SYLLABUS

FOR

DIPLOMA IN

PLASTIC TECHNOLOGY

(DIPLOMA COURSES IN ENGINEERING / TECHNOLOGY)

C23 REGULATION

TAMILNADU GOVERNMENT POLYTECHNIC COLLEGE

(AUTONOMOUS), MADURAI – 625 011

ProgramStructure

Diploma Plastic 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:

PO1: 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 analyse 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.

PO4: Engineering Tools, Experimentation, and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

PO5: 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 engineering activities.

PO7: Life-long learning: Ability to analyse individual needs and engage in updating in the context of technological changes.

Credit Distribution

Semester	No of Courses	Periods	Credits
Semester I	8	640	20
Semester II	9	640	20
Semester III	8	640	20
Semester IV	7	640	20
Semester V	7	640	21
Semester VI	3	640	19
Semester VII	1	-	12
		Total	**132**

SEMESTER – III

##	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	73310	Fundamentals of Organic Chemistry	3-1-0	60	3	Theory
2	Program Core	Theory	73320	Mould Making Technology	3-0-0	45	3	Theory
3	Program Core	Practicum	73330	Polymer Science	2-0-4	90	4	Practical
4	Program Core	Practicum	73340	Basics of Chemical Engineering	1-0-4	75	3	Practical
5	Program Core	Practical/Lab	73350	Tool Room Practical	0-0-4	60	2	Practical
6	Program Core	Practical/Lab	73360	Plastics Mould Elements Drawing Practical	0-0-4	60	2	Practical
7	Open Elective	Advanced Skill Certification	73370	Advanced Skills Certification – 3	1-0-2	60	2	NA
8	Humanities & Social Science	Integrated Learning Experience	73380	Health & Wellness	0-0-2	30	1	NA
9	Audit Course	Integrated Learning Experience	73390	Induction Program – II	-	16	0	-
10	Audit Course	Integrated Learning Experience	733A0	I&E/ Club Activity/ Community Initiatives	-	16	0	-
11	Audit Course	Integrated Learning Experience	733B0	Emerging Technology Seminars	-	8	0	-
12	Audit Course	Integrated Learning Experience	733C0	Shop floor Immersion	-	6	0	-
13	Audit Course	Integrated Learning Experience	733D0	Growth Lab	-	30	0	-
14	Audit Course	Integrated Learning Experience	733E0	Student-Led Initiative	-	24	0	-
Test & Revisions						45		
Library Hours						15		
TOTAL						640	20	

SEMESTER – IV

##	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	73410	Thermoplastic Materials	3-0-0	45	3	Theory
2	Program Core	Theory	73420	Plastics Processing Technology	3-0-0	45	3	Theory
3	Program Core	Practicum	73430	Process Control and Measurement	1-0-4	75	3	Practical
4	Program Core	Practicum	73440	Identification of Plastics	1-0-4	75	3	Practical
5	Program Core	Practical/Lab	73450	Thermoplastic Materials Preparation Practical	0-0-5	75	3	Practical
6	Program Core	Practical/Lab	73460	Plastics Processing Practical	0-0-5	75	3	Practical
7	Open Elective	Advanced Skill Certification	73470	Advanced Skills Certification - 4	1-0-2	60	2	NA
8	Audit Course	Integrated Learning Experience	73480	I&E/ Club Activity/ Community Initiatives	-	30	0	-
9	Audit Course	Integrated Learning Experience	73490	Special Interest Groups *(Placement Training)*	-	30	0	-
10	Audit Course	Integrated Learning Experience	734A0	Emerging Technology Seminars	-	8	0	-
11	Audit Course	Integrated Learning Experience	734B0	Shop floor Immersion	-	8	0	-
12	Audit Course	Integrated Learning Experience	734C0	Health & Wellness	-	30	0	-
13	Audit Course	Integrated Learning Experience	734D0	Student-Led Initiative	-	24	0	-
Test & Revisions						45		
Library Hours						15		
TOTAL						640	20	

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	73530	FRP Technology	3-0-2	75	4	Theory
4	Program Core	Practicum	73540	Plastics Mould and Die Design	2-0-4	90	4	Practical
5	Program Core	Practical/Lab	73550	Thermoset Plastics Preparation Practical	0-0-6	90	3	Practical
6	Humanities & Social Science	Project/Internship	73560	Innovation & Startup	1-0-2	45	2	Project
7	Open Elective	Advanced Skill Certification	73570	Advanced Skills Certification – 5	1-0-2	60	2	NA
8	Audit Course	Integrated Learning Experience	73580	Induction program III		40	0	-
9	Audit Course	Integrated Learning Experience	73590	Special Interest Groups (Placement Training)		40	0	-
10	Audit Course	Integrated Learning Experience	735A0	Health & Wellness		30	0	-
11	Audit Course	Integrated Learning Experience	735B0	Student-Led Initiative		30	0	-
Test & Revisions						35		
Library Hours						15		
TOTAL						640	21	

*	1	Program Elective-1	Theory	73511	Thermoset &Specialty Plastic Materials
	2	Program Elective-1	Theory	73512	Packaging Technology
	3	Program Elective-1	Theory	73513	Plastics Compounding Technology

**	1	Program Elective-2	Theory	73521	Plastics Recycling and Waste Management
	2	Program Elective-2	Theory	73522	Polymer Blends and Alloys
	3	Program Elective-2	Theory	73523	Fundamentals of Nano Technology
	4	Program Elective-2	Theory	73524	Biopolymers

SEMESTER – VI

##	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Elective	Theory	*	Electives-3 (Pathway)	3-1-0	60	3	Theory
2	Program Elective	Practicum	**	Elective-4 (Specialization)	2-0-4	90	4	Practical
3	Industrial Training / Project	Project / Internship	73630	In-house Project / Internship / Fellowship	-	490	12	Project
TOTAL						640	19	

1	Program Elective-3 |Pathway| Higher Education	Theory	73611	Advanced Processing Technology
2	Program Elective-3 |Pathway| Entrepreneurship	Theory	73612	Entrepreneurship and Business Management
3	Program Elective-3 |Pathway| Technocrats	Theory	73613	Industrial Engineering and Management
4	Program Elective-3 |Pathway| Technologists	Theory	73614	Online Elective Course#

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1	Program Elective-4 | Specialization	Practicum	73621	Analysis and Characterization of Plastics
2	Program Elective-4 | Specialization	Practicum	73622	Adhesive Technology
3	Program Elective-4 | Specialization	Practicum	73623	Latex Technology

Online course with the same credit available in AICTE, NPTEL, MOOCS and Reputed Institution with proper evaluation system and certification can be considered with prior approval from the Head of the Institution.

SEMESTER – VII

##	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Industrial Training	Internship/Training	73710	Industrial Training Report and Viva-voce	-	-	12	Viva-voce
TOTAL						-	12	

EQUIVALENT SUBJECTS IN C23 SCHEME FOR N20 SCHEME

' N 20'- SCHEME			' C23' - SCHEME	
Course Code	**Course Name/Subject**	**Term**	**Equivalent Course code**	**Equivalent Subject**
4973310	Basic Organic Chemistry	III	73310	Fundamentals of Organic Chemistry
4070320	General Engineering	III		No Equivalent
4973330	Polymer Science	III	73330	Polymer Science (Practicum)
4973340	Polymer Engineering DrawingPractical	III		No Equivalent
4973350	Polymer Science Practical	III	73330	Polymer Science (Practicum)
4070360	General Engineering Practical	III		No Equivalent
4973370	Computer Aided Design Practical	III	73360	Plastics Mould Elements Drawing Practical
4973410	Thermoplastic Materials	IV	73410	Thermoplastic Materials
4973420	Plastics Processing I	IV	73420	Plastics Processing Technology
4973430	Basics of Chemical Engineering and Process Measurement	IV	73340	Basics of Chemical Engineering (Practicum)
4973440	Thermoplastics Preparation Practical	IV	73450	Thermoplastic Materials Preparation Practical
4973450	Plastics Identification Practical	IV	73440	Identification of Plastics (Practicum)
4973460	Plastics Processing I Practical	IV	73460	Plastics Processing Practical
4973470	Chemical Engineering and Process Measurement Practical	IV	73340	Basics of Chemical Engineering (Practicum)
4973510	Specialty and Thermosetting Materials	IV	73511	Thermoset & Speciality Plastic Materials
4973520	Plastics Processing - II	V	73611	Advanced Processing Technology
4973530A	FRP Technology	V	73530	FRP Technology (Practicum)
4973540	Entrepreneurship and Startup	V	73560	Innovation & Startup
4973550	Thermosets Preparation Practical	V	73550	Thermoset Plastics Preparation Practical

