controlled variable, manipulated variable and set point – **General process control system**: Open loop system, closed loop system, Feedback control system, Feed forward control system and Ratio control system (Principles and Purpose only). **Automatic controllers**: Controllers classification: P,PI, PD, PID - Based on actuating medium: Pneumatic – Actuators, Final control element: control valves **List of Experiments** 6. Study of P, PI controller using Pressure controller Trainer kit by monitoring the process in SCADA mode. 7. Study of PID controller using Pressure controller Trainer kit by monitoring the process in SCADA mode 8. Study of valve flow coefficients and inherent characteristics of Linear, Equal% and Quick opening.	15

Unit V	APPLICATIONS OF PROCESS CONTROL	
	Control application: Liquid level system - Heat Exchanger - Control of temperature. Control of Pressure	

List of Experiments 9. Study of ON- OFF controller using Temperature controller Trainer kit by monitoring the process in SCADA mode. 10. Study of ON-OFF controller using Liquid Level controller Trainer kit by monitoring the process in SCADA mode.	**15**
TOTAL HOURS	**75**

List of Equipment / Instruments, Material, Manuals Required (For A Batch of 30 Students):

S.No.	Name of Equipment / Instrument	Quantity
1.	Temperature sensors like Thermocouple, RTD and Thermistor	1
2.	Pneumatic control valve (Linear, Equal % and Quick opening) set up.	1
3.	. Temperature control Trainer Kit with SCADA.	1
4.	Liquid Level control Trainer Kit with SCADA	1
5.	Pressure Control Trainer Kit with SCADA.	1
6.	Measurement of Pressure using Strain Gauge type Transducer	1
7.	Measurement of Pressure using Bourdon Pressure Transducer	1

TEXT Books:

1. Industrial Instrumentation by Donald Eckman , Allied Publishers, 1982
2. Industrial Instrumentation and control by S.K Singh , Twelfth edition, Tata McGraw Hill Publishing Company Ltd ., New Delhi.
3. Automatic Process Control by Donald P.Eckman, Sixth edition, Wiley Eastern Limited.,
4. Computer Control of Processes by M.chidambaram, Narosa Publishing House.

References:

1. Perry's Chemical Engineering Hand book, Seventh edition, Robert H. Perry, McGraw Hill Book Company, Singapore – 1997
2. Process Modeling, Simulation and control for Chemical Engineers by Luyben, McGraw Hill Kogakasha Ltd.
3. Chemical Process Control by George Stephanopoulos, PHI learning Pvt.Ltd.

74550	Polymer Testing Practical	L	T	P	C
Practical		2	0	4	4

Introduction

Any polymer product should tested as per the standards to meet the customer specification. Even if the formulation is perfect and processing method is appropriate, the wrongly performed test method will end up to an erroneous path. So, selecting the right test method, performing them as per the procedure and appropriate test specimen preparation is crucial in any product development and routine production to meet the customer specification and to maintain the quality. Hence, this course paly a very vital role in the professional career of the polymer students.

Course Objectives

The objective of this course is to enable the students to

1. Select the suitable test method to measure the necessary parameter.
2. Determine the properties required as per the standard.
3. Apply the procedure as per the standard.
4. Analyse the values obtained from the test.
5. Interpret the test result.

Course Outcomes

After successful completion of this course, the students should be able

CO1	To select the suitable test method to measure the necessary parameter.
CO2	To determine the properties required as per the standard.
CO3	To apply the procedure as per the standard.
CO4	To analyse the values obtained from the test.
CO5	To interpret the test result.

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	2	3	3
CO2	3	2	-	1	2	3	3
CO3	3	2	-	1	2	3	3
CO4	3	2	-	1	2	3	3
CO5	3	2	-	1	2	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)			**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	
Mode	Practical Test	Practical Test	Practical Document	Practical Examination
Portion	Part A/ Cycle 1 Exercises	Part B/ Cycle 2 Exercises	All Exercises	All Exercises
Duration	3 Periods	3 Periods	Regularly	3 Hours
Exam Marks	60	60	Each Practical 10 Marks	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7^{th} Week	14^{th} Week	15^{th} Week	

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the pattern to be decided by the departments.

  The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.

CA 3: Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate.

74550	POLYMER TESTING	L	T	P	C
Practical		0	0	6	3

List of Experiments		
1	Determination of Tensile strength of polymer	
2	Determination of Impact strength of plastics	
3	Determination of Heat distortion Temperature (HDT)	
4	Determination of DIN Abrasion resistance	
5	Determination of flammability of polymer	
6	Determination of MFI	
7	Study on effect of temperature on compression set rubber	
8	Determination of Rebound resilience of polymer	
9	Determination of ESCR	
10	Determination of Fatigue strength by De-mattia method	
TOTAL HOURS		**90**

List of Equipment / Instruments, Material, Manuals Required (For A Batch of 30 Students):

S.No.	Name of Equipment / Instrument	Quantity
1.	UTM with tensile fixture	1
2.	Impact tester	1
3.	Din abrader	1
4.	Falling Dart tester	1
5.	MFI tester	1
6.	Hot air oven	1
7.	Electronic weighing balance (3 decimal)	1
8.	De-mattia tester	1
9.	Dumbbell specimen cutter	1
10.	Tear specimen cutter	1
11.	Specimen cutter	1
12.	ESCR set	2
13.	Water bath	1
14.	Resilience tester	1
15.	Titration stand with tiles	5
16.	Vernier caliper	1
17.	Screw gauge	1
18.	Compression set apparatus	2

Text Books:

1. R.P.Brown, —Physical Testingof Rubbers‖, 3rd edition, Smither Rapra Publishing, 1992.
2. Vishu Shah, —Handbook of Plastic Testing Technology - Wiley Inter-science Publications, 1998.
3. J.Haslam and H.A.Willis, —Identification and Analysis of Polymer, ILIFFE, London, 1972.
4. Polymer Testing Lab Manual

References:

1. G.Gordon Cameron - Ellis Hand Book of Analysis of Synthetic Polymers- Honwood Ltd., - 1977
2. Maurice Morton - Rubber Technology - Robert E.KriegerPub.Co.1973.
3. A.S. Athalye–Identification and testing of plastics - Multitech publishers -1992.
4. How to identify plastics - CIPET Publication-2003.
5. Paul Kluckow-Rubber and Plastics Testing – Chapman & Hall, London –1963.
6. Murugan.N - Basics of Testing of Plastics – Study Material.
7. L.E.Nielsen -Mechanical properties of Plastics – Reinhold, New York – 1962.
8. J.H.Collins -Testing and Analysis of Plastics – Plastics Institute – 1955.
9. R. P. Brown - Handbook of plastic testing methods - 1971
10. K.J.Saunders-Identification of Plastics & Rubbers–Chapman & Hall –1966.
11. M.E.Baird - Electrical Properties of polymeric materials – Plastics and Rubber Institute, London – 1973.

