DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.SU/Engg./S.Y.B.Tech./02/2017

It is hereby informed to all concerned that, the syllabi prepared by the Committees & recommended by the Dean, Faulty of Science & Technology, the **Academic Council at its meeting held on 20 & 21 June 2017 has accepted the following syllabi in accordance with Choice Based Credits & Grading System for all Branches S.Y.B.Tech** under the Faulty of Science & Technology as enclosed herewith.

Sr.No.	Syllabi as per CBC & GS
[1]	Second Year B.Tech.[Civil Engineering],
[2]	Second Year B.Tech. [Mechanical Engineering],
[3]	Second Year B.Tech. [Agricultural Engineering],
[4]	Second Year B.Tech.[Electrical Engineering],
[5]	Second Year B.Tech. [Plastic & Polymer Engineering],
[6]	Second Year B.Tech [Electronics & Telecommunication Engg.],
[7]	Second Year B.Tech. [Computer Science Engineering].

This is effective from the Academic Year 2017-2018 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
Ref.No. SU/S.Y.B.Tech.2017/2173-84

Date:- 28-06-2017.

Deputy Registrar,
Syllabus Section.

Copy forwarded with compliments to :-
1] **The Principals, affiliated concerned Colleges,**
   Dr. Babasaheb Ambedkar Marathwada University.
2] The Director, University Network & Information Centre, UNIC, with **a request to upload this Circular on University Website.**
   Copy to :-
1] The Director, Board of Examinations & Evaluation,
2] **The Section Officer,[Engineering Unit] Examination Branch,**
3] The Section officer, [Eligibility Unit],
4] **The Programmer [Computer Unit-1] Examinations,**
5] **The Programmer [Computer Unit-2] Examinations,**
6] The In-charge, [E-Suvidha Kendra],
7] The Public Relation Officer,
8] The Record Keeper,

SCHEME AND DETAILED SYLLABUS

of

S. Y. B. Tech. (Plastic and Polymer Engineering)

Under Choice Based Credit & Grading System

(w.e.f. academic year 2017-18 & onwards/-)

FOUR YEAR DEGREE COURSE IN SCIENCE & TECHNOLOGY

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

FACULTY OF SCIENCE AND TECHNOLOGY
Revised Syllabus Structure w.e.f. 2017-18
Second Year B. Tech. (Plastic and Polymer Engineering)

Course Code	SEMESTER - III											
	Subject	L	T	P	Total	CT	TH	TW	P	Total	Credits	Duration of Theory Exam
BSH201	Engineering Mathematics-III	3	1	-	4	20	80	-	-	100	4	3 Hrs
PPE202	Organic Chemistry	4	-	-	4	20	80	-	-	100	4	3 Hrs
PPE203	Introduction to Polymer Engineering	3	1	-	4	20	80	-	-	100	4	3 Hrs
PPE204	Polymer Testing	4	-	-	4	20	80	-	-	100	4	3 Hrs
PPE205	Materials Engineering	4	-	-	4	20	80	-	-	100	4	3 Hrs
PPE206	Mechanical Operation	2	-	-	2	10	40	-	-	50	2	2 Hrs
PPE221	Lab I: Organic Chemistry	-	-	2	2	-	-	25	25	50	1	
PPE222	Lab II: Analysis of Polymer	-	-	2	2	-	-	25	25	50	1	
PPE223	Lab III: Polymer Testing	-	-	2	2	-	-	25	25	50	1	
PPE224	Lab IV: Mechanical Operation	-	-	2	2	-	-	50	-	50	1	
BSH225	Lab V: Development of Skills-II	-	-	2	2	-	-	50	-	50	1	
	Total of semester-III	**20**	**2**	**10**	**32**	**110**	**440**	**175**	**75**	**800**	**27**	

Course Code	SEMESTER - IV											
	Subject	L	T	P	Total	CT	TH	TW	P	Total	Credits	Duration of Theory Exam
BSH251A	Engineering Mathematics-IV	3	1	-	4	20	80	-	-	100	4	3 Hrs
PPE252	Process Calculations	4	-	-	4	20	80	-	-	100	4	3 Hrs
PPE253	Physical Chemistry of Polymers	4	-	-	4	20	80	-	-	100	4	3 Hrs
PPE254	Polymer Synthesis and Manufacturing	3	1	-	4	20	80	-	-	100	4	3 Hrs
PPE291-293	Programme Elective-I	4	_	-	4	20	80	-	-	100	4	3 Hrs
PPE255	Fluid Mechanics	2	-	-	2	10	40	-	-	50	2	2 Hrs
PPE271	Lab VI: Physical Chemistry of Polymers	_	_	2	2	-	-	25	25	50	1	
PPE272	Lab VII: Polymer Synthesis-I	_	_	4	4	-	-	50	50	100	2	
PPE273	Lab VIII: Fluid Mechanics	_	_	2	2	-	-	25	25	50	1	
PPE274	Lab IX: DOS-III Design Lab-I (CAD)	_	_	2	2	-	-	50	-	50	1	
	Total of semester-IV	**20**	**2**	**10**	**32**	**110**	**440**	**150**	**100**	**800**	**27**	
	Grand Total of III & IV	**40**	**4**	**20**	**64**	**220**	**880**	**325**	**175**	**1600**	**54**	

L: Lecture hours per week   T: Tutorial hours per week   P: Practical hours per week

CT: Class Test   TH: University Theory Examination   TW: Teachers Assessment

P: Practical/Oral Examination

Programme Elective-I

PPE291: Specialty Polymers

PPE292: Fibre Technology

PPE293: Biopolymers

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Syllabus of S. Y. B. Tech. (All) Semester-III		

Course Code: BSH201	**Course: Engineering Mathematics –III**
Teaching Scheme: 04Hrs/week	**Class Test: 20marks**
Theory: 03Hrs/week	**Theory Examination (Duration): 03 Hrs**
Tutorial: 01Hr/week	**Theory Examination (Marks): 80**
Credits:04	

Objectives	**:**	1. The contents aims to develop and apply the knowledge of the student in the direction of solving the practical problem of differential equation in the engineering and technology. 2. To develop Logical understanding of statistics. 3. To study the basic of Laplace transform.
Unit-I	**:**	**Linear Differential Equation**: Solution of linear differential equation of order n with constant coefficients: The complementary function, Method of finding particular integral: Short method, General method, Method of variation of parameters. Equations reducible to linear equations with constant coefficients: i) The Cauchy's linear equation. ii) The Legendre's linear equation. **(10 Hrs)**
Unit-II		**Application of linear differential equations to:** i) Mechanical system. ii) Electrical System iii) Beam and Shafts **(04 Hrs)**
Unit-III	**:**	**Vector Differentiation:** Differentiation of vectors, Radial, Transverse, Normal and tangential components of velocity and acceleration, Scalar and vector point function, Gradient of scalar point function, Divergence and curl of vector point function, Second order differentiation operator, Irrotational and solenoid fields. **(10 Hrs)**

Unit-IV	**:**	**Laplace Transform:**
		 Definition, Laplace Transform of elementary function and its table, Theorem and properties of Laplace Transform: First shifting theorem, Second Shifting Theorem, Multiplication by t, Division by t, Change of scale property, Laplace Transform of integral, Laplace Transform of Derivative.
		 Laplace Transform of some special functions: Periodic function, Heaviside Unit Step Function, Displaced Heaviside Unit Step Function Laplace Transform using Heaviside Unit function, Dirac delta function.
		 Method to find inverse Laplace Transform:
		   i. Use of Laplace Transform table
		   ii. Use of Theorem and properties of Laplace
		   iii. Use of partial fraction
		   iv. Convolution theorem
		   v. Use of development of Heaviside Unit Step Function
		 Application of Laplace Transform to solve linear differential equation
		 (12 Hrs)

Unit-V	**:**	**Fourier Transform**: Fourier integral: Complex form of Fourier integral, sine and cosine integral, Fourier transform and inverse transform. D.U.I.S. rule (only statement), Fourier

		transform and inverse transform for even and odd function, Fourier sine and cosine transform and inverse transform.**(7 Hrs)**
Unit-VI	**:**	**Statistics:** Measures of central tendency: Mean, Median, Quartiles and Mode. Measures of dispersion: Quartile deviation, Mean deviation, Standard deviation, coefficient of variation. **(5 Hrs)**
Reference Books:	**:**	1. A Text Book of Applied Mathematics Volume-III by P.N. Wartikar J.N.Wartikar, Pune Vidyarthi Griha Prakashan. 2. Advanced Engineering Mathematics by H. K. Dass, S. Chand and Co. Ltd. 3. Higher Engineering Mathematics by Dr. B. S. Grewal, Khanna Publishers. 4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publishing Co. Ltd. 5. Solution to Higher Engineering Mathematics Volume –III by C. P. Gandhi

Section A: Includes Unit I, II and III; **Section B**: Includes Unit IV, V and VI.

Pattern of Question Paper:

The six/four units in the syllabus shall be divided in two equal parts i.e. 3 units respectively. Question paper shall be set having two sections A and B. Section A questions shall be set on first part and Section B questions on second part. Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Minimum ten questions
2. Five questions in each section
3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for ten marks each. The Question no.1 and 6 should be of objective nature.
4. Two questions of 15 marks each from remaining questions from each section A and B be asked to solve.