4973560	Plastics Processing - II Practical	V		No Equivalent
4973570A	FRP Technology Practical	V		No Equivalent
4973610	Plant Engineering and Management	V	73613	Industrial Engineering and Management
4973620	Testing of Plastics	V	73621	Analysis and Characterization of Plastics (Practicum)
4973630A	Plastics Mould and Die Design	VI	73540	Plastics Mould and Die Design (Practicum)
4973640	Plastics Testing Practical	VI	73621	Analysis and Characterization of Plastics (Practicum)
4973650A	Plastics Mould and Die Design Practical	VI	73540	Plastics Mould and Die Design (Practicum)
4973660	Project Work	VI	73630	In-house Project / Internship / Fellowship
4973710	Industrial Training and Viva Voce	VII	73710	Industrial Training Report and Viva-voce

73310	FUNDAMENTALS OF ORGANIC CHEMISTRY	L	T	P	C
Theory		3	1	0	3

Introduction

This course makes the student to know about the basics of organic chemistry. This is the fundamental course, where students will be knowing about the organic compounds which are the base of all plastic materials. After doing this course student will be confident about the different organic compounds and functional groups. It will be useful for them during next semesters and in the professional career.

Course Objectives

The objective of this course is to enable the students

1. To learn about the classification of the organic compounds.
2. To know about the different methods of purification of the organic compound.
3. To understand the different types of isomerism.
4. To study about the different types of organic reactions.
5. To know about the methods of preparation, properties and uses of basic organiccompounds required for the preparation of polymer.

Course Outcomes

CO1	Understand nomenclature and purification techniques
CO2	Understand various polymerization techniques
CO3	Understand preparation properties and uses of various carbonyl compounds
CO4	Understand preparation properties and uses of various nitro compounds
CO5	Understand the fundamentals of fraction distillation of coal tar and aromatic products

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.

73310	FUNDAMENTALS OF ORGANIC CHEMISTRY	L	T	P	C
Theory		3	1	0	3

Unit I	**CLASSIFICATION AND PURIFICATION OF ORGANIC COMPOUNDS**	
Classification of organic compounds – Functional groups - Nomenclature with example for Alkane Alkene, Alkyne. Purification of organic compounds - Principles of crystallization, sublimation, simple distillation, fractional distillation.		**9**
Unit II	**ISOMERISM AND TYPES OF ORGANIC REACTIONS**	
Isomerism - structural isomerism - chain isomerism, position isomerism, functional isomerism, metamerism and tautomerism (Ketonol tautomerism only) - Stereoisomerism - optical isomerism (Lactic acid only) - Geometrical isomerism (Maleic acid and Fumaric acid). Types of organic reactions - Substitution reactions - Addition reaction - Addition in olefinic compounds - Markonikoff's Rule - Peroxide effect - Elimination reaction (Mechanism of E2and E1types are not included)		**9**
Unit III	**HYDROCARBONS AND ALCOHOLS**	
Preparation methods, properties and uses of METHANE, ETHANE, METHANOL (from water gas and by oxidation of CH4), ETHANOL (from ethylene, molasses and starch)		**9**
Unit IV	**CARBONYL COMPOUNDS AND AMINES**	
General methods of preparation, properties and uses of FORMALDEHYDE and AMINES (Primary secondary and tertiary amine) - Difference between primary, Secondary and tertiary amines - Separation of primary, secondary and tertiary amines by Hoffmann method – Glycerol (from fats and oil)		**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. General methods of preparation properties and application of nitrobenzene and aniline		**9**
TOTAL HOURS		**45**

Text Books:

1. B.S. Bahl and Arun Bahl - Text book of organic Chemistry
2. P.L. Soni and H.M. Chawla - Text book of organic Chemistry

References:

1. K.S. Tewari S.N. Mehrotra and N.K. Vishnoi - Text book of organic chemistry
2. B.K. Sharma, G.P. Pokhariyal and S.K.Sharma.- Organic Chemistry - Vol-I and II
3. S.P. Shukla and G.L. Trivedi - Modern Organic Chemistry
4. +1 and +2 Chemistry - Tamil Nadu Textbook Corporation

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.

73320	MOULD MAKING TECHNOLOGY	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the students to know about the importance of Manufacturing, the major and the most important aspects in industries needs utmost care and attention. knowledge about various process and allied areas will be of great use to the personnel involved in production. This will provide the students an opportunity to skill themselves for the industrial scenario. Since, it will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students to

1. Acquire knowledge about machines like lathe, planer etc
2. Describe about milling machine and grinding machine
3. Knowledge about machines like shaper, slotter etc
4. Acquire knowledge about various machines in industries

Course Outcomes

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

CO1	To operate the lathe and machine a component using lathe.
CO2	To machine a gear using milling machine.
CO3	To machine a cutting tool using tool and cutter grinder
CO4	To familiarize about measuring techniques of metrology instruments
CO5	To machine a components by using shaping machine, planning machine

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.

73320	MOULD MAKING TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

Unit I	**LATHE AND DRILLING**	
LATHE:- Principle of operation-Types of lathes-Specification-Work holding device-3 Jaw chuck- 4 Jaw chuck-Machining operation done on lathe-Methods of taper turning-Thread cutting **DRILLING:-** Principle of operation-Types of drilling machine-Specification-Drilling operations-Drilling-Reaming- Counter sinking- Counter boring- Methods of holding drill bit- Drill chuck- Socket- Sleeve		**9**
Unit II	**PLANER AND SHAPER AND SLOTTER**	
PLANER:- Principle of operation-Types of planer-Double housing planer only Specification-Operation done by planer-Work holding devices **SHAPER:-** Principle of operation-Types of shaper-Specification-Work holding devices- Shaper Operations **SLOTTER:-** Principle of operation-Types of slotter-Specification-Work holding devices- Slotter operations		**9**
Unit III	**MILLING**	
Types of milling machines- Plain milling machine- Vertical milling machine-Specification- Principle of operation- Work holding devices- Plain vise-swivel vise-Tool holding devices- Arbor- Adapter- Spring collet- Milling process-Conventional milling- Climb milling- Milling operations		**9**
Unit IV	**GRINDING**	
Principle of operation- classification of grinding machines-Specification – cyclindrical grinder- Centerless grinders- Planetary type internal grinder- Surface grinders- Horizontal spindle(reciprocating table surface grinder only)-Vertical spindle(reciprocating table surface grinder only)-Grinding wheels-Bond- Grit- Grade- Structure of wheels-Glazing and Loading- Dressing and Truing- Balancing of wheel- Mounting of grinding wheels		**9**
Unit V	**METROLOGY AND CUTTING TOOL MATERIAL**	
METROLOGY:-Definition- Vernier caliper- Vernier height gauge- Micrometer-Depth micrometer-Bevel protractor-Sinebar-Gauges-Plug-Ring-snap-Slipgauges-Comparators-Types-Mechanical comparator **CUTTING TOOL MATERIAL**:- Characteristics- Types of tools material- Carbon steel,MediumAlloy steel,High speed steels- Types of cutting tools-Single point cutting tools – Multi point cutting tools- Cutting fluid-Types – Purpose- Properties		**9**
TOTAL HOURS		**45**

Text Books:

1. Elements of Workshop Technology Volume 1 & 2 – Hajra chowdry & Bhattacharya- 2nd edition- media Promoters & Publishers Pvt Ltd, Seewai Building 'B', 20-G, Noshir

References:

1. Workshop Technology- Raghuwanshi - Khanna Publisher.Jain & Gupta
2. Workshop Tech vol 1 & 2 & 3 Waj Chapman, Published by viva books Pvt Ltd 4262/3, Ansari Road, Daryaganj, New Delhi 110 002
3. Production Technology –P.C.SHARMA-Edn X-S.Chand & Co Ltd,Ram Nagar ,New Delhi 110055-2006
4. Production Technology.HMT Edn 18 Published By Tata Mc Graw Hill Publishing Co LTD.7 West Patel Naqgar ,New Delhi 110008

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.

73330	Polymer Science	L	T	P	C
PRACTICUM		2	0	4	4

Introduction

This course makes the student to know about the polymerization techniques of various plastic materials and also about the basic analytical studies. After doing this course student will be confident about the different polymerization techniques and the physical chemistry of plastic materials. It will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students

1. To understand the fundamentals polymer reaction
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 different polymer reaction types

Course Outcomes

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

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

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

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.

