COMPETENCY BASED CURRICULUM

DIPLOMA
IN
PLASTIC TECHNOLOGY

(Duration 03 Years)
NSQF Level – 5

Under
Haryana State Board of Technical Education

Developed By

Curriculum Development Center

National Institute of Technical Teachers Training & Research
(Ministry of Education, Government of India)

Sector - 26, Chandigarh, UT, India

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PREFACE

Learning and learning experience are the foundation of any education system. Appropriateness of education and its useful implications stand on the platform of knowledge and skill. But the knowledge and skill cannot be quantified qualitatively without ensuring learning experience. Curriculum is the pathway to select and organise learning experience. It helps the teachers to provide tangible resources, goals and objectives to learners. Curriculum acts as a catalyst to stimulate creativity, innovation, ethics, values, responsibility and many human factors. Curriculum embodies rigour and high standards and creates coherence to empower learner to meet the industrial and societal needs. Curriculum is a central guide for a teacher to plan a standard based sequence for the instructional delivery.

The industrial revolution 4.0 has forced the technical education system to reinvent the curriculum to meet the human resource requirement of the industry. The data driven systems relying on the subjects like machine-learning, Artificial Intelligence, Data Science etc. are literally forcing the technical education system to offer different subjects differently to address the emerging challenges. The non-linear way of learning now facilitates students to choose path of knowledge to skill or vice-versa. The bi-directional process requires innovative curriculum design and revision. Diploma programme is now more challenging than ever. The level of skill and knowledge demanded by industry from diploma holders are highly interdisciplinary at the same time address special need. Hence, there is a need to align the curriculum to National Skill Qualification Framework (NSQF).

National Education Policy, NEP-2020 has now opened up diversities for the education system to explore and exploit to make the education relevant. The policy emphasises to inculcate value, ethics, respect to culture and society etc along with industry ready knowledge and skill among the students. The interdisciplinary nature of curriculum, academic bank of credits and integration of technology in teaching- learning envisaged in NEP-2020 make it more challenging for curriculum development. NITTTR, Chandigarh has developed the art of curriculum development over 54 years of its existence. The expertise and experience available in the institute follow time-tested and acclaimed scientific methods to design/revise curriculum. The experienced faculty members entrusted with the curriculum development or revision activities are well-versed with NSQF, NEP and Outcome based education. I am happy to note that **Haryana State Board of Technical Education, Panchkula, Haryana** reposed their confidence on this expertise to develop **AICTE/NSQF/NEP 2020** aligned curriculum for the state. This documented curriculum is an outcome of meticulous planning and discussions among renowned experts of the subject through series of workshops. The effective implementation of this curriculum supported with quality instructional resources will go a long way in infusing the learning experience among learners to make them industry ready.

Director
National Institute of Technical Teachers Training & Research, Chandigarh

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Professor & Head
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1. SALIENT FEATURES

1.	Name	:	**Diploma in Plastic Technology**
2.	Duration	:	**03 Years**
3.	Hours per week	:	**35**
4.	Entry Qualification	:	**10thPass**
5.	Student Intake	:	**As per sanctioned strength**
6.	Pattern	:	**Semester**
7.	Scheme	:	**Multi Pont Entry and Exit**
8.	NSQF Level	:	**5**
9.	Theory Practical Ratio	:	**37 : 63**
10.	Project Work	:	**Minor and Major Project**
11.	In-house/Industrial Training	:	**Mandatory after First and Second Year**

2. NSQF GUIDELINES

National Skill Qualification Framework has defined total Ten Levels. Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Fig1: NSQF Domains

NSQF LEVEL - 3 COMPLIANCE

The NSQF level - 3 descriptor is as follows:

Process	• Person may carry out a job which may require limited range of activities routine and predictable.
Professional Knowledge	• Basic facts, process and principle applied in trade of employment.
Professional Skill	• Recall and demonstrate practical skill, routine and repetitive in narrow range of application.
Core Skill	• Communication written and oral, with minimum required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment.
Responsibility	• Under close supervision. Some responsibility for own work within defined limit.

Fig 2: NSQF Level – 3 Descriptor

Work requiring knowledge, skills and aptitudes at level 3 will be routine and predictable. Job holders will be responsible for carrying out a limited range of jobs under close supervision. Their work may require the completion of a number of related tasks. People carrying out these job roles may be described as "Semi skilled workers". Individuals in jobs which require level 3 qualifications will normally be expected to be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation and should know the basic facts, processes and principles applied in the trade for which they are qualified and be able to apply the basic skills of the trade to a limited range of straightforward jobs in the occupation.

They will be expected to understand what constitutes quality in their job role and more widely in the sector or sub-sector and to distinguish between good and bad quality in the context of the jobs they are given. Job holders at this level will be expected to carry out the jobs they are given safely and securely. They will work hygienically and in ways which show an understanding of environmental issues. This means that they will be expected to take responsibility for their own health and safety and that of fellow workers and, where appropriate, customers and/or clients. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social environment. They should be able to make a good contribution to team work.

NSQF LEVEL - 4 COMPLIANCE

The NSQF level-4 descriptor is given below:

Process	• Work in familiar, predictable, routine, situation of clear choice
Professional Knowledge	• Factual knowledge of field of knowledge or study.
Professional Skill	• Recall and demonstrate practical skill, routine and repetitive in narrow range of application, using appropriate rule and tool, using quality concepts.
Core Skill	• Communication written and oral, with required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment.
Responsibility	• Responsibility for own work and learning.

Fig 3: NSQF Level – 4 Descriptor

Work requiring knowledge, skills and aptitudes at level 4 will be carried out in familiar, predictable and routine situations. Job holders will be responsible for carrying out a range of jobs, some of which will require them to make choices about the approaches they adopt. They will be expected to learn and improve their practice on the job. People carrying out these jobs may be described as "skilled workers". Individuals in jobs which require level 4 qualifications should be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation in which they are employed, to appreciate the nature of the occupation and to understand and apply the rules which govern good practice. They will be able to make choices about the best way to carry out routine jobs where the choices are clear.

They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their job roles. Job holders at this level will be expected to carry out their work safely and securely and take full account of the health and safety on colleagues and customers. They will work hygienically and in ways which show an understanding of environmental issues. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social and political environment. They should be able to guide or lead teams on work within their capability.

NSQF LEVEL - 5 COMPLIANCE

The NSQF level-5 description is given below:

Process	• Job that requires well developed skill, with clear choice of procedures in familiar context.
Professional Knowledge	• Knowledge of facts, principles, processes and general concepts, in a field of work or study.
Professional Skill	• A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information.
Core Skill	• Desired mathematical skill; understanding of social, political; and some skill of collecting and organising information, communication.
Responsibility	• Responsibility for own work and learning and some responsibility for others' works and learning

Fig 4: NSQF Level – 5 Descriptor

Work requiring knowledge, skills and aptitudes at level 5 will also be carried out in familiar situations, but also ones where problems may arise. Job holders will be able to make choices about the best procedures to adopt to address problems where the choices are clear. Individuals in jobs which require level 5 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They will require well developed practical and cognitive skills to complete their work. They may also have some responsibility for others' work and learning. People carrying out these jobs may be described as "fully skilled workers" or "supervisors".

Individuals employed to carry out these jobs will be expected to be able to communicate clearly in speech and writing and may be required to apply mathematical processes. They should also be able to collect and organize information to communicate about the work. They will solve problems by selecting and applying methods, tools, materials and information. They will be expected to have previous knowledge and skills in the occupation, and to know and apply facts, principles, processes and general concepts in the occupation. They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their work. They will be expected to operate hygienically and in ways which show an understanding of environmental issues. They will take account of health and safety issues as they affect the work they carry out or supervise.

In working with others, they will be expected to conduct themselves in ways which show an understanding of the social and political environment.

3. NATIONAL EDUCATION POLICY (NEP) -2020

NEP 2020 aims at a comprehensive holistic education to develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, and moral - in an integrated manner. A holistic arts education will help develop well-rounded individuals that possess: critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines.

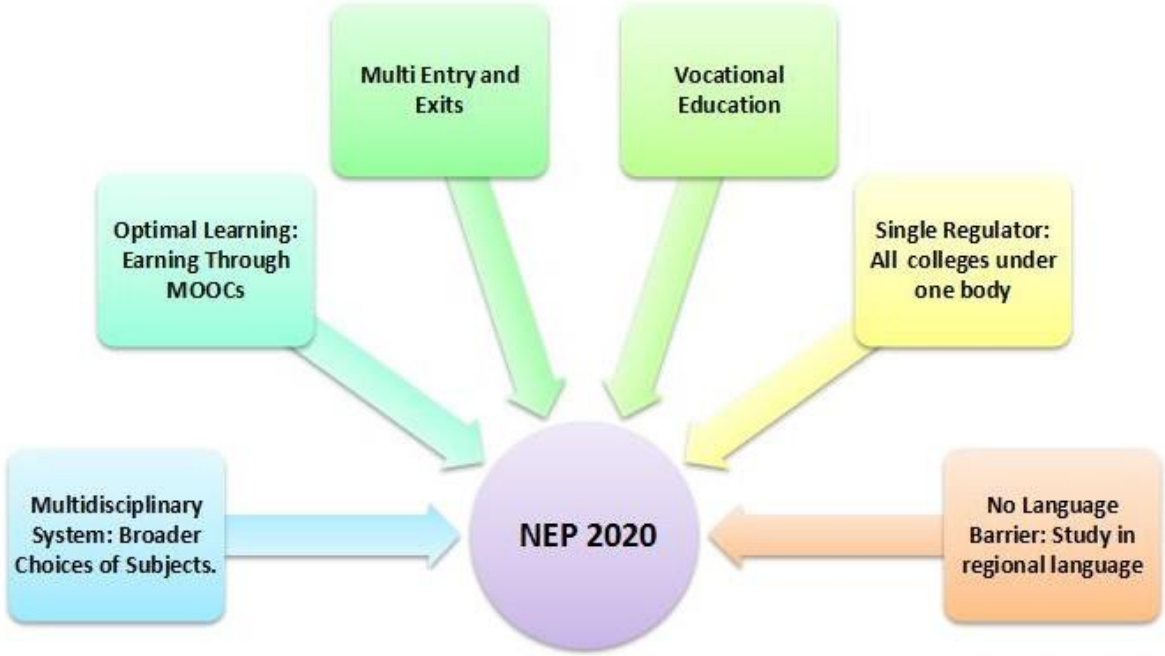

Fig 5: NEP 2020

Flexibility in curriculum and novel and engaging course options will be on offer to students, in addition to rigorous specialization in a subject or subjects. Pedagogy for courses will strive for significantly less rote learning and an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking. The flexible and innovative curriculum shall emphasize on offering credit-based courses and projects in the areas of community engagement and service, environmental education and value-based education. As part of a holistic education, students will be provided with opportunities for internships with local

industry, businesses, artists, crafts persons, villages and local communities, etc. as well as research internships with faculty and researchers at their own or other HEIs or research institutions, so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

Effective learning requires relevant curriculum, engaging pedagogy, continuous formative assessment and adequate student support. The curriculum must be updated regularly aligning with the latest knowledge requirements and shall meet specified learning outcomes. High-quality pedagogy is then necessary to successfully impart the curricular material to students; pedagogical practices determine the learning experiences that are provided to students - thus directly influencing learning outcomes. The assessment methods have to be scientific and test the application of knowledge. Higher Education Institutes should move to a criterion-based grading system that assesses student achievement based on the learning goals for each programme, making the system fairer and outcomes more comparable. HEIs should also move away from high-stakes examinations towards more continuous and comprehensive evaluation.

4. DIPLOMA PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this programme, the student will be able to:

PO1: Perform tasks in limited range of activities, familiar situation with clear choice of procedures.

PO2: Acquire knowledge of principles and processes in the field of Plastic Technology.

PO3: Develop skills to accomplish quality tasks and solve problems using methods, tools, materials and information**.**

PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.

PO5: Take the responsibility of own works and supervises others work.

PO6: Select multidisciplinary, open and programme electives of own interest and perform self-learning through Massive Open Online Courses.

5. DERIVING CURRICULUM SUBJECT AREAS FROM DIPLOMA PROGRAMME OUTCOMES

The following curriculum areas have been derived from Diploma Programme Outcomes:

Sr. No.	Programme Outcomes	Curriculum Subjects / Areas
1.	Perform tasks in limited range of activities, familiar situation with clear choice of procedures.	• Applied Physics -I • Introduction to Polymer Science and Technology • Applied Mechanics • Polymer Chemistry • Basics of Chemical Engineering • Plastic Processing Techniques – I • Plastic Materials and Properties – I • Programme Electives - I • Introduction to Plastic Processing Techniques • Programme Electives - II
2.	Acquire knowledge of principles and processes in Plastic Technology related field.	• Applied Physics –I • Introduction to Polymer Science and Technology • Polymer Chemistry • Introduction to Plastic Processing Techniques • Plastic Processing Techniques – I • Plastic Materials and Properties – I • Computer Aided Mould Design • Design of Dies and Mould – I • Plastic Processing Techniques-II • Plastic Materials and Properties – II • Design of Dies and Moulds – II • Programme Electives - I • Programme Electives - II
3.	Develop skills to accomplish quality tasks and solve problems using methods, tools, materials and information**.**	• Engineering Graphics • Introduction to Plastic Processing Techniques • General Workshop Practice • Workshop Practice-I

		• Industrial/In-House Training - I • Plastic Testing & Quality Control • Plastic Processing Techniques-III • Compounding and Formulation of Plastics • Programme Electives - I • Maintenance of Plastic Processing Machines • Plastic Product design • Programme Electives - II
4.	Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.	• English and Communication Skills -I • Applied Mathematics -I • Fundamentals of IT • Environmental Studies & Disaster Management • English & Communication Skills – II • Entrepreneurship Development & Management • Minor Project • Industrial/In-House Training – I • Industrial Training – II • Plastic Recycling and Waste Management • Major Project / Industrial Training
5.	Take the responsibility of own works and supervises others work.	• General Workshop Practice • Workshop Practice-I • Industrial/In-House Training - I • Minor Project • Industrial Training - II • Major Project / Industrial Training
6.	Select multidisciplinary, open electives of own interest and perform self-learning through Massive Open Online Courses.	• Multidisciplinary Elective • Open Elective

FIRST YEAR

NSQF LEVEL - 3

FIRST YEAR
6. STUDY AND EVALUATION SCHEME IN PLASTIC TECHNOLOGY

FIRST SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Total	Th	Pr	Total	
1.1	*English and Communication Skills-I	2	2	2+1=3	40	40	80	60	60	120	200
1.2	**Applied Mathematics	4	-	4+0=4	40	-	40	60	-	60	100
1.3	**Applied Physics	2	2	2+1=3	40	40	80	60	60	120	200
1.4	*Applied Chemistry	3	2	3+1=4	40	40	80	60	60	120	200
1.5	*Engineering Graphics	-	6	0+3=3	-	40	40	60	-	60	100
1.6	Introduction to Polymer Science and Technology	4	-	4+0=4	40	-	40	60	-	60	100
1.7	*General Workshop Practice	-	6	0+3=3	-	40	40	-	60	60	100
	#Student Centered Activities	-	2	-	-	-	-	-	-	-	-
	Total	**15**	**20**	**24**	**200**	**200**	**400**	**360**	**240**	**600**	**1000**

* Common with other diploma programmes

** Same as Applied Mathematics-I and Applied Physics-I. Also common with other Diploma Programmes.

\# Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India etc. games, yoga, human values and ethics, knowledge of Indian system, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self study etc.

SECOND SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Total	Th	Pr	Total	
2.1	***Applied Mechanics	3	2	3+1=4	40	40	80	60	60	120	200
2.2	Polymer Chemistry	3	-	3+0=3	40	-	40	60	-	60	100
2.3	*Fundamentals of IT	2	4	2+2=4	40	40	80	60	60	120	200
2.4	Introduction to Plastic Processing Techniques	3	6	3+3=6	40	40	80	60	60	120	200
2.5	*Environmental Studies and Disaster Management	2	-	2+0=2	40	-	40	60	-	60	100
2.6	**Workshop Practice	-	6	0+3=3	-	40	40	-	60	60	100
	#Student Centred Activities	-	4	-	-	-	-	-	-	-	-
	Total	**13**	**22**	**22**	**200**	**160**	**360**	**300**	**240**	**540**	**900**

* Common with other diploma programmes

***Common with Mechanical Engineering.

**Same as Workshop Practice-I and common with Mechanical Engineering.

\# Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India etc. games, yoga, human values and ethics, knowledge of Indian system, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

Summer Internship/In-house Training: After 2nd semester, students shall undergo Summer Internship of 4 Weeks.

7. HORIZONTAL AND VERTICAL ORGANISATION OF SUBJECTS

Sr. No.	Subjects/Areas	Hours Per Week	
		First Semester	Second Semester
1.	English and Communication Skills-I	4	-
2.	Applied Mathematics	4	-
3.	Applied Physics	4	-
4.	Applied Chemistry	5	-
5.	Engineering Graphics	6	-
6.	Introduction to Polymer Science and Technology	4	-
7.	General Workshop Practice	6	
8.	Applied Mechanics	-	5
9.	Polymer Chemistry	-	3
10.	Fundamentals of Information Technology	-	6
11.	Introduction to Plastic Processing Techniques	-	9
12.	Environmental Studies and Disaster Management	-	2
13.	Workshop Practice	-	6
14.	Student Centered Activities	2	4
	Total	**35**	**35**

8. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

In government and private sectors related to Plastic Technology **"Semi Skilled workers"** are required to carry out a limited range of predictable tasks under close supervision. They are normally expected to communicate clearly in speech and along with knowledge of arithmetic and algebraic processes. They should know the basic facts, processes and principles applied in limited area of Plastic Technology.

Plastic Technology NSQF Level – 3 pass out students are expected to recall and demonstrate practical routine and repetitive skills, in narrow range of related applications. They should have the basic knowledge of principles of Plastic Technology. They should demonstrate general manual and machining skills along with awareness of dignity of labour, safety at work place, team working and right attitude. They should have good knowledge of physical principles and analysis in various technical fields. They are expected to handle wide variety of instruments while testing, trouble shooting, calibration etc. along with the knowledge of working principles and operation of different instruments. They are expected to show their capability to design their own projects related to Plastic Technology as per industrial requirement.

They will have scope of wage employment in organizations like

- Plastic Processing Industries such as
  - Packaging
  - Carry Bag
  - Raw Material
  - Household Articles
  - Paints, Coatings and Lacquers
  - Adhesives
  - Wire and Cable Coating
  - Polymeric Composites, Elastomers and Sealants
  - Conduit Pipes
- Polymer Manufacturing Industry
- Industries manufacturing Electrical Components and Accessories
- Chemical Industry
- Automobile Industry
- Textile Industry

- Agricultural Appliances Industry
- Footwear Industry
- Furniture Making Units
- Toy Manufacturing
- Rexin (artificial leather cloth) Manufacturing Unit.
- Dairy Industry
- Medical Industry
- Sports Goods Industry
- Hand Tool Manufacturing Industry

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9. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 3 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Carry out a task which may require limited range of predictable activities.

PO2: Acquire knowledge of Basic facts, process and principles related to Plastic Technology for employment.

PO3: Demonstrate practical skill in narrow range of Plastic Technology applications.

PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.

PO5: Perform task under close supervision with some responsibility for own work within defined limit.

10. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Carry out a task which may require limited range of predictable activities.	• Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy. • Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications. • Identify tools, equipments and their respective functions. • Prepare independently simple jobs and inspect the same. Select proper tools for a particular operation. • Handle safety equipment, follow safety procedures and measures. • Identify various types of fluids and their basic properties. • State molecular weight of polymers and their measuring techniques. • Explain the concept and importance of Glass transition temperature. • Describe various polymerization reactions. • Draw Orthographic views of different objects viewed from different angles.. • Draw and interpret sectional views of an object which are otherwise not visible in normal view. • Draw Isometric views of different solids and develop their surfaces. • Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances/fittings. • Draw orthographic views of different objects by

	using basic commands of AutoCAD. • Solve problems by using principle of moment. • Calculate the least force required to maintain equilibrium on an inclined plane. • Determine the centroid/centre of gravity of plain and composite laminar and solid bodies. • Determine velocity ratio, mechanical advantage and efficiency of simple machines
PO2: Acquire knowledge of Basic facts, process and principles related to Plastic Technology for employment.	• Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy. • Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications. • Characterize properties of material to prepare new materials for various engineering applications. • Identify various organic chemical compounds, their IUPAC naming and structures. • State various reaction mechanisms used in the preparation of polymers. • Describe the effect of polymers on the environment and bio-degradability of polymers. • Explain different industrial chemicals and monomers derived from them. • Discuss the macromolecular concept and its behaviour and difference from low molecular weight compounds.
PO3: Demonstrate practical skill in narrow range of Plastic Technology applications.	• Identify various types of fluids and their basic properties. • State molecular weight of polymers and their measuring techniques. • Explain the concept and importance of Glass transition temperature. • Describe various polymerization reactions.

	• Elaborate scientific work, energy and power, forms of friction and solve problems related to them. • Comprehend properties of matter and effect of temperature on various matter and phenomenon. • Demonstrate the use of physical principles and analysis in various fields of engineering. • Prepare independently simple jobs and inspect the same. Select proper tools for a particular operation. • Handle safety equipment, follow safety procedures and measures. • Identify tools, equipments and their respective functions. • Prepare independently simple jobs and inspect the same. • Select and handle tools for a particular operation. • Handle safety equipment, follow safety procedures and measures. • Take measurements with basic measuring tools/equipment. • Perform safety procedures to maintain good housekeeping practices. • Handle materials, sequence of operations, tools to make a given job based on interpretation of drawing as per given specification • Develop a job using resources of shops and compare the job with given specifications. • Analyze a given job and identify various operations required to make it. • Use various processing techniques for thermoplastic materials. • Use various processing techniques for thermoset materials. • Use various pre and post operations processes

	for plastics.
PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.	• Identify the nuances of Communication, both Oral and Written. • Acquire knowledge of the meaning of communication, communication process and speaking skills. • Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication. • Communicate effectively with an increased confidence to read, write and speak in English language fluently. • Understand the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry. • Formulate engineering problems into mathematical formats with the use matrices, coordinate geometry and trigonometry • Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem. • Explore the idea of location, graph, and linear relationships between two variables. • Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers. • Handle the Computer / Laptop / Mobiles / Internet Utilities and Install/Configure OS. • Assemble a PC and connect it to external devices. • Manage and Use Office practiced Automation Tools. • Develop worksheets and Prepare presentations. • Formulate the engineering problems into mathematical format with the use of differential

	equations and differential • Use the differentiation and Integration in solving various Mathematical and Engineering problems. • Calculate the approximate area under a curve by applying integration and numerical methods • Understand the purposes of measures of central tendency and calculate the measures of central tendency (mode, median, mean) for a set of data. • Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLabsoftware. • Comprehend the importance of sustainable ecosystem • Demonstrate interdisciplinary nature of environmental issues. • Implement corrective measures for the abatement of pollution. • Identify the role of non-conventional energy resources in environmental protection. • Manage various types of disasters
PO5: Perform task under close supervision with some responsibility for own work within defined limit.	• Identify tools, equipments and their respective functions. • Prepare independently simple jobs and inspect the same. • Select and Handle tools for a particular operation. • Handle safety equipment, follow safety procedures and measures. • Take measurements with basic measuring tools/equipment. • Perform safety procedures to maintain good housekeeping practices. • Handle materials, sequence of operations, tools to make a given job based on interpretation of

	drawing as per given specification • Develop a job using resources of shops and compare the job with given specifications. • Analyze a given job and identify various operations required to make it. • Select materials, tools, and sequence of operations to make a job as per given specifications/drawing. • Prepare simple jobs independently and inspect the same. • Use safety equipment and Personal Protection Equipment (PPE). • Identify tools, equipment and materials used in preparing jobs. • Take measurements with the help of basic measuring tools/equipment.

11. SUBJECTS & DETAILED CONTENTS

FIRST SEMESTER

1.1 ENGLISH & COMMUNICATION SKILLS – I

L	P
2	2

RATIONALE

Language as the most commonly used medium of self-expression remains indispensable in all spheres of human life –personal, social and professional. This course is intended to break fresh ground in teaching of Communicative English as per the requirements of National Skill Quality Framework. This course is designed to help students to acquire the concept of communication and develop an ability or skills to use them effectively to communicate with the individuals and community.

COURSE OUTCOMES

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

CO1: Identify the nuances of Communication, both Oral and Written.

CO2: Acquire knowledge of the meaning of communication, communication process and Speaking skills.

CO3: Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication.

CO4: Communicate effectively with an increased confidence to read, write and speak in English language fluently.

DETAILED CONTENTS

UNIT I
Reading

1.1 Techniques of reading: Skimming and Scanning

1.2 Extensive and Intensive Reading: Textual Study

1.3 Homecoming – R.N. Tagore

1.4 Life Sketch of Sir MokshagundamVisvesvarayya

1.5 Life Sketch of Dr. Abdul Kalam

1.6 Narayan Murthy's speech at LBSNA, Dehradun

UNIT II

Fundamentals of Communication

2.1 Concept and Process of Communication,
2.2 Types of Communication (Verbal Communication)
2.3 Barriers to Communication
2.4 Speaking Skill: Significance and essentials of Spoken Communication
2.5 Listening Skill: Significance and essentials of Listening

UNIT III

Grammar and Usage

3.1 Nouns
3.2 Pronouns
3.3 Articles
3.4 Verbs(Main and Auxiliary)
3.5 Tenses

UNIT IV

Writing Skills

4.1 Significance, essentials and effectiveness of Written Communication
4.2 Notice Writing
4.3 Official Letters and E-mails.
4.4 Frequently-used Abbreviations used in Letter-Writing
4.5 Paragraph Writing
4.6 Netiquettes

PRACTICAL EXERCISES

1. **Reading**

   Reading Practice of lessons in the Lab Activity classes.

   i. Comprehension exercises of unseen passages along with the lessons prescribed.
   ii. Vocabulary enrichment and grammar exercises based on the selected readings.
   iii. Reading aloud Newspaper headlines and important articles.