74560	INNOVATION & START UP	L	T	P	C
Practicum		1	0	2	2

Introduction

The integration of Innovation and Start-ups concept within the syllabus is testament to the forward thinking nature of educational institutions. By introducing this concept, students are provided with a solid foundation upon which they can build their skills in Innovation and Start-ups. This course can bridge the gap between theory and practice. It allows students to apply the knowledge they have acquired in a real world context, thereby enhancing their understanding and retention of the above concept. This experimental learning approach not only.

fosters a deeper level of engagement but also trains student with practical skills necessary to navigate the complexities of the business world. This also empowers students to become an Innovator or Entrepreneur. With necessary tools and knowledge, educational institutions are preparing the next generation of entrepreneurs to tackle the challenges and opportunities that lie ahead. This syllabus will explore the different facets of innovation, including its importance, types and strategies for fostering a culture of innovation within organizations

Course Objectives

The objective of this course is to enable the students

- To understand the concept of Innovation and Start-ups.
- To acquire knowledge of Prototype development, IPR, Patents and Copyrights.
- To have practical experience in preparing Business plan for Start-ups.
- To visit the existing nearby industry to prepare a project report about the present challenges of that industry.
- To know the different funding supports available from Government and Non-Government schemes for Start-ups.

Course Outcomes

After successful completion of this course, the students should be able

CO1	Differentiate between Innovation and Start-ups
CO2	Explain the importance of IPR, Patents and Copyrights.
CO3	Describe the methodology to be adopted for preparing the Business Plan
CO4	CO 4: Gain practical experience by Industrial training and visiting the nearby industry
CO5	Explore and identify various funding facilities available from Government and Non-Government Schemes for Start-ups

CO/PO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			1		2	3	3
CO2			1		2	3	3
CO3			1		2	3	3
CO4			1		2	3	3
CO5			1		2	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.
- Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology:

	Continuous Assessment (40 marks)			**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	
Mode	Practical & Written Test	Practical & Written Test	Practical Test	Practical Examination
Portion	PART A/Cycle 1 Exercises & Two units	PART B/Cycle 2 Exercises & another two units	All Exercises	All Exercises
Duration	3 Periods	3 Periods	3 Hours	3 hours
Exam Marks	60	60	100	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7th Week	14th Week	16th Week	

Note:

- **CA1 and CA2:**.The practical and written test should be conducted as per the portion above and the scheme of evaluation can be decided by the departments. Assessment written & Practical test should be conducted for 60 Marks. The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.
- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted and the scheme of evaluation can be decided by the departments. The marks awarded should be converted to 10 Marks for the internal assessment.

74560	INNOVATION & START UP	L	T	P	C
Practicum		1	0	4	3

Unit I	INTRODUCTION TO INNOVATION	
An Introduction to Innovation and Creativity- Innovation in current Environment - Types of Innovation - Challenges of Innovation - Steps of Innovation Management - Divergent v/s Convergent thinking - Design thinking and Entrepreneurship.		6
Unit II	**INCUBATION CLUBS, IPR, PATENTS AND COPYRIGHTS**	
Idea Generation - Incubation Clubs - Prototype Development - Marketing of Innovation - Management of Innovation - Creation of IPR -Types of IPR - Patents and Copyrights - Patents in India - Technological and Non-Technological Innovation Process.		6
Unit III	**GOVERNMENT AND NON-GOVERNMENT FUNDING SCHEMES FOR START-UPS**	
An introduction to Start-up - Start-ups in India - Procedure for registration of Start-ups - Business Model- Business Plan - Case Studies - Opportunities and Challenges - funding supports from Government Schemes -MUDRA, TANSEED, NEEDS, PMEGP, UYEGP – Non-Government Schemes - CSR Fund - Angel Investors - Venture Capitalist.		6
Unit IV		
All the students have to select a minimum of 2 topics from the list given below. They are expected to collect the resources with the help of faculty assigned to them to prepare PPTs for presentation 1. Idea Generation. 2. Innovation Management. 3. Product Development. 4. Business Model Innovation. 5. Organizational Culture and Change Management. 6. Leadership and Innovation. 7. Barriers to Innovation. 8. Innovation Marketing. 9. E-Commerce success stories (any one). 10. Role of Start-ups in Higher Education. 11. Professional Networking in Building Brands. 12. How to start a start-up in India.		9
Unit V	**EXPOSURE TO INDUSTRY**	
All the students should visit and study the nearby industries, incubation centres, start-ups etc., and select any one to prepare a project report which covers the Name of the Industry/Organization, Introduction of the Industry, Type of the Industry, Scope of the Industry, Plant Layout and Location, Details of Plant and Machineries, Process flow chart, Manufacturing Methods, Process of Manufacturing, Product Manufacturing, Quality Control, Marketing, Product selling - Conclusion.		18
TOTAL HOURS		45

End Semester Examination - Project Exam

Students should be assessed for 100 Marks both by the internal examiner and external examiner appointed by the Chairman Board of Examinations.

Detailed Allocation of Marks

S. No		Description	Marks
Part A		Written Examination – Unit –I,II & III Theory Questions	45
	i)	10 questions out of 15 questions (10 x 3 marks = 30 marks)	
	ii)	3 questions either or pattern (3 x 5 marks = 15 marks)	
Part B	i)	Presentation of Industry Visit Project Report	25
	ii)	Interaction and Evaluation	30
TOTAL			100

4611	ADVANCED ELASTOMERIC TECHNOLOGY	L	T	P	C
Theory		4	0	0	4

Introduction

This course makes the student to know about the properties and applications of high performance polymers also To make them understand the structure property relationship and applications of high temperature polymers. To appreciate the use of polymers and therie compounding for specific end use for electronic applications, conducting polymers and other applications. After doing this course student will be confident about the different manufacturing processes of rubber industry. It will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students to

1. Know the important functions of management.
2. Distinguish about , ionic polymers, hydrogels and smart polymers,
3. Recognize about shape memory polymers, LCP's, IPN's
4. Describe about compounding of high performance elastomers like Halobutyl.
5. Pronounce about compounding of high performance elastomers like silicones, PUs.

Course Outcomes

After successful completion of this course, the students should be able to

CO1	Know the important functions of management.
CO2	Distinguish about , ionic polymers, hydrogels and smart polymers,
CO3	Recognize about shape memory polymers, LCP's, IPN's
CO4	Describe about compounding of high performance elastomers like Halobutyl.
CO5	Pronounce about compounding of high performance elastomers like silicones, PUs.

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	2	2	3	3	3
CO2	3	-	2	2	3	3	3
CO3	3	-	2	2	3	3	3
CO4	3	-	2	2	3	3	3
CO5	3	-	2	2	3	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.
- Activities for student should be planned on feasible topics.

- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of **EIGHT** questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

  Each question may have subdivisions. Maximum two subdivisions shall be permitted.
- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.
- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74611	ADVANCED ELASTOMERIC TECHNOLOGY	L	T	P	C
Theory		4	0	0	4
Unit I	**SPECIAL PURPOSE POLYMERS - I**				
Polymers for electronic applications, conducting polymers – Photoresists, polymers in Optoelectronics, polymers with piezoelectric properties, Polymers in telecommunications and power transmission					**12**
Unit II	**SPECIAL PURPOSE POLYMERS - II**				
Synthetic polymer membranes, ionic polymers, hydrogels and smart polymers, shape memory polymers, LCP's, IPN's					**12**
Unit III	**COMPOUNDING FOR GENERAL PURPOSE RUBBERS**				
Hardness specified NR, SBR, compounds for age resistance, compression set resistance, flexural fatigue, isolation pads and automobile applications.					**12**
Unit IV	**COMPOUNDING FOR SPECIFIC END USES - I**				
Hardness specified EPDM, CR, halobutyls, compounds for age resistance, heat resistance and beltings.					**12**
Unit V	**COMPOUNDING FOR SPECIFIC END USES - II**				
Principles and compounding of nitriles, silicones, fluorocarbons, acrylates and polyurethanes for any one specific end use.					**12**
TOTAL HOURS					**60**

TEXTBOOKS

1. The Mixing of Rubber (ed) by Richard F Grossman, Chapman & Hall, London, UK,1997,
2. "Rubber Technology - Compounding and Testing for Performance", John S Dick, Hanser Publishers, Munich, 2001.
3. Practical Rubber Compounding and Processing, Colin W Evans, Springer 1981.

