

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY**CIRCULAR NO.SU/Engg./T.Y.B.Tech./63/2018**

It is hereby informed to all concerned that, the syllabi prepared by the Board of Studies & recommended by the Dean, Faculty of Science & Technology, the Academic Council at its meeting held on 30 June & 02 July 2018 has accepted the following syllabi in accordance with Choice Based Credits & Grading System for all Branches T.Y.B.Tech under the Faculty of Science & Technology as enclosed herewith.

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

This is effective from the Academic Year 2018-2019 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/T.Y.B.TECH./2018/

Date:- 03-07-2018. /10486-36 *****

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6/7/18
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

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

of

FOUR YEAR DEGREE COURSE IN SCIENCE & TECHNOLOGY



DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

FACULTY OF SCIENCE AND TECHNOLOGY

Revised Structure w.e.f. 2018-2019

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

Sub No.	SEMESTER-V	Contact Hrs / Week				Examination Scheme						
	Subject	L	T	P	Total	CT	TH	TW	P	Total	Credits	Duration of Theory Exam
PPE301	Polymer Rheology and Morphology	4	-	-	4	20	80	-	-	100	4	3 Hrs
PPE302	Polymeric Materials-I	4	-	-	4	20	80	-	-	100	4	3 Hrs
PPE303	Heat Transfer	4	-	-	4	20	80	-	-	100	4	3 Hrs
PPE304	Instrumental Analysis of Polymers	4	-	-	4	20	80	-	-	100	4	3 Hrs
PPE305	Polymer Additives and Compounding	4	-	-	4	20	80	-	-	100	4	3 Hrs
PPE341-343	Elective-II	2	-	-	2	10	40	-	-	50	2	2 Hrs
PPE321	Lab-I: Polymer Synthesis II	-	-	4	4	-	-	50	50	100	2	NA
PPE322	Lab-II: Instrumental Analysis of Polymers	-	-	2	2	-	-	50	-	50	1	NA
PPE323	Lab-III: Heat Transfer	-	-	2	2	-	-	25	25	50	1	NA
PPE324	Minor Project	-	-	2	2	-	-	50	-	50	1	NA
	Total of semester-V	22	-	10	32	110	440	175	75	800	27	-
Sub No.	SEMESTER-VI	Contact Hrs / Week				Examination Scheme						
	Subject	L	T	P	Total	CT	TH	TW	P	Total	Credits	Duration of Theory Exam
PPE351	Polymer Processing Technology	4	-	-	4	20	80	-	-	100	4	3 Hrs
PPE352	Elastomer Technology	4	-	-	4	20	80	-	-	100	4	3 Hrs
PPE353	Mass Transfer	4	-	-	4	20	80	-	-	100	4	3 Hrs
BSH354	Industrial Management (All)	4	-	-	4	20	80	-	-	100	4	3 Hrs
*	Open Elective-I	4	-	-	4	20	80	-	-	100	4	3 Hrs
PPE355	Polymeric Materials-II	2	-	-	2	10	40	-	-	50	2	2 Hrs
PPE371	Lab-V: Polymer Processing Technology			2	2	-	-	25	25	50	1	NA
PPE372	Lab-VI: Elastomer Technology			2	2	-	-	25	25	50	1	NA
PPE373	Lab-VII: Mass Transfer			2	2	-	-	25	25	50	1	NA
PPE374	Lab-VIII: Design Lab-II			2	2	-	-	50	-	50	1	NA
PPE375	Lab-IX: Project-I			2	2	-	-	-	50	50	1	NA
**	# Audit Course	2	-	-	2	-	-	-	-	-	-	-
	Total of semester-VI	24	-	10	34	110	440	125	125	800	27	-
	Grand Total of V & VI	46	-	20	66	220	880	250	250	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: Term Work P: Practical/Oral Examination

Note: Interested students can opt for any one of the audit course offered by various departments.

#For Audit course, audit pass (NP) and audit fail (NF) grades will be awarded.

Elective-II

Sr. No.	Name of course	Course code
1.	Paint Technology	PPE341
2.	Adhesive Technology	PPE342
3.	Membrane Technology	PPE343

***Open Elective-I**

Sr. No.	Name of course	Department	Course code
1.	Remote Sensing and GIS	AED	AED391
2.	Professional Ethics and Cyber Security	CSED	CSE391
3.	Design for Environment	CED	CED391
4.	Robotics and Automation	EED	EED391
5.	Internet of Things	ETC	ETC391
6.	Costing and Financial Management	MED	MED391
7.	Introduction to Nanotechnology	PPED	PPE391

****Audit Course-I**

Sr. No.	Name of course	Department	Course code
1.	Japanese Language Module	BSH	BSH801
2.	Cyber Crime and Law	CSED	CSE801
3.	Road Safety Management	CED	CED801
4.	Value Education	BSH	BSH802
5.	Smart Cities	ETC	ETC801
6.	Rural Community Engagement	MED	MED801
7.	German Language Module	BSH	BSH803

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-V

Course Code: PPE301
Course: Polymer Rheology and Morphology
Teaching Scheme:
Theory: 4 hrs/week

Credits: 4
Class Test: 20 Marks
Theory Examination: 80 Marks
Theory Examination (Duration): 3 hrs

Objectives	:	To study rheology and morphology of polymers.
Unit-I	:	Introduction to polymer rheology: Overview and importance of rheology, stress, strain, viscosity, modulus, damping parameter, compliance, elasticity, plasticity, viscoelasticity, Newtonian and non-Newtonian fluids, thixotropy and rheopexy, thermal dependence of viscous flow (free volume), Deborah number, Taylor number, Weissenberg effect, die swell, melt and solution rheology. (08 h)
Unit-II	:	Viscoelastic behavior: Linear and non-linear viscoelasticity, correlations of rheological parameters, mechanical models of viscoelastic material (Maxwell model creep and relaxation, Voigt-Kelvin model, Four parameter model), visco-elastic retardation and time, power law, fracture, principles of interfacial rheology. (10 h)
Unit-III	:	Factors affecting shear flow: Introduction, effect of temperature, pressure, stress, strain and frequency on rheological behaviour, linear viscoelastic region, viscosity change during extrusion, effect of molecular structure on viscous flow. (06 h)
Unit-IV	:	Transition phenomena: Identification of phase transition temperatures, glass transition temperature and Sol-Gel transition temperature using rheometer, WLF equation, Time-temperature superposition, Melt fracture and irregular flow. (06 h)
Unit-V	:	Measurement of rheological properties: Classification (rotation and oscillation), capillary rheometer, Mooney viscometer, cone and plate rheometer, parallel plate rheology, Brookfield viscometer, torque rheometer, torsional and extensional rheology, moving die rheometer, rheo-optics, micro-rheology, application of various rheometers, application of rheology in processing. (10 h)
Unit-VI	:	Polymer Morphology: Overview and importance, crystallisation, stress induced crystallisation, melt phase morphology, surface morphology, morphology of cryo-fractured, tensile fractured and torn polymeric materials, correlation between rheology and morphology. (08 h)

Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1	Polymer melt rheology	F. N. Cogswell	Woodhead Publishing Limited	1 st , 1981
		2	Rheometry	K. Walters	Chapman and Hall, London	1 st , 1975
		3.	Flow properties of polymer melt	Brydson. J. George	George Goodwin Ltd., London	1 st , 1981
		4.	Viscoelastic properties of polymers	John D. Ferry	John Willey & Sons	3 rd , 1980
		5	A practical approach to rheology and rheometry	Gebhard Schramm	Gebrueder HAAKE GmbH	2 nd , 2000
		6	Rheology of chemists	J. Goodwin, R. Hughes	RSC Publishing	2 nd , 2008
		7.	Polymer melt rheology	F. N. Cogswell	Woodhead Publishing Limited	1 st , 1981
		8.	Rheometry	K. Walters	Chapman and Hall, London	1 st , 1975
		9.	Flow properties of polymer melt	Brydson. J. George	George Goodwin Ltd., London	1 st , 1981

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

Course Code: PPE302
Course: Polymeric Materials-I
Teaching Scheme:
Theory: 4 hrs/week

Credits: 4
Class Test: 20 Marks
Theory Examination: 80 Marks
Theory Examination (Duration): 3 hrs

Objectives	:	- To provide a general overview on structure- properties- relationship of polymeric materials. - To provide idea thorough understanding and knowledge on properties characteristics and applications of various polymeric materials.
Unit-I	:	Phenolics: Structure-properties relationship, properties and application of resol. Structure-properties relationship, properties and application of novolac. (10 h)
Unit-II	:	Alkyd Resin: Structure-properties relationship, properties and application of alkyd resin. (08 h)
Unit-III	:	Epoxies: Structure-properties relationships, properties and application of epoxies. Overview of curing of epoxies by amine, thiol and acetic anhydride. (06 h)
Unit-IV	:	Amino Resins: A: Urea Formaldehyde: Structure-properties relationships, properties and application of urea formaldehyde. B: Melamine Formaldehyde: Structure-properties relationships, properties and application of melamine formaldehyde. (12 h)
Unit-V	:	Furans: Structure-properties relationships, properties and application of furan polymers. (06 h)
Unit-VI	:	Natural Resins: Structure-properties relationship, properties and application of cellulose and its derivatives (cellulose acetate, cellulose nitrate, carboxymethyl cellulose and viscose rayon), starch, casein, shellac, bituminous plastic. (06 h)

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

		8.	Polystyrene: Synthesis, Production and Applications	J. R. Wunsch	Smithers Rapra Publishing	1 st
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Section A: Includes Unit I, II and III; **Section B:** Includes Unit IV, V and VI.

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For 80 marks Paper:

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The Question no.1 and 6 should be of objective nature.
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Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-V

Course Code: PPE303
Course: Heat Transfer
Teaching Scheme:
Theory: 4 hrs/week

Credits: 4
Class Test: 20 Marks
Theory Examination: 80 Marks
Theory Examination (Duration): 3 hrs

Objectives	:	- To understand the fundamental concepts, modes and laws related to heat transfer. - To understand various heat exchange equipments used industries. - To understand and comprehend the applications in industry.
Unit-I	:	Introduction Modes of heat transfer, fundamental laws used in heat transfer (law of conservation of mass, Newton's laws of motion, laws of thermodynamics). Heat transfer by conduction Fourier's law, Steady state heat conduction; one plane wall of uniform thickness, compound resistances in series, heat flow through cylinder and sphere, systems with variable thermal conductivity, thermal insulation, critical and economic thickness, unsteady state heat conduction, Internal temperature gradient, Biot and Fourier number and its physical significance. (10 h)
Unit-II	:	Heat transfer by convection Free and forced convection, Individual and overall heat transfer coefficient, fouling factor, application of dimensional analysis to heat transfer by convection, empirical correlations for flow across cylinders and spheres, film coefficients in pipes for laminar, turbulent and transitional flow, Wilson plot, empirical correlations for natural convection, momentum and heat transfer analogies. (08 h)
Unit-III	:	Heat transfer by Radiation Concept of black body and grey body, Laws of black body radiation (Kirchhoff's law, Stefan – Boltzmann law, Planck's Law, Wiens Displacement Law), radiative heat transfer coefficient, concept of radiation shield and radiation shape factor, application of radiation in industries. (06 h)
Unit-IV	:	Heat transfer of fluid with phase change Heat transfer to Boiling liquids, Pool boiling of saturated liquid, correlations in pool boiling heat transfer, drop-wise and film-wise condensation, Nusselt's theory, different regimes of boiling across length of vertical shell and tube reboiler, concept of quenching and its application in polymer industry. (08 h)
Unit-V	:	Heat exchange equipments in Polymer Industry Classification of heat exchangers, Energy balance in heat exchangers, log mean temperature difference, dirt factor, criteria of selection of various heat exchangers in industry, heat transfer through vertical heat exchanger v/s horizontal heat exchanger, selection of heating media in heat exchanger, designing of Double Pipe Heat Exchanger and Shell and Tube Heat Exchanger. (08 h)
Unit-VI	:	Applications of heat transfer in polymer engineering Thermal conductivity standards of plastic, heat transfer coefficient for different polymer processing equipments, cooling in molds-in air and in water, molding defects due to inferior heat transfer rate and remedies. (08 h)

Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Heat Transfer	D. Q. Kern	McGraw Hill Co.	1 st , 2000
		2.	Heat Transfer	J. P. Holman	Mcgraw Hill Company	8 th , 2006
		3..	Heat Transfer: A Practical Approach	Yunus A. Cengel	Mcgraw Hill Company	3 rd , 2007
		4.	Polymer Processing – Principles and Modelling	Jean-François Agassant, Pierre Avenas, Pierre J. Carreau,	Hanser Publications	2 nd , 2017
		5.	Unit Operations of, Chemical Engineering	McCabe & Smith	McGraw Hill Co.	6 th , 2007
		6.	Chemical Engineering Vol I & II	Richardson & Coulson	McGraw Hill Co.	6 th
		7.	Heat Transfer	S. P. Sukhatme	Universities Press	4 th , 2006
		8.	Heat & Mass Transfer	R. K. Rajput	S. Channd	4 th , 2001
Website	:		http://nptel.ac.in , www.cheresources.in			

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

Pattern of Question Paper:

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Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-V Course Code: PPE304 Course: Instrumental Analysis of Polymers Teaching Scheme: Theory: 4 hrs/week Credits: 4 Class Test: 20 Marks Theory Examination: 80 Marks Theory Examination (Duration): 3 hrs		
Objectives	:	- To understand about the mechanisms of different instrumental analysis methods. - To acquire fundamental knowledge about structural characteristics of polymers and correlation to the analysis methods.
Unit-I	:	Introduction to Instrumental Analysis of Polymers: Significance of instrumental analysis of polymers, molecular architecture of polymers, overview and classifications of various characterization techniques in terms of application. (04 h)
Unit-II	:	Spectroscopy: Introduction, basic working principle, strategy of analysis with examples and applications of FTIR (including ATR mode), UV-VIS, NMR (including molecular weight determination from NMR) and Raman spectroscopy. (10 h)
Unit-III	:	X-ray analysis: Introduction, basic working principle, strategy of analysis with examples and applications of XRD (including determination of crystallinity, crystal size and indexing), SAXS and XPS. (10 h)
Unit-IV	:	Chromatography: Introduction, basic working principle, strategy of analysis with examples and applications of HPLC, GPC (with reference to different types of detectors used) and GC-MS. (06 h)
Unit-V	:	Thermal and thermomechanical analysis: Introduction, basic working principle, strategy of analysis with examples and applications of DSC, TGA (including reverse engineering techniques, isothermal and non-isothermal degradation, isothermal DSC in correlation to crystallization characteristics) and DMA (Insight to loss modulus, storage modulus and tan delta). (08 h)
Unit-VI	:	Morphology: Introduction, basic working principle, sample preparation, strategy of analysis with examples and applications of OM, SEM (including EDS analysis and mapping), TEM (including brief introductory idea about SAED, cryo-TEM, tomography), AFM (including examples of current sensing atomic force microscopy and magnetic force microscopy) and introductory idea about STM. (10 h)

Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Undergraduate Instrumental Analysis	James W. Robinson, Eileen M. Skelly Frame, George M. Frame II	Marcel Dekker	2005
		2.	Modern Instrumental Analysis	S. Ahuja, N. Jespersen	Elsevier	2005
		3.	Polymer characterization - laboratory techniques and analysis	Nicholas P. Cheremisinoff	Noyes Publications	1996
		4.	Analytical Methods for Polymer Characterization	Rui Yang	CRC Press	2018
		5.	Characterization of Solid Polymers: New techniques and developments	S.J. Spells	Chapman & Hall	1994
		6.	Spectroscopy of Polymers	Jack L. Koenig	Elsevier	2 nd
		7.	Polymer Characterization by Liquid Chromatography	Gottfried Glockner	Elsevier	1986
		8.	Thermal Analysis Fundamentals and Applications to Polymer Science	T. Hatakeyama, F.X. Quinn	John Wiley & Sons	1999
		9.	Polymer Microscopy	Linda C. Sawyer, David T. Grubb, Gregory F. Meyers	Springer	3 rd

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

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Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-V Course Code: PPE305 Course: Polymer Additives and Compounding Teaching Scheme: Theory: 4 hrs/week Credits: 4 Class Test: 20 Marks Theory Examination: 80 Marks Theory Examination (Duration): 3 hrs		
Objectives	:	To provide understanding of the different additives, formulations and the process of their incorporation in plastics to obtain the best possible properties in the final material/compound.
Unit-I	:	Introduction Introduction, classification of additives, technical requirements for usage of additives in polymer compounding, types of additives used in polymers. (05 h)
Unit-II	:	Fillers Classification of fillers, properties and applications of jute fiber, coir, hemp, glass fiber, aramid fiber, carbon fiber, polymeric fiber, wood, calcium carbonate, talc, wollastonite, clay and silicates. (06 h)
Unit-III	:	Stabilizers, Colorants and Miscellaneous additives a) Stabilizers: Antioxidants, antiozonants, their mechanisms, testing of antioxidants, photodegradation of polymers, UV stabilization: UV absorbers, quenchers, hydro peroxide decomposers, free radical scavengers and heat stabilizers. b) Colorants-Pigments and dyes: White pigments, titanium dioxide, black colorants, azo pigments, non-azo pigments, dyes. c) Miscellaneous Additives: Impact modifiers, blowing and foaming agents, flame retardants, nucleating agents, coupling agents, anti-microbial agents, anti-fogging agents, anti-static agents, metal deactivators, biodegradable additives. (13 h)
Unit-IV	:	Processing aids a) Plasticizers: Plasticizers and anti-plasticizers, mechanism of plasticization and anti-plasticization; petroleum-based process oils-aromatic, naphthenic and paraffinic, synthetic plasticizers and their properties, characteristics and applications; testing of plasticizers. b) Lubricants: Types and effect of lubricants, zinc stearate, waxes, importance. (05 h)
Unit-V	:	Polymer compounding: Process, machinery and devices General objectives: Possibilities and limitations of mixing and compounding, methods of incorporation of additives into polymer materials, batch and internal mixers, continuous mixers, single screw extruder, kneader and co-kneader, modular co-rotating and counter-rotating twin screw extruder, residence time distribution, feeding and feeder, two roll mill, mixing mechanisms. (12 h)
Unit-VI	:	Formulations, Compounding and Quality Control Selecting formulations and compounding of PC/ABS for headlight body applications and polyamide-6 for under the hood products in automotive applications, PVC for FDA approved medical tubing/ wire and cable applications, ABS and PC for ROHS approved electronics body housing and electrical switches applications, Quality Control in testing of compounded polymers, health hazards. (07 h)

Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		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 Hand Book	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	7 th , 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

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

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

Course Code: PPE341
Course: Elective-II: Paint Technology
Teaching Scheme:
Theory: 2 hrs/week

Credits: 2
Class Test: 10 Marks
Theory Examination: 40 Marks
Theory Examination (Duration): 2 hrs

Objectives	:	To ensure effective training in practical and academic skills at an advanced level in various aspects of polymer and surface coatings science and technology.
Unit-I	:	Introduction to Paint Technology: Definition, importance, classification of paint (industrial, decorative, water borne, high solid etc.). (03 h)
Unit-II	:	Surface preparation: Introductory idea about various surface preparation methods such as chemical, electrochemical, mechanical (sand blasting, shot peening, vapor phase degreasing etc.). (03 h)
Unit-III	:	Components used in paint: Binders (acrylic, UF MF, etc.), pigments, pigment properties, different types, factors affecting pigment dispersion, preparation of pigment dispersion, extenders, solvents, Paint processing: sand mill, ball mill, high speed disperser (HSD). (06 h)
Unit-IV	:	Additive used in paint formulation: Definition and use of Wetting and dispersing agents, anti-skin, rheology modifier (flow promoter, sag, leveling agents, shear thickener, shelf stability promoter etc.), mar resistance, anti-foam, anti-settling, corrosion inhibitor, biocide, adhesion promoter and photo-stabilizers. (06 h)
Unit-V	:	Characterization: Viscosity, specific gravity, drying time, hardness (pencil hardness, pendulum harness, scratch hardness etc.), brief idea about rheological, optical and morphological characterization of paint, thermal barrier, corrosion, chemical and weather resistance properties. (03 h)
Unit-VI	:	Advanced Application: Definition and characteristics of super-hydrophobic coating, self-healing coating, thermal barrier coating, smart coating. (03 h)

Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Basics of Paints Technology (Part 1)	V. C. Malshe	Antar Prakash Centre for Yoga	1 st
		2.	Additives for Coatings	J. Bieleman	Wiley-VCH	1 st
		3.	Paint and Surface Coatings	R. Lambourne	Woodhead	2 nd
		4.	Introduction to Paint Chemistry	G. P. A. Turner	CRC Press	4 th
		5.	Outlines of Paint Technology	W. M. Morgans	Wiley	3 rd
		6.	Organic Coating Technology	H. F. Payne	John Wiley & Sons	3 rd

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.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-V Course Code: PPE342 Course: Elective-II: Adhesive Technology Teaching Scheme: Theory: 2 hrs/week Credits: 2 Class Test: 10 Marks Theory Examination: 40 Marks Theory Examination (Duration): 2 hrs		
Objectives	:	To ensure effective training in practical and academic skills at an advanced level in various aspects of adhesive science and technology.
Unit-I	:	Introduction to Adhesive Technology: Introduction to adhesives, role and importance of adhesives, classification, applications. (03 h)
Unit-II	:	Fundamentals of Adhesion: Overview of adhesion, adherent, types of bonds, adhesive joint strengths, interfaces. mechanical, electrostatic, diffusion and wetting theory, weak boundary layer theory, pressure sensitive adhesion, coupling agents. (05 h)
Unit-III	:	Surface Preparation: Introductory idea about various surface preparation methods, surface tension, surface free energy, work of adhesion, contact angle and effect of temperature on surface tension. (04 h)
Unit-IV	:	Natural Adhesive Materials: Animal glue, casein and mixed protein adhesives, starch based adhesives, natural rubber adhesives. (03 h)
Unit-V	:	Synthetic Adhesive Materials: Nitrile Rubber, SBR, carboxylic polymers, polysulfide, phenolic, amino, epoxy, polyurethane, polyvinyl acetate, polyvinyl alcohol, acrylic, polyester and polyamide-based adhesives, silicones, silanes and non-silane coupling agents. (05 h)
Unit-VI	:	Surface and Material Characterization Techniques: Introduction to rheological, optical and morphological characterization of adhesive material, hardness, scratch test, peel test, contact angle measurement, surface roughness, thermal analysis, corrosion test. (04 h)

Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Handbook of Adhesives	Irving Skeist	Chapman & Hall	1 st
		2.	Additives for Coatings	Johan Bieleman	Wiley-VCH	1 st
		3.	Organic Coating Technology	H. F. Payne	John Wiley & Sons	3 rd
		4.	Handbook of Adhesives and Surface Preparation	Sina Ebnesajjad	Elsevier	1 st
		5.	Handbook of Adhesion Technology	Lucas F. M. da Silva Andreas Öchsner Robert D. Adams	Springer-Verlag Berlin Heidelberg	1 st