2. Fundamentals of Communication

i. Introducing oneself, others and leave- taking(talking about yourself)
ii. Just a minute (JAM) sessions: Speaking extempore for one minute on given topics
iii. Situational Conversation: Offering-Responding to offers; Congratulating; Apologising and Forgiving; Complaining; Talking about likes and dislikes, Self-introduction Mock Interviews.

3. Grammar and Usage

i. Written and Oral Drills will be undertaken in the class to facilitate holistic linguistic competency among learners.
ii. Exercises on the prescribed grammar topics.

4. Writing Skills

i. Students should be given Written Practice in groups so as to inculcate team-spirit and collaborative learning .
ii. Group exercises on writing paragraphs on given topics.
iii. Opening an e-mail account, receiving and sending emails

RECOMMENDED BOOKS

1. Alvinder Dhillon and Parmod Kumar Singla, "Text Book of English and Communication Skills Vol – 2", M/S Abhishek Publications, Chandigarh.
2. V Sasikumar & PV Dhamija, "Spoken English", Tata MC Graw Hills, New Delhi, Second Edition.
3. JK Gangal, "A Practical Course in Spoken English", PHI Learning Pvt. Ltd., New Delhi.
4. NK Aggarwal and FT Wood, "English Grammar, Composition and Usage", Macmillan Publishers India Ltd., New Delhi.
5. RC Sharma and Krishna Mohan, "Business Correspondence & Report writing", Tata MC Graw Hills, New Delhi, Fourth Edition.
6. Kavita Tyagi & Padma Misra, "Professional Communication", PHI Learning Pvt. Ltd., New Delhi.
7. Nira Konar, "Communication Skills for professionals", PHI Learning Pvt. Ltd., New Delhi.
8. Krishna Mohan & Meera Banerji, "Developing Communication Skills", Macmillan Publishers India Ltd., New Delhi, Second Edition

9. M. Ashraf Rizwi, “Effective Technical Communication”, Tata MC Graw Hills, New Delhi.
10. Andrea J Rutherfoord, “Basic Communication Skills for Technology”, Pearson Education, New Delhi.

INSTRUCTIONAL STRATEGY

This is practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required communication skills in the students. This subject contains four units of equal weight age.

1.2 APPLIED MATHEMATICS – I

L	P
4	-

RATIONALE

Contents of this course provide fundamental base for understanding engineering problems and their solution algorithms. Contents of this course will enable students to use basic tools like logarithm, binomial theorem, matrices, t-ratios and co-ordinates for solving complex engineering problems with exact solutions in a way which involve less computational task. By understanding the logarithm, they will be able to make long calculations in short time and it is also a pre-requisite for understanding Calculus.

COURSE OUTCOMES

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

CO1: Understand the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry.
CO2: Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry
CO3: Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem.
CO4: Explore the idea of location, graph, and linear relationships between two variables.
CO5: Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software.

DETAILED CONTENTS

UNIT I
Algebra

1.1 Complex Numbers: definition of complex number, real and imaginary parts of a complex number, Polar and Cartesian Form and their inter conversion, Conjugate of a

complex number, modulus and amplitude, addition subtraction, multiplication and division of complex numb

1.2 Logarithms and its basic properties

UNIT II

Binomial Theorem, Determinants and Matrices

2.1 Meaning of ${}^{n}p_{r}$ & ${}^{n}c_{r}$ (mathematical expression). Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for any index (expansion up to 3 terms - without proof), first binomial approximation with application to engineering problems.

2.2 Determinants and Matrices – Evaluation of determinants (upto 2^{nd}order), solution of equations (upto 2 unknowns) by Crammer's rule, definition of Matrices and its types, addition, subtraction and multiplication of matrices (upto 2^{nd} order).

UNIT III

Trigonometry

3.1 Concept of angle, measurement of angle in degrees, grades, radians and their conversions.

3.2 T-Ratios of Allied angles (without proof), Sum, Difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa

3.3 Applications of Trigonometric terms in engineering problems such as to find an angle of elevation, height, distance etc.

UNIT IV

Co-ordinate Geometry

4.1 Cartesian and Polar co-ordinates (two dimensional), Distance between two points, mid-point, centroid of vertices of a triangle.

4.2 Slope of a line, equation of straight line in various standards forms (without proof); (slope intercept form, intercept form, one-point form, two-point form, symmetric form, normal form, general form), intersection of two straight lines, concurrency of lines, angle between straight lines, parallel and perpendicular lines, perpendicular distance formula, conversion of general form of equation to the various forms.

UNIT V

Geometry of Circle and Software Circle

5.1 General equation of a circle and its characteristics. To find the equation of a circle, given:

i. Centre and radius
ii. Three points lying on it
iii. Coordinates of end points of a diameter

Software

5.2 **MATLAB Or SciLab software –** Theoretical Introduction, MATLAB or Scilabas Simple Calculator (Addition and subtraction of values –Trigonometric and Inverse Trigonometric functions) – General Practice

RECOMMENDED BOOKS

1. R. D. Sharma, "Applied Mathematics – I & II for Diploma Courses", Dhanpat Rai Publications.
2. "Mathematics for Class XI", NCERT Publication, New Delhi.
3. "Mathematics for Class XII", NCERT Publication, New Delhi.
4. H. K Dass, "Applied Mathematics for Polytechnics", CBS Publishers & Distributers.
5. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics – I", CBS Publisher, New Delhi.
6. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics –II", CBS Publisher, New Delhi.
7. G. B. Thomas, R. L. Finney, "Calculus and Analytic Geometry", Addison Wesley, Ninth Edition.
8. B S Grewal, "Elementary Engineering Mathematics", Khanna Publishers, Delhi, Thirty-fifth edition.
9. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, New Delhi, Second Edition, 2003.
10. SS Sabharwal & Dr Sunita Jain, "Applied Mathematics Vol. I & II", Eagle Parkashan, Jalandhar.
11. S Kohli, "Engineering Mathematics Vol. I & II", IPH, Jalandhar.
12. Reena Garg & Chandrika Prasad, "Advanced Engineering Mathematics", Khanna Publishing House, New Delhi
13. R. Pratap, "Getting Started with MATLAB 7", Oxford University Press, Seventh Edition.

14. E-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://www.scilab.org

INSTRUCTIONAL STATREGY

This is theoretical subject and contains five units of equal weightage. Basic elements of algebra, trigonometry and co-ordinate geometry can be taught in the light of their applications in the field of engineering and technology. By laying more emphasis on applied part, teacher can also help in providing a good continuing education base to the students. Students need to be taught the skills needed to use software tools built by experts through multiple problem solving based on the topics related to Algebra, Trigonometry and Coordinate Geometry that the industry requires. Examples to be used should be related to engineering. Useful software MATLAB or open source software SciLab can be taught theoretically by books/online literatures and basic operations can be shown practically with practical software laboratory or small mobile apps of these software or authentic Trial version of MATLAB/ SciLab software. Students should be able to relate to the actual use of these examples and the way mathematical calculations will help them in doing their job.

1.3 APPLIED PHYSICS-I

L	P
2	2

RATIONALE

Applied physics includes the study of a large number of diverse topics all related to things that go on in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects will behave. Concrete use of physical principles and analysis in various technical fields are given prominence in the course content.

COURSE OUTCOMES

After completing this course, student should be able to:

CO1: Identify physical quantities, select their units and make measurements with accuracy.
CO2: Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications.
CO3: Elaborate scientific work, energy and power, forms of friction and solve problems related to them.
CO4: Comprehend properties of matter and effect of temperature on various matter and phenomenon.
CO5: Demonstrate the use of physical principles and analysis in various technical fields.

DETAILED CONTENTS

UNIT I
Unit and Dimensions

1.1 Definition of Physics, physical quantities- fundamental and derived
1.2 Units: fundamental and derived
1.3 System of units: CGS, FPS, MKS, SI
1.4 Dimension, dimensional formulae and SI units of physical quantities-distance, displacement, area, volume, density, velocity, acceleration, linear momentum, force, impulse, work, power, energy, pressure, surface tension, stress, strain)
1.5 Dimensional equations, principle of homogeneity of dimensional equation
1.6 Application of dimensional analysis: checking the correctness of physical equation, conversion of system of unit (force, work, acceleration)

UNIT II
Force and Motion

2.1 Scalar and vector quantities– definition and examples, representation of vector, types of vector (unit vector, position vector, co-initial vector, collinear vector, co-planar vector).

2.2 Vector algebra- addition of vectors, Triangle &Parallelogram law (statement and formula only).

2.3 Scalar and vector product (statement and formula only).

2.4 Force and its units, resolution of force (statement and formula only).

2.5 Newton's laws of motion (statement and examples).

2.6 Linear momentum, Law of conservation of linear momentum (statement and examples), Impulse.

2.7 Circular motion: definition of angular displacement, angular velocity, angular acceleration, frequency, time period; Relation between linear and angular velocity, centripetal and centrifugal forces (definition and formula only), application of centripetal force in banking of road.

2.8 Rotational motion: definition with examples.

2.9 Definition of torque, angular momentum, moment of inertia and its physical significance.

UNIT III
Work, Power and Energy

3.1 Work- definition, symbol, formula and SI unit, types of work (zero work, positive work and negative work) with example.

3.2 Friction– definition and its simple daily life applications.

3.3 Power- definition, formula and units.

3.4 Energy- definition and its SI unit, examples of transformation of energy.

3.5 Kinetic energy- definition, examples, formula and its derivation.

3.6 Potential energy- definition, examples, formula and its derivation.

3.7 Law of conservation of mechanical energy for freely falling bodies (with derivation).

3.8 Simple numerical problems based on formula of Power and Energy.

UNIT IV

Properties of Matter

4.1 Elasticity and plasticity- definition, deforming force, restoring force, example of elastic and plastic body

4.2 Definition of stress and strain, Hooke's law, modulus of elasticity

4.3 Pressure- definition, atmospheric pressure, gauge pressure, absolute pressure, Pascal's law

4.4 Surface tension- definition, SI unit, applications of surface tension, effect of temperature on surface tension

4.5 Viscosity: definition, unit, examples, effect of temperature on viscosity

UNIT V

Heat and Temperature

5.1 Definition of heat and temperature (on the basis of kinetic theory)

5.2 Difference between heat and temperature

5.3 Principle and working of mercury thermometer

5.4 Modes of transfer of heat- conduction, convection and radiation with examples.

5.5 Properties of heat radiation

5.6 Different scales of temperature and their relationship

PRACTICAL EXCERCISES

1. Familiarization of measurement instruments and their parts (for example – Vernier caliper, screw gauge, sphere meter, travelling microscope etc.), and taking a reading. (compulsory to all students)
2. To find diameter of solid cylinder using a Vernier caliper
3. To find internal dia meter and depth of a beaker using a Vernier caliper and hence find its volume.
4. To find the diameter of wire using screw gauge
5. To find thickness of paper using screw gauge.
6. To determine the thickness of glass strip using a sphero meter
7. To determine radius of curvature of a given spherical surface by a sphero meter.
8. To verify parallelgram law of force
9. To determine the atmospheric pressure at a place using Fortin's Barometer

10. To determine force constant of spring using Hooke's law
11. Measuring room temperature with the help of thermometer and its conversion in different scale.

RECOMMENDED BOOKS

1. "Text Book ofPhysics for Class XI (Part-I, Part-II)", N.C.E.R.T., Delhi.
2. Dr.HH Lal, "Applied Physics, Vol.I and Vol.II", TTTI Publications, Tata McGraw Hill, Delhi.
3. AS Vasudeva, "Applied Physics – I", Modern Publishers, Jalandhar.
4. R A Banwait, "Applied Physics – I", Eagle Prakashan, Jalandhar.
5. E-books/e-tools/relevant software to be used as recommended by AICTE/ HSBTE/ NITTTR.
6. C. L. Arora, "Practical Physics", S Chand Publication.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. The Physics Classroom
3. https://www.khanacademy.org/science/physics

INSTRUCTIONAL STATREGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

Teacher may use various teaching aids like models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. Students need to be exposed to use of different sets of units and conversion from one unit type to another. Software may be used to solve problems involving conversion of units. The teacher should explain about field applications before teaching the basics of mechanics, work, power and energy, rotational motion, properties of matter etc. to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students. Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to appreciate learning of these concepts and principles. In all contents, SI units should be followed. Working in different sets of units can be taught through relevant software.

1.4 APPLIED CHEMISTRY

L	P
3	2

RATIONALE

The regular use of a variety of chemistry based materials and processes in diverse technical and engineering fields have repeatedly proven the importance of Applied Chemistry and its role in current and future technological advancements. Ever increasing use of chemical materials in the emerging engineering applications demands engineers and technocrats to acquire an in-depth knowledge of Applied Chemistry to be able to choose the best suited materials to meet their needs while maintaining the environment sustainability. An understanding of the principles of Applied Chemistry will develop scientific attitude in the budding engineers to understand the physical and chemical properties of the available materials for engineering applications as well as an ability to design new and effective materials.

COURSE OUTCOMES

After studying this course, students will be able to:

CO1: Classify the elements into metals, non-metals and metalloids.

CO2: Explain the extraction of metals from ores, their mechanical properties and modification of properties by alloy formation.

CO3: Classify fuels and lubricants and apply them in different engineering applications.

CO4: Identify the polymeric materials, assess their properties and design suitable polymeric materials for current and future applications.

CO5: Apply effective methods for corrosion prevention

DETAILED CONTENTS

UNIT 1
Atomic Structure, Periodic Table and Chemical Bonding

1.1 Bohr's model of atom (qualitative treatment only), dual character of matter: derivation of de-Broglie's equation, Heisenberg's Principle of Uncertainty, modern concept of atomic structure: definition of orbitals, shapes of s, p and d-orbitals, quantum numbers and their

significance. Electronic configuration: Aufbau and Pauli's exclusion principles and Hund's rule, electronic configuration of elements up to atomic number 30.

1.2 Modern Periodic law and Periodic table, classification of elements into s, p, d and f-blocks, metals, non-metals and metalloids (periodicity in properties excluded).

1.3 Chemical bonding: cause of bonding, ionic bond, covalent bond, and metallic bond (electron sea or gas model), Physical properties of ionic, covalent and metallic substances.

UNIT II

Metals and Alloys

2.1 Metals: mechanical properties of metals such as conductivity, elasticity, strength and stiffness, luster, hardness, toughness, ductility, malleability, brittleness, and impact resistance and their uses.

2.2 Definition of a mineral, ore, gangue, flux and slag. Metallurgy of iron from haematite using a blast furnace. Commercial varieties of iron.

2.3 Alloys: definition, necessity of making alloys, composition, properties and uses of duralumin and steel. Heat treatment of steel- normalizing, annealing, quenching, tempering.

UNIT III

Water, Solutions, Acids and Bases

3.1 Solutions: definition, expression of the concentration of a solution in percentage (w/w, w/v and v/v), normality, molarity and molality and ppm. Simple problems on solution preparation.

3.2 Arrhenius concept of acids and bases, strong and weak acids and bases, pH value of a solution and its significance, pH scale. Simple numerical problems on pH of acids and bases.

3.4 Hard and soft water, causes of hardness of water, types of hardness – temporary and permanent hardness, expression of hardness of water, ppm unit of hardness; disadvantages of hard water; removal of hardness: removal of temporary hardness by boiling and Clark's method; removal of permanent hardness of water by Ion-Exchange method; boiler problems caused by hard water: scale and sludge formation, priming and foaming, caustic embrittlement; water sterilization by chlorine, UV radiation and RO.

UNIT IV
Fuels and Lubricants

4.1 Fuels: definition and classification of higher and lower calorific values, units of calorific value, characteristics of an ideal fuel. Petroleum: composition and refining of petroleum; gaseous fuels: composition, properties and uses of CNG, PNG, LNG, LPG; relative advantages of liquid and gaseous fuels over solid fuels. Scope of hydrogen as future fuel.

4.2 Lubricants- Functions and qualities of a good lubricant, classification of lubricants with examples; lubrication mechanism (brief idea only); physical properties (brief idea only) of a lubricant: oiliness, viscosity, viscosity index, flash and fire point, ignition temperature, pour point.

UNIT V
Polymers and Electrochemistry

5.1 Polymers and Plastics: definition of polymer, classification, addition and condensation polymerization; preparation properties and uses of polythene, PVC, Nylon-66, Bakelite; definition of plastic, thermoplastics and thermosetting polymers; natural rubber and neoprene, other synthetic rubbers (names only).

5.2 Corrosion: definition, dry and wet corrosion, factors affecting rate of corrosion, methods of prevention of corrosion—hot dipping, metal cladding, cementation, quenching, cathodic protection methods

5.3 Introduction and application of nanotechnology: nano-materials and their classification, applications of nanotechnology in various engineering applications (brief).

PRACTICAL EXERCISES

1. To prepare standard solution of oxalic acid.
2. To dilute the given $KMnO_4$ solution
3. To find out the strength in grams per litre of an unknown solution of sodium hydroxide using a standard (N/10) oxalic acid solution.
4. To find out the total alkalinity in parts per million (ppm) of a water sample with the help of a standard sulphuric acid solution.
5. To determine the total hardness of given water sample by EDTA method
6. To determine the amount of total dissolved solids(TDS) in ppm in a given sample of water gravimetrically
7. To determine the pH of different solutions using a digital pH meter.

8. To determine the calorific value of a solid/liquid fuel using a Bomb calorimeter.
9. To determine the viscosity of a lubricating oil using a Redwood viscometer
10. To prepare a sample of Phenol-formaldehyde resin (Bakelite)/Nylon-66 in the lab.

RECOMMENDED BOOKS

1. Textbook of Chemistry for class XI and XII (part I & II) NCERT, Delhi, 2017-18.
2. C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd, 2011.
3. Jain & Jain, Engineering Chemistry, Dhanpat Rai and Sons; New Delhi, 2015.
4. Dr. G. H. Hugar& Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II, NITTTR, Chandigarh, Publications, 2013-14.
5. Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt. Ltd, 2014.
6. Applied Chemistry by Usha Raju.

SUGGESTED WEBSITES

1.www.chemguide.co.uk/atommenu.html (Atomic structure and chemical bonding)
2.www.visionlearning.com (Atomic structure and chemical bonding)
3. www.cheml.com (Atomic structure and chemical bonding)
4. https://www.wastewaterelearning.com/elearning/ (Water treatment)
5. www.capital-refractories.com (Metals, Alloys, Cement, and Refractory Materials) 6.www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf(Fuel and combustion)

INSTRUCTIONAL STRATEGY

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

1.5 ENGINEERING GRAPHICS

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RATIONALE

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

COURSE OUTCOMES

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

CO1: Draw Orthographic views of different objects viewed from different angles.

CO2: Draw and interpret sectional views of an object which are otherwise not visible in normal view.

CO3: Draw Isometric views of different solids and develop their surfaces.

CO4: Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances /fittings.

CO5: Draw orthographic views of different objects by using basic commands of AutoCAD.

DETAILED CONTENTS

UNIT I

1. Introduction to Engineering Drawing and Graphics

1.1 Introduction to use and care of drawing instruments, drawing materials, layout and sizes of drawing sheets and drawing boards.

1.2 Symbols and conventions-

a) Conventions of Engineering Materials, Sectional Breaks and Conventional lines.
b) Civil Engineering Sanitary fitting symbols
c) Electrical fitting symbols for domestic interior installations.

1.3 Geometrical construction-geometrical figures such as triangles, rectangles, circles, ellipses

and curves, hexagons, pentagons bisecting a line and arc , division of line and circle with the help of drawing instruments.

2. Technical Lettering of Alphabet and Numerals

Definition and classification of lettering, Free hand (of height of 5,8,12 mm) and instrumental lettering (of height 20 to 35 mm): upper case and lower case, single and double stroke, vertical and inclined (Gothic lettering) at 75 degree to horizontal and with suitable height to width ratio 7:4.

3. Dimensioning

3.1 Necessity of dimensioning, method and principles of dimensioning (mainly theoretical instructions).

3.2 Dimensioning of overall sizes, circles, threaded holes, chamfered surfaces, angles, tapered surfaces, holes, equally spaced on P.C.D., countersunk holes, counter bored holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches.

4. Scales

4.1 Scales –Needs and importance (theoretical instructions), Type of scales, Definition of Representative Fraction (R.F.) and Length of Scale.

4.2 To draw/construct plain and diagonal scales.

UNIT II

1. Orthographic Projections

1.1 Theory of orthographic projections (Elaborate theoretical instructions).

1.2 Three views of orthographic projections of different objects of given pictorial view of a block in 1st and 3rd angle.

1.3 Projection of Points in different quadrant

1.4 Projection of Straight Line (1^{st} angle)

i. Line parallel to both the planes.
ii. Line perpendicular to any one of the reference plane and parallel to others
iii. Line inclined to any one of the references and parallel to another plane.

1.5 Projection of Plane – Different lamina like square rectangular, triangular, circle and Hexagonal pentagon. Trace of planes (HT and VT).

1.6 Identification of surfaces.

2. Sectioning

2.1 Importance and salient features

2.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections (theoretical only).

2.3 Orthographic sectional views of different objects.

UNIT III

1. Introduction of projection of right solids such as prism & pyramid (square, Pentagon, Hexagonal) cube, cone & cylinder (Axes perpendicular to H.P and parallel to V.P.)
2. Introduction of sections of right solids - Section planes, Sections of Hexagonal prism, pentagon pyramid, cylinder and cone (Section plane parallel to anyone reference planes and perpendicular to V.P. and inclined to H.P.)
3. Development of Surfaces – Development of lateral surfaces of right solids like cone, cylinder, pentagonal prism, pyramid and hexagonal pyramid (Simple problems)

UNIT IV
Isometric Views

1. Fundamentals of isometric projections and isometric scale.
2. Isometric views of different laminas like circle, pentagon and hexagon.
3. Isometric views of different regular solids like cylinder, cone, cube, cuboid, pyramid and prism.
4. Isometric views from given different orthographic projections(front, side and top view)

UNIT V
Introduction to AutoCAD

Basic introduction and operational instructions of various commands in AutoCAD. At least two sheets of different objects on AutoCAD (given pictorial/isometric view of a block). AutoCAD skill of student is evaluated in internal assessment only not in external exam.

RECOMMENDED BOOKS

1. A Text Book of Engineering Drawing by Surjit Singh; DhanpatRai& Co. Delhi
2. Engineering Drawing by PS Gill; SK Kataria& Sons, NewDelhi
3. Elementary Engineering Drawing in First Angle Projection by ND Bhatt;Charotar Publishing House Pvt. Ltd.,Anands
4. Engineering Drawing and Graphics using AutoCAD by T. Jeyapoovan,Vikas Publishing House Pvt, Ltd Noida.
5. A Text Book of Engineering Drawing by S.R.Singhal and O.P.Saxena, Asian Publisher, Delhi
6. Engineering Drawing by RB Gupta, SatyaPrakashan, New Delhi

INSTRUCTIONAL STRATEGY

Teacher should show model of regalia of the component/part whose drawing is to be made. Emphasis should be given on cleanliness, dimensioning and layout of sheet. Focus should be on proper selection of drawing instruments and their proper use. First angle projection is to be followed. Minimum of 20 sheets to be prepared and at least 2 sheets on AutoCAD**.** Instructions relevant to various drawings may be given along with appropriate demonstrations, before assigning drawing practice to students. This subject contains five units of equal weight age.

1.6 INTRODUCTION TO POLYMER SCIENCE AND TECHNOLOGY

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RATIONALE

This subject is designed to enable the students to acquire the basic knowledge of polymers, their rheology, molecular weight effect, glass transition temperature, polymer reactions and various techniques of polymerization. The elementary acquired knowledge will help the students in understanding the different polymer processes in detail in later part of the course.

COURSE OUTCOMES

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

CO1: Identify various types of fluids and their basic properties.
CO2: State molecular weight of polymers and their measuring techniques.
CO3: Explain the concept and importance of Glass transition temperature.
CO4: Describe various polymerization reactions.

DETAILED CONTENTS

UNIT I
Polymers and Rheology

Brief History of Polymers, Physical State of Polymers – Crystalline, Amorphous. Effect of Physical State on polymer properties.

Introduction to Rheology-Definition, properties and classification of fluids,(Ideal Fluid, Real Fluid, Newtonian Fluid, Non-Newtonian Fluids, compressible and non-compressible fluids), Newton's Law of Viscosity, Types of Viscosity (Dynamic and Kinematic, apparent/shear, relative and absolute), Effect of Temperature on Viscosity , Effect of Viscosity on Motion, Classification of flow (Viscous Flow, Laminar Flow, Turbulent Flow), Maxwell andvoigt model of visco-elasticity, Classification of materials on the basis of visco-elasticity.

UNIT II
Molecular weight and its determination

Molecular weight and its distribution, practical significance of polymer molecular weight (with reference to polymer properties and processing), Poly Disparity Index (PDI), Brief introduction to techniques of Molecular Weight determination (dilute solution viscometry, membrane osmometry, vapour phase osmometry, cryoscopy, ebulliometry, Gel permeation chromatography, light scattering).

UNIT III
Glass transition temperature and its determination techniques

Glass transition temperature, its importance. Factors influencing Glass transition temperature (T_g). Techniques for determination of Glass transition temperature (basic idea of thermo-gravimetric, calorimetric, DSC and TMA), Polymer melting temperature, relation between Tg and Tm, effect of glass transition temperature on properties of polymer materials.

UNIT IV
Polymer reaction mechanism and techniques

Types and basic concept of polymer reactions and their mechanism like chain growth polymerization (Free radical, ionic and coordination polymerization: initiators, chain transfer, inhibition and retardation), poly condensation, poly addition and ring-opening polymerization.

Techniques of Polymerization - Bulk, Solution, Suspension and Emulsion Polymerization their advantages and disadvantages.

UNIT V
Modification of Polymers

Chemical Modification - introduction of Co-polymerization - Importance of copolymers, different types of copolymers, copolymer equation, reactivity ratios.
Physical modification - polymer blends and alloys, introduction to composites.

