

**Study Scheme for  
Diploma Programme in  
PLASTIC TECHNOLOGY  
(BATCH-2018)**

For the State of Haryana



**Prepared by:**

**Curriculum Development Centre  
National Institute of Technical Teachers  
Training and Research  
Sector 26, Chandigarh - 160 019**

**Haryana State Board of Technical  
Education  
Bays 7-12, Sector 4  
Panchkula-134 112**

**July, 2018**

**FIRST YEAR (PLASTIC TECHNOLOGY)**

Sr. No.	SUBJECTS	STUDY SCHEME HOURS / WEEK			CREDIT	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
1.1*	English	2	-	2	6	40	25	65	60	3	50	3	110	175
1.2*	Applied Mathematics	3	1	-	7	40	-	40	60	3	-	-	60	100
1.3*	Applied Physics	2	1	2	7	40	25	65	60	3	50	3	110	175
1.4*	Applied Chemistry	2	-	1	5	40	25	65	60	3	50	3	110	175
1.5*	Applied Mechanics	2	-	2	6	40	25	65	60	3	50	3	110	175
1.6*	Environmental Studies	2	-	1	5	40	25	65	60	3	50	3	110	175
1.7*	Engg. Graphics	-	-	3	3	40	25	65	60	3	25 (viva)	3	85	150
1.8*	Information Technology	-	-	2	2	-	50	50	-	-	50	3	50	100
1.9*	Internet of Things & Artificial Intelligence	-	-	2	2	-	50	50	-	-	100	3	100	150
1.10*	General Workshop Practice	-	-	3	3	-	50	50	-	-	50	3	50	100
#	Student Centered Activities(SCA)	-	-	2	2	-	25	25	-	-	-	-	-	25
<b>Total</b>		13	02	20	48	280	325	605	420	-	475	-	895	1500

\*Common with other diploma programmes

# SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs, seminars, declamation contests, educational field visits, N.C.C., N.S.S., Cultural Activities and Disaster management etc.

### THIRD SEMESTER: PLASTIC TECHNOLOGY

Sr. No	Subject	STUDY SCHEME HOURS / WEEK L T P			EVALUATION SCHEME						Total Marks
					Internal Assessment		External Assessment (Examination)				
					Theory	Practical	Written Paper		Practical		
					Max. Marks	Max. Marks	Max. Marks	Hrs	Max. Marks	Hrs	
3.1	Plastic Processing Techniques- I	3	-	3	25	25	100	3	50	3	<b>200</b>
3.2*	Strength of Materials	4	-	3	25	25	100	3	50	3	<b>200</b>
3.3	Fluid flow	3	-	3	25	25	100	3	50	3	<b>200</b>
3.4	Polymer Science and Technology	4	-	-	25	-	100	3	-	-	<b>125</b>
3.5	Plastic Materials and Properties – I	3	-	-	25	-	100	3	-	-	<b>125</b>
3.6	Computer Aided Drafting & Design	-	-	3	-	50	-	-	50	3	<b>100</b>
3.7	Plastic Workshop Practices	-	-	4	-	50	-	-	100	3	<b>150</b>
Soft Skills –I		-	-	2	-	25	-	-	-	-	<b>25</b>
Total		<b>17</b>	-	<b>18</b>	<b>125</b>	<b>200</b>	<b>500</b>	-	<b>300</b>	-	<b>1125</b>

\* Common with diploma programmes in Mechanical Engineering

#### FOURTH SEMESTER: PLASTIC ENGINEERING

Sr. No	Subject	L T P Hrs/week			EVALUATION SCHEME						Total Marks
					Internal Assessment		External Assessment (Examination)				
					Theory	Practical	Written Paper		Practical		
					Max. Marks	Max. Marks	Max. Marks	Hrs	Max. Marks	Hrs	
4.1*	Basics of Electrical & Electronics Engg.	3	-	2	25	25	100	3	50	3	200
4.2	Plastic Testing -I	3	-	3	25	25	100	3	50	3	200
4.3	Fundamentals of Chemical Engineering	3	-	4	25	25	100	3	50	3	200
4.4	Plastic Processing Techniques-II	3	-	4	25	25	100	3	50	-	200
4.5	Plastic Materials and Properties –II	3	-	-	25	-	100	3	-	-	125
4.6	Computer Aided Mold and Die Design	-	-	3	-	50	-	-	100	3	150
4.7	Repair & Maintenance of Plastic Processing Machines	-	-	2	-	50	-	-	50	3	100
* Soft skill -II		-	-	2	-	25	-	-	-	-	25
<b>Total</b>		<b>15</b>	<b>-</b>	<b>20</b>	<b>125</b>	<b>225</b>	<b>500</b>	<b>-</b>	<b>350</b>	<b>-</b>	<b>1200</b>

#### Industrial Training

After examination of 4<sup>th</sup> Semester, the students will go for training in a relevant industry/field organisation for a minimum period of 4 weeks. He/She will be evaluated by his/her training officer in the industry/ organization (to be assigned in 5<sup>th</sup> semester).

**FIFTH SEMESTER: PLASTIC ENGINEERING**

S.No	Subject	L T P Hrs/week			EVALUATION SCHEME						Total Marks
					Internal Assessment		External Assessment (Examination)				
					Theory	Practical	Written Paper		Practical		
					Max. Marks	Max. Marks	Max. Marks	Hrs	Max. Marks	Hrs	
	Industrial Training	-	-	-	-	100	-	-	100	3	200
5.1	Plastic Processing Techniques-III	4	-	4	25	25	100	3	50	3	200
5.2	Design of Dies and Moulds – I	3	-	3	25	25	100	3	50	3	200
5.3	Plastic Testing -II	3	-	3	25	25	100	3	50	3	200
5.4	Compounding and Formulation of Plastics	4	-	2	25	25	100	3	50	3	200
5.5	Plastic Recycling and waste Management	3	-	2	25	25	100	3	50	3	200
	*Soft Skill -III	-	-	4	-	25	-	-	-	-	25
<b>Total</b>		<b>17</b>	<b>-</b>	<b>18</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>-</b>	<b>350</b>	<b>-</b>	<b>1225</b>

\* Common with other diploma programmes.

**SIXTH SEMESTER: PLASTIC ENGINEERING**

S.No	Subject	L T P Hrs/week			EVALUATION SCHEME						Total Marks
					Internal Assessment		External Assessment (Examination)				
					Theory	Practical	Written Paper		Practical		
					Max. Marks	Max. Marks	Max. Marks	Hrs	Max. Marks	Hrs	
6.1	Plastic Processing Techniques- IV	4	-	4	25	25	100	3	50	3	200
6.2	Design of Dies and Molds – II	4	-	4	25	25	100	3	50	3	200
6.3	Plastic Product Design	4	-	-	25	-	100	3	-	-	125
6.4*	Entrepreneurship Development and Management	3	-	-	25	-	100	3	-	-	125
6.5	Project Work	-	-	10	-	100	-	3	200	-	300
* Soft Skill -IV		-	-	2	-	25	-	-	-	-	25
<b>Total</b>		<b>15</b>	<b>-</b>	<b>20</b>	<b>100</b>	<b>175</b>	<b>400</b>	<b>-</b>	<b>300</b>	<b>-</b>	<b>975</b>

\* Common with other diploma programmes.



**FIRST YEAR**

**(Annual System)**



## 1.1 ENGLISH

**L T P**  
**2 - 2**

### RATIONALE

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

### LEARNING OUTCOMES

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

- Understand the importance of good communication
- Describe process of communication.
- Explain, Compare and re-write the types of communication
- Identify and match the parts of speech
- Rewrite sentences correctly
- Modify sentences and relate them with real life situations.
- Reproduce and match words and sentences in a paragraph.
- Re-write the sentences according to given situation.
- Relate and use various words using proper vocabulary and grammar.
- Write the various types of paragraphs, notices and composition on picture with appropriate format.

### DETAILED CONTENTS

- 1. Basics of Communication (06 Hrs)**
  - 1.1. Definition and process of communication
  - 1.2. Types of communication – Verbal (Listening, Speaking, Reading and Writing) and Non-verbal
  
- 2. Functional Grammar (22 Hrs)**
  - 2.1. Noun and Pronoun
  - 2.2. Punctuation
  - 2.3. Preposition
  - 2.4. Conjunction
  - 2.5. Tenses (verb (Main verb and Auxiliary verb)
  
- 3. Reading Skills (12 Hrs)**
  - 3.1. Unseen passage for comprehension. Based upon the passage, following aspects may be covered
    - Questions from the passage

- One-word substitution
- Prefixes and Suffixes
- Antonyms and Synonyms etc.

#### **4. Writing skills**

**(30 Hrs)**

- 4.1. Correspondence – Business and official
- 4.2. Notice, including Press Releases
- 4.3. Memos
- 4.4. Circular
- 4.5. Basics of Report Writing
- 4.6. Resume Writing
- 4.7. Writing E-mail
- 4.8. Paragraph writing
- 4.9. Picture composition

#### **LIST OF PRACTICALS**

1. Listening Exercises
2. Self and Peer Introduction
3. Debate
4. Situational Conversations: Offering - Responding to offers; Requesting – Responding to requests; Congratulating; Expressing sympathy and condolence; Apologizing and Forgiving; Complaining; Warning; Asking and giving information; Getting and giving permission; Asking for and giving opinions; Talking about likes and dislikes
5. Just a minute sessions – Extempore
6. Group Discussion
7. Newspaper reading
8. Mock Interviews: Telephonic and Personal

#### **INSTRUCTIONAL STRATEGY**

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

#### **MEANS OF ASSESSMENT**

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

#### **RECOMMENDED BOOKS**

1. Communicating Effectively in English, Book-I by Revathi Srinivas; Abhishek Publications, Chandigarh.
2. Communication Techniques and Skills by R. K. Chadha; Dhanpat Rai Publications, New Delhi.
3. High School English Grammar and Composition by Wren & Martin; S.Chand & Company Ltd., Delhi.
4. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

<b>Section</b>	<b>Percentage of syllabus to be covered</b>	<b>Units to be covered</b>	<b>Type of assessment</b>	<b>Weightage of Marks</b>	<b>Pass Percentage</b>
<b>A</b>	20%	Unit 1.1, 2.1, 4.1	1 <sup>st</sup> Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
<b>B</b>	20%	Unit 2.2, 4.2, 4.3	2 <sup>nd</sup> Internal		
<b>C</b>	60%	Unit 1.2, 2.3 to 2.5 , 3, 4.4 to 4.9	FINAL	60%	

## 1.2 APPLIED MATHEMATICS

L T P  
3 1 -

### 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, partial fractions, 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. Statistics is important for understanding of tolerances, quality assurance and quality control and it is also essential for data analysis.

### LEARNING OUTCOMES

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

- Apply complex number in engineering problems.
- Apply permutation and combination to count without actual counting.
- Apply permutation and combination to understand binomial theorem.
- Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem.
- Resolve rational functions to partial fractions for the use in Integral Calculus.
- Use matrices to provide solution to engineering problems.
- Solve different problems using trigonometry.
- Understand the geometric shapes used in engineering problems by Co-ordinate Geometry.
- Explore the idea of location, graph, and linear relationships between two variables.
- Compute slope, the equation of tangent and normal to a curve at a point using differentiation.
- Find maximum and minimum values of a function by application of differential calculus..
- Calculate simple integration by using concepts of integration.
- Find the velocity from acceleration and displacement from velocity using integration.
- Evaluate area under curves by using definite integrals
- Calculate the area under a curve and axes.
- Calculate the approximate area under a curve by applying numerical integration using Trapezoidal and Simpson's rules.
- Solve engineering and industrial problems using differential equations.
- Apply differential Equations and numerical methods for higher learning of mathematics and engineering applications.

## DETAILED CONTENTS

- 1. Algebra (30 Hrs)**
  - Law of Indices, Formula of Factorisation and expansion i.e.  $(a+b)^2$ ,  $(a^3+b^3)$  etc.
  - Partial fraction:- Definition of Polynomial fraction proper & improper fractions and definition of partial fractions. To resolve proper fraction into partial fraction with denominator containing non-repeated linear factors, only.
  - 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 number.
  - Logarithms and its basic properties
  - Determinants and Matrices – Evaluation of determinants (up to 3 order) by laplace method. Solution of equations (up to 3 unknowns) by Cramer’s Rule. Definition of Matrices and types, addition subtraction and multiplication of Matrices (up to 2 order).
  - Permutation, combination formula, Values of  ${}^n P_r$  and  ${}^n C_r$ .
  - Binomial theorem for positive integral index , General term, simple problems
  
- 2. Trigonometry (14 Hrs)**
  - Concept of angle: measurement of angle in degrees, grades, radians and their conversions.
  - T-Ratios of standard angle ( $0^\circ, 30^\circ, 45^\circ$  etc) and fundamental Identities, Allied angles (without proof) Sum, Difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa)
  - Applications of Trigonometric terms in engineering problems such as to find an angle of elevation, height, distance etc.
  
- 3. Co-ordinate Geometry (12 Hrs)**
  - Point: Distance Formula, Mid Point Formula, Centroid of triangle and area of triangle.
  - Straight line: 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, normal form, general form), angle between two straight lines.
  - Circle: General equation of a circle and identification of centre and radius of circle. To find the equation of a circle, given:
    - \* Centre and radius
    - \* Coordinates of end points of a diameter
  
- 4. Differential Calculus (40 Hrs)**
  - Definition of function; Concept of limits (Introduction only) and problems related to four standard limits only.

- Differentiation of standard function (Only formulas), Differentiation of Algebraic function, Trigonometric functions, Exponential function, Logarithmic function
- Differentiation of sum, product and quotient of functions.
- Successive differentiation (up to 2nd order)
- Application of differential calculus in:
  - (a) Rate measures
  - (b) Maxima and minima

**5. Integral Calculus (28 Hrs)**

- Integration as inverse operation of differentiation with simple examples.
- Simple standard integrals, Integrations by parts and related Simple problems
- Evaluation of definite integrals with given limits.

$$\text{Evaluation of } \int_0^{\pi/2} \sin^n x \, dx, \quad \int_0^{\pi/2} \cos^n x \, dx, \quad \int_0^{\pi/2} \sin^m x \cos^n x \, dx$$

using formulae without proof (m and n being positive integers only) using pre-existing mathematical models.

- Applications of integration: for evaluation of area under a curve and axes (Simple problems where the limits are given).
- Numerical integration by Trapezoidal Rule and Simpson's 1/3<sup>rd</sup> Rule using pre-existing mathematical models

**6. Differential Equations (04 Hrs)**

Definition, order, degree and linearity, of an ordinary differential equation. Solution of I<sup>st</sup> order and I<sup>st</sup> degree differential equation by variable separable method (Simple problems)

**7. Statistics (12 Hrs)**

- Measures of Central Tendency: Mean, Median, Mode
- Measures of Dispersion: Mean deviation from mean, Standard deviation
- Correlation coefficient and Coefficient of rank correlation (Simple problems)

**INSTRUCTIONAL STRATEGY**

Activity based teaching and learning process using Mathematics lab consisting of physical models and computer based tools/software emphasising Practice => Theory => Practice. 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.

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.

### MEANS OF ASSESSMENT

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

### RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics Vol. I & II by S Kohli, IPH, Jalandhar
3. Applied Mathematics, Vol. I & II by SS Sabharwal & Dr Sunita Jain, Eagle Parkashan, Jalandhar
4. Engineering Mathematics, Vol I, II & III by V Sundaram et al, Vikas Publishing House (P) Ltd., New Delhi
5. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
6. Applied Mathematics I, by Archana Sharma, Lords Publications, Jalandhar.
7. Engineering Mathematics by Srimanta Pal and Subodh C. Bhunia; Oxford University Press, New Delhi
8. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

### Websites for Reference:

<http://swayam.gov.in>

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
<b>A</b>	20%	Unit 1	1 <sup>st</sup> Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
<b>B</b>	20%	Unit 2,3	2 <sup>nd</sup> Internal		
<b>C</b>	60%	Unit 4,5,6,7	FINAL	60%	

## 1.3 APPLIED PHYSICS

L T P  
2 1 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 fields of engineering and technology are given prominence in the course content.

Note: Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to 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.

### LEARNING OUTCOMES

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

- Identify physical quantities, parameters and select their units for use in engineering solutions.
- Find units and dimensions of different physical quantities.
- Represent physical quantities as scalar and vectors.
- Use basic laws of motions,
- Analyse and design banking of roads and apply conservation of momentum principle to explain recoil of gun etc.
- Define work, energy and power and their units. Solve problems about work and power
  - State the principle of conservation of energy.
  - Identify forms of energy, conversion from one form to another.
  - Compare and contrast the physical properties associated with linear motion and rotational motion and give examples of conservation of angular momentum.
  - Describe the surface tension phenomenon and its units, applications, effects of temperature on surface tension.
  - Describe the viscosity of liquids.
  - Define stress and strain, modulus of elasticity.
  - State Hooke's law.
  - Measure temperature in various processes on different scales.
  - Distinguish between conduction, convection and radiation.
  - Use equipments like Vernier calliper, screw gauge, Spherometer.
- Differentiate between Transverse and Longitudinal, Periodic and Simple Harmonic Motion.
- Explain the terms: frequency, amplitude, wavelength, wave velocity, frequency and relation between them.