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.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-V Course Code: PPE343 Course: Elective-II: Membrane Technology Teaching Scheme: Theory: 2 hrs/week Credits: 2 Class Test: 10 Marks Theory Examination: 40 Marks Theory Examination (Duration): 2 hrs		
Objectives	:	- To provide a general overview on Advanced Separation Technology. - To provide idea through understanding and knowledge of Membrane Technology. - To be able to understand the preparation and characterization of membranes for different applications.
Unit-I	:	Overview of Membrane Science and Technology: 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. (04 h)
Unit-II	:	Techniques of Membrane Preparation: Membrane with symmetric structure: Track etching, precipitation from vapour phase, Membrane with asymmetric structure: dry wet phase inversion technique, thermally induced phase separation method. (04 h)
Unit-III	:	Membranes for Separation Processes: Classification of membrane process: microfiltration, ultrafiltration, nanofiltration, reverse osmosis, pervaporation, electrodialysis, dialysis. (04 h)
Unit-IV	:	Membrane Characterization: Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Raman Spectroscopy. (04 h)
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. (04 h)
Unit-VI	:	Applications of Membranes & its maintenance: Application of membranes in bio separation, gas separation, membrane distillation, Biomedical application of membranes and industrial applications RO, UF, ED, MF. Maintenance: 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. (04 h)

Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Chemical Engineering (Vol. 2)	Richardson and Coulson	Butterworth Heinemann Titles	2 nd
		2.	Industrial Membrane Separation Technology	K. Scott and R. Hughes	Blackie Academic & Professional London	1 st , 1981
		3.	Separation Processes	C. J. King	Tata McGraw Hill	
		4.	RO/UF Process, Principle	S. Sourirajan and T. Matsuura	National Research Council, Canada	
		5.	RO and Synthetic Membrane Theory, Technology & Engineering	S. Sourirajan	National Research Council, Canada	
		6.	Handbook of Industrial Membrane Technology	M. C. Portor	Crest Publishing House	2005
		7.	Membrane Technology and Application	R.W. Baker	John Wiley and Sons Ltd.	2004

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.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-V Course Code: PPE321 Course: Lab-I: Polymer Synthesis II Teaching Scheme: Practical: 4 hrs/week Credits: 02 Practical: 50 Marks Term Work: 50 Marks						
Objectives	:	• To prepare various thermoset polymers.				
List of Practical	:	1. Synthesis of Resol 2. Synthesis of Novolac. 3. Synthesis of unsaturated polyester. 4. Synthesis of alkyd resin. 5. Synthesis of Epoxy resin. 6. Analysis of epoxy resin. 7. Synthesis of urea formaldehyde. 8. Synthesis of melamine formaldehyde.				
List of Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Polymer Science & Technology of Plastics & Rubbers	P. Ghosh	Tata McGraw Hill	2 nd
		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	-	1 st
		6.	Principles of Polymerisation	George Odian	Wiley Interscience	4 th

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.

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

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

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-V Course Code: PPE322 Course: Lab II: Instrumental Analysis of Polymers Teaching Scheme: Practical: 2 hrs/week Credits: 01 Term Work: 50 Marks						
Objectives	:	To give an overview to the students about various instruments used for polymer characterization, their working principle, instrumentation and applications.				
List of Practical	:	1. To characterize a polymer through FTIR and analyze the spectrum. 2. To characterize a polymer solution through UV-VIS and analyze the spectrum. 3. To determine T_g and T_m of a polymer through DSC analysis. 4. To study thermal degradation of a polymer through TGA and DTG analysis. 5. To determine crystallinity, crystallite size and lattice strain of a polymer from X-ray diffractogram. 6. To index the peaks of an X-ray diffractogram of a polymer. 7. To analyze scanning electron micrographs of a polymer, polymeric blend and composite. 8. To analyze transmission electron micrographs of a polymer and polymeric composite. 9. To analyze purity of solvent using GC-MS. 10. To analyze purity of solvent using HPLC. At least any 8 experiments from the above-mentioned list of experiments should be performed.				
List of Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Polymer characterization - laboratory techniques and analysis	Nicholas P. Cheremisinoff	Noyes Publications	1996
		2.	Undergraduate Instrumental Analysis	James W. Robinson, Eileen M. Skelly Frame, George M. Frame II	Marcel Dekker	2005
		3.	Modern Instrumental Analysis	S. Ahuja, N. Jespersen	Elsevier	2005
		4.	Analytical Methods for Polymer Characterization	Rui Yang	CRC Press	2018

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.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-V Course Code: PPE323 Course: Lab-III: Heat Transfer Teaching Scheme: Practical: 4 hrs/week Credits: 01 Practical: 25 Marks Term Work: 25 Marks						
Objectives	:	• To prepare various thermoset polymers.				
List of Practical	:	1. Determination of thermal conductivity of insulating powder. 2. Determination of thermal resistances of a composite wall. 3. Conduction analysis of single and double material sphere. 4. Determination of heat transfer coefficient by forced convection. 5. Determination of heat transfer coefficient by natural convection. 6. To determine the overall heat transfer coefficient (U) in the parallel flow heat exchanger. 7. To determine the overall heat transfer coefficient (U) in the counter flow heat exchanger. 8. Determination of heat transfer coefficient in double pipe heat exchanger. 9. Determination of Stefan Boltzmann constant in Radiation. At least any 8 experiments from the above-mentioned list of experiments should be performed.				
List of Reference Books:	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Heat Transfer: A Practical Approach	Yunus A.Cengel	Mcgraw Hill Company	3 rd , 2007
		2.	Chemical Engineering Vol I & II	Richardson & Coulson	Mcgraw Hill Company	6 th
		3.	Unit Operations of, Chemical Engineering	McCabe & Smith	McGraw Hill Co	6 th , 2007
		4.	Heat Transfer	S. P. Sukhatme	Universities Press	4 th , 2006

The assessment of term work shall be done on the basis of the following. 1. Continuous assessment.

- Performing the experiments in the laboratory.
- 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

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

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

(Faculty of Science & Technology)

Syllabus of T. Y. B. Tech. (All) Semester-V

Course Code: PPE324

Course: Minor Project

Teaching Scheme:

Practical: 2 hrs/week

Credits: 01

Term Work: 50 Marks

Objectives	:	• To plan for various activities of the project and distribute the work amongst team members. • To develop the ability to define and design the problem and lead to its accomplishment with proper planning. • To understand the importance of document design by compiling Technical Report on the Minor Project work carried out. • To develop student's abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Minor Project.
Guidelines	:	1. Students should select a problem which addresses some basic home, office or other real life applications. 2. Projects which will address the social issues will be given due weightage. 3. It is desirable that the systems developed by the students have some novel features. 4. The batch size shall not exceed TWO students per batch. 5. The students have to select a suitable problem, design, prepare the drawings, produce the components, assemble and commission the project. 6. Institute may arrange demonstration with poster presentation of all mini projects developed by the students at the end of semester. 7. At the end of the semester, the students have to prepare and present 20-25 pages project report. 8. Final evaluation shall be based on continuous internal assessment followed by Viva-Voce.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-VI Course Code: PPE351 Course: Polymer Processing Technology Teaching Scheme: Theory: 4 hrs/week Credits: 4 Class Test: 20 Marks Theory Examination: 80 Marks Theory Examination (Duration): 3 hrs		
Objectives	:	To impart the understanding of various polymer processing techniques considering the equipment, material behavior, processing parameters etc.
Unit-I	:	Injection Moulding Introduction, basic components and processes, types of machines, machine specification and rating, materials, drying, moulding cycle, co-injection moulding, gas/water assisted injection moulding, advantages and limitations of the process, troubleshooting and safety measures, process parameters and their effects on product quality, Injection molding of thermosets. (14 h)
Unit-II	:	Compression Moulding Introduction, basic process, moulding cycle, moulding materials, bulk factor, process parameters, types of molds, advantages and limitation of process, troubleshooting. (05 h)
Unit-III	:	Transfer Moulding Introduction, basic process, moulding cycle, moulding materials, types of machines, process parameters and their effect on product quality, troubleshooting. (05 h)
Unit-IV	:	Extrusion Introduction, components of extrusion and extruder screw, process, materials, extruder output, extrusion blown film, sheet extrusion, pipe extrusion, process parameters & their effects on product quality, Mixing sections, co-extrusion, troubleshooting, twin screw extruder. (12 h)
Unit-V	:	a) Rotational Moulding Introduction, basic process, material, process parameters, cycle time, types of machines, process parameters & their effects on product quality, material flow, advantages & disadvantages, troubleshooting. (04 h) b) Calendering Introduction, material, process, types of calendar roll, process parameters, film and sheet lines, Advantages, disadvantages, troubleshooting. (03 h)
Unit-VI	:	Blow Moulding Introduction, basic process, materials, parison, wall thickness control, Extrusion blow moulding, Injection blow moulding, stretch blow moulding, process parameters and their effects on quality of product, advantages & disadvantages, troubleshooting. (05 h)

Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Plastics Engineering Handbook	J. Frados	Van Nostrand Reinhold Company	4 th , 2007
		2.	Plastics Processing Handbook	A. S. Athalye	Colour Publications (Pvt.) Ltd.	1 st , 2002
		3.	SPI Plastics Engineering Handbook	Michael Berins	Springer	5 th , 1991
		4.	Principles of Polymer Processing	A. Tadmor and C. G. Gagos	John Wiley & Sons, New York,	2 nd , 2006

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 (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-VI Course Code: PPE352 Course: Elastomer Technology Teaching Scheme: Theory: 4 hrs/week Credits: 4 Class Test: 20 Marks Theory Examination: 80 Marks Theory Examination (Duration): 3 hrs		
Objectives	:	• To understand different terminologies associated to elastomer technology. • To acquire fundamental knowledge about natural and synthetic rubbers, their structures, basic characteristics and applications. • To gain knowledge about compounding of elastomers. • To acquire knowledge about vulcanization of rubbers.
Unit-I	:	Introduction to Elastomers: Different terminologies, molecular structures, classifications (natural and synthetic, general purpose and special purpose, polar and non-polar), basic characteristics and miscellaneous applications of rubbers. (02 h) Testing of Rubbery Materials: Brief idea about the principles of dry rubber content, total solid content, non-rubber content, crosslink density, die swell, tensile strength, tear strength, hardness, abrasion resistance, resilience, compression set, plasticity retention index, heat build-up and gas barrier property measurement. (06 h)
Unit-II	:	Natural Rubber: Brief overview of natural rubber latex, composition, tapping and related notations, coagulation, latex preservation, concentration process of latex, processing of latex, different grades (RSS, SMR, ISNR), crepe rubber, properties and applications. (04 h) Derivatives of Natural Rubber: Brief discussion on preparation, properties and applications of oil extended, epoxidized, cyclized, deproteinized, chlorinated natural rubber and ebonite. (04 h)
Unit-III	:	Non-polar Rubber: Structure, synthesis reaction, grades, properties, processing and applications of IR, BR, SBR, IIR and EPDM rubber. (08 h)
Unit-IV	:	Polar Rubber: Structure, synthesis reaction, grades, properties, processing and applications of CR, NBR, CSM and silicone rubber. (08 h)
Unit-V	:	Rubber Compounding: Vulcanization, curing agents, accelerators, fillers (carbon black and silica), vulcanization methods, systems and techniques, roles of different additives, compounding formulation, analysis of rheo-curve. Calculation of induction time, scorch time, optimum cure time, cure rate and cure index. Calculation of density of compound and amounts of components required for a compounding formulation. Calculation based on volume-cost concept. (12 h)
Unit-VI	:	Thermoplastic elastomer: Fundamental idea about thermoplastic elastomer (TPE) and thermoplastic vulcanizates (TPV). Methods of preparation (static and dynamic vulcanization), structure, properties and applications of thermoplastic elastomers. TPE blend (with the example of PP/EPDM). (04 h)

Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Rubber Technology	Maurice Morton	Van Nostrand Reinhold	1987
		2.	Rubber Technology and Manufacture	C. M. Blow	Butterworths for the Institution of the Rubber Industry	1971
		3.	Handbook of Elastomers	Anil K. Bhowmick, Howard Stephens	CRC Press	2 nd , 2000
		4.	Rubber Engineering	Indian Rubber Institute	McGraw Hill, India	1998
		5.	Physical Testing of Rubber	Roger Brown	Springer	4 th

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

Course Code: PPE353
Course: Mass Transfer
Teaching Scheme:
Theory: 4 hrs/week

Credits: 4
Class Test: 20 Marks
Theory Examination: 80 Marks
Theory Examination (Duration): 3 hrs

Objectives	:	- To understand the fundamental concepts of mass transfer principles and apply these concepts to real engineering problems. - To get acquainted with the design of continuous contact and stage wise operations. - To provide theoretical understanding of various mass transfer operations such as diffusion, vapor-liquid, liquid-liquid and gas-liquid systems and drying.
Unit-I	:	Introduction to mass transfer and molecular diffusion: Introduction and various mass transfer operations, classification of mass transfer operations, Ficks law, molecular diffusion in gases and liquids, types of diffusion, diffusion in solids and its applications. (08 h)
Unit-II	:	Interphase mass transfer and mass transfer coefficients: Equilibrium, diffusion between phases, local and average phase /overall mass transfer coefficients, mass transfer coefficients in laminar and turbulent flow, theories for mass transfer: film theory, penetration theory, surface renewal theory, boundary layer theory. (08 h)
Unit-III	:	Absorption: Introduction, Ideal liquid solutions, material balance for one component transferred in countercurrent and cocurrent flow, counter current multistage operation, equipment for gas liquid operations. (08 h)
Unit-IV	:	Distillation: Vapour – liquid equilibria, Raoult's law, differential distillation and equilibrium distillation, steam distillation, azeotropic distillation, extractive distillation, fractionation, graphical methods for estimation of number of stages required in distillation column by McCabe Thiele method, minimum reflux ratio, optimum reflux ratio, effect of feed conditions on number of plates for separation, concept of HETP. (10 h)
Unit-V	:	Liquid liquid Extraction: Introduction, equilateral triangular coordinates, single stage extraction, calculation of number of equilibrium stages for cocurrent and countercurrent multistage contacting, rotary disc contactors. (08 h)
Unit-VI	:	Drying: Constant rate and falling rate periods, equilibrium moisture contents, mechanism of batch drying continuous drying, time required for drying, drying equipments: rotary dryers, drum dryers. (06 h)

Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Mass Transfer Operation	R. E. Trybel	Mcgraw Hill Company	3 rd
		2.	Chemical Engineering Vol I & II	Richardson & Coulson	Mcgraw Hill Company	6 th
		3.	Unit Operations of Chemical Engineering	McCabe & Smith	Mcgraw Hill Company	7 th
		4.	Principles of mass transfer and separation processes	Binay Dutta	PHI learning Pvt.Ltd, New Delhi	
		5.	Unit Operations of Chemical Engineering vol 1 & 2	P. Chattopadhyay	Khanna Publishers, New Delhi	
Website	:		http://nptel.ac.in/courses/103103034			

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 (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (All) Semester-VI		
Course Code: BSH354 Course: Industrial Management Teaching Scheme: Theory: 4 hrs/week Credits: 4 Class Test: 20 Marks Theory Examination: 80 Marks Theory Examination (Duration): 3 hrs		
Objectives	:	- Students should understand concept of management. - Students should understand human resource management, production management, marketing management, financial management and quality management. - Students should understand modern management techniques.
Unit-I	:	Basics of Management: Introduction: Definition of Management, Characteristics of management, functions of Management – planning, Organizing, Staffing, Directing, Coordinating, Controlling, Motivation, Communication, Decision Making, Principles of management – F. W. Taylor, Henry Fayol, Elton Mayo, Administration and Management, Nature of Management, Levels of Management, Managerial skills, managerial roles, Forms of organization, Line, Line-staff etc. Forms of ownership – Partnership, Proprietorship, joint stock, cooperative society, Government sector etc., concept of globalization. (08 h)
Unit-II	:	Human Resource Management: Objectives of HRM, Strategic importance of HRM, Challenges to HR Professionals, Roles and responsibilities of HR professionals, Human resources planning, talent acquisition, recruitment and selection, Career Planning & Management, Training & Development, discipline and disciplinary action, executive development, need and benefits of good HR policy. (08 h)
Unit-III	:	Purchase & Stores Management: Materials Function, Purchasing or Procurement, buying techniques, purchase procedure, vendor selection, vendor rating. Stores management: Introduction to Stores Management, Stores and material control, Receipt and issue of Materials, Concept of inventory control & its objectives, EOQ, ABC analysis, Material Requirement Planning. (08 h)
Unit-IV	:	Production and Quality Management: Types of production, Functions of Production Planning & Control, Plant location and layout, Method Study. Inspection, types of inspection, difference between inspection and quality control, sampling inspection statistical quality control, quality circles, reliability concept. (08 h)
Unit-V	:	Marketing Management & Financial Management: Marketing Management: Introduction, the sales concept, sales vs marketing, market research, sales forecasting, and channels of distribution, pricing. Financial Management: Introduction to financial management, types of capital, sources of finance, assets and Liabilities, factors affecting requirement of working capital, return on investment. (08 h)

Unit-VI	:	Modern Management Techniques: Kaizen, Flexible Manufacturing System, Just in Time, Lean Manufacturing, Total Productive Maintenance, Supply Chain Management, Agile Manufacturing, Six Sigma, Management Information System. (08 h)
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Reference Books	:	1. O. P. Khanna, “Industrial Engineering and Management”, 2nd Edition, Dhanpat Rai, 2004. 2. Korgaonkar M.G. ‘Just In Time Manufacturing’, Laxmi Publication. 3. Besterfield Dale H., Besterfield Carol, Total Quality Management 3rd Edn. 4. Chopra Sunil, Meindl Peter, Kalra D.V., Supply Chain Management : Strategy Planning & Operation 6th Edn., Pearson. 5. S. S. Patil & N K Hukeri, Industrial Engineering and Production and Operations Management, Electrotech Publication 6. S. Sadagopan, Management Information System, PHI Learning. 7. Craig W Baird, The six Sigma Manual for small and Medium Business.
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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 (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (All) Semester-VI		
Course Code: ADE391 Course: Open Elective-I: Remote Sensing and GIS Teaching Scheme: Theory: 4 hrs/week		
Credits: 4 Class Test: 20 Marks Theory Examination: 80 Marks Theory Examination (Duration): 3 hrs		
Objectives	:	• To develop applications of environmental remote sensing and GIS which can directly enhance service delivery on land use management, ground water management/prospects, agriculture, forestry, food and water security, disaster management. Present subject is designed for fulfillment of following objectives • To understand the fundamental principles and applications of Remote Sensing and Geographical Information Systems. • To increase awareness about RS and GIS among students for various researches pertaining to watershed management. • To describe how geographical information is used and managed.
Unit-I	:	Remote Sensing: Definition, Historical Development, remote sensing system, Multi concept of remote sensing. Advantages and disadvantages in remote sensing, general applications of remote sensing (Descriptive & Analytical) (08 h)
Unit-II	:	Electromagnetic radiation: Electromagnetic energy, energy interaction with atmosphere and earth surface, resolutions in remote sensing. (08 h)
Unit-III	:	Sensors and Platforms: Classification, Land observation satellites, Weather satellites, Satellite data reception, transmission and processing, Data products, Standard products, Digital data products, (Descriptive & Analytical). (08 h)
Unit-IV	:	Image interpretation: Procedure, elements, techniques, equipments for image interpretation, basic principles of image interpretation, factors governing the quality of an image, factors governing interpretability, visibility of objects, digital image processing, digital image, steps, remote sensing in agriculture progress and prospects, microwave radiometry for monitoring agriculture crops and hydrologic forecasting, aerial photo interpretation for water resources development and soil Conservation survey. (Descriptive & Analytical). (08 h)
Unit-V	:	Geographical Information System: History of development of GIS definition, basic components, GIS input data and output product, general application. (Descriptive & Analytical). (08 h)
Unit-VI	:	GIS data: Type, representation, source, data sets, acquisition, data structure, data base management systems (DBMS), GIS application. (Descriptive & Analytical). (08 h)

Reference Books	:	1. Remote sensing and Geographical Information System by A. M. Chandra & S. K. Ghosh, Narosa Publishing House, New Delhi. 2. Remote Sensing- Principals and Applications by B. C. Panda, Viva book Publication, New Delhi. 3. Basics of Remote Sensing & GIS by S. Kumar, an online book published by Laxmi Publications, New Delhi. 4. Remote Sensing & GIS by Basudeb Bhatta, an online book published by OUP India.
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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 (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (All) Semester-VI		
Course Code: CSE391 Credits: 4 Course: Open Elective-I: Professional Ethics and Cyber Security Class Test: 20 Marks Teaching Scheme: Theory Examination: 80 Marks Theory: 4 hrs/week Theory Examination (Duration): 3 hrs		
Objectives	:	• To make students familiar with the fundamental concepts of computer ethics. • To know the linkage between computer, professional ethics and ethical decision making • To know the ethical concepts and ethical theories • To Know the privacy and cyberspace • To know concept of cyber security. • To know the practice of administering using Cyber Security.
Unit-I	:	Introduction: Why Computer Ethics? The Standard Account: New Possibilities, a Vacuum of Policies, Conceptual Muddles• An Update to the Standard Account. Ethical Decision making: Ethical dilemma, Guidelines for dilemma (Formal and Informal), Solving ethical dilemma, Socio technical Computer Ethics, Micro- and Macro-Level Analysis, Intellectual Property: Copy right, Trade mark, Trade Secret, Patent (08 h)
Unit-II	:	Professional Ethics, Codes of Conduct, and Moral Responsibility: Professional Ethics: Profession, Professional, Computer/ IT Professional, Computer/IT Professionals Special Moral Responsibilities: Safety-Critical Software, Professional Codes of Ethics and Codes of Conduct: Purpose of Professional Codes, Criticisms of Professional Codes, Defending Professional Codes, Conflicts of Professional Responsibility: Employee Loyalty and Whistle-Blowing, Whistle-Blowing Issues, Strategy for Understanding Professional Responsibility. (08 h)
Unit-III	:	Ethical Concepts and Ethical Theories: Establishing and Justifying A Moral System. Ethics and Morality: Morality, Rules and Principles of a Moral System, Ethical Theories: Consequence-Based: Utilitarianism, Duty-Based: Deontology, Contract-Based, Rights-Based Contract, Character-Based: Moral Person vs. Following Moral Rules, Acquiring the “Correct” Habits, Integrating Aspects of Classical Ethical Theories into a Single Comprehensive Theory: Moor’s Just-Consequentiality Theory and Its Application to Cyber technology. (08 h)
Unit-IV	:	Privacy and Cyberspace Cyber technology Unique or Special, Personal Privacy: Accessibility Privacy, Decisional Privacy, Informational Privacy, Comprehensive Account of Privacy, Privacy as “Contextual Integrity”, Privacy Important: Intrinsic Value, Social Value. Gathering Personal Data: Dataveillance Techniques, Internet Cookies, RFID Technology, Cyber technology and Government Surveillance, Exchanging Personal Data: Merging Computerized Records, Matching Computerized Records. Protecting Personal Privacy in Public Space: Search Engines and the Disclosure of Personal Information, Accessing Online Public Records. (08 h)
Unit-V	:	Security Basics Security Basics: Introduction, Elements of Information security, Security Policy,