RECOMMENDED BOOKS

1. Polymer Science, V.R. Gowarikar, New Age International [P] Ltd. Publishers.
2. Polymer science and technology of plastics and rubbers, by Premamoy Ghosh, Tata McGraw-Hill, New Delhi, India.
3. Fundamentals of Polymer Science & Technology, Anshu Srivastava and Shakun Srivastava, Katson Publications.
4. Polymer Science and Technology by Joel E Fried, Prentice Hall of India publication, New Delhi, 2000
5. Materials Science of Polymers for engineers by Tim Osswald, Powell Publication
6. Polymer Material by J.A. Brydson, Published by M/s. Butterworth Heinemann, Linacre House, Jordan Hill, UK.
7. Principles of Polymerization, George Odian, Wiley Inter science John Wiley and Sons.

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

In plastic industry the basic raw material is polymer. The purpose of this subject is to give the knowledge about the material, processing behaviour, applications, grades. That will help them to select the most suitable material for particular product manufacturing. So at one time one polymer should be taught and products made from that should be shown in the class room if possible.

1.7 GENERAL WORKSHOP PRACTICE

L	P
-	6

RATIONALE

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

COURSE OUTCOMES

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

CO1: Identify tools, equipment and materials used in preparing jobs.
CO2: Take measurements with the help of basic measuring tools/equipment.
CO3: Select materials, tools, and sequence of operations to make a job as per given specifications/drawing.
CO4: Prepare simple jobs independently and inspect the same.
CO5: Use safety equipment and Personal Protection Equipment (PPE).
CO6: Maintain good housekeeping practices.

PRACTICAL EXERCISES

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

The following shops are included in the syllabus:

1. Welding Shop I
2. Fitting and Plumbing Shop I

3. Sheet Metal Shop I
4. Carpentry Shop I
5. Painting Shop I
6. Electric and Electronics Shop I

1. Welding Shop – I

1.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, best practices in the concerned shop.

1.2 Introduction and importance of welding process as compared to other material joining processes. Specifications and type of ARC welding machines, parts identification, classification, selection and coding of electrodes, welding parameters, welding joints and welding positions. Common weldable materials, safety precautions in welding shop, use of Personal Protective Equipment, Use of welding screens, Hazards and remedies during welding, Elementary symbolic representations, demo of tools, equipment, sample jobs prepared, set up of Gas welding apparatus, and welding defects.

1.3 Jobs to be prepared

Job I Practice of striking arc and depositing uniform and straight beads on flat at different current levels. (Minimum 4 beads on M.S. flat at four setting of current level using shielded metal arc welding and differentiating their characteristics).

Job II Edge Preparation and welding lap joint using shielded metal arc welding (SMAW) process.

Job III Edge Preparation and welding butt joint using shielded metal arc welding process.

Job IV Edge Preparation and welding T Joint using shielded metal arc welding (100mm x 6 mm M.S. Flat).

Job V To make a simple job using oxy acetylene gas welding.

2. Fitting and Plumbing Shop – I

2.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, best practices in the concerned shop.

2.2 Introduction and Function of holding/ clamping devices, hand tools and cutting tools,

2.3 Practical applications of fitting and plumbing

2.4 Introduction, function and types of marking and measuring tools and instruments (surface plate, try square, caliper, steel rule, scriber and Vernier caliper)

2.5 Identification of materials. (Iron, Copper, Stainless Steel, Aluminum etc.) and identification of various steel sections (flat, angle, channel, bar etc.).

2.6 Introduction to various types of pipes (eg water, steam, gas etc.) and functions of various pipe fitting items (GI pipe fittings, CPVC pipe fittings), Methods of pipe joints

2.7 Introduction to various types of threads (internal and external)

2.8 Description and demonstration of various types of drills, taps and dies.

2.9 Jobs to be prepared:

Job I To fit hacksaw blade in its frame and perform hacksawing operation by using marking media and marking tool and straight sawing practice.

Job II To perform filing on MS work piece (75 * 50 * 6 mm) for giving it a perfect rectangular shape and drilling, tapping operation.

Job III To perform step filing operation at right angle on MS work piece.

Job IV Making external threads on a pipe by using die and to make a PVC/GI pipe connection using nipple and socket.

Job V Fitting of all components of wash basin and ball valve in a tank.

3. Sheet Metal Shop I

3.1. Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, best practices in the concerned shop.

3.2 Demonstration of various power tools, apparatus, equipment, hand tools used in sheet metal shop.

3.5 Jobs to be prepared

Job I Prepare a seam joint by using hand tools on GI sheet.

Job II To prepare riveted lap joint (single/double) on GI sheet.

Job III To fabricate a funnel of GI sheet using operations of shearing, flattening and bending.

Job IV To fabricate a conduit joint using various sheet metal operations.

Job V To fabricate a utility job (eg soap case/file tray/canister box) of thin GI sheet.

4. Carpentry Shop - I

4.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, best practices in the concerned shop.

4.2 Introduction and industrial applications of carpentry jobs.

4.2.1 Name and use of raw materials used in carpentry shop: wood & alternative materials (board, plywood)

4.2.2 Introduction to wood, timber and their identification, shapes and specifications, their properties, applications & defects. Study of the joints in roofs, doors, windows and furniture, seasoning of wood

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

4.2.4 Specification of iron jack plane used in carpentry shop.

4.3 Practice

4.3.1 Practices for Basic Carpentry Work

4.3.2 Sawing practice using different types of saws

4.3.3 Assembling jack plane — planning practice including sharpening and blade adjustment of jack plane cutter

4.3.4 Chiselling practice using different types of chisels including sharpening of chisel

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

4.3.6 Housekeeping practices and instructions.

4.4 Jobs to be Prepared

Job 1 Prepare a rectangular wooden block involving operations like Marking, sawing, planning to size, chiseling.

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

Job III Prepare a Mortise and Tenon joint (T-Joint).

Job IV Prepare a Dove tail Joint (Half lap dovetail joint.

Job V Prepare a Bridle Joint.

5. Painting Shop

5.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, best practices in the concerned shop.

5.2 Introduction to paints, varnishes, primers and their types, General properties of paints, Constituents of paints, polishes, their advantages and applications.

5.3 Introduction of powder coating and spray painting with their uses. Different types of tools and equipment used in polishing and painting.

5.4 Preparation of different colours of the paints by using prime colours, Practical demonstration of powder coating and spray painting on a utility object

5.5 Jobs to be Prepared

Job I Prepare wooden surface for painting such as cleaning, sanding, applying putty, filling procedure and application of primer coat and brush paint the same.

Job II Painting on wooden and metallic surfaces by spray gun.

Job III Practice of lettering: name plates / sign board.

Job IV Practice of dip painting/powder coating.

Job V Prepare wooden surface for polishing, apply French polish on wooden surface.

6. Electrical and Electronics Shop - I

6.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, best practices in the concerned shop.

6.2 Demonstration and identification of common electrical materials with standard ratings and specifications such as wires, cables, switches, MCB & ELCB, fuses, cleats, clamps and allied items, tools and accessories.

6.3 Identification of phase, Neutral and Earth wires for connection to domestic electrical appliances and their connections to three pin plugs. Difference between series and parallel wiring.

6.4 Jobs to be performed

Job I Carrying out house wiring circuits using fuse, switches, sockets, ceiling rose etc. in batten or P.V.C. casing-caping. Demo of conduit wiring through junctions.

Job II To prepare a three level Godown wiring circuit with PVC conduit wiring system.

Job III Installation of Solar Panel, inverter and batteries.

6.5 Identification and familiarization with the following tools used in electronic shop such as Tweezers, Screw drivers (different sizes), Insulated Pliers, Cutter, Sniper, Philips Screw Driver (Star Screw Driver), L- Keys, Soldering Iron, soldering wire, flux and their demonstration and uses. Identification and familiarization with multimeter (analog and digital). Various types of protective devices such as wire fuse, cartridge fuse etc. Identification and familiarization with ear phone speaker connector, telephone jacks and similar male and female connectors (audio, video).

6.6 Jobs to be performed

Job IV Practice in the use of tools and instruments used in electronic shop. For this a small experimental set up may be done.

Job V Cut, strip, join an insulated wire with the help of soldering iron (repeat with different types of wires).

RECOMMENDED BOOKS

1. SK Hajra Choudhary and AK Choudhary, “Workshop Technology I, II, III”, Media Promoters and Publishers Pvt. Ltd., Mumbai, Fifteenth Edition, 2016.
2. RK Jain, “Workshop Technology Vol I& II’’, Khanna Publishers, New Delhi, First Edition, 2021.
3. Manchanda, “Workshop Technology Vol. I, II, III”, India Publishing House, Jalandhar.
4. S.S. Ubhi, “Workshop Training Manual Vol. I, II’’, Katson Publishers, Ludhiana.
5. K Venkata Reddy, “Manual on Workshop Practice”, MacMillan India Ltd., New Delhi, Sixth Edition, 2020.
6. “General Workshop Manual (Diploma Jobs)”, Khanna Publishers, First Edition, 2021.
7. T Jeyapoovan, “Basic Workshop Practice Manual”, Vikas Publishing House (P) Ltd., New Delhi.
8. B. S. Raghuvanshi, “Workshop Technology, Vol. I”, DhanpatRai and Sons, Delhi, Eleventh Edition, 2017.
9. Kannaiah K L, Narayana, “Workshop Manual”, Scitech Publications, Chennai, Second Edition 1998.
10. H S Bawa, “Workshop Practice”, Tata McGraw Hill Publication, First Edition, 2004

INSTRUCTIONAL STRATEGY

This is hands-on practice based workshop for development of required skills in the students.

SECOND SEMESTER

2.1 APPLIED MECHANICS

L	P
3	2

RATIONALE

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

COURSE OUTCOMES

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

CO1: Draw free body diagrams.by analyzing different types of forces acting on a body.
CO2: Determine the resultant of coplanar concurrent forces.
CO3: Solve problems by using principle of moment.
CO4: Calculate the least force required to maintain equilibrium on an inclined plane.
CO5: Determine the centroid/centre of gravity of plain and composite laminar and solid bodies.
CO6: Determine velocity ratio, mechanical advantage and efficiency of simple machines.

DETAILED CONTENTS

UNIT 1

Introduction

Concept of mechanics, Classification of mechanics, utility of mechanics in engineering field, Concept of rigid body, scalar and vector quantities.

Laws of forces

Definition of force, measurement of force in SI units, its representation, types of force: Point force/concentrated force & Uniformly distributed force, effects of force, characteristics of a force, Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of superposition, Free body diagram, Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, parallelogram law of forces (with derivation), triangle law of forces, polygon law of forces - graphically,

analytically, resolution of forces, resolving a force into two rectangular components, Lami's theorem, Simple numericals, Equilibrium of forces and its determination.

UNIT II
Moment

Concept of moment, Moment of a force and units of moment, Varignon's theorem (definition only), Principle of moment and its applications (Levers – simple and compound, steel yard, safety valve), Simple numericals. Parallel forces (like and unlike parallel force), calculating their resultant, Concept of couple, its properties and effects, General conditions of equilibrium of bodies under coplanar forces, Position of resultant force by moment.

UNIT III
Friction

Definition and concept of friction, types of friction, force of friction, Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction, Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane. Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force acting along the inclined plane and subjected to a force acting at some angle with the inclined plane, Simple numericals.

UNIT IV
Centre of Gravity and Centroid

Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies. Axis of symmetry, Reference axis. Determination of centroid of plain and composite lamina (T, L, C and I shape) using moment method only, centroid of bodies with removed portion. Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed.

Laws of Motion
Newton’s laws of motion and their applications, Concept of momentum. Derivation of force equation from second law of motion, numerical problems on second law of motion.Bodies tied with string, Newton’s third law of motion, numerical problems, conservation of momentum, impulse and impulsive force.

UNIT V
Simple Machines

Definition of effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines, Simple and compound machine (Examples). Definition of ideal machine, reversible and self-locking machine. Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency, Simple numerical. System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency. Working principle and application of wheel and axle, Weston's Differential Pulley Block, simple screw jack, worm and worm wheel, single and double winch crab. Expression for their velocity ratio and field of their application.

PRACTICAL EXERCISES

1. Verification of polygon law of forces using universal force table/Gravesend apparatus.
2. Verification of Lami's theorem.
3 To verify law of moments by using Bell crank lever.
4. To verify the forces in different members of jib crane.
5. To determine coefficient of friction between three pairs of given surface.
6. To find out center of gravity of regular lamina.
7. To find out center of gravity of irregular lamina.
8. To find the mechanical advantage, velocity ratio and efficiency of a screw jack.
9. To find the mechanical advantage, velocity ratio and efficiency of worm andworm wheel.
10. To find mechanical advantage, velocity ratio and efficiency of single purchase crab.

RECOMMENDED BOOKS

1. Birinder Singh,"Text Book of Applied Mechanics", Katson Publishing House, New Delhi.
2. A. K. Upadhyay, "Text Book of Applied Mechanics", SK Kataria & Sons, New Delhi.
3. S. Ramamurtham, "A Text Book of Applied Mechanics", Dhanpat Rai Publishing Company Pvt. Ltd, Delhi.
4. R. S. Khurmi, "A Text Book of Engineering Mechanics (Applied Mechanics)", S Chand and Co. Ltd., New Delhi.
5. R. K. Rajput, "A Text Book of Applied Mechanics", Laxmi Publications, New Delhi.
6. D. S. Bedi, "Engineering Mechanics", Khanna Publishing House, New Delhi.

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

2.2 POLYMER CHEMISTRY

L	P
3	-

RATIONALE

Organic chemistry is the foundation on which plastic technology is built up. Manufacturing of plastic raw materials and processing of plastic will never be desirable without understanding introductory polymer chemistry. This course has been designed to include some relevant topics from organic chemistry to understand various subsequent courses in polymers.

COURSE OUTCOMES

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

CO1: Identify various organic chemical compounds, their IUPAC naming and structures.
CO2: State various reaction mechanisms used in the preparation of polymers.
CO3: Describe the effect of polymers on the environment and bio-degradability of polymers.
CO4: Explain different industrial chemicals and monomers derived from them.
CO5: Discuss the macromolecular concept and its behaviour and difference from low molecular weight compounds.

DETAILED CONTENTS

UNIT I
Classifications and Nomenclature of Organic Compounds

Classification of organic compounds; IUPAC nomenclature of Alkanes, Alkenes and Alkynes. IUPAC nomenclature of compounds containing various functional groups. IUPAC nomenclature of polyfunctional compounds. Nomenclature of Benzene derivatives. Writing the structure of a compound whose name is given. Some commonly used abbreviations. Names of simple aliphatic compounds.

UNIT II
Macromolecular concept

Macromolecular concept, secondary bonding forces like dispersion forces, induced & permanent dipole, Hydrogen bonding and vander - waal forces of interaction in polymers. Isomerism and its types (Origin of chirality, optical, geometric, racemic mixture). Alkenes (Isomerism including cis, trans).

UNIT III
Polymer Solutions

Polymer dissolution process, thermodynamics, Flory-Huggins theory, the effect of: molecular weight, crystalline and amorphous structure of polymers on dissolution; Size and shape of macromolecule in solution, the viscosity of dilute and concentrated polymer solutions

UNIT IV
Industrial Chemicals

Sources of monomers (Petrochemicals), manufacture, properties and applications of Vinyl Chloride, Ethylene, Propylene, Alkyl halides, Acrylonitrile, Styrene, Methyl Methacrylate, Ethylene Glycol, Terephthalic Acid, Phenol, Isocyanates

UNIT V
Polymer degradation, stabilization and pro-environment effects

Introduction to polymer degradation, factors or agents for polymers degradation, types of degradation, a brief introduction to polymer stabilization, role of polymers in energy conservation and protection of the environment, concept of biodegradability, Need of recycling, methods of recycling of polymer (Primary, Secondary and Tertiary).

RECOMMENDED BOOKS

1. Polymer Science, V.R. Gowarikar, New Age International [P] Ltd. Publisher.
2. Polymer science and technology of plastics and rubbers, by Premamoy Ghosh, Tata McGraw-Hill, New Delhi, India.
3. A Textbook of Polymer Chemistry, M.S. Bhatnagar, S. Chand.

4. Polymer Chemistry - An Introduction, M.P. Stevens, Oxford University Press.
5. Textbook of Polymer Science, F.W. Billmeyer Jr., Inter science Publisher John Wiley and Sons.
6. Polymer Science and Technology, Joel R. Fried, PHI publications Pvt. Ltd., New Delhi.
7. Interaction of Polymers with Polluted Atmospheres, Smithers Information Ltd.
8. Text book of Engineering Chemistry - Jain & Jain, DhanpatRai& Co. New Delhi

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://onlinecourses.nptel.ac.in/noc21_cy50/preview

INSTRUCTIONAL STRATEGY

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

2.3 FUNDAMENTALS OF IT

L	P
2	4

RATIONALE

Information technology has great influence on all aspects of life. Almost all work places and living environment are being computerized. In order to prepare diploma holders to work in these environments, it is essential that they are exposed to various aspects of information technology such as understanding the concepts of information technology and its scope, operating a computer: use of various office management tools, using internet and mobile applications etc. This course is intended to make new students comfortable with computing environment - Learning basic computer skills, learning basic application software tools, Understanding Computer Hardware, Cyber security awareness.

COURSE OUTCOMES

At the end of the course student will be able to

CO1: Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers

CO2: Handle the computer/laptop/mobiles/Internet Utilities and Install/Configure OS

CO3: Assemble a PC and connect it to external devices

CO4: Manage and Use Office practiced Automation Tools

CO5: Develop worksheets and Prepare presentations

DETAILED CONTENTS

UNIT I

Basics of Computer

Brief history of development of computers, Definition of Computer, Block diagram of a Computer, Hardware, Software, Booting: Cold and Hot Booting, Interaction between the CPU and Memory with Input/Output devices, Function of CPU and major functional parts of CPU.

Memory, Bit, Nibble, Byte, KB, MB, GB, TB, PB, Functions of memory, Use of storage devices in a Computer, List types of memory used in a Computer, Importance of cache memory, CPU speed and CPU word length

UNIT II
Basic Internet Skills

Understanding browser, Introduction to WWW, efficient use of search engines, awareness about Digital India portals (state and national portals) and college portals. Advantages of Email, Various email service providers, Creation of email id, sending and receiving emails, attaching documents with email and drive.
Effective use of Gmail, G-Drive, Google Calendar, Google Sites, Google Sheets, Online mode of communication using Google Meet & WebEx.

UNIT III
Basic Logic building

Introduction to Programming, Steps involved in problem solving, Definition of Algorithm, Definition of Flowchart, Steps involved in algorithm development, differentiate algorithm and flowchart, symbols used in flowcharts, algorithms for simple problems, flowcharts for simple problems, Practice logic building using flowchart/algorithms

UNIT IV
Office Tools

Office Tools like Libre Office/Open Office/MSOffice.
Open Office Writer – Typesetting Text and Basic Formatting, Inserting Images, Hyperlinks, Bookmarks, Tables and Table Properties in Writer
Introducing Libre Office/Open Office Calc, Working with Cells, Sheets, data, tables, using formulae and functions, using charts and graphics.
Open Office Impress – Creating and Viewing Presentations, Inserting Pictures and Tables, Slide Master and Slide Design, Custom Animation.

UNIT V

Use of Social Media

Introduction to Digital Marketing – Why Digital Marketing, Characteristics of Digital Marketing, Tools for Digital Marketing, , Effective use of Social Media like LinkedIn, Google+, Facebook, Twitter, etc.: Features of Social media, Advantages and Disadvantages of Social Media.

PRACTICAL EXERCISES

1. Browser features, browsing, using various search engines, writing search queries
2. Visit various e-governance/Digital India portals, understand their features, services offered
3. Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, recognize various ports/interfaces and related cables, etc.
4. Using Administrative Tools/Control Panel Settings of Operating Systems
5. Connect various peripherals (printer, scanner, etc.) to computer, explore various features of peripheral and their device driver software.
6. Explore features of Open Office tools and MS-Office, create documents, create presentation, create spread sheet, using these features, do it multiple times
7. Working with Conversion Software like pdf To Word, Word to PPT, etc.
8. Working with Mobile Applications – Searching for Authentic Mobile app, Installation and Settings, Govt. of India Mobile Applications
9. Creating email id, sending and receiving mails with attachments.
10. Using Google drive, Google calendar
11. Create Flow chart and Algorithm for the following:
    a. Addition of n numbers and display result
    b. To convert temperature from Celsius to Fahrenheit
    c. To find Area and Perimeter of Square
    d. Swap Two Numbers
    e. find the smallest of two numbers
    f. Find whether given number is Even or Odd
    g. To print first n even Numbers
    h. find sum of series 1+2+3+…..+N
    i. print multiplication Table of a number
    j. generate first n Fibonacci terms 0,1,1,2,3,5…n (n>2)
    k. sum and average of given series of numbers

l. Factorial of number n (n!=1x2x3x…n)
m. Armstrong Number
n. Find whether given number is Prime or not

RECOMMENDED BOOKS

1. R.S. Salaria, “Computer Fundamentals” Khanna Publishing House
2. Ramesh Bangia, “PC Software Made Easy – The PC Course Kit” Khanna Publishing House
3. Online Resources, Linux man pages, Wikipedia
4. Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by MokhtarEbrahim, Andrew Mallett
5. Vikas Gupta, “Comdex Hardware and Networking Course Kit” Dream Tech press, New Delhi, 2008
6. SumitabhaDas,“UNIX concepts and applications” Tata McGraw Hill, New Delhi, 4th Edition, 2008

SUGGESTED WEBSITES

1. https://nptel.ac.in/courses/106/106/106106222/ - NPTEL Course on Modern Application Development
2. https://onlinecourses.swayam2.ac.in/aic19_de01/preview -
3. https://spoken-tutorial.org/ - Tutorials on Introduction to Computers, HTML, LibreOffice Tools, etc.
4. NOTEPAD++
5. https://tms-outsource.com/blog/posts/web-development-ide/

INSTRUCTIONAL STRATEGY

This is a skill based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weight age.

2.4 INTRODUCTION TO PLASTICS PROCESSING TECHNIQUES

L	P
3	6

RATIONALE

This subject enables the students to acquire basic knowledge of advantages of plastics over other materials, application areas of plastics, main processing techniques for plastic materials and post processing operations. The elementary acquired knowledge will help the students to understand different areas of applications and conversion processes used for plastics processing that will be taught in detail later in the course.

COURSE OUTCOMES

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

CO1: Explain the advantages of plastic materials over other conventional materials.
CO2: Identify various areas of applications for plastics.
CO3: Use various processing techniques for thermoplastic materials.
CO4: Use various processing techniques for thermoset materials.
CO5: Use various pre and post operations processes for plastics.

DETAILED CONTENTS

UNIT I
Plastics versus other materials

Significance of using Plastics materials compared to other conventional materials such as wood, ceramics and metals, general properties of plastics, plastic materials as a choice, concept, reduction in a number of parts during construction, increased possibilities in several shapes, new products, cost-effectiveness and aesthetics, reusability.

UNIT II
Applications of Plastics

Applications of plastics in various fields such as agriculture, household, automobile, building and construction, electrical & electronics, medical, sports, space and defence sectors.

UNIT III

Processing Techniques for Thermoplastics

Introduction and Preliminary ideas and basic terminology used in Injection moulding, blow moulding, extrusion (pipe, cast-film and blown film), rotational moulding, thermoforming and its types by taking examples of commonly used products made by each process.

UNIT IV

Processing Techniques for Thermosets

Preliminary ideas and basic terminology with advantages and limitations of compression moulding, transfer moulding, reaction injection moulding (foam moulding), casting.

UNIT V

Pre-processing and secondary operations

Drying /pre-conditioning of polymers, finishing of plastics (painting, coating), post-processing operations like printing (screen printing, pad printing, flexographic and rotogravure printing), Lamination and its types such as plastic-plastic laminates, plastic -paper laminates, plastic-metals laminates.

PRACTICAL EXERCISES

1. To draw the layout of Plastic Processing Lab.
2. Study of hand injection molding machine –parts and their function, Operating Principles.
3. Practice on hand-operated injection moulding machine for making different products (at least three) by setting the moulds.
4. Study of Automatic injection molding machine- parts and their function and specifications.
5. Study of hand-operated blow moulding machine–parts and their function, Operating Principles.
6. Practice on hand-operated Blow moulding machine (die setting and making different products (three) on available moulds).
7. Study of Automatic blow molding machine –parts and their function and specifications.
8. Study of hand-operated compression moulding machine - parts and their function
9. Practice on hand-operated compression moulding machine and making different products (at least three) on available moulds.

10. Study of thermoforming machine, parts and their functions.
11. Practice on thermoforming machine and making different products (at least three) on available moulds.
12. Practice on pad printing machine and printing on various products available for printing.

RECOMMENDED BOOKS

1. Polymer Science, V.R. Gowarikar, New Age International [P] Ltd. Publisher.
2. Rubber and Plastic Technology, R. Chandra and S. Mishra,CBS Publishers & Distributors.
3. Hand Book of Plastic Materials and Processing Technology (English, Paperback, Board Eiri), Engineers India Research Institute.
4. Plastics Processing Techniques- Series for Beginners, Notion Press.
5. Fundamental of Plastic Processing vol. 1 & 2, Sanjay k Nayak, S Sugumar, RT Nagaralli,Mc- Graw Hill India.
6. Plastics: Materials by J.A. Brydson.
7. SPI Plastics Engineering Handbook of the Society of the Plastics Industry, Inc. by **Berins**, Michael L., Springer Publisher.

SUGGESTED WEBSITES

1. https://onlinecourses.nptel.ac.in/noc21_me17/preview

INSTRUCTIONAL STRATEGY

Industrial visit or a laboratory should be shown to the students. This is a skill based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weight age.

2.5 ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT

L	P
2	-

RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industrial and construction activities so that he/she may help in balancing the ecosystem and controlling pollution by various control measures. The course is intended to provide a general concept in the dimensions of environmental pollution and disasters caused by nature beyond the human control as well as the disasters and environmental hazards induced by human activities with emphasis on disaster preparedness, response and recovery.

COURSE OUTCOMES

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

CO1: Comprehend the importance of sustainable ecosystem
CO2: Demonstrate interdisciplinary nature of environmental issues
CO3: Implement corrective measures for the abatement of pollution.
CO4: Identify the role of non-conventional energy resources in environmental protection.
CO5: Manage various types of disasters

DETAILED CONTENTS

UNIT I
Introduction

1.1 Basics of ecology, eco system- concept, and sustainable development, Sources, advantages, disadvantages of renewable and nonrenewable energy.
1.2 Rain water harvesting
1.3 Deforestation – its effects & control measures

UNIT II
Air and Noise Pollution

2.1 Air Pollution: Source of air pollution. Effect of air pollution on human health, economy, Air pollution control methods.
2.2 Noise Pollution: Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimizing noise pollution.