Reference Books:

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
3. Blackley & Halsted - Emulsion Polymerisations: Theory and Practice - McGraw-Hill, New York
4. - 1975
5. Murugan N - Fundamentals of Polymer Science – Study Material
6. I.Herman S.Haufman and Joseph J.Falce - Introduction to Polymer Science and Technology - Wiley Inter Science Publications- 1977.

LIST OF EQUIPMENTS / INSTRUMENTS, MATERIAL, MANUALS REQUIRED (FOR A BATCH OF 30 STUDENTS)

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

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.

Scheme of Evaluation (For End Semester Examination)

- Aim 10 Marks
- Apparatus Required 10 Marks
- Procedure 15 Marks
- Formula 15 Marks
- Tabulation 15 Marks
- Calculation 20 Marks
- Result 05 Marks
- Viva-Voice 10 Marks

- **Total** **100 Marks**

73340	BASICS OF CHEMICAL ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

Introduction

This course makes the student to know about the importance of Chemical Engineering and various unit operations involved in plastic and polymer industries. It is therefore necessary to provide information to students to impart knowledge about new materials, chemicals involved and manufacturing process of some important industrial operations. This will provide the students an opportunity to skill themselves for the industrial scenario. Since, 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 behaviour
2. Familiarize about the working principle of centrifugal pump and friction in pipes
3. Select the required method to reduce the size of the material
4. Understand the principle behind the heat transfer process and drying
5. Know about the principle of mixing, agitation, settling and its equipments

CO1	To explain the properties of the fluid and its behavior,
CO2	To familiarize about the working principle of centrifugal pump and friction in pipes
CO3	To select the required method to reduce the size of the material
CO4	To understand the principle behind the heat transfer process and drying
CO5	To know about the principle of mixing, agitation and its equipments

]

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.

73340	BASICS OF CHEMICAL ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

Unit I	FLUID MECHANICS	
Properties of fluids- density- specific weight- specific volume- specific gravity- vapour pressure. Pressure- fluid pressure - Atmospheric pressure - Gauge pressure - Absolute pressure Flow of fluids - Laminar flow - Viscosity – Dynamic viscosity-Kinematic viscosity - Bernoulli's Theorem -Principle of Venturi meter, Orifice meter, Roto meter **List of experiments:** 1. Study and operation on Orifice meter 2.Study and operation on Venturi meter 3.Study and operation on Rotameter		**15**
Unit II	**PUMPS AND FRICTION IN PIPES**	
Pumps – Principle of centrifugal pump - parts of pump - working of a centrifugal pump - priming of centrifugal pump. Major properties and types of hydraulic fluids - Friction in pipes-Laws of fluid friction **List of experiments** 4. Study and operation on Centrifugal pump 6. Determination of pipe friction		**15**
Unit III	**HEAT TRANSFER AND DRYING**	
Conduction - Fourier's law , convection: Natural convection - Forced convection ; Radiation Drying: principles, Drying characteristics - Classification of driers - Tray driers and its application, **List of experiments** 7. Study and operation on Drier		**15**
UNIT IV	**SIZE REDUCTION, SCREENING**	
Size reduction machines: Crushers - Jaw crusher - angle of nip - Ball mill - Critical speed - Operating speed – Screening: Sieve standards motions of screens - actual screen and ideal screen. **List of experiments** 8. Study and operation on screening 9. Study and operation on Jaw crusher 10. Study and operation on Ball mill		**15**
UNIT V	**MIXING, AGITATION AND SETTLING**	
Purposes of agitation - Agitation of liquids - equipments - propellers - paddles - turbines - flow patterns in agitated vessels - Vortex and Swirling prevention. Settling – stokes law - batch settling - hindered settling and free settling **List of experiments** 11. Experiment on Batch settling 12. Study and operation on Industrial mixer		**15**
TOTAL HOURS		**75**

LIST OF EQUIPMENTS / INSTRUMENTS, MATERIAL, MANUALS REQUIRED (FOR A BATCH OF 30 STUDENTS):

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

Text Book

1. Chemical Engineering Manual by W.L.Mc Cabe & J.C.Smith
2. Chemical Engineering Manual by W.L.Badger & J.T.Banchero

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.

Scheme of Evaluation (For End Semester Examination)

➢ Aim	5 Marks
➢ Apparatus Required	5 Marks
➢ Procedure	10 Marks
➢ Tabulation	25 Marks
➢ Calculation	30 Marks
➢ Graph	10 Marks
➢ Result	05 Marks
➢ Viva-Voice	10 Marks
➢ **Total**	**100 Marks**

73350	TOOL ROOM 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 machines, tools and measuring instruments relevant to their field of study. This is accomplished by doing mechanical related experiments in practical classes.

Course Objectives

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

1. To identify the parts of drilling machine.
2. To identify the work holding devices.
3. To set the tools for various operation.
4. To identify the tools and instruments used in milling
5. To determine the least count of measuring instruments
6. To familiarize about measuring techniques of metrology instruments.

Course Outcomes

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

CO1	To understanding of error sources in measurements and methods to minimize them.
CO2	To determine the least count of measuring instruments.
CO3	To obtain accurate measurements.
CO4	To ability to set up and operate a lathe machine safely and efficiently.
CO5	To understanding of appropriate cutting speeds and feeds for different material

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

73350	TOOL ROOM PRACTICAL	L	T	P	C
Practical		0	0	4	2

List of Experiments		
1	Make a “V” block using shaping machine	
2	Make a spur gear using milling machine by differential indexing	
3	Make a turning tool using tool and cutter grinder	
4	Make a round to hexagon in milling machine	
5	Measure the dimension of ground ms flat using vernier caliper compare with digital/dial vernier caliper	
6	Measure the height of gauges blocks or parallel bars using vernier height gauge	
7	Measure the angle of machined surface using sinebar	
8	Step turning and Knurling	
9	Step turning and Facing and Chamfering	
10	Step turning and Taper turning	
	TOTAL HOURS	**60**

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

S.No	Name of Equipment / Instrument	Quantity
1	Chuck key	Required Numbers
2	Lathe Minimum	15 nos
3	3 Jaw Chuck	Required Numbers
4	Cutting Tools	Sufficient Quantity
5	Steel Rule(0-150)	Sufficient Quantity
6	Calipers(Inside /Outside)	Sufficient Quantity
7	Safety Glass	15 Nos
8	Shaping machine	2Nos
9	Tools and cutter grinder	1 Nos
10	Universal milling machine	2 Nos
11	Sine Bar	2 NOS
12	Vernier Caliper	2 NOS
13	Vernier Height Gauge	2 NOS
14	Marking Gauges	Sufficient Quantity

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.

Scheme of Evaluation (For End Semester Examination)

➢ Aim	10 Marks
➢ Tools Required	10 Marks
➢ Procedure	25 Marks
➢ Job Output	40 Marks
➢ Result	10 Marks
➢ Viva-Voce	5 Marks
➢ **Total**	**100 Marks**

73360	PLASTICS MOULD ELEMENTS DRAWING	L	T	P	C
PRACTICAL		0	0	4	2

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

73360 Practical	Plastics Mould Elements Drawing Practical	L	T	P	C
		0	0	4	2

List of Experiments		
1	Introduction to Injection Mould Elements	
2	Draw the Sectional view of Guide Pillar	
3	Draw the Sectional view of Guide Bush	
4	Draw the Sectional view of Sprue Bush	
5	Draw the Sectional view of Register Ring	
6	Draw the Sectional view of Core Plate	
7	Draw the Sectional view of Cavite Plate	
8	Draw the Sectional view of Ejector Pin	
9	Draw the Sectional view of Ejector Plate	
10	Draw the Sectional view of Sprue Puller	
11	Draw the Sectional view of Ejector Retaining Plate	
TOTAL HOURS		**60**

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

S.No.	Name of Equipment / Instrument	Quantity
1.	AutoCad Software (2015 and above)	1
2.	System (above P3 configuration)	30

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.

Scheme of Evaluation (For End Semester Examination)

➢ Aim	10 Marks
➢ Commands	10 Marks
➢ Drawing 1	30 Marks
➢ Drawing 2	30 Marks
➢ Print out	10 Marks
➢ Viva-Voice	10 Marks
➢ **Total**	**100 Marks**

73410	Thermoplastic Materials	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the manufacture of various thermoplastic Materials. After doing this course student will be confident about the different manufacturing processes of plastic 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 learn about the classification of plastic compounds.
2. To know about the different methods of manufacturing of the plastic compound.
3. To understand the properties and applications of plastic material
4. To study about the reactions of manufacturing of plastic material
5. To know about the structure of compounds required

Course Outcomes

After Successful completeion of this course, the students will able to

CO1	Classify the plastic compounds.
CO2	Differentiate the methods of manufacturing of the plastic compound.
CO3	Understand the properties and applications of plastic material
CO4	Know the reactions of manufacturing of plastic material
CO5	Understand about the structure of compounds required

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.