REFERENCES

1. Bayer Handbook on Rubber Technology,
2. Vanderbilt Handook,
3. NOCIL manual,
4. Rubber Technology, Maurice Morton.

74612	ENTREPRENEURSHIP AND BUSINESS MANAGEMENT	L	T	P	C
Theory		4	0	0	4

Introduction

This course aims to provide necessary knowledge and attitude to understand and appreciate the process of starting and developing a new venture. After doing this course student will be confident about starting a rubber industry. It will be useful for them for their professional career.

Course Objectives

The objective of this course is to enable the students to

1. Have knowledge on entrepreneurial tasks such as, generating idea, planning business
2. Have knowledge on financial management
3. Understand the organizational management and business development strategies
4. Have knowledge on entrepreneurial tasks such as, generating idea, planning business
5. Have knowledge on financial management

Course Outcomes

After successful completion of this course, the students should be able to

CO1	Have knowledge on entrepreneurial tasks such as, generating idea, planning business
CO2	Have knowledge on financial management
CO3	Understand the organizational management and business development strategies
CO4	Have knowledge on entrepreneurial tasks such as, generating idea, planning business
CO5	Have knowledge on financial management

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	2	1	3	3	3
CO2	3	-	2	1	3	3	3
CO3	3	-	2	1	3	3	3
CO4	3	-	2	1	3	3	3
CO5	3	-	2	1	3	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.

- Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of **EIGHT** questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

  Each question may have subdivisions. Maximum two subdivisions shall be permitted.
- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.
- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74612	ENTREPRENEURSHIP AND BUSINESS MANAGEMENT	L	T	P	C
Theory		4	0	0	4

Unit I	**ENTREPRENEURS**	
Mind-set, character, motivation. Competencies: Creativity – Innovation - Risk taking _ Leadership – Communication - Negotiation and networking skill. Myths about entrepreneurs - Benefits and drawbacks of entrepreneurship - Reasons for a venture failure - Successful entrepreneurs in polymer sector: Case study.		**12**
Unit II	**BUSINESS PLANNING**	
Generating idea; converting an idea into business venture. Conducting feasibility analysis – Financial, Commercial, Technical, Environmental and Legal. Developing a business plan for Polymer product - Presenting a business plan to investors to pitch for funds.		**12**
Unit III	**BUSINESS FINANCE**	
Forms of ownership, Financial projections and pro- forma of profit and loss - Capital budgeting and investment. Analysis - Breakeven point - Source of funds: Own funds, banks, long term development financial institutions, Angel investors, Venture Capitalist, Public issue (IPO). Taxes: VAT, Service Taxes, Excise and Customs duties, CST, GST, tax exemptions for exports and SEZ.		**12**
Unit IV	**BUILDING TEAM**	
Creating growth oriented organizational culture. Employee motivation - Retention strategies. Organizational structure with clear roles, responsibilities, authorities and accountabilities - Training and development - Operators, Supervisors and Managers of the polymer industry		**12**
Unit V	**BUSINESS EXPANSION**	
Marketing strategy – Segmenting, Targeting and Positioning of the brand - New Product development. - E-commerce fundamentals; strategy for expansion. Franchising - benefits and drawbacks of franchising. Global marketing: Overseas marketing strategies; Export documentation - Intellectual Property - patents, trademarks, copyrights and trade secrets to grow the business in polymer field.		**12**
TOTAL HOURS		**60**

REFERENCES:

1. Entrepreneurial Development – Dr. S.S. Khanna - S. Chand -2012 ISBN – 81- 219-1801-4
2. Handbook for New Entrepreneurs – P.C. Jain – Entrepreneurship Development Institute of India – 2010; ISBN:13 : 978-0-19-565224-6
3. Essentials of Entrepreneurship and Small Business Management – Thomas W. Zimmerer, Norman M. Scarborough – PHI Learning Ltd New Delhi. ISBN : 978 – 81- 203-3911-8
4. http://smallb.in/entrepreneurship - A SIDBI initiative
5. http://business.gov.in/ - Business Knowledge Resources for SMEs
6. http://www.dcmsme.gov.in/ - Development Commissionaire (MSME) Ministry of Small Micro Medium industries

74613	INDUSTRIAL MANAGEMENT	L	T	P	C
Theory		4	0	0	4

Introduction

This course makes the student to know about the important functions of management. And make them Analyze planning, organizing and staffing in an organization also to understand Directing and Importance of Controlling techniques. It throws light on motivation and change management and also make them understand eMarketing and modern concepts in managements. After doing this course student will be confident about the different manufacturing processes of rubber industry. It will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students to

1. Know the important functions of management.
2. Analyze planning, organizing and staffing in an organization
3. Know about Directing and Importance of Controlling techniques
4. Describe about motivation and change management.
5. Understand eMarketing and modern concepts in managements

Course Outcomes

After successful completion of this course, the students should be able to

CO1	Know the important functions of management.
CO2	Analyze planning, organizing and staffing in an organization
CO3	Know about Directing and Importance of Controlling techniques
CO4	Describe about motivation and change management.
CO5	Understand eMarketing and modern concepts in managements

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	2	2	3	3	3
CO2	3	-	2	2	3	3	3
CO3	3	-	2	2	3	3	3
CO4	3	-	2	2	3	3	3
CO5	3	-	2	2	3	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.

- The demonstration can make the subject exciting and foster the student's scientific mindset.Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of **EIGHT** questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

  Each question may have subdivisions. Maximum two subdivisions shall be permitted.
- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.
- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74613	INDUSTRIAL MANAGEMENT	L	T	P	C
Theory		4	0	0	4

Unit I	**INTRODUCTION**	
Definition and functions of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor – Fayol - Weber– Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Corporate Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Pros and cons.		**12**
Unit II	**PLANNING, ORGANISING AND STAFFING**	
Planning: Importance – Steps - Limitation – Organizing: Process; Types – Departmentalization: Functional – Divisional (Product; Customer; Geographic) – Staffing: Systems Approach; Recruiting and Selection Process		**12**
Unit III	**DIRECTING, CONTROLLING AND DECISION MAKING**	
Directing (Leading): Traits; Style; Managerial Grid – Communication: Purpose; Model; Barriers – Controlling: Types – Importance - Controlling techniques – Decision Making: Elements – Process.		**12**
Unit IV	**MOTIVATION AND CHANGE MANAGEMENT**	
Motivation Theories: Maslow's Hierarchy of Needs Theory; Herzberg's Motivation - Hygiene Theory; McClelland's Needs Theory Change Management Sources of Resistance; Overcoming Resistance		**12**
Unit V	**MODERN CONCEPTS**	
Concept, features, merits and demerits of: SWOT Analysis; Business Process Reengineering (BPR); Supply Chain Management (SCM) – Marketing: Concept; Functions; Importance; Segmentation; Mix; Problems of Marketing in Small Enterprise; Competitive Analysis and Advantage – E-marketing		**12**
TOTAL HOURS		**60**

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.
2. Stephen P. Robbins and Mary Coulter, " Management", Prentice Hall (India)Pvt. Ltd.,10th Edition, 2009.