		Techniques, steps, Categories, Operational Model of Network Security, Basic Terminologies in Network Security. Intrusion and Firewall: Introduction, Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges, Firewall Introduction, Characteristics and types, Benefits and limitations. Trusted Systems, Access Control. (08 h)
Unit-VI	:	Security perspective of Hacking and its counter majors: Remote connectivity and VoIP hacking, Wireless Hacking, Mobile Hacking, Hacking Hardware, Application and data Hacking, Mobile Hacking, Counter majors: General Strategies, Example Scenario's: Desktop, Servers, Networks, Web, Database, Mobile. (08 h)

Reference Books	:	1. Computer Ethics by Deborah Johnson, 4 th edition. 2. Ethics and Technology Controversies, Questions, and Strategies for Ethical Computing by HERMAN T. TAVANI, 4 th Edition, Wiley. 3. Dr. V.K. Pachghare, Cryptography and Information Security, PHI, ISBN 978-81-303-5082-3. 4. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, ISBN:978-81-345-2179-1.
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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

(Faculty of Science & Technology)

Syllabus of T. Y. B. Tech. (All) Semester-VI

Course Code: CED391

Course: Open Elective-I: Design for Environment

Teaching Scheme:

Theory: 4 hrs/week

Credits: 04

Class Test: 20 Marks

Theory Examination: 80 Marks

Theory Examination (Duration): 3 hrs

Objectives	:	This course has been designed to teach about environmental engineering, energy and economy through the use of case studies, computer software tools, and seminars from the point of view of sustainable development and changing societal, industrial demands. Case studies provide the basis for group projects as well as individual theses
Unit-I	:	Review of physical, chemical, ecological, and economic principles used to examine interactions between humans and the natural environment. Modeling concepts, applications in all engineering domains. (7 h)
Unit-II	:	Mass balance concepts are applied to ecology, chemical kinetics, hydrology, and transportation; energy balance concepts are applied to design, ecology, and climate change; and economic and life cycle concepts are applied to resource evaluation and engineering design. (7 h)
Unit-III	:	Design for Environment (DfE) concepts, applications, and Case studies. (10 h)
Unit-IV	:	Assessment, Monitoring and control of Rural, Urban and Industrial Pollutions using CDTs (8 h)
Unit-V	:	Numerical models are used to integrate concepts and to assess environmental impacts of human activities. Problem sets involve development of MATLAB and GIS models for engineering applications in all domains. (8 h)
Unit-VI	:	Emphasis on the principles of infrastructure planning with a focus on appropriate and sustainable technologies incorporating technical, socio-cultural, public health, and economic factors into the planning and design of urban, industrial systems. (8 h)

Reference Books:	:	1. Ecological Water Quality (Water Treatment and Reuse) – Kostas Voudouris and Dimitra Voutsas. 2. Wastewater Engineering- Metcalf and Eddy, McGraw Hill Publication. 3. MATLAB for Engineering Application- Williams J. Palm, Tata McGraw Hill Publication. 4. Application of GIS and Remote Sensing in Environmental Management- S. A. Abbasi, DPH Publications. 5. Harte, John "Consider a Cylindrical Cow: More Adventures in Environmental Problem Solving." Mill Valley, CA: University Science Books, 2001. 6. Fay, James A., and Dan S. Golomb. Energy and the Environment. New York, NY: Oxford University Press, 2002 7. Etter, Dolores. Introduction to MATLAB for Engineers and Scientists. Upper Saddle River, NJ: Prentice Hall, 1996 8. Etter, Dolores, David Kuncicky, and Holly Moore, "Engineering Problem Solving with MATLAB" . Upper Saddle River, NJ: Prentice Hall, 2006. 9. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous "Environmental Engineering" Mcgraw Higher Ed. ISBN: 9789351340263
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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.

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

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 (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (All) Semester-VI Course Code: EED391 Course: Open Elective-I: Robotics and Automation Teaching Scheme: Theory: 4 hrs/week Credits: 4 Class Test: 20 Marks Theory Examination: 80 Marks Theory Examination (Duration): 3 hrs		
Objectives	:	- Describe the history and early beginnings of automated manufacturing & Robotics. Ability to recognize industrial control problems. - Aims to Develop understanding Robotics Components. - Apply creative approaches to practical applications, identify technological opportunities in robotics. - An over view of technology of advanced topics such as CNC Machines, Human Robot Interaction. - The ability to provide Automation solution.
Unit-I	:	Introduction to Automation: Types of Automation; Architecture of Industrial Automation Systems, Advantages and limitations of Automation, Effects of modern developments in automation on global competitiveness. Introduction of CNC Machines: Basics and need of CNC machines, NC, CNC and DNC (Direct NC) systems, Structure of NC systems, Applications of CNC machines in manufacturing, Advantages of CNC machines. (08 h)
Unit-II	:	Robotics: Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems Hydraulic, Pneumatic and Electric system. (08 h)
Unit-III	:	Robot Transformation, Sensors & End effectors: Transformation types: 2D, 3D. Translation- Homogeneous coordinates multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors Robotic vision sensor-Force sensor-Light sensors, Pressure sensors End effectors: Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers- Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems. (08 h)
Unit-IV	:	Kinematics: Rigid body Kinematics, Inverse Kinematics, Rotation matrix, Homogenous transformation matrix, Denavit - Hartenberg convention, Euler angles, RPY representation, Direct and inverse Kinematics for industrial robots for position and orientation Redundancy, Manipulator, Jacobian Joint, End effector, velocity – direct and inverse velocity analysis. Control: Individual joint computed torque. (08 h)
Unit-V	:	Dynamics: Lagrangian Dynamics, link inertia tensor and manipulator inertia tensor, Newton-Euler Dynamics of Robot, Newton-Euler formulation for RR & RP manipulators, Dynamics of systems of Interacting Rigid Bodies, D-H Convention, Trajectory planning for Flexible Robot, Cubic polynomial linear segments with parabolic blending, static force and moment transformation, solvability, stiffness, Singularities. (08 h)

Unit-VI	:	Robot Control & Applications 6L Control approaches: Oscillatory based time varying control law, control law based on vector field orientation approach. Advanced strategies of control: conventional aerial vehicle, Bidirectional X4-flyer. Applications of Fuzzy Logic and Neural network in Robot Control, Neural controllers, Implementation of Fuzzy controllers: Trajectory tracking controller. Applications of Robotic system: complex control system, vision system in complex control system. Human Robot Interaction: Architecture. (08 h)
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Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Robotics and Automation Handbook	Thomas R. Kurfess,	CRC Press	2004, ISBN 0- 8493-1804-1
		2.	Robotics: Appin Knowledge Solutions (Firm)		Infinity Science Press	2007, ISBN 978-1934015-02-5
		3.	Robot Motion and Control (Recent Developments)	M.Thoma & M. Morari		2018
		4.	Welding Robots - Technology, System Issues and Applications	J. Norberto Pires, Altino Loureiro and Gunnar Bölmsjö	Springer-Verlag	2006, ISBN-10:1852339535
		5.	Robotics: Designing the Mechanisms for Automated Machinery	Ben-Zion Sandler,	Academic Press,	2 nd , 1999

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 (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (All) Semester-VI	
Course Code: ETC391 Course: Open Elective-I: Internet of Things Teaching Scheme: Theory: 4 hrs/week	
Credits: 4 Class Test: 20 Marks Theory Examination: 80 Marks Theory Examination (Duration): 3 hrs	
Objectives	: • To understand IOT value chain structure (device, data cloud), application areas and technologies involved • To understand IOT sensors and technological challenges faces by IoT devices. • Explore and learn about Internet of things with the help of projects.
Unit-I	: Introduction to IoT: Definition of IOT- Evolution of IOT and related terms, hardware, software, network stack for IoT, Business Scope, SAAS Model, Industry 4.0. (08 h)
Unit-II	: Elements of IoT: Introduction to elements of IOT, Basic Architecture of an IOT application sensors, and Actuators – Edge Networking (WSN) – Gateways – IOT Communication Model – WPAN and LPWA, 6LoPAN, Sigfox, Introduction to basis looping and conditional statements, basics of HTML. (08 h)
Unit-III	: IoT Sensors: Node MCU ESP 8266- hardware specification, GPIO programming, WIFI connectivity programming, Access Point Programming. (08 h)
Unit-IV	: Communication and Connectivity Technologies: Introduction to: TCP/IP, UDP, NTP, MQTT, Network and Sockets, WIFI. Cloud Computing in IOT - IOT Communication Model – Cloud Connectivity, Things speak, ‘100’, HCR. (08 h)
Unit-V	: Data Analytics and IOT Platforms: Basics of statistics, Descriptive statistics and probability distributions. Big Data Analytics - Hadoop, Data Visualization – radar charts, – IOT Platforms- Microsoft Azure and Amazon Web Services, IBM Watson, Google Home and Amazon’s Alexa. (08 h)
Unit-VI	: Preparing IoT Projects: (Creating the sensor project with Node MCU ESP 8266 - Sensor libraries - Interacting with the hardware, Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data - Creating the actuator project Hardware - Interfacing the hardware - Creating a controller - Representing sensor values - Parsing sensor data - Calculating control states. (08 h)

Reference Books	:	Text Books: • The Internet of Things: Applications and Protocols, Wiley publications. Author(s): Oliver Hersent, David Boswarthick, Omar Elloumi. • Architecting the Internet of Things, Springer publications. Author(s): Dieter Uckelmann, Mark Harrison, Florian Michahelles. • Internet of Things with Arduino Cookbook, Packt Publications. Author(s): Marco Schwatz. Reference Books: • Internet of Things and Data Analytics, Wiley.
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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 (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (All) Semester-VI	
Course Code: MED391 Course: Open Elective-I: Costing and Financial Management Teaching Scheme: Theory: 4 hrs/week	Credits: 4 Class Test: 20 Marks Theory Examination: 80 Marks Theory Examination (Duration): 3 hrs
Objectives	: • To understand the basic concepts and processes used to determine product costs. • To be able to analyze and evaluate information for cost ascertainment, planning, control and decision making, and • To develop ability to analyze and interpret various tools of financial analysis and planning, • To gain knowledge of management and financing of working capital. • To understand concepts relating to financing and investment decisions.
Unit-I	: Costing: Methods of costing and elements of cost. Material Cost: Different methods of pricing of issue of materials. Labour Cost: Different methods, wages and incentive plans. Principles of good remunerating system, labour turnover. Depreciation: Concept, importance and different methods of depreciation. (08 h)
Unit-II	: Overheads: Classification, collection of overheads, Primary and Secondary apportionment of overheads, absorption of overheads- Machine hour and labour hour rate. Under and over absorption of overheads. (08 h)
Unit-III	: Standard Costing: Concept, development and use of standard costing, variance analysis. Marginal Costing: Use of Marginal Costing in decision-making. Capital Budgeting: Control of Capital Expenditure, techniques of capital budgeting –Pay Back Method, Accounting rate of return, Internal Rate of Return, DCF, Net Present Value and profitability index. (08 h)
Unit-IV	: Introduction to Financial Management: Concept of business finance, Goals & objectives of financial management, Sources of financing - LONG TERM: shares, debentures, term loans, lease & hire purchase, retained earnings, public deposits, bonds (Types, features & utility), SHORT TERM: bank finance, commercial paper, trade credit & bills discounting, INTERNAL: Retained earnings, Cost of Capital & Means of Finance. (08 h)
Unit-V	: Financial Statement Preparation, Analysis & Interpretation: Preparation of financial statement and Profit & Loss Account, Balance Sheet. Ratio Analysis: Classification, Ratio Analysis and its limitations, Index Statement & Common Size Statement. (08 h)

Unit-VI	:	Working Capital Management: Concept and design of Working Capital, types of working capital, sources of working capital, Time value of money, definition of cost and capital, Cash management, creditors management, debtors management. (08 h)
Reference Books	:	1. Bhattacharya A. K., “Principles and Practice of Cost Accounting”, Prentice Hall India. 2. B K Bhar, “Cost Accounting – Methods and Problems”, Academic Publishers. 3. Khan M. Y., Jain P. K., “Financial Management”, Tata McGraw Hill. 4. Pariasamy P., “Financial, Cost & Management Accounting”, HH Publication.
Text Books	:	1. Colin Drury, “Management and Cost Accounting”, English Language Book Society, Chapman and Hall London. 2. Tulsian P. C., “Financial Management”, S. Chand.