- Explain various engineering and industrial applications of ultrasonics.
- Apply acoustics principles to various types of buildings to get best sound effect.
- Explain the laws of reflection and refraction of light.
- Explain total internal reflection as applied to optical fibers.
- Define capacitance and its unit and solve simple problems using  $C=Q/V$
- Explain the role of free electrons in insulators, conductors and semiconductors.
- Application of semiconductors as diode, rectifiers, concept of transistors
- Explain electric current as flow of charge, the concept of resistance, heating effect of current.
- State and apply Ohm's law.
- Calculate the equivalent resistance of a variety of resistor combinations.
- Apply the concept of light amplification in designing of various LASER based instruments and optical sources.
- Apply the use of optical fibre in medical field and optical fibre communication.

## **DETAILED CONTENTS**

- 1. Units and Dimensions (11Hrs)**
  - 1.1 Definition of Physics, Physical quantities (Fundamental and derived),
  - 1.2 Units: fundamental and derived units,
  - 1.3 Systems of units: CGS, FPS, MKS, SI
  - 1.4 Definition of Dimensions;
  - 1.5 Dimensional formulae and SI units of physical quantities (distance, displacement, area, volume, velocity, acceleration, momentum, force, impulse, work, power, energy, pressure, surface tension, stress, strain)
  - 1.6 Principle of homogeneity of dimensions
  - 1.7 Dimensional equations, Applications of dimensional equations; checking of correctness of equation, Conversion of system of unit (force, work)
  
- 2. Force and Motion (14 Hrs)**
  - 2.1 Scalar and vector quantities –(Definition and examples),
  - 2.2 Addition of Vectors, Triangle & Parallelogram Law (Statement only),
  - 2.3 Scalar and Vector Product (statement and formula only)
  - 2.4 Definition of Distance, displacement, speed, velocity, acceleration
  - 2.5 Force and its units, concept of Resolution of force
  - 2.6 Newton's Law of motion (Statement and examples),
  - 2.7 Linear Momentum, conservation of momentum (Statement only), Impulse
  - 2.8 Circular motion: definition of angular displacement, angular velocity, angular acceleration, frequency, time period; Relation between linear and angular velocity.

- 2.9 Centripetal and centrifugal forces(definition and formula only)
- 2.10 Application of centripetal force in Banking of roads (derivation for angle of banking)

**3. Work, Power and Energy (08 Hrs)**

- 3.1 Work (Definition, Symbol, Formula and SI units)
- 3.2 Energy (Definition and its SI units), Examples of transformation of energy.
- 3.3 Kinetic Energy (Formula, examples and its derivation)
- 3.4 Potential Energy (Formula, examples and its derivation)
- 3.5 Law of conservation of mechanical energy for freely falling bodies (With . Derivation)
- 3.6 Power (definition, formula and units)
- 3.7 Simple Numerical problems based on formula of Power

**4. Rotational Motion (05 Hrs)**

- 4.1 Rotational motion with examples
- 4.2 Definition of torque and angular momentum and their examples
- 4.3 Conservation of angular momentum (quantitative) and its examples
- 4.4 Moment of inertia and its physical significance, radius of gyration (definition, derivation and formula).

**5. Properties of Matter (10 Hrs)**

- 5.1 Definition of Elasticity, Deforming force, Restoring force, example of Elastic and plastic body,
- 5.2 Definition of Stress and strain with their types,
- 5.3 Hooke's law, Modulus of Elasticity (Young's, Bulk modulus and shear)
- 5.4 Pressure (definition, formula, unit), Pascals Law
- 5.5 Surface tension: definition, its units, applications of surface tension, effect of temperature on Surface tension
- 5.6 Viscosity: definition, units, effect of temperature on viscosity
- 5.7 Fluid motion, stream line and turbulent flow.

**6. Heat and temperature (05 Hrs)**

- 6.1 Definition of heat and temperature (on the basis of kinetic theory),
- 6.2 Difference between heat and temperature
- 6.3 Principles of measurement of temperature.
- 6.4 Modes of transfer of heat (Conduction, convection and radiation with examples).
- 6.5 Properties of heat radiation
- 6.6 Different scales of temperature and their relationship

- 7. Wave motion and its applications (09 Hrs)**
- 7.1 Wave motion, transverse and longitudinal wave motion with examples, Terms used in wave motion like displacement, amplitude, time period, frequency, wavelength, wave velocity; relationship among wave velocity, frequency and wave length .
  - 7.2 Simple Harmonic Motion (SHM): definition, examples
  - 7.3 Cantilever (definition, formula of time period (without derivation).
  - 7.4 Free, forced and resonant vibrations with examples
  - 7.5 Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time.
  - 7.6 Ultrasonics: Introduction and their engineering applications (cold welding, drilling, SONAR)
- 8. Optics (05 Hrs)**
- 8.1. Reflection and refraction with laws, refractive index, lens formula (no derivation), power of lens (related numerical problems).
  - 8.2. Total internal reflection and its applications, Critical angle and conditions for total internal reflection
  - 8.3. Microscope, Telescope (definition)
  - 8.4. Uses of microscope and telescope.
- 9. Electrostatics (09 Hrs)**
- 9.1. Electric charge, unit of charge, conservation of charge.
  - 9.2. Coulombs law of electrostatics,
  - 9.3. Electric field, Electric lines of force (definition and properties), Electric field intensity due to a point charge.
  - 9.4. Definition of Electric flux, Gauss law (Statement and derivation)
  - 9.5. Capacitor and Capacitance (with formula and units), Series and parallel combination of capacitors (simple numerical problems)
- 10. Current Electricity (08 Hrs)**
- 10.1 Electric Current and its Unit, Direct and alternating current,
  - 10.2 Resistance, Specific Resistance and Conductance (definition and units)
  - 10.3 Series and Parallel combination of Resistances.
  - 10.4 Ohm's law (statement and formula),
  - 10.5 Heating effect of current, Electric power and its units
  - 10.6 Kirchhoff's laws (statement and formula)
- 11 Electromagnetism (05 Hrs)**
- 11.1. Introduction to magnetism, Types of magnetic materials. Dia, para and ferromagnetic materials with examples.
  - 11.2. Magnetic field, magnetic intensity, magnetic lines of force, magnetic flux and

their units

11.3. Electromagnetic induction (definition)

**12. Semiconductor physics (08 Hrs)**

12.1. Definition of Energy level, Energy bands,

12.2. Types of materials (insulator, semi conductor, conductor) with examples,

12.3. Intrinsic and extrinsic semiconductors, p-n junction diode and its V-I characteristics

12.4. Diode as rectifier – half wave and full wave rectifier (centre tap only)

12.5. Semiconductor transistor; pnp and npn (Introduction only), symbol.

**13. Modern Physics (08 Hrs)**

13.1. Lasers: full form, principle, spontaneous emission, stimulated emission, population inversion, engineering and medical applications of lasers.

13.2. Fibre optics: Introduction to optical fibers (definition, parts), applications of optical fibers in different fields.

13.3. Introduction to nanotechnology (definition of nanomaterials with examples) and its applications.

**LIST OF PRACTICALS (To perform minimum fourteen experiments)**

1. To find diameter of solid cylinder using a vernier calliper
2. To find internal diameter and depth of a beaker using a vernier calliper and hence find its volume.
3. To find the diameter of wire using screw gauge
4. To find thickness of paper using screw gauge.
5. To determine the thickness of glass strip using a spherometer
6. To determine radius of curvature of a given spherical surface by a spherometer.
7. To verify parallelogram law of forces
8. To determine the atmospheric pressure at a place using Fortin's Barometer
9. To determine force constant of spring using Hooke's law
10. Measuring room temperature with the help of thermometer and its conversion in different scale.
11. To find the time period of a simple pendulum
12. To determine and verify the time period of Cantilever
13. To verify ohm's laws by plotting a graph between voltage and current.
14. To verify laws of resistances in series combination.
15. To verify laws of resistance in parallel combination.
16. To find resistance of galvanometer by half deflection method
17. To verify laws of reflection of light using mirror.
18. To verify laws of refraction using glass slab.
19. To find the focal length of a concave lens, using a convex lens

20. To study colour coding scheme of resistance.

## INSTRUCTIONAL STRATEGY

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.

## MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, exercises and viva-voce

## RECOMMENDED BOOKS

1. Text Book of Physics for Class XI (Part-I, Part-II); N.C.E.R.T., Delhi
2. Applied Physics, Vol. I and Vol. II by Dr. HH Lal; TTTI Publications, Tata McGraw Hill, Delhi
3. Concepts in Physics by HC Verma, Vol. I & Vol.II, Bharti Bhawan Ltd. New Delhi
4. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
5. e-books/e-tools/relevant software to be used as recommended by AICTE/ HSBTE/ NITTTR.
6. Practical Physics, by C. L. Arora, S Chand Publication

### Websites for Reference:

<http://swayam.gov.in>

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
A	20%	Unit 1,2	1 <sup>st</sup> Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
B	20%	Unit 3,4,5	2 <sup>nd</sup> Internal		
C	60%	Unit 6,7,8,9, 10,11, 12, 13	FINAL	60%	

## 1.4 APPLIED CHEMISTRY

**L T P**  
**2 - 1**

### **RATIONALE**

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

### **LEARNING OUTCOMES**

After undergoing this subject, the students will able to:

- Classify matter based on state of aggregation.
- Calculate percentage composition of chemical compounds.
- Substantiate the laws and principles on which structure of atom is established.
- Prepared solution of required concentration.
- Understand pH and prepare buffer solution and understand their significance in industrial processes such as electrolysis, electrochemical machining of materials etc.
- Explain various characteristics of water.
- Explain cause and facture factors which adversely affecting natural water quality and remedial measure available for water purification to achieve water quality standards required for domestic, agriculture and industrial applications .
- Explain chemistry and technology of industrial metal extraction processes.

- Explain chemistry of fuel and relative advantages.
- Select most efficient fuel for engine and engineering applications.
- Explain mechanism of lubrication and their advantages.
- Explain the chemistry of various polymers and plastics.
- Verify suitability and select polymer/ plastic material for engineering applications.

## **DETAILED CONTENTS**

1. Some Basic Concepts in Chemistry (8 Hrs)
  - 1.1 General introduction: Importance and scope of chemistry.
  - 1.2 Classification of matter:
    - a) Physical classification: Solid, Liquid and Gases (only definition with examples).
    - b) Chemical Classification: elements, compounds and mixture (Definition and examples Types of mixture excluded).
  - 1.3 Definition of atom, molecule, symbol and significance of symbol.
  - 1.4 Molecular Formula, Writing the formula of compounds containing  $\text{Cl}^-$ ,  $\text{OH}^-$ ,  $\text{HCO}_3^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{CO}_3^{2-}$  and  $\text{NH}_4^+$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$  ions
  - 1.5 Calculation of molecular mass (Atomic mass of constituents should be provided),  
Calculation of mass percentage composition of elements in compound (Atomic masses of elements should be provided)
  
2. Structure of Atom (8 Hrs)
  - 2.1 Fundamental particles of atom: electron, proton and neutron, charge and mass of electron, proton and neutron.
  - 2.2 Bohr's model of atom (postulates only) i.e concept of orbit or shell.

- 2.3 Atomic number ( $Z$ ), mass number ( $A$ ), calculation of protons, electrons and neutrons in  ${}^A_ZX$ .
- 2.4 Isotopes, isobars and isotones (definition with examples).
- 2.5 Concept of orbital (wave nature of electron), difference between orbit and orbital.
- 2.6 Principles of filling electrons in various orbital: a) Aufbau principle b) Hund's Rule of maximum multiplicity c) Pauli's exclusion principle.
- 2.7 Electronic configuration of atoms (upto  $Z=30$ )
3. Chemical Bonding (5 Hrs)
- 3.1 Valence electrons, Lewis symbol.
- 3.2 Octet rule (Limitation excluded).
- 3.3 Chemical bond (definition) and its type.
- 3.4 Electrovalent or Ionic Bond with example of NaCl,
- 3.5 Covalent Bonding in  $H_2$ ,  $O_2$
4. Solution (8 Hrs)
- 4.1 Definition of solution, Binary solution, aqueous solution.
- 4.2 Definition of solute, solvent.
- 4.3 Definition of acid and base and salt.
- 4.4 Definition of acidity and basicity.
- 4.5 Concentration of solution
- 4.6 Modes of expressing concentration of solution
- a) Strength
  - b) Molarity ( $M$ )
  - c) Normality ( $N$ ) and
  - d) simple numerical problems based on (a) and (b)



- 4.7 Definition of pH and industrial application of pH. (Numericals excluded)
5. Electrochemistry. (8 Hrs)
- 5.1 Electronic concept of oxidation, reduction
  - 5.2 Definition of terms electrolyte, non electrolyte with example
  - 5.3 Types of electrolytes: strong and weak with examples
  - 5.4 Definition of electrolysis.
  - 5.5 Faradays laws of electrolysis
  - 5.6 Industrial applications of electrolysis: Electroplating, electrolytic refining, electrometallurgy.
6. General Principles of extraction of metals (8 Hrs)
- 6.1 Metals and Non-metals (definition)
  - 6.2 Definition of Mineral, Chief ores of iron, aluminum and copper.
  - 6.3 Definition of metallurgy, types of metallurgy
  - 6.4 General Steps of metallurgy
    - a) Crushing
    - b) Pulverization of ore
    - c) Concentration or purification of ore:
      - i) Gravity separation method ii) froth flotation method.
    - d) Oxidation of ore:
      - i) Roasting ii) Calcination
    - e) Reduction:
      - i) Smelting (Pyrometallurgy) and ii) Electrolytic reduction
    - f) Refining of Metal:

i) Electrolytic refining

6.5 Definition of alloy, types of alloys and purpose of alloying.

7. Fuel (8Hrs)

7.1 Definition of fuel, classification of fuel a) on the basis of physical state b) on the basis of source.

7.2 Definition of calorific value

7.3 Characteristics of good fuel, advantages of gaseous fuel over solid fuels.

7.4 Coal- Proximate analysis of coal and its importance.

7.5 Fuel quality rating- octane number and cetane number (definition only)

7.6 Gaseous fuel: Composition, calorific value and application of CNG, LPG and biogas.

8. Water (8 Hrs)

8.1 Type of water: Soft and hard water.

8.2 Types of hardness of water

8.3 Units of hardness of water: ppm, mg/L (with simple numericals).

8.4 Disadvantages of using hard water in boiler. a) Scale and sludge formation  
b) Boiler Corrosion c) Caustic embrittlement

8.5 Qualities of drinking (potable) water

9. Lubricants (4 Hrs)

9.1 lubricant and lubrication.

9.2 Functions of lubricants.

9.3 Classification of lubricants: solid, semisolid and liquid lubricants with examples.

- 9.4 Type of lubrications – hydrodynamic and boundary lubrication with illustrative diagrams.
- 9.5 Properties of lubricants
- a) Physical properties- viscosity, viscosity index, cloud point, pour point, flash point, fire point, oiliness
  - b) Chemical properties- TAN or TAV (Total acid number), emulsification, aniline point and iodine value.
10. Polymer and Plastic (5 Hrs)
- 10.1 Definition of polymer, Monomer, Degree of Polymerization
  - 10.2 Monomer and uses of PE, PVC, PS, Teflon, Nylon-66, Bakelite
  - 10.3 Brief introduction to addition and condensation polymers with suitable examples (PE, PVC, PS, Teflon, Nylon-66, Bakelite).
  - 10.4 Definition of plastics, thermoplastic and thermosetting polymer with example, difference between thermoplastic and thermosetting polymers.
  - 10.5 Uses of polymer and plastic in daily life and in industries.

### **LIST OF PRACTICALS**

1. Volumetric analysis and apparatus used their in.
2. To prepare standard solution of oxalic acid (N/20).
3. To determine the strength of given sodium hydroxide solution by titrating against standard oxalic acid (N/10) solution using phenolphthalein as indicator.
4. Gravimetric analysis and apparatus used their in.
5. To determine the percentage of moisture in given sample of coal.

6. To determine the percentage of ash in given sample of coal.
7. To determine the percentage of volatile and non volatile substance in given mixture.
8. To determine the viscosity of lubricant by using Redwood viscometer.
9. To determine total acid number (TAN) or Total acid value of given lubricant (liquid).
10. Detection of iron metal in the given solution of rust.