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

Course Code: PPE202   **Credits: 4**
Course: Organic Chemistry   **Class Test: 20 Marks**
Teaching Scheme: **Theory Examination: 80 Marks**
Theory: 4 hrs/week   **Theory Examination (Duration): 3 hrs**

Objectives	1) To teach students an understanding of different organic materials used in preparation of different polymers. 2) To teach students how the organic materials are related the fundamental properties of organic chemicals, their nomenclature, their different reaction mechanisms, their properties and applications.
Unit-I	**Nomenclature of Organic Compounds** Common Name System IUPAC Name System (05 h)
Unit-II	**Fundamentals of Chemical Bonding:** Concept of hybridization, geometry of molecules, molecular orbital theory and valence bond theory (06 h)
Unit-III	**Fundamentals of Organic Reactions:** **A) Electronic Theory:** Introduction, Types of bonds, Bond fission, Generation, Structure and stability of reactive intermediates (Carbocation, Carbanion, Free radicals and Carbene),Inductive Effect, Resonance effect and Steric effect. (06 h) **B) Organic Reaction Mechanism:** Types of reactions: Addition, Substitution, Elimination, Rearrangement Reactions, Electrophilic and Nucleophilic substitution reactions of Benzene (Nitration, Sulphonation, Halogenation) (07 h)
Unit-IV	**Stereochemistry :** Stereoisomerism, Structural isomerism, Configurational & Conformationalstrereoisomer, Geometric isomerism, Optical isomerism, Enantiomers,Diastereomers, Mesomers, Concept of chirality, Methods of racemisation and resolution, E & Z nomenclature, R-S system of nomenclature. (07 h)
Unit-V	**Selective Organic Name Reactions and Rearrangements:** Aldol Condensation, Gabriel Synthesis, Cannizzaro Reaction, Friedel-Crafts Reaction, Knoevenagel condensation, Darzen Reaction, Reformatsky Reaction, Beckmann Rearrangement,Yamaguchi Reaction. (07 h)

Unit-VI	**Study of some Organic Compounds and their functional group detections:**
	Hydrocarbons & Sub. Hydrocarbons : Ethylene, Propylene, Butadiene, Styrene, Vinyl chloride
	Carboxylic Acids : Adipic Acid, Terepthalic acid
	Alcohols : Ethylene glycol, Glycerol
	Phenols : Phenol, Cresol, Resorcinol
	Amines : Hexamethylene tetramine, Melamine
	Amide: Urea, ε-caprolactum
	Nitrile : Acrylonitrile
	Aldehydes: Formaldehyde, Acetaldehyde
	Carbohydrates : Glucose, Fructose
	(10 h)

Reference Books:	Sr. No.	Title	Author	Publication	Edition
	1.	Textbook of Organic Chemistry	Bahl & Bahl	S. Chand	18th
	2.	Stereochemistry of Organic Compounds	P. S. Kalsi	New Age	5th
	3.	Reactions, Reagents and Rearrangements	S.N. Sanyal	Bharti Bhavan	1st
	4.	Organic Chemistry	F. A. Carry	Mc Graw Hill	3rd
	5.	Organic Chemistry	T.W. Graham Solomons and Craig Fryle	John iley and Sons	7th
	6.	Practical Organic Chemistry	Frederick G. Mann and Bernard Charles Saunders	Longman Inc, New York	4th
	7.	Practical Organic Chemistry	Arthur Vogel	Longman Inc, New York	5th

Section A: Includes Unit I, II and III; **Section B:** Includes Unit IV, V and VI.

Pattern of Question Paper:

The six units in the syllabus shall be divided in two equal parts i.e. 3 units respectively. Question paper shall be set having two sections A and B. Section A questions shall be set on first part and Section B questions on second part. Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Minimum ten questions
2. Five questions in each section
3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for 10 marks each. The Question no.1 and 6 should be of objective nature.
4. Two questions of 15 marks each from remaining questions from each section A and B be asked to solve.

<table>
<tr><td colspan="2" align="center">**Dr. Babasaheb Ambedkar Marathwada University, Aurangabad**
(Faculty of Science & Technology)
Syllabus of S. Y. B. Tech. (Plastic and Polymer Engineering) Semester-III</td></tr>
<tr><td colspan="2">
Course Code: PPE203
Course: Introduction to Polymer Engineering   **Credits: 4**
Teaching Scheme: **Class Test: 20 Marks**
Theory: 3 hrs/week   **Theory Examination: 80 Marks**
Tutorial: 1 hr/week   **Theory Examination (Duration): 3 hrs**
</td></tr>
<tr><td>**Objectives**</td><td>To provide a general overview of polymers, their types, molecular weight concept and to understand the structure of polymers and predict polymer properties.</td></tr>
<tr><td>**Unit-I**</td><td>**Introduction to Polymers**:
Historical developments in polymeric materials, Basic raw materials for polymers, Basic concepts and definitions: Macromolecules, Monomers, Oligomers, Telomers, polymer, repeating unites. Functionality concept and determination of functional groups. Carothers equation and their application. Introduction to types of polymerization, emulsion, solution, Bulk with typical examples.
(08 h)</td></tr>
<tr><td>**Unit-II**</td><td>**Classification of Polymers:**
Classification of polymers: Thermoplastic/Thermoset, Addition/Condensation, Natural/Synthetic, Crystalline/Amorphous, Step growth/ Chain growth, Homochain/ Heterochain, Confirmation: Homo and Copolymers, Configuration Cis/Trans; Tacticity, Branched/Crosslinked, Classification based on end use, Commodity/Specialty. Polymer degradation and polymer stabilization.
(08 h)</td></tr>
<tr><td>**Unit-III**</td><td>**Molecular Weight, its Distribution and Determination:**
Concept of average molecular weight of polymers (M_n, M_w, M_v and M_z), Molecular weight distribution: monodispersity, polydispersity, degree of polymerization, size of the polymer molecules. Molecular weight determination by end group analysis, solution viscosities, gel permeation chromatography etc.
(08 h)</td></tr>
<tr><td>**Unit-IV**</td><td>**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: glass transition (T_g), melt transition (T_m), relationship between T_g and T_m, factors affecting T_g, significance of T_g.
(10 h)</td></tr>
<tr><td>**Unit-V**</td><td>**Electrical and Optical Properties:**
Effect of polymer structure on dielectric constant, power factor, dissipation factor, and loss factor. Factors affecting the electrical conductivity of polymers. Effect of polymer structure on clarity, transparency, haze, transmittance, absorbance, reflectance, gloss, Static charges, volume & surface resistivity, arc resistance.
(08 h)</td></tr>
</table>

Unit-VI	**Chemical Properties:** Effect of polymer structure on solubility in solvents and oils, Cohesive energy, solubility parameter, determination and Prediction of solubility parameter of polymers, water repellency, Chemical resistance of polymers, diffusion and permeability, Polymer toxicity. **(06 h)**				
Reference Books	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1	Polymer Science & Technology of Plastics & Rubbers	P. Ghosh	TataMcGraw Hill	2nd
	2	Polymer Science & Technology	Joel R. Fried	Prentice Hall of India Pvt. Ltd.	3rd
	3	Text Book of Polymer Science	F.W. Billmeyer	Wiley Interscience	3rd
	4	Principles of Polymerisation	George Odian	Wiley Interscience	4th
	5	Polymer Structure,Property and application	R.D. Deanin	American Chemical Society	1974
	6	Polymer Science	V R Gowarikar	New Age International Publishers	3rd, 2005
	7	Introduction to Polymer Science and Technology	S. D. Dawande	Denett & Co.	2006
	8	Plastic Materials	J A Brydson	Butterworth Heinemann Ltd	6th, 1995

Section A: Includes Unit I, II and III; **Section B**: Includes Unit IV, V and VI.

Pattern of Question Paper:
The six units in the syllabus shall be divided in two equal parts i.e. 3 units respectively.
Question paper shall be set having two sections A and B. Section A questions shall be set on first
part and Section B questions on second part. Question paper should cover the entire syllabus.

For 80 marks Paper:
1. Minimum ten questions
2. Five questions in each section
3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for 10 marks each. The Question no.1 and 6 should be of objective nature.
4. Two questions of 15 marks each from remaining questions from each section A and B be asked to solve.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
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Syllabus of S. Y. B. Tech. (Plastic and Polymer Engineering) Semester-III

Course Code: PPE204	**Credits: 4**
Course: Polymer Testing	**Class Test: 20 Marks**
Teaching Scheme:	**Theory Examination: 80 Marks**
Theory: 4 hrs/week	**Theory Examination (Duration): 3 hrs**