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 (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (All) Semester-VI		
Course Code: PPE391 Course: Open Elective-I: Introduction to Nanotechnology Teaching Scheme: Theory: 4 hrs/week		Credits: 4 Class Test: 20 Marks Theory Examination: 80 Marks Theory Examination (Duration): 3 hrs
Objectives	:	• To study the introduction to nanomaterials and the factors affecting it. • To study the types and synthesis methods of nanomaterials. • To study the characterizations and properties of nanomaterials. • To study the different applications of nanomaterials.
Unit-I	:	Introduction: Introduction to nanotechnology, conventional micro vs. nano-material properties, role of size in properties of nano-materials, length scale and surface to volume concept, and uniqueness of nanostructured materials; health hazards and handling of nanomaterials. (04 h)
Unit-II	:	A) Types of Nano-Materials: Montmorillonite, Layer double hydroxide (LDH), Carbon nanofibers (CNFs) – vapour grown carbon fibers (VGCFs), Polyhedral Oligomeric Sisoquioxane (POSS), Carbon nanotubes, Nanosilica, Nanoaluminium oxide, Nanotitanium oxide, Nano-hybrids. (04 h) B) Synthesis: Bottom-up and Top-down approach for nano materials synthesis, Methods: Ball Milling, Chemical vapor deposition, Pressure vapor deposition, Ultrasound assisted, Minimulsion, Microemulsion, Nanoemulsion, Hydrothermal, Sol-gel, Miscellaneous techniques. (08 h)
Unit-III	:	Properties of Nanomaterials in terms of Structure Property Relationship: Thermal properties, Mechanical properties, Gas barrier properties, Flame retardant properties, Electrical and electrochemical properties, Electronic properties, Optical properties, Magnetic properties, Biodegradable properties, Antimicrobial properties, Catalytic properties. (08 h)
Unit-IV	:	Preparation of Polymer Nanocomposites: Solution intercalation, Melt intercalation, Roll Milling, Emulsion Polymerization, In-Situ Polymerization. (06 h)
Unit-V	:	Characterization of Nanomaterials and Nanocomposites: X ray diffraction (XRD), Dynamic light scattering (DLS), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Energy dispersive x-ray spectroscopy (EDS), Atomic force microscopy (AFM), Small angle X ray scattering (SAXS), Differential scanning calorimetry (DSC), Thermo gravimetric analysis (TGA). (10 h)
Unit-VI	:	Application of Nanomaterials and Nanocomposites: Biomedical-Drug delivery, Bone replacement; Sensors – gas sensor, Metal adsorption and recovery, Bio-molecule detectors; Energy storage and conversion - Super capacitors, Solar cells, Energy generators; Electronics; Self-cleaning and Self-healing paints, Nano-engineering of cement-based materials, Agricultural Nanotechnologies. (08 h)

Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Polymer Nanocomposites Processing, Characterization, and Applications	Joseph H. Koo	McGraw-Hill Nanoscience and Technology Series	1 st , 2006
		2.	Encyclopedia of Nanoscience and Nanotechnology	Hari singh Nalwa	American Scientific publishers	-
		3.	Nanoparticle Technology Handbook	M Hosokawa, K Nogi, M Naito, T Yokoyama	Elsevier	-
		4.	The Science of Nanotechnology: An introductory text	Luanne Tilstra et al	Nova Science Publishers, Inc.	-
		5.	Polymer-Layered Silicate and Silica Nanocomposites	Y.C. Ke, P. Stroeve	Elsevier	2005
		6.	Nanotechnology in concrete – A review	Florence Sanchez, Konstantin Sobolev	Construction and Building Materials, Elsevier	24 (2010) p. 2060 –2071
		7.	Agricultural Nanotechnologies: What are the current possibilities?	Claudia Parisi et al	Nano Today, Elsevier	2014

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

Course Code: PPE355
Course: Polymeric Materials-II
Teaching Scheme:
Theory: 2 hrs/week

Credits: 2
Class Test: 10 Marks
Theory Examination: 40 Marks
Theory Examination (Duration): 2 hrs

Objectives	:	- To provide a general overview on structure- properties- relationship of polymeric materials. - To provide idea thorough understanding and knowledge on properties characteristics and applications of various polymeric materials.
Unit-I	:	Polyethylene: structure-properties relationships, properties and application of LDPE, LLDPE, UHDPE, HDPE, CSPE, CPE, Cross linking PE. (04 h)
Unit-II	:	Polypropylene: structure-properties relationships, properties and application of Isotactic and syndiotactic PP, chlorinated PP, cast PP, ethylene-propylene copolymer. (04 h)
Unit-III	:	Styrenic Polymers: Grades of polystyrene, structure-properties relationships, properties and application of PS, HIPS, Stereoregular polystyrene, SAN copolymer. (04 h)
Unit-IV	:	Vinyl and Acrylics: Structure-properties relationship, properties and application of PVC, crystalline & chlorinated PVC, Saran, Vinylchloride-propylene copolymer, polyvinyl alcohol, polyvinyl acetate, PMMA, PAN, thermoset acrylic polymer. (05 h)
Unit-V	:	Polyamides and Polyesters: Structure-properties relationship, properties and application of various nylons, aromatic polyamide, PET, PBT etc. (04 h)
Unit-VI	:	Miscellaneous Polymeric Materials: Structure-properties relationship, properties and application of PTFE, PC, PU etc. (03 h)

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

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.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-VI Course Code: PPE371 Course: Lab-V: Polymer Processing Technology Teaching Scheme: Practical: 2 hrs/week Credits: 01 Practical: 25 Marks Term Work: 25 Marks						
Objectives	:	• To prepare various thermoset polymers.				
List of Practical	:	1. To produce an article from hand operated injection moulding machine. 2. To produce an article from reciprocating screw type injection moulding machine. 3. To produce granules / products from extrusion moulding machine. 4. To produce an article from blow moulding machine. 5. To produce an article from compression moulding machine. 6. To produce an article from rotational moulding machine. 7. Study of construction and working of transfer moulding. 8. Study of construction and working of calendaring. 9. Study of construction and working of thermoforming. 10. Study of construction and working of rotational moulding for multilayered product. At least any 8 experiments from the above-mentioned list of experiments should be performed.				
List of Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Plastics Engineering Handbook	J.Frados	Van Nostrand Reinhold Company	4 th , 2007
		2.	Plastics Processing Handbook	A S Athalye	Colour Publications (Pvt.) Ltd.	1 st , 2002
		3.	SPI Plastics Engineering Handbook	Michael Berins	Springer	5 th , 1991
		4.	Principles of Polymer Processing	Tadmor A. and Gagos C.G.	John Wiley & Sons, New York	2 nd , 2006

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

Course Code: PPE372
Course: Lab-VI: Elastomer Technology
Teaching Scheme:
Practical: 2 hrs/week

Credits: 01
Practical: 25 Marks
Term Work: 25 Marks

Objectives	:	● To give practical exposure of elastomer technology in laboratory.				
List of Practical	:	1. To determine dry rubber content (DRC), total solid content (TSC), non-rubber content (NRC) and ash content of rubber latex. 2. To determine total alkalinity of rubber latex. 3. To determine magnesium content of rubber latex. 4. To identify different rubbers by solubility test. 5. To identify different rubbers by pyrolysis test. 6. To determine specific gravity of different rubbers. 7. To masticate rubber in external/ internal mixer. 8. To mix a rubber compound using different ingredients. 9. To determine minimum torque, maximum torque, induction time (t_{s2}), scorch time (t_{s5}), optimum cure time (t_{c90}) and cure rate index from rheometer curve (rheography analysis). 10. To determine gel content of rubber vulcanizate. 11. To study swelling of unvulcanized and vulcanized rubber. 12. To determine carbon black content in rubber composite.				
		At least any 8 experiments from the above-mentioned list of experiments should be performed.				
List of Reference Books	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Rubber Technology	Maurice Morton	Van Nostrand Reinhold	1987
		2.	Rubber Technology and Manufacture	C. M. Blow	Butterworths for the Institution of the Rubber Industry	1971
		3.	Handbook of Elastomers	Anil K. Bhowmick, Howard Stephens	CRC Press	2 nd , 2000
		4.	Rubber Engineering	Indian Rubber Institute	McGraw Hill, India	1998
		5.	Physical Testing of Rubber	Roger Brown	Springer	4 th

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.

