Evaluation Reforms NEP 2020

2nd Year Bachelor of Engineering

Chemical Technology (Polymer & Rubber)

Shroff S R Rotary Institute of Chemical Technology,

Ankleshwar

EFFECTIVE FROM A.Y. 2026-2027

Teaching Scheme for

Second Year Bachelor of Chemical Technology

(Polymer & Rubber Technology)

Semester-III (Polymer & Rubber Technology) Structure

Course Code	Course	Teaching Scheme (hrs. / week)			Total	Credit	Examination Scheme				
		L	T	P	Hr	C	SEE	CCE	I/TW	V	Total
BUNBS311	Mathematics-III	3	1	0	4	4	50	50	25	25	150
BPTPR301	Synthesis and Analysis of Polymer & Rubber	4	0	0	4	4	50	50	0	0	100
BCTPC302	Physical Chemistry	3	0	2	5	4	50	50	25	25	150
BCTPC303	Material Energy Balance Calculation	3	1	0	4	4	50	50	25	25	150
BUNAE321	English Proficiency Course	2	0	2	4	3	50	50	25	25	150
BUNVA331	Yoga for Well Being	0	0	4	4	2	0	0	25	25	50
	Total	15	**2**	**8**	25	21	250	250	125	125	750

Semester-IV (Polymer & Rubber Technology) Structure

Course Code	Course	Teaching Scheme (hrs/week)			Total	Credit	Examination Scheme				
		L	T	P	Hr	C	SEE	CCE	I/TW	V	Total
BPRPC401	Chemistry of Polymer & Rubber	3	0	2	5	4	50	50	25	25	100
BPRPC402	Polymer Processing Technology	3	0	0	3	3	50	50	0	0	150
BCTPC403	Material Science & Engineering	4	0	0	5	4	50	50	0	0	100
BCTPE404	Basics of Fluid Flow	3	0	2	5	4	50	50	25	25	150
BPRVS405	Polymer Processing Technology - Practical	0	0	2	2	1	0	0	25	25	50
BUNVA431	Universal Human Values	2	0	0	2	2	50	50	0	0	100
BXXOE441	Open Elective – 1	2	0	0	2	2	50	50	0	0	100
	Total	17	**0**	6	23	20	300	300	75	75	750
Multi-Disciplinary Minor Course											
BXXMD451	Multi-Disciplinary Minor Course – 1	3	0	2	5	4	50	50	25	25	150

Open Elective - I (Semester – IV)

(Open Electives for Chemical Technology students)

Sr.	Course Code	Course	Offered by (department)
1	BMEOE441	Basics of Maintenance Engineering	Mechanical Engineering
2	BEVOE441	Industrial Wastewater Treatment	Environmental Science & Technology
3	BCHOE441	Introduction to Chemical Industry	Chemical Engineering
4	BITOE441	IT for Sustainability	Information Technology
5	BCOOE441	Emerging Technologies in	Computer Engineering
6	BEEOE441	Fundamentals of Renewable Energy Technologies	Electrical Engineering

**Detailed syllabus separately available*

MDC - I (Semester – IV)
Multidisciplinary Minor Course (MDC-1) for Chemical Technology (Polymer & Rubber) Students

Sr.	Course code	MDC-1 (Semester-4)	Minors (Certification)	Offered by (department)
1	BMEMD451	Boiler and Steam Utility Systems	Mechanical Aspects of Process Utilities	Mechanical Engineering
2	BEVMD451	Introduction to Environmental Management	Environmental Management	Environmental Science & Technology
3	BCHMD451	Process Safety and Risk Management	Industrial Safety	Chemical Engineering
4	BITMD451	Fundamentals of Cloud and Virtualization	Cloud computing	Information Technology
5	BEEMD451	Basics of Measuring Instruments	Industrial Instrumentation and Automation	Electrical Engineering
6	BPTMD451	Pharmaceutical Science and Technology	Pharmaceutical Analysis	Pharmaceutical Technology
7	BGCMD451	Fundamentals of Materials Science and Engineering	Ceramics Engineering	Glass & Ceramics Technology
8	BDPMD451	Introduction to Paint and Coating Technology	Paint Technology	Dyes & Pigments Technology
9	BCOMD451	Fundamentals of Data Science	Data Science	Computer Engineering

**Detailed syllabus separately available*

UPL University of Sustainable Technology

Shroff S R Rotary Institute of Chemical Technology

B.E. Semester III

Mathematics –III (BUNBS311)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	1	0	4	4	50	50	25	25	150