### **INSTRUCTIONAL STRATEGY**

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

### **MEANS OF ASSESSMENT**

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, exercises and viva-voce

### **RECOMMENDED BOOKS**

1. Chemistry in Engineering by J.C. Kuricose & J. Rajaram, Tata McGraw Hill, Publishing Company Limited, New Delhi.
2. Engineering Chemistry by P.C. Jain & Monika Jain, Dhanapat Rai Publishing Company, New Delhi.
3. Eagle's Applied Chemistry - I by S. C. Ahuja & G. H. Hugar, Eagle Prakashan, Jalandhar.
4. Engineering Chemistry – A Text Book by H. K. Chopra & A. Parmar, Narosa Publishing House, New Delhi.
5. Engineering Chemistry by Dr.Himanshu Pandey, Goel Publishing House, Meerut, India.
6. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

**Websites for Reference:**

<http://swayam.gov.in>

<b>Section</b>	<b>Percentage of syllabus to be covered</b>	<b>Units to be covered</b>	<b>Type of assessment</b>	<b>Weightage of Marks</b>	<b>Pass Percentage</b>
<b>A</b>	20%	Unit 1, 2	1 <sup>st</sup> Internal	40%	40%(Combined in internal & final assessment)with minimum 25% marks in final assessment)
<b>B</b>	20%	Unit 3, 4	2 <sup>nd</sup> Internal		
<b>C</b>	60%	Unit 5, 6, 7, 8, 9, 10	FINAL	60%	

## 1.5 APPLIED MECHANICS

(Common for Civil Engineering, Automobile Engineering, Mechanical Engineering, Production Engineering, Plastic Technology, Mechanical Engineering (Tool & Die), Mechanical Engineering (Production), Mechanical Engineering (CAD/CAM), Aircraft Maintenance Engineering, Packaging Technology, Mechatronics Engineering)

**L T P**  
**2 - 2**

### RATIONALE

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

### LEARNING OUTCOMES

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

- Interpret various types of units and their conversion from one to another.
- Analyze different types of forces acting on a body and draw free body diagrams.
- Determine the resultant of coplanar concurrent forces.
- Use the principle of movement in various applications.
- Calculate the co-efficient of friction for different types of surfaces.
- Calculate the least force required to maintain equilibrium on an inclined plane.
- Determine the centroid/centre of gravity of plain and composite laminar and solid bodies.
- Determine velocity ratio, mechanical advantage and efficiency of simple machines

### DETAILED CONTENTS

1. Introduction (06 Hrs)
  - 1.1 Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields.
  - 1.2 Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another e.g. density, force, pressure, work, power, velocity, acceleration( Simple Numerical Problems), Fundamental Units and Derived Units.
  - 1.3 Concept of rigid body, scalar and vector quantities
2. Laws of forces (12 Hrs)
  - 2.1 Definition of force, Bow's Notations, types of force: Point force/concentrated

- force & Uniformly distributed force, effects of force, characteristics of a force.
- 2.2 Different force systems, principle of transmissibility of forces, law of superposition
  - 2.3 Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces
  - 2.4 Free body diagram
  - 2.5 Equilibrant force and its determination
  - 2.6 Lami's theorem  
[Simple problems on above topics]
3. Moment (12 Hrs)
- 3.1 Concept of moment
  - 3.2 Moment of a force and units of moment
  - 3.3 Varignon's theorem (definition only)
  - 3.4 Principle of moment and its applications (Levers – simple and compound, steel yard, safety valve, reaction at support)
  - 3.5 Parallel forces (like and unlike parallel force), calculating their resultant
  - 3.6 Concept of couple, its properties and effects
  - 3.7 General conditions of equilibrium of bodies under coplanar forces
  - 3.8 Position of resultant force by moment  
[Simple problems on the above topics]
4. Friction (14 Hrs)
- 4.1 Definition and concept of friction, types of friction, force of friction, Limiting Friction.
  - 4.2 Laws of static friction, coefficient of friction, angle of friction, angle of repose.
  - 4.3 Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane.
  - 4.4 Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force:
    - a) Acting along the inclined plane
    - b) At some angle with the inclined plane
  - 4.5 Ladder friction
  - 4.6 Advantages and Disadvantages of friction
  - 4.7 Methods of increasing/decreasing the force of friction.  
[Simple problems on the above topics]
5. Centre of Gravity (10 Hrs)

- 5.1 Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies, difference between centroid and C.G.
  - 5.2 Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion
  - 5.3 Determination of center of gravity of solid bodies - cylinder, cube, cuboid and sphere; composite bodies and bodies with portion removed  
[Simple problems on the above topics]
6. Simple Machines (16 Hrs)
- 6.1. Definition of Simple and compound machine (Examples)
  - 6.2. Definition of load, effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines
  - 6.3. Definition of ideal machine, reversible and self locking machine
  - 6.4. Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency
  - 6.5. System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency
  - 6.6. Working principle and application of wheel and axle, Weston's Differential Pulley Block, simple screw jack, worm and worm wheel, single and double winch crab. Expression for their velocity ratio and field of their application  
[Simple problems on the above topics]

### **LIST OF PRACTICALS**

1. Verification of the polygon law of forces using Gravesand's apparatus.
2. To verify the forces in different members of jib crane.
3. To verify the reaction at the supports of a simply supported beam.
4. To find the mechanical advantage, velocity ratio and efficiency in case of an inclined plane.
5. To find the mechanical advantage, velocity ratio and efficiency of a screw jack.
6. To find the mechanical advantage, velocity ratio and efficiency of worm and worm wheel.
7. To find mechanical advantage, velocity ratio and efficiency of single purchase crab.
8. To find out center of gravity of regular lamina.
9. To find out center of gravity of irregular lamina.
10. To determine coefficient of friction between three pairs of given surface.

### **INSTRUCTIONAL STRATEGY**

Applied Mechanics being a fundamental subject, the teachers are expected to emphasize on the



applications of “Applied Mechanics” in various subjects so that students are able to appreciate the importance of the subject. Students should also be made conversant with the use of scientific calculator to solve numerical problems.

<b>Section</b>	<b>Percentage of syllabus to be covered</b>	<b>Units to be covered</b>	<b>Type of assessment</b>	<b>Weightage of Marks</b>	<b>Pass Percentage</b>
<b>A</b>	20%	Unit 1,2	1 <sup>st</sup> Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
<b>B</b>	20%	Unit 3	2 <sup>nd</sup> Internal		
<b>C</b>	60%	Unit 4 to 6	FINAL	60%	

## 1.6 ENVIRONMENTAL STUDIES

L T P  
2 - 1

### RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industries and constructional activities so that he may help in balancing the ecosystem and controlling pollution by various control measures. He should also be aware of environmental laws related to the control of pollution. He should know how to manage the waste. Energy conservation is the need of hour. He should know the concept of energy management and its conservation.

### LEARNING OUTCOMES

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

- Comprehend the importance of ecosystem and sustainable
- Demonstrate interdisciplinary nature of environmental issues
- Identify different types of environmental pollution and control measures.
- Take corrective measures for the abatement of pollution.
- Explain environmental legislation acts.
- Define energy management, energy conservation and energy efficiency
- Demonstrate positive attitude towards judicious use of energy and environmental protection
- Practice energy efficient techniques in day-to-day life and industrial processes.
- Adopt cleaner productive technologies
- Identify the role of non-conventional energy resources in environmental protection.
- Analyze the impact of human activities on the environment

### DETAILED CONTENTS

1. Introduction (4 Hrs)
  - Basics of ecology, eco system- concept, and sustainable development, Resources renewable and non renewable.
2. Air Pollution (12 Hrs)
  - Source of air pollution. Effect of air pollution on human health, economy, plant, animals. Air pollution control methods.
3. Water Pollution (16 Hrs)
  - Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of dissolved O<sub>2</sub>, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

4. Soil Pollution (14 Hrs)
- Sources of soil pollution
  - Types of Solid waste- House hold, Hospital, From Agriculture, Biomedical, Animal and human, excreta, sediments and E-waste
  - Effect of Solid waste
  - Disposal of Solid Waste- Solid Waste Management
5. Noise pollution (8 Hrs)
- Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimize noise pollution.
6. Environmental Legislation (10 Hrs)
- Introduction to Water (Prevention and Control of Pollution) Act 1974, Introduction to Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board and National Green Tribunal (NGT), Environmental Impact Assessment (EIA).
7. Impact of Energy Usage on Environment (6 Hrs)
- Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings.

### **LIST OF PRACTICALS**

1. Determination of pH of drinking water
2. Determination of TDS in drinking water
3. Determination of TSS in drinking water
4. Determination of hardness in drinking water
5. Determination of oil & grease in drinking water
6. Determination of alkalinity in drinking water
7. Determination of acidity in drinking water
8. Determination of organic/inorganic solid in drinking water
9. Determination of pH of soil
10. Determination of N&P (Nitrogen & Phosphorus) of soil
11. To measure the noise level in classroom and industry.
12. To segregate the various types of solid waste in a locality.
13. To study the waste management plan of different solid waste
14. To study the effect of melting of floating ice in water due to global warming

## INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies like expert lectures, seminars, visits to green house, effluent treatment plant of any industry, rain water harvesting plant etc. may also be organized.

## MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests

## RECOMMENDED BOOKS

1. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
2. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.
3. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi
4. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
5. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.
6. Environmental Studies by Erach Bharucha; University Press (India) Private Ltd., Hyderabad.
7. Environmental Engineering and Management by Suresh K Dhamija; S K Kataria and Sons, New Delhi.

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A	20%	Unit 1,2	1 <sup>st</sup> Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
B	20%	Unit 3	2 <sup>nd</sup> Internal		
C	60%	Unit 4,5,6,7	FINAL	60%	

## 1.7 ENGINEERING GRAPHICS

L T P  
- - 3

### RATIONALE

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

#### Note:

- i) First angle projection is to be followed
- ii) Minimum of 30 sheets to be prepared
- iii) Instructions relevant to various drawings may be given along with appropriate demonstrations, before assigning drawing practice to students
- iv) For better understanding, students should be encouraged to use engineering graph book, and computer based software like Auto CAD for free hand and orthographic projection practice.

### LEARNING OUTCOMES

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

- Identify and use of different grades of pencils and other drafting instruments which are used in engineering field
- Draw free hand sketches of various kinds of objects.
- Utilize various types of lines used in engineering drawing.
- Read and apply different dimensioning methods on drawing of objects.
- Use different types of scales and their utilization in reading and reproducing drawings of objects and maps.
- Draw 2 - dimensional view of different objects viewed from different angles (orthographic views)
- Draw and interpret complete inner hidden details of an object which are otherwise not visible in normal view
- Generate isometric (3D) drawing from different 2D (orthographic) views/sketches
- Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances
- Use AutoCAD or other drafting software for making fast engineering drawings and even animating the assembly drawings.

## DETAILED CONTENTS

1. Introduction to Engineering Drawing (4 sheets)
  - 1.1 Definition of Engineering Drawing, Introduction to drawing instruments, materials, layout and sizes of drawing sheets and drawing boards, engineering graph book, different grades of pencils to be used.
  - 1.2 Different types of lines in engineering drawing as per BIS specifications
  - 1.3 Practice of vertical, horizontal and inclined lines
  - 1.4 Principles of dimensioning: Types, elements, placing, different methods of dimensioning
  - 1.5 Practice of geometrical figures such as –triangles, rectangles, circles, ellipses and parabola, hexagonal, pentagon with the help of drawing instruments.
  - 1.6 Definition and classification of lettering, single stroke vertical and inclined lettering at  $75^{\circ}$  (alphabet and numerals)
  - 1.7 Freehand letter writing and sketches of various kind of objects in graph Sketch book/graph paper.
  
- 2 Scales (2 sheets)
  - 2.1 Scales-their needs and importance(theoretical instructions), types of scales, definition of Representative Fraction(R.F.) and length of scale.
  - 2.2 Construction of Plain and diagonal scale.
  
- 3 Orthographic Projection (5 sheets)
  - 3.1 Theory of orthographic projections (Elaborate theoretical instructions)
  - 3.2 Projections of points in different quadrants
  - 3.3 Projection of line (1<sup>st</sup> angle and 3<sup>rd</sup> angle)
    - 3.3.1 Line parallel to both planes
    - 3.3.2 Line perpendicular to any one of the principal plane
    - 3.3.3 Line inclined to any one of the principal plane and parallel to other
  - 3.4 Projection of Solid-Cube, Cuboid, Cone, Prism, pyramid
  - 3.5 Three views of orthographic projections of different objects (At least one sheet in 3<sup>rd</sup> angle)
  
- 4 Sectioning and Identification of surfaces (2 sheets)
  - 4.1 Identifications of surfaces, Importance and salient features of sectioning of objects.
  - 4.2 Description of full section, half section.
  
- 5 Isometric Views (2 sheets)
  - 5.1 Fundamental of isometric projections and isometric scale

- 5.2 Isometric views of different objects
- 6 Graphics using CAD (5 sheets )
  - 6.1 Meaning, requirement of computer graphics, CAD, screen structure and toolbars in AutoCAD, coordinate system, Drawing Limits, Units.
  - 6.2 Practice of LINE command, coordinates-Absolute, incremental, polar. POLYLINE, CIRCLE(3P,2P, TTR), ARC, ELLIPSE
  - 6.3 Using above geometrical commands for making figure e.g. triangle, rectangle, hexagon, pentagon, parabola.
  - 6.4 Editing commands-Scale, erase, copy, stretch, lengthen and explode.
  - 6.5 Use of SNAP, GRID and ORTHO mode for selection of points quickly. Use of these modes while picking points in LINE, CIRCLE, PLINE, ARC, ELLIPSE etc commands.
  - 6.6 Drawing projections of lines and solids.
  - 6.7 Drawing orthographic projections of different objects (at least 2 sheets )
  - 6.8 AutoCAD for the isometric views sheets. Making single computer sheet showing all the three views and an isometric (in single split screen view) of any object showing understanding of use of AutoCAD in making isometric views – at least 1 sheet
- 7 Common Symbols and conventions used in Engineering (1 sheet)
  - 7.1 Civil Engineering sanitary fitting symbols
  - 7.2 Electrical fitting symbols for domestic interior installations
  - 7.3 Safety symbols used in engineering works
- 8 Development of surfaces (cylinder, cuboid, cone) (1 sheet)
  - 8.1 Parallel line, radial line method  
(The teacher may explain both methods but will use one method in sheet in classroom and other method on sketchbook)
- 9 Detailed and assembly drawing (3 sheets)
  - 9.1 Principle and utility of detailed and assembly drawings
  - 9.2 Wooden joints i.e. corner mortise and tenon joint, Tee Halving joint, Mitre faced corner joint, Tee bridle joint , crossed wooden joint, cogged joint, dovetail joint, through Mortise and tenon joint, furniture drawing – freehand and with the help of drawing instruments
  - 9.3 Making Wooden Joint sheets in AutoCAD, rendering & showing assembly animation at least 1 sheet
- 10 Screw threads and threaded fasteners (5 sheets)
  - 10.1 Type of threads-external and internal threads, right and left hand threads (actual conventional representation), Single and multiple start thread.
  - 10.2 Different forms of screw threads –V threads (B.S.W. threads, B.A thread,

- American National and Metric thread), Square threads (Square, Acme, buttress and Knuckle thread)
- 10.3 Different views of hexagonal and square nuts. Square and hexagonal headed bolt.
- 10.4 Foundations bolts-Rag bolt, Lewis bolt, Curved bolt and eye bolt.
- 10.5 Freehand sketches of various types of screws and studs.

11 Keys and Cotters (3 sheets)

- 11.1 Various types of keys and cotters - their practical application, drawings of various keys and cotters showing keys and cotters in position.
- 11.2 Various types of Joints  
-Spigot and Socket Joints  
-Gib and cotter joint  
-Knuckle joint

12 Couplings (2 sheets)

- 12.1 Introduction to coupling, their use and types
- 12.2 Muff coupling
- 12.3 Flange coupling (protected)
- 12.4 Flexible Coupling

### MEANS OF ASSESSMENT

- Drawing sheets
- Assignments and quiz/class tests

### RECOMMENDED BOOKS

1. A Text Book of Engineering Drawing by Surjit Singh; Dhanpat Rai & Co., Delhi
2. Engineering Drawing by PS Gill; SK Kataria & Sons, New Delhi
3. Elementary Engineering Drawing in First Angle Projection by ND Bhatt; Charotar Publishing House Pvt. Ltd., Anand
4. Engineering Drawing I & II by JS Layall; Eagle Parkashan, Jalandhar
5. Engineering Drawing I by DK Goel, GBD Publication.
6. CAD/CAM by J.S.Narang, Dhanpat Rai & Sons Publishers, New Delhi.
7. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.
8. Engineering Drawing with AutoCAD 2000 by T. Jeyapooran, Vikas Publishing House, Delhi
9. AutoCAD for Engineering Drawing Made Easy by P. Nageswara Rao; Tata McGraw Hill;, New Delhi.

### Websites for Reference:

<http://swayam.gov.in>



<b>Section</b>	<b>Percentage of syllabus to be covered</b>	<b>Units to be covered</b>	<b>Type of assessment</b>	<b>Weightage of Marks</b>	<b>Pass Percentage</b>
<b>A</b>	20%	Unit 1 ,2	1 <sup>st</sup> Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
<b>B</b>	20%	Unit 3,4,5	2 <sup>nd</sup> Internal		
<b>C</b>	60%	Unit 6, 7, 8, 9, 10, 11, 12	FINAL	60%	

## 1.8 INFORMATION TECHNOLOGY

L T P  
- - 2

### RATIONALE

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

### Note:

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

### LEARNING OUTCOMES

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

- Identify Computer hardware components, network components and peripherals.
- Explain the role of an operating System.
- Install system and application software.
- Explain the function of the system components including processor, motherboard and input-output devices.
- Use Word Processing software to prepare document.
- Use spreadsheet software to create workbooks and automate calculation.
- Use presentation software to create interactive presentation.
- Perform fundamental tasks common to most application software including print, save, edit, cut, copy, paste, format, spell and grammar check.
- Find and evaluate information on the Web.
- Install antivirus.
- Safeguard against online frauds, threats and crimes.

## **TOPICS TO BE EXPLAINED THROUGH DEMONSTRATION**

### 1. Basic Concepts of IT and Its Application

Information Technology concept and scope, applications of IT. in office, Air and Railway Ticket reservation, Banks financial transactions, E-Commerce and E- Governance applications etc., Ethics of IT, concept of online frauds, threats of IT crimes.