Objectives	To study and understand the necessity and methodology of various polymer testing processes to evaluate various polymer properties.
Unit-I	A. **Introduction:** Basic Concepts, Purpose of testing, Specifications and Standards, Purpose of specifications, Basic specification format, Testing samples, Sample conditioning. B. **Electrical Properties:** Introduction, Dielectric strength, Dielectric constant and dissipation factor, Electrical resistance test, Arc resistance. **(08 h)**
Unit-II	**Mechanical Properties:** Introduction, Stress-strain relationship, Tensile tests, Flexural properties, Compressive properties, Impact properties, Shear strength, Abrasion, Fatigue resistance, creep and stress relaxation, Hardness Tests. Burst strength test. **(08 h)**
Unit-III	A. **Optical Properties:** Introduction, Refractive Index, Luminous Transmittance, Haze, color evaluation, Gloss. B. **Analytical Tests:** Specific gravity tests, Density gradient method, Water absorption tests, Moisture analysis. **(08 h)**
Unit-IV	**Material Characterization Test:** Melt flow index, Capillary rheometer test, Viscosity test, Gel permeation chromatography, Differential Scanning Calorimetry (DSC), Thermogravimetric Analysis (TGA), Thermo-mechanical Analysis (TMA), Material characterization tests for thermosets – bulk density, bulk factor and pourability of plastic, viscosity tests, styrene content. **(08 h)**
Unit-V	A. **Flammability:** Introduction, Flammability test, Ignition properties of plastics, Ignition temperature determination, Oxygen index test, UL 94 flammability test. B. **Thermal Properties:** Introduction, Heat distortion temperature, Vicat softening temperature, Long term heat resistance test, Thermal conductivity, Thermal expansion, Brittleness temperature. **(08 h)**
Unit-VI	A. **Chemical Properties:** Introduction, Immersion tests, Stain resistance test, Solvent stress cracking resistance, Environmental stress cracking resistance, Acetone immersion test. B. **Weathering Properties:** Accelerated Weathering tests, Outdoor weathering properties, Resistance of plastics to fungi and bacteria. **(08 h)**

Reference Books:	Sr. No.	Title	Author	Publication	Edition
	1	Handbook of Plastics Testing Technology	Vishu Shah	A Wiley Interscience	2nd
	2	Handbook of Plastics Test Methods	R.P. Brown	Longman Scientific And Technical	3rd
	3	Testing & Evaluation of Plastics.	Mathur & Bhardwaj	Allied publisher Pvt Ltd. 2003	1st
	4	Identification and Testing of Plastics	A.S. Athalye	Multi-Tech Publishing, 1992	1st

Section A: Includes Unit I, II and III; **Section B:** Includes Unit IV, V and VI.

Pattern of Question Paper:

The six units in the syllabus shall be divided in two equal parts i.e. 3 units respectively. Question paper shall be set having two sections A and B. Section A questions shall be set on first part and Section B questions on second part. Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Minimum ten questions.
2. Five questions in each section.
3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for 10 marks each. The Question no.1 and 6 should be of objective nature.
4. Two questions of 15 marks each from remaining questions from each section A and B be asked to solve.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
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Syllabus of S. Y. B. Tech. (Plastic and Polymer Engineering) Semester-III

Course Code: PPE205	**Credits: 4**
Course: Materials Engineering	**Class Test: 20 Marks**
Teaching Scheme:	**Theory Examination: 80 Marks**
Theory: 4 hrs/week	**Theory Examination (Duration): 3 hrs**

Objectives	1) To make students to understand structure-properties relationships in materials. 2) To make students to able to manipulate atomic/micro-structural processes to create desired structure and properties.
Unit I	**Types of Materials:** Materials, Materials Classification, Engineering requirements of materials, concept of amorphous , single crystals, polycrystalline materials. **(04 h)**
Unit II	**Structure of Materials:** Crystal symmetry, point groups, space groups, indices of planes, close packing in solids, bonding in materials, coordination and radius ratio concepts, point defects, dislocations, grain boundaries, surface energy and equilibrium shapes of crystals, crystallinity and its effect on physical properties. **(12 h)**
Unit III	**Processing of Materials:** Basic heat treatment of metals, Powder Synthesis, Sintering, Chemical methods, crystal growth techniques, zone refining, preparation of nanoparticles and thin films. **(08 h)**
Unit IV	**Thermodynamics and Diffusion:** Concepts of Enthalpy, Entropy, Gibbs Free Energy, First and second law of thermodynamics, Phase rule, phase diagrams, solid solutions, solidification and phase transformations, Fick's laws of diffusion, mechanisms of diffusion, temperature dependence of diffusion. **(08 h)**
Unit V	**A) Mechanical Properties :** Stress-strain response of metallic, ceramic, and polymer materials, yield strength, tensile strength and modulus of elasticity, toughness, plastic deformation, fatigue, creep and fracture. **(04 h)**
	B) Thermal Properties:: Specific heat, thermal conductivity, thermal expansion, thermoelectricity. **(04 h)**

Unit VI	**A) Electronic Properties:** Free electron theory, Fermi energy, density of states, elements of band theory, semiconductors, Hall effect, dielectric behavior, piezo, ferro and pyroelectricmaterials. **(03 h)** **B) Magnetic Properties:** Origin of magnetism in metallic and ceramic materials, paramagnetism, dimagnetism, ferro and ferrimagnetism. **(02 h)** **C) Optical Properties:** Refractive index, absorption and transmission of electromagnetic radiation in solids, electro-optic and magneto-optic materials, spontaneous and stimulated emission, gas and solid state lasers. **(03 h)**			

Reference Books	Sr. No.	Title	Author	Publication	Edition
	1	Material s Science and Engineering	William D. Callister	Wiley India	6th
	2	Materials Science and Engineering	V. Raghavan	PHI	5th
	3	Material Science and Metullergy	V. D. Kodgire	Everest Publication House	1st
	4	Essentials of Materials For Science And Engineering	Donald R. Askeland, Pradeep P. Phule	Thomson-Engineering	1st
	5	Introduction to Material Science for Engineering	James F. Shackel ford	Prentice Hall	6th
	6	Foundation of Material Science and Engineering	Smith	McGraw Hill	3rd

Section A: Includes Unit I, II and III; **Section B:** Includes Unit IV, V and VI.

Pattern of Question Paper:

The six units in the syllabus shall be divided in two equal parts i.e. 3 units respectively. Question paper shall be set having two sections A and B. Section A questions shall be set on first part and Section B questions on second part. Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Minimum ten questions.
2. Five questions in each section.
3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for 10 marks each. The Question no.1 and 6 should be of objective nature.
4. Two questions of 15 marks each from remaining questions from each section A and B be asked to solve.

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Course Code: PPE206	**Credits: 2**
Course: Mechanical Operation	**Class Test: 10 Marks**
Teaching Scheme:	**Theory Examination: 40 Marks**
Theory: 2 hrs/week	**Theory Examination (Duration): 2 hrs**

Objectives	1) To provide students with a thorough understanding and knowledge of the mechanical operating elements and adjustments. 2) To make them aware of basics of different operations like size reduction, sedimentation, mixing, Gas cleaning Transportation etc.
Unit-I	**Particulate Solids and Sorting:** Properties of solids, characterization of solid particles, particle size analysis. Gravity settling, classifier, hydraulic jig, cyclones. **(04 h)**
Unit-II	**Size Reduction:** Principles and laws of crushing, construction and working of equipments like jaw crusher, pulverizer, ball mill. Screening and screen efficiency, open and closed circuit grinding. **(04 h)**
Unit-III	**Sedimentation and Filtration:** Free and hindered settling, thickeners and settlers, Flocculation. Filter media, filter aids, plate and frame press, rotary drum filter and filter leaf, Centrifugal filtration. **(04 h)**
Unit-IV	**Mixing and Agitation:** Agitation and mixing of liquids/solid/gas, Types of mixers dispersion operations, design of agitator and its effects on viscosity of liquids. **(05 h)**
Unit-V	**Gas Cleaning:** Gas cleaning equipment, Gravity separators, Centrifugal separators, Momentum separators, Electrostatic precipitators, Liquid washing, Odour removal, Fabric filters, Impingement method and Miscellaneous methods, and Coal essence. **(05 h)**
Unit-VI	**Storage and conveying of solids:** Different methods of solids storage (Bunkers, Silos, Bins Hoppers) Conveyors, elevators, pneumatic conveying etc. **(02 h)**

Reference Books:	Sr. No.	Title	Author	Publication	Edition
	1	Unit Operations In Chemical Engineering	McCabe and Smith	McGraw Hill	1st
	2	Chemical Engineering (Vol. 2)	Richardson and Coulson	Butterworth Heinemann Titles	5th
	3	Chemical Engineers Handbook	Perry and Chilton.	McGraw Hill	1st
	4	Principles of Unit operations	Foust A.S and Associates	John Wiley and Sons	1st

Section A: Includes Unit I, IV, V; **Section B**: Includes Unit II, III and VI.

Pattern of Question Paper:

The six units in the syllabus shall be divided in two equal parts i.e. 3 units respectively. Question paper shall be set having two sections A and B. Section A questions shall be set on first part and Section B questions on second part. Question paper should cover the entire syllabus.

For 40 marks Paper:

1. Minimum ten questions

2. Five questions in each section

3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for 6 marks each. The Question no.1 and 6 should be of objective nature.
4. Two questions of 7 marks each from remaining questions from each section A and B be asked to solve.