REFERENCES:

1. Robert Kreitner and MamataMohapatra, " Management", Biztantra, 2008.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.
3. Tripathy PC and Reddy

74614	Advanced Polymer Processing	L	T	P	C
Theory		4	0	0	4

Introduction

This course makes the student to know about the manufacture of various automotive and non-automotive rubber products. After doing this course student will be confident about the different manufacturing processes of rubber industry. It will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students to

1. Select a suitable processing method to manufacture a polymer product as per the requirement
2. Differentiate the various advanced processing methods
3. Identify the various components and the functions of the advanced polymer processing machinery
4. Define the function of various components of the polymer processing machinery
5. Choose a suitable method to join the various polymer parts

Course Outcomes

After successful completion of this course, the students should be able

CO1	To select a suitable processing method to manufacture a polymer product as per the requirement
CO2	To differentiate the various advanced processing methods
CO3	To identify the various components and the functions of the advanced polymer processing machinery
CO4	To define the function of various components of the polymer processing machinery
CO5	To choose a suitable method to join the various polymer part

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	2	1	3	2	3
CO2	3	-	2	1	3	2	3
CO3	3	-	2	1	3	2	3
CO4	3	-	2	1	3	2	3
CO5	3	-	2	1	3	2	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.

- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test	Written test	Quiz MCQ	Model Examination	Written Examination
Portion	Two units	Another Two units	Online / Offline	All units	All units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

Note:

- **CA1 and CA2: W**ritten test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
- **CA1 and CA2 Question Pattern:**

  FOUR questions should be asked from each unit. Students shall write any **FIVE** questions out of **EIGHT** questions. Each question carries 10 marks each. (5 X 10 Marks = 50 Marks)

  Each question may have subdivisions. Maximum two subdivisions shall be permitted.
- **CA3:** 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.
- **CA4:** Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. (5 X 20 Marks = 100 Marks)

Four questions will be asked from every unit. Students should write any two questions from each unit. The question may have two subdivisions only.

74614	Advanced Polymer Processing	L	T	P	C
Theory		4	0	0	4

Unit I	**ADVANCED INJECTION MOULDING PROCESS - I**	
Introduction - Co-injection moulding, Two-colour injection moulding process - applications, Gas assisted Injection Moulding - Basic processes and procedures - Moulding aspects - shrinkage and summary. Reaction Injection Moulding (RIM) - Process - Mould – Process Controls – Merits.		**12**
Unit II	**ADVANCED INJECTION MOULDING PROCESS – II**	
Multi-layer Moulding, Counter flow moulding, Liquid Injection Moulding processes. Structural foam moulding - Low pressure and high pressure processes - Merits & demerits.		**12**
Unit III	**ADVANCED EXTRUSION PROCESSES**	
Introduction - Profile Extrusion - Material - Process - Process optimization – Cooling Profile applications. Process, downstream equipment - dies and application. Multi-layer films, co- extruded sheets, Pipes, Corrugated pipes.		**12**
Unit IV	**ADVANCED BLOW MOULDING – I**	
Introduction - Classification of advanced Blow moulding processes - Deep draw Double Wall Blow Moulding Technology - Split moulds- Versatility - Applications. Press Blow Moulding Technology Process - Applications, Three dimensional Blow Moulding Process - Applications.		**12**
Unit V	**ADVANCED BLOW MOULDING – II**	
Stretch blow moulding - Injection stretch blow moulding - Extrusion stretch blow moulding - Process - Merits & demerits - Applications. Multi-layer Blow Moulding - Process - Applications.		**12**
TOTAL HOURS		**60**

Text Books:

1. James F. Stenvension, Innovation in Polymer Processing Moulding, Hanser Publishers,New York, 1996.

References:

1. Donald V. Rosato, Injection Moulding Handbook, International Thomson Publishing Company, 1985.
2. Friedhelm Henson, Plastics Extrusion Technology, Hanser Publishers, New York, 1988.
3. Brunt Strong, Plastics: Materials and Processing, Prentice-Hall, New Jersey,1996.

74621	Polymer Recycling and Waste Management	L	T	P	C
Practicum		2	0	4	4

Introduction

This course makes the student to know about the importance of polymer recycling and various methods to recycle polymers. Since, it is the need essential to solve environmental related issues this course will play a vert vital role. It will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students to

1. Know the various segregation and sorting of plastics
2. Understand the size reduction methods
3. Analyse the polymer waste management approaches
4. Explain the recycling of thermoplastics
5. Understand the recycling of composite

Course Outcomes

After successful completion of this course, the students should be able

CO1	To know the various segregation and sorting of plastics
CO2	To understand the size reduction methods
CO3	To analyse the polymer waste management approaches
CO4	To explain the recycling of thermoplastics
CO5	To understand the recycling of composite

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	2	2	3	3	3
CO2	3	-	2	2	3	3	3
CO3	3	-	2	2	3	3	3
CO4	3	-	2	2	3	3	3
CO5	3	-	2	2	3	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.

- The demonstration can make the subject exciting and foster the student's scientific mindset.
- Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology:

	Continuous Assessment (40 marks)			**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	
Mode	Practical & Written Test	Practical & Written Test	Practical Test	Practical Examination
Portion	PART A/Cycle 1 Exercises & Two units	PART B/Cycle 2 Exercises & another two units	All Exercises	All Exercises
Duration	3 Periods	3 Periods	3 Hours	3 hours
Exam Marks	60	60	100	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7^{th} Week	14^{th} Week	16^{th} Week	

Note:

- **CA1 and CA2:**.The practical and written test should be conducted as per the portion above and the scheme of evaluation can be decided by the departments. Assessment written & Practical test should be conducted for 60 Marks. The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.
- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted and the

scheme of evaluation can be decided by the departments. The marks awarded should be converted to 10 Marks for the internal assessment.

74621	Polymer Recycling and Waste Management	L	T	P	C
Practicum		4	0	0	4

Unit I	**SEPARATION TECHNIQUES**	
Introduction - sources of plastics waste – separation techniques - density based sorting –optical sorting - spectroscopic sorting - electrostatic sorting - melting temperature— sorting by size reduction - selective dissolution. 1.sorting of plastics waste based on density. 2. sorting of plastics waste based on size reduction. 3. sorting of plastics waste based on melting point.		**18**
Unit II	**PLASTICS WASTE MANAGEMENT APPROACH**	
Plastics Waste Management - 4R's approach - reduction – reuse – repair – recycling - recycling classification-code of practice - primary - secondary - tertiary - quaternary recycling with examples. 1. Recycling classification by code of plastics. 2. Prepare a chart of recycling code for different plastics.		**18**
Unit III	**SIZE REDUCTION METHODS**	
Size reduction: Shredder – Granulator – Slicer – Laminate separation by size reduction - Densification: Agglomeration by compression – Pulverization: Disc pulverization – Cryogenic pulverization – Solid state shear extrusion pulverization 1. Size reduction by Granulator 2. Size reduction by Disc pulverization		**18**
Unit IV	**RECYCLING OF THERMOPLASTICS**	
Recycling of Polyolefins - PVC, PET, Polystyrene, Nylon, Polyurethanes, polyacetals -mechanical process - applications of recycled materials. 1. Recycling of Polyolefins 2. Recycling of PVC, 3. Recycling of Polystyrene.		**18**
Unit V	**RECYCLING OF POLYMER COMPOSITES**	
Recycling of polymer composites - thermoset composites-thermoplastic composites - rubber tyre recycling - tyre size reduction - Applications of recycled rubber - Tyre derived fuel		**18**
	TOTAL HOURS	**90**