73410	Thermoplastic Materials	L	T	P	C
Theory		3	0	0	3

Unit-I	
POLYOLEFINS AND STYRENICS PLASTICS Plastics - Classifications - Abbreviations. Polyethylene - types –Method of Manufacturing of Low Density Polyethylene by high pressure process, structure properties and applications. Polypropylene - types – structure - Method of Manufacturing by Ziegler process - properties and applications. Polystyrene – structure - Method of Manufacturing by continuous bulk polymerisation process - properties and applications - Styrene copolymers: HIPS, SAN and ABS – their structure, properties and applications.	**9**
Unit II	
Polyvinyl chloride – Method of Manufacturing of PVC-structure - Types: soft and rigid PVC - properties and applications - VC copolymers - applications. Method of Manufacturing of Polyvinyl alcohol – structure – properties and applications. Acrylic plastics: Method of Manufacturing Polymethyl methacrylate (PMMA) - by Suspension polymerisation - structure, properties and applications	**9**
Unit III	
ENGINEERING PLASTICS Polyamides - Method of Manufacturing, Properties and applications of Polyamide 6, and Polyamide 6,6 Acetal resins - Method of Manufacturing, structure, properties and applications	**9**
Unit IV	
CELLULOSE PLASTICS, FLUORO PLASTICS,& SATURATED POLYESTERS Cellulose plastics: Method of Manufacturing of cellulose acetate,cellulose nitrate –their structure - properties and applications. Fluoro Plastics : PTFE – Method of manufacturing – Properties - Applications Method of Manufacturing of Polyethylene terephthalate (PET) a structure, properties, and applications.	**9**
Unit V	
THERMO PLASTIC ELASTOMERS Properties and application – Thermoplastic styrene block copolymers, Polyester thermoplastic elastomers, Polyamide thermoplastic elastomers, Polyurethane thermoplastic	**9**
TOTAL HOURS	**45**

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

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.

73420	Plastics Processing Technology	L	T	P	C
Theory		3	0	0	3

Introduction

In today's scenario metals, wood, ceramics, glass, etc., are replacing the 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 realize the application of theoretical knowledge gained in the classroom.
- Incorporation of Blended/Flipped learning will help the students to understand the content better.

73420	Plastics Processing Technology	L	T	P	C
Theory		3	0	0	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.		9
Unit II	**INJECTION MOULDING**	
Injection moulding types (Name only) – Parts of reciprocating screw injection moulding and their function – Types of screw - Thermoplastic injection moulding process and cycle time – Types of clamping system –Toggle clamping – Hydraulic Clamping - Troubleshooting		9
Unit III	**BLOW MOULDING AND THERMOFORMING**	
BLOW MOULDING : Parison programming - extrusion blow moulding process - Injection blow moulding process - Injection stretch blow moulding process – Blow up ratio - Troubleshooting. **THERMOFORMING :** Basic Principle of thermoforming **-** Thermoforming techniques - Vacuum forming techniques – Plug assist forming - Bubble or blister forming - Troubleshooting		9
Unit IV	**EXTRUSION**	
Extruder parts and functions – Extrusion process – Barrel – Screw Nomenclature – L/D Ratio – Compression Ratio – Screen Pack – Breaker Plate – Types of Extruder – Single Screw and Two Screw Extruder – Pipe Production – Blown film Extrusion		9
Unit V	**ROTATIONAL MOULDING**	
Rotational moulding process: Types of rotational moulding - Batch type machine process - Straight line (Shuttle) machine process - Carousel type machine process - Applications – Advantages – Troubleshooting.		9
TOTAL HOURS		**45**

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, NewYork.
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)

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.

73430	Process Control and Measurement	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 and automatic 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 plastic 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 and automatic 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.

73430	Process Control and Measurement	L	T	P	C
Practicum		1	0	4	3

Unit I	BASIC CONCEPT OF MEASUREMENT	
	Purpose of Instrumentation– measurement- Functional elements of Instruments – Static and Dynamic characteristics of Instruments	10
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.	20
Unit V	**APPLICATIONS OF PROCESS CONTROL**	
	Control application: Liquid level system - Heat Exchanger - Control oftemperature. 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 30Students):

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 EasternLimited.,
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.

Assessment Technology

	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.

Scheme of Evaluation (For End Semester Examination)

- Aim 10 Marks
- Apparatus Required 10 Marks
- Procedure 10 Marks
- Tabulation 30 Marks
- Calculation 05 Marks
- Graph 20 Marks
- Result 05 Marks
- Viva-Voice 10 Marks

- **Total** **100 Marks**

73440	Identification of Plastics	L	T	P	C
PRACTICUM		1	0	4	3

Introduction

To study the manufacturing technology, properties and applications of various plastics, the students should have primarily known about the identification methods of a given unknown plastic. This practicum will be useful to know about the influence of chemical structure on various properties of plastics and also to acquire basic knowledge on thermoplastic and thermoset plastics properties and its applications.

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 thermoplastics and thermo set materials by chemical method

Course Outcomes

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

CO1	Identify a plastic by chemical method
CO2	Select a plastic for a given application based on its properties
CO3	Differentiate the various categories of plastics
CO4	Understand the applications of various plastics
CO5	Acquire basic knowledge about identification of different plastics by functional group analysis

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.

73440	IDENTIFICATION OF PLASTICS	L	T	P	C
PRACTICUM		1	0	4	3

Unit I	
Identification of plastics - Simple physical preliminary tests like visual examination, heating and softening behavior, floatation test, cutting with knife, scratching with nail, bending, tearing and dropping sound test. Burning tests - Nature of flame, odour, speed of burning, smoke and other characteristics - Detection of elements by Copper wire test (Beilstein test) and Sodium fusion extract test – Confirmation of plastics by chemical analysis. Functional group analysis FTIR	**15**
Unit II	
List of experiments: **IDENTIFICATION OF PLASTICS BY SIMPLE PRELIMINARY TESTS** 1. Preliminary Identification of Polyolefins 2. Preliminary Identification of Vinyl plastics 3. Preliminary Identification of Acrylic Plastics 4. Preliminary Identification of Polyamides 5. Preliminary Identification of saturated polyester 6. Preliminary Identification of Thermoset plastic materials •	**15**
Unit III	
IDENTIFICATION OF PLASTICS BY DETECTION OF ELEMENTS & CONFIRMATORY TESTS Preparation of sodium fusion extract. Detection of elements (Chloride, Nitrogen, Fluoride and Sulphur) from sodium fusion Extract	**15**
UNIT IV	
7. Identification of elements and Confirmatory tests for Polyolefins 8. Identification of elements and Confirmatory tests for Vinyl plastics 9. Identification of elements and Confirmatory tests for Polyamides	**15**
UNIT V	
.List of experiments: 10. Identification of elements and Confirmatory tests for saturated polyester 11. Identification of elements and Confirmatory tests for Thermoset Plastics 12. Identification of elements and Confirmatory tests Acrylic Plastics	**15**
TOTAL HOURS	**75**

LIST OF EQUIPMENTS / INSTRUMENTS, MATERIAL, MANUALS REQUIRED (FOR A BATCH OF 30 STUDENTS)

S.No.	Name of Equipment / Instrument	Quantity
1.	Polymer preparation table with electrical, tap and burner facility	06
2.	Electronic weighing balance	01
3.	Water bath	10
4.	Tripod stand	10
5.	Mortar and pestal	5
6.	Tongs	10
7.	Test tube	25
8.	Beaker	10

Text Books:

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

References:

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

Assessment Technology

	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.

Scheme of Valuation (For End Semester Examination)

- Aim 10 Marks
- Procedure 30 Marks
- Observation 20 Marks
- Inference 20 Marks
- Result 10 Marks
- Viva-Voice 10 Marks

- **Total** **100 Marks**

73450	THERMOPLASTIC MATERIALS PREPARATION PRACTICAL	L	T	P	C
PRACTICAL		0	0	5	3

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

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 polymerization techniques.
4. To understand the procedure to prepare various thermoplastics.
5. To infer the stages of polymerization reactions.