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

Course Code: PPE221	**Credits:1**
Course: Lab I: Organic Chemistry	**Practical: 25 marks**
Teaching Scheme:	**Termwork: 25 marks**
Practical: 2 hrs/week	

Course Objectives	To study the Organic Chemistry applicable to Plastics and Polymer Engineering.
List of Practicals	1. Identification of functional groups: primary amine, carboxylic, phenolic, carbonyl, aromatic hydrocarbon etc. 2. Solubility test and classification of the compound. 3. Preparation of derivative, conclusion, naming of the compound / structure of compound. 4. Detection of N, S and halogens in organic compounds. 5. Estimation of Phenol from given solution. 6. Estimation of Formaldehyde from given solution 7. Determination of the percentage purity of Styrene. 8. Determination of Iodine value of given compound. 9. Molecular weight determination by acid base titration method. 10. Determination of melting point of solid and boiling point of liquid organic compounds. **At least any 8 experiments from the above-mentioned list of experiments should be performed.**

List of Reference Books	Sr. No.	Title	Author	Publication	Edition
	1.	Text book of Organic Chemistry	Bahl & Bahl	S. Chand	18th
	2.	Stereochemistry of Organic Compounds	P. S. Kalsi	New Age	5th
	3.	Reactions, Reagents and Rearrangements	S. N. Sanyal	Bharti Bhavan	1st
	4.	Organic Chemistry	F. A. Carry	Mc Graw Hill	3rd
	5.	Practical Organic Chemistry	Frederick G. Mann and Bernard Charles Saunders	Longman Inc,New York	4th
	6.	Organic Chemistry	T.W. Graham Solomons and Craig B.Fryle	John Wiley and Sons	7th

The assessment of term work shall be done on the basis of the following:
1. Continuous assessment.
2. Performing the experiments in the laboratory.
3. Oral examination conducted on the syllabus and term work mentioned above.

Practical Examination

The practical examination shall consist of performing an experiment based on the practical work done during the course, the record of the experiment performed by the candidate and viva voce based on the syllabus. The assessment will be based on
1. Performing the experiment.
2. Record of experiment performed by the candidate.
3. Viva-voce on the syllabus.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
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Syllabus of S. Y. B. Tech. (Plastic and Polymer Engineering) Semester-III

Course Code: PPE222   **Credits:1**
Course: Lab II: Analysis of Polymer   **Practical: 25 marks**
Teaching Scheme: **Termwork: 25 marks**
Practical: 2 hrs/week

Objectives	To identify and analyze the various properties of polymer materials.
List of Practicals	1. Determination of bulk density of polymers. 2. Determination of Iodine value 3. Determination of Amine value 4. Determination of molecular weight of polymer by end group analysis. 5. Determination of molecular weight of polymer by viscometry. 6. Determination of moisture and volatile content in plastics/rubbers. 7. Determination of water absorption in polymer sample. 8. Determination of the percentage purity of HMTA. 9. Determination of Melamine content . **At least any 8 experiments from the above-mentioned list of experiments should be performed.**

List of ReferenceBooks	Sr. No.	Title	Author	Publication	Edition
	1	Handbook of Plastics Testing Technology	Vishu Shah	A Wiley Interscience	2nd
	2	Handbook of Polymer Synthesis, Characterization, and Processing	Enrique Saldívar-Guerra, Eduardo Vivaldo-Lima.	Wiley Interscience	1St
	3	Polymer Synthesis and Characterization: Laboratory Manual	Sandler , Karo , Bonesteel & Pearce	Elsevier	1St
	4	Laboratory experiments in polymer synthesis and characterization	Eli M. Pearce, Carl E. Wright, Binoy K. Bordoli	Article	1St
	5	Experiments in Polymer Science, Technology and Testing of Polymer	Dr. A. D. Ashtaputre	-	1St

The assessment of term work shall be done on the basis of the following:
 4. Continuous assessment.
 5. Performing the experiments in the laboratory.
 6. Oral examination conducted on the syllabus and term work mentioned above.

Practical Examination

The practical examination shall consist of performing an experiment based on the practical work done during the course, the record of the experiment performed by the candidate and viva voce based on the syllabus. The assessment will be based on
 1. Performing the experiment.
 2. Record of experiment performed by the candidate.
 3. Viva-voce on the syllabus.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
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Syllabus of S. Y. B. Tech. (Plastic and Polymer Engineering) Semester-III

Course Code: PPE223	**Credits:1**
Course: Lab III: Polymer Testing	**Practical: 25 marks**
Teaching Scheme:	**Termwork: 25 marks**
Practical: 2 hrs/week	

Course Objectives	To study and perform testing of various properties of plastics materials.
List of Practicals	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 the Heat Deflection Temperature of given polymer sample.
	7. To determine the Vicat Softening Temperature of given polymer sample.
	8. To determine specific gravity/density of given polymer sample.
	9. To determine Melt Flow Index of given polymer sample.
	10. To determine the surface resistance of given polymer product.
	11. Determination of moisture content of calcium carbonate, silica, carbon black, china clay.
	12. Determination of ash content of calcium carbonate, silica, carbon black, china clay.
	At least any 8 experiments from the above-mentioned list of experiments should be performed.

List of Reference Books	Sr. No.	Title	Author	Publication	Edition
	1	Handbook of Plastics Testing Technology	Vishu Shah	A Wiley Interscience	2nd
	2	Handbook of Plastics Test Methods	R.P. Brown	Longman Scientific And Technical	3rd
	3	Experiments in Polymer Science, Technology & Testing of Polymers	Dr. A.D. Ashtaputre	-	1st
	3	Testing & Evaluation of Plastics.	Mathur & Bhardwaj	Allied publisher Pvt Ltd. 2003	1st
	4	Identification and Testing of Plastics	A.S. Athalye	Multi-Tech Publishing, 1992	1st

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

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

Practical Examination

The practical examination shall consist of performing an experiment based on the practical work done during the course, the record of the experiment performed by the candidate and viva voce based on the syllabus. The assessment will be based on

1. Performing the experiment.
2. Record of experiment performed by the candidate.
3. Viva-voce on the syllabus.

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Course Code: PPE224	**Credits:1**
Course: Lab IV: Mechanical Operation	
Teaching Scheme:	**Termwork: 50 marks**
Practical: 2 hrs/week	

Course Objectives	To understand the working principles of various unit operations required in Plastics and Polymer Engineering.
List of Practicals	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 grinding, critical speed of ball mill and effect of grinding with change in number of balls.
	6. To determine the effect of wet grinding, critical speed of ball mill and effect of grinding with change in number of balls.
	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.
	At least any 8 experiments from the above-mentioned list of experiments should be performed.

List of Reference Books	Sr. No.	Title	Author	Publication	Edition
	1	Unit Operations In Chemical Engineering	McCabe and Smith	McGraw Hill	1st
	2	Chemical Engineering (Vol.2)	Richardson and Coulson	Butterworth Heinemann Titles	5th
	3	Chemical Engineering Handbook	Perry and Chilton	McGraw Hill	1st
	4	Principles of Unit Operations	Foust A.S. and Associates	John Wiley and Sons	1st

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

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

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Syllabus of S. Y. B. Tech. (All) Semester-III

Course Code: BSH225	**Credits:1**
Course: Lab V: Development of Skills-II	
Teaching Scheme:	**Termwork: 50 marks**
Practical: 2 hrs/week	

Objectives	1.Students will be able to apply communicative English Grammar in communication.
	2.Students will be able to enhance the level of English vocabulary.
	3.Students will be able to pronounce and articulate words as well as sentences accurately.
	4.Students will be able to understand and apply correct body language eventually.
	5.Students will be able to develop life skills.
	6.Students will be able to develop placeability skills and business correspondence.

	Sr. No.	Section	Contents	Duration
List of Practical	1	English Communicative Grammar	Structure of sentences, types of sentences, clauses, grammatical common errors in English	4 hrs
	2	Vocabulary Building	Usage of words in sentences, common errors in spelling of words, synonyms, antonyms, phrases and idioms	2 hrs
	3	Phonetics	Syllables, Stress, intonation, pronunciation of words, phonetic transcription - conversion of words to phonetic symbols and from phonetic symbols to words, British and American English (basic difference in vocabulary, spelling, pronunciation and structure), non-verbal language.	4 hrs
	4	Non-verbal Communication (Body language)	Posture, gesture, eye contact, facial expression, proxemics, chronemics, appearance and symbols.	2 hrs
	5	Soft Skills	Personality development, self analysis through SWOT, Johari window, interpersonal skills, perception and attitude, values and ethics, career planning.	2 hrs
	6	Placeability Skills	Job application, resume writing, analytical and reasoning test, debate, group discussion, demo presentation and interview skills.	4 hrs
	7	Business Correspondence	Letter writing at work place (hard copy and soft copy), telephone and Email etiquette, report writing.	2 hrs

List of Reference Books	Sr. No.	Title	Author	Publication
	1	The Essence of Effective Communication	Adrian Budday, Ron Ludlow and Fergus' Panton	Prentice Hall of India-Private Ltd.
	2	Communicating in Style	Yateendra Joshi	The energy Resource Institute
	3	Effective Technical Communication	Anne Eisenberge	Mc Graw Hill International Editors
	4	Professional Communication Skills	A. K. Jain, Pravin, S. R. Bhatia, A. M. Sheikh	S. Chand & Company Ltd.
	5	Business Communication	Urmila Rai, S. M. Rai	Himalya Publishing House
	6	Developing Communication Skills	Krishna Mohan and Meera Banerjee	Macmillan India Limited
	7	Better English Pronunciation	J.D.O'Connor.	Cambridge Publication
	8	Professional Communication Skill	Pravil S.R. Bhatia, S.Bhatia	S. Chand & Co
	9	Living English Structure	Allan Walter	Pearson Education India
	10	Communication Techniques & Skill	R.K. Chadha	
	11	Technical Communication-Principles and Practice	Meenakshi Raman & Sangeeta Sharma	Oxford University Press
	12	A course in Phonetics & Spoken English	J.Sethi,P.V.Dharmatma	PHI publication
	13	Communication Skills for Engineers	Sunita Mishra, C. Murli Krishna	Pearson Education
	14	Communication Skills	Leena Sen	PHI
	15	Technical Communication A Reader Centered Approach	Paul V. Anderson	Thomson Publication
	16	Grammar of Spoken and Written English	Dauglas Biber, Geoffrey Leech	Longman
	17	A Practical English Grammar	A.J. Thomson & A.V. Martinet	Oxford University Press
	18	Oxford English Grammar	Sydney Greenbaum	Oxford University Press
	19	Developing Graduate Employability Skills: Your Pathway to Employment	Mercy V. Chaita	Universal Publishers

The assessment of term work shall be done on the basis of the following:
1. Continuous assessment.
2. Performing the experiments in the laboratory.
3. Oral examination conducted on the syllabus and term work mentioned above.

