



Maharashtra Institute of Technology, Aurangabad
(An Autonomous Institute)



MAHARASHTRA INSTITUTE OF TECHNOLOGY, AURANGABAD

**An Autonomous Institute Affiliated to Dr.
Babasaheb Ambedkar Marathwada University,
Aurangabad, Maharashtra (India)**

**Second Year B. Tech. Syllabus
(Plastic and Polymer
Engineering) 2022-23**



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S. Y. B. Tech. Syllabus Structure w.e.f. 2022-23														
Plastic and Polymer Engineering														
Sr. No	Course Category	Course Code	Course Title	L	T	P	Contact Hr /Wk	Credits	MSE-I	MSE-II	CIE	TA	ESE/ Oral	Total
Orientation Program (2 Days)														
1.1	BSC	BSC204	Linear Algebra & Transform	3	1	-	4	4	15	15	10	10	50	100
1.2	PC	PPE201	Introduction to Polymer Engineering	3	-	-	3	3	15	15	10	10	50	100
1.3	PC	PPE202	Polymer Testing	3	-	-	3	3	15	15	10	10	50	100
1.4	PC	PPE203	Physical Chemistry of Polymers	3	-	-	3	3	15	15	10	10	50	100
1.5	PC	PPE204	Materials science	3	-	-	3	3	15	15	10	10	50	100
1.6	PC	PPE221	Lab-I: Introduction to Polymer Engineering	-	-	2	2	1	-	-	-	-	25	25
1.7	PC	PPE222	Lab-II: Mechanical Operations lab	-	-	2	2	1	-	-	-	25	-	25
1.8	PC	PPE223	Lab-III: Physical Chemistry of Polymers	-	-	2	2	1	-	-	-	25	25	50
1.9	PC	PPE224	Lab-IV: Polymer Testing	-	-	2	2	1	-	-	-	-	25	25
1.10	PC	PPE225	Lab-V: Data Analytics Lab	-	-	2	2	1	-	-	-	25	-	25
1.11	HSMC	HSM804	Mandatory Non-Credit Course	2	-	-	2	Non-Credit Mandatory Course						
S3				17	1	10	28	21	75	75	50	125	325	650
Sr. No	Course Category	Course Code	Course Title	L	T	P	Contact Hr /Wk	Credits	MSE-I	MSE-II	CIE	TA	ESE/ Oral	Total
2.1	BSC	BSC251B	Complex Variable & Vector Calculus	3	1	-	4	4	15	15	10	10	50	100
2.2	PC	PPE251	Polymer Synthesis and Manufacturing	3	-	-	3	3	15	15	10	10	50	100
2.3	PC	PPE252	Polymer Additives and Compounding	3	-	-	3	3	15	15	10	10	50	100
2.4	PC	PPE253	Process calculations	3	-	-	3	3	15	15	10	10	50	100
2.5	PC	PPE281-283	Professional Elective-I	3	-	-	3	3	15	15	10	10	50	100
2.6	PC	PPE271	Lab-I: Polymer Synthesis & Manufacturing	-	-	2	2	1	-	-	-	-	25	25
2.7	PC	PPE272	Lab II: Design Lab - I	-	-	2	2	1	-	-	-	25	-	25
2.8	PC	PPE273	Lab-III: Raw material analysis for polymers and resins	-	-	2	2	1	-	-	-	-	25	25
2.9	HSMC	HSM254	Lab-IV: Development of Skills (Soft Skills)	-	-	2	2	1	-	-	-	25	25	50
2.10	PC	PPE274	Lab-V: Problem-based learning	-	-	2	2	1	-	-	-	25	-	25
2.11	HSMC	HSM805-HSM807	Mandatory Non-Credit Course	2	-	-	2	Non-Credit Mandatory Course						
S4				17	1	10	28	21	75	75	50	125	325	650



Semester – 3:

Mandatory Non-Credit Course

HSM804 Constitution of India

Semester – 4:

Professional Elective-I

PPE281 Fiber Technology

PPE282 Biopolymers

PPE283 Membrane Technology

Mandatory Non-Credit Course

HSM805 Professional Ethics and Corporate Social Responsibility

HSM806 Emotional Intelligence

HSM807 Stress Management Through Yoga



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester III)	
Course Code: BSC204 Course: Linear Algebra & Transform Teaching Scheme: Theory: 03 Hrs/week Tutorial: 01Hr/week	Credits: 3-1-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs
Prerequisite	<ul style="list-style-type: none"> • Basic formulae of trigonometry, derivative, integration, basic knowledge of determinant and matrices.
Objectives	<ol style="list-style-type: none"> 1. To know the application of the matrix technique in finding find solution of system of linear equations that arises in many engineering problem. 2. To understand and solve higher order differential equations and apply them by mathematical modelling in various engineering problems. 3. To study and apply concept of transform.
Unit-I	Complex Number: Introduction to complex number, De-Moivrer's theorem, root of complex number, circular function & hyperbolic function, relation between circular & hyperbolic function, inverse hyperbolic functions, separation of real & imaginary parts, Logarithm of complex quantity. <div style="text-align: right;">(07 Hrs)</div>
Unit-II	Matrix: Introduction to matrix, rank of matrix-echelon form, normal form, solution of simultaneous linear equations (homogeneous & non homogeneous). Eigen values and Eigen vectors, Cayley-Hamilton theorem. <div style="text-align: right;">(06 Hrs)</div>
Unit-III	Probability Distribution: Introduction, Probability distribution: Binomial distribution, Poisson distribution, Normal distribution. <div style="text-align: right;">(05 Hrs)</div>
Unit-IV	Linear Differential Equation & Its Applications: Solution of n^{th} order linear differential equation with constant coefficients: Complementary function, Particular integral- short method, method of variation of parameters, Application of Linear differential equation to electrical circuit, Civil and mechanical. <div style="text-align: right;">(06 Hrs)</div>
Unit-V	Laplace Transform : Definition, Laplace Transforms of elementary functions, Theorems and properties of Laplace transform (without proof): First shifting and second shifting theorem, Change of scale, Multiplication by t , Division by t , Laplace transform of Derivatives, Laplace transform of integral, Evaluation of integrals using Laplace transform, Laplace transform of Unit step function and Dirac's delta function. <div style="text-align: right;">(06 Hrs)</div>
Unit-VI	Inverse Laplace transform: Definition, Inverse Laplace transforms using: <ol style="list-style-type: none"> a) Some elementary functions b) Theorem and properties of Laplace transform c) Partial fraction method



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	d) Convolution theorem Application of Laplace transform to solve linear differential equations with given initial conditions (06 Hrs)				
Textbooks / Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Advanced Engineering Mathematics	Erwin Kreyszig	Wiley eastern Ltd	10 th
	2.	Higher Engineering Mathematics	B.V. Ramana	Tata McGraw-Hill	1 st
	3.	Higher Engineering Mathematics	Dr. B. S. Grewal	Khanna Publications	43 rd
	4.	Applied Mathematics	P. N. Wartikar & J. N. Wartikar	Pune Vidyarthi Griha Prakashan, Pune	9 th
	5.	A text book of Engineering Mathematics	N.P. Bali and Manish Goyal	Laxmi Publications	Laxmi Publications
	6.	Advanced Engineering Mathematics.	H. K. Dass	S. Chand And Co. Ltd.	18 th