Course Outcomes

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

CO1	To know the structure and property relationship of various plastics
CO2	To select a plastic for a given application based on its properties
CO3	To differentiate the various polymerization techniques.
CO4	To understand the procedure to prepare various thermoplastics.
CO5	To infer the stages of polymerization reactions

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

73450	Thermoplastic Materials Preparation Practical	L	T	P	C
Practical		0	0	5	3

List of Experiments		
1	Preparation of PMMA by Bulk Polymerization	
2	Preparation of PMMA by Solution Polymerization	
3	Preparation PMMA by Suspension Polymerization	
4	Preparation PMMA by Emulsion Polymerization	
5	Solution polymerization of Acrylonitrile	
6	Ring opening polymerization of Caprolactum	
7	Interfacial polymerization of Nylon 6,6	
8	Copolymerization of styrene and MMA	
9	Preparation of PVC plastisol	
10	Preparation of polystyrene	
TOTAL HOURS		**75**

LIST OF EQUIPMENTS / INSTRUMENTS, MATERIAL, MANUALS REQUIRED (FOR A BATCH OF 30 STUDENTS):

S.No.	Name of Equipment / Instrument	Quantity
1.	Polymer preparation table with electrical, tap and burner facility	06
2.	Electronic weighing balance	01
3.	Water bath	10
4.	Tripod stand	10
5.	Mortar and pestal	5
6.	Tongs	10
7.	Test tube	25
8.	Beaker	20
9.	Test Tube Holder	20
10	Watch glass	20

Text Book

1. Polymer Preparation Lab Manual

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.

Scheme of Evaluation (For End Semester Examination)

➢ Aim	10 Marks
➢ Chemicals Required	10 Marks
➢ Procedure	20 Marks
➢ Yield Calculation	20 Marks
➢ Reaction	20 Marks
➢ Result	10 Marks
➢ Viva-Voice	10 Marks
➢ **Total**	**100 Marks**

73460	PLASTICS PROCESSING PRACTICAL	L	T	P	C
PRACTICAL		0	0	5	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 polymer processing techniques.

Course Objectives

The objective of this course is to enable the students to

1. Operate the various polymer processing machineries.
2. Select the suitable processing machineries as per the requirement.
3. Demonstrate the skill to operate the polymer 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

73460	Plastics Processing Practical	L	T	P	C
Practical					

List of Experiments		
1	Reprocessing of used plastics by Granulator	
2	Processing of plastics using Compression moulding machine	
3	Processing of plastics using Hand Injection moulding machine	
4	Processing of plastics using Roto-Type Injection moulding machine	
5	Processing of plastics using Semi-Automatic Injection moulding machine (Pneumatic)	
6	Processing of plastics using Semi-Automatic Injection moulding machine (Hydraulic)	
7	Processing of plastics using Fully Automatic Injection moulding machine	
8	Processing of plastics using Hand Blow moulding machine	
9	Processing of plastics using Extrusion Blow moulding machine	
10	Processing of plastic sheet by Thermoforming machine	
11	Processing of Plastics using Rotational Moulding Machine	
TOTAL HOURS		**90**

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

S.No.	Name of Equipment / Instrument	Quantity
1.	Granulator	1
2.	Compression moulding machine with mould	1
3.	Hand Injection moulding machine with mould	1
4.	Roto-Type Injection moulding machine with mould	1
5.	Semi-Automatic Injection moulding machine (Pneumatic) with mould	1
6.	Semi-Automatic Injection moulding machine (Hydraulic) with mould	1
7.	Fully Automatic Injection moulding machine with mould	1
8.	Hand Blow moulding machine with mould	1
9.	Extrusion Blow moulding machine with mould	1
10.	Vaccum Thermoforming machine with mould	1
11.	Lab Model Rotational Moulding Machine with mould	1
12.	Thermoplastic materials	25 Kg
13.	Mould Release Agent	5 litre

Reference:

1. Polymer Processing manual

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.

Scheme of Valuation (For End Semester Examination)

- Aim 10 Marks
- Apparatus Required 10 Marks
- Procedure 15 Marks
- Machine Drawing 15 Marks
- Tabulation 15 Marks
- Product 20 Marks
- Result 05 Marks
- Viva-Voice 10 Marks

- **Total** **100 Marks**

73511	Elective IA - Thermoset & Specialty Plastic Materials	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the manufacture of various thermoplastic Materials. After doing this course student will be confident about the different manufacturing processes of plastic 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 learn about the classification of thermo set plastic compounds.
2. To know about the different methods of manufacturing of the plastic compound.
3. To understand the properties and applications of thermoset and specialty plastic materials
4. To study about the reactions of manufacturing of plastic material
5. To know about the structure of compounds required

Course Outcomes

After Successful completeion of this course, the students will able to

CO1	Classify the plastic compounds.
CO2	Differentiate the methods of manufacturing of the plastic compound.
CO3	Understand the properties and applications of of thermoset and specialty plastic materials
CO4	Know the reactions of manufacturing of plastic material
CO5	Understand about the structure of compounds required

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.

73511	Elective IA - Thermoset & Specialty Plastic Materials	L	T	P	C
Theory		3	0	0	3

SPECIALIY AND HIGH PERFORMANCE PLASTICS Speciality plastics: Polyphenylene oxide (PPO), Polyphenylene sulphide (PPS), polysulfones (PSU), Poly ether ether ketone (PEEK), Polyamide-imides (PAI), Raw materials, structure, properties, processing behavior and applications - Liquid crystalline polymers	**9**
Unit II	
THERMOSETTING RESINS - I Phenolic plastics - Novolaks - Resols – hardening - resin manufacture - Phenol formaldehyde moulding powder – compounding ingredients – preparation of moulding powders - properties of Phenolic mouldings and applications. Amino plastics: Urea formaldehyde resins – theories of resinification - moulding powders - properties - applications Melamine formaldehyde resins - resinification – moulding powders - properties and applications. Unsaturated Polyesters laminating resins, raw materials – production of resins – curing systems (examples only) - properties and applications	**9**
Unit III	
THERMOSETTING RESINS - II Epoxy resins - preparation of resins from Bis-phenol A - structure and properties of cured resins – Applications. Polyurethanes: Flexible foams, rigid foams (properties and applications only) Silicones: Silicone resins – preparation – properties – applications	**9**
Unit IV	
COMPOUNDING Compounding - Principles of compounding - Compounding ingredients and their functions: Fillers-Plasticisers - Colorants (Dyes and Pigments) - Lubricants - Stabilizers - Processing aids - Flame retardants - Blowing agents - Anti - oxidants - UV stabilizers - Anti static agents and Impact modifiers	**9**
Unit V	
PLASTICS BLENDS & ALLOYS Introduction to polymer blends and alloys – difference between blends and alloys – classification of polymer blends – compatible and incompatible blends – important properties and applications of industrial polyblends like PPO/PS (NORYL), POM/Elastomer (DELRIN)	**9**
TOTAL HOURS	**45**

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. Athalye & Prakash Trivedi, PVC Tech, Multitech Publishing Co, Bombay,1994.
2. Geoffrey Pritchard, "Plastics Additives", Rapra Technology Ltd, UK, 2005.
1. OlagokeOlabisi, "Hand
2. Book of Thermoplastics", Marcel Decker, inc., 1997
3. James M. Margolis "Engineering. Plastics Handbook" McGraw – Hill, 2006.
4. G.Gordon Cameron - Ellis Hand Book of Analysis of Synthetic Polymers-Honwood Ltd., - 1977

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.

73512	Elective IB - Packaging Technology	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the requirements of packaging, materials used for packaging and the various packaging methodologies. Since, it is yet an another important field of application of plastics, 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

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.

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73512	Elective IB - 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

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.

73513	Elective IC - Plastics Compounding Technology	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the lab formulation and physical; processes needed to achieve the color, property and performance requirements of raw plastic materials by compounding. Since the raw plastic materials directly can not be used in various applications, this course is important in application field. Hence .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

1. Will attain the knowledge in role of additives at polymers
2. Will have knowledge in selection of compounding ingredients
3. To differentiate the various types of fillers and reinforcement
4. To know the different curing agents
5. To understand the functions of various compounding machineries

Course Outcomes

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

CO1	Attain the knowledge in role of additives at polymers
CO2	Have a knowledge in selection of compounding ingredients
CO3	Differentiate the various types of fillers and reinforcement
CO4	Know the functions of curing system
CO5	Differentiate various compounding machineries

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.