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

Course Code: BSH251A	**Course: Engineering Mathematics -IV**
Teaching Scheme: 04Hrs/week	**Class Test: 20 marks**
Theory: 03 Hrs/week	**Theory Examination (Duration): 03 Hrs**
Tutorial: 01 Hr/week	**Theory Examination (Marks): 80**
Credits: 04	

Objectives	:	1) To develop the mathematical skills of the student related to Function of complex variable and Vectors. 2) To study and apply various types of transforms and partial derivatives. 3) To provide Numerical techniques for solving the practical problem 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. **(12 Hrs)**
Unit-II	:	**Application of Complex Variable:** Evaluation of real integrals: Integration along unit circle and along the upper half semi-circle, Conformal Transformation, Bilinear transformation. **(5Hrs)**
Unit-III	:	**Vector Integration:** Line integral, Surface integral, Gauss divergent theorem, Stoke's theorem, Green's theorem. **(7 Hrs)**
Unit-IV	:	**Numerical Method:** Solution of algebraic and transcendental equation, Newton Raphson method, Lagrange's interpolation, Solution of linear simultaneous equation by Gauss Elimination method, Gauss-Seidel method, Solution of ordinary differential equations: Taylor series method, Fourth order Runge-Kutta method.**(10 Hrs)**
Unit-V	:	**Probability:** Introduction, Probability Distributions: Binomial Distribution, Poisson Distribution, Normal Distribution. **(6 Hrs)**
Unit-VI	:	**Application of partial differential equation** : Solution of partial differential equation by method of separation variable, Application to i. Vibration of a string (The wave equation) (without proof) ii. One dimensional heat flow (The diffusion equation) (without proof) iii. Two dimensional heat flow (The diffusion equation) (without proof) **(8 Hrs)**

Reference Books:	:	1. A Text Book of Applied Mathematics Volume-III BY P.N. Wartikar J.N.Wartikar, Pune Vidyarthi Griha Prakashan.
		2. Advanced Engineering Mathematics BY H. K. Dass, S. Chand and Co. Ltd.
		3. Higher Engineering Mathematics BY Dr. B. S. Grewal, Khanna Publishers.
		4. Higher Engineering Mathematics BY B. V. Ramana, Tata McGraw-Hill Publishing Co. Ltd.
		5. Solution to Higher Engineering Mathematics Volume –III BY C. P. Gandhi

Section A: Includes Unit I, II and III; **Section B**: Includes Unit IV, V and VI.

Pattern of Question Paper:

The six/four units in the syllabus shall be divided in two equal parts i.e. 3 units respectively. Question paper shall be set having two sections A and B. Section A questions shall be set on first part and Section B questions on second part. Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Minimum ten questions
2. Five questions in each section
3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for ten marks each. The Question no.1 and 6 should be of objective nature.
4. Two questions of 15 marks each from remaining questions from each section A and B be asked to solve.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of S. Y. B. Tech. (Plastic and Polymer Engineering) Semester–IV	
Course Code: PPE252	**Credits: 4**
Course: Process Calculation	**Class Test: 20 Marks**
Teaching Scheme:	**Theory Examination: 80 Marks**
Theory: 4 hrs/week	**Theory Examination (Duration): 3 hrs**

Objectives	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	**Basic Units and Conversion:** Vapor pressure, partial pressure, ideal gas law, Dalton's law, Raoult's law, Amagat's law, Weight percent, volume percent, mole percent, density of gas mixture, average molecular weight of mixture. **(08 h)**
Unit-II	**Material Balance without Chemical Reaction:** Material balance for distillation, drying, extraction, absorption, crystallization, blending, evaporation and filtration. Purge and bypass calculations. **(08 h)**
Unit-III	**Material Balance with Chemical Reaction:** Material balance with different types of chemical reaction. Limiting and excess reactants. **(08 h)**
Unit-IV	**Energy Balance:** Energy balances with chemical reaction, heat capacity of pure substances and mixtures, standard heat of reaction, standard heat of formation, standard heat of combustion and standard heat of neutralization. **(10 h)**
Unit-V	**Humidification:** Relative humidity, percent saturation, dew point, dry and wet bulb temperature, psychometric chart. **(06 h)**
Unit-VI	**Fuels and Combustion:** Types of fuels and combustion, calorific value, air requirement, theoretical and excess calculations **(08 h)**

Reference Books/ Websites	Sr. No.	Title	Author	Publication	Edition
	1	Stoichiometry	Bhatt and Vora	Tata McGraw Hill	4th
	2	Chemical Process Principles - Part I	Hougen & Watson	Asia Publishing House	2nd
	3	Basic Principles and Calculation in Chemical Engineering	D. M. Himmelblau.	Prentice – Hall India	6th
Website		http://www.nptelvideos.in/2012/12/materials-and-energy-balance.html			

Section A: Includes Unit I, II and III; **Section B:** Includes Unit IV, V and VI.

Pattern of Question Paper:
The six units in the syllabus shall be divided in two equal parts i.e. 3 units respectively. Question paper shall be set having two sections A and B. Section A questions shall be set on first part and Section B questions on second part. Question paper should cover the entire syllabus.

For 80 marks Paper:
1. Minimum ten questions
2. Five questions in each section
3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for 10 marks each. The Question no.1 and 6 should be of objective nature.
4. From each section solve any two questions of 15 marks each.

Dr.BabasahebAmbedkarMarathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of S. Y. B. Tech. (Plastic and Polymer Engineering) Semester-IV	
Course Code: PPE253 **Course: Physical Chemistry of Polymers** **Teaching Scheme:** **Theory: 3 hrs/week** **Tutorial: 1 hr/week**	**Credits: 4** **Class Test: 20 Marks** **Theory Examination: 80 Marks** **Theory Examination (Duration): 3 hrs**
Objectives	1) This course is intended to introduce students to the physico-chemical 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, isomerism and stereochemistry. Origin and types of stereoisomerism in polymers; factors influencing stereo-regulation, Conformation of Polymer Chain. **(8 h)**
Unit-II	**Crystalline State of Polymers:** Spherulite formation, nucleation, grain boundary, crystalline structures. Intermolecular orders: Amorphous, crystalline and oriented forms of polymers, crystallinity in polymers, factors affecting crystallinity, properties affected by crystallinity of polymers. **(10 h)**
Unit-III	**Polymer Solutions:** Polymer Solutions: Dilute and Concentrate, phase separation;good, bad and theta solvents; Hilderbrand and Hansen solubility parameter. **(06 h)**
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, Factors determining chain flexibility, Practical importance of chain flexibility. **(12 h)**
Unit-V	**Osmosis:** Osmotic pressure, vapour pressure osmometry, ideal solution, Vant Hoff analysis, virial expansion, Application in determining molecular weight of polymer. **(06 h)**

Unit-VI	**Polymer Surface Chemistry:** Cohesive energy, surface tension and surface energy, contact angle (definition, theory and application), hydrophilic and hydrophobic polymer surfaces. **(06 h)**				
Reference Books:	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1	Polymer Science & Technology of Plastics & Rubbers	P. Ghosh	TataMcGrawHill	2nd
	2	Polymer Science & Technology	Joel R. Fried	Prentice Hallof IndiaPvt.Ltd.	3rd
	3	Polymer Science	V.R. Gowarikar	New Age International Publishers	3rd2005
	4	Introduction to Polymer Physics	M. Doi	Oxford Science	1995
	5	Principles of Polymer Chemistry	P.J. Flory	Cornell Univ. Press, New York	1955
	6	*Introduction to Polymers.*	Young, R. J., and P. A. Lovell	Boca Raton, FL: CRC Press, ISBN: 9780748757404.	2nd 2000
	7	Textbook of Polymer Science	Golding	Van Nostrand Reinhold company	-
	8	Plastics Materials	J.A.Brydson	Elsevier	6th
	9	Textbook of Polymer Science	PL Nayak, S Lenka	Kalyani	2nd

Section A: Includes Unit I, II and III; **Section B**: Includes Unit IV, V and VI.

Pattern of Question Paper:
The six units in the syllabus shall be divided in two equal parts i.e. 3 units respectively.
Question paper shall be set having two sections A and B. Section A questions shall be set on first part and Section B questions on second part. Question paper should cover the entire syllabus.

For 80 marks Paper:
1. Minimum ten questions
2. Five questions in each section
3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for 10 marks each. The Question no.1 and 6 should be of objective nature.
4. Two questions of 15 marks each from remaining questions from each section A and B be asked to solve.