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester III)	
Course Code: PPE201 Course: Introduction to Polymer Engineering Teaching Scheme: Theory: 3 Hrs/week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs
Prerequisite	<ul style="list-style-type: none"> • Fundamental knowledge of chemistry based on 10th and 12th standard.
Objectives	To provide 1. General overview of polymers, their types, concept of molecular weight. 2. General understanding of structure of polymers and predict polymer properties.
Unit-I	Introduction: Historical developments of different polymers – a general overview, basic raw materials, concepts and definitions of monomers, oligomers, macromolecules, polymers, repeating units, degree of polymerization, functionality concept, functional groups. <div style="text-align: right;">(02 Hrs)</div>
Unit-II	Classification of Polymers: Basic concepts and definitions of: organic and inorganic, thermoplastics and thermosets, addition and condensation, natural, semi synthetic and synthetic, crystalline and amorphous, homopolymers and copolymers, homochain and heterochain; linear, branched and crosslinked. Concept of rubber, plastic and fiber, conformation and configuration, tacticity. Commodity and specialty polymers. <div style="text-align: right;">(07 Hrs)</div>
Unit-III	Molecular Weight: Distribution and Determination: concept of average molecular weight of polymers (M_n , M_w , M_v and M_z), molecular weight distribution and concept of polydispersity and monodispersity, degree of polymerization, determination of molecular weight by end group analysis, solution viscosities, size exclusion chromatography, membrane osmometry, light scattering method. <div style="text-align: right;">(09 Hrs)</div>
Unit-IV	Mechanical and Thermal Properties: Effect of crystallinity, molecular weight, cross link density and additives on modulus of elasticity, tensile strength, flexural strength, impact strength, yield strength, fracture toughness. Transition temperature in polymers: melting temperature (T_m) and glass transition temperature (T_g), factors affecting T_m and T_g . <div style="text-align: right;">(08 Hrs)</div>
Unit-V	Electrical and Optical Properties: Effect of polymer structure on dielectric constant, power factor, dissipation factor, loss factor, electrical conductivity, static charges, resistivity and arc resistance of polymers. Effect of polymer structure on optical properties, viz. clarity, transparency, haze, transmittance, absorbance, gloss. <div style="text-align: right;">(06 Hrs)</div>
Unit-VI	Chemical Properties: Effects of polymer structure on solubility in different solvents, concept of cohesive energy and solubility parameter, chemical resistance of polymers, diffusion and permeability. <div style="text-align: right;">(04 Hrs)</div>



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Textbooks / Reference	Sr. No.	Title	Author	Publication	Edition
Books	1.	Polymer Science and Technology: Plastics, Rubber, Blends and Composites	Premamoy Ghosh	Tata McGraw Hill	2 nd
	2.	Plastics Materials	J. Brydson	Butterworth Heinemann	7 th
	3.	Introduction to Polymer Science and Chemistry :A Problem-Solving Approach	Manas Chanda	CRC Press	2 nd
	4.	Principles of Polymerization	George Odian	Wiley Interscience	4 th
	5.	Textbook of Polymer Science	F. W. Billmeyer	Wiley Interscience	3 rd
	6.	Polymer Science	V. R. Gowarikar	New Age	3 rd



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester III)	
Course Code: PPE202 Course: Polymer Testing Teaching Scheme: Theory: 3 Hrs/week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs
Prerequisite	<ul style="list-style-type: none"> • Basic knowledge of chemistry and physics.
Objectives	1. To impart understanding of the necessity and methodology of different polymer testing processes to evaluate polymer properties.
Unit-I	<p>a) Introduction: Purpose of testing, destructive and non-destructive testing, specifications and standards, testing samples, sample conditioning.</p> <p>b) Physicochemical properties: Specific gravity, density (gradient method), water absorption tape test for films.</p> <p style="text-align: right;">(6Hrs)</p>
Unit-II	<p>Mechanical Properties: Introduction, tensile strength, flexural strength, compressive strength, impact strength, abrasion, fatigue resistance, creep and stress relaxation, hardness, burst strength, coefficient of friction test for films.</p> <p style="text-align: right;">(6Hrs)</p>
Unit-III	<p>a) Optical Properties: Introduction, refractive index, luminous transmittance, haze, colour evaluation.</p> <p>b) Electrical Properties: Introduction, dielectric strength, dielectric constant and dissipation factor, electrical resistance, electrical conductivity, arc resistance.</p> <p style="text-align: right;">(6Hrs)</p>
Unit-IV	<p>a) Flammability: Introduction, ignition properties of plastics, ignition temperature determination, oxygen index test, UL 94 flammability test.</p> <p>b) Thermal Properties: Introduction, heat distortion temperature, Vicat softening temperature, thermal conductivity, thermal expansion.</p> <p style="text-align: right;">(6Hrs)</p>
Unit-V	<p>a) Chemical Properties: Introduction, immersion tests, stains resistance test, solvent stress cracking resistance, and environmental stress cracking resistance.</p> <p>b) Weathering Properties: Accelerated weathering tests, outdoor weathering properties.</p> <p style="text-align: right;">(6Hrs)</p>



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Unit-VI	Miscellaneous Test: Melt flow index, dilute solution viscosity test for thermoplastics, cup viscometer for thermosets, rheometer (6Hrs)				
Textbooks / Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Handbook of Plastics Testing Technology	Vishu Shah	A Wiley Interscience	2 nd
	2.	Handbook of Plastics Test Methods	R. P. Brown	Longman Scientific And Technical	3 rd
	3.	Testing & Evaluation of Plastics	Mathur and Bhardwaj	Allied publisher Pvt Ltd.	2003
	4.	Identification and Testing of Plastics	A. S. Athalye	Multi-Tech Publishing,	1992



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester III)	
Course Code: PPE203 Course: Physical chemistry of polymers Teaching Scheme: Theory: 3 Hrs/week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs
Prerequisite	<ul style="list-style-type: none"> • Basic knowledge of physics and chemistry.
Objectives	<ol style="list-style-type: none"> 1. This course is intended to introduce to the students the physicochemical concepts associated with the macromolecular chain nature of polymeric materials. 2. The student will have a basic understanding of the physical and physicochemical principles which result from the chainlike structure of synthetic macromolecules. 3. The student can predict major characteristics of a polymer from its chemical structure and molecular architecture.
Unit-I	Structure of Polymer Chain: Introduction to chain conformation, configurations, conformation of ethane and butane, factors influencing stereoregularity, conformation of polymer chain. <div style="text-align: right;">(4 Hrs)</div>
Unit-II	Crystalline State of Polymers: Degree of crystallinity, crystallisability, T_c , crystallization mechanisms (by stretching, from solution), spherulite formation, nucleation, grain boundary, crystalline structures. Intermolecular orders: amorphous, crystalline and oriented forms of polymers, factors affecting crystallinity, properties affected by crystallinity of polymers. <div style="text-align: right;">(8 Hrs)</div>
Unit-III	Polymer Solutions: Polymer Solutions: Dilute and Concentrate, phase separation; good, bad and theta solvents, Hilderbrand and Hansen solubility parameter. <div style="text-align: right;">(6 Hrs)</div>
Unit-IV	Thermodynamics of Polymer Solutions: Laws of thermodynamics, enthalpy, entropy, Gibbs free energy, Helmholtz free energy, Clausius inequality, thermodynamic condition for solubility, Flory-Huggins theory, phase diagrams of binary solution; upper and lower critical solution temperature with examples of each kind. Thermodynamic and kinetic flexibility of polymer chains, practical importance of chain flexibility. <div style="text-align: right;">(9 Hrs)</div>
Unit-V	Osmosis: Osmotic pressure, vapour pressure osmometry, reverse osmosis (RO), ideal solution, Van't Hoff analysis, virial expansion, application in determining molecular weight of polymer. <div style="text-align: right;">(5 Hrs)</div>
Unit-VI	Polymer Surface Chemistry: Cohesive energy, surface tension and surface energy, contact angle (definition, theory and application), hydrophilic and hydrophobic polymer surfaces. <div style="text-align: right;">(4 Hrs)</div>



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Textbooks / Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Polymer Science and Technology: Plastics, Rubber, Blends and Composites	Premamoy Ghosh	Tata McGraw Hill	2 nd
	2.	Polymer Science and Technology	Joel R. Fried	Prentice Hall of India Pvt. Ltd.	3 rd
	3.	Polymer Science	V. R. Gowarikar	New Age International Publishers	3 rd 2005
	4.	Principles of Polymer Chemistry	P.J. Flory	Cornell Univ. Press, New York	1955
	5.	Plastics Materials	J. A. Brydson	Elsevier	6 th