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73513	Elective IC - Plastics Compounding Technology	L	T	P	C
Theory		3	0	0	3

Unit I	INTRODUCTION TO PLASTICS COMPOUNDING	
Introduction - limitations of polymeric materials - additives for plastics- Propertie technical requirements of additives - classification - types - chemistry and mechanisms- Limitations, selection, general effect on properties -antioxidants – lubricants - plasticizers- fillers and reinforcements.		9
Unit II	**ADDITIVES**	
Processing aids - toughening agents - antistatic agents - anti-blocking agents - slip and anti-slip agents - Ultra violet absorbers and stabilizers - Fire retardants - Blowing agents – Coupling agents- Colorants- master batch – color matching - miscellaneous additives.		9
Unit III	**MECHANISM OF MIXING**	
General consideration formulation methods of incorporation of additives and mixing and compounding basic concepts, mechanism of mixing and dispersion, mixing of solid-solid, liquid-liquid and liquids-solids, dispersive mixing, distributive mixing and laminar mixing, mixing entropic measures and its applications, mixing indices, scale of segregation and intensity of segregation, kinetics of mixing, rheology of filled polymers		9
Unit IV	**TYPES AND CHARACTERISTICS OF COMPOUNDS**	
Introduction to Types and characteristics of compounds – polymer blends, polymer formulations, filled polymers and polymer composites, compounding practice - selection of polymer - selection of compounding ingredients - methods of incorporation of additives into polymeric materials- Compounding of PVC, PE and PP - mixing types, solid additives, morphology of filler, compatibilizers – mechanism and theory, filler surface modification and interfacial agents.		9
Unit V	**MIXING MACHINERIES AND DEVICES**	
Overview of polymer mixing and blending machinery- Batch and internal mixers, single screw extruder, kneaders, modular co-rotating and counter rotating twin screw extruders, continuous mixers, co-kneader, mixing mechanisms in kneader, modeling of kneader, residence time distribution, feeding and feeder, distributive mixing sections, cavity mixers, pin mixers, slotted fight mixers, variable depth mixers, dispersive mixing, blister ring, fluted mixing section, planetary gear mixers, CRD mixers.		9
TOTAL HOURS		**45**

TEXT BOOKS:

1. George Mathews, "Polymer mixing technology", Applied science, London,1984
2. Gatcher and Muller, “Handbook of Plastics Additives”, Hanser Publishers, New York.

REFERENCES:

1. J.L. White, A.L. Coran and A. Moet, “Polymer Mixing Technology and Engineering”, Hanser

Gardner Publications Ltd., USA, 2001.
2. Manas Chanda and Salil K. Roy, “Plastics Technology Handbook “, Marcel Dekker, New York.
3. Marcel Dekker, "Mixing in polymer processing "- Edited by Chris Rawendaal,
4. Z. Tadmor, C.G. Gogos, “Principles of Polymer Processing”, Second Ed., Wiley-Interscience, 2006.

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.

73521	Elective II A - Plastics Waste Management	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the importance of plastics recycling and various methods to recycle plastics. Since, it is the need essential to solve environmental related issues this course will play a very 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. Analyze 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 analyze 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.

73522	Elective II A - Plastics Waste Management	L	T	P	C
Theory		3	0	0	3

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		**9**
Unit II	**PLASTICS WASTE MANAGEMENT APPROACH**	
Plastics Waste Management - 4R's approach - reduction – reuse – repair – recycling - recycling classification-code of practice - primary - secondary - tertiary - recycling with examples.		**9**
Unit III	**SIZE REDUCTION METHODS**	
Size reduction: Shredder – Granulator – Slicer – Laminate separation by size reduction - Densification: Agglomeration by compression – Pulverization: Disc pulverization – Cryogenic pulverization		**9**
Unit IV	**RECYCLING OF THERMOPLASTICS**	
Recycling of Polyolefins - PVC, PET, Polystyrene, Nylon, Polyurethanes, polyacetals -mechanical process - applications of recycled materials		**9**
Unit V	**RECYCLING OF POLYMER COMPOSITES**	
Recycling of polymer composites - thermoplastic composites –Recycling of thermoset composites – SMC scrap – BMC scrap - pyrolysis and energy recovery –- Act on plastic waste management		**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. 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

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.

73522	Elective II B - 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

nstructional 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.

73522	Elective II B - 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

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.

73523	Elective II C - Fundamentals of Nano Technology	L	T	P	C
Theory		3	0	0	3

Introduction

This course makes the student to know about the fundamentals of nanoscience. It will help the students to move at pace with advancement in technology. This course will motivate the students to go for higher studies and lifelong learning and will be useful for them during the professional career.

Course Objectives

The objective of this course is to enable the students to

1. Classify various nanomaterials
2. Prepare nanomaterial
3. Characterise nanomaterials
4. Explore the applications of nanomaterials

CO1	To Classify various nanomaterials
CO2	Prepare nanomaterial
CO3	Characterise nanomaterials
CO4	Explore the applications of nanomaterials

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

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.

73523	Elective II C - Fundamentals of Nano Technology	L	T	P	C
Theory		3	0	0	3

Unit I	**INTRODUCTION**	
Nanoscale Science and Technology - Classifications of nanostructured materials – nanoparticles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.		**9**
Unit II	**GENERAL METHODS OF PREPARATION**	
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical, Milling, Colloidal routes, Vapour phase deposition, Sputtering, Evaporation,.		**9**
Unit III	**NANOMATERIALS**	
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis (arc-growth, laser ablation, CVD routes, Plasma CVD).		**9**
Unit IV	**CHARACTERIZATION TECHNIQUES**	
X-ray diffraction technique, Scanning Electron Microscopy - Transmission Electron Microscopy techniques – AFM		**9**
Unit V	**APPLICATIONS**	
Applications of nanoscience: Nanocomputer – Nanobiotechlogy – Nano medicines - Bioimaging - Micro Electro Mechanical System – Nanosensors – Packaging		**9**
TOTAL HOURS		**45**

Textbooks:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. N John Dinardo, “Nanoscalecharecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

References:

1. G Timp (Editor), “Nanotechnology”, AIP press/Springer, 1999.

2. AkhleshLakhtakia (Editor),“The Hand Book of Nano Technology,Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007

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.

73524	Elective II D - 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.

73524	Elective II D - 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”,

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.

73530	FRP Technology	L	T	P	C
PRACTICUM		3	0	2	4

Introduction

FRP technology course will enrich the students with various FRP applications. This course will make the students to understand about the various matrix used, types of reinforcement, different processing techniques. Since, polymer composites are used in various field such as defense, marine, medical, electronics, aerospace, military, etc. applications, this course will kindle the young minds towards continuous learning.

Course Objectives

The objective of this course is to enable the students to

1. Know the important terminologies in FRP technology.
2. Classify the matrix and reinforcements used in polymer composite.
3. Explain the various processing techniques involved in making FRP.
4. Determine the test parameters to satisfy the required properties.
5. Explore the applications of polymer composite in various field.

Course Outcomes

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

CO1	To know the important terminologies in Polymer composite.
CO2	To classify the matrix and reinforcements used in polymer composite.
CO3	To explain the various processing techniques involved in making FRP.
CO4	To determine the test parameters to satisfy the required properties.
CO5	To explore the applications of polymer composite in various field.

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.