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

Course Code: PPE254	Credits: 4
Course: Polymer Synthesis and Manufacturing	Class Test: 20 Marks
Teaching Scheme:	Theory Examination: 80 Marks
Theory: 4 hrs/week	Theory Examination (Duration): 3 hrs

Objectives	1) To provide a general overview on polymer synthesis and their kinetics. 2) To providea thorough understanding and knowledge on manufacturing process of various thermoplastics.
Unit-I	**A. Introduction to Polymer Synthesis:** Definition and characteristics of monomers, initiators, catalyst, chain transfer agent, inhibitors, retarder. Homo-polymerization, co-polymerization. **(02 h)** **B. Polymerization Techniques:** Bulk, solution, emulsion, suspension, ring-opening and interfacial polymerization; examples of various polymers prepared by each polymerization techniques. **(06 h)**
Unit-II	**Addition Polymerization:** Radical, cationic and anionic polymerization : theory , Techniques and mechanism, advantages and disadvantages, Chain transfer, inhibition, retardation, auto-acceleration, Initiator efficiency, Kinetics of additionpolymerization reaction, Rate of polymerization of the reaction (Derivation and assumptions), Extent of reaction, Number average degree of polymerization. **(08 h)**
Unit-III	**Condensation Polymerization:** Kinetics of step polymerization, copolymerization with few examples. Reactivity of functional groups; Stoichiometric control of molecular weight for step polymers. Effect of temperature on rate of polymerization reaction. Reactivity ratio and its influence on type of copolymer formation.Carother's equation, Extent of reaction, Number average degree of polymerization, Numerical problems. **(08 h)**
Unit-IV	**Manufacturing of Thermoplastic Materials:** Coordination polymerization (Ziegler-Natta polymerization, metallocene polymerization), manufacturing process for polyolefins (LDPE, LLDPE, HDPE, Isotactic and Syndiotactic PP), Manufacturing process of Polystyrene (PS), high impact grades (HIPS), Acrylonitrile-co-Butadiene-co-Styrene (ABS). Preparation and processing of Polyethylene terephthalate (PET), Polyamides (Nylon 6 and Nylon 6,6) and Polycarbonate, Poly(tetrafloro ethylene) **(10 h)**

Unit-V	**Manufacturing of Thermosets:** Raw materials, commercial production, resinification and hardening of Phenolic resins (Novolac and Resol), Amino resins (Urea formaldehyde and Melamine formaldehyde), Epoxies, Alkyd resins. **(08 h)**
Unit-VI	**Miscellaneous Polymeric Materials:** Raw materials and manufacturing process of Polyurethanes (Elastomer, Fibre, Foam and Adhesive) and Silicones (Plastics resin and Rubber). **(06 h)**

Reference Books:	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1	Polymer Science and Technology	P. Ghosh	Tata McGraw Hill	2nd
	2	Plastics Materials	J.A. Brydson	Elsevier	7th
	3	Textbook of Polymer Science	Golding	Van Nostrand Reinhold company	
	4	Introduction to Polymers	Young, R. J., and P. A. Lovell	CRC Press	2nd
	5	Handbook of Polyolefins	Cornelia Vasile	Marcel Dekker	2nd
	6	Manufacture and Processing of PVC	R. H. Burgess	Elsevier Applied Science Publishers	1st
	7	Polyesters and polyamides	BL Deopura, R. Alagirusamy, M. Joshi, B. Gupta	Woodhead Publishing in Textiles	1st
	8	Polystyrene: Synthesis, Production and Applications	J. R. Wünsch	Smithers Rapra Publishing	1st

Section A: Units I, II, III and **Section B:** Units IV, V, VI.

Pattern of Question Paper:
The six units in the syllabus shall be divided in two equal parts i.e. 3 units respectively. Question paper shall be set having two sections A and B. Section A questions shall be set on first part and Section
B questions on second part. Question paper should cover the entire syllabus.

For 80 marks Paper:
1. Minimum ten questions
2. Five questions in each section
3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for 10 marks each. The Question no.1 and 6 should be of objective nature.
4. Two questions of 15 marks each from remaining questions from each section A and B be asked to solve.

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(Faculty of Science & Technology)
Syllabus of S. Y. B. Tech.(Plastic and Polymer Engineering)Semester-IV

Course Code: PPE291	**Credits: 4**
Course: Programme Elective-I: Specialty Polymers	**Class Test: 20 Marks**
Teaching Scheme:	**Theory Examination: 80 Marks**
Theory: 4 hrs/week	**Theory Examination (Duration): 3 hrs**

Objectives	To provide general idea of different specialty polymers, their synthesis, structure-property relationships and applications.
Unit-I	**Heat Resistant Polymer** Introduction, preparations, structure-property relationships, properties and application of the followings polymers: a) Polyetherether ketone, b) Polysulphone, c) Polybenziimidazole d)Polyphenylene oxide, e)Polyphenylene sulphide **(08 h)**
Unit-II	**Inorganic Polymers** Classifications based on chemical constituents (fully inorganic, organometallic, organic-inorganic polymers and hybrids), dimensionality (1D, 2D and 3D), connectivity (1, 2, 3, 4, 6, 8 and mixed connectivities) and polymerization methods (step-growth, chain-growth, ring-opening polymerization). Preparation, properties and applications of the following polymers: a)Polysilane, b) Polydimethylsiloxanes, c) Polyphosphazene, d) Polyborazylene **(08 h)**
Unit-III	**Liquid Crystalline Polymer** Introduction of liquid crystals, Classification, definition of mesophase, spacer and disruptor, Lyotropic and Thermotropic System, Temperature dependent phase change in liquid crystals, Liquid crystal main chain polymer, Liquid crystal side chain polymer, liquid crystal dendrimer. Synthesis, Structure-Property Relationships, Characterization and Applications of LCPs. **(08 h)**
Unit-IV	**Conducting Polymers** Introduction of conducting polymers and classifications. Different synthesis methods (oxidative chemical, electrochemical, interfacial, solid state and enzymatic synthesis) and techniques (template and template-free synthesis). Doping of intrinsically conducting polymers. Dedoping, redoping, secondary doping, self doping and simultaneous dual doping mechanisms. Polaron, bipolaron and solition states. Electrical and electrochemical characterizations of conducting polymers. Miscellaneous applications of conducting polymers. Synthesis, properties and applications of the following polymers: a)Polyaniline, b) Polypyrrole, c) Polythiophene and d) Polyacetylene. **(10 h)**

Unit-V	**Ionic Polymers** Introduction and classifications of ionic polymers. Synthesis, properties and applications of ionomers and polyelectrolytes. **(04 hr)**				
Unit-VI	**Smart Polymers** Stimuli-responsive characteristics of polymers. Physical forms of the smart polymer chains. Polymers showing LCST behaviour. Polymers with dual responsive characteristics. Polymers with amphiphilic balance. Basic idea of shape memory polymers with examples. Working mechanisms of temperature, strain, pH, solvent, gas and vapour sensitive smart polymeric systems with examples. Smart polymers for drug delivery. **(10 hr)**				

Reference Books:	Sr. No.	Title	Author	Publication	Edition
	1	Liquid Crystalline Polymers	Xin-Jiu Wang. Qi Feng Zhou	World Scientific Publishing Co. Pvt. Ltd.	1st (2004)
	2	Specialty Polymers	R.W. Dyson	Chapman & Hall, New York	2nd (1998)
	3	Engineering Polymer Sourcebook	Raymond B. Seymour	McGraw-Hill, USA	1st (1990)
	4	Stimuli-Responsive Polymers: Synthesis and Properties	Andrew B. Lowe, Peter J. Roth	Wiley	1st (2016)
	5	Smart Polymers and their Applications	*M.R. Aguilar De Armas and J.S. Román*	Woodhead Publishing	1st (2014)
	6	Inorganic and Organometallic Polymers	Ronald D. Archer	Wiley	1st (2001)
	7	Heat-Resistant Polymers: Technologically Useful Materials	J.P. Critchley, G.J. Knight, W.W. Wright	Springer	1st (1983)

Section A: Includes Unit I, II and III; **Section B**: Includes Unit IV, V and VI.

Pattern of Question Paper:
The six units in the syllabus shall be divided in two equal parts i.e. 3 units respectively.
Question paper shall be set having two sections A and B. Section A questions shall be set on first
part and Section B questions on second part. Question paper should cover the entire syllabus.

For 80 marks Paper:
1. Minimum ten questions
2. Five questions in each section
3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for 10 marks each. The Question no.1 and 6 should be of objective nature.
4. Two questions of 15 marks each from remaining questions from each section A and B be asked to solve.