### 2. Computer Hardware:

Block diagram of a computer, components of computer system, CPU, Memory, Input devices; keyboard, Scanner, mouse etc; Output devices; VDU, LCD, Printers etc. Primary and Secondary Memory: RAM, ROM, magnetic disks – tracks and sectors, optical disk (CD, DVD & Blue Ray Disk.), USB/Flash Drive.

### 3. Software Concepts:

System software, Application software, Virtualization software and Utility software, Introduction of Operating System, Installation of Window / linux, Features of OPEN OFFICE/MS\_OFFICE(MS word, Excel, PowerPoint) .

### 4. Internet Concepts:

Basics of Networking – LAN, WAN, Wi-Fi technologies and sharing of printers and other resources, Concept of IP addresses, DNS, introduction of internet, applications of internet like: e-mail and browsing, concept of search engine and safe searching. Various browsers like Internet explorer/Microsoft Edge, Mozilla Firefox, use of cookies and history, WWW (World Wide Web), hyperlinks, introduction to Anti-virus.

## **LIST OF PRACTICAL EXERCISES**

1. Given a PC, name its various components and peripherals. List their functions .
2. Installing various components of computer system and installing system software and application software
3. Installation of I/O devices, printers and installation of operating system viz. Windows/BOSS/LINUX
4. Features of Windows as an operating system
  - Start
  - Shut down and restore
  - Creating and operating on the icons
  - Opening, closing and sizing the windows and working with windows interfacing elements (option buttons, checkbox, scroll etc.)
  - Using elementary job commands like – creating, saving, modifying, renaming, finding and deleting a file and folders
  - Changing settings like, date, time, colour (back ground and fore ground etc.)
  - Using short cuts
  - Using on line help

5. Word Processing (MS Office/Open Office)
  - a) File Management:
    - Opening, creating and saving a document, locating files, copying contents in some different file(s), protecting files, giving password protection for a file
  - b) Page set up:
    - Setting margins, tab setting, ruler, indenting
  - c) Editing a document:
    - Entering text, cut, copy, paste using tool- bars
  - d) Formatting a document:
    - Using different fonts, changing font size and colour, changing the appearance through bold/italic/underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods
    - Aligning of text in a document, justification of document, inserting bullets and numbering
    - Formatting paragraph, inserting page breaks and column breaks, line spacing
    - Use of headers, footers: Inserting footnote, end note, use of comments, autotext
    - Inserting date, time, special symbols, importing graphic images, drawing tools
  - e) Tables and Borders:
    - Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table
    - Print preview, zoom, page set up, printing options
    - Using find, replace options
  - f) Using Tools like:
    - Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printing envelopes and labels
    - Using shapes and drawing toolbar,
    - Working with more than one window .
  
6. Spread Sheet Processing (MS Office/Open Office)
  - a) Starting excel, open worksheet, enter, edit, data, formulae to calculate values, format data, save worksheet, switching between different spread sheets
  - b) Menu commands:

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

Managing workbooks (create, open, close, save), working in work books, selecting the cells, choosing commands, data entry techniques, formula creation and links, controlling calculations

Editing a worksheet, copying, moving cells, pasting, inserting, deletion cells, rows, columns, find and replace text, numbers of cells, formatting worksheet, conditional formatting

- d) Creating a chart:  
Working with chart types, changing data in chart, formatting a chart, use chart to analyze data  
Using a list to organize data, sorting and filtering data in list
- e) Retrieve data with query:  
Create a pivot table, customizing a pivot table. Statistical analysis of data
- f) Exchange data with other application:  
Embedding objects, linking to other applications, import, export document.

## 7. PowerPoint Presentation (MS Office/Open Office)

- a) Introduction to PowerPoint
  - How to start PowerPoint
  - Working environment: concept of toolbars, slide layout & templates.
  - Opening a new/existing presentation
  - Different views for viewing slides in a presentation: normal, slide sorter.
- b) Addition, deletion and saving of slides
- c) Insertion of multimedia elements
  - Adding text boxes
  - Adding/importing pictures
  - Adding movies and sound
  - Adding tables and charts etc.
  - Adding organizational chart
  - Editing objects
  - Working with Clip Art
- d) Formatting slides
  - Using slide master
  - Text formatting
  - Changing slide layout
  - Changing slide colour scheme
  - Changing background
  - Applying design template
- e) How to view the slide show?
  - Viewing the presentation using slide navigator
  - Slide transition
  - Animation effects, timing, order etc.
- f) Use of Pack and Go Options.

## 8. Internet and its Applications

- a) Establishing an internet connection.
- b) Browsing and down loading of information from internet.
- c) Sending and receiving e-mail
  - Creating a message
  - Creating an address book
  - Attaching a file with e-mail message

- Receiving a message
- Deleting a message
- d) Assigning IP Addresses to computers and use of domain names.

9. Functioning of Antivirus

- a) Installation and updation of an antivirus.
- b) How to scan and remove the virus.

## **INSTRUCTIONAL STRATEGY**

Since this subject is practice oriented, the teacher should demonstrate the capabilities of computers to students while doing practical exercises. The students should be made familiar with computer parts, peripherals, connections and proficient in making use of MS Office/Open Office in addition to working on internet. The student should be made capable of working on computers independently.

## **RECOMMENDED BOOKS**

1. Fundamentals of Computer by V Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi
2. Computers Fundamentals Architecture and Organisation by B Ram, revised Edition, New Age International Publishers, New Delhi
3. Computers Today by SK Basandara, Galgotia publication Pvt Ltd. Daryaganj, New Delhi.
4. A First Course in Computer by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
5. Computer Fundamentals by PK Sinha; BPB Publication, New Delhi
6. Fundamentals of Information Technology by Leon and Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
7. Fundamentals of Information Technology by Vipin Arora, Eagle Parkashan, Jalandhar

## 1.9 INTERNET OF THINGS AND ARTIFICIAL INTELLIGENCE

L T P  
- - 2

### LEARNING OUTCOMES

At the end of this course, the students will be able to:

- Understand the concepts of Internet of Things
- Build small IoT applications
- Understand and analysing sensor generated data using analytic techniques in Excel

### DETAILED CONTENTS

1. Introduction to Internet of Things (IoT) ( 8 hrs )
  - Applications, architecture, protocols
  - Characteristics of IoT
  - Physical Design/Logical Design of IoT
  - Functional blocks of IoT, Communication Models.
2. Basics of C language using Arduino IDE ( 14 hrs )
  - Understating basics of Arduino IDE
  - Variables, datatype, loops, control statement, function
3. Practical using Arduino-interfacing sensors ( 28 hrs )
  - i. Interfacing Light Emitting Diode(LED)- Blinking LED
  - ii. Interfacing Button and LED – LED blinking when button is pressed
  - iii. Interfacing Light Dependent Resistor (LDR) and LED, displaying automatic night lamp
  - iv. Interfacing Temperature Sensor(LM35) and/or humidity sensor (e.g. DHT11)
  - v. Interfacing Liquid Crystal Display(LCD) – display data generated by sensor on LCD
  - vi. Interfacing Air Quality Sensor-pollution (e.g. MQ135) - display data on LCD , switch on LED when data sensed is higher than specified value.
  - vii. Interfacing Bluetooth module (e.g. HC05)- receiving data from mobile phone on Arduino and display on LCD
  - viii. Interfacing Relay module to demonstrate Bluetooth based home automation application. (using Bluetooth and relay).
4. Introduction to Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL). ( 20 hrs )
  - Role of AI in IoT and its applications
  - Managing and Analysing data generated by IoT devices – Big Data
  - Machine learning (ML) Techniques e.g. classification, linear

regression, etc.

- Numerical based on above techniques.
- Understanding excel for analysing data

### **INSTRUCTIONAL STRATEGY:**

Since this subject is practical oriented, the teacher should demonstrate functioning of various sensors and demonstrate building of IoT applications. Solution to various regression and classification problems should also be built.

### **LIST OF REFERENCE BOOKS:**

1. Vijay Madiseti, Arshdeep Bahga, “Internet of Things: A Hands On Approach, University Press
2. Yashavant Kanetkar, Shirang Korde, “21 Internet Of Things (IOT) Experiments”
3. Neerparaj Rai , “Arduino Projects For Engineers”
4. Chandra S.S.V, “Artificial Intelligence and Machine Learning”

### **LIST OF COMPONENTS**

1. One kit for 3-4 students : Arduino Uno, sensors(Bluetooth module(HC05), MQ135, DHT11, breadboard , LCD, 2-relay module etc)
2. Consumables : LED, button, connecting wires, LDR, LM35, battery, etc



## **1.10 GENERAL WORKSHOP PRACTICE**

(Common for Agriculture Engineering, Automobile Engineering, Aircraft Maintenance Engineering, Civil Engineering, Mechanical Engineering, Mechanical Engineering (Tool & Die), Mechanical Engineering (Production), Mechanical Engineering (CAD/CAM), Production Engineering, Packaging Technology, Plastic Technology )

**L T P**  
**- - 3**

### **SCHEDULING**

The students will visit the different workshops in two major rounds in a year. In 1<sup>st</sup> round, they will learn basic skills of each workshop and in 2<sup>nd</sup> round, they will refine their skills further.

### **RATIONALE**

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

### **LEARNING OUTCOMES**

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

- Identify tools and equipment used and their respective functions.
- Identify different types of materials and their basic properties.
- Use and take measurements with the help of basic measuring tools/equipment.
- Select materials, tools, and sequence of operations to make a job as per given specification/drawing.
- Prepare simple jobs independently and inspect the same.
- Inspect visually to identify various types of defects in different type of materials.
- Follow safety procedures and precautionary measures.
- Use safety equipment and Personal Protection Equipment (PPE).
- Maintain good housekeeping practices.

### **DETAILED CONTENTS (PRACTICAL EXERCISES)**

#### **1<sup>st</sup> ROUND**

Workshop Safety Induction Session:

First turn of each shop shall be dedicated to safety practices and the contribution of safety to quality. The safety aspects should be categorised into 3 categories

- PSS (Process Safety System)
- SSS (Safety Shutdown System)
- ESD (Emergency Shutdown) or Emergency Depressurisation System.

The following practices should be included:

- Use of PPE (Personal Protection Equipment)

- Use of Safety Equipment like fire extinguishers etc.
- Paramedic teaching suite, First aid
- Reports to be prepared for the damages
- At the end of this session the student must sign “Student Safety Declaration form”.

**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 Shop – I
3. Sheet Metal Shop – I
4. Electric Shop - I
5. Carpentry Shop – I
6. Smithy Shop – I
7. Painting Shop

## **1. WELDING SHOP – I**

- 1.1 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, use of PPEs, welding screens, Hazards and remedies during welding, Elementary symbolic representations, demo of types of welding defects.
- 1.2 Jobs to be prepared
 

Job I	Practice of striking arc (Minimum 4 continuous beads on 100 mm long M.S. flat).
Job II	Practice of depositing beads on plate at different current levels. (Minimum 4 beads on M.S. plate at four setting of current level and differentiating their characteristics).

Types of joints and their edge preparations:

- |         |   |
|---------|---|
| Job III | Preparation of lap joint using arc welding process.                 |
| Job IV  | Preparation of butt joint using arc welding process. (100 mm long). |
| Job V   | Preparation of T Joint using arc welding (100mm x 6 mm M.S. Flat).  |

## **2. FITTING SHOP – I**

- 2.1 Introduction and Practical Importance of fitting jobs
- 2.2 Basic deburring processes.
- 2.3 Introduction to fitting shop tools, marking and measuring devices/equipment.
- 2.4 Identification of materials. (Iron, Copper, Stainless Steel, Aluminium etc.)
- 2.5 Identification of various steel sections (flat, angle, channel, bar etc.).
- 2.6 Introduction to various fitting shop operations/processes (Hacksawing, Drilling, Chipping and Filing). Demonstration of wrong fitting practices causing damage to

filed surfaces(outsized, out angled etc.) and tool/blade breakages.

2.7 Jobs to be prepared:

- Job I Marking of job, use of marking tools and various types of files, use of tri square, surface plate, filing and use of measuring instruments. (zero error and least count of Vernier calliper, Micrometer and Vernier height gauge).
- Job II Filing a rectangular/square piece to maintain dimensions within an accuracy of  $\pm 0.5$  mm.
- Job III Making a cut-out from a square piece of MS flat using hand hacksaw and chipping.

### 3. SHEET METAL SHOP – I

- 3.1. Introduction and practical importance of sheet metal jobs, use of hand tools and accessories e.g. different types of hammers, hard and soft mallet, sheet and wire gauge, necessary allowance required during job fabrication, selection of material.
- 3.2 Introduction and demonstration of hand tools used in sheet metal shop.
- 3.3 Introduction and demonstration of various machines and equipment used in sheet metal shop e.g. Shearing Machine, Bar Folder, Burring Machine, Turning Machine, Wiring Machine, Setting Down Machine, Forming Machine, Stake etc.
- 3.4 Introduction and demonstration of various raw materials used in sheet metal shop e.g. black-plain sheet, galvanized-iron plain sheet, galvanised corrugated sheet, aluminium sheet etc.
- 3.5 Study of various types of nuts, bolts, rivets, screws etc.
- Job I Shearing practice on a sheet using hand shears.
- Job II Prepare a seam joint of G.I. Sheet
- Job III Practice on making Single(/double) riveted lap joint/Butt Joint.
- Job IV Development of sheet for preparation of cubical container(300x150x25 mm)

### 4. ELECTRIC SHOP - I

- 4.1 Study, 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.
- 4.2 Study of electrical safety measures and protective devices.
- Job I Identification of phase, Neutral and Earth wires for connection to domestic electrical appliances and their connections to three pin plugs. Difference between series and parallel wiring.
- Job II 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 III To prepare a three level Godown wiring circuit with PVC conduit wiring system.
- 4.3 Introduction to the construction of lead acid battery, its working and its specification parameters(maH, specific gravity), precautions while handling

battery, Introduction to battery charger and its functioning. Types of charging

Job IV Installation of battery and connecting two or three batteries in series and parallel and its effect. Charging a battery and testing with hydrometer and cell tester

4.4 Introduction to solar energised lighting or water heater system and their defects.

Job V Installation of Solar cells, costing according to capacity

## **5. CARPENTRY SHOP - I**

5.1 Introduction and industrial applications of carpentry jobs.

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

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

5.1.3 Specification of tools used in carpentry shop.

5.1.4 Identification of different types of Timbers, their properties, uses & defects. Study of the joints in roofs, doors, windows and furniture available in Polytechnic

5.1.5 Seasoning of wood and its need.

5.1.6 Estimation of wood.

5.2 Practice

5.2.1 Practices for Basic Carpentry Work

5.2.2 Sawing practice using different types of saws

5.2.3 Assembling jack plane — Planning practice including sharpening and blade adjustment of jack plane cutter

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

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

5.2.6 Housekeeping practices and instructions.

5.3 Job Practice

Job I Marking, sawing, planning to size , chiselling and their practice

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

Job III Mortise and Tenon joint (T-Joint)

Job IV Dove tail Joint (Half lap dovetail joint or Bridle Joint)

## **6. SMITHY SHOP - I**

6.1 Introduction and industrial applications of smithy jobs.

- 6.1.1 Purpose of Smithy shop
  - 6.1.2 Different types of Hearths used in Smithy shop, Types of fuel used and maximum temperature obtained
  - 6.1.3 Purpose, specifications, uses, care and maintenance of various tools and equipments used in hand forging by segregating as cutting tools, supporting tools, holding tools, measuring tools, punches etc.
  - 6.1.4 Types of raw materials used in Smithy shop
  - 6.1.5 Uses of Fire Bricks & Clays in Forging workshop.
- 6.2 Practice
- 6.2.1 Practice of firing of hearth/Furnace, Cleaning of Clinkers and Temperature Control of Fire.
  - 6.2.2 Practice on different basic Smithy/Forging operations such as Cutting, Upsetting, Drawing down, Setting down, Necking, Bending, Fullering, Swaging, Punching and Drifting
    - a) Demonstration — Making cube, hexagonal cube, hexagonal bar from round bar
  - 6.2.3 Practice of Simple Heat treatment processes like Tempering, Normalizing, and Hardening etc

Job Practice: Job Preparation

- Job I Making a cold / hot, hexagonal flat chisel including tempering of edges.
- Job II Production of utility goods e.g. hexagonal bolt / square shank boring tool, fan hook (long S-type) [Two jobs are to be done by the students].
- Job III To prepare a cube from a M.S. round by forging method.

## 7 PAINTING SHOP

Introduction to painting shop and its necessity. Different types of paints. Introduction of powder coating plant and spray painting with their uses.

- Job I Preparation of surface before painting such as cleaning, sanding, applying putty, filling procedure and application of primer coat and painting steel item.
- Job II Painting practice by brush on MS sheet
- Job III Practice of dip painting
- Job IV Practice of lettering: name plates / sign board
- Job V Polishing and painting on wooden and metallic surfaces(furniture or utility of Polytechnic)
- Job VI Practical demonstration of powder coating
- Job VII Practical demonstration of spray painting on a utility object

## 2<sup>nd</sup> ROUND

### DETAILED CONTENTS (PRACTICAL EXERCISES)

The following shops are included in the syllabus.