Text Books:

1. John Scheirs., - "Polymer Recycling" John Wiley and Sons,1998
2. Nabil Mustafa – "Plastics Waste Management" John Wiley and Sons,1998

References:

1. Muna Bitter, Johannes Brandup, Georg Menges "Recycling and Recovery of plastics" 1996
2. Attilio.L.Bisio,Marino Xanthos, " How to manage plastics waste: Technology and market Opportunities" Hanser Publishers, 1994
3. Francesco La Mantia., " Handbook of Plastics Recycling" Chem Tec Publishing,2002of Polymerisation – McGraw-Hill, New York – 1970

74622	Adhesive Technology	L	T	P	C
Practicum		4	0	0	4

Introduction

This course makes the student to know about the various adhesives, their applications in various fields. After doing this course student will be confident about the different bonding processes of polymer products. It will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students to

1. Understand the concept of adhesion as a joining operation and how it compares with fastening and welding
2. Appreciate the physical chemistry of adhesives and paints, mechanisms of setting and development of strength in the joints and coatings
3. Know the principles of formulating various adhesives and paints
4. Understand the importance of and methods of surface preparations for adhesion and painting of substrates.
5. Comprehend the importance of testing

Course Outcomes

After successful completion of this course, the students should be able

CO1	To understand the concept of adhesion as a joining operation and how it compares with fastening and welding
CO2	To appreciate the physical chemistry of adhesives and paints, mechanisms of setting and development of strength in the joints and coatings
CO3	To know the principles of formulating various adhesives and paints
CO4	To understand the importance of and methods of surface preparations for adhesion and painting of substrates.
CO5	Comprehend the importance of testing

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	2	3	1	2	3
CO2	3	-	2	3	1	2	3
CO3	3	-	2	3	1	2	3
CO4	3	-	2	3	1	2	3
CO5	3	-	2	3	1	2	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.

- The demonstration can make the subject exciting and foster the student's scientific mindset.Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology:

	Continuous Assessment (40 marks)			**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	
Mode	Practical & Written Test	Practical & Written Test	Practical Test	Practical Examination
Portion	PART A/Cycle 1 Exercises & Two units	PART B/Cycle 2 Exercises & another two units	All Exercises	All Exercises
Duration	3 Periods	3 Periods	3 Hours	3 hours
Exam Marks	60	60	100	100
Converted to	15	15	10	60
Marks	30		10	60
Tentative Schedule	7^{th} Week	14^{th} Week	16^{th} Week	

Note:

- **CA1 and CA2:**.The practical and written test should be conducted as per the portion above and the scheme of evaluation can be decided by the departments. Assessment written & Practical test should be conducted for 60 Marks. The marks awarded will be converted to 15 Marks for each assessment test. Addition of CA1 and CA2 will be considered for the internal assessment of 30 Marks.
- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted and the scheme of evaluation can be decided by the departments. The marks awarded should be converted to 10 Marks for the internal assessment.

74622	Adhesive Technology	L	T	P	C
Practicum		4	0	0	4

Unit I	**INTRODUCTION**	
Definition of adhesive – Types of adhesive – Advantages and disadvantages of adhesive – Requirements for good bonding - Adhesion mechanism: Wetting theory – Diffusion theory – Mechanical bonding theory – Chemical bonding theory.		**18**
Unit II	**SURFACE PREPARATION**	
Various substrates used – Surface preparation of metals – Surface preparation of plastics and rubbers. 1.Preparation of metal surface by mechanical methods. 2. Preparation of plastics surface by mechanical methods. 3. . Preparation of rubbers surface by mechanical methods.		**18**
Unit III	**COMPOUDING ADDITIVES FOR ADHESIVES**	
Classification of adhesive: Source – Chemical composition – Function – Physical form – Compounding additives for adhesive: Adhesive base (binder) – Hardener – Solvent – Diluent - Filler – Carrier – Special additives. 1.Preparation of primer for adhesion 2. Design a compound formula for adhesive. 3,Preparation of adhesive solution.		**18**
Unit IV	**METHOD OF ADHESIVE APPLICATION**	
Brushing – blowing – Spraying – Roll coating – Squeeze bottles – Dipping – Film form – Mixing head dispenser. 1. Adhesive application by hand Brushing. 2. Adhesive application by blowing 3. Adhesive application by Roll coating 4. Adhesive application by Dipping		**18**
Unit V	**TESTING OF ADHESIVE BONDING**	
Adhesive failure vs Cohesive failure – Equipment and procedure: Brookfield viscosity - Lap shear strength – Compressive shear strength (Pin and collar method) - Peel off strength (90° and 180°). 1.Measurement of viscosity of adhesive solution. 2.Determination of peel off strength.		**18**
TOTAL HOURS		**90**

Text Books:

1. Gerald L. Schreberger, Adhesive in manufacturing, Marcel Dekker Inc., New York, 1983
2. W.C. Wake, Adhesion and the formulation of adhesives. Applied Science Publishers, London, 1976.

References:

1. Swaraj Paul, Surface Coatings, John Wiley & Sons, NY, 1985.
2. George Mathews, Polymer Mixing Technology, Applied Science Publishers.

74623	Latex Technology	L	T	P	C
Practicum		2	0	4	4

Introduction

Latex technology is a separate field of study in Polymer. It is mainly used in the medical application widely. The technical know-how of latex is entirely different from that of a solid polymer. Hence, the processing of latex product is completely different. Thereby, this course will help the polymer students to gain a specialized knowledge in latex. Hence, this course paly a very vital role in the specialized professional career of the polymer students.

Course Objectives

The objective of this course is to enable the students to

1. Define the important terminologies in Latex Technology.
2. Explain the process of conversion of NR latex into solid rubber.
3. Estimate the necessary test parameters as per the standard.
4. Demonstrate the procedural knowledge about the various processes like Dipping, Extrusion and Moulding.
5. Analyse the give latex for various test parameters as per the standard.

Course Outcomes

After successful completion of this course, the students should be able

CO1	To define the important terminologies in Latex Technology.
CO2	To explain the process of conversion of NR latex into solid rubber.
CO3	To estimate the necessary test parameters as per the standard.
CO4	To demonstrate the procedural knowledge about the various processes like Dipping, Extrusion and Moulding.
CO5	To analyse the give latex for various test parameters as per the standard.

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	2	3	3
CO2	3	2	-	1	2	3	3
CO3	3	2	-	1	2	3	3
CO4	3	2	-	1	2	3	3
CO5	3	2	-	1	2	3	3

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

Instructional Strategy

- To help students learn and appreciate new concepts and principle, teachers should provide examples from daily life, realistic situations and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster the student's scientific mindset.Activities for student should be planned on feasible topics.
- Throughout the course, a theory-demonstrate-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).ICT tools must be used to deliver the content more attractively so that the attention of the learners are drawn and will create a curiosity in them to understand the content in a better way.
- Industrial visit can be arranged to make the students to realise the application of theoretical knowledge gained in the classroom.Incorporation of Blended/Flipped learning will help the students to understand the content better.