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Course Code: PPE292   **Credits: 4**
Course:Programme Elective-I: Fiber Technology   **Class Test: 20 Marks**
Teaching Scheme: **Theory Examination: 80 Marks**
Theory: 4 hrs/week   **Theory Examination (Duration): 3 hrs**

Objectives	1) To understand different terminologies associated to fibre technology. 2) To acquire fundamental knowledge about natural and man-made fbres, their structures and basic characteristics. 3) To gain knowledge about preparation of man-made fibres. 4) To acquire knowledge about processing and applications of fibres.
Unit-I	**Introduction to Fibres:** Definitions and terminologies, classification (natural, synthetic, regenerated fibres), staple and filament fibres, orientation in fibre structure, general idea about the physical properties of fibres (fibre length, fineness, tenacity, initial modulus, work of rupture, moisture regain), physical and chemical identification of fibres. **(08h)**
Unit-II	**Natural Fibres:** Origin, structure, properties and applications of the following fibres: cotton, wool,silk, jute, flax and sisal. **(08h)**
Unit-III	**Fibre Production Methods:** Melt spinning, dry spinning, wet spinning, dry-jet wet spinning, electrospinning. **(08 h)**
Unit-IV	**Synthetic Fibres:** Origin, structure, preparation, properties and applications of the fibres based on polyester, polyamide, polyacrylic, polyolefin and polyaramid. **(08h)**
Unit-V	**Regenerated and Inorganic Fibres:** Structure, preparation (in brief), properties and applications of the regenerated cellulosic fibres: rayon (viscose, cuprammonium, polynosic). Properties and applications of the following inorganic fibres: steel, glass, carbon, boron. **(08h)**

Unit-VI	**A) Chemical Processing of Fibres:**
	     Scouring, Bleaching, Dyeing.
	 (04 h)
	
	 B) Mechanical Processing of Fibres:
	     General idea about post-synthesis processing of fibres, twisting and spinning of fibres, nonwoven fabrics, fibre reinforced composites (FRP).
	 (04h)

Reference Books:	Sr. No.	Title	Author	Publication	Edition
	1	Manufactured Fibre Technology	V. B. Gupta, V. B. Kothari	Springer	1st
	2	Man-made Fibres	R. W. Moncrieff	Wiley	1st
	3	Textile Science: An Explanation of Fibre Properties	E. P. G. Gohl, L. D. Vilensky	Guilford Publications	1st
	4	Dyeing and Chemical Technology of Textile Fibres	E. R. Trotman	John Wiley & Sons Inc.	4th
	5	Man-made fibres	Gordon J. Cook	Woodhead Publishing	1st

Section A: Includes Unit I, II and III; **Section B:** Includes Unit IV, V and VI.

Pattern of Question Paper:

The six units in the syllabus shall be divided in two equal parts i.e. 3 units respectively. Question paper shall be set having two sections A and B. Section A questions shall be set on first part and Section B questions on second part. Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Minimum ten questions.
2. Five questions in each section.
3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for 10 marks each. The Question no.1 and 6 should be of objective nature.
4. Two questions of 15 marks each from remaining questions from each section A and B be asked to solve.

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Course Code: PPE293	**Credits: 4**
Course: Programme Elective-I: Biopolymers	**Class Test: 20 Marks**
Teaching Scheme:	**Theory Examination: 80 Marks**
Theory: 4 hrs/week	**Theory Examination (Duration): 3 hrs**

Objectives	1) To gain an understanding on the chemical structure of biopolymers, their classification andnomenclature. 2) To acquire acknowledge about the resources and preparation involved in the production and the recovery of biopolymers. 3) To acquire knowledge about the basic properties of biopolymers and their various applications.
Unit-I	**Biopolymers:** Definition, classification and nomenclature of biopolymers, origin of various natural biopolymers, structure, properties and applications of various biopolymers, advantages and disadvantages of biopolymers. **(06 h)**
Unit-II	**Preparation, Properties and Applications of Biopolymers:** Technology, production and application of biopolymers based on Lactic acid, Lipids, Cellulose, Starch, Chitosan and glycol-proteins. **(08 h)**
Unit-III	**Microbial Biopolyesters [Polyhydroxyalkanoates]:** Introduction, biosynthesis, isolation – solvent extraction - sodium hypo chloride digestion, enzymatic digestion, properties – crystal structure – nascent morphology, degradation - intracellular biodegradation - extra cellular biodegradation - thermal degradation - hydrolytic degradation - environmental degradation - effects of recycling, applications, economics, future prospects. **(10 h)**
Unit-IV	**A) Test Methods and Standards for Biodegradable Plastics:** Introduction, defining biodegradability, criteria used in the evaluation of biodegradable polymers, tiered systems for evaluating biodegradability, choice of environment, choosing the most appropriate methodology, description of current test methods - screening test for ready biodegradability, tests for inherent biodegradability, tests for simulation studies, other methods for assessing biodegradability - petri dish screen - environmental chamber method - soilburial tests, test method developments for the future. **(06 h)** **B) Biocompatibility and Toxicological Screening of biomaterials:** Biocompatibility & Toxicological screening of biomaterials [Definition of Biocompatibility, cytotoxicity (Principal, method and few examples)], *in vitro* hemocompatibility, cell adhesion property and morphology. **(04 h)**

Unit-V	**Biopolymer Based Materials:**
	A) Blends and composites: Processing technique, Mechanical and dynamic properties and applications. Comparative properties (mechanical and physic-chemical) of tissue and body parts with bio-polymers.
	(04 h)
	B) Bio-nanocomposites: Properties, characteristics and applications of Poly(lactic acid) based bio-nanocomposites, Polyhydroxyalkanoate based bio-nanocomposites, Polycaprolactone based bio-nanocomposites, Starch based bio-nanocomposites, nanoclaybased bio-nanocomposites.
	(04 h)
Unit-VI	**Renewable Raw Materials and Feedstock for Biopolymers:**
	Introduction-First- and Second-generation crops: advantages and disadvantages-The amount of land needed to grow feedstock for bio-based plastics- productivity and availability of arable land- research on feedstock optimization- advanced breeding technologies and green biotechnology- some facts about food prices and recent food price increases- availability of land for food, animal feed, bio-energy and industrialmaterial use, including bio-based plastics.
	(06 h)

Reference books	Sr. No.	Title	Author	Publication	Edition
	1	Bio-Based Plastics	Stephan Kabasci	Wiley	1st 2014
	2	Handbook of Biopolymer-Based Materials	Sabu Thomas,Dominique Durand,Christophe Chassenieux, andP. Jyotishkumar	Wiley	1st 2013
	3	Chemistry &Technology of Biodegradable Polymers	G.J.L.Griffin Blackie(ed.)	Academic & Professional London	1st 1994
	4	Handbook of Biodegradable Polymers	Abraham J.Donb and others(ed.)	Harwood Academic Publishers	1st 1998
	5	Green Polymer Composites Technology Properties and Applications	Inamuddin	Taylor & Francis CRC Press	1st 2016
	6	Biopolymer Nanocomposites Processing, Properties, And Applications	Alain Dufresne, Sabu Thomas and Laly A. Pothan	Wiley	1st 2013
	7	Polymeric Biomaterials	Piskin and A.S. Hoffmann	MartinusNijhof f Publishers. (Dordrecht.)	2nd 1986
	8	Biomaterials – An introduction	J.B. Park	Plenum Press	2nd 1979

9	Bio-materials Science- An introduction to materials in medicine	Buddy D. Ratner, Allans S. Hoffman, Frederick J. Schoen, Jack E. Lemons	Academic press	-
10	The intersection of biology and materials science	G. M. Whitesides and A. P. Wong	MRS bulletin	-
11	Sujata V. Bhat	Biomaterials	Alpha Science International Ltd. New Delhi, India	-

Section A: Includes Unit I, II and III; **Section B:** Includes Unit IV, V and VI.

Pattern of Question Paper:

The six units in the syllabus shall be divided in two equal parts i.e. 3 units respectively. Question paper shall be set having two sections A and B. Section A questions shall be set on first part and Section B questions on second part. Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Minimum ten questions
2. Five questions in each section
3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for 10 marks each. The Question no.1 and 6 should be of objective nature.
4. Two questions of 15 marks each from remaining questions from each section A and B be asked to solve.

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Course Code: PPE255 **Course: Fluid Mechanics** **Teaching Scheme:** **Theory: 2 hrs/week**	**Credits: 2** **Class Test: 10 Marks** **Theory Examination: 40 Marks** **Theory Examination (Duration): 2 hrs**

Objectives	To understand basic concepts of fluid flow and its applications in upstream and downstream process industry.
Unit-I	**Introduction:** Fluid, Properties of fluid, classification of fluids, Newton's law of viscosity and numerical, rheological classification of fluids, types of flow, lines to describe the flow. **(04h)**
Unit-II	**Fluid Pressure and Measurement:** Pascal's law, Hydrostatic law, concept of atmospheric, gauge, vacuum and absolute pressure, manometers, and pressure measurement by simple and differential manometer, Numerical based on above. **(04h)**
Unit-III	**Basic Equations of Fluid Flow and Flow Measuring Devices:** Basic equations of fluid flow: continuity equation, equation of motion, flow measurement using venturimeter, orifice meter, rotameter, pitot tube, Numerical based on above **(04h)**
Unit-IV	**Dimensional Analysis:** Fundamental dimensions of quantities, dimensional homogeneity, types of similarities dimensional analysis by Rayleigh's method and Buckingham's method, dimensionless numbers. **(04 h)**
Unit-V	**Single and Multi Phase Flows :** Flow of incompressible fluid in circular pipe; Hagen-Poiseuille equation, friction factor-Fanning and Darcy equation, major and minor losses; pipe fittings and equivalent diameter. Turbulent flow in a pipe, Boundary Layer theory and its significance, Flow resistance of immersed bodies, concept of drag and lift; variation of drag coefficient with Reynolds number. Flow through porous media, packed bed and fluidized bed. **(04 h)**
Unit-VI	**Fluid Transporting Machines :** Classification fluid flow Machinery as Fans, Blowers, Pumps and Compressors and their types and applications. Centrifugal Pumps: Operating Characteristics, Performance curves, NPSH. **(04 h)**

Reference Books	Sr.No.	Title	Author	Publication	Edition
	1	Unit Operations of Chemical Engineering	McCabe,W. L, J. Smith, and P. Harriot	McGraw-Hill International Edition	7th
	2	Hydraulics and Fluid Mechanics	Modi, L.P., Seth, S.M.,	Standard Book House	5th
	3	Fluid Mechanics for Chemical Engineers	Noel de Nevers	McGraw Hill	3rd
	4	Coulson, Richardson Chemical Engineering, Volume-1	M. Coulson, J.F. Richardson, with J.R. Backhurst and J.H. Harker	Butterworth-Heinemann	6th
	5	Fluid Mechanics: fundamentals and Applications	Yunus A Cengel , John M. Cimbala	McGraw-Hill	3rd

Section A: Includes Unit I, II and III; **Section B:** Includes Unit IV, V and VI.