- 1 Welding Shop – II
- 2 Fitting Shop – II
- 3 Sheet Metal Shop – II
- 4 Electric Shop -II
- 5 Carpentry Shop – II
- 6 Smithy Shop – II (Not for Civil Engg. Branch)
- 7 Plumbing Shop (only for Civil Engg. Branch)

#### 1. WELDING SHOP - II

- 1.1 Introduction to gas welding, gas welding equipment, introduction to soldering and brazing, introduction to resistance welding, safety precautions.
- 1.2 Jobs to be prepared
  - Job I Identification and adjustment of various types of gas flames. Practice them on pipe joint in round and linear fashion
  - Job II Preparation of lap joint on 75 mm × 35 mm × 3mm M.S. plate using gas welding.
  - Job III Preparation of butt joint on 75mm×35mm×3mm M.S.flat using gas welding process.
  - Job IV Preparation of a small cot frame (M.S. steel bed frame) from M.S. conduit pipe using gas welding process.
  - Job V Preparation of a square pyramid from M.S. rod by welding (Arc or Gas welding).
  - Job VI Practice of Spot/Seam welding or repair of an iron furniture of institute or demo of Gas cutting process

#### 2. FITTING SHOP - II

- 2.1 Care and maintenance of various measuring tools.
- 2.2 Handling of measuring instruments, finding least count and checking of zero error. Use of dial gauges and feeler gauges.
- 2.3 Description and demonstration of various types of drills, taps and dies.
- 2.4 Selection of drills and taps.
- 2.5 Precautions while drilling soft metals (Aluminium, Copper, Brass etc.).
  - Job I Drilling practice on soft metals-Aluminium
  - Job II Preparation of a job by filing on non ferrous metals upto an accuracy of  $\pm 0.1$  mm.
- 2.6 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 III Step fit(.02mm accuracy) or angular V fit(30 minute) or radius fitting(40x40x3mm MS sheet)
- 2.7 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 T fit or H fit with highest lapped accuracy to be checked by feeler gauge or any as deemed to be.

### **3. SHEET METAL SHOP - II**

3.1 Introduction to various metal forming processes e.g. Spinning, Punching, Blanking, cup drawing

3.2 Introduction to soldering and brazing.

3.3 Introduction to metal spinning process.

Job I Preparation of job involving shearing, circular shearing, rolling, folding, beading and soldering process e.g. Funnel/oil can/bucket or any other job involving above operations.

Job II Exercise on job involving brazing process

Job III Spinning a bowl/cup/saucer

Job IV Visit to a sheet metal industry e.g. coach builders etc.

### **4. ELECTRIC SHOP - II**

4.1 Introduction to single phase and three phase supply and wiring system. Importance of three phase supply (RYB)& its sequence and wiring system.

Job I Connecting Generator and 3 phase wiring through Change over Switch.

4.2 Estimating and costing of power consumption

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

4.3 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 III Dismantling, servicing and reassembling of any of the above electrical appliances, finding faults with series testing lamp and multimeter.

4.4 Testing and reversing direction of rotation of single phase and three phase motors.

Job IV Acceptance Testing of single phase/three phase motors by using voltmeter, ammeter and tachometer.

Job V Reversing direction of rotation of single phase and three phase motors.

4.5 Identification and familiarisation with the following tools:

Tweezers, Screw Drivers (Different sizes), Insulated pliers, Cutters, Sniper, Philips Screw driver (star screw driver), L-Keys, Soldering Iron and their demonstration and uses.

Job VI Practice on joining using soldering flux and removing components/wires by desoldering

## 5. CARPENTRY SHOP – II

5.1 Introduction to joints, their relative advantages and uses.

Job I Preparation of glued joint. \*

Job II Preparation of mitre joint \*

Job III Preparation of a lengthening joint \*

\* These jobs should be more prepared for utility articles like coat-hanger, shoe-rack, book-shelf etc.

5.2 Demonstration of job showing use of Rip Saw, Bow saw and Tenon saw, method of sharpening various saws.

5.3 Demonstration of job on Band Saw and Circular Saw, Chain and Chisel, Universal wood working machine, Saw re-sharpening machine, Saw Brazing unit.

5.4 Importance and need of polishing wooden items, Introduction to polishing materials.

5.5 Practice on Wood Working Lathe

a) Safety precaution on wood working machines

b) Study of wood working lathe

c) Sharpening of lathe tools

d) Setting of jobs and tools

e) Different type of wood turning practice

Job IV a) Making Handles of chisels/files/screw drivers etc.

b) Making legs of cabinets: Straight, Tapered and Ornamental

Job V Repair of wooden furniture of the Institute

## 6. SMITHY SHOP – II (Not for Civil Engg Branch)

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

6.2 Description of various types of power hammers and their usage (Demonstration only).

Job I To forge a ring to acquaint the students with forge welding.

Job II To forge a chisel and acquaint the students with simple idea of hardening and tempering.

Job III To forge squares on both ends of a circular rod.\*

Job IV To prepare a job involving drawing down process\*

\* Prepare utility articles like screw drivers, hinges, hexagonal nut, gib head key, chain links

## 7. PLUMBING SHOP (only for Civil Engg. Branch)

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

7.2 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.

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

Job I Making internal and external threads on a job by tapping and



dieing operations (manually)

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

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

Job III Practice on opening a jammed pipe(MS or PVC) joint with least damage and repair of a leaking joint, reconditioning of a tap.

Job IV Preparation of job involving thread on GI pipe/ PVC pipe and fixing of at least 5 types of fittings (viz. elbow, tee, union, socket, reducer, nipple, stopcock, taps etc)

## **MEANS OF ASSESSMENT**

- Workshop jobs
- Report writing, presentation and viva voce

## **RECOMMENDED BOOKS**

1. Workshop Technology I,II,III, by SK Hajra, Choudhary and AK Choudhary; Media Promoters and Publishers Pvt. Ltd. Mumbai.
2. Workshop Technology Vol. I, II, III by Manchanda; India Publishing House, Jalandhar.
3. Workshop Training Manual Vol. I, II by S.S. Ubhi; Katson Publishers, Ludhiana.
4. Manual on Workshop Practice by K Venkata Reddy; MacMillan India Ltd., New Delhi
5. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd., New Delhi
6. Workshop Technology by B.S. Raghuvanshi; Dhanpat Rai and Co., New Delhi
7. Workshop Technology by HS Bawa; Tata McGraw Hill Publishers, New Delhi
8. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

## **Websites for Reference:**

<http://swayam.gov.in>

# **THIRD SEMESTER**

### 3.1 PLASTIC PROCESSING TECHNIQUES-1

L T P  
3 - 3

#### 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 competence of the students in major industrially practiced processing techniques.

#### DETAILED CONTENTS

##### **Unit –I: Introduction to Polymer Processing (6 Hrs)**

Introduction to polymer processing, polymer melt flow processes Preliminary ideas of extrusion, injection moulding, blow moulding, extrusion, rotational moulding, compression and transfer moulding taking examples of commonly used products made by each process. Introduction to installation and commissioning of plant and machines.

##### **Unit –II: Extrusion (8 Hrs)**

Introduction to extrusion process, different types of extruders:- single screw and twin screw extruder, vented barrel extruder, general principles of and twin screw extruder, vented barrel extruder, general principles of operation, die swell, function of various parts with details of operating conditions i.e. barrel, screw, screen pack, die, breaker plate, adaptor.

##### **Unit –III: Extrusion components (8 Hrs)**

Types of screws in use for processing different plastics Feed, Compression and Metering zone, Die zone, L/D ratio and its significance, Nip rolls, bubble casing, winding equipment, cutting devices, stretching and orientation. Extruder performance and their curves.

##### **Unit – IV: Extrusion processes (6 hrs)**

Blown film extrusion, extrusion of pipes, wires and cables, sheets and filaments

##### **Unit –V: Calendering (6 Hrs)**

Process Description - Materials used - Advantages over extrusion - Types of Calendar Rolls - Heating System - Roll Bending - Complete Description of Calendaring line with their function – Heating & Cooling System - Winding Types and Method - Finishing – Trouble Shooting.

##### **Unit –VI: Printing techniques (8 Hrs)**

Flexographic printing, gravure printing, pad printing, screen printing, hot stamping.

### **Unit –VII: Maintenance**

**(6 Hrs)**

Maintenance, objective of maintenance, importance of maintenance, corrective maintenance periodic maintenance, preventive maintenance, breakdown maintenance, predictive maintenance, schedule maintenance, maintenance planning.

### **LIST OF PRACTICALS**

1. To draw the layout of plastic processing laboratory.
2. Study of PVC Pipe Plant, Free sketch of machines, their parts and parts-function, List of products manufactured by Extrusion process.
3. Procedure for setting up of the machine for production of pipe (Including die fitting and centring).
4. Study of components produced at serial no. C for various defects and to suggest remedies for the same.
5. To study Blown film Plant.
6. To study rotogravure and flexographic printing
7. To print components with pad printing machines.

### **INSTRUCTIONAL STRATEGY**

Industrial visit may be organized for practicals as per requirement.

### **RECOMMENDED BOOKS**

1. Polymer Processing by DH Morton Jones, published by Chapman and Hall, London
2. Plastic Engineering Handbook by Joel Frados, published by Chapman and Hall, London, UK.
3. Polymer extrusion Chris Rauwendaal, By Hansar Publications.
4. The complete Technology Book on Plastic Extrusion, moulding and mould Design by Asia pacific Business press inc.,Kamla nagar, Delhi.

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	6	15
2	8	15
3	8	15
4	6	15
5	6	15
6	8	15
7	6	10
<b>Total</b>	<b>48</b>	<b>100</b>

## 3.2 STRENGTH OF MATERIALS

L T P  
4 - 2

### RATIONALE

Diploma holders in this course are required to analyze reasons for failure of different components and select the required material for different applications. For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress, strain, bending moment, shearing force, shafts, columns and springs. It is expected that efforts will be made to provide appropriate learning experiences in the use of basic principles in the solution of applied problems to develop the required competencies.

### DETAILED CONTENTS

1. Stresses and Strains (08 hrs)
  - 1.1. Concept of load, stresses and strain
  - 1.2. Tensile compressive and shear stresses and strains
  - 1.3. Concept of Elasticity, Elastic limit and limit of proportionality.
    - 1.3.1. Hook's Law
    - 1.3.2. Young Modulus of elasticity
    - 1.3.3. Nominal stress
    - 1.3.4. Stress strain diagram
    - 1.3.5. Yield point, plastic stage
    - 1.3.6. Ultimate strength and breaking stress
    - 1.3.7. Percentage elongation
    - 1.3.8. Proof stress and working stress
    - 1.3.9. Factor of safety
    - 1.3.10. Poisson's ratio
    - 1.3.11. Shear modulus
  - 1.4. Principle of Super position and free body Diagram
2. Resilience (06 hrs)
  - 2.1 Resilience, proof resilience and modulus of resilience
  - 2.2 Strain energy due to direct stresses
  - 2.3 Stresses due to gradual, sudden and falling load.
  - 2.4 Numerical problems
3. Moment of Inertia (06 hrs)

- 3.1 Concept of moment of Inertia and second moment of area
  - 3.2 Radius of gyration, section modulus
  - 3.3 Theorem of perpendicular axis and parallel axis (without derivation)
  - 3.4 Second moment of area of common geometrical sections: Rectangle, triangle, Circle (without derivation), Second moment of area for I, T, L, Z section
  - 3.5 Simple numerical problems.
4. Bending Moment and Shearing Force (10 hrs)
- 4.1 Concept of beam and type of loading
  - 4.2 Concept of end supports-Roller, hinged and fixed
  - 4.3 Concept of bending moment and shearing force
  - 4.4 B.M. and S.F. Diagram for cantilever and simply supported beams subjected to concentrated and U.D.L.
  - 4.5 Simple numerical problems
5. Bending stresses (08 hrs)
- 5.1 Concept of Bending stresses
  - 5.2 Theory of simple bending
  - 5.3 Use of the equation  $f/y = M/I = E/R$
  - 5.4 Concept of moment of resistance
  - 5.5 Calculation of maximum bending stress in beams of rectangular, circular, and T section.
  - 5.6 Permissible bending stress Section modulus for rectangular, circular and symmetrical I section.
  - 5.7 Simple numerical problems
- 6 Columns (08 hrs)
- 6.1. Concept of column, modes of failure
  - 6.2. Types of columns
  - 6.3. Buckling load, crushing load
  - 6.4. Slenderness ratio
  - 6.5. Factors effecting strength of a column
  - 6.6 End restraints
  - 6.7 Effective length
  - 6.8 Strength of column by Euler Formula without derivation
  - 6.9. Rankine Gourdan formula ( without derivation)
  - 6.10 Simple numerical problems
- 7 Torsion (08hrs)
- 7.1 Concept of torsion- difference between torque and torsion.
  - 7.2 Use of torque equation for circular shaft
  - 7.3 Comparison between solid and hollow shaft with regard to their strength and weight.

- 7.4 Power transmitted by shaft
- 7.5 Concept of mean and maximum torque
- 7.6 Simple numerical problems

8. Springs (10 hrs)

- 8.1. Closed coil helical springs subjected to axial load and impact load
- 8.2 Stress deformation
- 8.3 Stiffness and angle of twist and strain energy
- 8.4 Proof resilience
- 8.5 Laminated spring (semi elliptical type only)
- 8.6 Determination of number of plates
- 8.7 Simple numerical problems

### **LIST OF PRACTICALS**

1. Tensile test on bars of Mild steel and Aluminium.
2. Bending tests on a steel bar or a wooden beam.
3. Impact test on metals
  - a) Izod test
  - b) Charpy test
4. Torsion test on specimens of different metals for determining modulus of rigidity.
5. To determine the stiffness of a helical spring and to plot a graph between load and extension.
6. Hardness test on different metals.

### **INSTRUCTIONAL STRATEGY**

1. Expose the students to real life problems.
2. Plan assignments so as to promote problem solving abilities and develop continued learning skills.

### **RECOMMENDED BOOKS**

1. SOM by Birinder Singh,; Katson Publishing House, New Delhi.
2. SOM by RS Khurmi; S.Chand & Co; New Delhi
3. Elements of SOM by D.R. Malhotra & H.C.Gupta; Satya Prakashan, New Delhi.

### SUGGESTED DISTRIBUTION OF MARKS

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	08	12
2	06	10
3	06	10
3	10	16
4	08	12
5	08	12
6	08	12
7	10	16
<b>Total</b>	<b>64</b>	<b>100</b>



### 3.3 FLUID FLOW

L T P  
3 - 3

#### RATIONALE

A thorough knowledge of Unit Operations is essential for the study of polymer science and plastic processing. This course acquaints the students with the basic principles of fluid .

#### DETAILED CONTENTS

1. **Basics of Fluid Flow:** (10 hrs)  
Fluids - Definition, properties and classification, Ideal Fluid, Real Fluid, Newton's Law of Viscosity Newtonian Fluid, Non-Newtonian Fluid, Viscosity (Dynamic and Kinematics), Effect of Viscosity on Temperature, Effect of Viscosity on Motion, Classification of Viscous Flow, Laminar Flow, Turbulent Flow, Steady and Unsteady Flow, Uniform & Non Uniform Flow.
2. Bernoulli's Equation and its application in fluid flow, Venturi Meter, Orifice Meter, Pitot tubes, Rota-meter, Rate of discharge, velocity measurement, continuity equation, Reynold's and Froude's number and their use. (08 hrs)
- 3 **Flow through pipes** (10 hrs)  
Discharge through a compound pipe(series and parallel arrangement), Flow through sudden enlargement, Flow through sudden contraction, Flow through obstruction in a pipe, Loss of head in pipes (Darcy's and Chezy's formula), Loss of head due to friction in a viscous flow.
- 4 **Pressure Measurement** (10 hrs)  
Concept of Gauge Pressure, Absolute Pressure, Atmospheric Pressure, Measurement of Fluid Pressure, Piezometer Tube, Manometer, Simple Manometer, Micro manometer, Differential Manometer, Mechanical Gauge, Bourdon's Gauge, Diaphragm Pressure Gauge, Dead Weight Pressure Gauge.
5. **Pumps and Valves** (10 hrs)  
Construction and working of the Reciprocating Pump, Centrifugal Pump, gear pump, piston pump, radial/axial pump and screw pump.  
**Types of Valves:**
  - a) Based on operating Principle: Ball Valve, Butterfly valve, choke valve, gate valve, globe valve, piston valve, plug valve, solenoid valve
  - b) Based on function: check valve, flow control valve, poppet valve, pressure reducing valve, thermal expansion valve, safety or relief valve.

## LIST OF PRACTICALS

1. To identify viscosity of visco- elastic /gel fluids
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 an venturimeter.
5. To determine the discharge coefficient ( $C_d$ ) for an orifice meter.
6. To determine the discharge coefficient ( $C_d$ ) for a Pitot tube.
7. To study the constructional features of reciprocating and centrifugal pump .
8. To calibrate Bourdon gauge on pressure calibration test rig.

## RECOMMENDED BOOKS

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

## INSTRUCTIONAL STRATEGY

Polymer based industrial problems (numericals) should be given as assignments to make students acquainted with basic principles of unit operations and unit processes..

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	20
2	8	20
3	10	20
4	10	20
5	10	20
<b>Total</b>	<b>48</b>	<b>100</b>

### 3.4 POLYMER SCIENCE AND TECHNOLOGY

L	T	P
4	-	-

#### RATIONALE

This subject is designed to enable the students to acquire the basic knowledge of polymers, their advantages, application, classification and conversion. The elementary acquired knowledge will help the students in understanding the different polymer processes in detail in later part of the course.