UNIT III
Water and Soil Pollution

3.1 Water Pollution: Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of DO, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.
3.2 Soil Pollution :Sources of soil pollution, Effects and Control of soil pollution, Types of Solid waste- House hold, Industrial, Agricultural, Biomedical, Disposal of solid waste, Solid waste management E-waste, E – waste management

UNIT IV
Impact of Energy Usage on Environment

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

UNIT V
Disaster Management

A. Different Types of Disaster:
Natural Disaster: such as Flood, Cyclone, Earthquakes and Landslides etc.
Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea Rail & Road), Structural failures(Building and Bridge), War & Terrorism etc.

B. Disaster Preparedness:
Disaster Preparedness Plan Prediction, Early Warnings and Safety Measures of Disaster

Psychological response and Management (Trauma, Stress, Rumour and Panic)

RECOMMENDED BOOKS

1. Environmental Studies by S.C. Sharma & M.P. Poonia, Khanna Publishing House, New Delhi
2. Environmental and Pollution Awareness by Sharma BR; SatyaPrakashan, New Delhi.
3. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi
4. Environmental Studies by ErachBharucha; University Press (India) Private Ltd., Hyderabad.
5. Environmental Engineering and Management by Suresh K Dhamija; S K KatariaandSons, New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/BTE/NITTTR, Chandigarh.
7. Disaster Management by Dr. Mrinalini Pandey, Wiley India Pvt. Ltd.
8. Disaster Science and Management by Tushar Bhattacharya, McGraw Hill Education (India) Pvt. Ltd.

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies and Disaster Management like expert lectures, seminars, visits etc. may also be organized This subject contains five units of equal weightage.

2.6 WORKSHOP PRACTICE

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-	6

RATIONALE

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

COURSE OUTCOMES

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

CO1: Identify tools, equipment and materials used in preparing jobs.
CO2: Take measurements with the help of basic measuring tools/equipment.
CO3: Select materials, tools, and sequence of operations to make a job as per given specifications/drawing.
CO4: Prepare simple jobs independently and inspect the same.
CO5: Use safety equipment and Personal Protection Equipment (PPE).
CO6: Maintain good housekeeping practices.

PRACTICAL EXERCISES

The following shops are included in the syllabus.

1 Welding Shop – II
2 Fitting and Plumbing Shop – II
3 Carpentry Shop II
4 Smithy Shop
5 Electric and Electronics Shop II
6 Turning Shop

1. WELDING SHOP – II

1.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, Best practices in the concerned shop.

1.2 Introduction to gas welding, gas welding equipment, introduction to soldering and brazing, introduction to resistance welding, safety precautions.

1.3 Identification and adjustment of various types of gas flames

1.4 Demonstration of brazing and gas cutting

1.5 Demonstration of Welding defects

1.6 Jobs to be prepared

Job I Beading Practice by gas welding.

Job II Preparation of lap joint on M.S. flat using gas welding.

Job III Preparation of double V butt joint/corner joint on M.S. flat using gas welding / arc welding process

Job IV Preparation of pipe joint using gas/arc welding

Job V Preparation of a small cot frame/stool/table frame/drawing table frame) using gas or arc welding.

2. FITTING AND PLUMBING SHOP – II

2.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, Best practices in the concerned shop.

2.2 Handling of measuring instruments, Use of dial gauges and feeler gauges.

2.3 Demonstration of various types of drills, taps and dies.

2.4 Introduction to tapping and dieing

Job I To perform drilling and reaming operation on mild steel flat.

2.5 file and make angle, surfaces (Bevel gauge accuracy 1 degree) make simple open and sliding fits Inside square fit, make combined open and sliding fit, straight sides

Job II To make assembly for V shape or square shape fit.

Job III Radius form filing on the corners

2.6 Sliding fitting, Diamond fitting, Lapping flat surfaces using lapping plate. Application of lapping, material for lapping tools, lapping abrasives, charging of lapping tool. Surface finish importance, equipment for testing-terms relation to surface finish

Job IV To make step assembly.

2.7 Introduction to various types of threads (internal and external)-single start, multi-start, left hand and right hand threads.

2.8 Description and demonstration of various types of drills, taps and dies. Selection of dies for threading, selection of drills, taps and reamers for tapping operations.

2.9 Introduction to use of plumbing tools like pipe wrench , plumber vice and materials like Putty, thread, duct(Teflon) tape, epoxy resin, araldite, m-seal.

2.10 Precautions while drilling soft metals, e.g. copper, brass, aluminium etc.

Job V To make overhead tank assembly with GI/C-PVC pipes and joints.

3. CARPENTRY SHOP – II

3.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, Best practices in the concerned shop.

3.2 Introduction to joints, their relative advantages and uses.

Job I To make a dovetail joint.

Job II To make a mitred joint.

Job III To make a lengthening joint by using different joints.

3.3 Demonstration of machines like Band Saw and Circular Saw, Chain and Chisel, Universal wood working machine, Saw re-sharpening machine, Saw Brazing unit.

3.4 Introduction and function of various parts of Wood Working Lathe

a) Study of wood working lathe tool.

b) Sharpening of lathe tools.

c) Setting of jobs and tools.

Job IV To make a job using different type of wood turning operations including form turning and grooving.

OR Repair of any utility item.

Job V To make a medium size wooden dust bin/ wooden tray.

4. SMITHY SHOP

4.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, Best practices in the concerned shop.

4.2 Introduction and industrial applications of smithy jobs.

4.2.1 Purpose of Smithy shop.

4.2.2 Different types of Hearths used in Smithy shop, Types of fuel used and maximum temperature obtained.

4.2.3 Purpose, specifications, uses, care and maintenance of various tools andequipment used in hand forging by segregating as cutting tools, supporting tools, holding tools, measuring tools, punches etc.

4.2.4 Types of raw materials used in Smithy shop.

4.2.5 Uses of Fire Bricks and Clays in Forging workshop.

4.3 Practice

4.3.1 Practice of firing of hearth/Furnace, Cleaning of Clinkers and Temperature Control of Fire.

4.3.2 Practice on different basic Smithy/Forging operations such as Cutting, Upsetting, Drawing down, Setting down, Necking, Bending, Fullering, Swaging, Punching and Drifting. Demonstration of making cube, hexagonal cube, hexagonal bar from round bar

4.3.3 Practice of Simple Heat treatment processes like Tempering, Normalizing, and Hardening.

4.4 Introduction to various heat treatment processes e.g annealing, hardening, tempering, normalizing.

4.5 Description of various types of power hammers and their usage (Demonstrationonly).

4.6 Jobs to be prepared

Job I To forge a square/hexagonal shape on both endsfrom a MS round by cold forging

Job II To make a utility item like fan hook, ring, U type door handle

Job III To make a ring of MS round by forge welding

Job IV To make a hexagonal chisel by hot forging process withhardening and tempering

Job V To perform bending process by hot forging.

5. ELECTRICAL AND ELECTRONICS SHOP - II

5.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, Best practices in the concerned shop.

5.2 Introduction to single phase and three phase supply and wiring system. Importance ofthree phase supply (RYB) and its sequence and wiring system. Estimating andcosting of power consumption.

Job I Connecting single phase energy meter with supply and load. Reading and working out power consumption and cost of energy.

5.3 Study of internal wiring diagram of common electrical appliances such as auto electric iron, electric kettle, ceiling/table fan, desert cooler etc. Demonstration of dismantling, servicing and reassembling of table/ceiling fan, air-cooler, auto electric iron, heater etc.

Job II Connection of single phase/three phase motor by using starter. Reversing direction of rotation of single phase and three phase motors.

Job III Cut, bend, tin components, leads, inserts. Solder components for example resistor, capacitor, diode, transistor and other components ona PCB.

5.4 Demonstrate the joining for connecting methods mounting and dismounting method as well as using of the various plugs, sockets, conductors, suitable for generalpurpose, audio video used conductors, banana plugs, socket and similar male and female conductor and terminal strips

5.5 Various types of switches such as normal, miniature toggle, slide, push button.

Job IV Wiring of a small circuit on a PCB/ TAG strip involving laying, sleeving and use of identifier tags.

Job V Cut, strip, join and insulate two lengths of wires/cables.

Desoldering practice with desoldering pump and desoldering wick.

6. TURNING SHOP

6.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, best practices in the concerned shop.

6.2 Jobs to be Prepared

Job 1 Centering practice in 4 jaw chuck, setting of cutting tool point at appropriate height and perform facing and plain turning operationson MS rod.

Job II To sharpen various angles of turning tool.

Job III To perform step turning on MS rod.

Job IV To perform taper turning and under cutting operation.

Job V To perform step turning and knurling operation on MS rod.

RECOMMENDED BOOKS

1. SK Hajra Choudhary and AK Choudhary, “Workshop Technology I,II,III”, Media Promoters and Publishers Pvt. Ltd., Mumbai, Fifteenth Edition, 2016.
2. RK Jain, “Workshop Technology Vol I& II’’, Khanna Publishers, New Delhi , First Edition, 2021.
3. Manchanda, “Workshop Technology Vol. I, II, III”, India Publishing House, Jalandhar.
4. S.S. Ubhi, “Workshop Training Manual Vol. I, II’’, Katson Publishers, Ludhiana.
5. K Venkata Reddy, “Manual on Workshop Practice”, MacMillan India Ltd., New Delhi, Sixth Edition, 2020.
6. “General Workshop Manual (Diploma Jobs)”, Khanna Publishers, First Edition, 2021.
7. T Jeyapoovan, “Basic Workshop Practice Manual”, Vikas Publishing House (P) Ltd., New Delhi.
8. B. S. Raghuvanshi, “Workshop Technology, Vol. I”, Dhanpat Rai and Sons, Delhi, Eleventh Edition, 2017.
9. Kannaiah K L, Narayana , “Workshop Manual”, Scitech Publications, Chennai, Second Edition 1998.
10. H S Bawa, “Workshop Practice”, Tata McGraw Hill Publication, First Edition, 2004

INSTRUCTIONAL STRATEGY

This is hands-on practice based workshop for development of required skills in the students.

SECOND YEAR

NSQF LEVEL - 4

12. STUDY AND EVALUATION SCHEME

THIRD SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P=C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
3.1	Industrial/In-house Training - I	-	2	0+1=1	-	40	40	-	60	60	100
3.2	Plastic Processing Techniques – I	3	4	3+2=5	40	40	80	60	60	120	200
3.3	Plastic Materials and Properties – I	3	-	3+0=3	40	-	40	60	-	60	100
3.4	Computer Aided Mould Design	-	4	0+2=2	-	40	40	-	60	60	100
3.5	Design of Dies and Mould – I	2	4	2+2=4	40	40	80	60	60	120	200
3.6	Basics of Chemical Engineering	3	4	3+2=5	40	40	80	60	60	120	200
3.7	Multidisciplinary Elective (MOOCs^{+}/Offline)	2	-	2+0=2	40	-	40	60	-	60	100
# Student Centered Activities(SCA)		-	4	-	-	-	-	-	-	-	-
	Total	**13**	**22**	**22**	200	200	400	300	300	600	1000

\+ Assessment of Multidisciplinary through MOOCs shall be based on assignments out of 100 marks.

\# Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

FOURTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P=C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
4.1	*English &Communication Skills – II	2	2	2+1=3	40	40	80	60	60	120	200
4.2	Plastic Processing Techniques-II	3	4	3+2=5	40	40	80	60	60	120	200
4.3	Plastic Materials and Properties - II	3	-	3+0=3	40	-	40	60	-	60	100
4.4	Plastic Testing & Quality Control	3	4	3+2=5	40	40	80	60	60	120	200
4.5	Design of Dies and Moulds – II	2	4	2+2=4	40	40	80	60	60	120	200
4.6	Open Elective (MOOCs^{+}/Offline)	2	-	2+0=2	40	-	40	60	-	60	100
4.7	Minor Project	-	4	0+2=2	-	40	40	-	60	60	100
# Student Centered Activities(SCA)		-	2	-	-	-	-	-	-	-	-
	Total	**15**	**20**	**24**	240	200	440	360	300	660	1100

* Common with other Diploma Courses

\+ Assessment of Open Elective through MOOCs shall be based on assignments out of 100 marks.

\# Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

Industrial Training: After 4th Semester, students shall undergo Industrial Training of 4 Weeks.

13. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects/Areas	Hours Per Week	
		Third Semester	Fourth Semester
1.	Industrial/In-house Training - I	2	-
2.	Plastic Processing Techniques – I	7	-
3.	Plastic Materials and Properties – I	3	-
4.	Computer Aided Mould Design	4	-
5.	Design of Dies and Mould – I	6	-
6.	Basics of Chemical Engineering	7	-
7.	Multidisciplinary Elective (MOOCs/Offline)	2	-
8.	English &Communication Skills – II	-	4
9.	Plastic Processing Techniques-II	-	7
10.	Plastic Materials and Properties - II	-	3
11.	Plastic Testing & Quality Control	-	7
12.	Design of Dies and Moulds – II	-	6
13.	Open Elective (MOOCs/Offline)	-	2
14.	Minor Project	-	4
15	Student Centered Activities	4	2
	Total	**35**	**35**

14. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Government and private sectors related to Plastic Technology require **skilled workers** to work in familiar, predictable, routine situations of clear choice. They are expected to have factual knowledge of automation and robotics field. They shall be able to write and speak with required clarity. Students after passing level 4 shall have understanding of basic arithmetic, algebraic principles along with basic understanding of social and natural environment. They are expected to recall and demonstrate quality skill in narrow range of applications using appropriate rules and tools.

Skilled workers will be responsible for carrying out a range of jobs, some of which will require them to make choices about the approaches they adopt. They will be expected to learn and improve their practice on the job. They should know what constitutes quality in the occupation and should distinguish between good and bad quality in the context of their job roles. Skilled worker at this level will be expected to carry out their work safely and securely and take full account of the health and safety on colleagues and customers. They should work hygienically and in ways which show an understanding of environmental issues. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social and political environment. They might find work with various plastic manufacturing companies.

They will have scope of wage employment in organizations like

- Plastic Processing Industries such as
    - Packaging
    - Carry Bag
    - Raw Material
    - Household Articles
    - Paints, Coatings and Lacquers
    - Adhesives
    - Wire and Cable Coating
    - Polymeric Composites, Elastomers and Sealants
    - Conduit Pipes
- Polymer Manufacturing Industry
- Industries manufacturing Electrical Components and Accessories
- Chemical Industry
- Automobile Industry
- Textile Industry
- Agricultural Appliances Industry

- Footwear Industry
- Furniture Making Units
- Toy Manufacturing
- Rexin (artificial leather cloth) Manufacturing Unit.
- Dairy Industry
- Medical Industry
- Sports Goods Industry
- Hand Tool Manufacturing Industry

15. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 4 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Work in familiar, predictable, routine situation of clear choice.

PO2: Acquire factual knowledge in the field of Plastic Technology for employment.

PO3: Recall and demonstrate quality skills in routine and repetitive in narrow range of applications using appropriate rules and tools.

PO4: Write and speak with required clarity and show basic understanding of social and natural environment.

PO5: Perform tasks with responsibility for own work and learning.

PO6: Select multidisciplinary and open elective of own interest to develop self-learning through MOOCs.

16. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be Assessed	Assessment Criteria for the Course Outcomes
PO1: Work in familiar, predictable, routine situation of clear choice.	• Describe plastic processing techniques such as extrusion and its components. • State the concept of Calendaring. • Explain the concept of Printing and its various techniques. • Select right thermoplastics materials for desired applications. • Select correct elastomer for desired applications • Explain the basic concept of Bernoulli's Equation, various types of flow meters. • State various modes of heat transfer and heat exchanger equipment. • Describe thermodynamic system and their types, various laws of thermodynamics, thermodynamic process. • State concept of mass transfer and their application. • Apply concept of mechanical operations and various equipment used in it.
PO2: Acquire factual knowledge in the field of Plastic Technology for employment	• Describe properties and applications of various thermoplastic materials. • Explain the concept of thermoset plastic materials and their applications. • Describe preparation and properties of elastomeric materials. • Explain the concept of mould impressions, types of cavity and core, their advantages and disadvantages.

	• Describe the concept of parting surface, feed system, ejection system and cooling system of mould. • **S**elect correct materials used for dies and moulds. • Prepare mould design, used for dies and moulds • Manage faults and remedies of Thermoforming. • Apply various FRP techniques in different composites. • Use new and emerging materials for scope of future work
PO3: Recall and demonstrate quality skills in routine and repetitive in narrow range of applications using appropriate rules and tools	• Understand the working environment of industries. • Take necessary safety precautions and measures. • Work in team for solving industrial problems. • Develop competencies and skills required by relevant industries. • Describe basics of compression mould design, their types and various component. • State basics of transfer mould design, their types and various component • Describe basics of blow mould design, their types and various component.
PO4: Write and speak with required clarity and show basic understanding of social and natural environment.	• Develop writing, speaking and presentations skills • Communicate effectively with an increased confidence; read, write and speak in English language fluently. • Comprehend special features of format and style of formal communication through various modes.

	• Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews • Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships. • Create writing and communication skills. • Develop Presentation skills.
PO5: Perform tasks with responsibility for own work and learning.	• Handle Extrusion process and its important components like Screw. • Apply different extrusion processes. • Apply AutoCAD 2-dimensional commands. • Use Surface and solid Modeling through various commands like Extrude, Revolve, Blend, Helix, Sweep, Holes, and Ribs & Bosses etc. • Calculate stresses on various designs and structures. • Use AutoCAD/ solidwork/ Catia /UG software and design of various components used in plastic industries. • Perform simple thermal and flammability tests on plastics. • Perform electrical and optical tests. • Test for determining chemical and weathering properties of polymers

PO6: Select multidisciplinary and open elective of own interest to develop self-learning through MOOCs	• State the basic concepts and principles of multidisciplinary and open elective subject. • Perform in a better way in the professional world. • Learn the subject related to own interest. • Explore latest developments in the multidisciplinary and open elective field. • Develop the habit of self-learning. • Display analytical and research abilities. • Integrate multiple knowledge domains. • Enhance the scope and depth of learning.

17. SUBJECTS & CONTENTS

(SECOND YEAR)

THIRD SEMESTER

3.1 INDUSTRIAL / IN–HOUSE TRAINING-I

L	P
-	2

RATIONALE

Industrial training / In – house training will help the students to understand the working environment of relevant industries. The student will learn to work in team to solve the industrial problems. It will also give exposure about the present and future requirements of the relevant industries. This training is very important for development of required competencies and skills for employment and start– ups.

COURSE OUTCOMES

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

CO1: Understand the working environment of industries
CO2: Take necessary safety precautions and measures.
CO3: Learn about present and future requirement of industries.
CO4: Work in team for solving industrial problems
CO5: Develop competencies and skills required by relevant industries.
CO6: Develop writing, speaking and presentations skills.

PRACTICAL EXERCISES

1. Report writing based on industrial training.
2. Preparation of Power Point Slides based on industrial training and presentation by the candidate.
3. Internal Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.
4. External Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.

GUIDELINES

Students will be evaluated based on Industrial training / In – house training report and their presentation using Power Point about the knowledge and skills gained during the training. The Head of the Department will depute faculty coordinators by assigning a group of students to each. The coordinators will mentor and guide the students in preparing the PPTs for final presentation.

The following performance parameters are to be considered for assessment of the students out of 100 marks:

	Parameter	**Weightage**
i	Industrial / In-house assessment of the candidate by the trainer	40%
ii	Report Writing	20%
iii	Power Point Presentation	20%
iv	Viva-voce	20%

3.2 PLASTIC PROCESSING TECHNIQUES - I

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RATIONALE

The purpose of this subject is to equip the students with the knowledge of plastic processing machineries and injection moulding. This subject develops the competency in the students in major industrially practiced plastic processing techniques.

COURSE OUTCOMES

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

CO1: Describe plastic processing techniques such as extrusion and its components.
CO2: Handle Extrusion process and its important components like Screw.
CO3: Apply different extrusion processes.
CO4: State the concept of Calendaring.

DETAILED CONTENTS

UNIT I

Extruder and its Components

General principles of operation, function of various parts i.e. barrel, screw, screen pack, breaker plate, adaptor, die (attachment with extruder general geometry of die swell), cooling and Haul off system, embossing and printing.
Nip rolls, bubble casing, winding equipment, cutting devices, stretching and orientation.

UNIT II

Extruder and Importance of Screw

Different types of extruders, single screw and twin screw extruder, vented barrel extruder, Screw and its construction(various terms used like pitch, channel width, land width, helix angle, screw diameter, root diameter, channel depth, land), types of screws used in extrusion

(conventional screws, barrier screws, two stage venting screw) screw cooling, L/D ratio and its significance.

UNIT III

Extrusion processes

Blown film extrusion, extrusion of pipes and sheets (simple and corrugated), wires and cables, filaments

UNIT IV

Advance Extrusion processes

Introduction to co extrusion, Multi-layer blown films, coextruded sheets and pipes

UNIT V

Calendaring Process

Introduction, Blending, scrap and cold trimming, Mills and strainers, types of calendars, take off stripper section, embosser, winders, and advantages of calendaring over extrusion, various calendaring defects and their remedies.

PRACTICAL EXERCISES

1. To draw the layout of plastic processing laboratory.
2. Setting up of the extruder for production of pipe (Including die fitting and centering).
3. To identify various defects of pipes and suggest their remedies.
4. To study process of Blown film Plant.
5. To identify various defects of Blown films and suggest their remedies.
6. To study corrugated sheet extrusion plant.
7. To study corrugated pipe extrusion plant.
8. Study of construction and working of wire and cable coating plant.
9. To identify various defects of wire and cable samples and suggest their remedies.

RECOMMENDED BOOKS

1. DH Morton Jones, “Polymer Processing”, Chapman and Hall, London.
2. “SPI Plastics Engineering Handbook”.

3. "Hand Book of Plastic Materials and Processing Technology (English, Paperback, Board Eiri)".
4. Chris Rauwendaal, "Polymer Extrusion", Hansar Publications.
5. "The Complete Technology Book on Plastic Extrusion, Moulding and Mould Design", Asia Pacific Business Press Inc.,Kamlanagar, Delhi.

SUGGESTED WEBSITES

1. https://polymerdatabase.com/home.html
2. https://swayam.gov.in
3. https://youtu.be/ZN2oxUvUgN0

INSTRUCTIONAL STRATEGY

Teacher may use various teaching aids like models, charts and experimental work. Teacher should show model of replica of the component/working models of machines. This is a practice based subject and topics taught in the class should be practiced as exercises in the lab regularly for the development of processing skills in the students. For this purpose, Industrial visit may be organized at local level to enhance the skill of students. This subject contains five units of equal weightage.

3.3 PLASTIC MATERIALS AND PROPERTIES - I

L	P
3	-

RATIONALE

This subject gives a detailed description of polymeric materials in the category of thermoplastics, thermoset and elastomers. This subject enables the students in acquiring the knowledge for selection of right type of materials for processing in order to make the product. Various plastic materials can be identified with property assessments.

COURSE OUTCOMES

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

CO1: Describe properties and applications of various thermoplastic materials.
CO2: Select right thermoplastics materials for desired applications.
CO3: Explain the concept of thermoset plastic materials and their applications.
CO4: Describe preparation and properties of elastomeric materials.
CO5: Select correct elastomer for desired applications.

DETAILED CONTENTS

UNIT I

Commodity Thermoplastics

Preparation (brief description), types, properties and applications of the following:

- Poly Ethylene's (LLDPE,LDPE,HDPE,UHMWHDPE)
- Poly Propylene (PP)
- Poly Vinyl Chloride(PVC)

UNIT II

Engineering Thermoplastics

- Poly Carbonate
- Poly Styrene-General Purpose, High impact Poly styrene.

- Styrene Acrylonitrile, Acrylonitrile-butadiene-styrene.
- Polyamides
- Polymethy methacrylate
- Cellulose plastics
- Thermoplastic polyester(PET,PBT)

UNIT III

Thermosetting Plastics

Basic knowledge of preparation, types, properties and applications of the following

- Phenol formaldehyde
- Urea formaldehyde
- Melamine formaldehyde
- Poly urethanes
- Silicone resins
- Epoxy resin
- Unsaturated polyesters.

UNIT IV

Elastomers I

Basic knowledge of preparation, types, properties and applications of the following

- Natural rubber
- Styrene butadiene rubber
- Poly-isoprene
- Chloroprene

UNIT V

Elastomers II

- Poly-butadiene
- Ethylene propylene
- diene monomer
- Nitrile butadiene rubber
- Silicone rubbers

RECOMMENDED BOOKS

1. J.A. Brydson, “Polymer Material”, M/S Butterworth Heinemann, Linacre House, Jordan Hill, UK Organic Chemistry of Polymers by Saunders.
2. P Ghosh, “Polymer Science and Technology”, by M/S Chapman and Hall, London.
3. “Polymer Materials - I Ed.”, Polymer Research Centre, Bangalore, M/s. Tata McGraw Hill, Publishing Co; New Delhi.
4. “Polymer Materials - II Ed.”, Polymer Research Centre, Bangalore.

SUGGESTED WEBSITES

1. https://polymerdatabase.com/home.html
2. https://swayam.gov.in
3. https://youtu.be/JWzVC0v-fhU
4. https://youtu.be/vE6x9iIgST0

INSTRUCTIONAL STRATEGY

Teacher may use various teaching aids like charts, pictures and product made from different type of plastic materials. Use of modern teaching aids like computers, projectors may be done for better delivery of subject matter the purpose of this subject is to give the knowledge about the material, processing behavior, applications, and grades. That will help them to select the most suitable material for particular product manufacturing. So at one time one polymer should be taught and products made from that should be shown in the class room if possible. This subject contains five units of equal weightage.

3.4 COMPUTER AIDED MOULD DESIGN

L	P
-	4

RATIONALE

In this practical subject, the students are required to learn the basics of software such as Mechanical Desktop, Mould Creator, Mould Flow, etc. and further to design molds for given components using this software. The students are supposed to use AutoCAD/ solid work/ Catia /UG software and design various components used in plastic industries.