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester III)	
Course Code: PPE204 Course: Materials Science Teaching Scheme: Theory: 3 Hrs/week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs
Prerequisite	<ul style="list-style-type: none"> • Basic Physics, Chemistry, and Mathematics
Objectives	<ol style="list-style-type: none"> 1. Understand the basic concepts and properties of materials. 2. Convey the significance of material selection in process designing. 3. Understand structure property relationship and selection of appropriate material for specific applications. 4. Explain the latest developments in material science and technology.
Unit-I	Introduction to materials and atomic bonding Introduction, history and evolution of materials, classification of materials, need to study of materials, bonding in atoms-Primary bonding and Secondary bonding. <div style="text-align: right;">(4Hrs)</div>
Unit-II	Crystal structure and imperfections: Concepts of unit cell and Bravais lattice, crystallographic directions and planes, Miller indices, linear and planar density, crystal defects. <div style="text-align: right;">(6Hrs)</div>
Unit-III	Thermodynamics: Phase rule, phase diagrams, Lever rule, Solid solutions, Invariant reactions, basic heat treatment of metals, Fick's laws of diffusion, mechanisms of diffusion, phase transformation. Mechanical properties: Concept of stress-strain, shear stress, torsion, tensile strength, ductility, brittleness, resilience, toughness, impact strength, hardness, creep. <div style="text-align: right;">(8Hrs)</div>
Unit-IV	Properties of materials: Electronic Properties -Free electron theory, Semiconductors, Dielectric behavior, Piezo, Ferro, Pyroelectric materials. Magnetic Properties -Origin of magnetism in metallic and ceramic materials, Paramagnetism, Diamagnetism, Ferro, Ferrimagnetism. Optical Properties -Refractive index, absorption and transmission of electromagnetic radiation in solids, electro-optic and magneto-optic materials. <div style="text-align: right;">(5Hrs)</div>
Unit-V	Metals and ceramics: a) Metals: Ferrous alloys: classification, types of steels, effect of impurities, cast iron, non-ferrous alloys: aluminium and its alloys, copper and its alloys, nickel and its alloys, zinc and its alloys, titanium and its alloys, cobalt and its alloys, bulk metallic glass, strengthening and corrosion in metals. b) Ceramics: Introduction, classification, ceramic crystal structure, processing of



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	ceramics, ceramic elastic modulus, Weibull modulus, hardness, fracture toughness, failure in ceramics. (8 Hrs)				
Unit-VI	Composites: Introduction, definition, composite classification, fiber reinforced composites (polymer matrix, metal matrix, ceramic matrix, carbon-carbon composites), structural composites, manufacturing and processing of composites (hand lay-up, spray lay-up, pultrusion, prepreg, resin-transfer moulding, pressure bag and vacuum bag techniques). (5Hrs)				
Textbooks / Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Material Science and Engineering An Introduction	William D. Callister	Wiley	8 th
	2.	Material Science and Engineering	V. Raghavan	Prentice Hall of India	5 th
	3.	Foundation of Material Science & Engineering	William Smith, Javad Hashemi	McGraw Hill	5 th
	4.	Polymer Science and Technology	Joel R. Ried	Prentice Hall	3 rd
	5.	Introduction to Material science for Engineers	James F. Shackelford	Pearson	8 th



Faculty of Science & Technology Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester III)	
Course Code: PPE221 Course: Lab-I: Introduction to Polymer Engineering Teaching Scheme: Practical: 02 Hrs/week	Credits: 0-0-1 Practical Examination: 25 Marks
Objective	<ul style="list-style-type: none">• To identify and analyze the various properties of polymer materials.
List of practicals	Any 8 practical to be conducted <ol style="list-style-type: none">1. Identification of polymers by<ol style="list-style-type: none">a. Preliminary tests like cut test, drop test, float test.b. Heating tests, solubility tests.c. Confirmatory tests of specific polymers.2. Determination of moisture and volatile content in plastics /rubbers.3. Determination of bulk density of polymers.4. Determination of water absorption in polymer sample.5. Determination of molecular weight of polymer by viscometry.6. Determination of the percentage purity of HMTA.7. Determination of amine value.8. Determination of acid value.9. Determination of ash content.

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.



Faculty of Science & Technology Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester III)	
Course Code: PPE222 Course: Lab-II: Mechanical Operations lab Teaching Scheme: Practical: 02 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks
Objective	<ul style="list-style-type: none">• To provide students with a thorough understanding and knowledge of the mechanical operating elements and adjustment.• To make students aware of basics of different operations like size reduction, filtration, sedimentation, grinding etc.
List of practicals	Any 8 practical to be conducted <ol style="list-style-type: none">1. To find particle size distribution by sieve analysis.2. To determine the effectiveness of double deck vibrating screen.3. To determine the crushing efficiency, reduction ratio in jaw crusher.4. To determine the crushing efficiency of pulverizer.5. To determine the effect of dry and wet grinding on critical speed of ball mill.6. To determine the effect of number of balls on dry and wet grinding.7. To determine the effect of diameter of the tank on batch settling.8. To study constant pressure filtration characteristics and washing of cake in a plate and frame filter.9. To study filter characteristics using vacuum filter.10. To determine the efficiency of the grinder.

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.



Faculty of Science & Technology Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester III)	
Course Code: PPE223 Course: Lab-I: Physical Chemistry of Polymers Teaching Scheme: Practical: 02 Hrs/week	Credits: 0-0-1 Term work: 25 Marks Practical Examination: 25 Marks
Objective	<ul style="list-style-type: none">• To teach students various techniques to determine physical properties of polymers such as solubility, refractive index, swelling parameter, surface energy.
List of practicals	Any 8 practical to be conducted <ol style="list-style-type: none">1. Determine of molecular weight by conductometric titration.2. Determination of molecular weight by potentiometric titration.3. Identification of good/ bad/ theta solvent of polymer.4. Determination of solubility parameter.5. Verify the applicability of a mixture of non-solvents as effective solvent of a polymer.6. Determination of softening point of polymer.7. Determination of swelling parameter.8. Determination of UCST/ LCST of polymer.9. Determination of surface energy of polymer.10. Determination of refractive index of polymer solutions.

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester III)	
Course Code: PPE224 Course: Lab-IV: Polymer Testing Teaching Scheme: Practical: 02 Hrs/week	Credits: 0-0-1 Practical Examination: 25 Marks
Objective	<ul style="list-style-type: none">• To enable the student's learning about various polymer testing procedures.• To enable the student's visualization of the test method and machine operations for performing various testing on polymer materials/products.
List of practicals	Any 8 practical to be conducted <ol style="list-style-type: none">1. To determine the Tensile strength of given polymer sample.2. To determine the Compression strength of given polymer sample.3. To determine the Flexural strength of given polymer sample.4. To determine the Impact strength of given polymer sample.5. To determine the Hardness of given polymer sample.6. To determine Melt Flow Index of given polymer sample.7. To determine the surface resistance of given polymer product.8. To determine specific gravity/density of given polymer sample.9. To determine the Heat Deflection Temperature of given polymer sample.10. To determine the Vicat Softening Temperature of given polymer sample.

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester III)	
Course Code: PPE225 Course: Lab-V: Data Analytics Lab Teaching Scheme: Practical: 02 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks
Objective	<ul style="list-style-type: none">To provide knowledge of data analysis techniques required for plastic and polymer engineering.
List of practicals	Any 8 practical to be conducted <ol style="list-style-type: none">To study the basic functions of MS Excel required for data analytics.To determine slope and intercept by linear curve fitting of given data points.To normalize a peak for given multiple graphs.To retrieve data from given graphical image.To select data points at specific interval.To compare given graphical data sets by overlay and split graph.To compare graphs, based on given data sets by changing scale.To differentiate a graph based on given data points.To construct a multiple-Y graph based on given different graphs.To separate the coinciding peaks by deconvoluting a graph.To analyze 3D graph based on given data points.