#### DETAILED CONTENTS

##### **Unit – I: Introduction to Polymer Science** (10 Hrs)

Brief History of Polymers, Classifications of Polymers - Types based on Structure- Processing and Applications - Macromolecular concept , Molecular Force and secondary bonding in Polymers –Concept of Isomerism stereo- isomerism, Geometrical, Optical isomerism,

##### **Unit –II Molecular weight of Polymers** (10 Hrs)

Molecular weight distribution and practical significance of Polymer Molecular weight, Poly Dispersity Index (PDI), Molecular Weight and its determination by dilute solution viscometry, end group analysis, membrane osmometry, vapourphase osmometry, cryoscopy, ebulliometry, light scattering, centrifugation, Gel permeation chromatography.

##### **Unit III– Physical State of Polymers** (10 Hrs)

Polymer solutions and solubility – General Rules for Polymer solubility – solubility Parameters, Properties of Dilute solutions – Physical State of Polymer – Crystalline, Amorphous and their relation to processing and applications.

##### **Unit – IV Thermal transitions in polymers** (8 Hrs)

Glass transition temperature, its importance, Factors influencing Glass transition temperature (T<sub>g</sub>), Techniques for its determination, melting temperature, relationship of polymer properties with structure.

##### **Unit – V Polymer Rheology** (8 Hrs)

Introduction to Rheology and Visco-elasticity, time dependent and time independent viscosity behaviour; power law fluids; Zero shear viscosity, Maxwell and Voigt models of visco-elastic materials

##### **Unit –VI: Chemistry of Polymerization** (10 Hrs)

Chain growth Polymerization - Free Radical Reaction – Ionic Reaction – Coordination Polymerization – Step Growth Polymerisation - Condensation Polymerization – Ring Opening

Polymerization. Co-polymerization - Importance of copolymers, different types of copolymers, copolymer equation, reactivity ratios.

**Unit – VII: Techniques of Polymerization**

(8 Hrs)

Bulk, Solution, Suspension and Emulsion Polymerization their advantages and disadvantages.

**INSTRUCTIONAL STRATEGY**

Industrial visit or a laboratory scale polymerization should be shown to the students.

**RECOMMENDED BOOKS**

1. Polymer Science and Technology by Joel E Fried, Prentice Hall of India publication, New Delhi, 2000
2. Materials Science of Polymers for engineers by Tim Osswald, Powell Publication
3. Polymer Material by J.A. Brydson, Published by M/S Butterworth Heinemann, Linacre House, Jordan Hill, UK

**SUGGESTED DISTRIBUTION OF MARKS**

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	16
2	10	16
3	10	16
4	8	12
5	8	12
6	10	16
7	8	12
<b>Total</b>	<b>64</b>	<b>100</b>

### 3.5 PLASTIC MATERIALS AND PROPERTIES - I

L T P

3 - -

#### RATIONALE

This subject gives a detailed description of polymeric materials in the category of thermoplastics, thermo sets 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.

#### DETAILED CONTENTS

##### 1. Thermoplastics

General preparation, properties and applications of the following: (20 hrs)

- PE - Linear low density polyethylene (LLDPE),
- low density Polyethylene (LDPE),
- high density polyethylene (HDPE)
- UHMWHDPE
- PVC and major vinyl chloride co-polymers
- PP,PC
- PS-GPPS, HIPS
- Nylons - Nylons 6, 66
- PMMA
- ABS, SAN
- Cellulose plastics
- PET, PBT.

##### 2. Thermosetting resins (16 hrs)

Synthesis, properties and applications of phenol resins (urea, melamine), poly urethanes, silicone resins, epoxy resin and unsaturated polyesters.

##### 3. Elastomers (12 hrs)

General preparation, Properties and Applications of NR, SBR, Polyisoprene, Chloroprene, Polybutadiene, EPDM, Nitrile rubber, Silicone rubbers.

## **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.

## **RECOMMENDED BOOKS**

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

## **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	20	40
2	16	35
3	12	25
<b>Total</b>	<b>48</b>	<b>100</b>

### 3.6 COMPUTER AIDED DRAFTING AND DESIGN

L T P  
- - 3

#### RATIONALE

Computer aided drafting these days is extensively being used in the industry. This subject has been added to enable a diploma holder to make drawings using computer software and take prints/plots.

#### PRACTICE WORK

1. Introduction to AutoCAD : Starting up, practice on – how to create a new drawing file, setting drawing limits & saving a file, drawing lines in different ways using absolute co-ordinates, user co-ordinates, WCS, UCS, drawing circles, drawing arcs, drawing ellipses. Drawing polygons, drawings splines. Drawing polylines, using window, zoom commands.
2. Practice on Edit commands such as erase, copy, mirror, array, offset, rotate, oops, undo, redo, scale, stretch, trim, break, extend, chamfer, fillet, O snap command
3. Practice on Text commands: editing text, text size, text styles, change properties commands.
4. Practice on Layer Commands: creating layer, freeze, layer on/off colour assigning, current layer, load line type, lock & unlock layer, move from one layer to other.
5. Practice on Hatching, Hatch pattern selection.
6. Practice on Dimensioning, linear dimensioning, angular dimensioning radius/.diameter dimensioning O-snap command, aligned dimensioning, editing of dimensioning, tolerances in dimensioning.
7. Practice on making complete drawings of components by doing following exercises:
  - a) Detail and assembly drawing of the following using AUTOCAD (2D)  
(4 sheets)
  - b) Isometric Drawing by CAD using Auto CAD (one sheet)Drawings of following on computer:
  - Cone
  - Cylinder
  - Isometric view of objects
9. Modelling (02 sheets)  
3D modelling, Transformations, scaling, rotation, translation

## 10. Creating Chamfer and Fillet

Practice on surface modeling, create part file, practice on assembly of parts, creating assembly view, orthographic views, section view ( Practice on different views, practice on data transfer)

### **INSTRUCTIONAL STRATEGY**

1. Teachers should show model
2. Emphasis should be given on cleanliness, dimensioning, & layout of sheet.
3. Teachers should ensure use of IS codes related to drawing.

### **RECOMMENDED BOOKS**

1. Engineering Drawing with AutoCAD 2000 by T. Jeyapooran; Vikas Publishing House, Delhi.
2. AutoCAD for Engineering Drawing Made Easy by P. Nageswara Rao; Tata McGraw Hill, New Delhi.
3. AutoCAD 2000 for you by Umesh Shettigar and Abdul Khader; Janatha Publishers, Udupi.
4. Auto CAD 2000 by Ajit Singh, TMH, New Delhi.



### 3.7 GENERAL WORKSHOP PRACTICE- III

L T P  
- - 6

#### RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, knowledge about various machining processes, modern machining methods, CNC machining, tool is required to be imparted. Hence the subject of workshop technology.

NOTE : The following topics may be taught in the laboratory along with the practical exercises.

#### DETAILED CONTENTS (Practicals)

##### 1. Advance turning shop

- Job 1. Exercise of boring with the help of boring bar
- Job 2. Exercises on internal turning on lathe machine
- Job 3. Exercises on internal threading on lathe machine
- Job 4. Exercises on external turning with greater finishing/accuracy on lathe machine
- Job 5. Resharpener of single point cutting tool with given geometry

##### 2. Turning Shop

- Job 1. Grinding of single point turning tool with demonstration of all angles.
- Job 2. Exercise of simple turning and step turning.
- Job 3. A composite job involving, turning, taper turning, external thread cutting and knurling.

##### 3. Fitting Shop

- Job 1. Exercise on drilling, reaming, counter boring, counter sinking and tapping
- Job 2. Dove tail fitting in mild steel
- Job 3. Radius fitting in mild steel
- Job 4. Pipe threading with die and assemblage of same.

##### 4. Machine Shop

- Job 1. Prepare a V-Block up to  $\pm 0.8\text{mm}$  accuracy on shaper machine
- Job 2. Exercise on key way cutting and spline cutting on shaper machine.

##### 5. Milling Shop

- Specification and working principle of milling machine
- Classification, brief description and applications of milling machines

- Job 1. Produce a rectangular block using a milling machine with a side and face cutter
- Job 2. Prepare a slot on one face using milling machine

## 6. Grinding

- Purpose of grinding
- Specifications of grinding wheel - Abrasive, Grade, structure, Bond

Job 1. Job on grinding machine using a surface grinder

Job 2. Prepare a job on cylindrical grinding machine.

Job 3. Grinding a drill-bit on tool and cutter grinder

Job 4. Exercise on dressing a grinding wheel

## 7. Shaping, Planing and Slotting

- Working principle of shaper, planer and slotter.
- Speeds, feeds and depth of cut

Job 1. Prepare a V-block to  $\pm 0.2$  mm accuracy on shaper machine.

Job 2. Produce a rectangular block by face milling and prepare a slot on one face with a slotting cutter / side and face cutter.

## 8. Fabrication Shop

### 8.1 Electrical Discharge Machining (EDM)

Introduction, principle parts of EDM machine, EDM terminology. principal, metal removing rate, dielectric fluid and properties of electric fluid, applications. EDM.

### 8.2 CNC Wirecut

Introduction, principle parts of CNC Wirecut, terminology, principal, metal removing rate, dielectric fluid and properties of electric fluid, applications, Wire cut. Exercise on EDM for preparation of electrodes (Core & Cavity).

## RECOMMENDED BOOKS

1. Workshop Technology by Hazra, Choudary; published by Khanna Publishers, New Delhi
2. Workshop Technology by Manchanda, Khanna Publishers, New Delhi

# **FOURTH SEMESTER**

## 4.1 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

**L T P**  
**3 - 2**

### RATIONALE

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

### LEARNING OUTCOMES

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

- Measure basic electrical quantities.
- Measure and improve power factor in a given circuit.
- Explain the construction, working principle, performance and applications of transformers.
- Identify different wires of distribution system.
- Select and operate single phase and three phase motors.
- Follow electrical safety measures.
- Describe the characteristics and applications of diodes, transistors and thyristor.

### DETAILED CONTENTS

#### 1. Application and Advantage of Electricity (03 periods)

Difference between ac and dc, various applications of electricity, advantages of electrical energy over other types of energy

#### 2. Basic Electrical Quantities (04 periods)

Definition of voltage, current, power and energy with their units, name of instruments used for measuring above quantities, connection of these instruments in an electric circuit

#### 3. AC Fundamentals (08 periods)

Electromagnetic induction-Faraday's Laws, Lenz's Law; Fleming's rules, Principles of a.c. Circuits; Alternating emf, Definition of cycle, frequency, amplitude and time period. Instantaneous, average, r.m.s and maximum value of sinusoidal wave; form factor and Peak Factor. Concept of phase and phase difference. Concept of resistance, inductance and capacitance in simple a.c. circuit. Power factor and improvement of power factor by use of capacitors. Concept of three phase system; star and delta connections; voltage and current relationship (no derivation)

4. Transformers (06 periods)

Working principle and construction of single phase transformer, transformer ratio, emf equation, losses and efficiency, cooling of transformers, isolation transformer, CVT, auto transformer (brief idea), applications.

5. Distribution System (06 periods)

Difference between high and low voltage distribution system, identification of three-phase wires, neutral wire and earth wire in a low voltage distribution system. Identification of voltages between phases and between one phase and neutral. Difference between three-phase and single-phase supply

6. Electric Motor (08 periods)

Description and applications of single-phase and three-phase motors. Connection and starting of three-phase induction motors by star-delta starter. Changing direction of rotation of a given 3 phase induction motor. Motors used for driving pumps, compressors, centrifuge, dyers etc. Totally enclosed submersible and flame proof motors

7. Domestic Installation (04 periods)

Distinction between light-fan circuit and single phase power circuit, sub-circuits, various accessories and parts of domestic electrical installation. Identification of wiring systems. Common safety measures and earthing

8. Electrical Safety (04 periods)

Electrical shock and precautions against shock, treatment of electric shock, concept of fuses and their classification, selection and application, concept of earthing and various types of earthing, applications of MCBs and ELCBs

9. Basic Electronics (05 periods)

Basic idea of semiconductors – P and N type; diodes, zener diodes and their applications, transistor – PNP and NPN, their characteristics and uses. Characteristics and applications of a thyristor, characteristics and applications of stepper motors and servo motors in process control.

## LIST OF PRACTICALS

1. Connection of a three-phase motor and starter with fuses and reversing of direction of rotation
2. Connection of a single-phase induction motor with supply and reversing of its direction of rotation

3. Troubleshooting in domestic wiring system, including distribution board
4. Connection and reading of an electric energy meter
5. Use of ammeter, voltmeter, wattmeter, and multi-meter
6. Measurement of power and power factor in a given single phase ac circuit
7. Study of different types of fuses, MCBs and ELCBs
8. Study of zener diode as a constant voltage source and to draw its V-I characteristics
9. Study of earthing practices
10. To draw V-I characteristics of a (i) NPN transistor (ii) thyristor (SCR)
11. Study of construction and working of a (i) stepper motor and (ii) servo motor

### **INSTRUCTIONAL STRATEGY**

The teacher should give emphasis on understanding of concept and various terms used in the subject. Practical exercises will reinforce various concepts.

### **MEANS OF ASSESSMENT**

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

### **RECOMMENDED BOOKS**

1. Basic Electrical Engineering by PS Dhogal; Tata McGraw Hill Publishers, New Delhi
2. A Text Book of Electrical Technology, Vol. I and II by BL Thareja; S Chand and Co., New Delhi
3. Basic Electricity by BR Sharma; Satya Prakashan, New Delhi
4. Basic Electrical Engineering by JB Gupta, S Kataria and Sons, Delhi
5. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International Publishers Ltd., New Delhi
6. Basic Electronics by VK Mehta; S Chand and Co., New Delhi
7. Electrical Machines by SK Bhattacharya; Tata McGraw Hill, New Delhi
8. Basic electronics and Linear circuits by NN Bhargava and Kulshreshta, Tata McGraw Hill New Delhi.
9. Electronic principles by SK Sahdev, Dhanpat Rai and Sons, New Delhi.
10. Electronic Devices and circuits by Rama Raddy Narora Publishing House Pvt. Ltd. New Delhi.
11. Principles of electrical and electronics Engineering by VK Mehta; S Chand and Co. New Delhi
12. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

### **Websites for Reference:**

<http://swayam.gov.in>

### SUGGESTED DISTRIBUTION OF MARKS

<b>Topic No.</b>	<b>Time Allotted (Periods)</b>	<b>Marks Allotted (%)</b>
1	03	06
2	04	08
3	08	16
4	06	12
5	06	12
6	08	16
7	04	10
8	04	10
9	05	10
<b>Total</b>	<b>48</b>	<b>100</b>

## 4.2 PLASTIC TESTING – I

L T P  
3 - 3

### 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.

### DETAILED CONTENTS

#### **Unit-I: Concept of testing.** (8 hrs)

Basic concepts of testing, overview of various test standards such as ASTM, BIS, DIN and ISO.

Test specimen preparation: preconditioning and test atmosphere, milling, punching, template, cutting from sheets or films

**Unit-II:** Basic concept of statistical quality control, Statistical process control, quality control tools such as control charts, histogram, pareto chart, kaizen, six - Sigma and root cause analysis, Analysis of test data to control finished product in relation to service requirement.  
(10 hrs)

#### **Unit-III: Identification of Plastics** (8 hrs)

Physical Identification: Visual examination, solubility test, Flame test

Chemical Identification: elemental analysis, group detection test, characterisation like DSC, TGA and FTIR.

#### **Unit-IV: Physical properties** (6Hrs)

Specific gravity, bulk density and Water absorption

#### **Unit-V: Mechanical Properties** (10 Hrs)

##### **Short term Properties -**

-Tensile strength, impact strength (Izod & Charpy), Dart impact for films, flexural strength, fatigue resistance, compression strength, tear test.

##### **Long term properties -**

- creep and stress relaxation

##### **Other mechanical properties -**

- Hardness – Shore, Rockwell and Brinell hardness , Abrasion resistance.



## **Unit–VI: Thermal properties**

(6Hrs)

Melting point, Melt flow index, vicat softening point, heat distortion temperature

### **LIST OF PRACTICALS**

1. To identify at least 3 given polymers by following methods:
  - Visual examination
  - Specific gravity test
  - Bulk density of 2 given polymers
  - Burning test and odour test
  - Solubility test
  - Softening and melting point test
2. To determine the tensile strength, flexural strength of plastics specimen.
3. To determine water absorption of various plastics (at least 3 samples)
4. To determine impact strength of different plastics specimen.
5. To determine hardness (Shore and Rockwell) of different specimen of plastics.
6. To carry out dart impact test on given plastics films/laminates.
7. To determine the Melt Flow Index of given samples of plastics.
8. To carry out
  - (i) Heat detection test on given samples of plastics.
  - (ii) Vicat softening point test on given samples of plastics
9. To carry out environmental stress cracking resistance test on given samples of plastics.

### **INSTRUCTIONAL STRATEGY**

Different articles or products should be given to the student to do testing and quality control

### **RECOMMENDED BOOKS**

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

### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	8	15
2	10	20
3	8	15
4	6	15
5	10	20
6	6	15
<b>Total</b>	<b>48</b>	<b>100</b>

## 4.3 FUNDAMENTALS OF CHEMICAL ENGINEERING

L T P

3 - 3

### RATIONALE

A thorough knowledge of unit operations is essential for the study of polymer science and plastic processing. This course acquaints the students with the fundamentals of thermodynamics, heat transfer and mass transfer and mechanical operations.