COURSE OUTCOMES

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

CO1: Apply AutoCAD 2-dimensional commands.
CO2: Use Surface and solid Modeling through various commands like Extrude, Revolve, Blend, Helix, Sweep, Holes, and Ribs & Bosses etc.
CO3: Calculate stresses on various designs and structures.
CO4: Use AutoCAD/ solid work/ Catia /UG software and design of various components used in plastic industries.

PRACTICAL EXERCISES

UNIT I
Basic AutoCAD Commands

Introduction and practice on 2D commands like Draw toolbar, Editing Toolbar, knowledge of Dimensioning, Layers, single line and Multiline text.

UNIT II
Surface Modeling Commands

Various types of surface creation like mesh, ruled surfaced, edged surface, tabulated surface etc. using MDT or AutoCAD.

UNIT III
Solid Modeling Commands

Introduction and practice on 3D Modeling using AutoCAD software including various commands like Extrude, Revolve, Blend, Helix, Sweep, Holes, Ribs & Bosses etc. and practice these command making 3D design of different plastics.

UNIT IV
Analysis and Report Generation

For calculating stresses on various designs and structures.

UNIT V
Design Activities

Design of various components used in plastic industries.

RECOMMENDED BOOKS / SOFTWARE

1. Practical Autodesk AutoCAD 2021 by Jai Prakash Pandey
2. Introduction to AutoCAD 3D Design by Shanu Aggarwal.
3. Mechanical Desktop (MDT)
4. Solid Works
5. Mold-flow/ Mold Creator
6. PRO-E, CATIA
7. IDEAS

SUGGESTED WEBSITES

1. https://swayam.gov.in
2. https://youtu.be/1gDmNDJ9SHc

INSTRUCTIONAL STRATEGY

Teacher may use various teaching aids like models, charts, graphs and experimental work. Teacher should show model of replica of Mould/product design. This is ah ands on practice based subject and topic taught in the class should be practiced in the lab regularly for the development of required skills in the students. Various software like AutoCAD, Solid work, mould-flow and Mold Creator software may be used for developing the understating of interface of various design based software. Students should gather practical knowledge about designing of various products and moulds like mould for electrical switches, plastic bottles and packaging plastic containers.

3.5 DESIGN OF DIES AND MOULD – I

L	P
2	4

RATIONALE

A diploma holder in plastic technology is engaged in manufacturing plastic components for which design of moulds and dies is essential. This subject will impart them requisite knowledge and skill in design of moulds and dies.

COURSE OUTCOMES

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

CO1: Explain the concept of mould impressions, types of cavity and core, their advantages and disadvantages.
CO2: Describe the concept of parting surface, feed system, ejection system and cooling system of mould.
CO3: **S**elect correct materials used for dies and moulds.
CO4: Prepare mould design, used for dies and moulds.

DETAILED CONTENTS

UNIT I
General Mould Construction

Basic terminology, mould cavities and core, bolster and its types, ancillary items (guide bush and guide pillars, sprue bush, register ring and its types, mould plate fastening), attachment of mould to platen.
Classification of moulds (Integer, insert, two plate, three plate, split and runner-less/ hot runner mould).
Brief introduction to materials used for dies and moulds.

UNIT II
Ejection System

Ejector grid, ejector plate assembly, ejection techniques, sprue pullers

UNIT III
Feed System

Runners - Sprue, runners and its types, balancing of runners, size of runners
Gates - Types of gates.

UNIT IV
Parting Surface

Parting surface - Types of parting surface, selection of parting surface

UNIT V
Cooling System

Cooling integer type mould plates and its types, cooling insert bolster assembly and its types,

PRACTICAL EXERCISES

1. To draw basic mould consisting of cavity and core plate.
2. To draw types of cavity and core inserts (Rectangular, circular)
3. To draw guide pillar and guide bush (standard)
4. To draw rectangular and circular frame type ejector grid.
5. To draw various types of ejector elements.
6. To draw and illustrate balanced runner layouts.
7. To draw Integer cavity plate cooling circuit(Z and balanced Z)
8. To draw Integer core cooling circuits (angled hole baffled straight hole, stepped)
9. Design of Multi impression two plate Injection Mould
10. Design of Three Plate Injection Mould (multi impression)
11. Design of Injection Mould for internal undercut components.
12. To design and draw a runner less mould.

RECOMMENDED BOOKS

1. R.C.W Pye, "Injection Mould Design", Longman Scientific and Technical Publication Tata McGraw Hill Co., New Delhi.
2. J. Harry Don Bose and Mayne I Pribble, "Plastic Mould Engineering Hand Book", Van Nostrand Reinhold Company Publication, Tata McGraw Hill Co., New Delhi.
3. Dominick V Rosato and Donald V Rosato, "Injection Moulding Handbook", Tata McGraw Hill Co., New Delhi.
4. Joel Frados, "Plastic Engineering Handbook", Van Nostrand Reinhold Company Publication, Tata McGraw Hill Co., New Delhi.

SUGGESTED WEBSITES

1. https://swayam.gov.in
2. https://youtu.be/5VaspVpqiFQ
3. https://youtu.be/eZWO8qH7egQ

INSTRUCTIONAL STRATEGY

Teacher should show replica of the component/product for effective mould design. This is a practice based subject and topic taught in the class should be practiced as exercises in the lab regularly for the development of designing skill in the students. Teacher may use various teaching aids like models, charts, graphs, mould materials and mould design for various processing techniques used in plastic processing industry.

Out of these, the student is required to prepare 10 nos. of sheets and a minimum of 02 sheets will be prepared by the student on computer using AutoCAD software or latest design software. This subject contains five units of equal weightage.

3.6 BASICS OF CHEMICAL ENGINEERING

L	P
3	4

RATIONALE

A thorough knowledge of Unit Operations is essential for the study of plastic technology. This course acquaints the students with the basic principles of thermodynamics, heat and mass transfer and various devices for measurements of pressure and fluid flow.

COURSE OUTCOMES

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

CO1: Explain the basic concept of Bernoulli's Equation, various types of flow meters.
CO2: State various modes of heat transfer and heat exchanger equipment.
CO3: Describe thermodynamic system and their types, various laws of thermodynamics, thermodynamic process.
CO4: State concept of mass transfer and their application.
CO5: Apply concept of mechanical operations and various equipment used in it.

DETAILED CONTENTS

UNIT I

Basics of Fluid Flow

Bernoulli's Equation and its application in fluid flow, venturimeter, Orifice Meter, pitot-tubes, Rota-meter, Rate of discharge, velocity measurement, continuity equation, Reynolds's number and their use, friction losses during flow. Measurement of fluid pressure (concept of manometer – simple, differential)

UNIT II

Heat Transfer

Modes of Heat Transfer, Fourier's law of heat conduction, Conduction across Single & Composite wall, Convection -Heat transfer by natural & forced convection, Individual and

overall heat transfer coefficients. LMTD, Heat Exchanger Equipment (Double pipe, Shell and Tube Heat Exchanger)

UNIT III
Thermodynamics

Thermodynamic system and surroundings, total heat & specific heat, thermodynamic cycle, Homogenous and heterogeneous system, thermodynamic equilibrium, Equation of State, Three Laws of Thermodynamics, concept of Thermodynamic process such as Isometric, Isothermal, Isobaric & Adiabatic, Concept of Gibbs free energy, phase change.

UNIT IV
Mechanical Operations

Size Reduction law, Crushers & Grinders, Screening & Screening Equipment, Filtration-Principle and filtration equipment (Filter press), Cyclones Separators.

UNIT V
Pumps and valves

Construction and working of the following:

a) Reciprocating, centrifugal, gear and screw pump
b) Ball valve, gate valve, butterfly valve, piston valve, solenoid valve.

PRACTICAL EXERCISES

1. To perform an experiment on cyclone separator
2. To verify Bernoulli theorem.
3. To determine the Reynolds number and observe the pattern of laminar and turbulent flow.
4. To determine the discharge coefficient (C_d) for venturimeter.
5. To determine the discharge coefficient (C_d) for a Pitot tube.
6. To study the constructional features of reciprocating pump.
7. To study the constructional features centrifugal pump.
8. To perform an experiment on a mixer for liquid-liquid mixing

9. To carry out the sieve analysis of a product obtained from size reduction equipment such as ball mill, grinder etc.
10. To determine overall heat transfer co-efficient in, a double pipe heat exchanger in Parallel and counter flow heat exchange modes

RECOMMENDED BOOKS

1. RK Bansal, “Fluid Mechanics and Hydraulics”.
2. Modi and Seth, “Fluid Mechanics and Hydraulics”.
3. K. A. Gavhane, “Unit operation-1”.
4. D.K. Jain, “Fluid Mechanics”.

SUGGESTED WEBSITES

1. https://swayam.gov.in
2. https://www.youtube.com/@chemicalengineering8215/featured\
3. https://youtu.be/nsIMQP0QhpE

INSTRUCTIONAL STRATEGY

Teacher should show replica of the equipments for fluid flow operations. This is a practice based subject and topic taught in the class should be practiced as exercises in the lab regularly for the development of learning skills of the students. Teacher may use various teaching aids like models, charts, graphs, videos, prototypes for various Unit processes and operations.
Polymer based industrial problems (numerical) should be given as assignments to make students acquainted with basic principles of unit operations and unit processes. This subject contains five units of equal weightage.

3.7 MULTIDISCIPLINARY ELECTIVE

L	P
2	-

RATIONALE

Multidisciplinary electives are very important and play major role in implementation of National Education Policy. Multidisciplinary is a subject which is useful for two or more disciplines in which students are asked to understand the concept of multidisciplinary or interdisciplinary. It will help the students to gain an arsenal of skills that are easily transferable across work environments.

COURSE OUTCOMES

At the end of the open elective, the students will be able to:

CO1: Apply critical thinking problem solving.
CO2: Demonstrate self and time management.
CO3: Display analytical and research abilities.
CO4: Integrate multiple knowledge domains.
CO5: Enhance the scope and depth of learning.

LIST OF MULTIDISCIPLINARY ELECTIVES

(The list is indicative and not exhaustive)

1. Introduction to Internet of Things
2. Introduction to Robotics
3. Introduction to Embedded System Design
4. Fundamentals of Artificial Intelligence
5. Digital Image Processing
6. Introduction to Machine Learning
7. Fundamentals of Artificial Intelligence
8. The Joy of Computing Using Python
9. Cloud Computing
10. Introduction to Industry 4.0
11. Industrial Internet of Things
12. Object Oriented System Development using UML, Java and Patterns

GUIDELINES

Multidisciplinary Elective shall be offered preferably in online mode. Online mode multidisciplinary elective shall preferably be through Massive Open Online Courses (MOOCs) from Swayam, NPTEL, Upgrad, Udemy, KhanAcademy or any other online portal to promote self-learning. A flexible basket of large number of multidisciplinary electives is suggested which can be modified depending upon the availability of courses at suggested portals and requirements. For online multidisciplinary electives, department coordinators shall be assigned to monitor and guide the group of students for selection of minimum 20 hours duration online course of their choice. For offline multidisciplinary electives, a suitable relevant subject shall be offered by the respective department to the students with minimum 40% of the total class strength as per present and future requirements.

Assessment of MOOCs multidisciplinary elective shall be based on continuous evaluation by the respective coordinator. The coordinator shall consider the submitted assignments by the students from time to time during the conduct of MOOCs. The MOOCs assessment shall be conducted by the coordinator along with one external expert by considering submitted assignments out of 100 marks.

In case, no suitable open elective is available online, only then the course may be conducted in offline mode. The assessment of offline multidisciplinary elective shall be internal and external. The offline multidisciplinary elective internal assessment of 40 marks shall be based on internal sessional tests, assignments etc. and external assessment of 60 marks shall be based on external examination at institute level.

SUGGESTED WEBSITES

1. https://swayam.gov.in/
2. https://www.udemy.com/
3. https://www.upgrad.com/
4. https://www.khanacademy.org/

FOURTH SEMESTER

4.1 ENGLISH AND COMMUNICATION SKILLS - II

L	P
2	2

RATIONALE

Communication II moves a step further from Communication Skills I and is aimed at enhancing the linguistic competency of the students. Language as the most commonly used medium of self-expression remains indispensable in all spheres of human life – personal, social and professional. This course is intended to make fresh ground in teaching of Communicative English as per the requirements of National Skill Quality Framework.

COURSE OUTCOMES

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

CO1: Communicate effectively with an increased confidence; read, write and speak in English language fluently.
CO2: Comprehend special features of format and style of formal communication through various modes.
CO3: Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews
CO4: Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships.

DETAILED CONTENTS

UNIT I

Reading

1.1 Portrait of a Lady - Khushwant Singh
1.2 The Doctor's Word by R K Narayan
1.3 Speech by Dr Kiran Bedi at IIM Indore2007 Leadership Concepts
1.4 The Bet - by Anton Chekov

UNIT II

Effective Communication Skills

2.1 Modern means of Communication (Video Conferencing, e- mail, Teleconferencing)

2.2 Effective Communication Skills: 7 C's of Communication
2.3 Non-verbal Communication – Significance, Types and Techniques for Effective Communication
2.4 Barriers and Effectiveness in Listening Skills
2.5 Barriers and Effectiveness in Speaking Skills

Unit III

Professional Writing

3.1 Correspondence: Enquiry letters, placing orders, complaint letters
3.2 Report Writing
3.3 Memos
3.4 Circulars
3.5 Press Release
3.6 Inspection Notes and tips for Note-taking
3.7 Corrigendum writing
3.8 Cover Letter

UNIT IV

Grammar and Vocabulary

4.1 Prepositions
4.2 Conjunctions
4.3 Punctuation
4.4 Idioms and Phrases: A bird of ill omen, A bird's eye view, A burning question, A child's play, A cat and dog life, A feather in one's cap, A fish out of water, A shark, A snail's pace, A snake in the grass, A wild goose chase, As busy as a bee, As faithful as dog, Apple of One's eye, Behind one's back, Breath one's last, Below the belt, Beat about the bush, Birds of a feather flock together, Black Sheep, Blue blood, By hook or crook, Chicken hearted, Cut a sorry figure ,Hand in glove, In black and white, In the twinkling, In full swing ,Is blind as a bat, No rose without a thorn, Once in a blue moon, Out of the frying pan in to the fire, know no bounds ,To back out, To bell the cat, To blow one's trumpet, To call a spade a spade, To cut one's coat according to one's cloth, To eat humble pie, To give ear to, To have a thing on one's finger tips, To have one's foot in the grave, To hold one's tongue, To kill two birds with one stone, To make an ass of oneself, To put two and two together, To the back bone, Turn coat, ups and downs.
4.5 Pairs of words commonly misused and confused: Accept-except, Access-excess, Affect-effect, Artificial- artful, Aspire-expire, Bail-bale, Bare-bear, Berth-birth, Beside-besides,

Break-brake, Canvas-canvass, Course- coarse, Casual-causal, Council-counsel, Continual-continuous, Coma-comma, Cue- queue, Corpse- corps-core, Dairy-diary, Desert-dessert, Dual-duel, Dew- due, Die-dye, Draft- draught-drought, Device-devise, Doze-dose, Eligible-illegible, Emigrant- immigrant, Envelop-envelope, Farther-further, Gate-gait, Goal-goal, Human-humane, Honorable-honorary, Hail-hale, Hair-heir-hare, Industrial-industrious, Impossible- impassable, Idle-idol-ideal, Lose-loose, Later-latter, Lesson-lessen, Main-Mane, Mental-mantle, Metal-mettle, Meter-metre, Oar-ore, Pray-prey, Plain-plan, Principal - principle, Personal- personnel, Roll- role, Route-rout- roote, Stationary-stationery, Union- unity, Urban- urbane, Vocation- vacation, Vain- vein-vane, Vary- very.

4.6 Translation of Administrative and Technical Terms in Hindi or Mother tongue: Academy, Abandon, Acting in official capacity, Administrator, Admission, Aforesaid, Affidavit, Agenda, Alma Master, Ambiguous, Appointing Authority, Apprentice, Additional, Advertisement, Assistant, Assumption of charge, Assurance, Attested copy, Bonafide, Bond, Cashier, Chief Minister, Chief Justice Clerical error, Commanding ,Officer, Consent, Contractor, corruption, Craftsman, Compensation, Code, Compensatory allowance, Compile, Confidential letter, Daily Wager, Data, Dearness allowance, Death - Cum Retirement, Dispatch, Dispatch Register, Disciplinary, Disciplinary Action, Disparity Department, Dictionary, Director, Director of Technical Education, Earned Leave, Efficiency Bar, Estate, Exemption, Executive Engineer, Extraordinary, Employment Exchange, Flying Squad, General Body, Head Clerk, Head Office, High Commission, Inconvenience, Income Tax, Indian Assembly Service, Justify, Legislative Assembly, Negligence, Officiating ,Office Record, Office Discipline, On Probation, Part Time, Performance, Polytechnic, Proof Reader Precautionary, Provisional, Qualified, Regret, Responsibility, Self-Sufficient, Senior, Simultaneous ,Staff, Stenography ,Superior, Slate, Takeover, Target Data Technical Approval, Tenure, Temporary, Timely Compliance, Under Investigation, Under Consideration, Verification, Viva-voce, Write off, Working Committee, Warning, Yours Faithfully , Zero Hour.

UNIT V

Employability Skills

5.1 Presentation Skills: How to prepare and deliver a good presentation

5.2 Telephone Etiquettes

5.3 Importance of developing employable and soft skills

5.4 Resume Writing: Definition, Kinds of Resume, Difference between Bio-data and Curriculum Vitae and Preparing a Resume for Job/ Internship

5.5 Group discussions: Concept and fundamentals of GD, and learning Group Dynamics.

5.6 Case Studies and Role Plays

PRACTICAL EXERCISES

1. Reading Practice of the above lessons in the Lab Activity classes.
2. Comprehension exercises of unseen passages along with the given lessons.
3. Vocabulary enrichment and grammar exercises based on the above selective readings.
4. Situational Conversation: Requesting and responding to requests; Expressing sympathy and condolence.
5. Warning; Asking and giving information.
6. Getting and giving permission.
7. Asking for and giving opinions.
8. A small formal and informal speech.
9. Seminar.
10. Debate.
11. Interview Skills: Preparing for the Interview and guidelines for success in the Interview and significance of acceptable body-language during the Interview.
12. Written Drills will be undertaken in the class to facilitate a holistic linguistic competency among learners.
13. Participation in a GD, Functional and Non-functional roles in GD, Case Studies and Role Plays
14. Presentations, using audio-visual aids (including power-point).
15. Telephonic interviews, face to face interviews.
16. Presentations as Mode of Communication: Persuasive Presentations using multi-media aids.
17. Practice of idioms and phrases on: Above board , Apple of One's eye , At sea, At random, At large, A burning question, A child's play, A wolf in sheep's clothing, A deal, Breath one's last, Bid fair to, Beat about the bush, Blue Blood, Big Gun, Bring to Book, Cut a sorry figure, Call names, Carry weight, Dark Horse, Eat Humble pie, Feel small, French leave, Grease the palm, Go against the grains, Get One's nerves, Hard and Fast, Hue and Cry, Head and ears, In full swing, Jack of all trades, know no bounds, kiss the dust, Keep an eye on, Lion's share, learn by rote, Null and void, on the cards, Pull a long face, Run amuck, Right and Left, Rain on Shine, Small talk, Take to one's heels, Tooth and nail, to take by storm, , Wet blanket, Yearn for.

RECOMMENDED BOOKS

1. Alvinder Dhillon and Parmod Kumar Singla, "Text Book of English and Communication Skills Vol – 1, 2", M/s Abhishek Publications, Chandigarh.
2. J Sethi, Kamlesh Sadanand & DV Jindal, "Course in English Pronunciation", PHI Learning Pvt. Ltd., New Delhi.
3. Wren and Martin, "High School English Grammar and Composition" .
4. NK Aggarwal and FT Wood, "English Grammar, Composition and Usage", Macmillan Publishers India Ltd., New Delhi.
5. RC Sharma, and Krishna Mohan, "Business Correspondence & Report Writing", (4^{th} Edition), by Tata MC Graw Hills, New Delhi.
6. Varinder Kumar, Bodh Raj & NP Manocha, "Business Communication Skills", Kalyani Publisher, New Delhi.
7. Kavita Tyagi & Padma Misra, "Professional Communication", PHI Learning Pvt. Ltd., New Delhi.
8. Nira Konar, "Communication Skills for Professionals", PHI Learning Pvt. Ltd., New Delhi.
9. Krishna Mohan & Meera Banerji, "Developing Communication Skills", (2^{nd} Edition), Macmillan Publishers India Ltd., New Delhi.
10. M. Ashraf Rizwi, "Effective Technical Communication", Tata MC Graw Hills, New Delhi.
11. Andrea J Rutherford, "Basic Communication Skills for Technology", Pearson Education, New Delhi.

INSTRUCTIONAL STRATEGY

This is practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required communication skills in the students. Emphasis should be given on practicing of communication skills. This subject contains five unit of equal weightage.

4.2 PLASTIC PROCESSING TECHNIQUES -II

L	P
3	4

RATIONALE

The purpose of this subject is to equip the students with the knowledge of processes utilized in compression and transfer moulding. This subject develops the competency in the students in major industrially practiced plastic processing techniques.

COURSE OUTCOMES

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

CO1: Explain compression moulding and transfer moulding and its principle, and various control parameters.
CO2: Describe principle, method, limitations and advantages, types of heating and
CO3: Manage faults and remedies of Thermoforming.
CO3: Apply various FRP techniques in different composites.
CO4: State different types of casting and finishing techniques.

DETAILED CONTENTS

UNIT I
Compression and Transfer Molding

General principles and working of compression molding machine, Types of compression molding machine – hand operated, automatic, single and multi-daylight machines, bulk factor, preheating of molds, cycle time, process variables and their control, common faults and their remedies.

Principles of transfer molding. Types of transfer molding machines, molding cycle, faults causes and remedies. Comparison between compression and Transfer Moulding.

UNIT II
Thermoforming

Basic principles, method of thermoforming – straight forming, drape forming, matched mold forming, snap back forming, reverse draw forming and vacuum forming, limitations and advantages of forming, types of heating systems, faults: causes and their remedies.

UNIT III
FRP Processing Methods

Hand Lay-up technique, Spray- up, bag moulding, Filament winding, centrifugal casting, pultrusion.

UNIT IV
Casting Techniques

Introduction, Plastics materials used in casting Techniques like Thermoplastic, Thermoset and Biodegradable Plastics, Forms of Plastics Materials used in Casting Techniques. Casting techniques used with Plastics materials like Cell casting, Potting and encapsulation, film casting, Mould Casting, Embedding, Plastisol Casting : Dip casting, Slush Casting.

UNIT V
Post Processing and Finishing of Plastics

Engraving, vacuum metalizing, painting, electroplates.

PRACTICAL EXERCISES

1. To produce small components on hand operated compression molding machine
2. To produce components on automatic compression molding machine
3. To determine various defects and their remedies in Compression moulding process
4. To produce articles on vacuum forming machine
5. To determine various defects and their remedies in Vacuum forming process
6. To do casting of polyester resin.
7. Exercises on high frequency PVC welding machine
8. To study various parts and operating conditions of transfer moulding machine

9. Preparation of FRP sheet by hand lay-up technique
10. To determine various defects and role of additives in FRP process.

RECOMMENDED BOOKS

1. Joel Frados, “Plastic Engineering Handbook”, Chapman and Hall, London, UK.
2. Davis Gramann, “Compression Moulding”, Osswald by Hanser Publication.
3. Manju Nanathan Rathod, “Casting Concepts and Mould Design”, Azuko Technical Institute.
4. Svan Englmann, “Advanced Thermoforming”, Wiley Publisher.

SUGGESTED WEBSITES

1. https://swayam.gov.in
2. https://youtu.be/Tn0Tcn2mS9E
3. https://youtu.be/6fZqLZ5SktU
4. https://youtu.be/649fIwvIvRc

INSTRUCTIONAL STRATEGY

Teacher may use various teaching aids like models, charts, graphs and experimental work. Teacher should show model of replica of the component/working models of machines. This is a practice based subject and topic taught in the class should be practiced as exercises in the lab regularly for the development of processing skills in the students. For this purpose, Industrial visit may be organized at local level to enhance the skill of students. This subject contains five units of equal weightage.

4.3 PLASTIC MATERIALS AND PROPERTIES-II

L	P
3	-

RATIONALE

This subject gives a detailed description of advanced High performance engineering and specialty polymeric materials in category of thermoplastics, thermosets and elastomers. The student acquires the knowledge of new and advanced polymers so that he/she can select the right type of materials for processing to make the product.

COURSE OUTCOMES

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

CO1: Explain various High performance engineering and speciality thermoplastics materials, properties and their applications.
CO2: Describe the concept composite and Nano-composite materials and different types reinforcing fillers.
CO3: State the concept of blends and alloys and blends materials and their advantages.
CO4: Use new and emerging materials for scope of future work.

DETAILED CONTENTS

UNIT I
High performance and Specialty Polymers

Preparation (brief description), properties and application of Engineering, thermoplastics –, Poly-acetals (POM), Poly-sulphones (PSO), Poly Tetra Flouro Ethylene (PTFE), Poly Ether Ether Ketone (PEEK), Poly Phenylene Oxide (PPO), Liquid Crystalline Polymer (LCP).

UNIT II
Reinforced Plastics

Principles of composite reinforcement, fillers and additives, effect of reinforcement on strength of plastics. Various types of reinforcement fibers like glass fiber, carbon fiber, aramid fiber.

Resin (binders) used in reinforced plastics (Unsaturated Polyester, epoxy, Poly Urethane, Phenol formaldehyde), coupling agents. Concept of nano-composite polymers.

UNIT III
Poly-blends and Alloys

Definition, advantage of polymers blends and alloys, role of composition,
Interpenetrating polymer networks, PVC- Nitrile rubber, ABS-PVC and PP-EPDM

UNIT IV
Emerging Materials and Applications

Preliminary concept of new materials such as conducting polymers, biopolymers, opto-electronic plastics and polymer concretes.
Use of polymers in new applications such as food packaging, biomedical and membrane separation.