73530	FRP Technology	L	T	P	C
Practicum		3	0	2	4

Unit I	**RESIN AND MATRIX SYSTEM**	
Basic concept of fiber reinforced plastics - Properties of composites and comparison of fiber reinforced plastics and metals – Resins used, unsaturated polyester resin, vinyl ester resins, epoxy resins, PP and ABS – Reinforcing materials used		**9**
Unit II	**REINFORCEMENT MATERIALS**	
Fibre Reinforcements – Glass fibre and its types, carbon, aramid, natural fibres, Boron, Ceramic Fibers- Miscellaneous additives used, catalyst, accelerator, fillers, pigments and mould release agents – Their functions in moulding.		**9**
Unit III	**FABRICATION AND PROCESSING**	
Basic concept of fabrication of moulds for fiber reinforced plastics – Type of moulds used – Prepregs – SMC – DMC compounds – Their properties - Processing method of fiber reinforced plastics – Hand lay up – Spray up – Vacuum bag – Compression moulding – Injection moulding – Filament winding – Pultrusion – Resin transfer moulding.		**9**
Unit IV	**POST PROCESSING METHODS**	
Post processing methods – Cutting – Trimming – Machining – Joining – Filling - grinding – buffing – drilling – turning - slitting - Preparation for decorating - Mechanical fastening – Adhesive bonding and painting- Moulding defects and their remedies.		**9**
Unit V	**APPLICATION AND TESTING**	
Applications of FRP – Household applications -– Building and Construction applications - Land transportation applications – Automobile applications - Marine applications – Aerospace applications – Medical applications. Testing of Composites – Non Destructive Testing (X ray image, Ultrasonic test - introduction only), Fiber volume fraction		**9**
LIST OF EXPERIMENTS		
1. Determination geltime for UPE resin 2. Preparation of moulding compound (any one) 3. Preparation of Glass fiber reinforced thermoset laminate 4. Preparation of Natural fiber reinforced thermoset laminate 5. Preparation of Thermoplastic Composites 6. Manufacture of a simple FRP product by Hand lay-up technique (UPE resin) 7. Manufacture of a simple FRP product by Hand lay-up technique (Epoxy resin)		**30**
TOTAL HOURS		**75**

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 EQUIPMENTS / INSTRUMENTS, MATERIAL, MANUALS REQUIRED (FOR A BATCH OF 30 STUDENTS)

S.No.	Name of Equipment / Instrument	Quantity
1.	Stop Watch	02
2.	100 ml Beaker	10
3.	Stirrer	10
4.	Hot Air Oven	01
5.	BMC Mixer	01
6.	Spray Gun	02
7.	Wooden Slab Mould	10
8.	UPE Resin	5 litre
9.	Epoxy Resin	02 litre
10.	Hardener	500ml
11.	Initiator for UPE Resin	500ml
12.	Accelerator for UPE Resin	500ml
13	Applicator	05
14	Scissors	05
15	Glass fibre (Chopped & Mat)	1 kg
16	Glass filled PP	1 kg
17	Mold Release Agent	500 gm
18	Any Natural Fibre	1 kg

Assessment Methodology:

	Continuous Assessment (40 marks)			End Semester Examination (60 marks)
	CA1	**CA2**	**CA3**	
Mode	Written Test Theory & Practical Test	Written Test Theory & Practical Test	Written Test	Written Examination
Portion	Two Units & Part A/Cycle 1 exercises	Another Two Units & Part B/Cycle 2 exercises	Complete Theory Portions	Complete Theory Portions
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	6th Week	12th Week	16th Week	

Note:

- **CA1 and CA2: The** written & practical 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.
- **CA3:** Model examination should be conducted for complete theory portions as per the end semester question pattern. The marks awarded should be converted to 10 marks for the internal assessment.

Question Pattern: Model Examination and End Semester Examination-Theory Exam

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.

73540	Plastics Mould and Die Design	L	T	P	C
PRACTICUM		2	0	4	4

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.

73540	Plastics Mould and Die Design	L	T	P	C
Practicum		2	0	4	4

Unit I	INTRODUCTION	
Introduction to product design – 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 **List of experiments:** 1. Design and Draw the Guide Pillar and Guide Bush assembly 2. Design and Draw the Sprue Bush and Register Ring Assembly		**15**
Unit II	**FEED, EJECTION & COOLING SYSTEM**	
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. Design and Draw the Ejector Grid Assembly 4. Draw the sectional view of any 4 gate system 5. Draw the sectional view of Balancing of Runner System		**20**
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 – Hot Runner Mould. **List of experiments:** 6. Design and Draw the Core Plate Assembly with Core Retainer Plate 7. Design and Draw the Cavity Plate Assembly with Cavity Retainer Plate 8. Design and Draw the Sectional View of single impression injection mould 9. Design and Draw the sectional view of multi impression injection mould		**28**
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		**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 - Extrusion Die geometry – Torpedo – mandrel – Design of Pipe Die – Design of Sheet Die		**12**
	TOTAL HOURS	**90**

LIST OF EQUIPMENTS / INSTRUMENTS, MATERIAL, MANUALS REQUIRED (FOR A BATCH OF 30 STUDENTS):

S.No.	Name of Equipment / Instrument	Quantity
1.	AutoCad Software (2015 and above)	1
2.	System (above P3 configuration)	30

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

Assessment Technology

	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.

Scheme of Valuation (For End Semester Examination)

➢ Aim	10 Marks
➢ Commands /Procedure	10 Marks
➢ Design	25 Marks
➢ Drawing	25 Marks
➢ Printout	10 Marks
➢ Result	10 Marks
➢ Viva-Voce	10 Marks
➢ **Total**	**100 Marks**

73550	THERMOSET PLASTICS PREPARATION PRACTICAL	L	T	P	C
PRACTICAL		0	0	5	3

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

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 polymerization techniques.
4. To understand the procedure to prepare various thermoplastics.
5. To infer the stages of polymerization reactions.

Course Outcomes

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

CO1	To know the structure and property relationship of various plastics
CO2	To select a plastic for a given application based on its properties
CO3	To differentiate the various polymerization techniques.
CO4	To understand the procedure to prepare various thermoplastics.
CO5	To infer the stages of polymerization reactions

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

73550	THERMOSET PLASTICS PREPARATION PRACTICAL	L	T	P	C
Practical		0	0	5	3

LIST OF EXPERIMENTS

1. Preparation of novolac (PF) resin 2. Preparation of resol (PF) resin 3. Preparation of Urea formaldehyde resin 4. Preparation of Melamine formaldehyde resin 5. Preparation of Resorcinol formaldehyde resin 6. Preparation of Polyurethane 7. Preparation of unsaturated polyester resin 8. In situ polymerization of thermoset materials (any one) 9. Preparation of epoxy resin 10. Preparation of blends / copolymer (any one)	**75**
TOTAL HOURS	**75**

LIST OF EQUIPMENTS / INSTRUMENTS, MATERIAL, MANUALS REQUIRED (FOR ABATCH OF 30 STUDENTS):

S.No.	Name of Equipment / Instrument	No.
1.	Polymer preparation and identification bench with burner facility	1
2.	Electronic weighing balance	1

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.

Scheme of Evaluation (For End Semester Examination)

➢ Aim	10 Marks
➢ Chemicals Required	10 Marks
➢ Procedure	20 Marks
➢ Yield Calculation	20 Marks
➢ Reaction	20 Marks
➢ Result	10 Marks
➢ Viva-Voice	10 Marks
➢ **Total**	**100 Marks**

73611	Elective III A - Advanced Processing Technology	L	T	P	C
Theory		3	0	0	3

Introduction

In today's scenario metals, wood, ceramics, glass, etc., are replaced by 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.

73611 Theory	Elective III A - Advanced Processing Technology	L	T	P	C
		3	0	0	3

Unit I	COMPRESSION AND TRANSFER MOULDING	
	COMPOUNDING AND ANCILLARY EQUIPMENTS **Compounding equipments** - Two roll mill - Banbury mixer - Twin screw extruder - Sigma mixer. **Ancillary equipments** - Drier - Definition of moisture content, Types of Dryers, Tray Dryer and Oven dryers— Hopper dryer – Vacuum hopper loader - Granulator - 3 blade, 4blade granulator - Mould temperature controller	9

Unit II	ADVANCED PLASTICS PROCESSING	
	ADVANCED PLASTICS PROCESSING: Basic principles, process and application of- thermoset injection moulding- Gas Assisted Moulding- Sandwich Moulding- - Liqiud Injection Moulding- Injection Compression Molding(Coining)- Multilevel feed injection moulding.	9

Unit III	CALENDARING	
	Basic principles of calendering process and materials - Types of canlenders - Super imposed calendar –- 5 roll calender - 4 roll calender- Offset calendar- 3 roll and 4 roll calender - Z type calendar- 3 roll and 4 roll calender - Inverted L type calendar. Nomenclature of calendering machine-Temperature control of calender rolls - Cored rolls - Peripherally drilled rolls - Manufacturing of PVC calendered sheets - controlling of Sheets thickness- - Crowning effect – Application and limitation of calendering process	9

Unit IV	FOAMS & WELDING OF PLASTICS	
	Introduction to plastic foaming process - Structural foam moulding – Low pressure and high pressure moulding - Foaming process - Expandable polystyrene foam - PVC foam - Polyethylene foam - UF foam - Rigid PU foam - Flexible PU foam - Applications. Welding of plastics - Ultrasonic welding - Vibration welding - Sealing - Thermal sealing - Dielectric sealing	9

Unit V	POST PROCESSING OPERATIONS	
	Finishing of plastics - Filing, grinding, buffing, drilling, turning, slitting. Decoration of plastics - Preparation for decorating - Printing - Silk screen printing - Pad printing - Rotogravure printing and flexographic printing - Hot stamping Adhesives - Types of adhesives - Advantage of adhesive bonding - Characteristic of adhesives.	9
	TOTAL HOURS	**45**

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.