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. All (Semester III)	
Course Code: HSM804 Course: Non-Credits Mandatory course (Constitution of India) Teaching Scheme: Theory: 02 Hrs/week	Credits: 0-0-0
Objectives	1. To provide the basic knowledge about the Political System of the Country. 2. To make the students aware of their duties and rights. 3. To educate the pupils about the working of different organs of the government, various constitutional bodies and the agencies of the government.
Unit-I	Meaning and Concept of Indian Constitution: Nature of Constitution; brief idea of Indian Constitution [Parts, Articles and Schedule] <div style="text-align: right;">(2 Hrs)</div>
Unit-II	Silent Features of Indian Constitution Written and enacted Constitution; the longest and most detailed Constitution of the World; rigidity and flexible Constitution; Parliamentary system of Government; Federal system with unitary bias; adult franchise; single citizenship; Sovereign, Democratic, Republic; Secularism; Directive Principles of State Policy; Independent Judiciary; Fundamental Rights; Fundamental Duties. <div style="text-align: right;">(5Hrs)</div>
Unit-III	Fundamental Rights Concept of State (Art. -12); Right to Equality (Art. -14 to 18); Right to Freedom (Art. -19 to 22); Right against Exploitation (Art. -23 & 24); Right to Religion (Art. -25 to 28); Right of Minorities (Art. -29 & 30); Constitutional Remedies (Art.-32). Fundamental Duties (Art.-51 A) <div style="text-align: right;">(5 Hrs)</div>
Unit-IV	Directive Principles of State Policy (DPSP's) Meaning and Significance of Directive Principles; Classification/ Principles of D.P.S.P.; Relationship between F.Rs. and D.P.S.P. <div style="text-align: right;">(4Hrs)</div>
Unit-V	Executives A) Union Government The President, Council of Ministers and Prime Minister. B) State Government The Governor, Council of Ministers and Chief Minister <div style="text-align: right;">(4Hrs)</div>
Unit-VI	Election Commission: Election Commission: Role and Functioning; Chief Election Commissioner and Election Commissioners; State Election Commission: Role and Functioning; Institute and Bodies for the welfare of SC/ST/OBC and women. <div style="text-align: right;">(4Hrs)</div>



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Textbooks / Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Constitution of India, Bare Act. Govt. of India.	-	-	-
	2.	Our Constitution (AN Introduction of Indians Constitution and Constitutional tow	Subhash C Kashyap	National Book Trust, India	2001
	3.	Indian Constitution	Avasthi &, Maheshwari	Lakshmi Narain Agrawal Agra	2017
	4.	Introduction to the Constitution of India	Basu D.D	Lexis Nexis	2013
	5.	Indian Prime Minister, the Macmillan Company of India	Sharma L.N	-	1976
	6.	Union Executive	Jain H.M.	Chaitanya Publishing House	1969
	7.	Framing of Indian Constitution	Dr. S.N. Busi, Dr. B.R. Ambedkar	-	1 st 2015
	8.	Indian Constitution Law	M.P. Jain	Nexis	7 th 2014
	9.	Outlines of Indian Legal and Constitutional History	M.P. Jain	Lexis Nexis	2014



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester IV)	
Course Code: BSC251B Course: Complex Variable & Vector Calculus Teaching Scheme: Theory: 03 Hrs/week Tutorial: 01Hr/week	Credits: 3-1-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs
Prerequisite	<ul style="list-style-type: none"> • Basic formulae of trigonometry, Derivative, Integration, algebra of complex numbers, fundamentals of vector algebra.
Objectives	1. To develop the mathematical skills of the students related to function of complex variables. 2. To make the students familiarize with concept of vector differentiation and vector integration. 3. To apply mathematical concepts for solving the practical problems in engineering and technology.
Unit-I	Function of Complex Variable: Introduction, analytic function, Cauchy-Riemann equation in Cartesian and polar coordinates, Harmonic function, Orthogonal system, integration in complex plane: line integral, Contour integral, Cauchy's integral theorem, Cauchy's integral formula, extension of Cauchy's theorem on multiply connected region, singularities, residues, Cauchy's residue theorem. <p style="text-align: right;">(07 Hrs)</p>
Unit-II	Fourier Series: Definition, Dirichlet's conditions; Fourier series for function having period $2L$; Fourier series for even and odd function, half range expansion; Fourier sine and cosine series. <p style="text-align: right;">(06 Hrs)</p>
Unit-III	Fourier Transform: Fourier integral theorem (without proof), Fourier sine and cosine integral, Fourier sine and cosine transform, inverse Fourier transform, inverse Fourier sine and cosine transform. <p style="text-align: right;">(05 Hrs)</p>
Unit-IV	Vector Differentiation: Differentiation of vectors, scalar and vector point functions, gradient of a scalar point function, directional derivative, Divergence and Curl of vector point function, Irrotational and Solenoidal vector fields. <p style="text-align: right;">(06 Hrs)</p>
Unit-V	Vector Integration: Line integral, work done by a force, surface integral, Green's theorem, Stokes's theorem. <p style="text-align: right;">(06Hrs.)</p>
Unit-VI	Application of Partial Differential Equation Solution of partial differential equation by method of separation of variables, Applications to i) Vibration of a string (Wave equation) (without proof) ii) One dimensional heat flow equation (Diffusion equation) (without proof) iii) Two dimensional heat flow equation (Diffusion equation) (without proof). <p style="text-align: right;">(6 Hrs)</p>



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Textbooks / Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Advanced Engineering Mathematics	Erwin Kreyszig	Wiley eastern Ltd	10 th
	2.	Higher Engineering Mathematics	B.V. Ramana	Tata McGraw-Hill	1 st
	3.	Advanced Engineering Mathematics	C. R. Wylie	McGraw Hill Publications	6 th
	4.	Higher Engineering Mathematics	Dr. B. S. Grewal	Khanna Publications	43 rd
	5.	Applied Mathematics	P. N. Wartikar & J. N. Wartikar	Pune Vidyarthi Griha Prakashan, Pune	9 th
	6.	A text book of Engineering Mathematics	N. P. Bali and Manish Goyal	Laxmi Publications	-
	7.	Advanced Engineering Mathematics.	H. K. Dass	S. Chand And Co. Ltd	18 th



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester IV)	
Course Code: PPE251 Course: Polymer Synthesis and Manufacturing Teaching Scheme: Theory: 03 Hrs/week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs
Prerequisite	<ul style="list-style-type: none"> • Introduction to Polymer Engineering. • Organic Chemistry of Polymers.
Objectives	To provide <ol style="list-style-type: none"> 1. General overview of synthesis of polymers. 2. General overview of kinetics and different techniques of polymerization. 3. A thorough understanding and knowledge of manufacturing processes of various thermoplastics and thermosets.
Unit-I	Addition polymerization: Free radical polymerization, ionic polymerization, free radical copolymerization: theory, techniques, mechanism, kinetics (assumptions and derivations of rate of polymerization), advantages and disadvantages, examples of polymers prepared by these methods. Chain transfer, inhibition and retardation, autoacceleration, number average degree of polymerization, numericals. <p style="text-align: right;">(6 Hrs)</p>
Unit-II	Techniques of polymerisation: Brief idea about different polymerization techniques: bulk, solution, suspension, emulsion and interfacial polymerization (sample recipes, examples of polymers prepared by these techniques). Binary Co-polymerisation: Concept of copolymerization, free radical binary copolymerization of Vinyl monomers, structure and reactivity of monomers, kinetics of binary copolymerization and copolymer composition, monomer reactivity ratios and determination, types of copolymerization, Q-e scheme. <p style="text-align: right;">(6 Hrs)</p>
Unit-III	Condensation polymerization: Kinetics of condensation polymerization, copolymerization, examples of polymers prepared by these methods. Carother's equation. Reactivity of functional groups, rate of polymerization, catalyzed and self-catalyzed polyesterification reaction, stoichiometric control of molecular weight, effect of temperature on rate of polymerization, number average degree of polymerization, numericals. <p style="text-align: right;">(6 Hrs)</p>
Unit-IV	Manufacturing of thermoplastic materials: Ziegler-Natta polymerization and metallocene polymerization with emphasis on manufacturing of PE and PP, raw materials and manufacturing processes of PS, HIPS, ABS, PET, PC and PTFE. Ring-opening polymerization of Nylon 6, manufacturing processes of Nylon 66 and Aramid with emphasis on commercial production processes of each. <p style="text-align: right;">(7Hrs)</p>