UNIT V
Thermoplastic Elastomers

Basic properties and applications of the following
Styrene block copolymer, Thermoplastic polyurethane elastomers, Polyamide block copolymer, co-polyester elastomers, thermoplastic poly-olefins.

RECOMMENDED BOOKS

1. Premamoy Ghosh, “Polymer Science & Technology”, Tata McGraw Hill Co., New Delhi.
2. Arends, “Polymer Blends and Alloys”, M/s Hanser Publishers, New York.
3. “Plastic Materials”, M/s. Ishan Publications, Ambala City.
4. Brydson, “Plastics Materials”, PHI Publication, M/s. Vikas Publishing, New Delhi.
5. Dyson, “Engineering Polymers”, PHI Publication, Khanna Publishers, New Delhi.
6. Jean Michael Charrier, “Polymer Materials and Processing”, M/S Hanser Publishers, New York.

SUGGESTED WEBSITES

1. https://swayam.gov.in
2. https://youtu.be/PTcffCr19XY
3. https://youtu.be/3ilMfdGQxOU

INSTRUCTIONAL STRATEGY

Teacher may use various teaching aids like models, charts, pictures and product made from different type of plastic materials. In plastic industry the basic raw material is polymer. The purpose of this subject is to give the knowledge about the material, processing behavior, applications, and grades. That will help them to select the most suitable material for particular product manufacturing. So at one time one polymer should be taught and products made from that should be shown in the class room if possible. This subject contains five units of equal weightage.

4.4 PLASTIC TESTING AND QUALITY CONTROL

L	P
3	4

RATIONALE

It is necessary to test the raw materials and the products during various stages of their manufacture to control the quality. This subject provides the essential knowledge and skills to the students for assessing its potential application by evaluating various associated properties.

COURSE OUTCOMES

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

CO1: Identify Plastics and their specifications, standards, test specimen preparation, Preconditioning and test atmosphere and Quality control techniques.
CO2: Determine simple mechanical tests for plastics.
CO3: Perform simple thermal and flammability tests on plastics.
CO4: Perform electrical and optical tests.
CO5: Test for determining chemical and weathering properties of polymers.

DETAILED CONTENTS

UNIT I
Concept of Testing & Quality Control

Basic concepts of testing, overview of various test standards such as ASTM, BIS, DIN and ISO. Test specimen preparation: preconditioning and test atmosphere. Basic concept of statistical quality control, Statistical process control, kaizen, three–sigma, 5S and root cause analysis, Analysis of test data to control finished product in relation to service requirement.

UNIT II
Mechanical Testing

Visual examination, Physical Identification test for identification of Plastics, Specific gravity, bulk density and Water absorption, Tensile strength, flexural/ fatigue resistance, compression

strength, impact strength (Izod & Charpy), Dart impact for films, tear test, Creep and stress relaxation.
Hardness test – Shore, Rockwell and Brinell hardness, Abrasion resistance.

UNIT III
Thermal and Flammability Test

Flame test for identification of Plastics, Melting point, Melt flow index, vicat softening point, heat distortion temperature, limiting oxygen index, smoke density test.

UNIT IV
Electrical and Optical Test

Dielectric strength, insulation resistance, dielectric constant, volume and surface resistivity, arc resistance, refractive index - Luminous transmittance - Clarity and Haze, colour measurement and Gloss.

UNIT V
Chemical and Weathering Testing:

Solubility test for identification of Plastics, Environment Stress cracking resistance, Accelerated weathering tests, outdoor weathering of plastics, Resistance of plastics to biological systems.

PRACTICAL EXERCISES

1. To determine the tensile strength, flexural strength of plastics specimen.
2. To determine water absorption of various plastics.
3. To determine impact strength of different plastics specimen.
4. To determine hardness (Shore and Rockwell) of different specimen of plastics.
5. To carry out dart impact test on given plastics films/laminates.
6. To determine the Melt Flow Index of given samples of plastics.
7. To carry out Heat detection test on given samples of plastics.
8. To carry out vicat softening point test on given samples of plastics
9. To carry out environmental stress cracking resistance test on given samples of plastics.
10. Identification of Plastics by Simple methods / primary tests like visual examination, solubility test, burning and odour test.

11. To determine volume and surface resistivity of different plastics specimens.
12. To determine gloss of different plastics specimens.
13. To perform tear testing on plastics specimens.

RECOMMENDED BOOKS

1. Roger Brown, “Testing of Plastics by; Blackwell Publishing Ltd Oxford, UK
2. Plastics Testing by Vishu Shah, published by Vishu Shah Publisher, New York
3. CIPET, “Identification of Plastics”, Kluwer Academic Publishers, New York.
4. “Identification of Plastics”, M/S AS Athalye, London lliffe Books Ltd., New York.

SUGGESTED WEBSITES

1. https://swayam.gov.in
2. https://youtu.be/4fcPga2wjSk
3. https://youtu.be/aFiE9E457Bs
4. https://youtu.be/zWvDfvUOqaY

INSTRUCTIONAL STRATEGY

This is hands on practice based subject and topic taught in the class should be practiced in lab regularly for development of required skills in the students. The teacher may use various teaching aids like models, charts, graphs and experimental kits for imparting effecting instruction in the subjects. The students need to be exposed to various specimen preparation and conditioning behavior of polymer materials. The use of demonstration can make the subject interesting. The teacher may plan local industrial visit to develop proper understanding of physical phenomenon and relevant aspect of plastic testing. This subject contains five units of equal weightage.

4.5 DESIGN OF DIES AND MOULDS – II

L	P
2	4

RATIONALE

A diploma holder is engaged in manufacturing plastic components for which design of moulds and dies is essential. This subject will impart them requisite knowledge and skills in design of moulds and dies such as extrusion dies, compression mould design, transfer mould design and blow mould design.

COURSE OUTCOMES

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

CO1: Explain extrusion die design and its types.
CO2: Describe basics of compression mould design, their types and various component.
CO3: State basics of transfer mould design, their types and various component
CO4: Describe basics of blow mould design, their types and various component

DETAILED CONTENTS

UNIT I
Introduction to Extrusion Dies

General features of extrusion dies, Die materials, design features like characteristic of polymers, polymer melt flow, die geometry, material of construction, strength and rigidity, heating system and temperature control, ease of maintenance and cleaning.

UNIT II
Types of Extrusion Dies

Dies for solid sections (like rods), hollow sections (like pipes and tubes), dies for blown films, parison dies, flat film and sheet dies, wire and cable coating.

UNIT III
Compression Mould Design

Types of compression moulds – hand compression moulds, semi-automatic moulds like Open flash, semi-positive and positive type.
Calculation of clamp pressure, ram pressure, platen size, number of impressions and type of loading chamber design.

UNIT IV
Transfer Mould Design

Principles of transfer moulding, pot capacity, design of sprue, runner and gates, types of Transfer moulds- pot transfer, plunger transfer, Transfer pot calculations, calculation of Clamp pressure, ram pressure, platen size, no. of impressions.

UNIT V
Blow Mould Design

Materials for Blow moulds, Extrusion blow moulds - cavity and pinch off, injection blow moulds - neck design, mandrel design, and parison thickness control.

PRACTICAL EXERCISES

1. Draw split and plate dies for solid sections.
2. Draw pipe die (In-line type and offset type).
3. To draw side fed die for blown film.
4. To draw bottom fed die for blown film.
5. To draw rotating tubular die for blown film.
6. To draw axial flow crosshead parison die
7. To draw radial flow crosshead parison die
8. Drawing of flat film dies like fish tail, coat hanger die.
9. To draw adjustable core die and die for core deflector for wire and cable coating
10. Drawing of Open flash, semi-positive and positive type compression moulds.
11. To draw a Pot type transfer mould

12. To draw a Plunger type transfer mould
13. To draw various types of pinch off design.
14. To draw layout of a Blow mould.

RECOMMENDED BOOKS

1. R.C.W Pye, "Injection Mould Design", Longman Scientific and Technical Publication, Tata McGraw Hill Co., New Delhi.
2. J. Harry Don Bose and Mayne I Pribble, "Plastic Mould Engineering Hand Book", Van Nostrand Reinhold Company Publication, Tata McGraw Hill Co., New Delhi.
3. Dominick V Rosato and Donald V Rosato, "Injection Moulding Handbook", Tata McGraw Hill Co., New Delhi.
4. Joel Frados, "Plastic Engineering Handbook"; Van Nostrand Reinhold Company Publication, Tata McGraw Hill Co., New Delhi.
5. RJ Crawford, "Plastic Engineering", Maxwell Macmillan International Edition Publication, Tata McGraw Hill Co., New Delhi.

SUGGESTED WEBSITES

1. https://swayam.gov.in
2. https://youtu.be/5VaspVpqiFQ
3. https://youtu.be/eZWO8qH7egQ

INSTRUCTIONAL STRATEGY

Students should practically make injection moulds for household, medical equipment and auto parts. Out of these, the student is required to prepare 10 nos. of sheets and a minimum of 02 sheets will be prepared by the student on computer using AutoCAD software or latest design software. This subject contains five units of equal weightage.

4.6 OPEN ELECTIVE

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RATIONALE

Open electives are very important and play major role in implementation of National Education Policy. These subjects provide greater autonomy to the students in the curriculum, giving them the opportunity to customize it to reflect their passions and interests. The system of open electives also encourages cross learning, as students pick and choose subjects from the different streams.

COURSE OUTCOMES

At the end of the open elective, the students will be able to:

CO1: State the basic concepts and principles about the subject of interest.
CO2: Perform in a better way in the professional world.
CO3: Select and learn the subject related to own interest.
CO4: Explore latest developments in the field of interest.
CO5: Develop the habit of self-learning through online courses.

LIST OF OPEN ELECTIVES

(The list is indicative and not exhaustive)

1. Computer Application in Business
2. Introduction to NGO Management
3. Basics of Event Management
4. Event Planning
5. Administrative Law
6. Introduction to Advertising
7. Moodle Learning Management System
8. Linux Operating System
9. E-Commerce Technologies
10. NCC
11. Marketing and Sales
12. Graphics and Animations

13. Digital Marketing
14. Human Resource Management
15. Supply Chain Management
16. TQM

GUIDELINES

Open Elective shall be offered preferably in online mode. Online mode open elective shall preferably be through Massive Open Online Courses (MOOCs) from Swayam, NPTEL, Upgrad, Udemy, Khan Academy or any other online portal to promote self-learning. A flexible basket of large number of open electives is suggested which can be modified depending upon the availability of courses at suggested portals and requirements. For online open electives, department coordinators shall be assigned to monitor and guide the group of students for selection of minimum 20 hours duration online course of their choice. For offline open electives, a suitable relevant subject shall be offered by the respective department to the students with minimum 40% of the total class strength as per present and future requirements.

Assessment of MOOCs open elective shall be based on continuous evaluation by the respective coordinator. The coordinator shall consider the submitted assignments by the students from time to time during the conduct of MOOCs. The MOOCs assessment shall be conducted by the coordinator along with one external expert by considering submitted assignments out of 100 marks.

In case, no suitable open elective is available online, only then the course may be conducted in offline mode. The assessment of offline open elective shall be internal and external. The offline open elective internal assessment of 40 marks shall be based on internal sessional tests; assignments etc. and external assessment of 60 marks shall be based on external examination at institute level.

NOTE

The students enrolled under NCC will compulsorily undertake NCC as an open elective subject.

SUGGESTED WEBSITES

1. https://swayam.gov.in/
2. https://www.udemy.com/
3. https://www.upgrad.com/
4. https://www.khanacademy.org/

4.7 MINOR PROJECT

L	P
-	4

RATIONALE

Minor project work will help in developing the relevant skills among the students as per National Skill Qualification Framework. It aims at exposing the students to the present and future needs of various relevant industries. It is expected from the students to get acquainted with desired attributes for industrial environment. For this purpose, students are required to be involved in Minor Project Work in different establishments.

COURSE OUTCOMES

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

CO1: Define the problem statement of the minor project according to the need of industry.
CO2: Work as a team member for successful completion of minor project.
CO3: Write the minor project report effectively.
CO4: Present the minor project report using PPT.

GUIDELINES

Depending upon the interest of the students, they can develop minor projects as per present and future demand of the industry. The supervisors may guide the students to identify their minor project work and chalk out their plan of action well in advance. As a minor project activity each student is supposed to study the operations at site and prepare a detailed project report of the observations/processes/activities. The supervisor may create a group of 4-5 students as per their interest to work as a team for successful completion of the minor project.

The supervisor shall evaluate the students along with one external expert by considering the following parameters:

	Parameter	**Weightage**
i	Defining problem statement, focus and approach	20%
ii	Innovation / creativity	20%
iii	Report Writing	20%
iv	Power Point Presentation	20%
v	Viva - voce	20%

THIRD YEAR

NSQF LEVEL - 5

FIFTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits L+P= C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Total	Th	Pr	Total	
5.1	Industrial Training II	-	2	0+1=1	-	40	40	-	60	60	100
5.2	Plastic Processing Techniques-III	3	6	3+3 = 6	40	40	80	60	60	120	200
5.3	* Entrepreneurship Development & Management	3	-	3+0 = 3	40	-	40	60	-	60	100
5.4	Compounding and Formulation of Plastics	2	6	2+3 = 5	40	40	80	60	60	120	200
5.5	Plastic Recycling and Waste Management	2	6	2+3 = 5	40	40	80	60	60	120	200
5.6	Programme Elective-I	3	-	3+0 = 3	40	-	40	60	-	60	100
#	Student Centered Activities(SCA)	-	2	-	-	-	-	-	-	-	-
Total		**13**	**22**	**23**	**200**	**160**	**360**	**300**	**240**	**540**	**900**

* Common with other diploma programs.

\# Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

Programme Elective-1: 5.6.1 Plastic Packaging and Printing 5.6.2 Adhesive and Coating Technology
5.6.3 Industrial Hazards and Safety

SIXTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits L+P= C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Total	Th	Pr	Total	
6.1	Maintenance of Plastic Processing Machines	3	2	3+1= 4	40	40	80	60	60	120	200
6.2	Plastic Product design	3	-	3+0 = 3	40	-	40	60	-	60	100
6.3	Programme Elective II	3	-	3+0 =3	40	-	40	60	-	60	100
6.4	Major Project / Industrial Training	-	20	0+10 =10	-	40	40	-	60	60	100
# Student Centered Activities (SCA)		-	4	-	-	-	-	-	-	-	-
Total		**9**	**26**	**20**	**120**	**80**	**200**	**180**	**120**	**300**	**500**

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

Programme Elective II: 6.3.1 Advance Plastic Processing Techniques 6.3.2 Polymer Composites 6.3.3 Rubber Technology

19. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects/Areas	Hours Per Week	
		Fifth Semester	Sixth Semester
1.	Industrial Training II	2	-
2.	Plastic Processing Techniques-III	9	-
3.	Entrepreneurship Development& Management	3	-
4.	Compounding and Formulation of Plastics	8	-
5.	Plastic Recycling and Waste Management	8	-
6.	Programme Elective-I	3	-
7.	Maintenance of Plastic Processing Machines	-	5
8.	Plastic Product design	-	3
9.	Programme Elective II	-	3
10.	Major Project / Industrial Training	-	20
11.	Student Centered Activities	2	4
	Total	**35**	**35**

20.COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Government and private sectors related to **Plastic Technology** require **supervisors** having well developed skills with clear choice of procedures. They are expected to have complete knowledge and practical skills related to plastic technology field. They shall be able to communicate clearly with others. Diploma holders after passing level 5 shall have understanding of desired mathematical skills and understanding of social and natural environment. They are expected to collect, organize and communicate information effectively.

Work requiring knowledge, skills and aptitudes at level 5 will also be carried out in familiar situations, but also ones where problems may arise. Job holders will be able to make choices about the best procedures to adopt to address problems where the choices are clear. Individuals in jobs which require level 5 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They will require well developed practical and cognitive skills to complete their work. They may also have some responsibility for others' work and learning.

Plastic Technology diploma pass out students will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their work. They will be expected to operate hygienically and in ways which show an understanding of environmental issues. They will take account of health and safety issues as they affect the work they carry out or supervise. They are expected have good theoretical and practical knowledge of various plastic processes to work efficiently in plastic technology related companies. They might find work with various plastic manufacturing companies.

They will have scope of wage employment in organizations like

- Plastic Processing Industries such as
    - Packaging
    - Carry Bag
    - Raw Material
    - Household Articles
    - Paints, Coatings and Lacquers
    - Adhesives
    - Wire and Cable Coating
    - Polymeric Composites, Elastomers and Sealants
    - Conduit Pipes
- Polymer Manufacturing Industry

- Industries manufacturing Electrical Components and Accessories
- Chemical Industry
- Automobile Industry
- Textile Industry
- Agricultural Appliances Industry
- Footwear Industry
- Furniture Making Units
- Toy Manufacturing
- Rexin (artificial leather cloth) Manufacturing Unit.
- Dairy Industry
- Medical Industry
- Sports Goods Industry
- Hand Tool Manufacturing Industry

21. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 5 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Perform task that require well developed skills with clear choice of procedures.

PO2: Acquire knowledge of facts, principles and processes related to plastic technology.

PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems.

PO4: Develop skills to collect, organize and communicate information.

PO5: Accomplish own work and supervise others work.

22. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Perform task that require well developed skills with clear choice of procedures.	• Describe plastic processing technique like injection moulding and their construction features. • Explain injection moulding for thermosets. • Describe blow moulding process and their types. • Describe concept of rotational moulding. • Discuss harmful effect of Plastic pollutants. • Describe plastic waste and its separation techniques. • Explain concept of polymer degradation. • Define and classify additives. • Describe various formulations and role of ingredients. • Describe various design activities. • Discuss various assembly methods related to joining of plastics. • Describe melt adhesive technique, uses. • Explain different types of resins used in Adhesive. • Explain concept to polymer composites. • Describe various polymer composites materials. • Explain various polymer composites properties and testing.
PO2: Acquire knowledge of facts, principles and processes related to plastic technology.	• Explain concept of compounding and differentiation from mixing. • Define and classify additives.

	• Describe various formulations and role of ingredients. • Use various compounding equipments. • Manage plastic waste. • Use various machines used in plastic recycling and other value addition of plastic waste. • Install and commission plastic processing machinery. • Repair and maintenance of electrical equipments. • Repair and maintenance of Mechanical parts and valves. • Describe conversion techniques of different plastic materials used in packaging. • Discuss application of different plastics packaging materials. • Explain plastic packaging products application for food products, medicines, horticulture, agriculture etc. • Describe different printing techniques used in packaging. • Discuss latest advancement in process of Injection moulding. • Explain advance process of Blow moulding. • Explain advance extrusion. process. • Describe compounding and reinforcement. • Discuss various methods used in the processing of rubbers.
PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems.	• Install and commission plastic processing machinery. • Repair and maintenance of electrical equipments. • Repair and maintenance of Mechanical parts and valves. • Explain various product design features.

	• Describe various design activities. • Discuss various assembly methods related to joining of plastics. • Explain importance of safety in chemical process industry. • Use concept of Toxicology in handling the chemicals • Use safety precautions and practices.
PO4: Develop skills to collect, organize and communicate information.	• Understand the working environment of industries • Learn about present and future requirement of industries. • Develop writing, speaking and presentations skills. • Observe technological developments as per present and future needs of industries. • Collect, communicate and manage the data from connected devices. • Comprehend the importance of entrepreneurship and its role in nation's development. • Classify the various types of business and business organizations. • Identify the various resources / sources and / or schemes for starting a new venture. • Explain the principles of management including its functions in an organisation. • Conduct market survey and prepare project report. • Define the problem statement of the Major project /Industrial training according to the need of industry. • Write the Major project / Industrial training report effectively. • Present the Major project / Industrial training report using PPT.

PO5: Accomplish own work and supervise others work.	• Take necessary safety precautions and measures. • Work in team for solving industrial problems • Develop competencies and skills required by relevant industries. • Define the problem statement of the Major project /Industrial training according to the need of industry. • Work as a team member for successful completion of Major project /Industrial training. • Write the Major project /Industrial training report effectively. • Present the Major project /Industrial training project report using PPT.

23. SUBJECTS & CONTENTS

(THIRD YEAR)

FIFTH SEMESTER

5.1 INDUSTRIAL TRAINING - II

L	P
-	2

RATIONALE

Industrial training will help the students to understand the working environment of relevant industries. The student will learn to work in team to solve the industrial problems. It willalso give exposure about the present and future requirements of the relevant industries. This trainingis very important for development of required competencies and skills for employment and start– ups.

COURSE OUTCOMES

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

CO1: Understand the working environment of industries
CO2: Take necessary safety precautions and measures.
CO3: Learn about present and future requirement of industries.
CO4: Work in team for solving industrial problems.
CO5: Develop competencies and skills required by relevant industries.
CO6: Develop writing, speaking and presentations skills.

PRACTICAL EXERCISES

1. Report writing based on industrial training.
2. Preparation of Power Point Slides based on industrial training and presentation by the candidate.
3. Internal Evaluation based on quality of Report, PPT preparation, PPT presentation and answerto queries.
4. External Evaluation based on quality of Report, PPT preparation, PPT presentation and answerto queries.

GUIDELINES

Students will be evaluated based on Industrial training report and their presentation using Power Point about the knowledge and skills gained during the training. The Headof the Department will depute faculty coordinators by assigning a group of students to each. The coordinators will mentor and guide the students in preparing the PPTs for final presentation. The following performance parameters are to be considered for assessment of the students out of 100 marks:

	Parameter	**Weightage**
i	Industrial assessment of the candidate by the trainer	40%
ii	Report Writing	20%
iii	Power Point Presentation	20%
iv	Viva-voce	20%

5.2 PLASTIC PROCESSING TECHNIQUES–III

L	P
3	6

RATIONALE

The purpose of this subject is to equip the students with the knowledge of processes utilized in extrusion and blow moulding. This subject develops the competence of the students in major industrially practiced plastic processing techniques.

COURSE OUTCOMES

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

CO1: Describe plastic processing technique like injection moulding and their construction features.

CO2: Explain injection moulding for thermosets.

CO3: Describe blow moulding process and their types.

CO4: Describe concept of rotational moulding.

DETAILED CONTENTS

UNIT I

Injection Moulding machines, their parts and specification

Selection criteria for injection moulding machine, basic principles of operations of injections moulding machinery, types of injection moulding machines, construction and working of injection moulding machines. Introduction, principles, process variables, mechanical, electrical, electronic control system. Parts and functions, general specification, construction of barrel, nozzles, interaction of moulding variable, optimization of cycle time.

UNIT II

Injection Moulding for thermo-set and defects

Injection moulding of thermosets. Defects in injection moulding products, their causes and remedies. Loading and unloading of mould on Injection moulding machine. Start-up and shut-down procedure for Injection Molding Machines.

UNIT III

Extrusion Blow Moulding

Basic principles of Extrusion blow moulding, blow moulding of irregular shapes, production of parison by extrusion, parison wall thickness control, parison blowing systems, effect of process variables on product design and properties, parison programming.

UNIT IV

Injection Blow Moulding

Basic principles of Injection Blow molding, their types, mould venting, Injection blow moulding principle, preform, stretch blow molding, blow up ratio.

UNIT V

Rotational Moulding

Basic principle, material selection, type of machines, process variables, wall thickness control, heating and cooling system, process requirement for the moulding of water tanks and dust bins. Application of rotational moulding, ejection and finishing. Defects and remedies of rotational moulding process.

PRACTICAL EXERCISES

1. Practice of Mould setting and produce small components on hand operated injection molding machine (at least 05 components each on 2/3 different moulds).
2. To study the specifications, construction and working principle of automatic injection molding machine.
3. To study the specifications, construction and working principle of PLC injection molding machine.
4. To practice on mould setting and produce components on automatic / CNC injection molding
5. To determine mould shrinkage for the component produced by Injection moulding machine.
6. Practice of mould setting and production of component on hand operated blow molding machine, using at least two different moulds.
7. Practice of mould setting, production of components on automatic blow moulding machine by setting the process parameters.
8. To produce small components on vertical hydraulic injection moulding machine.

RECOMMENDED BOOKS

1. SPI Plastics Engineering Handbook of the Society of the Plastics Industry by M.L. Berin
2. Plastic Engineering Hand book by Joel Frados
3. Processing of Plastics by AS Athalye
4. Plastic Processing Data Handbook by Rosato and Rosato

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://www.youtube.com/watch?v=RMzGBRL_o3E&list=PLSGws_74K01_G67ptndBraskY3jCW7FLQ

INSTRUCTIONAL STRATEGY

Teacher may use various teaching aids like models, charts, graphs and experimental work. Teacher should show model of replica of the component/working models of machines. This is a practice based subject and topic taught in the class should be practiced as exercises in the lab regularly for the development of processing skills in the students. For this purpose, Industrial visit may be organized at local level to enhance the skill of students. This subject contains five units of equal weightage.

5.3 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

L	P
3	-

RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

COURSE OUTCOMES

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

CO1: Comprehend the importance of entrepreneurship and its role in nation's development.
CO2: Classify the various types of business and business organizations.
CO3: Identify the various resources / sources and / or schemes for starting a new venture.
CO4: Explain the principles of management including its functions in an organisation.
CO5: Conduct market survey and prepare project report.

DETAILED CONTENTS

UNIT I

Entrepreneurship: Concept and definitions, classification and types of entrepreneurs, entrepreneurial competencies, Traits / Qualities of entrepreneurs, manager v/s entrepreneur, role of Entrepreneur, barriers in entrepreneurship, Sole proprietorship and partnership forms of business organisations, small business vs startup, critical components for establishing a start-up, Leadership: Definition and Need, Manager Vs leader, Types of leadership

UNIT II

Definition of MSME (micro, small and medium enterprises), significant provisions of MSME Act, importance of feasibility studies, technical, marketing and finance related problems faced by new enterprises, major labor issues in MSMEs and its related laws, Obtaining financial assistance through various government schemes like Prime Minister Employment Generation

Program (PMEGP) Pradhan Mantri Mudra Yogna (PMMY) , Make in India, Start up India, Stand up India , National Urban Livelihood Mission (NULM); Schemes of assistance by entrepreneurial support agencies at National, State, District level: NSIC, NRDC, DC:MSME, SIDBI, NABARD, Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubator (TBI) and Science and Technology Entrepreneur Parks (STEP).