Assessment Methodology:

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Marks	30		10	60
Tentative Schedule	7^{th} Week	14^{th} Week	16^{th} Week	

Note:

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- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted and the scheme of evaluation can be decided by the departments. The marks awarded should be converted to 10 Marks for the internal assessment.

74623	Latex Technology	L	T	P	C
Practicum		1	0	4	3

Unit I	**INTRODUCTION OF NR LATEX**	
Definition of Latex, classification, Comparison between latex and polymer solution; Natural rubber latex – composition of NR field latex - Preservative – Coagulant **List of experiments:** 1. Determination of Total solid content of NR latex 2. Determination of Dry rubber content of NR latex		**18**
Unit II	**LATEX COMPOUNDING**	
Methods of concentrating latex - creaming, centrifuging, & evaporation. Conversion of NR latex into RSS, Pale crepe - Preparation of Dispersions, Emulsion, Slurries using Ball mill **List of experiments:** 3. Determination of Total alkalinity of NR latex 4. Preparation of NR latex compound		**18**
Unit III	**DIPPING PROCESS**	
Types of gloves - Manufacture of Surgical Gloves – Manufacture of Balloons – Troubleshooting **List of experiments:** 5. Determination of Mechanical stability time of NR latex 6. Manufacture of dipped latex product		**18**
Unit IV	**EXTRUSION AND CASTING PROCESS**	
Manufacture of elastic thread – Manufacture of latex tubing – Troubleshooting. **List of experiments:** 7. Manufacture of extruded latex product 8. Casting of latex		**18**
Unit V	**LATEX FOAM**	
Manufacture of foam by Talley process – Dunlop process – Synthetic latex. **List of experiments:** 9. Study on different coagulant vs coagulum nature 10. Determination of KOH number for NR latex		**18**
	TOTAL HOURS	**90**

List of Equipment / Instruments, Material, Manuals Required (For A Batch of 30 Students):

S.No.	Name of Equipment / Instrument	Quantity
1.	Hot air oven	1
2.	Stirrer set	2
3.	Titration stand	5
4.	pH meter	1
5.	Balloon mould	5
6.	Latex extrusion set	1
7.	Electronic weighing balance	1
8	Mechanical stability Tester	1
9	Watch glass and beakers	30 set
10	Glass rod	30 set

Text Books:

1. Blackley, D.C., “High Polymer Latices”, Vol 1 and 2, Chapman & Hall, 1997

References:

1. Mausser, R.F., “The Vanderbilt Latex Hand book” 3rdedn.R.T. Vanderbilt Company, 1987.
2. Calvert, “Polymer Latex and Applications”, Applied Science Publishing Ltd, 1985.
3. Latex Technology – Lab manual.

74630	IN HOUSE PROJECT WORK	L	T	P	C
Project		0	0	24	12

Introduction

Every student must do one major project in the Final year of their program. Students can do their major project in Industry or R&D Lab or in-house or a combination of any two for the partial fulfillment for the award of Diploma in Engineering.

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

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

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

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

Course Objectives

Academic project work plays a crucial role in the education of Diploma in Engineering students, as it helps them apply theoretical knowledge to practical situations and prepares them for real- world engineering challenges.

- **Integration of Knowledge**: Consolidate and integrate theoretical knowledge acquired in coursework to solve practical engineering problems.
- **Skill Development**: Enhance technical skills related to the specific field of engineering through hands-on experience and application.
- **Problem-Solving Abilities**: Develop critical thinking and problem-solving abilities by addressing complex engineering issues within a defined scope.
- **Project Management**: Gain experience in project planning, execution, and management, including setting objectives, timelines, and resource allocation.
- **Teamwork and Collaboration**: Foster teamwork and collaboration by working in multidisciplinary teams to achieve project goals and objectives.

- **Research Skills**: Acquire research skills by conducting literature reviews, gathering relevant data, and applying research methodologies to investigate engineering problems.
- **Innovation and Creativity**: Encourage innovation and creativity in proposing and developing engineering solutions that may be novel or improve upon existing methods.
- **Communication Skills**: Improve communication skills, both oral and written, by presenting project findings, writing technical reports, and effectively conveying ideas to stakeholders.
- **Ethical Considerations**: Consider ethical implications related to engineering practices, including safety, environmental impact, and societal concerns.
- **Professional Development**: Prepare for future professional roles by demonstrating professionalism, initiative, and responsibility throughout the project lifecycle.

Course Outcomes

After successful completion of this course, the students should be able

CO1	To demonstrate the ability to apply theoretical concepts and principles learned in coursework to solve practical engineering problems encountered during the project.
CO2	To develop and enhance technical skills specific to the field of engineering relevant to the project, such as design, analysis, simulation, construction, testing, and implementation.
CO3	To apply critical thinking and problem-solving skills to identify, analyze, and propose solutions to engineering challenges encountered throughout the project lifecycle.
CO4	To acquire project management skills by effectively planning, organizing, and executing project tasks within defined timelines and resource constraints.
CO5	To improve communication skills through the preparation and delivery of project reports, presentations, and documentation that effectively convey technical information to stakeholders.

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	3	3	2	3
CO2	2	3	2	3	3	2	3
CO3	2	3	2	3	3	2	3
CO4	1	3	2	3	3	2	3
CO5	3	3	2	3	3	2	3

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

Important points to consider to select the In-house project.

- Selecting a project work in Diploma Engineering is a significant decision that can greatly influence your learning experience and future career prospects.
- Choose a project that aligns with your career aspirations and interests within the field of engineering. Consider how the project can contribute to your professional development and future opportunities.
- Ensure the project aligns with your coursework and specialization within the Diploma program. It should complement and build upon the knowledge and skills you have acquired in your studies.
- Evaluate the scope of the project to ensure it is manageable within the given timeframe, resources, and constraints. Avoid projects that are overly ambitious or impractical to complete effectively.
- Assess the availability of resources needed to conduct the project, such as equipment, materials, laboratory facilities, and access to relevant software or tools. Lack of resources can hinder project progress.
- Select a project that genuinely interests and motivates you. A project that captures your curiosity and passion will keep you engaged and committed throughout the project duration.
- Consider the availability and expertise of faculty advisors or industry mentors who can provide guidance and support throughout the project. Effective mentorship is crucial for success.
- Clearly define the learning objectives and expected outcomes of the project. Ensure that the project will help you achieve specific learning goals related to technical skills, problem-solving, and professional development.
- Look for opportunities to propose innovative solutions or explore new methodologies within your project. Projects that encourage creativity can set you apart and enhance your learning experience.
- Consider ethical implications related to the project, such as safety protocols, environmental impact, and compliance with ethical guidelines in research and engineering practices.
- Evaluate whether the project offers opportunities for collaboration with peers, experts from other disciplines, or industry partners. Interdisciplinary projects can broaden your perspective and enhance your teamwork skills.
- Consider the potential impact of your project on society or the engineering community. Projects that address significant challenges or contribute to social

good can be highly fulfilling and make a meaningful difference.

By carefully considering these points, Diploma Engineering students can make informed decisions when selecting project work that not only enhances their academic learning but also prepares them for successful careers in engineering.