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.

73612	Elective III B - ENTREPRENEURSHIP AND BUSINESS MANAGEMENT	L	T	P	C
Theory		3	0	0	3

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.

73612	Elective III B - ENTREPRENEURSHIP AND BUSINESS MANAGEMENT	L	T	P	C
Theory		3	0	0	3

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.		**9**
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.		**9**
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.		**9**
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		**9**
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.		**9**
TOTAL HOURS		**45**

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

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.

73613	Elective III C - INDUSTRIAL ENGINEERING AND MANAGEMENT	L	T	P	C
Theory		3	0	0	3

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.

73613	Elective III C - INDUSTRIAL ENGINEERING MANAGEMENT	L	T	P	C
Theory		3	0	0	3

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		**9**
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		**9**
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.		**9**
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		**9**
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		**9**
TOTAL HOURS		**45**

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 PN, "Principles of Management", Tata Mcgraw Hill, 1999

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.

73621	Elective IV A - Analysis and Characterization of Plastics	L	T	P	C
Practicum		2	0	4	4

Introduction

Any plastic product should be 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 plastic 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.

73621 Practicum	Elective IV A Analysis and Characterization of Plastics	L	T	P	C
		2	0	4	4

Unit I	MECHANICAL PROPERITES OF POLYMER	
Importance of testing - Test specimen preparation of plastics - Standards (ASTM, ISO, ISI - Brief idea only) - Conditioning procedure. **Mechanical Properties**: Tensile strength - Stress curve - Equipment and procedure – Compression Strength - Impact strength - Izod – Charpy – Falling dart - Equipment and procedure – Abrasion resistance (Taber Abrasion Resistance) - Equipment and procedure – Rebound resilience - Equipment and procedure **List of experiments:** 1. Determination of Tensile strength of polymer 2. Determination of Izod & Charpy Impact strength of plastics		**18**
Unit II	**THERMAL PROPERTIES OF POLYMER**	
Thermal properties: Heat distortion Temperature (HDT) - Equipment and procedure – Vicat Softening Point – equipment and procedure - Melt Flow Index – equipment and procedure **Flammability tests**: - Limiting oxygen index – Horizontal burning method **List of experiments:** 3. Determination of Falling dart impact strength 4. Determination of Taber Abrasion resistance		**16**
Unit III	**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. **List of experiments:** 5. Determination of MFI 6. Determination of HDT 7. Determination of VSP		**20**
Unit IV	**WEATHERING & CHEMICAL PROPERTIES**	
Weathering properties: Weathering test Accelerated & Outdoor – equipment and procedure **Chemical properties:** Solvent stress cracking resistance – equipment and procedure – Environmental Stress Cracking Resistance (ESCR) – equipment and procedure 8. Determination of ESCR		**16**
Unit V	**PRODUCT TESTING AND NON-DESTRUCTIVE TEST**	
Pipe testing – Classification of pipes - PVC and HDPE Pipes - Test methods. Plastic packages - Laminates / Multilayer films - General test methods. Testing of Blow moulded containers.- Testing of cellular materials **Nondestructive testing:** Importance of non-destructive testing – Various NDT methods available (List only) **List of experiments:** 9. Determination of Tear Strength for films 10. Determination of Compression Set for Foams 11. Reversion Test for PVC Pipes		**20**
	TOTAL HOURS	**90**

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

S.No.	Name of Equipment / Instrument	Quantity
1.	UTM with fixture	1
2.	Izod & Charpy Impact tester	1
3.	Taber Abrader	1
4.	Falling Dart tester	1
5.	HDT Tester	1
6.	Hot air oven	1
7.	Electronic weighing balance (3 decimal)	1
8.	VSP Tester	1
9.	Contour cutter	1
11.	Specimen cutter	1
12.	ESCR Apparatus	1
13.	Water bath	2
15.	Tear strength tester	1
16.	Vernier caliper	2
17.	Screw gauge	2
18.	Compression set apparatus	1

Text Books:

1. Vishu Shah, —Handbook of Plastic Testing Technology - Wiley Inter-science Publications, 1998.
2. J.Haslam and H.A.Willis, —Identification and Analysis of Polymer, ILIFFE, London, 1972.
3. 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.

Assessment Technology

	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.

Scheme of Valuation (For End Semester Examination)

➢ Aim	10 Marks
➢ Apparatus Required	10 Marks
➢ Procedure	15 Marks
➢ Diagram	15 Marks
➢ Tabulation	10 Marks
➢ Formula	10 Marks
➢ Calculation	10 Marks
➢ Result	10 Marks
➢ Viva-Voice	10 Marks
➢ **Total**	**100 Marks**

73622	Elective IV B - Adhesive Technology	L	T	P	C
Practicum		2	0	4	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.

73622	Elective IV B - Adhesive Technology	L	T	P	C
Practicum		2	0	4	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.		**12**
Unit II	**SURFACE PREPARATION**	
Various substrates used – Surface preparation of metals – Surface preparation of plastics. **List of Experiments** 1. Surface Preparation for Adhesives by sand blasting method 2. Surface Preparation for Adhesives by chemical etching method		**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. **List of Experiments** 3. Preparation of Epoxy Adhesive 4. Preparation of Hot Melt Adhesives 5. Preparation of Structural Adhesives		**20**
Unit IV	**METHOD OF ADHESIVE APPLICATION**	
Brushing – Flowing – Spraying – Roll coating – Squeeze bottles – Dipping – Film form – Mixing head dispenser. **List of Experiments** 6. Application of adhesive by Roll Coating method onto a plastic substrate 7. Application of adhesive by Dipping method onto a plastic substrate		**20**
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 strength (90° and 180°). **List of Experiments** 8. Measurement of viscosity by Ostwald Viscometer 9. Measurement of Shear Strength 10. Measurement of Peel Strength		**20**
TOTAL HOURS		**90**

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

S.No.	Name of Equipment / Instrument	Quantity
1.	UTM with fixture (with peel strength specimen holder)	1
2.	Hot air oven	1
3.	Electronic weighing balance (3 decimal)	1
4.	Ostwals Viscometer	5
5.	Specimen cutter	1
6.	Shear strength tester	1
7.	Vernier caliper	2
8.	Screw gauge	2
9.	Dipping Mould	1
10.	Glass Beaker 1000 ml	5
11.	Glass Beaker 500 ml	5
12.	Brush 4inch	10
13.	Roller	10
14.	Sandblasting machine	1

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.

Assessment Technology

	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.

Scheme of Valuation (For End Semester Examination)

➢ Aim	10 Marks
➢ Apparatus Required	10 Marks
➢ Procedure	10 Marks
➢ Tabulation	30 Marks
➢ Calculation	05 Marks
➢ Graph /formula	20 Marks
➢ Result	05 Marks
➢ Viva-Voice	10 Marks
➢ **Total**	**100 Marks**

73623	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.

73623	Latex Technology	L	T	P	C
Practicum		2	0	4	4

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		**15**
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		**15**
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		**15**
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		**15**
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 of NR latex		**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.	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

Text Books:

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

References:

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

Assessment Technology

	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.

Scheme of Valuation (For End Semester Examination)

➢ Aim	10 Marks
➢ Apparatus Required	10 Marks
➢ Procedure	20 Marks
➢ Tabulation	30 Marks
➢ Calculation	10 Marks
➢ Result	10 Marks
➢ Viva-Voice	10 Marks
➢ **Total**	**100 Marks**

73630	Project Work	L	T	P	C
Project		-	-	-	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 six 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 (20 Marks)	Review 2 (20 Marks)
Committee: 10 Marks. Supervisor: 10 Marks	Committee: 10 Marks Supervisor: 10 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.

- Record / Project Report 20 Marks
- Presentation 20 Marks
- Viva Voce 30 Marks
- **Product / Model /Analysis Report 30 Marks**

Total 100 Marks

The marks scored will be converted to 60 Marks.

73710	Industrial Training	540 Periods	C
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 for one full semester in the VII th semester. The Apprenticeship (Amendment) Act 1973 is followed in regulating the Industrial trainingprocedure for Sandwich Course.

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 organisation 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 Organisation.

Scheme of Evaluation

Internal Assessment

Students should be assessed for 40 Marks by industry supervisor and polytechnic faculty mentor during 10^{th} week. 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