Pattern of Question Paper:

The six units in the syllabus shall be divided in two equal parts i.e. 3 units respectively. Question paper shall be set having two sections A and B. Section A questions shall be set on first part and Section B questions on second part. Question paper should cover the entire syllabus.

For 40 marks Paper:

1. Minimum ten questions
2. Five questions in each section
3. Question no 1 from section A and Question no 6 from section B be made compulsory and should cover complete syllabus of the respective section and should be set for 6 marks each. The Question no.1 and 6 should be of objective nature.
4. Two questions of 7 marks each from remaining questions from each section A and B be asked to solve.

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Course Code: PPE271	**Credits:1**
Course: LabVI: Physical Chemistry of Polymers	**Practical: 25 marks**
Teaching Scheme:	**Termwork: 25 marks**
Practical: 2 hrs/week	

Course Objectives	To study the physical structure of polymers and understand how their properties are dependent upon their internal structure.
List of Practicals	13. Determine of molecular weight by conductometric titration. 14. Determination of molecular weight by potentiometric titration. 15. Determination of softening point of polymer. 16. Determination of solubility parameter. 17. Determination of swelling parameter. 18. Determination of UCST/LCST of polymer. 19. Verify the applicability of a mixture of non-solvents as effective solvent of a polymer. 20. Determination of surface energy of polymer. 21. Determination of refractive index of polymer solutions. **At least any 8 experiments from the above-mentioned list of experiments should be performed.**

List of Reference Books	Sr. No.	Title	Author	Publication	Edition
	1	OrganicSpectroscopy	William Kemp	Macmillan	-
	2	Introduction toPhysical Polymer Science	L.H.Sperling	Wiley Interscience	2006
	3	The Elements ofPolymer Science andEngineering	A. Rudin	Academic Press	1999
	3	Characterization ofPolymers (EncyclopediaReprints)	Norbert M. Bikales (Ed.)	Wiley Interscience	-
	4	Stereochemistry ofOrganic Compounds:Principles and Applications	D. Nasipuri	New Age International Pvt. Ltd	-

The assessment of term work shall be done on the basis of the following.
1. Continuous assessment.
2. Performing the experiments in the laboratory.
3. Oral examination conducted on the syllabus and term work mentioned above.

Practical Examination

The practical examination shall consist of performing an experiment based on the practical work done during the course, the record of the experiment performed by the candidate and viva-voce based on the syllabus. The assessment will be based on
1. Performing the experiment.
2. Record of experiment performed by the candidate.
3. Viva-voce on the syllabus.

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Course Code: PPE272	**Credits: 2**
Course: Lab VII: Polymer Synthesis-I	**Practical: 50 marks**
Teaching Scheme:	**Termwork: 50 marks**
Practical: 2 hrs/week	

Objectives	To prepare various polymers through different polymerization techniques
List of Practicals	1. Synthesis of Polystyrene (PS) or Poly(Methyl methacrylate)(PMMA) by bulk polymerization technique. 2. Synthesis of PMMA by solution polymerization technique. 3. Synthesis of PS or PMMA by suspension polymerization technique. 4. Synthesis of PS or PMMA by emulsion polymerization technique. 5. Synthesis of Nylon 6 using condensation polymerization technique. 6. Ring opening polymerization of Caprolactone. 7. Interfacial polymerization of aniline. 8. Synthesis of Acrylamide/Acrylate copolymer (Bulk/Solution/Emulsion)

List of Reference Books	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1	Polymer Science & Technology of Plastics & Rubbers	P. Ghosh	TataMcGrawHill	2nd
	2	Handbook of Polymer Synthesis, Characterization, and Processing	Enrique Saldívar-Guerra, Eduardo Vivaldo-Lima.	Wiley Interscience	-
	3	Polymer Synthesis and Characterization: Laboratory Manual	Sandler , Karo , Bonesteel & Pearce	Elsevier	-
	4	Laboratory experiments in polymer synthesis and characterization	Eli M. Pearce, Carl E. Wright, Binoy K. Bordoli	Article	-
	5	Experiments in Polymer Science, Technology and Testing of Polymer	Dr. A. D. Ashtaputre	-	1St
	6	Principles of Polymerisation	George Odian	Wiley Interscience	4th

The assessment of term work shall be done on the basis of the following.
1. Continuous assessment.
2. Performing the experiments in the laboratory.
3. Oral examination conducted on the syllabus and term work mentioned above.

Practical Examination

The practical examination shall consist of performing an experiment based on the practicalwork done during the course, the record of the experiment performed by the candidate and vivavoce based on the syllabus. The assessment will be based on
1. Performing the experiment.
2. Record of experiment performed by the candidate.
3. Viva-voce on the syllabus.

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Course Code: PPE273	**Credits:1**
Course: Lab VIII: Fluid Mechanics	**Practical: 25 marks**
Teaching Scheme:	**Termwork: 25 marks**
Practical: 2 hrs/week	

Course Objectives	To study/demonstrate conceptual understandings of Fluid Mechanics practically.
List of Practicals	11. To determine nature of flow (laminar or turbulent) by using Reynold's experiment.
	12. To verify the Bernoulli's Equation.
	13. To determine the coefficient of discharge of Orifice meter.
	14. To determine the coefficient of discharge of Venturi Meter.
	15. To determine major losses in pipe during flow.
	16. To determine minor losses in pipe during flow.
	17. Flow through packed beds.
	18. Flow through fluidized beds.
	19. To study construction and working of centrifugal and reciprocating pumps.
	20. Study of Centrifugal Pumps: Pump curves, NPSH, Cavitation, Selection and Performance.
	21. Study of different types of valves and pipe fittings.
	At least any 8 experiments from the above-mentioned list of experiments should be performed.

List of Reference Books	Sr.No.	Title	Author	Publication	Edition
	1	Unit Operations of Chemical Engineering	McCabe,W. L, J. Smith, and P. Harriot	McGraw-Hill International Edition	7th
	2	Hydraulics and Fluid Mechanics	Modi, L.P., Seth, S.M.	Standard Book House	5th
	3	Fluid Mechanics for Chemical Engineers	Noel de Nevers	McGraw Hill	3rd

	4	Coulson, Richardson Chemical Engineering, Vol. 1	M. Coulson, J.F. Richardson, with J.R. Backhurst and J.H. Harker	Butterworth-Heinemann	6th
	5	Fluid Mechanics: fundamentals and Applications	Yunus A Cengel , John M. Cimbala	McGraw-Hill	3rd

The assessment of term work shall be done on the basis of the following.
1. Continuous assessment.
2. Performing the experiments in the laboratory.
3. Oral examination conducted on the syllabus and term work mentioned above.

Practical Examination

The practical examination shall consist of performing an experiment based on the practical work done during the course, the record of the experiment performed by the candidate and vivavoce based on the syllabus. The assessment will be based on
4. Performing the experiment.
5. Record of experiment performed by the candidate.
6. Viva voce on the syllabus.

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CourseCode: PPE274	**Credits:1**
Course: Lab IX: DOS-III Design Lab-I (CAD)	
Teaching Scheme:	**Termwork: 50 marks**
Practical: 2 hrs/week	

Course Objective	To impart knowledge of handling CAD 2D package in order to draft the engineering drawing including plastics products and mould components.
List of Practicals	1. Introduction to CAD software. 2. To study and practice setting up limits, units, and other settings. 3. To study and practice basic draw tools like line, circle, rectangle, arc etc. 4. To study and practice use of drawing & construction aids like ORTHO, OSNAP, OTRACK, DYN, POLAR etc. 5. To study and practice line type, line weight, grouping, blocks, quick properties etc. 6. To study and practice modifying tools like copy, move, rotate, trim, mirror, scale, fillet, offset etc. 7. To study and practice use of TEXT, TEXT stylesetc. for 2D drawing. 8. To study and practice use of blocks, dimensions, dimensioning style, editing dimensions, utilities applicable for 2D drawing. 9. To study and practice use of layers, colors. 10. To study and practice layout, printing and plotting. **At least any 8 experiments from the above-mentioned list of experiments should be performed.**

List of Reference Books	Sr. No.	Title	Author	Publication	Edition
	1	Up and Running with AutoCAD 2012	Elliot Gindis	Elsevier	-
	2	Up and Running with AutoCAD 2015	Elliot Gindis	Elsevier	-
	3	Up and Running with AutoCAD 2017	Elliot Gindis	Elsevier	-
	4	AutoCAD 2012 Essentials	Scott Onstott	John Wiley & Sons	-

The assessment of term work shall be done on the basis of the following:
1. Continuous assessment.
2. Performing the experiments in the laboratory.
3. Oral examination conducted on the syllabus and term work mentioned above.