Unit-V	Manufacturing of thermosetting materials: Raw materials, commercial production process, resinification and crosslinking of phenol formaldehyde resins, amino resins (UF and MF), epoxies and alkyds. (7 Hrs)				
Unit-VI	Miscellaneous Materials: Raw materials and manufacturing of silicones (rubber and plastics) and polyurethanes (foam, adhesive, plastic and rubber). (4 Hrs)				
Textbooks / Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Polymer Science and Technology: Plastics, Rubber, Blends and Composites	Premamoy Ghosh	Tata McGraw Hill	2 nd
	2.	Plastics Materials	J. Brydson	Butterworth Hienemann	7 th
	3.	Introduction to Polymer Science and Chemistry: A Problem-Solving Approach	Manas Chanda	CRC Press	2 nd
	4.	Principles of Polymerization	George Odian	Wiley Interscience	4 th
	5.	Handbook of Industrial Polyethylene and Technology Definitive Guide to Manufacturing, Properties, Processing, Applications and Markets	Mark A. Spalding and Ananda M. Chatterjee	Scrivener Publishing	2 nd
	6.	Polyurethane and Related Foams	Kaneyoshi Ashida	Taylor and Francis	1 st



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester IV)	
Course Code: PPE252 Course: Polymer Additives and Compounding Teaching Scheme: Theory: 03 Hrs/week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs
Prerequisite	<ul style="list-style-type: none"> Basics about mixing Fundamentals of plastics
Objectives	<ol style="list-style-type: none"> 1. To understand about different additives and its applications. 2. To understand the process of incorporation of additives in polymers for achieving desired properties in the final material/compound.
Unit-I	Introduction: Introduction, classification of additives, technical requirements of use of additives in polymer compounding, types of additives used in polymers. <div style="text-align: right;">(3 Hrs)</div>
Unit-II	Fillers and reinforcements: Fibrous fillers: Properties and applications of jute, coir, hemp, aramid, polypropylene, carbon and glass fibers. Other fillers: Properties and applications of wood, calcium carbonate, talc, wollastonite, clay and silicates. <div style="text-align: right;">(8 Hrs)</div>
Unit-III	Stabilizers and colorants: a) Stabilizers: Photodegradation of polymers, antioxidants, antiozonants, heat stabilizers. b) Colorants: Pigments and dyes, types of pigments and their role in coloration, master batches, color matching. <div style="text-align: right;">(7 Hrs)</div>
Unit-IV	Processing aids: a) Plasticizers: Plasticizers and anti-plasticizers, properties, characteristics and applications. b) Lubricants: Types and effect of lubricants, zinc stearate, waxes. <div style="text-align: right;">(4 Hrs)</div>
Unit-V	Miscellaneous additives: Impact modifiers, peptizers, blowing agents, flame retardants, nucleating agents, coupling agents, anti-microbial agents, anti-fogging agents, anti-static agents, metal deactivators, cross linking agents, biodegradable additives <div style="text-align: right;">(6 Hrs)</div>
Unit-VI	Polymer compounding: process, machinery and devices: Mixing mechanisms, internal batch mixers, continuous mixers, two roll mill, single screw extruder, modular twin screw extruder, rotation mechanisms, screw elements, kneaders, vent and vacuum ports, conveying systems: feeding types, feeders and screws, feed enhancement technology (FET). <div style="text-align: right;">(8 Hrs)</div>



Textbooks / Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	The Additives for Plastics Hand Book	John Murphy	Elsevier Advanced Technology	2 nd 2001
	2.	Plastics Additives	R. Gachter and H. Muller	Hanser Publishers	3 rd 1993
	3.	Plastics Additives and Modifiers Handbook	Jesse Edenbaum	Springer	1 st 1992
	4.	Mixing and Compounding of Polymers: Theory and Practice	Ica Manas – Zloczower and Zehev Tadmor	Hanser Publications	2 nd 2009
	5.	Polymer Mixing and Extrusion Technology	Nicholas P. Cheremisionoff	Marcel Decker Inc	1 st 1987
	6.	Plastics Materials	J. A. Brydson	Butterworth Heinemann	1 st 1999
	7.	Polymer Mixing Technology and Engineering	J. L. White, A. L. Coran and A. Moet	Hanser Gardner Publications Ltd.	1 st 2001
	8.	Understanding Compounding	R. H. Wildi and C. Maier	Hanser Gardner Publications	1 st 1998
	9.	A concise introduction to additives for thermoplastic polymers	Johannes Karl Fink	Scrivener Publishing	1 st 2010



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester IV)	
Course Code: PPE253 Course: Process Calculations Teaching Scheme: Theory: 03 Hrs/week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs
Prerequisite	<ul style="list-style-type: none"> • Basic Engineering Mathematics and Organic Chemistry of Polymers
Objectives	<ol style="list-style-type: none"> 1. To understand the basic calculation of various processes in Polymer Engineering. 2. To study the calculations of energy requirements of processes. 3. To understand the implications of steady state processes of various unit operations through material balances with and without chemical reactions.
Unit-I	Basics of stoichiometry: Vapor pressure, partial pressure, ideal gas law, Dalton's law, Henry's law, Raoult's law, Amagat's law, weight percent, volume percent, mole percent, normality, molarity, molality, density of gas mixture, average molecular weight of mixture <div style="text-align: right;">(7 Hrs)</div>
Unit-II	Material Balance without Chemical Reaction: Material balance for unit operations: Distillation, drying, mixing, extraction, absorption, evaporation. <div style="text-align: right;">(6 Hrs)</div>
Unit-III	Material Balance with Chemical Reaction: Material balance with different types of chemical reactions. Limiting and excess reactants. <div style="text-align: right;">(5 Hrs)</div>
Unit-IV	Energy Balance: Energy balance with chemical reactions, heat capacity of pure substances and mixtures, standard heat of reaction, standard heat of formation and combustion, Hess's law. <div style="text-align: right;">(6 Hrs)</div>
Unit-V	Humidification: Dry and wet bulb temperature, dew point, absolute, relative and relative humidity, effects of humidity, humidifier and dehumidifier, Mollier diagram. <div style="text-align: right;">(6 Hrs)</div>



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Unit-VI	Fuels and Combustion: Fuels and its classification, calorific value, determination of calorific value using Bomb calorimeter and Dulong's Method, combustion and its types, methods of controlling fire (6 Hrs)				
Textbooks / Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Stoichiometry	Bhatt and Vora	Tata McGraw Hill	4 th
	2.	Chemical Process Principles (Part-I)	Hougen & Watson	Asia Publishing House	2 nd
	3.	Basic Principles and Calculation	D. M. Himmelblau	Prentice-Hall India	6 th
4.	Stoichiometry and Process Calculations	K. V. Narayanan, B. Lakshmikutty	PHI Learning Pvt. Ltd.	2 nd	



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester IV)	
Course Code: PPE281 Course: Professional Elective Courses-I: Fiber Technology Teaching Scheme: Theory: 03 Hrs/week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs
Prerequisite	<ul style="list-style-type: none"> • Introduction to Polymer Engineering. • Polymer Testing.
Objectives	<ol style="list-style-type: none"> 1. To understand different terminologies associated with fiber technology. 2. To acquire fundamental knowledge about natural and man-made fibers, their structures and the basic characteristics. 3. To gain knowledge about preparation of man-made fibers. 4. To acquire knowledge about processing and applications of fibers.
Unit-I	Introduction to fiber Technology: Definitions and terminologies, classification (natural, synthetic, regenerated fibers), staple and filament fibers, orientation in fiber structure, general idea about the physical properties of fibers (fiber length, fineness, tenacity, initial modulus, work of rupture, work factor, moisture content and regain with examples), numerical problems on conversion, comparative mechanical properties of fibers, physical and chemical identification of fibers, types of yarns and fabrics, brief idea about testing methods, applications of fiber, yarn and fabric. <p style="text-align: right;">(8Hrs)</p>
Unit-II	Structures of yarn and fabric: Types of twist, twist multiplier, contraction and retraction factor, relation between mechanical properties of fiber and yarn, fabric nomenclature, basic weave structures (plain, twill, matt), packing fraction, and brief idea about knitted and non-woven fabrics. <p style="text-align: right;">(6Hrs)</p>
Unit-III	Natural fibers: Structure, properties and applications of the following fibers: cotton, flax, wool, silk. <p style="text-align: right;">(4Hrs)</p>
Unit-IV	Man-made fiber production methods: Melt spinning, dry spinning, wet spinning, dry-jet wet spinning, electrospinning. Production of polyester, Nylon 6, acrylic, viscose rayon. <p style="text-align: right;">(8Hrs)</p>
Unit-V	Chemical processing: General idea about post-synthesis chemical processing of textile fiber, yarn and fabric: desizing, scouring, bleaching (bleaching powder, sodium hypochlorite and hydrogen peroxide), dyeing (types of dyes and their applicability on fibers, dye cycle, Munsell color wheel), mercerization, outline of the types of chemical finishing. <p style="text-align: right;">(6 Hrs)</p>