Duties Responsibilities of the internal faculty advisor.

Each group should have an internal faculty advisor assigned by the HOD/Principal.

- The in-house project should be approved by the project monitoring committee constituted by the Chairman Board of Examinations.
- The in-house project should be selected in the fifth semester itself. Each in-house project shall have a maximum of four students in the project group.
- Provide comprehensive academic advising to help in the selection of appropriate in- house project that align with their interests and career goals.
- Offer expertise and feedback to ensure rigorous methodology, innovative approaches, and meaningful contributions to the field.
- Assist in developing technical and professional skills through hands-on projects, laboratory work, and practical applications of theoretical knowledge.
- Provide personal mentorship, fostering a supportive relationship that encourages growth, resilience, and a positive academic experience.
- Facilitate connections between students and industry professionals, alumni, and other relevant networks to enhance their professional opportunities and industry exposure.
- Ensure students have access to necessary resources, including research materials, lab equipment, software, and academic literature.
- Regularly monitor and evaluate the progress of the in-house project, providing constructive feedback and guidance to help them stay on track and achieve their goals.
- Instill and uphold high ethical and professional standards, encouraging students to practice integrity and responsibility in their work.
- Assist in preparing progress reports, writing recommendation letters, and facilitating grant applications.
- Organize and participate in workshops, seminars, and other educational events that enhance the learning experience and professional development .
- Address any issues or conflicts that arise, providing mediation and support to ensure a positive and productive academic environment.

Instructions to the students:

- Regularly meet with your internal faculty advisor for guidance on academic progress, research projects, and career planning. Be proactive in seeking advice and support from your faculty advisor.
- Use planners, calendars, and task management tools to keep track of assignments, project deadlines, and study schedules. Prioritize tasks to manage your time efficiently.
- Take advantage of opportunities to participate in in-house projects and hands-on activities. These experiences are crucial for applying your theoretical knowledge and gaining practical skills.
- Focus on improving essential professional skills such as communication, teamwork, problem-solving, and leadership. Participate in workshops and

seminars that enhance these competencies.

- Actively seek networking opportunities through industry events, seminars, and meetings. Establish connections with peers, alumni, and professionals in your field to build a strong professional network.
- Seek internships, co-op programs, or part-time jobs related to your field of study. Real-world experience is invaluable for understanding industry practices and enhancing your employability.
- Uphold high ethical standards in all your academic and professional activities. Practice integrity, honesty, and responsibility. Adhere to the ethical guidelines and standards set by your institution and the engineering profession.
- Adopt a mindset of lifelong learning. Stay updated with the latest developments and trends in engineering by reading industry journals, attending conferences, and taking additional courses.

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

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

Rubrics for In-House Project Work

Sl. No.	Topics	Description
1	Objectives	Clearly defined and specific objectives outlined. Objectives align with the project's scope and purpose.
2	Literature Review	Thorough review of relevant literature. Identification of gaps and justification for the project's contribution.
3	Research Design and Methodology	Clear explanation of the research design. Appropriateness and justification of chosen research methods.
4	Project Management	Adherence to project timeline and milestones. Effective organization and planning evident in the project execution.
5	Documentation	Comprehensive documentation of project details. Clarity and completeness in recording methods, results, and challenges.
6	Presentation Skills	Clear and articulate communication of project findings. Effective use of visuals, if applicable.
7	Analysis and Interpretation	In-depth analysis of data. Clear interpretation of results in the context of research questions.

8	Problem-Solving	Demonstrated ability to identify and address challenges encountered during the project. Innovative solutions considered where applicable.
9	Professionalism and Compliance	Adherence to ethical standards in research. Compliance with project guidelines and requirements.
10	Quality of Work	Overall quality and contribution of the project to the field. Demonstrated effort to produce high-quality work.

SCHEME OF EVALUATION

The mark allocation for Internal and End Semester Viva Voce are as below.

Internal Marks (40 Marks)*		
Review 1 (10 Marks)	Review 2 (15 Marks)	Review 3 (15 marks)
Committee: 5 Marks. Supervisor: 5 Marks	Committee: 7.5 Marks Supervisor: 7.5 Marks	Committee: 7.5 Marks Supervisor: 7.5 Marks

Note: * The rubrics should be followed for the evaluation of the internal marks during reviews.

END SEMESTER EXAMINATION - Project Work

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

End Semester (100)#			
Record (20 Marks)	Presentation (20 Marks)	Viva Voce (20 Marks)	Produc t/ Model / Analysis Report (40 Marks)
External: 10 Internal: 5 Supervisor: 5	External: 10 Internal: 5 Supervisor: 5	External: 10 Internal: 5 Supervisor: 5	External: 20 Internal: 10 Supervisor: 10

The marks scored will be converted to 60 Marks.

74710	Industrial Training and viva voce	L	T	P	C
Industrial Training		-	-	-	12

Introduction

The main objective of the sandwich Diploma course is to mould a well-rounded technician acclimated with the industrial environment while being a student in the institution.

The Sandwich Diploma Course study is pursued by students, in 7 Semesters of 3 ½ years duration, the subjects of 3 years-Full Time Diploma Course being regrouped for academic convenience. The students have to undergo in-plant training in the VII th semester.

The Apprenticeship (Amendment) Act 1973 is followed in regulating the Industrial training procedure for Sandwich Course.

- **Duration: June to October.**

Objectives

The main objective of industrial training for a diploma engineer is to provide practical, hands-on experience in real-world industrial settings, bridging the gap between academic learning and professional practice. This training aims to equip students with the skills, knowledge, and competencies required to effectively perform and succeed in the mechanical engineering industry.

Key aspects of this objective include:

- Enable students to apply the concepts and principles learned in the classroom to real-world engineering problems and scenarios.
- Develop essential technical skills.
- Enhance soft skills like communication, teamwork, problem-solving, and time management.
- Provide exposure to industrial machinery, tools, and equipment, along with the operational procedures and safety practices in a manufacturing or engineering environment.
- Offer insights into the daily operations and responsibilities of technicians, preparing students for the transition from academic settings to professional work environments.
- Educate students on industry standards, quality control measures, and best practices in mechanical engineering and manufacturing processes.
- Help students explore various career paths within mechanical engineering, enabling them to make informed decisions about their future professional goals.
- Provide opportunities for networking with industry professionals and potential employers.
- Encourage creative thinking and innovation by challenging students to solve real-world engineering problems and improve existing processes or products.
- Instill a sense of professionalism, work ethics, and responsibility required in the engineering field.

Course Outcomes

After successful completion of this course, the students should be able

CO1	To demonstrate proficiency in using industrial machinery, tools, and software.
CO2	To identify, analyze, and solve engineering problems using industry-Standard methods and practices.
CO3	To comprehend industrial manufacturing processes, quality control, and safety practices.
CO4	To exhibit improved communication, teamwork, and professional Behavior in an industrial setting.
CO5	To apply theoretical concepts learned in their coursework to practical Engineering tasks and projects.

CO/PO Mapping

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

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

Duties Responsibilities of the Faculty Mentor.

Faculty mentors play a crucial role in overseeing and guiding students during their industrial training program in Diploma engineering.

Pre-Training Responsibilities:

1. Orientation and Preparation:
    - Conduct orientation sessions to familiarize students with the objectives, expectations, and guidelines of the industrial training program.
    - Assist students in understanding the importance of industrial training in their academic and professional development.
2. Placement Coordination:
    - Collaborate with the placement cell or industry liaison office to secure suitable training placements for students that align with their academic specialization and career interests.
    - Facilitate communication between the institution and host organizations to ensure smooth coordination of training arrangements.