UNIT III

NATURE AND FUNCTIONS OF MANAGEMENT: Definition, Nature of Management, Management as a Process, Management as Science and Art, Management Functions, Management and Administration, Managerial Skills, Levels of Management; Leadership.

PLANNING AND DECISION MAKING: Planning and Forecasting - Meaning and definition, Features, Steps in Planning Process, Approaches, Principles, Importance, Advantages and Disadvantages of Planning, Types of Plans, Types of Planning, Management by Objective. Decision Making-Meaning, Characteristics.

UNIT IV

ORGANISING AND ORGANISATION STRUCTURE: Organizing Process - Meaning and Definition, Characteristics Process, Need and Importance, Principles, Span of Management, Organisational Chart - Types, Contents, Uses, Limitations, Factors Affecting Organisational Chart.

STAFFING: Meaning, Nature, Importance, Staffing process. Manpower Planning, Recruitment, Selection, Orientation and Placement, Training, Remuneration.

CONTROLLING AND CO-ORDINATION Controlling - Meaning, Features, Importance, Control Process, Characteristics of an effective control system, Types of Control. Co-ordination - characteristics, essentials.

UNIT V

Market Survey and Opportunity Identification, Scanning of business environment, Assessment of demand and supply in potential areas of growth, Project report Preparation, Detailed project report including technical, economic and market feasibility, Common errors in project report preparations, Exercises on preparation of project report.

RECOMMENDED BOOKS

1. BS Rathore and Dr JS Saini, "A Handbook of Entrepreneurship", Aapga Publications, Panchkula (Haryana).
2. Entrepreneurship Development, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. CB Gupta and P Srinivasan, "Entrepreneurship Development in India", Sultan Chand and Sons, New Delhi.
4. Poornima M Charantimath, "Entrepreneurship Development - Small Business Enterprises", Pearson Education, New Delhi.
5. David H Holt, "Entrepreneurship: New Venture Creation", Prentice Hall of India Pvt. Ltd., New Delhi.
6. PM Bhandari, "Handbook of Small Scale Industry".
7. L M Prasad, "Principles and Practice of Management", Sultan Chand & Sons, New Delhi.

SUGGESTED WEBSITES

1. https://ipindia.gov.in/

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment or seminar method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organizations on visit. Approach extracted reading and handouts may be provided. In addition, different activities like conduct of entrepreneurship awareness camp extension lecturers by outside experts, interactions sessions with entrepreneurs and industrial visits may also be organized. This subject contains five units of equal weightage.

5.4 COMPOUNDING AND FORMULATION OF PLASTICS

L	P
2	6

RATIONALE

Properties of all plastics get significantly modified by judicious addition of certain additives and appropriate compounding techniques. This subject aims at giving a detailed exposure on this topic. This subject combined with the subject on Engineering and Specialty Polymers makes the students capable of preparing and formulating the right materials for processing.

COURSE OUTCOMES

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

CO1: Explain concept of compounding and differentiation from mixing.

CO2: Define and classify additives.

CO3: Describe various formulations and role of ingredients.

CO4: Use various compounding equipments.

DETAILED CONTENTS

UNIT I

Compounding Principle

Principles of compounding for modifying and enhancing:

a) processing characteristics
b) application properties
c) service life of plastics

UNIT II

Definition and classification of additives

a) Properties Modifiers : Plasticizers, Fillers, Impact modifiers, extenders,
b) Processing aids : Heat stabilizers, Lubricants, solvents and diluents,
c) Surface property modifiers: anti-block/anti-slip additives,
d) Colourants: Pigments and dyes.

UNIT III

Anti-ageing additives

a) Anti-ageing additives: Antioxidants, anti-ozonants, UV - stabilizers,
b) Miscellaneous additives: blowing agent, flame retardants and mould release agents, defoamers, smoke-suppressants.

UNIT IV

Formulations

Formulation and role of various ingredients in the compounding for both thermoplastics (PVC for rigid, semi-rigid and flexible applications and plastisols) and thermoset materials (unsaturated polyester, Epoxies)

UNIT V

Compounding equipments

Ribbon blender, High speed mixer, Banbury mixer, Tworoll mill, Mixer extruder (construction and working of these equipments), High sheer mixers, Intensive dry mixer, Twins crew extruders, construction and working of Kneaders, Dispersers.

PRACTICAL EXERCISES

1. Study and demonstration of compounding on Two Roll Mill machine.
2. Study and demonstration compounding on Mixer Extruder.
3. Study and demonstration of Kneaders.
4. Study of compounding on High Speed Mixers.
5. Formulations of PVC compounds: Rigid, Semi Rigid and Flexible.
6. Cutting dumbbell shaped test pieces for tensile strength from compression moulded sheet as prepared in (5) and finding tensile strength and elongation
7. Analysis of the effects off illers on mechanical properties of PVC compound.
8. Compounding of polyethylene with various additives, fillers, stabilizers, blowing agent and rubber.
9. Mechanical property measurement of compounded polyethylene and evaluation of the effect of compounding variables.

RECOMMENDED BOOKS

1. Modern Plastics Encyclopedia,Vol.59,No.10A, McGraw Hill, New York,
2. The Role of Additives in Plastics by L. Mascia, John Viley and Sons, New York
3. Anti-Oxidants by RRPaolino, in Modern Plastics Encyclopedia (MPE),1982
4. Polymer Mixing Technology by George Mathews, Elsevier, New York
5. Encyclopedia of PVC, Vol. 1,Marcel Dekker, New York
6. PVC Technology by Titow, Elsevier, UK
7. PVC Technology by ASA thalye, Popular Plastics and Packaging

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

Teacher may use various teaching aids like models, charts, graphs and experimental work. Teacher should show model of replica of the component/working models of machines. This is a practice based subject and topic taught in the class should be practiced as exercises in the lab regularly for the development of processing skills in the students. For this purpose, Industrial visit may be organized at local level to enhance the skill of students. This subject contains five units of equal weightage.

5.5 PLASTIC RECYCLING AND WASTE MANAGEMENT

L	P
2	6

RATIONALE

The objective of this subject is to create awareness in the students about the pollution aspects related to the plastic solid waste disposal, air pollution by plastics waste, incineration, and reusability and reprocessing of plastics and bio-degradation of plastics.

COURSE OUTCOMES

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

CO1: Discuss harmful effect of Plastic pollutants.

CO2: Describe plastic waste and its separation techniques.

CO3: Explain concept of polymer degradation.

CO4: Manage plastic waste.

CO5: Use various machines used in plastic recycling and other value addition of plastic waste.

DETAILED CONTENTS

UNIT I

Pollution and Hazards related to Plastics

Pollution caused by plastics, loading of toxic chemicals from plastics into soil and water, Landfill, Incineration of Plastics. Public awareness regarding hazards caused by indiscriminate use of plastics, Proper disposal of plastics waste.

UNIT II

Plastic waste and its separation

Sources of plastic wastes, Collection of plastic waste, Sorting and segregation methods such as Identification marks, Density separation, Solvent separation, Floatation techniques and Equipment based sorting techniques.

UNIT III

Polymer degradation and their life expectancy

Natural and synthetic polymer and their compatibility with surroundings (starch and proteins,

silicones and other man-made fabrics). Agents for increasing life expectancy of polymers (stabilizers, plasticizers, lubricants).

UNIT IV

Plastic Waste Management Technique and waste disposal Techniques

Need and importance of plastic reprocessing, various stages in plastic recycling, Types of recycling: Primary, Secondary (Mechanical) and Tertiary recycling (Chemical). Advantages and disadvantages of recycling, land-filling, pyrolysis and incineration.

UNIT V

Recycling machinery and products:

Process flow chart by mechanical route - Basic Mechanical recycling Plant-Additives for improving quality of recycled products– value addition in Plastics recycling viz., PP/HDPE woven-sacks to Pots, PE/PE multilayer film waste to moulded products. Mulching, canal lining, rain water harvesting, wastewater recovery by membrane separation.

PRACTICAL EXERCISES

1. To conduct recycle ability test.
2. Collection of different plastic wastes and their segregation in various groups.
3. Conversion of collected samples into plastic granules.
4. Property modification of plastic granules by adding natural material like cellulose.
5. Mixing of virgin polymers with recycled polymers by melt method.
6. Mixing of virgin polymers with recycle polymers by solvent method.
7. To carry out plastic waste management of at least one department/ section of the polytechnic.
8. To recycle plastic film using agglomerate.
9. Plastic waste grinding using scrap grinder.

RECOMMENDED BOOKS

1. Natural Resource and Conservation by Oliver's Owen and Chisal
2. Living in the Environment by T.S. Miller
3. Environmental Science by Cumming an Saigo
4. Ecology of Natural Resource by Ramma Dey
5. Environmental and Plastics by AK Dey, New Age Publication

SUGGESTED WEBSITES

1. https://onlinecourses.nptel.ac.in/noc24_ce25/preview
2. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

Teacher may use various teaching aids like models, charts, graphs and experimental work. Teacher should show model of replica of the component/working models of machines. This is a practice based subject and topic taught in the class should be practiced as exercises in the lab regularly for the development of processing skills in the students. For this purpose, Industrial visit may be organized at local level to enhance the skill of students. This subject contains five units of equal weightage.

5.6 PROGRAMME ELECTIVE-I
5.6.1 PLASTIC PACKAGING AND PRINTING

L	P
3	-

RATIONALE

Packaging is recognized as major industry in all the developing countries. Many countries, export has increased, demanding more and more from packaging. Packaging is becoming a highly competitive field. The Course covers study of basic packaging materials like Plastic, Films, Laminated and other conventional and modern forms of packaging used in Food, Pharmaceuticals, Engineering and other Industries. It also covers packaging techniques and processes, etc.

COURSE OUTCOMES

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

CO1: Describe conversion techniques of different plastic materials used in packaging.
CO2: Discuss application of different plastics packaging materials.
CO3: Explain plastic packaging products application for food products, medicines, horticulture, agriculture etc.
CO4: Describe different printing techniques used in packaging.

UNIT I

Plastics, Thermoforming in Packaging

Co-extrusion, Extrusion-stretch Blow Moulding Low Density Polyethylene, Linear Low-Density Polyethylene .High Density Polyethylene, Ultra High Molecular High-Density Polyethylene, Polypropylene-Properties and Applications in Packaging,

UNIT II

Biaxial Oriented films

Polypropylene Films, Polystyrene-Properties, Processing and Applications, PVC in Packaging, Nylon - 6 Films, Polyester Film, identification of Plastics, Expanded Polystyrene, Expanded Polyethylene, Plastic Woven Sacks, Polycarbonate (PC).

UNIT III

Product Packaging-I

Packaging of Processed Food Products, dehydrated. Ready to use Foods, Packaging of Meat, Fish & Poultry, Packaging of Fresh Foods, Packaging of Dairy Products, Packaging of Biscuits, Bread & Confectionery, Packaging of fruit Juices, A septic Packaging–Sterilization of Packaging Materials, Using Aseptic System, Aseptic Packaging, Sterilization by Irradiation, radiation.

UNIT IV

Product Packaging-II

Packaging of Horticultural Crops, Packaging of Pharmaceutical Products injectable, Packaging of Pharmaceutical products - Orals, Packaging of Textiles, Packaging of Fertilizers &Chemical.

UNIT V

Printing Techniques

Printing Techniques, Gravure, Flexography, Inkjet Printing for coding, Marking Applications, Surface Design and Sales Appeal, Graphic and Surface design, Printing Inks, Bar Coding, Reinforcements on Distribution Packages, Corrosion Prevention in Packaging, Principles of Corrosion and its impact on Packaging. Adhesive Tapes, their Manufacture, Properties & Laminations, BOPP Pressure Sensitive Tapes.

RECOMMENDED BOOKS

1. Plastics Packaging Properties, Processing, Applications, & Regulations by Susan E.M. Selke and John D. Culter
2. Plastic Films: Technology and Packaging Applications by Wilmer A. Jenkins, Kenton R. Osborn.

SUGGESTED WEBSITES

1. https://onlinecourses.nptel.ac.in/noc24_ag07/preview

INSTRUCTIONAL STRATEGY

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

5.6.2 ADHESIVE AND COATING TECHNOLOGY

L	P
3	-

RATIONALE

This course is designed to impart knowledge relating to adhesive and coatings to the students. Study of this course will enable them to learn about the types, raw materials, defects and testing of adhesive and coatings. The students will also learn about the water and solvent based adhesive.

COURSE OUTCOMES

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

CO1: Describe melt adhesive technique, uses.
CO2: Explain different types of resins used in Adhesive.
CO3: Discuss coating and their types.
CO4: Explain water and solvent based adhesive**.**

DETAILED CONTENTS

UNIT I
Introduction to Adhesives

Definition of adhesives, classification of adhesives, components of adhesives, various terms like glue line, setting time, solvent cementing etc. Effect of various factors on bond strength like pressure, temperature, surface energy, surface preparation, time given for adhesion.

UNIT II
Hot Melt Adhesive

Definition, applications, preparation, advantages and disadvantages (poly-ethylene's)

UNIT III

Various Resins used in Adhesives and their applications

Preparation, properties, advantages and limitation of:

1. Urea formaldehyde,
2. Melamine formaldehyde,
3. Epoxies,
4. Polyurethanes, Adhesives for wood, adhesives for metals, adhesives for polymers etc.,

UNIT IV

Introduction to Coatings

Definition, components of coatings (solvent, resin, pigments, stabilizers, additives, filters) Types of coatings - water borne (latex), oil borne coatings, varnishes with and without Solvent (elastomeric coatings).

UNIT V

Water and solvent based Soluble Coatings and their defects

Raw materials, manufacturing, properties and applications, Solvent Based Coatings Raw materials, manufacturing, properties of varnishes and applications of epoxy coatings, Polyurethane, silicone, polyester coatings, cratering, all yatoring, moisture inhepment, peel-off, Fading, yellowing etc.

RECOMMENDED BOOKS

1. Adhesive Technology by John Delmonk
2. Coatings by Swaraj Paul

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

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

5.6.3 INDUSTRIAL HAZARDS AND SAFETY

L	P
3	-

RATIONALE

This subject is introduced to give the students a thorough knowledge of safety techniques and other safety parameters, which is essentially required for working in any plastic industry.

COURSE OUTCOMES

After completion of this course, the students will be able to:
CO1: Explain importance of safety in chemical process industry.
CO2: Use concept of Toxicology in handling the chemicals
CO3: Use safety precautions and practices.
CO4: Classify fire and accidents and their prevention.
CO5: Apply safety precaution in storing inflammable gases/vapors.

DETAILED CONTENTS

UNIT I

Concept of Safety

Definition of safety and loss prevention, hazards and their classification, importance of safety in chemical process industry, statutory requirement for safety norms to be maintained by the industries.

UNIT II

Toxicology

Concept of toxicity, dose and response, concept of threshold limit value, hazards from gases/chemicals, symptoms and their remedial action. Effect on ecosystem, hazards prevention techniques.

UNIT III

Accidents and Safety

Accidents and their classifications, treatment after accident, safety precautions and

promotion of safety practices. Personal protective equipment and clothing used in industry.

UNIT IV

Fire and Prevention

Classification of fires, flammable and inflammable liquids, concept of fire triangle, various types of fire extinguishers with their applications, Boiling Liquid Expansion Vapor Explosion, Concept of flammability, lower and upper flammability limiting oxygen concentration (theoretical only)

UNIT V

Safety in Chemical Industry

Receiving, storing and transporting chemicals. Precautions in the case of processes/ operations involving explosives or inflammable dusts, gases, vapours.

RECOMMENDED BOOKS

1. Fawelt and Wood, "Safety and Accident Prevention in Chemical Operation", Inter Science Publication.
2. Coulson and Richardson, "Chemical Engineering, Vol I, II, II and IV", Pergamon Press Publication.
3. Wills, G.L., "Safety in Process Plant Design".
4. Less, F.P., "Loss Prevention in Process Industries".
5. "Safety for Chemical Engineers", AI.ChE Publications.
6. Pandey, G.N., and GC Carney, "Environment Engineering", Tata McGraw Hill Publication.
7. Nemerow, "Liquid Wastes of Industries", Addison Wesley Publication.

INSTRUCTIONAL STRATEGY

Industry visits can be planned to give idea about he practices adopted in the industry. Demonstrations can be arranged for various types of fire extinguishers used in buildings. Pictures and movies can be shown to the students regarding prevention and abetment of fire, use of firefighting devices, precautions taken while storing and transporting plastic.

SIXTH SEMESTER

6.1 MAINTENANCE OF PLASTIC PROCESSING MACHINES

L	P
3	2

RATIONALE

Most of the diploma holders get employment in plastic processing industry, where they operate processing machinery and manage production. The purpose of this subject is to equip these students with the knowledge of repair and maintenance of such machines and equipments.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:
CO1: Describe maintenance and their classification.
CO2: Install and commission plastic processing machinery.
CO3: Repair and maintenance of electrical equipments.
CO4: Repair and maintenance of Mechanical parts and valves.

DETAILED CONTENTS

UNIT I
Maintenance and its types

Maintenance, objective of maintenance, importance of maintenance, preventive maintenance, break-down maintenance, predictive maintenance, schedule maintenance, maintenance planning and total productive maintenance.

UNIT II
Commissioning and alignment of machines

Factors to be considered by installation/erection and commissioning of plastic processing machinery, Vibrations and foundation. General method of alignment/ leveling.

UNIT III
Repair and maintenance of following electrical equipments

Electrical induction motors (slipping motors and squirrel cage motors),variable speed motors,theircharacteristicsandspeedcontrol-Starters,circuitbreakers(aircircuit breakers, oil

circuit breakers and miniature circuit breakers) - Brief introduction to limit switches timers, relays, temperature controllers, and thermocouples, heaters (ordinary and ceramic type) - Study of safety rules and regulations

UNIT IV

Repair and maintenance of plastics processing machinery

Repair and maintenance of following components used in plastics processing machinery like Barrel, screw, thrust unit, primary gearboxes, calendar roll, mill rolls. Pumps such as gear pump, piston pump, radial/axial pump and screw pump.

UNIT V

Repair and Maintenance of Valves

Valves, valve sequences, valve counted balance, break valve, pressure reducing valve throttle valve, different control valves, solenoid valves - Hydraulic motors, hydraulic actuators and pneumatic controls, filters, compressors, oil seeds, o-rings-Lubrication system-central lubrication, system-Transmission system i.e. gears, v-belts, chains.

PRACTICAL EXERCISES

1. To check the alignment and leveling of PVC pipe plant,
2. To check the alignment and leveling of injection moulding machine
3. To check the alignment and leveling of extrusion and blow moulding machine.
4. Maintenance of Hydraulic system such as pumps, motors, valves, O-rings, oil seals.
5. To carry out lubrication and use of lubrication system in machines such as Injection moulding, Blow moulding machines.
6. Repair and maintenance of Pneumatic System like air compressors and valves.
7. Study and demonstration of various transmission systems (i.e. gears, V-belts, chains, rope).
8. Use of Precision equipments (such as vernier calipers, micrometer etc.) for measurement of dimension of parts/ components.
9. Maintenance of mould, die, screw and barrel.
10. To carry out breakdown maintenance of electrical equipments like induction motors, variables pedometers, circuit breakers used in plastics department.
11. Study of temperature control with thermocouples and timer (Digital & Analogue).

12. Hydraulic and Pneumatic Trainer Kit.

RECOMMENDED BOOKS

1. SPI Plastics Engineering Handbook of the Society of the Plastics Industry by M.L. Berin
2. Plastic Engineering Handbook by Joel Frados
3. Processing of Plastics by AS Athalye
4. Plastic Processing Data Handbook by Rosato and Rosato

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://www.youtube.com/watch?v=RMzGBRL_o3E&list=PLSGws_74K01_G67ptndBrask3jCW7FLQ

INSTRUCTIONAL STRATEGY

Teacher may use various teaching aids like models, charts, graphs and experimental work. Teacher should show model of replica of the component/working models of machines. This is a practice based subject and topic taught in the class should be practiced as exercises in the lab regularly for the development of processing skills in the students. For this purpose, Industrial visit may be organized at local level to enhance the skill of students. This subject contains five units of equal weightage.

6.2 PLASTIC PRODUCT DESIGN

L	P
3	-

RATIONALE

Diploma holders in plastic technology are expected to prepare the design of simple plastic products leading to development and its manufacturing. For doing this, they have to decide about material, process, machinery and testing procedures to manufacture equality products. This subject will impart requisite skills for plastic product design.

COURSE OUTCOMES

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

CO1: Describe basic requirement of plastic product design.

CO2: Explain various material and their selection criteria.

CO3: Explain various product design features.

CO4: Describe various design activities.

CO5: Discuss various assembly methods related to joining of plastics.

DETAILED CONTENTS

UNIT I
Design considerations

1. Preliminary design considerations for plastic product,
2. Mechanical requirements of Plastic product design,
3. various stages of product development,
4. Feasibility study and product lifecycle.

UNIT II
Materials Selection

Various materials and selection of material for particular application, cost economics, various processing limitations with plastic product design, effects of environmental exposure.

UNIT III

Product Design Features I

1. Surface finish
2. Texturing
3. Shape
4. Positioning of holes
5. Ribs and bosses
6. Fillet sand rounds
7. Wall thickness

UNIT IV

Product Design Features-II

1. Weld lines
2. Draft angles
3. Gate side and location
4. Moulded inserts
5. Plastic threads and profiles
6. Undercuts
7. Tolerance
8. Functional surfaces and Letters and alphabets

UNIT V

Assembly Methods and Designing Techniques

Welding and their types, riveting, solvent cementing and adhesion. Exposure to recent trends in product development like rapid prototyping, 3D printing etc. Basic concept of plastic gears.

RECOMMENDED BOOKS

1. Plastic product Design, Vol.1& II by RD Beck,Van Nostr and Reinhdol Co. Publication
2. Plastic Engineering Hand book by Brydson
3. PlasticsEngineeringHandbookbyJ.Frados,InternationalThomasPublishing

4. Plastics: Materials and Processing by A. Brent Strong, Prentice Hall of India, New Delhi
5. Plastic Product Design Hand book by Edward Miller, Marcel Dekker Publications
6. Plastics Technology: Theory, Design and Manufacture by William J. Patton

INSTRUCTIONAL STRATEGY

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

6.3 PROGRAMME ELECTIVE - II

6.3.1 ADVANCE PLASTIC PROCESSING TECHNIQUES

L	P
3	-

RATIONALE

After fabrication of the product post processing operations are necessary to make the product commercially presentable. Finishing and other decorating and printing operations are instrumental in enhancing the aesthetics and visual appeal of the product. The emphasis is given especially on printing, lamination, coating techniques, compression and transfer moulding and rotational moulding**.**

COURSE OUTCOMES

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

CO1:.Discuss latest advancement in process of Injection moulding.

CO2:.Explain advance process of Blow moulding.

CO3: Explain advance extrusion. process.

CO4: Describe low pressure foam and high pressure foam.

CO5:.Discuss Multilayer packaging and laminates.

DETAILED CONTENTS

UNIT I

Specialized Injection Moulding Process

Co-Injection Moulding

1. Two Colour Injection Moulding,
2. Gas – Assisted Moulding,
3. Water - Assisted Moulding,
4. Liquid Injection Moulding,
5. Lost core Injection moulding

Moulding Machines

1. Tie-bar less Injection Moulding
2. Robotics
3. Thin wall injection Moulding
4. Insert injection Moulding.

UNIT II

Advanced Blow Moulding Process

Classification of Advanced Blow Moulding Processes

1. Stretch Blow Moulding,
2. Extrusion Stretch Blow Moulding,
3. Injection Stretch Blow Moulding,
4. Multi-layer Blow Moulding.

UNIT III

Advanced Extrusion Process:

Profile Extrusion, material, process, process optimization and applications. Multi-layer blown films, its advantages and disadvantages, co-extruded sheets, Pipes, Corrugated sheets.

UNIT IV

Foam Moulding

Low Pressure foam, high pressure foam, Sandwich Moulding, Thin Wall Product Moulding, Reaction Injection Moulding and applications.

UNIT V

Laminates

Conversion of plastic films in to laminating. metal- plastic laminates, paper plastic laminates, plastic-plastic laminates. Advantages of multi- layer packaging, disadvantages of multi-layer packaging.

RECOMMENDED BOOKS

1. SPI Plastics Engineering Handbook of the Society of the Plastics Industry by M.L. Berin.
2. Plastic Engineering Hand book by Joel Frados.
3. Processing of Plastics by AS Athalye.
4. Plastic Processing Data Handbook by Rosato and Rosato.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://www.youtube.com/watch?v=RMzGBRL_o3E&list=PLSGws_74K01_G67ptndBraskY3jCW7FLQ

INSTRUCTIONAL STRATEGY

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

6.3.2 POLYMER COMPOSITES

L	P
3	-

RATIONALE

This course is designed to enable the students to acquire basic knowledge of reinforced plastics. The acquired knowledge will help the students in identifying the need for reinforcements, types of reinforcements and applications of reinforced plastics. Topics like nano-technology will help the students to keep abreast with the latest technological developments.

COURSE OUTCOMES

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

CO1: Explain concept to polymer composites.

CO2:Describe various polymer composites materials.

CO3: Explain various polymer composites properties and testing.

CO4: Discuss various applications and design parameters.

DETAILED CONTENTS

UNIT I

Types of Reinforcements Fiber

Reinforcements fibers, types, long and short fibers and particulates. Application area, Classification of Reinforced Plastics.

- FRP (fiber reinforced plastics)
- Particulate reinforced plastics
- Laminates/panels

UNIT II

Fiber Reinforced Plastics

Types of Fibers: carbon, glass fibers (E-glass), natural fibers (jute, aramid etc.), man-made fibers (acrylic, nylon, (PAN), FRPs, Preparation, properties and applications of FRPs including.

- Glass fiber reinforced polyesters
- Glass fiber reinforced epoxies

- Glass fiber with polyurethanes
- Carbon fiber reinforced epoxies, polyesters
- Nature fiber reinforced polyesters

UNIT III
Particulate Reinforced Plastics (PRP)

Different types of particulates; carbon black, silica, fly ash, talc, mica,$CaCO_3$, Metallic powder) Preparation, properties and applications of PRPs - Fly ash, reinforced epoxies, polyesters, metal particles filled polyurethanes, epoxy, Silica reinforced polyurethanes and epoxies-Talc reinforced silicones.