### DETAILED CONTENTS

#### 1. Heat Transfer (12 hrs)

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)

#### 2. Thermodynamics (12 hrs)

Thermodynamic system and surrounding. Total heat & specific heat, thermodynamic cycle, Homogenous and heterogeneous system, thermodynamic equilibrium, Equation of State, Three Laws of Thermodynamics, Thermodynamic process-Isometric, Isothermal, Isobaric & Adiabatic, Concept of Gibbs free energy, phase change, Raoult's law.

#### 3. Mass Transfer (12 hrs)

Principle's of Diffusion, Mass Transfer Coefficient, Application of Mass Transfer-Distillation(Simple and Steam), Drying-Principle and definition of Drying, Equipment for Drying, Humidification-Humidity and Saturation, Dry & Wet bulb Temp., Percentage Saturation, Dew Point, Humid Volume & Humid Heat

#### 4. Mechanical Operations (12 hrs)

Size Reduction law, Crushers & Grinders, Screening & Screening Equipment, Filtration-Principle and filtration equipment (Filter press, air filter, fluid filter, EMI/RFI filters, fuel filters, Hydraulic filters and water filter), Cyclones Separators.

### LIST OF PRACTICALS

1. To measure the thermal conductivity of insulating materials
2. To determine overall heat transfer co-efficient in, a double pipe heat exchanger in parallel and counter flow heat exchange modes
3. To measure diffusivity of solids in liquid or gas
4. To perform an experiment on batch distillation unit.

5. To perform an experiment on humidification column.
6. To carry out the calibration of a thermocouple.
7. To carry out the sieve analysis of a product obtained from size reduction equipment such as ball mill, grinder etc.
- 8 To perform an experiment on cyclone separator
- 9 To find the rate of filtration using filter press
- 10 To perform an experiment on a mixer for liquid-liquid mixing
- 11 To perform an experiment on a mixer for solid-liquid mixing

### **INSTRUCTIONAL STRATEGY**

Polymer based industrial problems (numerical) should be given as assignments to make students acquaint with basic principles of unit operations.

### **RECOMMENDED BOOKS**

1. Heat & Mass Transfer by D S Kumar
2. Unit Operations-II by K. A. Gavhane
3. Thermodynamics by P.K. Nag
4. Chemical Engineering Thermodynamics by KV Narayanan
5. Unit Operations by McCabe and Smith

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	12	25
2	12	25
3	12	25
4	12	25
<b>Total</b>	<b>48</b>	<b>100</b>

#### 4.4 PLASTIC PROCESSING TECHNIQUES -II

L T P

##### RATIONALE

3 - 3

The subject is designed to enable the students to acquire basic knowledge of polymer chemistry and polymer physics for better understanding of polymer related subjects. This will help the students in identifying different polymeric materials to be processed in the industry and determine their quality based on physical and chemical properties.

#### DETAILED CONTENTS

##### **Unit – I: Compression Molding (09 Hrs)**

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. Effect of process variables on product properties, compression molding of SMC and DMC compound and composites, common faults and their remedies.

##### **Unit- II : Transfer Molding (09 Hrs)**

Principles of transfer molding. Types of transfer molding machines, molding cycle, theoretical calculation of line pressure, injection ram, pressure, clamping pressure, pot capacity, heating requirements, faults causes and remedies.

##### **Unit- III : Thermoforming (10 Hrs)**

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

##### **Unit- IV : FRP processing methods (6 hrs)**

Contact Moulding- Hand Lay up , Spray- up, vacuum bag and pressure bag moulding, Filament winding, centrifugal casting , Pultrusion.

##### **Unit – V Casting Techniques: (08 Hrs)**

Cell casting , encapsulation, potting, film casting

##### **Unit- VI : Post processing and Finishing of Plastics (06 Hrs)**

Cutting, turning, drilling, sanding, polishing different types of welding. Engraving, metallisation, painting, electroplating.

## LIST OF PRACTICALS

1. To produce small components on hand operated compression molding machine
2. To produce components on automatic/semi automatic compression molding machine
3. To produce articles on vacuum forming machine
4. To do casting of polyester resin
5. To do casting of PMMA
6. Exercises on high frequency PVC welding machine
7. Preparation of FRP sheet by hand lay up technique
8. To study various parts and operating conditions of transfer moulding machine

## INSTRUCTIONAL STRATEGY

Industrial visit or a laboratory scale polymerization should be shown to the students.

## RECOMMENDED BOOKS

1. Plastic Engineering Handbook by Joel Frados, published by Chapman and Hall, London, UK.
2. Compression moulding by Davis Gramann, Osswald by Hanser publication.
3. Casting Concepts and Mould Design by Manju Nanathan Rathod, Azuko Technical Institute.
4. Advanced thermoforming, By Svan Englmann, Wiley Publishers

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	09	20
2	09	15
3	10	20
4	06	15
5	08	15
6	06	15
<b>Total</b>	<b>48</b>	<b>100</b>

## 4.5 PLASTIC MATERIALS AND PROPERTIES-II

L T P

3 - -

### RATIONALE

This subject gives a detailed description of advanced engineering and speciality polymeric materials in category of thermoplastics, thermosets and elastomers. The students 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.

### DETAILED CONTENTS

1. Engineering thermoplastics – Poly Ether Ether Ketone (PEEK), Poly Phenylene Oxide (PPO), Poly acetals (POM), Polysulphones(PSO) ,Poly Tetra Floro Ethylene (PTFE), Liquid Crystalline Polymer (LCP) (10Hrs)
2. Special materials like Poly Ether Sulphones (PES), Poly Phenylene Sulphide(PPS), Polyarylates. (6Hrs)
3. Reinforced plastics - principles of composite reinforcement, effect of reinforcement on strength of plastics. Role and nature of binders and coupling agents, properties and preparation of graphite and boron fibers. Miscellaneous fillers (Talc, mica, glass beads). Properties and applications of FRPs (un-saturated polyesters, epoxies, PU, nylon), Nanocomposites (use of CNT, graphite, clay, silica, nano -particles) (14Hrs)
4. Polyblends and alloys - Definition, advantages of polymers, blends and alloys, role of composition, properties and applications of parameters for compability, interpenetrating polymer networks, PVC- Nitrile rubber, ABS-PVC and PP-EPDM (08Hrs)
5. Preliminary concept of new materials such as conducting polymers, food packaging ,bio degradable polymers, Biopolymers and biomedical applications, opto-electronic plastics, membrane separations, polymer concretes. (10Hrs)

### INSTRUCTIONAL STRATEGY

In plastic industry the basic raw material is polymer. The purpose of this subject is to give the knowledge about the material, grades, processing behavior and applications. That will help the students 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.

### RECOMMENDED BOOKS

1. Polymer Science & Technology by Premamoy Ghosh, Published by Tata McGraw Hill Co., New Delhi
2. Polymer Blends and Alloys by Arends, published by M/S Hanser Publishers, New York
3. Polymers Science & Technology by JR Fried, published by M/S Hanser Publishers, New

York

4. Plastics Materials by Brydson, PHI Publication, M/S Vikas Publishing, New Delhi
5. Engineering Polymers by Dyson, PHI Publication, published by Khanna Publishers, New Delhi
6. Polymer Materials and Processing by Jean Michael Charrier, published by M/S Hanser Publishers, New York

#### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	10	20
2	06	10
3	14	30
4	08	20
5	10	20
<b>Total</b>	<b>48</b>	<b>100</b>



## **4.6 COMPUTER AIDED MOULD AND DIE DESIGN**

**L T P**  
**- - 3**

### **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 these software.

### **DETAILED CONTENTS**

1. Surface Modeling:

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

2. Solid Modeling:

Various commands like Extrude, Revolve, Blend, Helix, Sweep, Holes, Ribs & Bosses etc. and practice these command making 3D design of different plastics.

3. Analysis and Report generation :

For calculating stresses on various designs and structures.

4. Interface with Mold-flow and Mold Creator software.

5. Design of various components used in plastic industries and lab exercise

### **INSTRUCTIONAL STRATEGY**

Students should gather practical knowledge about designing of electrical switches, plastic bottles and other liquid packaging plastic containers.

### **RECOMMENDED SOFTWARE**

1. Mechanical Desktop (MDT)
2. Solid Works
3. Mold-flow/ Mold Creator
4. PRO-E, CATIA
5. IDEAS

## **4.7 REPAIR AND MAINTENANCE OF PLASTIC PROCESSING MACHINES**

L T P  
- - 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 the students with the knowledge of repair and maintenance of such machines and equipments.

### **LIST OF PRACTICALS** (perform at least 8 practicals)

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

### **INSTRUCTIONAL STRATEGY**

Students may be made familiar with the components/instruments by demonstration of models/ cut sections and should be asked to do repair activities in the laboratories and workshops.

## **SOFT SKILLS – II**

L T P  
- - 2

### **RATIONALE**

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. The diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market.

### **LEARNING OUTCOMES**

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

- Develop Communication Skills
- Work in a team
- Learn to resolve conflict by appropriate method
- Identify leadership traits and learn self motivation
- Follow ethics

### **DETAILED CONTENTS**

- Concept of team building, behavior in a team
- Developing Interpersonal Relations- empathy, sympathy
- Communication skills-improving non-verbal communication
- Conflict Management
- Motivation
- Leadership
- Professional Ethics and Values
- Health, Hygiene, Cleanliness and Safety

In addition, the students must participate in the following activities to be organized in the institute

- Sports
- NCC/NSS
- Camp – Environment awareness
- Cultural Event

Note : Extension Lectures by experts may be organized. There will be no examination for this subject.

## **INDUSTRIAL TRAINING OF STUDENTS (During summer vacation after IV Semester)**

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

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

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

An internal assessment of 100 and external assessment of 100 marks have been provided in the study and evaluation scheme of V Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations. The formative and summative evaluation may comprise of weightage to performance in testing, general behavior, quality of report and presentation during viva-voce examination. It is recommended that such evaluations may be carried out by a team comprising of concerned HOD, teachers and representative from industry.

# **FIFTH SEMESTER**

## 5.1 PLASTIC PROCESSING TECHNIQUES - III

L T P  
4 - 4

### 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 processing techniques.

### DETAILED CONTENTS

#### Unit –I: Injection Moulding Process: (30Hrs)

Selection criteria for injection moulding machine, basic principles of operations of injections moulding machinery/types of injection moulding machines, description with detailed construction.

- Introduction, principles, process variables, mechanical, electrical, electronic control system.
- Parts and functions, general specification, construction, start up and shutdown procedure, cylinder nozzles, interaction of moulding variable, optimization of cycle flow.
- Defects in injection moulding products, their causes and remedies.
- Loading and unloading of Mould on Injection moulding machine
- Injection moulding of thermosets.

#### Unit –II: Blow Moulding (20Hrs)

Basic principles of blow moulding, Types of blow moulding :- Extrusion blow moulding, Injection blow moulding. Blow moulding of irregular shapes.

Production of parison: a) by extrusion b) by injection. Parison wall thickness control, Parison blowing systems, effect of process variables on product design and properties. Parison programming, mould venting, Trouble shooting.

#### Unit –III : Rotational Moulding (14 Hrs)

Basic principle - Material selection and Estimation through trial analysis - Type of machine - Process variables - Charge size - wall thickness control - Heating and Cooling system Process requirement for the moulding of water tank - Dust Bin etc. Application of Rotational Moulding - Ejection and Finishing – Fault - Causes and Remedies - Merits and Demerits of Rotational Moulding Process.

### LIST OF PRACTICALS

Practice of Die setting and produce small components on hand operated injection molding machine (at least 10 components each on 2/3 different moulds)

- To study the specifications, construction and working principle of automatic injection molding machine.

2. To study the specifications, construction and working principle of CNC injection molding machine.
3. Practice of Die setting and produce components on automatic / CNC injection molding machine.
4. To determine mould shrinkage for the component produced by Injection moulding.
5. Practice of Die setting and production of component on hand operated blow molding machine, using at least 3 moulds.
6. Practice of Die setting Production of components on automatic blow machine by setting the process parameters.
7. To produce small components on vertical hydraulic injection moulding machine

### **INSTRUCTIONAL STRATEGY**

Industry visits should be organized.

### **RECOMMENDED BOOKS**

1. Plastic Engineering Handbook by Joel Frados
2. Processing of Plastics by AS Athalye
3. Plastic Processing Data Handbook by Rosato and Rosato

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	30	40
2	20	35
3	14	25
<b>Total</b>	<b>64</b>	<b>100</b>

## 5.2 DESIGN OF DIES AND MOULDS – I

L T P  
3 - 3

### RATIONALE

A diploma holder in polymer technology is engaged in manufacturing polymer 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.

### DETAILED CONTENTS

- 1 Mould design: Concept considerations and materials used for dies and moulds and their Characteristics, Classification of moulds(Integer , insert, two plate, three plate, Split and runnerless) (08 hrs)
- 2 Impressions - Core and cavity, Types of cavity and core, their advantages and disadvantages. Bolster plate and its types, guide pillar, guide bush, register ring and their types. (08 hrs)
- 3 Parting surface - Types of parting surface, selection of parting surface, Relief of parting surfaces, venting (06 hrs)
- 4 Feed system (08 hrs)
  - Runners - Sprue, runners and its types, balancing of runners, size of runners
  - Gates - Types of gates, size of gates
- 5 Ejection system - Ejector grid, ejector plate assembly, ejection techniques, ejection from fixed half, sprue pullers (06 hrs)
6. Cooling system - Cooling integer type mould plates and its types, Cooling insert bolster assembly and its types, Cooling other mold parts, Water connection and its types (06 hrs)
7. Brief introduction to intermediate mould design - splits , side core and side cavities, moulds for internal undercuts, Mould for threaded component ,Multi daylight moulds and runner less moulds, Two plate mould, Three plate mould. (06 hrs)

### LIST OF PRACTICALS

1. Procedure for Designing an Injection Mold: Primary positioning of inserts, the ejector system, the ejector grid, complete the top half of drawing, complete the plan view, complete the cross-section and complete the drawing.
2. To design and draw various mould parts.
3. To design and draw a single impression two plate injection mould by taking suitable at least four component.



4. To design and draw a multiple impression two plate injection mould by taking suitable at least two component.
5. To design and draw a multiple impression three plate injection mould by taking suitable at least two component.
6. To design and draw a multiple impression split mould by taking suitable at least two component.
7. To design and draw a multiple impression runner less mould by taking suitable component.

**Note:** Maximum 10 sheets will be prepared by the students on computer using AutoCAD software or latest design software.

### **INSTRUCTIONAL STRATEGY**

Students should practically make injection moulds for household, medical equipment and auto parts.

### **RECOMMENDED BOOKS**

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

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	08	20
2	08	20
3	06	10
4	08	20
5	06	10
6	06	10
7	06	10
<b>Total</b>	<b>64</b>	<b>100</b>

### 5.3 PLASTIC TESTING – II

**L T P**  
**3 - 3**

#### **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.

#### **DETAILED CONTENTS**

##### **Unit – I Electrical Properties (8Hrs)**

Dielectric strength - Dielectric constant - Insulation resistance - Volume and Surface resistivity - Arc resistance - Antistatic tests.

##### **Unit – II Optical Properties : (8Hrs)**

Refractive index - Luminous transmittance - Clarity and Haze - Colour measurements and Gloss.

##### **Unit – III Chemical Properties (6Hrs)**

Introduction – Immersion test – Stain Resistance of Plastics – Environmental Stress Cracking Resistance (ESCR).

##### **Unit –IV Flammability (8Hrs)**

Introduction – Flammability Test – Ignition Properties – Oxygen Index Test – Flammability of Cellular Plastics – Smoke Density Test – UL90 Flammability Test.

##### **Unit – V Weathering Properties (6Hrs)**

Introduction – environmental factors affecting plastics – Accelerated weathering tests – outdoor weathering of plastics – Resistance of plastics to biological systems.

##### **Unit – VI Bio-degradability Testing (6Hrs)**

Test methods and standards for bio-degradable plastics - Criteria used in evaluation of bio-degradable plastics - Description of current test methods.

##### **Unit – VII Product Testing (6Hrs)**

Plastics Pipes(PVC & HDPE) – Films – Woven sacks – Water Tanks – Containers & Plastic Foams.

## LIST OF PRACTICALS

1. To carry out volume and surface resistivity test on given samples of plastic
2. To measure gloss of plastic specimen.
3. To determine refractive index of 2 given monomers to establish its purity.
4. To determine Arc resistance of plastic sample
5. To determine Oxygen index .
6. To carryout smoke density test.
7. To determine ESCR of given plastic sample.
8. To carryout Product testing for two plastic product e.g. pipes, containers and films etc.

## INSTRUCTIONAL STRATEGY

- Industrial visit may be organized for conducting tests if required.
- Different articles or products should be given to the student to do testing and quality control

## RECOMMENDED BOOKS

1. Text Book on Fundamentals of Plastics Testing - Prof. (Dr.) S.K. Nayak.
2. Testing of Plastics by Roger Brown; Blackwell Publishing Ltd Oxford, UK
3. Plastics - Materials and Processing by Abrentstrong, Prentice Hall of India publication, New Delhi, 2000
4. Plastics Testing by Vishu Shah, published by M/S Vishu Shah Publisher, New York
5. Identification of Plastics by CIPET, published by Kluwer Academic publishers, New York
6. Identification of Plastics by published by M/S AS Athalye, London life Books Ltd., New York.