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Unit-VI	Mechanical processing: General idea about post-synthesis mechanical processing of textile fiber, yarn and fabric: blowroom, carding, combing, roving, spinning, warping, beaming, weaving, singeing; outline of the types of mechanical finishing.				
	(4Hrs)				
Textbooks / Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Manufactured Fiber Technology	V. B. Gupta, V. B. Kothari	Springer	1 st
	2.	Man-made Fibers	R. W. Moncrieff	Wiley	1 st
	3.	Textile Science: An Explanation of Fiber Properties	E. P. G. Gohl, L. D. Vilensky	Guilford Publications	1 st
	4.	Dyeing and Chemical Technology of Textile Fibers	E. R. Trotman	John Wiley & Sons Inc.	4 th
	5.	Man-made Fibers (Vol. I & II)	Gordon J. Cook	Woodhead Publishing	1 st
	6.	Textile Yarns: Technology, Structure, and Applications	B. C. Goswami, J. G. Martindale, F. L. Scardino	John Wiley & Sons Inc.	1 st
	7.	Principles of Weaving	R. Marks, A. T. C. Robinson	The Textile Institute	1 st
	8.	Fundamentals and Advances in Knitting Technology	Sadhan C. Ray	WPI Publishing	1 st
	9.	Handbook of Nonwovens	S. Russell	Elsevier	2 nd
Website	1.	https://nptel.ac.in/courses/116/102/116102026/			
	2.	https://nptel.ac.in/courses/116/102/116102010/			
	3.	https://nptel.ac.in/courses/116/102/116102016/			



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Faculty of Science & Technology					
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester IV)					
Course Code: PPE282 Course: Professional Elective Courses-I: Biopolymer Teaching Scheme: Theory: 03 Hrs/week			Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs		
Objectives	<ol style="list-style-type: none"> 1. To gain an understanding on the chemical structure of biopolymer, their classification and nomenclature. 2. To acquire knowledge about the preparation involved in the production and the recovery of biopolymers. 3. To acquire the knowledge about the basic properties of biopolymers and their various applications. 				
Unit-I	Introduction Biopolymers, difference between polymer and biopolymer, origin of natural biopolymers, classification of biopolymers, advantages and disadvantages of biopolymers. Applications of Biopolymers. <div style="text-align: right;">(06 Hrs)</div>				
Unit-II	Structure, synthesis, properties and application of biopolymer Technology, production and application of biopolymer based on starch, cellulose, chitosan, gelatin, keratin, fatty acids, lipids, aliphatic polyesters (PLA, PHB) <div style="text-align: right;">(06 Hrs)</div>				
Unit-III	Biodegradability: Natural biodegradable polymer, synthetic and modified biodegradable polymers, biodegradation processes, measuring of biodegradation of polymers. Effects of recycling, applications, economics and future prospectus. <div style="text-align: right;">(06 Hrs)</div>				
Unit-IV	Characterization and Testing of Biopolymers: Bulk analysis methods applied to the study of biopolymers (XRD, FTIR, DSC, TGA, etc.). Surface analysis methods applied to the study of biopolymers (SEM, TEM, AFM, etc.). Mechanical test: wear, friction, flexibility, fatigue, etc. <div style="text-align: right;">(06 Hrs)</div>				
Unit-V	Bioplastics and biocomposites: Processing, properties and applications Introduction of bioplastics and biocomposites, processing of bioplastics and biocomposites, properties and applications of bioplastics and their composites. <div style="text-align: right;">(08 Hrs)</div>				
Unit-VI	Bio-nanocomposite: Bio-nanocomposites: Properties, characteristic and applications of bio nanocomposites <div style="text-align: right;">(04 Hrs)</div>				
Textbooks / Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Bio-Based Plastics	Stephan Kabasci	Wiley	1 st 2014
	2.	Handbook of Biopolymer-Based	Sabu Thomas, Dominique Durand,	Wiley	1 st 2013



	Material	Christophe Chassenieux and, P. Jyotishkumar		
3.	Chemistry and Technology of Biodegradable Polymers	G. J. L. Griffin Blackie(ed.)	Academic & Professional London	1 st 1994
4.	Handbook of Biodegradable Polymers	Abraham J. Donb and others(ed.)	Harwood Academic Publishers	1 st 1998
5.	Green Polymer Composite Technology Properties and Applications	Inamuddin	Taylor & Francis CRC Press	1 st 2016
6.	Biopolymer Nanocomposites Processing, Properties and Applications	Alain Dufresne, Sabu Thomas and Laly A. Pothan	Wiley	1 st 2013
7.	Polymeric Biomaterials	Piskin and A. S. Hoffinann	Martinus Nijhoff Publishers	2 nd 1986
8.	Biomaterials: An Introduction	J. B. Park	Plenum Press	2 nd 1979
9.	The intersection of Biology and Materials Science	G. M. Whitesides and A. P. Wong	MRS Bulletin	-
10.	Biomaterials	Sujata V. Bhat	Alpha Science International Ltd. New Delhi	-



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester IV)	
Course Code: PPE283 Course: Professional Elective Courses-I: Membrane Technology Teaching Scheme: Theory: 03 Hrs/week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs
Prerequisite	<ul style="list-style-type: none"> • Basic knowledge of chemistry and polymer science.
Objectives	<ol style="list-style-type: none"> 1. To provide a general overview on Advanced Separation Technology. 2. To provide idea through understanding and knowledge of Membrane Technology. 3. To be able to understand the preparation and characterization of membranes for different applications.
Unit-I	Overview of membrane science and technology Historical development of membrane, type of membrane, basics of membrane science, introduction to membrane separation process, osmosis, reverse osmosis, membrane separation and transport mechanism, cross flow and pressure filtration, selective and permeability of membranes. <div style="text-align: right;">(6 Hrs)</div>
Unit-II	Membrane, its modules and techniques of membrane preparation Isotropic membrane, inorganic membrane, liquid membrane, hollow fiber membrane, membrane module, membrane with symmetric structure: track etching, precipitation from vapor phase, membrane with asymmetric structure: dry wet phase inversion technique, thermally induced phase separation method. <div style="text-align: right;">(6 Hrs)</div>
Unit-III	Membrane transport theory and membranes for separation processes The solution-diffusion model, structure-permeability relationship in solution-diffusion membrane, pore-flow membrane, classification of membrane process: microfiltration, ultrafiltration, nanofiltration, reverse osmosis, pervaporation. Ion Exchange Membrane Process Electrodialysis, fuel cell membrane, membrane in chlor-alkali processes, membrane distillation and membrane reactors <div style="text-align: right;">(6 Hrs)</div>
Unit-IV	Membrane characterization Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Raman Spectroscopy. <div style="text-align: right;">(6 Hrs)</div>
Unit-V	Testing of membrane Integrity testing method (destructing and non-destructing), bubble point test, diffusion test, spray testing, capacitance testing, pore size testing, distribution testing. <div style="text-align: right;">(6 Hrs)</div>
Unit-VI	Applications of membranes and its maintenance Application of membranes in bio separation, gas separation, membrane distillation, Biomedical application of membranes and industrial applications (RO, UF, ED, MF).