UNIT IV
Nano-composites

Introduction to Nano-particles and Nano-composites based on Nano clay and their types and applications, carbon nano tubes, application and manufacturing methods of nano-composites

UNIT V
Types of laminates

Rigid and flexible laminates Plastic – plastic laminates Plastic –other material (plastic–wood, plastic-paper, plastic-metal etc.) Laminates preparation, properties and applications of following laminates:

- Packing material of potato chips and biscuits
- Plywood

RECOMMENDED BOOKS

1. Handbook of Plastics, Elastomers and Composites by Charles A. Harper; Published by McGraw Hill Company, New Delhi.
2. Polymer Engineering Composites by McW Richardson; Published by Applied Science Publishers,
3. London Micro Component Polymer Systems by IS Miller and S Rostame.

SUGGESTED WEBSITES

1. https://www.youtube.com/watch?v=0kB0G6WKhKE&list=PLSGws_74K01-bdEEUElQ9-obrujIKGEhg
2. https://swayam.gov.in

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INSTRUCTIONAL STRATEGY

Theoretical knowledge of this subject should be properly imparted to the students. Extension lectures by experts from polymer industries can enrich the students with better inputs regarding the various processes involved for improving the quality of polymer products. Various types of techniques and latest development in polymer industry is essential for complete knowledge of the subject. This subject contains five units of equal weightage.

6.3.3 RUBBER TECHNOLOGY

L	P
3	-

RATIONALE

This course is designed to enable the students to acquire the basic knowledge of natural and synthetic rubber which will enable them to understand the fabrication of rubber articles. This specialized subject will help the students to keep abreast with the latest technological developments.

COURSE OUTCOMES

After undergoing this course, the students will be able to:
CO1: Describe different sources of natural and synthetic rubber.
CO2: Explain various synthetic rubbers and vulcanization processes
CO3: Describe compounding and reinforcement.
CO4: Discuss various methods used in the processing of rubbers.

DETAILED CONTENTS

UNIT I
Sources of natural and synthetic rubber

Historical background of natural and synthetic rubber, production of different grades of natural rubber from latex, smoke sheet and pale creep, rubber elasticity; basic concept and behavior. Definition, classification, scope, advantages of synthetic rubber over natural rubber.

UNIT II
Properties and applications of various synthetic rubbers

Properties and applications of synthetic rubbers like poly-butadiene rubber, polyisoprenebuty rubber, chloroprene rubber, nitrile rubber, SBR, EPDM rubber, poly-acrylic rubber, silicone rubber, poly-urethane rubber.

UNIT III
Vulcanization

Chemistry and technology of vulcanization, sulphur vulcanization, non-sulphur vulcanization, physical aspects of vulcanization

UNIT IV
Compounding and Reinforcement

Carbon black and non-black filters, plasticizers, softeners, extenders, antioxidants, anti-ozonants, special purpose additives, textiles.

UNIT V
Rubber Processing

Mixing, two roll mills, ban bury mixer, extrusion, calendaring, batch curing and continuous vulcanization, Manufacturing/fabrication of following rubber articles like tyres, cable etc.

RECOMMENDED BOOKS

1. Rubber and Plastics Technology by Premamoy Ghosh, Tata McGraw Hill Publishers, New Delhi, Mc Graw Hill Rubber Technology by M Morton.
2. Science and Technology of Rubbers by. Marks, Erman and Eirich
3. Rubber and Plastics Technology by. R Chandra and S Mishra, CBS Publishers and Distributors, New Delhi.
4. Rubber Technology and Manufacture by M Blow and C Hopburn.

INSTRUCTIONAL STRATEGY

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

6.4 MAJOR PROJECT/ INDUSTRIAL TRAINING

L	P
-	20

RATIONALE

Major project/Industrial training will help in developing the relevant skills among the students as per National Skill Qualification Framework. It aims at exposing the students to the present and future needs of various relevant industries. It is expected from the students to get acquainted with desired attributes for industrial environment. For this purpose, students are required to be involved in industrial training / Major Project Work in different establishments.

COURSE OUTCOMES

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

CO1: Define the problem statement of the Industrial training / Major project according to the need of industry.
CO2: Work as a team member for successful completion of Industrial training / Major project.
CO3: Write the Internship / Major project report effectively.
CO4: Present the Internship / Major project report using PPT.

GUIDELINES

Depending upon the interest of the students, they can go for Industrial training / Major project as per present and future demand of the industry. The supervisors may guide the students to identify their project work and chalk out their plan of action well in advance. As an Industrial training / Major project activity each student is supposed to study the operations at site and prepare a detailed project report of the observations/processes/activities. The supervisor may create a group of 4-5 students as per their interest to work as a team for successful completion of the Industrial training / Major Project.

The supervisor shall evaluate the students along with one external industry / academic expert by considering the following parameters:

	Parameter	**Weightage**
I	Defining problem statement, focus and approach	20%
ii	Innovation / creativity	20%
iii	Report Writing	20%
iv	Power Point Presentation	20%
v	Viva - voce	20%

24. ASSESMENT TOOLS AND CRITERION

The assessment is carried out by conducting:

1. Formative assessments
2. Summative assessments

1. FORMATIVE ASSESSEMENT

The formative assessment will be evaluated on the basis of the internal assessments for theory subjects and practical by the concerned teachers for evaluating the knowledge and skill acquired by students and the behavioral transformation of the students. This internal assessment is primarily carried out by collecting evidence of competence gained by the students by evaluating them at work based on assessment criteria, asking questions and initiating formative discussions to assess understanding and by evaluating records and reports, and sessional marks are awarded to them.

2. SUMMATIVE ASSESSMENT

The summative assessment will include end semester examination for theory part for each candidate and practical examination with viva voice. Each Performance Criteria will be assigned marks proportional to its importance and proportion of marks for Theory and Skills Practical for each subject should be laid down. The following assessment tools are used for effective student evaluation:

1. Theory
2. Practical
3. Minor & Major Project
4. Massive Open Online Courses(MOOCs)
5. Viva Voce
6. Industrial/In House Training
7. Professional Industrial Training

1. Theory Assessment

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems.

The formative evaluation for theory subjects may be caused through

i. Sessional/class-tests,
ii. Quizzes,
iii. Assignments,
iv. Seminars /Presentations
v. Attendance
vi. Case Studies

For Summative evaluation of theory, the question paper may comprise of three sections.

i. It should contain objective type question and multiple choice questions. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.

ii. It should contain short answer questions.

iii. Descriptive type questions, with some internal choice of the questions set may be given in this section

2. Practical Assessment

Evaluation of students performance in practical work (Laboratory experiments, Workshop practical /field exercises) aims at assessing students ability to apply or practice the concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work related attitudes. This will comprise of a creation of mock environment, wherever applicable in the skill lab which is equipped with all required equipment for development of desired skills. Candidate's soft skills, communication, aptitude, safety consciousness, quality consciousness etc. will be ascertained by observation and will be marked in observation checklist along with the assessment of Job carried out in labs and maintenance of Lab Record Files.

Formative and summative evaluation may comprise of weight ages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject. The end product will be measured against the specified dimensions and standards to gauge the level of skill achievements

3. Minor and Major Project Assessment

The purpose of evaluation of project work is to assess student's ability to apply, in an integrated manner, knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The project work assigned should be of relevance to the core skill, state of the art topics and the project areas that are pertaining to enhance job skill and enhance occupational opportunities. For both, minor and major project, Formative and summative evaluation may comprise of weight ages to performance on task, quality of product, nature and relevance of project and general behavior.

The formative assessment should include the continuous assessment based on the work allocated and mid semester viva voice or presentation. The final assessment will be the combination of the project undertaken, report submission and should be followed by viva- voce of the relevant subject.

In case of the assessment of this component, the team of examiners should be constituted and half of the examiners in the team should be invited from outside of the institute as expert for conducting the examination.

4. Massive Open Online Courses (MOOCs) Assessment

Open Elective and Multi-Disciplinary Elective may be covered through Massive Open Online Courses (MOOCs) to promote self-learning. These platforms promise open, online courses to massive numbers of students as they are free to join; they provide a wide range of courses. They allow for space and time flexibility and their participants can benefit from various online communication tools and access to quality content.

The coordinating Department/Centre/Office shall monitor every student to adopt the courses online of their choice and preference on Swayam portal. The duration of courses will vary depending on the level and credit points. Courses offered in the duration of 4-10 weeks for 2 to 3 credits at diploma level are to be opted. Students can get a certificate after registering and attending the classes and submitting the assignments/quizzes and qualifying nationwide conducted written exam.

On successful completion of each course, the institution offering the MOOCs course would issue the certificate, along with the number of credits and grades, through which the student can get credits transferred into his marks certificate issued by the parent institution. There may be standard norms for the host Institution to conduct the course that may include continuous evaluation through assignments, online quizzes, case studies, online writing exercises, term examinations, student feedback, online forum management, etc. The coordinating Department/Centre/Office of the

respective department shall monitor every student and submit to the Office of Examinations, a score sheet before the close of the even semester.

5. Viva Voce Assessment

This tool will be used to assess the conceptual understanding and the behavioral aspects as regards the job role and the specific task at hand. It will also include questions on safety, quality, environment and equipment's etc. Ask questions on non-prescribed tasks to ensure that the learners have complete knowledge on the assessment

6. Industrial / In-house Training Assessment

The two mandatory internships after First and Second Year of are to be assessed in 3rd and 5th semester subsequently. The training should be preferably done in the industry but can also be in house depending upon the stream and availability of resources in and around the institute. Faculty should be assigned each student and made responsible for the evaluation and assessment of the training. Formative assessment should be taken from the industry/institute/ department on the basis of performance, behavior and learning capabilities. Summative evaluation may comprise of weight ages on the basis of report submission / presentation followed by viva-voce of the relevant subject.

7. Professional Industrial Training Assessment

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. Formative and summative evaluation may comprise of weight ages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject.

The formative assessment should include the evaluation from the employer where the student is doing his training in the ratio of 40:60. The final assessment will be the combination of the employer assessment and evaluation by the faculty of the institute which shall include report submission/ presentation/ seminar followed by viva-voce of the relevant subject.

SGPA AND CGPA ASSESSMENT

The UGC recommends the following procedure to compute the Semester Grade Point Average

(SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the marks scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student ,i.e

SGPA (Si) = $\sum$(Ci x Gi) / $\sum$Ci

where Ci is the number of credits of the ith course and Gi is the marks scored by the student in the its course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme ,i.e.

CGPA = $\sum$(Ci x Si) / $\sum$ Ci

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

25. TEACHING LEARNING TOOLS FOR EFFECTIVE IMPLEMENTATION

For effective implementation of curriculum, the faculty and staff of institutions have to play a vital role in planning instructional experiences for the courses in four different environments viz. class-room, laboratory, library and field and execute them in right perspective. It is emphasized that only a proper mix of different teaching methods in all these places of instruction can bring the changes in students behaviour as stipulated in the curriculum document. It is important to understand curriculum document holistically and further be aware of intricacies of Teaching- Learning Tools for achieving curriculum objectives. Given below are certain recommendations which may help in carrying out teaching-learning effectively:

PROGRAMME LEVEL RECOMMENDATIONS

1. Curriculum implementation takes place at programme, course and class-room level respectively and synchronization among them is required for its success. The first step towards achieving synchronization is to read curriculum document holistically and understand its rationale and philosophy.

2. An academic plan needs to be prepared at institute level. The Head of the institute has a great role to play in its dissemination and percolation up to grass-root level.

3. Heads of Department are required to prepare academic plan at department level referring to institutional academic plan.

COURSE LEVEL RECOMMENDATIONS

Teachers are educational managers at class room level and their success in achieving course level objectives lies in using course plan and their judicious execution which is very important for the success of programme by achieving its objectives. Teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/workshop practical's, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practical's and field experiences. Teachers are also required to do all these activities within a stipulated period which is made available to them in the academic plan at Board level. With the amount of time to their credit, it is essential for them to use

it judiciously by planning all above activities properly and ensure execution of the plan effectively. Following is the gist of suggestions for subject teachers for effective utilization of Teaching Learning Tools to achieve the course objectives:

1. Teachers need to ensure attainment of course outcomes so as to help the students achieve program outcomes and also meet the desired learning outcomes in five domains of NSQF i.e. Process, Professional knowledge, Professional skills, Core skills and Responsibility.

2. Teachers are required to prepare a course plan, taking into account number of weeks available and courses to be taught.

3. Teachers are required to prepare lesson plan for every theory class. This plan may comprise of contents to be covered, learning material for execution of a lesson plan.

4. Teachers are required to plan for expert lectures from field/industry. For this, necessary steps need to be taken such as planning in advance, identifying field experts, making correspondence to invite them, taking necessary budgetary approval etc.

5. Teachers are required to plan for guided library exercises by identification of course specific experience requirement, setting time, assessment, etc. The assignments and seminars can be thought of as terminal outcome of library experiences.

6. Concept based industrial/field visits may be planned and executed for such contents of course which are abstract in nature and no other requisite resources are readily available in institute to impart them effectively.

7. Lot of focus needs to be laid on skill development. There is need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem based learning and experiential learning effectively. The development and use of lab manuals will enable the institutes to provide lab experiences effectively.

8. Emphasis should to laid on developing soft skills like communication skills, personality Development, self-learning, inter personal skills, problem solving, and creativity etc.

9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time. While teaching, the teacher should make extensive use

of audio visual aids such as video films, power point presentations and IT tools.

10. Teachers may take an initiative in establishing liaison with industries and field organizations for imparting field experiences to the students.

11. To enhance digital learning, open electives and multi-disciplinary electives have been provided in the curriculum to be taken up in the form of MOOCs. For Open electives, some courses may be identified out of the prescribed list given in the curriculum keeping in mind the interest of students. Similarly, for multi-disciplinary electives, courses to be offered may be identified by considering their relevance and utility. Every year SWAYAM is notifying the list of courses which are going to be offered in forthcoming even and odd semester. The institute needs to select the courses that are offered on SWAYAM platform or any other online platform.

12. For effective implementation of Massive Open Online Courses (MOOCs), a faculty member in the department may be identified and given the responsibility to coordinate various activities related to MOOCs. The concerned faculty member will facilitate in registration of students for MOOCs. The faculty member will also be responsible for compiling the result of students on the completion of MOOCs and pass on the information to the concerned authority.

13. Flexibility has been provided in the curriculum for the students to choose a course related to the discipline as per their interest. For effective implementation of discipline-specific electives, the institute should identify some courses from the list of courses prescribed in the curriculum. The courses should be selected and offered keeping in mind the interest of students, infrastructure and expertise available in and around the institute related to the courses. Option for discipline-specific elective may be taken from students through a form and a course, with more than 10 students opting for it, may be run.

14. Students should be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.

15. Any relevant contents beyond the syllabus may be covered by the teacher or experts in extra time.

16. Minor project should be identified and allocated taking into consideration the inputs from industry stake-holders, and departmental faculty. The minor project work should be such

that it enhances the fundamental skill-sets of the students from industry perspective and subsequently helps them to handle major project.

17. For major project work, students may be given relevant and well thought out problems, which are purposeful and develop practical skills. This will help the students in developing creativity and confidence for their gainful employment.

18. A Project bank may be developed in consultation with related industry, research institutes and other relevant field organizations. It may be ensured that that the students take up some live problems being faced by industry as part of project work.

26. LIST OF EXPERTS

1. Controller of Examination, Haryana State Board of Technical Education, Panchkula.
2. Controller of Admn. & Finance, Haryana State Board of Technical Education, Panchkula.
3. Joint Secretary, Haryana State Board of Technical Education, Panchkula.
4. Deputy Secretary, Training & Placement, Haryana State Board of Technical Education, Panchkula.
5. Deputy Secretary, Examination, Haryana State Board of Technical Education, Panchkula.
6. Deputy Secretary, Academic, Haryana State Board of Technical Education, Panchkula.
7. Assistant Secretary, Academic, Haryana State Board of Technical Education, Panchkula.
8. Mr. Pankaj Garg, HOD, Plastic Engineering Department, Government Polytechnic, Ambala
9. Mr. Shiv Kumar, Lecturer, Plastic Engineering Department, Government Polytechnic, Ambala.
10. Mr. Ajay Kumar, Lecturer, Plastic Engineering Department, Government Polytechnic, Ambala.
11. Mr. Rahul Singh, Lecturer, Plastic Engineering Department, Government Polytechnic, Ambala.
12. Mr. Durg Singh, Plant Head, Sanmati Packaging Pvt. Ltd., Ghaziabad
13. Mr. Praveen Kumar Panda, Sr. General Manager, The Supreme, Industries Ltd., Village Serseni, Lalru.
14. Mr. Shaik Mohammed Khaja, CIPET – IPT, Murthal.
15. Mr. Rajesh Kumar Dhunna, HOD, Plastic Engineering Department, Pt. JR Government Polytechnic College, Hoshiarpur.
16. Mr. Rajiv Sharma, HOD, Plastic Engineering Department, CR Polytechnic, Rohtak.
17. Dr. Keshak Babu, Lecturer, Plastic Engineering Department, CR Polytechnic, Rohtak
18. Smt. Pushpa Rani, Senior Lecturer, Applied Science Department, Government Polytechnic, Sonipat, Haryana.

19. Smt. Krishna Bhoria, Lecturer, Applied Science Department, Government Polytechnic, Ambala,

20. Ms. Monika, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.

21. Dr Neena Sharma, English Department, MCM College, Chandigarh.

22. Mr. Satyawan Dhaka, Senior Lecturer, Applied Science Department, Government Polytechnic, Nilokheri.

23. Mrs. Sapna Sang, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla.

24. Mr. Ravi Bansal, Lecturer, Applied Science Department, Government Polytechnic, Manesar.

25. Mrs. Kiran, Lecturer, Applied Science Department, Government Polytechnic, Sonepat.

26. Dr. Naveen Jha, Assistant Professor, Department of Mathematics, Government Engineering College, Bharatpur.

27. Dr. KC Lachhwani, Assistant Professor, Applied Science, NITTTR, Chandigarh

28. Dr. Vidhi Grover, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla.

29. Mr. Tavinder Singh, Lecturer, Applied Science Department, Government Polytechnic, Sirsa.

30. Ms. Sunita Rani, Lecturer, Applied Science Department, Government Polytechnic, Ambala.

31. Mr. Subhash Chandra Bhoria, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Hisar.

32. Mr. Jagjit Singh Narang, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Ambala.

33. Mr. Pardeep Kumar, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Nilokheri.

34. Dr. Bhajan Lal, Lecturer, Applied Science Department, Government Polytechnic for Women, Sirsa, Haryana.

35. Sh. Anil Nain, Lecturer, Applied Science Department, Government Polytechnic, Hisar, Haryana.

36. Dr. Sarita Mann, Lecturer, Applied Science Department, Government Polytechnic,Ambala, Haryana.

37. Smt. Bindu Verma, Lecturer, Applied Science Department, Seth Jai ParkashPolytechnic, Damla, Haryana.

38. Dr. Pankaj Sharma, Professor, Applied Science Department, NITTTR, Chandigarh.

39. Dr. Ashok Kumar, Associate Professor, Applied Science Department, NITTTR, Chandigarh.

40. Sh. Vikas Sharma, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Nilokheri, Haryana.

41. Sh. Rajiv Verma, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Adampur, Haryana.

42. Sh. Parveen Saini, Lecturer, Mechanical Engineering Department, Government Polytechnic, Nilokheri, Haryana.

43. Sh. BaljeetSiwach, Lecturer, Mechanical Engineering Department, Government Polytechnic, Sonepat, Haryana.

44. Sh. Kapil Sharma, Lecturer, Mechanical Engineering Department, Seth Jai Parkash Polytechnic, Damla, Haryana.

45. Sh. Gulab Singh, Workshop Instructor, Mechanical Engineering Department, Seth Jai Parkash Polytechnic, Damla, Haryana.

46. Sh, Baltar Singh, Workshop Superintendent, Mechanical Engineering Department, Government Polytechnic, Ambala, Haryana.

47. Sh. Dinesh Mor, Workshop Superintendent, Workshop Department, Government Polytechnic, Sonipat, Haryana.

48. Sh. Balwan Singh, Workshop In-charge, Mechanical Engineering Department, Aryabhatt Institute of Technology, Delhi.

49. Sh. Veer Daman Singh, Regional Manager, Lincoln Electric India Company Pvt Ltd.

50. Sh. Manmohan Singh, Workshop Superintendent, Mechanical Engineering Department, Government Polytechnic, Damla, Haryana.

51. Sh. Ashwani Kumar, Workshop Instructor, Electrical Engineering Department, Government Polytechnic, Damla, Haryana.

52. Sh. Rajneesh Rana, Workshop Instructor, Electronics Engineering Department, Government Polytechnic, Damla, Haryana.

53. Mr. KG Srinivasa, Professor, Information Management & Emerging Engineering, NITTTR, Chandigarh.

54. Dr. Rajesh Mehra, Professor and Head, Curriculum Development Centre, NITTTR, Chandigarh.

55. Dr. AB Gupta, Professor and Head, Education & Educational Management Department, NITTTR, Chandigarh.

56. Er. PK Singla, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.

57. Dr. SK Gupta, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.
Coordinator

58. Dr. Meenakshi Sood, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.

27. APPENDIX

Sr. No.	LIST OF EQUIPMENT
1.	Ball Mill
2.	Mixer (liquid- liquid mixing)
3.	Two roll mill for crushing
4.	Air Compressor
5.	Jaw Crusher
6.	Cyclone Separator
7.	Plate and frame filter press
8.	Sieve shaker
9.	High vacuum pumps
10.	Packed column
11.	Agitating equipment
12.	Particle setting in fluids
13.	Sedimentation apparatus
14.	Friction pipe
15.	Weirs, channels, v-notch
16.	Centrifugal pumps
17.	Viscometer
18.	Rota-meter, Pitot tube
19.	Manometer
20.	Globe valve, Check valve, butter fly valve, blind valve
21.	Orifice meter
22.	Gate valve
23.	Bernoulli's equation apparatus
24.	Bimetallic thermometer
25.	Pneumatic gauge
26.	Hydraulic gauges
27.	Pyrometer
28.	Thermocouple
29.	Reynolds measuring apparatus
30.	Lathe Machine (gear operated with motor 1.8 m size, 4 jaw or 3 jaw, chucks and center chuck)
31.	Shaper

32.	Radial drill machine
33.	Radial drill machine (25 mm size)
34.	Grinder 250 mm size
35.	Universal milling machine with DRO system
36.	Vertical milling machine with DRO system
37.	Surface grinder (with magnetic chuck size 800x400 mm)
38.	Pantograph machine
39.	Fitter benches
40.	Vice 150 mm
41.	CNC EDM
42.	Jig boring
43.	CNC Lathe
44.	Hand operated injection molding machine (10 grams capacity with thermostat control)
45.	Hand operated injection molding machine (25 grams capacity)
46.	Hand operated compression molding machine with thermostat (25 ton)
47.	Extrusion Blow molding machine
48.	Injection Blow moulding Machine
49.	Heating Oven
50.	Dehumidifiers
51.	Embossing machine
52.	Grinder cum polisher
53.	Hand Grinder
54.	Horizontal injection molding machine 120 grams capacity, hydraulic operated
55.	Compression molding machine (hydraulic operated 50T)
56.	Thermal Guns (IR based)
57.	Auto ancillary equipment (hopper and auto-suction mechanism)
58.	PVC extruder 40 mm size, with motor cutter with haul up system for pipe and cable coating
59.	Rotogravure (Multi-color printing)
60.	Film blowing machine 19 mm size with blower and motor (LDPE/LLDE/HDPE)
61.	Extruder for blown film and die for granulation
62.	Two roll mixing mill electrically heated 3000C maximum 300 mm with speed controller with gear (including watt meter)
63.	High speed Blender
64.	Scrap Granulator
65.	Horizontal injection molding machine (120 – 160 grams with micro processor attachment)

66.	Horizontal injection moulding semiautomatic – 100 gm capacity
67.	Thermoforming/vacuum forming machines
68.	Lab model for injection moulding
69.	Lab model for vacuum forming
70.	Lab model for Extrusion process
71.	Plunger type Transfer Molding Machine
72.	
73.	High impact – polystyrene
74.	General purpose polystyrene (transparent)
75.	High density polyethylene
76.	Low density polyethylene (LDPE) and Linear low density polyethylene (LLDPE)
77.	Low density polyethylene (Blow molding grade)
78.	PVC powder
79.	Nylon 6, nylon 66
80.	ABS
81.	Acrylic
82.	Polypropylene
83.	Cellulose acetate
84.	Melamine formaldehyde
85.	Phenol formaldehyde
86.	Urea formaldehyde
87.	Plastic sheet 3 mm thickness
88.	Unsaturated polyester resin
89.	Polyester (PETP)
90.	PVC Sheets
91.	VSP and HDT tester
92.	Hardness testing machines (Rockwell Hardness and Shore Hardness
93.	Impact testing machine
94.	Ring and ball apparatus for softening point
95.	Abbe refractometer
96.	Apparatus for water content determination
97.	Photo-colorimeter
98.	PH meter
99.	Centrifuge (Lab Model)
100.	Vacuum drying oven with vacuum pump

101.	Industrial oven (hot air)
102.	Stirrers (magnetic and electrical)
103.	Analytical balances
104.	Heating mantles (500 w and 250 w)
105.	Water bath
106.	Temperature regulators
107.	Vacuum pump
108.	Falling dart
109.	Film bursting test
110.	Tear tester
111.	Heat resistor
112.	Constant temperature bath
113.	Specimen cutting press, Strip cutter
114.	Hydraulic Press
115.	Climatic/conditioning chamber
116.	Hot air oven
117.	Bending Tester
118.	Burst Strength Tester
119.	Dart Impact tester
120.	Water vapour permeability apparatus
121.	Melt flow indexer
122.	Gloss meter
123.	Mega ohm-meter
124.	Viscosity/molecular weight determination set up
125.	Spiral flow mould
126.	Smoke density tester
127.	Environmental stress cracking resistance tester (ESCR)
128.	Carbon black content tester
129.	Abrader
130.	Brook field viscometer


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