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	8	16
2	8	16
3	6	13
4	8	16
5	6	13
6	6	13
7	6	13
<b>Total</b>	<b>48</b>	<b>100</b>

## 5.4 COMPOUNDING AND FORMULATION OF PLASTICS

L T P  
4 - 2

### 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.

### DETAILED CONTENTS

1. Principles of compounding for modifying and enhancing processing and application properties and service life of plastics (10 hrs)
2. Definition and classification of additives (24 hrs)  
Description of following additives and their functions
  - Properties Modifiers - Plasticisers, Fillers, Impact modifiers, extenders
  - Processing aids - Heat stabilizers, Lubricants, solvents and diluents
  - Surface property modifiers -antistatic agents, antislip agent, antiblock/slip additives.
  - Colourants : Pigments and dyes
  - Antiageing additives: - antioxidants, anti-ozonants, UV stablisers, fungicides, antitermites, bactericide additives
  - Miscellaneous additives: - blowing agent, flame retardants and mould release agents, defoamers, smoke, suppressants
3. 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) (10 hrs)
4. Compounding equipments - Ribbon blender, High speed mixer, Banbury, Two roll mill, Mixer extruder (construction and working of these equipments), Ultra turax mixers, High shear mixers, Intensive dry mixer, Compounder, Twin screw extruders, construction and working of Kneaders, Dispersers (20 hrs)

### LIST OF PRACTICALS

Demonstrations/operations of the following practicals (Approx. five experiments)

1. Extraction of inorganic additives from PVC i.e. fillers, pigments etc. by dissolving PVC compound in solvents such as THF, EDC and Cyclohexanone and removing PVC and soluble organic materials

2. Making a PVC compound having following ingredients (100 parts)  
Stabilizer (2 – 3 parts), Lubricant (0.5 – 1.0 parts); plasticizers (20 – 50 parts); Pigment (0.5 – 1 part) and Filler (10 –40 parts) on a two roll mill and compression moulding of a sheet
3. Cutting dumbbell shaped test pieces for tensile strength from compression moulded sheet as prepared in (2) and finding tensile strength and elongation with or without plasticizer. Calculation of percent increase in elongation
4. Analysis of the effects of fillers on mechanical properties of PVC compound
5. Compounding of polyethylene with various additives, fillers, stabilizers, blowing agent and rubber
6. Mechanical property measurement of compounded polyethylene and evaluation of the effect of compounding variables.

### INSTRUCTIONAL STRATEGY

Compounding and additives should be shown in the industry.

### 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 Wiley and Sons, New York
3. Anti-Oxidants by RR Paolino, 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, “Plasticizers” by LG Krauskopf
6. PVC Technology by Titow, Elsevier, UK
7. PVC Technology by AS Athalye, Popular Plastics and Packaging

### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	15
2	24	40
3	10	15
4	20	30
<b>Total</b>	<b>64</b>	<b>100</b>

## 5.5 PLASTIC RECYCLING AND WASTE MANAGEMENT

L T P  
3 - 2

### 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, reusability and reprocessing of plastics and bio-degradation of plastics.

### DETAILED CONTENTS

- 1. Pollution and Hazards related to Plastics: (09 hrs)**  
Pollution caused by plastics, loading of toxic chemicals from plastics into soil and water (including additives, flame retardants, chlorinated additives etc.), Landfill, incineration of Plastics.  
ISI Standards regarding limits of these chemicals in effluents.
- 2. Plastic waste and its Separation: (08 hrs)**  
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.
- 3. Polymer degradation and their life expectancy: (08 hrs)**  
Natural and synthetic polymer and their compatibility with surroundings (starch and proteins, silicones and other man made fabrics). Life expectancy of different plastics in environment and thermal degradation, biodegradation and photo degradation. Agents for increasing life expectancy of polymers.
- 4. Plastic Waste Management: (03 hrs)**  
Public awareness regarding hazards caused by indiscriminate use of plastics, Proper disposal of plastics, Need and importance of plastic reprocessing.
- 5. Plastic Waste Management Techniques: (10 hrs)**  
Stages in plastic recycling, Types of recycling: Primary, Secondary, Tertiary and Quaternary techniques with examples like Fuel from Plastic waste, Energy recovery from plastic waste, Co-processing in cement Kiln, Plastic waste in road construction. Advantages and disadvantages of recycling.

## 6. Machinery and Value addition:

(10 hrs)

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, waste water recovery by membrane separation.

### LIST OF PRACTICALS:

1. To conduct recyclability 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. Determination of BOD and COD of given samples of effluents of plastic industry
6. Mixing of virgin polymers with recycled polymers (both by melt method and solvent method)
7. To carry out plastic waste management of at least one department/section of the polytechnic

### INSTRUCTIONAL STRATEGY

Visit to various industries/environment awareness camp/talk should be organized by experts.

### 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 Cumminghan Saigo
4. Ecology of Natural Resource by Ramma Dey
5. Environmental and Plastics by AK Dey; New Age Publication

### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	09	15
2	08	15
3	08	15
4	03	05
5	10	25
6	10	25
<b>Total</b>	<b>48</b>	<b>100</b>

## **SOFT SKILLS – III**

L	T	P
-	-	4

### **RATIONALE**

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. The diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market.

### **LEARNING OUTCOMES**

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

- Develop communication skills.
- Learn how to speak without fear and get rid of hesitation
- Use effective presentation techniques
- Understand entrepreneurial traits
- Exhibit attitudinal changes

### **DETAILED CONTENTS**

- Communication Skills – Handling fear and phobia
- Resume Writing
- Applying for job through email/job portal
- Interview preparation : Mock Interview, Group Discussions and Extempore
- Presentation Techniques
- Developing attitude towards safety. Disaster management.

In addition, the students must participate in the following activities to be organized in the institute

- Sports
- NCC/NSS
- Camp – Entrepreneurial awareness
- Cultural Event

Note: Extension Lectures by experts may be organized. There will be no examination for this subject.



# **SIXTH SEMESTER**

## 6.1 PLASTICS PROCESSING TECHNIQUES - IV

L T P  
4 - 4

### 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.

### DETAILED CONTENTS

#### **Unit – I: Specialized Injection Moulding Process (12 Hrs)**

Co-Injection Moulding - Two Colour Injection Moulding - Gas Assisted Moulding - Water Assisted Moulding - Liquid Injection Moulding – Lost Core Moulding All Electric Injection Moulding Machines - Tie bar less Injection Moulding, Robotics, Thin Wall injection Moulding, Insert injection Moulding.

#### **Unit – II Advanced Blow Moulding Process (12 Hrs)**

Classification of Advanced Blow Moulding Processes - Stretch Blow Moulding – Extrusion Stretch Blow Moulding – Injection Stretch Blow Moulding, Multi-layer Blow Moulding

#### **Unit – III Advanced Extrusion Process (12 Hrs)**

Profile Extrusion - Material - Process - Process optimization - Downstream equipments - Dies 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.

**(10 Hrs)**

**Unit – V: Laminates** : Conversion of plastic films into laminate e.g. metal plastic laminates, paper plastic laminates, plastic-plastic laminates. Advantages of multi- layer packaging, disadvantages of multi layer packaging.

**(10 Hrs)**

#### **Unit - VI : Textile processing (8 Hrs)**

Polymer processing for textiles, needle punching, melt spinning ,dry spinning, wet spinning, orientation in fibres and post treatment of fibres.

## LIST OF PRACTICALS

1. Study of two colour Injection molding machine.
2. Study of reaction injection moulding machine
3. To produce small components by reaction injection moulding
4. Practice on small laminate manufacturing machine.
5. Study of Stretch blow moulding process.
6. Study of Robotics in Injection Moulding process.

## INSTRUCTIONAL STRATEGY

Industry visits should be organized.

## RECOMMENDED BOOKS

1. Basic Engineering Handbook by Michael L Berins
2. Plastic Processing Data Handbook by Rosato and Rosato
3. Moulding of Plastics by N M Bekalis

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	20
2	12	20
3	12	20
4	10	15
5	10	15
6	08	10
<b>Total</b>	<b>64</b>	<b>100</b>

## 6.2 DESIGN OF DIES AND MOULDS – II

L T P

4 - 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.

### DETAILED CONTENTS

1. Dies (28 hrs)
  - General features of extrusion dies
  - Die materials
  - Design features dies - Polymer melt flow, die geometry, material of construction, ease of maintenance and cleaning. Die land, die swell
  - Heating system and temperature control
  - Types of dies
  - Dies for rod, flexible tube, wire coating
  
2. Compression Mould and Transfer Moulds (20 hrs)
  - Types of compression moulds - positive, semi-positive, flash and landed positive type
  - Calculation of clamp pressure, ram pressure, platen size, no. of impressions. Selection of compression moulding machine
  - Principles of transfer moulding, pot capacity, design of sprue, runner and gates
  
3. Blow Moulds (16 hrs)
  - Materials for Blow moulds
  - Extrusion blow moulds - cavity and pinch off
  - Injection blow moulds - neck design, mandrel design, parison thickness control
  - Mould cooling

### LIST OF PRACTICALS

1. Design and drawing of a single impression compression mould
2. Design and drawing of a multi-impression compression mould
3. Design and drawing of a transfer mould
4. Design and drawing of a blow mould
5. Design and drawing of a die for pipe/tubing

**Note:** Minimum 10 sheets will be prepared by the students on computer using AutoCAD software or latest design software

### **INSTRUCTIONAL STRATEGY**

Students should practically make injection moulds for household, medical equipment and auto parts.

### **RECOMMENDED BOOKS**

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

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	28	50
2	20	30
3	16	20
<b>Total</b>	<b>64</b>	<b>100</b>

### 6.3 PLASTIC PRODUCT DESIGN

L T P  
4 - -

#### 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 quality products. This subject will impart requisite skills for plastic r product design.

#### DETAILED CONTENTS

1. Preliminary design considerations (06 hrs)
  - Design steps for plastic product, mechanical requirements.
2. Materials Selection (12 hrs)
  - Various materials and selection of material for particular application. Cost economics
  - Various processing limitations with Plastic product design, effects of environmental exposure
3. Product Design Features (14 hrs)
  - Surface finish
  - Texturing
  - Shape
  - Positioning of holes
  - Ribs
  - Fillets and rounds
  - Wall thickness
4. Design Activities (08 hrs)
  - Stages of product development
  - Feasibility study and product life cycle
5. Method of joining and machining such as welding, riveting, cementing and adhesion, cutting, sampling, drilling (18 hrs)
  - Assembly methods
  - Inside sharp corners
  - Weld lines

- Draft angles
- Gate side and location
- Moulded inserts
- Internal plastics threads
- Undercuts
- Tolerance
- Functional surfaces and Letters and alphabets

6. Case study of plastic product like Gears & Springs. (06 hrs)

### **INSTRUCTIONAL STRATEGY**

Diploma students should do practical to design injection moulds types two plate and three plate moulds for automatic and semi-automatic machines.

### **RECOMMENDED BOOKS**

1. Plastic product Design, Vol. 1 & II by RD Beck, Van Nostrand Reinhdol Co. Publicatio
2. Plastic Engineering Handhook by Brydson
3. Plastics Engineering Handbook by J. Frados, International Thomas Publishing
4. Plastics : Materials and Processing by A Brent Strong, Prentice Hall of India, New Delhi
5. Plastic Product Design Handbook by Edward Miller, Marcel Dekker Publications
6. Plastics Technology : Theory, Design and Manufacture by William J.Patton

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	6	10
2	12	18
3	14	20
4	8	12
5	18	30
6	6	10
<b>Total</b>	<b>64</b>	<b>100</b>

## 6.6 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

L T 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.

### DETAILED CONTENTS

#### SECTION – A ENTREPRENEURSHIP

1. Introduction (14 hrs)
  - Concept /Meaning and its need
  - Qualities and functions of entrepreneur and barriers in entrepreneurship
  - Sole proprietorship and partnership forms of business organisations
  - 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).
  
2. Market Survey and Opportunity Identification (10 hrs)
  - Scanning of business environment
  - Salient features of National and State industrial policies and resultant business opportunities
  - Types and conduct of market survey
  - Assessment of demand and supply in potential areas of growth
  - Identifying business opportunity
  - Considerations in product selection
  
3. Project report Preparation (08 hrs)
  - Preliminary project report
  - Detailed project report including technical, economic and market feasibility
  - Common errors in project report preparations
  - Exercises on preparation of project repor



## SECTION –B

### MANAGEMENT

- Introduction to Management (04 hrs)
4.  Definitions and importance of management  
 Functions of management: Importance and Process of planning, organising, staffing, directing and controlling  
 Principles of management (Henri Fayol, F.W. Taylor)  
 Concept and structure of an organisation  
 Types of industrial organisations
- Line organisation  
Line and staff organisation  
Functional Organisation
5. Leadership and Motivation (03 hrs)
- a) Leadership
- Definition and Need
  - Qualities and functions of a leader
  - Manager Vs leader
  - Types of leadership
- b) Motivation
- Definitions and characteristics
  - Factors affecting motivation
  - Theories of motivation (Maslow, Herzberg, McGregor)
6. Management Scope in Different Areas (06 hrs)
- a) Human Resource Management
- Introduction and objective
  - Introduction to Man power planning, recruitment and selection
  - Introduction to performance appraisal methods
- b) Material and Store Management
- Introduction functions, and objectives
  - ABC Analysis and EOQ

c) Marketing and sales

- Introduction, importance, and its functions\
- Physical distribution
- Introduction to promotion mix
- Sales promotion

d) Financial Management

- Introductions, importance and its functions
- Elementary knowledge of income tax, sales tax, excise duty, custom duty and VAT

7. Miscellaneous Topics

(03 hrs)

a) Customer Relation Management (CRM)

- Definition and need
- Types of CRM

b) Total Quality Management (TQM)

- Statistical process control
- Total employees Involvement
- Just in time (JIT)

c) Intellectual Property Right (IPR)

- Introductions, definition and its importance
- Infringement related to patents, copy right, trade mark

**Note:** 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.

## **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 organisations on visit. Approach extracted reading and handouts may be provided.

## RECOMMENDED BOOKS

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

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	28
2	10	20
3	08	16
4	04	10
5	03	06
6	06	14
7	03	06
<b>Total</b>	<b>48</b>	<b>100</b>

## 6.6 PROJECT WORK

L T P  
- - 10

Project work aims at developing skills in the students whereby they apply the totality of knowledge and skills gained through the course in the solution of particular problem or undertaking a project. The students have various aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given for a group. The students should identify or given project assignment at least two to three months in advance. The project work identified in collaboration with industry may be preferred.

Each teacher is expected to guide the project work of 5-6 students.

- Projects related to designing new dies, moulds, jigs and fixtures
- Projects related to increasing productivity
- Projects related to quality assurance
- Projects related to estimation and economics of production
- Projects connected with repair and maintenance of plant and equipment
- Projects related to identification of raw material thereby reducing the wastage
- Projects related to suggesting substitutes of the polymer being used
- Any other related problems of interest of host industry

A suggestive criteria for assessing student performance by the external (personnel from industry) and internal (teacher) examiner is given in table below:

Sr. No.	Performance criteria	Max.** marks	Rating Scale				
			Excellent	Very good	Good	Fair	Poor
1.	Selection of project assignment	10	10	8	6	4	2
2.	Planning and execution of considerations	10	10	8	6	4	2
3.	Quality of performance	20	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20	20	16	12	8	4
5.	Sense of responsibility	10	10	8	6	4	2
6.	Self expression/ communication skills	5	5	4	3	2	1
7.	Interpersonal skills/human relations	5	5	4	3	2	1
8.	Report writing skills	10	10	8	6	4	2
9.	Viva voce	10	10	8	6	4	2
<b>Total marks</b>		<b>100</b>	<b>100</b>	<b>80</b>	<b>60</b>	<b>40</b>	<b>20</b>

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

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

In order to qualify for the diploma, students must get “Overall Good grade” failing which the students may be given one more chance of undergoing 8 -10 weeks of project oriented professional training in the same industry and re-evaluated before being disqualified and declared “not eligible to receive diploma ”. It is also important to note that the students must get more than six “goods” or above “good” grade in different performance criteria items in order to get “Overall Good” grade.

### **Important Notes**

- 2 This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.**
- 3 The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.**
- 4 The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.**
- 5 It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.**

The teachers are free to evolve another criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organisations in such an exhibition. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific industries are approached for instituting such awards.

## 6.6 SOFT SKILLS – IV

L	T	P
-	-	2

### RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. The diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market.

### LEARNING OUTCOMES

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

- Communicate effectively.
- Apply techniques of effective time management
- Develop habits to overcome stress
- Face problems with confidence
- Exhibit attributes required to appear for an interview
- Learn about current and future career opportunities
- Exhibit entrepreneurial skills
- Use QC/QT tools

### DETAILED CONTENTS

- Communication Skills - Presentation
- Time management
- Stress Management
- Problem solving
- Career opportunities-Current and future
- Entrepreneurial Skills
- Quality and Quality tools used in industry

In addition, the students must participate in the following activities to be organized in the institute

- Sports
- NCC/NSS
- Cultural Event

Note : Extension Lectures by experts may be organized. There will be no examination for this subject.