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	Membrane fouling, filtration/fouling mechanisms filter cakes, types of foulants and scalants, prevention of fouling, fouling control, backwashing, chemically enhanced backwash cleaning optimization, water recovery. (6 Hrs)				
Textbooks / Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Material Science and Engineering An Introduction	William D. Callister	Wiley	8 th
	2.	Material Science and Engineering	V. Raghavan	Prentice Hall of India	5 th
	3.	Foundation of Material Science & Engineering	William Smith, Javad Hashemi	McGraw Hill	5 th
	4.	Polymer Science and Technology	Joel R. Ried	Prentice Hall	3 rd
	5.	Introduction to Material science for Engineers	James F. Shackelford	Pearson	8 th



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester IV)	
Course Code: PPE271 Course: Lab-I: Polymer Synthesis & Manufacturing Teaching Scheme: Practical: 02 Hrs/week	Credits: 0-0-1 Practical Examination: 25 Marks
Objective	<ul style="list-style-type: none">To prepare thermoplastics and thermosetting polymer through different polymerization techniques.To provide the practical exposure of polymer synthesis in the laboratory.
List of practicals	<p>Any 8 practical to be conducted</p> <ol style="list-style-type: none">1. Synthesis of Resol.2. Synthesis of Novolac.3. Synthesis of urea formaldehyde.4. Synthesis of melamine formaldehyde.5. Synthesis of polyacrylamide by free radical polymerization.6. Synthesis of acrylamide-acrylic acid copolymer by solution polymerization.7. Synthesis of PMMA by emulsion polymerization technique.8. Synthesis of alkyd resin.9. Synthesis of epoxy resin.10. Synthesis of unsaturated polyester.

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.



Faculty of Science & Technology																
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester IV)																
Course Code: PPE272 Course: Lab II: Design Lab - I Teaching Scheme: Practical: 02 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks															
Prerequisite	<ul style="list-style-type: none">Basic knowledge of engineering drawing.															
Objectives	<ol style="list-style-type: none">To impart knowledge of handling CAD 2D software package in order to draft the engineering drawing.															
List of practicals	<p>Any 8 practical to be conducted</p> <ol style="list-style-type: none">Introduction to CAD software along with the user interface.To study and practice setting up limits, units, and other settings.To study and practice basic draw tools including line, circle, rectangle, arc.To study and practice modifying tools including copy, move, rotate, trim, mirror, scale, fillet, offset.To study and practice use of drawing and construction aids including ORTHO, OSNAP, OTRACK, DYN, POLAR.To study and practice line type, line weight, grouping, blocks, quick properties.To study and practice use of dimensions, dimensioning style, editing dimensions, tolerances, utilities applicable for 2D drawing.To study and practice use of TEXT, TEXT styles etc. for 2D drawing.To study and practice use of layers and colors.To study and practice layout, printing and plotting. <p>List of Reference Books:</p> <table border="1"><thead><tr><th>Sr. No.</th><th>Title</th><th>Author</th><th>Publication</th><th>Edition</th></tr></thead><tbody><tr><td>1</td><td>Up and Running with AutoCAD 2022</td><td>Elliot Gindis</td><td>Elsevier</td><td>1st</td></tr><tr><td>4</td><td>AutoCAD 2012 Essentials</td><td>Scott Onstott</td><td>John Wiley & Sons</td><td>-</td></tr></tbody></table>	Sr. No.	Title	Author	Publication	Edition	1	Up and Running with AutoCAD 2022	Elliot Gindis	Elsevier	1 st	4	AutoCAD 2012 Essentials	Scott Onstott	John Wiley & Sons	-
Sr. No.	Title	Author	Publication	Edition												
1	Up and Running with AutoCAD 2022	Elliot Gindis	Elsevier	1 st												
4	AutoCAD 2012 Essentials	Scott Onstott	John Wiley & Sons	-												

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester IV)	
Course Code: PPE273	Credits: 0-0-1
Course: Lab-III: Raw material analysis for polymers and resins	Practical examination: 25 Marks
Teaching Scheme: Practical: 02 Hrs/week	
Objective	<ul style="list-style-type: none">To synthesize various polymers.
List of practicals	<p>Any 8 practical to be conducted</p> <ol style="list-style-type: none">To find out the percentage purity of phenol.To find out the percentage purity of formalin.To determine the peroxide value of the given sample.To determine the saponification value of the given sample.To determine the iodine value of the given sample.To find out the percentage purity of glycerin.To analyze carbon black: bulk density/ moisture content/ ash content/ plasticizer content.To analyze PVC: bulk density/ water solubility/ ash content/ plasticizer content/chloride content.To analyze saw dust: bulk density/ water solubility/ ash content/ cellulose content.To find out the percentage purity of the given plasticizer.To determine color and viscosity of the given sample on Gardner's scale.

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.



Faculty of Science & Technology	
Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester IV)	
Course Code: HSM254 Course: Lab-IV: Development of Skills (Soft Skills) Teaching Scheme: Practical: 02 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks Practical examination: 25 Marks
Objective	<ol style="list-style-type: none"> 1. Students will be able to communicate in English accurately and effectively. 2. Students will be able to enhance employability skills. 3. Students will be able to participate in debate and group discussion in English effectively. 4. Students will be able to enhance verbal ability. 5. Students will be able to face interview effectively.
Unit-I	Common Errors in English Communication <ul style="list-style-type: none"> • Grammatical • Spelling • Pronunciation <p style="text-align: right;">(2 Hrs)</p>
Unit-II	Enhancing Employability skills <ul style="list-style-type: none"> • Job application • Resume / CV • Essay • Reading Comprehension <p style="text-align: right;">(6 Hrs)</p>
Unit-III	Debate and Group Discussion <ul style="list-style-type: none"> • Communication • Appearance • Preparation <p style="text-align: right;">(4 Hrs)</p>
Unit-IV	Verbal Ability-I <ul style="list-style-type: none"> • Synonyms • Antonyms • Idioms and Phrases <p style="text-align: right;">(4 Hrs)</p>
Unit-V	Verbal Ability-II <ul style="list-style-type: none"> • One word substitution • Word analogy <p style="text-align: right;">(4 Hrs)</p>
Unit-VI	Interview Skills <ul style="list-style-type: none"> • Body language • Grooming • Preparation <p style="text-align: right;">(4Hrs)</p>



Textbooks/ Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Verbal and Non-Verbal Reasoning	R.S. Agrawal	S. Chand Publication	2018
	2.	Effective Technical Communication	Anne Eisenberge	Mc Graw Hill International Editors	1982
	3.	Professional Communication Skills	A. K. Jain, Pravin, S. R. Bhatia, A. M. Sheikh	S. Chand & Company Ltd.	2001
	4.	Business Communication	Urmila Rai, S. M. Rai	Himalaya Publishing House	2011
	5.	Better English Pronunciation	J.D. O'Connor.	Cambridge University Press	1980
	6.	Grammar of Spoken and Written English	DauglasBiber, Geoffrey Leech	Longman	1999
	7.	Technical Communication-Principles and Practice	Meenakshi Raman & Sangeeta Sharma	Oxford University Press	2004
	8.	A course in Phonetics & Spoken English	J. Sethi, P.V. Dhamija	PHI publication	2006
	9.	Communication Skills for Engineers	Sunita Mishra, C. Murli Krishna	Pearson Education	2011
	10.	Soft Skills: Enhancing Employability: Connecting Campus with Corporate	M.S. Rao	I.K. International	2013



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	11.	Technical Communication A Reader Centered Approach	Paul V. Anderson	Thomson Publication	2007
	12.	Oxford English Grammar	Sydney Greenbaum	Oxford University Press	1996



Faculty of Science & Technology

Syllabus of S. Y. B. Tech. Plastic and Polymer Engineering (Semester IV)

Course Code: PPE274

Credits: 0-0-1

Course: Lab-V: Problem-based learning

Term Work: 25 Marks

Teaching Scheme: Practical: 02 Hrs/week

Objective

On completion of the course, learner will be able to –

- To develop positive attitude, new skills or new ways of thinking.
- To introduce independent and group learning by solving real world problem with the help of available resources.
- To be able to develop systematic approach in technical documentation.
- To select and utilize appropriate Software tools/Equipment/Problem solving tools to solve real life problems.

Guidelines:

The students plan, manage and complete a activity which addresses the stated problem.

1. The students must work in group to solve real life problem.
2. Open ended problems from course teachers can be considered from any course related to engineering field. (It can be domain/specific/ multidisciplinary but the emphasis on Plastic and Polymer Engineering)
3. A mentor to be assigned to 3-4 groups / one batch.
4. The steps to be followed for problem based learning are as mentioned below:

Step 1: Explore the issue.