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

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

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-VI Course Code: PPE373 Course: Lab-VII: Mass Transfer Teaching Scheme: Practical: 2 hrs/week Credits: 01 Practical: 25 Marks Term Work: 25 Marks						
Objectives	:	• To understand the fundamental concepts of mass transfer principles and apply these concepts to real engineering problems. • To get acquainted with the design of continuous contact and stage wise operations. • To provide theoretical understanding of various mass transfer operations such as diffusion, vapor-liquid, liquid-liquid and gas-liquid systems and drying.				
List of Practical	:	1. Determination of diffusivity of volatile liquid vapor into air. 2. Determination of mass transfer coefficient of naphthalene balls in air 3. Verification of Rayleigh’s equation for differential distillation 4. Preparation of boiling point diagram and plot of T-X-Y diagram for binary system at equilibrium. 5. Determination of HETP for packed column. 6. Determination of mass transfer coefficient in gas absorption column. 7. Preparation of ternary equilibrium curve for liquid extraction. 8. Determination of number of theoretical stages in distillation column 9. Determination of rate of drying in batch dryer. At least any 8 experiments from the above-mentioned list of experiments should be performed.				
References	:	Sr. No.	Title	Author	Publication	Ed.
		1.	Mass Transfer Operation	R.E.Trybel	Mcgraw Hill Company	3 rd
		2.	Chemical Engineering Vol I & II	Richardson & Coulson	Mcgraw Hill Company	6 th
		3.	Unit Operations of Chemical Engineering	McCabe & Smith	Mcgraw Hill Company	7 th
		4.	Chemical Engineering Handbook	Robert Perrys	Mcgraw Hill Company	8 th

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 (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (Plastic and Polymer Engineering) Semester-VI						
Course Code: PPE374			Credits: 01			
Course: Lab-VIII: Design Lab-II			Term Work: 50 Marks			
Teaching Scheme:						
Practical: 2 hrs/week						
Objectives	:	- Understanding CAD - solid modeling, Surface modeling, assembly modeling and drafting of different engineering parts. - Students will be able to design and model the objects as per defined dimensions & features. - Students will be able to simulate the models of different assemblies.				
List of Practical	:	1. Solid Modeling: (a) Introduction: 3D modeling software package, basic 3D modeling concept, basics of sketching constraints, extrude, revolve, sweep, Boolean operations etc. (04 h) (b) Model Editing: Edit, edge blend, shell, array, pattern, mirror etc. (04 h) 2. Surface Modeling: Introduction to surface modeling, freeform modeling ruled, through curves, through curve mesh, swept and N-sided, Trim sheet, face blend, surface through points, X form, curve on surface. (04 h) 3. Assembly Modeling: Basic assembly concepts, Bottom-up approach, top-down approach, creating assemblies, assembly constraints, components, assembly explosion. (06 h) 4. Drafting: Introduction to drafting, drawings & views, linear dimensions, radial dimensions, notes & labels, section views, half section, detailed view, stepped section views, broken view, revolved section views, centerline symbols, additional drafting symbols like thread, weld, surface finish, annotation edit. (02 h) 5. Motion simulation: Motion simulation of assemblies, defining links, joints & motors, assembly sequencing and motion. (06 h)				
References	:	Sr. No.	Title	Author	Publication	Ed.
		1	Unigraphics NX6	-	-	-
		2	CAD/CAM Principles & Applications	Rao	Tata McGraw-Hill	3 rd
		3	CAD/CAM: Computer- Aided Design and Manufacturing	Grover	Prentice Hall	1 st , 2007
		4	Solid works 2013 for designers	Sham Tikoo	CADCIM Technologies	1 st , 2013

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.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (All) Semester-VI Course Code: PPE375 Course: Lab-IX: Project-I Teaching Scheme: Practical: 2 hrs/week Credits: 01 Practical: 50 Marks		
Objectives	:	The Projects in the undergraduate study of engineering aims at developing in the student, knowledge and skills to match the current and projected needs of industry, society or user systems and to create social awareness and professional attitudes. Apart from monitoring the engineering processes and maintenance of engineering work, machines and equipments, an engineer has to do investigate survey, collect data, refer handbooks/datasheets, prepare estimates and design the systems.
Contents	:	• The completion of project is to be carried out in two semesters i.e. in T.Y. Sem. VI and final year B. Tech Sem. VII. • The students shall form project group of maximum 3 students for within department projects and maximum of 6 students in case of interdepartmental projects of their choice. • The students groups shall collect the information on the topic/area of interest and submit brief synopsis to Project Coordinator. • The Project Coordinator shall allot the Project Guide depending upon the area or specialization of eligible faculty members from the department. • The individual student from the project group shall maintain the project diary and update weekly by taking remark of respective guide. • The industry sponsored projects and inter departmental projects shall be encouraged and in case of inter departmental projects, students of maximum 3 different departments/disciplines shall work together by forming the group. The guide allotment and internal/external assessment of such groups shall be done by the respective departments. • The projects addressing issues related to environmental, rural development and societal issues shall be preferred. • The selected project shall help to promote participation in government approved schemes like Unnat Maharashtra Abhiyaan (UMA) and Unnat Bharat Abhiyaan (UBA). • The students shall aim to promote their project work in project exhibitions/competitions, paper presentation/publication in reputed journals and conferences. • The relevance of project and implementation including details of attainment of POs and PSOs addressed through the projects with justification must be clearly stated. Phases of Project Part- I: Phase I: Problem Identification, Literature survey, data collection, deciding scope of topic and objectives of the project. Phase II: Confirmation of block diagram or layout of the proposed project. Phase III: Submission of small report of project work.

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Syllabus of T.Y.B. Tech. (All) Semester-VI

Course Code: BSH801

Course: Audit I: Japanese Language module

Teaching Scheme:

Theory: 2 hrs/week

Examination Scheme

Total Marks: 50 (Continuous Assessment)

Objectives		- Students will be able to apply communicative Japanese Grammar in communication. - Students will be able to enhance the level of Japanese vocabulary. - Students will be able to pronounce and articulate words as well as sentences accurately. - Students will be able to understand and apply Japanese language eventually. - Students will be able to develop Japanese language skills. - Students will be able to manage situational communication in Japanese.
Unit-I	:	Kana scripts Hiragana & Katakana (02 h)
Unit-II	:	Chinese characters Kanji- Pictograms with stroke order (02 h)
Unit-III	:	Grammar Parts of speech, articles, word order or syntax, demonstratives & interrogatives, counters, verbs and verb conjugation, adjectives, adverbs, comparisons, giving and receiving, requests and commands, potential and conditionals, possessive, direct indirect speech, various other form, etc (08 h)
Unit-IV	:	Vocabulary Nouns, verbs tenses-past and present, adjectives, adverbs, expressions of time, expression and phrases etc. (05 h)
Unit-V	:	Situational conversations and practice drills Self-introduction, numbers, day and date, time, location and presence, possession of objects, time expressions and their usage, visiting people, accepting and receiving objects, hospital, asking direction, asking price of objects etc. (05 h)
Unit-VI	:	Introduction to the history of Japan and its cultural Aspects Ikebana, origami, calligraphy, kabuki etc (02 h)

Reference Books	Sr. No.	Title	Author	Publication
	1	Japanese Kanji for Beginners	Timothy G. Stout and Kaori Hakone	Tuttle Publishing
	2	Essential Japanese Grammar: A Comprehensive Guide to Contemporary Usage	Masahiro Tanimori and Eriko Sato Ph.D.	Tuttle Publishing
	3	15-Minute Japanese: Learn in Just 12 Weeks	D.K. Goel and Rajesh Goel	Amazon.in

	4	Oxford Japanese Grammar and Verbs (Dictionary)	Bunt Jonathan	Oxford Publication
	5	Read and write Japanese scripts: Teach yourself	Helen Gilhooly	Teach Yourself
	6	Complete Japanese Beginner to Intermediate Book and Audio Course: Learn to read, write, speak and understand a new language with Teach Yourself	Helen Gilhooly	Teach Yourself

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (All) Semester-VI Course Code: CSE801 Course: Audit I: Cyber Crime and Law Teaching Scheme: Theory: 2 hrs/week Credits: - Class Test: - Theory Examination: - Theory Examination (Duration): -		
Objectives	:	• To introduce the cyber world and cyber law in general. • To enhance the understanding of problems arising out of online transactions and provoke them to find solutions. • To examine the effects of cyber crime through the experiences of victims and law enforcement. • To Know the technologies that stand behind certain cyber crimes. • To identify and analyze statutory, regulatory, constitutional, and organizational laws that affect the information technology professional. • To distinguish between Copyright Law, Patent Law and Trademarks.
Unit-I	:	Introduction: Overview of Computer and Web Technology, Need for Cyber Law, Cyber Jurisprudence at International and Indian Level. (04 h)
Unit-II	:	Jurisdictional Aspects in Cyber Law: Issues of jurisdiction in cyberspace, Types of jurisdiction, The Test evolved, Minimum Contacts Theory, Sliding Scale Theory, Jurisdiction under IT Act, 2000. (04 h)
Unit-III	:	Cyber Crimes & Legal Framework: Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Identity Theft & Fraud, Cyber Terrorism, Right to Privacy and Data Protection on Internet, Different offences under IT Act, 2000. (04 h)
Unit-IV	:	Digital signature and Electronic Signature and Data Protection: Concept of public key and private key, Certification authorities and their role, Creation and authentication of digital signature, Concept of electronic signature certificates, Electronic Governance. (04 h)
Unit-V	:	E Contracting & E Commerce: Salient features of E-contract, Formation of E-contract and types, E-mail Contracting, Indian Approach on E-contracts, E-commerce-Salient Features and advantages, Models of E-commerce like B2B, B2C, Indian Laws on E-commerce. (04 h)
Unit-VI	:	Intellectual Property Issues in Cyber Space: Copyright Law, Patent Law, Trademarks & Domain Names Related issues, Dispute Resolution in Cyberspace. (04 h)
Reference Books	:	1. Karnika Seth, Computers, Internet and New Technology Laws, Lexis Nexis Butterworths Wadhwa Nagpur. 2. Chris Reed & John Angel, Computer Law, OUP, New York, (2007). 3. Cyber Crime An Introduction by Prasad R.S. 4. Cyber Laws by Ed. Kumar Krishna.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (All) Semester-VI Course Code: CED801 Course: Audit I: Road Safety Management Teaching Scheme: Theory: 2 hrs/week Credits: - Class Test: - Theory Examination: - Theory Examination (Duration): -		
Objectives	:	• To acquire knowledge and understanding of the road environment. • To inculcate decision making and behavioural skills necessary to survive in the road environment. • To impart knowledge and understanding of the causes and consequences of accidents. • To understand roles and responsibilities in ensuring road safety.
Unit-I	:	Introduction to Road Safety & Planning: Road traffic accidents scenario in India and in world. Road Safety and its importance. Traffic Rules and Driving Behaviour. Characteristics of accidents, accidents vs. crash. Need of Road Safety. Awareness about rules and regulations of traffic. Assisting Traffic control authorities. Multidisciplinary approach to planning for traffic safety and injury control. Vulnerable road users: crashes related to pedestrian and bicyclists, their safety, provision for disabled. (04 h)
Unit-II	:	Traffic Signs, signals & traffic furniture & Role of traffic signals: Warning, cautioning & Informing sign. Location of Road sign, Traffic signals. Road Marking: Colour of road marking, kerb marking, night driving aid, traffic light signals. Types of Signals. Road safety tips for different categories of Road users. Causes of accidents, prevention & 1st aid to accident victim. Rules on road. Necessity of traffic lights. Major violations leading to accidents. (04 h)
Unit-III	:	Responsibility of Road accidents and Safety measures: People responsible for accident prevention: Police, Politicians, Community members, Policy makers, Teachers, Parents, Infrastructure authorities, Drivers and Official road safety body. Reasons of students/ children have accidents. 4 E's of Accidents Prevention: 1. Engineering - by altering the environment 2. Enforcement - by imposing laws 3. Encouragement - by the use of publicity campaigns 4. Education - by gaining and using knowledge. (04 h)
Unit-IV	:	Road Safety Education & Events: Introduction to Road Safety Education. 5 P's of Road safety education: 1. Pre-school road safety education 2. Practical rather than theory education 3. Principles of own development about road safety education 4. Presentations on road safety education 5. Place for road safety education in syllabus. Discussions on efforts done by Government on Road Safety. Workshop on Road Safety week/ Organization of seminar on Road Safety. (04 h)
Unit-V	:	Traffic Flow Analysis: Macroscopic, Microscopic & Mesoscopic approach Types of Flow, Traffic stream characteristics, Space, Time diagram, Relationship between speed, flow & density, Level of service & capacity analysis, Shockwave theory. (04 h)
Unit-VI	:	Road Safety Audit: Global & Local perspective, Road safety issues, Road safety programmes, types of RSA, planning, design, construction & operation stage audits, Methodology, Road safety audit measures. (04 h)