3. Training Plan Development:
    - Help students develop a detailed training plan outlining learning objectives, tasks, and expected outcomes for the training period.
    - Guide students in setting SMART (Specific, Measurable, Achievable, Relevant, Time-bound) goals for their training experience.
    -

During Training Responsibilities:

4. Monitoring and Support:
    - Regularly monitor the progress of students during their industrial training. Maintain communication with both students and industry supervisors to track performance and address any issues that may arise.
    - Provide ongoing support and guidance to students, offering advice on technical challenges, professional conduct, and workplace etiquette.
5. Technical Guidance:
    - Offer technical guidance and mentorship related to the specific engineering discipline or specialization of the students. Help them apply theoretical knowledge to practical situations encountered in the industry.
6. Problem-Solving Assistance:
    - Assist students in overcoming obstacles or challenges encountered during their training. Encourage them to develop problem-solving skills and resilience in real-world engineering scenarios.
7. Feedback and Evaluation:
    - Provide constructive feedback on students' performance based on reports, assessments, and observations gathered from industry supervisors.
    - Evaluate students' achievements in relation to their training objectives and competencies developed during the program.

Post-Training Responsibilities:

8. Reflection and Debriefing:
    - Conduct debriefing sessions with students to reflect on their training experiences, discuss lessons learned, and identify areas for further improvement.
    - Help students articulate their learning outcomes and how these experiences contribute to their professional growth.
9. Documentation and Reporting:
    - Ensure comprehensive documentation of students' training activities, achievements, and feedback received from industry supervisors.
    - Prepare reports summarizing students' performance and submit

these to relevant departments or committees for review and assessment.

10. Career Counseling:
    - Provide career guidance and counseling to students based on their industrial training experiences. Assist them in leveraging these experiences for future job applications or further academic pursuits.
11. Continuous Improvement:
    - Collaborate with industry partners to continuously improve the quality and relevance of the industrial training program.
    - Incorporate feedback from students and industry supervisors to enhance the effectiveness of future training placements.

By fulfilling these duties and responsibilities, faculty mentors contribute significantly to the overall educational experience and professional development of Diploma engineering students during their industrial training program.

Instructions to the students

Here are some instructions for Diploma engineering students undergoing industrial training during their academic duration:

Before Starting Industrial Training:

1. **Orientation and Preparation:**
    - Attend orientation sessions conducted by the institution or faculty mentors to understand the objectives, expectations, and guidelines of the industrial training program.
    - Familiarize yourself with the specific policies, procedures, and safety regulations of the host organization where you will be undergoing training.
2. Setting Goals:
    - Set clear and specific goals for your industrial training period. Define what skills, knowledge, and experiences you aim to gain during this time.
    - Discuss your goals with your faculty mentor and seek their guidance in developing a training plan that aligns with your career aspirations.
3. Professional Attire and Conduct:
    - Dress appropriately and professionally according to the standards of the industry and host organization.
    - Maintain a positive attitude, demonstrate punctuality, and adhere to workplace etiquette and norms.

During Industrial Training:

4. Learning and Engagement:
    - Actively engage in all assigned tasks and projects. Seek opportunities to learn new skills and technologies relevant to your field of study.
    - Take initiative in asking questions, seeking clarification, and participating in discussions with supervisors and colleagues.
5. Adaptability and Flexibility:
    - Adapt to the work environment and demonstrate flexibility in handling various responsibilities and challenges that arise during your training.
    - Be open to different roles and tasks assigned to you, as this will broaden your experience and skill set.

6. Professionalism and Communication:
    - Communicate effectively with supervisors, colleagues, and clients as required. Practice clear and concise verbal and written communication.
    - Demonstrate professionalism in all interactions, respecting confidentiality, and adhering to company policies and procedures.
7. Safety and Compliance:
    - Prioritize safety at all times. Familiarize yourself with safety protocols, procedures, and emergency exits in the workplace.
    - Follow all safety guidelines and regulations to ensure your well-being and that of others around you.

After Completing Industrial Training:

8. Reflection and Documentation:
    - Reflect on your training experience. Evaluate what you have learned, the challenges you faced, and how you have grown professionally.
    - Maintain a journal or log documenting your daily activities, achievements, and lessons learned during the training period.
9. Feedback and Evaluation:
    - Seek feedback from your industry supervisor and faculty mentor on your performance and areas for improvement.
    - Use constructive feedback to enhance your skills and competencies for future career opportunities.
10. Career Planning:
    - Use your industrial training experience to inform your career planning and decision-making process.
    - Discuss your career goals and aspirations with your faculty mentor or career counselor for guidance on next steps after completing your diploma.

By following these instructions, Diploma engineering students can make the most of their industrial training experience, gain valuable insights into their chosen field, and prepare themselves effectively for future professional endeavors.

Attendance Certification

Every month students have to get their attendance certified by the industrial supervisor in the prescribed form supplied to them. Students have also to put their signature on the form and submit it to the institution supervisor. Regularity in attendance and submission of report will be duly considered while awarding the Internal Assessment mark.

Training Reports

The students have to prepare two types of reports: Weekly reports in the form of a diary to be submitted to the concerned faculty mentor of the institution. This will be reviewed while awarding Internal assessment. The details of the activity during the training will be monitored by the Faculty mentor through the faculty advisor and student.

The feedback shall be given to the HOD / Principal for further necessary action.

Industrial Training Diary

Students are required to maintain the record of day-to-day work done. Such a record is called Industrial training Diary. Students have to write this report regularly. All days for the week should be accounted for clearly giving attendance particulars (Presence, absence, Leave, Holidays etc.). The concern of the Industrial supervisor is to periodically check these progress reports.

Comprehensive Training Report

In addition to the diary, students are required to submit a comprehensive report on training with details of the organization where the training was undergone after attestation by the supervisors. The comprehensive report should incorporate study of plant / product / process / construction along with intensive in-depth study on any one of the topics such as processes, methods, tooling, construction and equipment, highlighting aspects of quality, productivity and system. The comprehensive report should be completed in the last week of Industrial training. Any data, drawings etc. should be incorporated with the consent of the Organization.

Scheme of Evaluation

Internal Assessment

Students should be assessed for 40 Marks by industry supervisor and polytechnic faculty mentor during 3rd Month and 5th Month. The total marks (40 + 40) scored shall be converted to 40 marks for the Internal Assessment.

Sl. No.	Description	Marks
A	Punctuality and regularity. (Attendance)	10
B	Level / proficiency of practical skills acquired. Initiative in learning / working at site	10
C	Self-expression / communication skills. Interpersonal skills / Human Relation.	10
D	Presentation and Daily activity report	10
Total		40

End Semester Examination – Industrial Training

Students should be assessed for 100 Marks both by the internal examiner and external examiner appointed by the Chairman Board of Examinations after the completion of industrial training of six months. The marks scored will be converted to 60 marks for the End Semester Examination.

Sl. No.	Description	Marks
A	Daily Activity Report.	20
B	Comprehensive report on Internship, Relevant Internship Certificate from the concerned department.	30
C	Presentation by the student at the end of the Internship.	30
D	Viva Voce	20
Total		100

END