Gather necessary information; learn new concepts, principles, and skills about the proposed topic.

Step 2: State what is known.

Individual students and groups list what they already know about the scenario and list what areas they are lacking information.

Step 3: Define the issues.

Frame the problem in a context of what is already known and information the students expect to learn.

Step 4: Research the knowledge.

Find resources and information that will help create a compelling argument.

Step 5: Investigate solutions.

List possible actions and solutions to the problem, formulate and test potential hypotheses

Step 6: Present and support the chosen solution.

Clearly state and support your conclusion with relevant information and evidence.

Step 7: Review your performance.

Often forgotten, this is a crucial step in improving the problem-solving skills. Students must evaluate their performance and plan improvements for the next problem.



Recommended parameters for assessment, evaluation and weightage:

- Identification of the Problem. (20%)
 - Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents). (30%)
 - Demonstration (Poster Presentation/Model Exhibition etc). (20%)
 - Awareness /Consideration of - Environment/ Social /Ethics/ Safety measures/Legal aspects. (10%)
- Outcome (Participation in technical events / publication in national international conference journal/copyright/patent/prototype). (20%).

	Sr. No.	Title	Author
Reference Books/ Research Articles:	1.	A new model of problem based learning	Terry Barrett
	2.	Research Methodology: Methods and Techniques	C. R. Kothari
Web Resources:	1.	https://www.coursera.org/lecture/university-teaching/problem-based-learning-i-pbl-in-practice-SMXol	
	2.	https://onlinecourses.swayam2.ac.in/ntr20_ed29/preview	



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Syllabus of S. Y. B. Tech. All Branches (Semester IV)	
Course Code: HSM805 Course: Non-Credits Mandatory course (Professional Ethics and Corporate Social Responsibility) Teaching Scheme: Theory: 02 Hrs/week	Credits: 0-0-0
Objectives	<ul style="list-style-type: none"> • To develop understanding of professional ethics in different organizational context. • To identify, analyze, and resolve ethical issues in business decision making. • To develop various corporate social Responsibilities and practice in the professional life
Unit-I	Professional Ethics and Business: The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business. <div style="text-align: right;">(4 Hrs)</div>
Unit-II	Professional Ethics in the Marketplace: Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources. <div style="text-align: right;">(4 Hrs)</div>
Unit-III	Professional Ethics of Consumer Protection: Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy. <div style="text-align: right;">(4 Hrs)</div>
Unit-IV	Introduction to Corporate Social Responsibility: Corporate Social Responsibility: Concept, Scope & Relevance and Importance of CSR in Contemporary Society. CSR and Indian Corporations- Legal Provisions and Specification on CSR, A Score Card, Future of CSR. <div style="text-align: right;">(4 Hrs)</div>
Unit-V	Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. <div style="text-align: right;">(4 Hrs)</div>



Unit-VI	Corporate Social Responsibility: Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India. <p style="text-align: right;">(4 Hrs)</p>				
Textbooks / Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Business Ethics: Texts and Cases from the Indian Perspective	Ananda Das Gupta	Springer	2014
	2.	Business Ethics: Concepts and Cases	Manuel G. Velasquez.	Pearson	2014
	3.	Corporate Social Responsibility: Readings and Cases in a Global Context	Andrew Crane, Dirk Matten, Laura Spence;	Routledge	2013
	4.	Corporate Social Responsibility in India	Bidyut Chakrabarty	Routledge	2015



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Syllabus of S. Y. B. Tech. All Branches (Semester IV)					
Course Code: HSM806			Credits: 0-0-0		
Course: Non-Credits Mandatory course (Emotional Intelligence)					
Teaching Scheme: Theory: 02 Hrs/week					
Objectives	<ol style="list-style-type: none"> 1. To interpret and manage emotions. 2. To learn the four core skills required to practice emotional intelligence. 3. To relate emotional intelligence to the workplace. 				
Unit-I	Introduction to emotion, Development of emotions and emotional maturity, intelligence & wisdom, Science of Emotional Intelligence, EQ and IQ (4 Hrs)				
Unit-II	Concept, theory, measurement and applications of intelligence, Dimensions of Trait EI Model: Self-awareness, Self-regulation, Motivation, Empathy, Social skills. (4 Hrs)				
Unit-III	Emotional intelligence: concept, theory and measurements, Correlates of emotional intelligence (4 Hrs)				
Unit-IV	Emotional intelligence, culture, schooling and happiness, Emotional Intelligence at Work place: Importance of Emotional Intelligence at Workplace? Cost-savings of Emotional Intelligence. (4 Hrs)				
Unit-V	For enhancing emotional intelligence EQ mapping, Managing stress, suicide prevention, through emotional intelligence, spirituality and meditation. (4 Hrs)				
Unit-VI	Application of emotional intelligence at family, school and workplace, Case Studies Measuring Emotional Intelligence: Emotionally Intelligence Tests.(4 Hrs)				
Textbooks	Sr. No.	Title	Author	Publication	Edition
Reference Books	1.	Emotional Intelligence- Why it can Matter More than IQ	Daniel Goleman	Bantam Doubleday Dell Publishing Group	1996
	2.	Working with Emotional Intelligence	Manuel G. Velasquez.	Bantam Doubleday Dell Publishing Group	2000
	3.	Emotional Intelligence Coaching	Liz Wilson, Stephen Neale &	Kogan Page India Private Limited	2012



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			Lisa Spencer-Arnell		
	4.	Corporate Social Responsibility in India	Bradberry, Travis and Jean Greaves	Perseus Books Group	2009



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Syllabus of S. Y. B. Tech. All Branches (Semester IV)				
Course Code: HSM807		Credits: 0-0-0		
Course: Non-Credits Mandatory course (Stress Management Through Yoga)				
Teaching Scheme: Theory: 02 Hrs/week				
Objectives	<ul style="list-style-type: none"> • To identify common stressors inherent in today's global marketplace. • To develop an understanding of the impact of stress on physiological, emotional and cognitive processes. • To learn to manage the stress through art of Yoga 			
Unit-I	Mental Health: Meaning and Importance; Yogic Perspective of Mental Health, Indicators of Mental Health, Stress: Meaning and Definition; Symptoms, Causes and Consequences of Stress, Meaning of Management – Stress Management, Stress in Modern Culture & Society. (6Hrs)			
Unit-II	Concept of Stress according to Yoga, Assessing your Stress & Building Resilience. (3Hrs)			
Unit-III	Physiology of Stress on: Autonomic Nervous System (ANS), Endocrine System, Hypothalamus, Cerebral Cortex and Neurohumours. (3Hrs)			
Unit-IV	Mechanism of Stress related diseases: Psychic, Psychosomatic, Somatic and Organic phase. Role of Meditation & Pranayama on stress - physiological aspect of Meditation, Constant stress & strain, anxiety. (4 Hrs)			
Unit-V	Meaning and definition of Health: various dimensions of health (Physical, Mental, Social and Spiritual) - Yoga and health -Yoga as therapy. Physical fitness. Stress control exercise - Sitting meditation, Walking meditation, Progressive muscular relaxation, Gentle stretches and Massage. (5Hrs)			
Unit-VI	Preventive and curative effects of Yoga on stress related disorders: Hypertension, Heart problems, Bronchial Asthma, Peptic Ulcer, Diabetes Mellitus, Arthritis, Anxiety Neurosis and Headache (3Hrs)			
Textbooks	Sr. No.	Title	Author	Publication
Reference	1.	Stress Control for	Linda Wasmer	Main Street
				2005



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Books				
		peace of Mind	Andrews	
	2.	Yoga for stress	VimlaLalvani	Hamlyn 1998
	3.	Yoga perspective in stress management	H.R. Nagendra, and R. Nagarathana,	Swami Vivekananda Yoga Prakashana 2004
	4.	Yoga practices for anxiety & depression	H.R. Nagendra, and R. Nagarathana,	Swami Sukhabodhanandha Yoga Prakashana 2004
	5.	Stress management by Yoga	K.N. Udupa,	Motilal Banaridass Publishers Private Limited. 1996