Reference Books	:	1. Traffic Flow Theory & Control- D. R. Drew- McGraw Hill, New York, 1968. 2. Traffic Engineering and Transport Planning- L.R. Kadiyali- Khanna Publishers, New Delhi, 2002. 3. Transportation Engineering-An Introduction- C. J. Khisty- Prentice-Hall, NJ, 2005 4. Traffic Flow Fundamentals- A. D. May- Prentice – Hall, Inc., New Jersey, 1990. 5. Highways- Traffic Planning & Engineering- C. A. O’Flaherty- Edward Arnold, UK 6. Traffic Engineering – Theory & Practice- L. J. Pignataro- John Wiley, 1985. 7. Highway Traffic Analysis and Design, R. J. Salter, N. D. Hounsel- Macmillan, London, 1996. 8. Traffic Engineering & Transport Planning- L. R. Kadiyali- Khanna Publishers, 2003.
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Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (All) Semester-VI Course Code: BSH802 Course: Audit I: Value Education Teaching Scheme: Theory: 2 hrs/week Credits: - Class Test: - Theory Examination: - Theory Examination (Duration): -		
Objectives	:	The students will be able to: • Understand the need of values and its classification in contemporary society. • Appreciate the values needed for peaceful society like democratic, secular, and socialist etc. • Become aware of role of education in building value as dynamic social reality. • Know the importance of value education towards personal, national and global development.
Unit-I	:	Introduction to Value Education: Value Education, Purpose of Value Education as specifying the present deterioration in the value system in the fast changing world trends. (04 h)
Unit-II	:	Importance of Values in Life: What is a Value system? What kinds of values need to be inculcated? Eg. Ethical, moral and spiritual instead of materialistic values, value inculcation, trend of values such as a permissive culture. (04 h)
Unit-III	:	Character Building: Advantages of good character, importance of trust, honesty, integrity, morality, and reliability as qualities of a good character. Building Relationship-Group Behaviour, limitations of a relationship. How to be a better person, better manager and better Engineer? (04 h)
Unit-IV	:	The Purpose of Life & Education: Meaning, purpose of one's life, Destination success - why are you here? How to make every day worth living? (04 h)
Unit-V	:	Values for Personal Life & Professional Life: Self sovereignty-Discernment-Decision making-Self-actualization, Caring-Patience-Honesty-Forgiveness, Competence-Co-operation-Perseverance, Flexibility-Reliability-Tolerance-Unity- Knowledge Thirst, Sincerity in Profession, Regularity, Punctuality, Faith. (04 h)
Unit-VI	:	Value Education towards National and Global Development: • Constitutional Values: Sovereign, Democracy, Socialism, Secularism, Equality, Justice, Liberty, Freedom, Fraternity. • Social Values: Pity and Probity, Self-Control, Universal Brotherhood. • Religious and Moral Values: Tolerance, Wisdom, character. • Aesthetic Values: Love and Appreciation of literature, fine arts and respect for the same. • Environmental Ethical Values. • National Integration and international understanding. • Need of Humanistic value for espouse peace in the society. • Conflict of cross-cultural influences, cross-border education. (04 h)

Reference Books	:	1. Sharma, S.P. Moral and Value Education; Principles and Practices, Kanishka publishers, 2013. 2. Kiruba Charles & V. Arul Selvi. Value Education: Neelkamal Publications, New Delhi, 2012. 3. Passi, B.K. and Singh, P. Value Education. National Psychological Corporation, Agra. 2004. 4. Chitakra, M.G.: Education and Human Values, A.P.H. Publishing Corporation, New Delhi. 2003. 5. Monica J. Taylor. Values in Education and Education in Value. Routledge. 1996. 6. Neil Postman. The End of Education: Redefining the Value of School. Vintage publisher. 1996. 7. http://cbseportal.com/exam/e-books/download-free-ncert-e-book-education-for-values-in-school-a-framework\ 8. http://cbseacademic.in/web_material/ValueEdu/Value%20Education%20Kits.pdf
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Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (All) Semester-VI		
Course Code: ETC801 Course: Audit I: Smart Cities Teaching Scheme: Theory: 2 hrs/week		Credits: - Class Test: - Theory Examination: - Theory Examination (Duration): -
Objectives	:	• To identify urban problems. • To study Effective and feasible ways to coordinate urban technologies. • To study models and methods for effective implementation of Smart Cities. • To study new technologies for Communication and Dissemination. • To study new forms of Urban Governance and Organization.
Unit-I	:	Understanding Inclusive Planning: Definition and components; urban consultations; basic principles of urban consultation, process of urban consultations; urban strategic planning, good urban governance, subsidiarity, equity, efficiency, transparency and accountability, civic engagement and citizenship, security; valuing difference and working with diversity; livable cities. (04 h)
Unit-II	:	Participatory Planning Process and Policies, Programmes and Legislation: Methods, role of stakeholders (including civil society organizations), etc.; Related Acts, Five year plans, policies and programmes at various levels. (04 h)
Unit-III	:	Smart Cities: Innovation economy (Innovation in industries, clusters, districts of a city; Knowledge workforce: Education and employment; Creation of knowledge-intensive companies). (04 h)
Unit-IV	:	Smart Cities: Urban Infrastructure (Transport, Energy/ Utilities, protection of the environment and safety); Governance (Administration services to citizens, participatory and direct democracy, services to the citizen, quality of life) (04 h)
Unit-V	:	Planning interventions –I: Inclusive zoning, development and building regulations, Slum Improvement; drafting strategic urban development plans – objectives and key actors; planning framework for actions, process of drafting the plan, key considerations. (04 h)
Unit-VI	:	Planning interventions –II: Urban design and decision-making; city transport for all; water supply and sanitation, urban disaster management, management through decentralization. (04 h)

Reference Books	:	1. Jo Beall (1997); “A city for all: valuing differences and working with diversity”; Zed books limited, London (ISBN: 1-85649-477-2) 2. UN-Habitat; “Inclusive and sustainable urban planning: a guide for municipalities”; Volume 3. Urban Development Planning (2007); United Nations Human Settlements Programme (ISBN: 978-92-1-132024-4). 3. Arup Mitra; “Insights into inclusive growth, employment and wellbeing in India”; Springer (2013), New Delhi (ISBN: 978-81-322-0655-2) 4. William J. V. Neill (2004); “Urban Planning and cultural identity”; Routledge, London (ISBN: 0-415-19747-3). 5. John S. Pipkin, Mark E. La Gory, Judith R. Balu (Editors); “Remaking the city: Social science perspective on urban design”; State University of New York Press, Albany (ISBN: 0-87395-678-8). 6. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science 7. "Draft Concept Note on Smart City Scheme". Government of India - Ministry of Urban Development(http://indiansmartcities.in/downloads/CONCEPT_NOTE_-3.12.2014__REVISED_AND_LATEST_.pdf)
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Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of T. Y. B. Tech. (All) Semester-VI Course Code: MED801 Course: Audit I: Rural Community Engagement Teaching Scheme: Theory: 2 hrs/week Credits: - Class Test: - Theory Examination: - Theory Examination (Duration): -		
Objectives	:	1. To provide practical opportunities for students for participation in rural community mobilization, service engagement and empowerment activities. 2. To promote preparation of strategies for building resilience and community responding system in nutrition, water, food safety and healthcare.
Unit-I	:	Dynamics of Rural Society, Panchayat Raj System: Social, Economic, Political and Cultural Community Goal Setting : SAGY, MPLADS and UBA (04 h)
Unit-II	:	Unit-II Approaches and Methods, Community Project Proposal and Project Management, Concept and Steps, Thematic Maps, Social Map Transect Walk, Seasonal Map, Natural and Human Resource Mapping and Management, Ethnographic Research (04 h)
Unit-III	:	Unit-III Vulnerability, Rural Resilience - Risk Reduction, Role and Responsibilities Rehabilitation: Social, Physical and Psychological Aspect Increasing Efficiency in Water, Energy, Sanitation and Waste (Solid and Liquid) Management (04 h)
Unit-IV	:	Unit-IV Engagement With School for Competency Enhancement/Health Centre/Panchayat/Gram Sabha/SHGs Awareness: Rural Health Management, Indigenous or Folk Medicine and Hygiene/ Sports/ Rights/ Policies and Programs/ Transparency/Corruption/Social Benefits, addressing Issue In inclusive and Inclusive Identification of Beneficiaries, Improving Implementation Efficiencies While Plugging Leakages In Benefits Scheme, Direct Benefit Transfer (04 h)
Unit-V	:	Unit-V Making of Gram Panchayat Development Plan Including Aspects and Process of Preparation of Village Disaster Management Plan (04 h)
Unit-VI	:	Unit-VI Village Livelihoods, Rural Tourism, Entrepreneurship, Appropriate Technology Access Including Digitized Transaction. (04 h)
Reference Books	:	1. Katar Singh "Rural development- Principles, Policies and Management" SAGE Publication 1999. 2. Agoramoorthy Govindaswamy "Sadguru Model of Rural Development: Elevates Food Security and Ease Poverty" Daya Publishing House, a division of Astral International Pvt. Limited, 2016. 3. V. Gopalkrishnan Asari "Technological Change for Rural Development in India". B.R.Publisher 4. B.S.Gautam "Cooperatives And Rural Development In India" Radha Publications.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science and Technology)
Syllabus of T.Y.B. Tech. (All) Semester-VI

Course Code: BSH803

Course: Audit I: German Language Module

Teaching Scheme:

Theory: 2 hrs/week

Examination Scheme

Total Marks: 50 (Continuous Assessment)

Objectives	- Students will be able to apply communicative German Grammar in communication. - Students will be able to enhance the level of German vocabulary. - Students will be able to pronounce and articulate words as well as sentences accurately. - Students will be able to understand and apply German language eventually. - Students will be able to develop German language skills. - Students will be able to manage situational communication in German.
Unit-I	: Significance and purpose The Significance of Language study, Speaking and Thinking, Self – discovery, Communication, Language Competence, Language and Culture, Language Changes, Connection with other areas of study, The Mother—language, Other languages and Purpose of Language study (02 h)
Unit-II	: Purpose of the Study of the German Language Listening, Speaking, Reading and writing. (02 h)
Unit-III	: Grammar Parts of speech, articles, word order or syntax, demonstratives & interrogatives, counters, verbs and verb conjugation, adjectives, adverbs, comparisons, giving and receiving, requests and commands, potential and conditionals, possessive, direct indirect speech, various other form, etc. (08 h)
Unit-IV	: Vocabulary Nouns, verbs tenses-past and present, adjectives, adverbs, expressions of time, expression and phrases etc. (05h)
Unit-V	: Situational conversations and practice drills Self-introduction, numbers, day and date, time, location and presence, possession of objects, time expressions and their usage, visiting people, accepting and receiving objects, hospital, asking direction, asking price of objects etc. (05 h)
Unit-VI	: Introduction to the history of German and its cultural Aspects Norms and values, Lifestyles and aims in life, Cultural traditions (02 h)

List of Reference	Sr. No.	Title	Author	Publication
Books	1	German Made Simple: Learn to speak and understand German quickly and easily	Arnold Leitner	Namrata's Amazon.in
	2	The Everything Learning German Book: Speak, write, and understand basic German in no time	Edward Swick	Adams Media
	3	Langenscheidt German in 30 Days	Von Angelika G. Beck	Langenscheidt
	4	Complete German Beginner to Intermediate Book and Audio Course: Learn to read, write, speak and understand a new language with Teach Yourself	Heiner Schenke	The McGraw Hill
	5	German: How to Speak and Write It (Beginners' Guides)	Joseph Rosenberg	Repro Books
	6	Collins Easy Learning – Collins Easy Learning German Grammar and Practice	Collins	Collins