PREREQUISITES: Students should have a basic understanding of Calculus, including limits, continuity, differentiation, and integration. Familiarity with Trigonometric Functions and identities is important. Knowledge of Differential Equations and coordinate geometry in Cartesian and polar forms is required. Students should also understand functions, graphs, and basic algebraic manipulation, which will help in learning Fourier series, Laplace transforms, and double integrals.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (45)
	SECTION-A		
1	**Fourier Series:** Periodic function, Trigonometric series, Fourier series, Functions of any period, Even and odd functions, Half-range Expansion.	1	7
2	**Fourier integral:** Sine and cosine integral, even and odd functions	2	6
3	**Laplace Transforms**: Definition of the Laplace transform, Linearity, shifting theorems, Laplace transformation of elementary function, basic properties of Laplace transformation, Differentiation of Laplace transformation (multiplication by t), Integration of Laplace transformation (division by t), Laplace transformation of derivatives and integrals, Evaluation of integrals using Laplace transformation.	4	10
	SECTION-B		
4	**Inverse Laplace transformation and its application:** Properties of inverse Laplace transformation, shifting theorem, multiplication and division by differentiation and integration of Laplace transformation. Convolution theorem, inverse Laplace transformation using partial fraction, solution of linear differential equation.	5	10
5	**Double integral and its applications of:** over rectangular and general regions, properties of double integrals, Change of order, change of variables, Area by double Integrals.	6	7
6	**Curve Sketching**: Curve sketching in Cartesian Co-ordinates and Polar co-ordinates, Relation between Polar and Cartesian Co-ordinates.	3	5

LIST OF TUTORIALS:

1. Tutorial-1 (Fourier Series)
2. Tutorial-2 (Fourier Series)
3. Tutorial-3 (Fourier Integral)
4. Tutorial-4 (Laplace Transform)

5. Tutorial-5 (Laplace Transform)
6. Tutorial-6 (Inverse Laplace Transformation)
7. Tutorial-7 (Inverse Laplace Transformation)
8. Tutorial-8 (Double Integral and its application)
9. Tutorial-9 (Double Integral and its application)
10. Tutorial-10 (Curve sketching)

TEXT BOOKS:

1. Advanced Engineering Mathematics by Ravish Singh and Mukul Bhatt.MC Graw Hill Education Pvt Ltd.
2. Engineering Mathematics Vol 2, by Baburam, Pearson

REFERENCE BOOKS:

1. Thomas' Calculus, Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.
2. Advanced Engineering Mathematics (8th Edition), by E. Kreyszig, Wiley- India (2007)..
3. R. V. Churchill and J. W. Brown, Fourier series and boundary value problems (7th Edition), McGraw-Hill (2006).

ONLINE RESOURCES:

- https://digimat.in/nptel/courses/video/111105134/L36.html
- http://www.digimat.in/nptel/courses/video/122104017/L12.html
- https://www.digimat.in/nptel/courses/video/111105123/111105123.html

COURSE OUTCOMES

CO1	Define Fourier series, periodic functions, trigonometric series, and perform half-range expansions for even and odd functions.
CO2	Solve problems involving Fourier sine and cosine integrals, including applications to even and odd functions.
CO3	Sketch curves in Cartesian.
CO4	Calculate Laplace transforms of functions using properties, shifting theorems, and apply them to evaluate integrals.
CO5	Calculate inverse Laplace transforms and solve linear differential equations using properties, convolution theorem, and partial fractions.
CO6	Construct and evaluate double integrals over different regions, including change of order and change of variables.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester III
Synthesis and Analysis of Polymer & Rubber (BPRPC301)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
4	0	0	4	4	50	50	0	0	100

COURSE OVERVIEW:

The main objective of this subject is to deliver the knowledge of basics of polymer technology and raw materials used in polymer and rubber industries.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (60)
	SECTION-A **Polymer Fundamentals**		
1	**Polyolefins & Industrial Polymerization Systems** Industrial synthesis of: LDPE (High pressure process), HDPE (Ziegler–Natta catalyst), LLDPE (Metallocene catalysis), Polypropylene synthesis, Ethylene–propylene rubber (EPR/EPDM) synthesis, Catalyst systems (Ziegler–Natta, Metallocene), Structure–property–application correlation	1	10
2	**Vinyl & Condensation Polymers – Industrial Perspective** PVC polymerization and processing grades, Copolymerization of vinyl chloride (industrial relevance), PET, PBT, PTT – synthesis routes & applications, Interfacial and melt polycondensation, Process variables affecting molecular weight, Industrial challenges in polyester production	2	10
3	**Engineering & High-Performance Thermoplastics** ABS & SAN – graft copolymer mechanism, Toughening mechanisms in thermoplastics, Polyamides – synthesis & structure–property engineering, Polycarbonate – interfacial polymerization, Polyoxymethylene (POM) High-performance polymers: PEEK, PES, LCPs, Application in automotive & aerospace sectors	3	10
	SECTION-B **Properties and Rubber Basics**		
4	**Polymer Characterization Techniques:** Molecular weight determination: Viscometry, GPC (basic principle), Thermal analysis: DSC, TGA, Spectroscopic methods: FTIR, NMR (basic idea), Crystallinity measurement, Mechanical property testing	4	10
5	**Polymer Morphology & Failure Analysis** SEM & optical microscopy (basic principle), Fracture analysis of polymers, Stress cracking, Environmental degradation analysis, Rheological measurements, Melt flow index (MFI)	5	10

6	**Rubber Testing & Quality Control** Mooney viscosity, Cure characteristics (Rheometer curve), Swelling index & crosslink density, Tensile testing of rubber, Abrasion resistance, Hardness testing (Shore A), Ageing studies	6	10

TEXT BOOKS:

1. Rubber Materials and their components, by J. A. Brydson
2. Rubber Technology : by Maurice Morton
3. Natural Rubber Science and Technology, by Roberts
4. Principles of Polymer Science, Bahadur&Sastry, Narosa Publishing Houses, 2002
5. Polymer Science , Gowarikar,John Wiley & Sons ,1986
6. Handbook of Rubber Projects, Technology and Product Formulations, by SBP Consultants & Engineers (P) Ltd.

COURSE OUTCOMES:

CO1	To know about the polyethylene and its copolymers.
CO2	To be able to apply the knowledge of vinyl chloride to formulate its derivatives.
CO3	To be able to prepare various copolymers of styrene.
CO4	To be able to get knowledge about polyamide materials.
CO5	To be able to understand the detail chemical structure liquid crystalline materials.
CO6	To be able to modified the rubber materials.

UPL University of Sustainable Technology
Shroff S. R. Rotary Institute of Chemical Technology
B.E. Semester III
Physical Chemistry (BCTPC302)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	0	2	5	04	50	50	25	25	150

COURSE OVERVIEW: This course provides a foundation in Physical Chemistry, covering gases, kinetics, surface chemistry, electrochemistry, phase equilibria and thermodynamics. It includes gaseous behaviour (diffusion, liquefaction, equations of state, supercritical fluids), interfacial phenomena (surface tension, emulsions, surfactants), and chemical kinetics (rate laws, reaction mechanisms, temperature effects). The course also explores catalysis, electrochemical cells and the Nernst equation, phase rule and phase diagrams, and fundamental thermodynamic concepts such as energy, entropy, and free energy.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Gaseous state & Interfacial chemistry** • Molecular diffusion & effusion • Critical constants • Liquefaction of gasses • Equation of state • Supercritical fluids & their applications • Surface free energy • Capillary & surface tension, bubbles, droplets • Young Laplace equation • Surface active agents • Emulsions	1,6	8
2	**Kinetics & molecular reaction dynamics** • Significance of reaction kinetics • Rate law • Rate constants • Order of reaction • Reversible reactions • Equilibrium • Parallel • Consecutive reactions • Rate determining parameters • Chemical potential • Chemical reactions • Effect of temperature on reaction rates • Free energy of reaction	2,5	8

	• Collision theory		
3	**Catalysis** • Criteria for catalysis • Homogenous catalysis • Acid Base • Enzymatic Catalysis • Heterogeneous catalysis • Concept of promoters • Inhibitors • poisoning	3,5	6
	SECTION-B		
4	**Electrochemistry** • Equilibrium electrochemistry • Electrochemical cells • Half-cell reactions • Type of electrochemical cells • Free energy & EMF • Nernst equation • Relevance of electrochemical reactions	3,4	8
5	**Phase rule** • Definition & various terms • Gibb's phase rule • Application of Phase rule • One component system: Water • One component system: Sulphur • Two component system: Lead • Two component system: Silver	3,6	7
6	**Thermodynamics** • Internal Energy • Isothermal reversible expansion work of an ideal gas • Isothermal irreversible expansion work of an ideal gas • First Law of Thermodynamics • Enthalpy of a System • Molar Heat Capacities at constant pressure & volume • Relation between Cp and Cv Entropy • Statement of Second law of thermodynamics • Free energy function(G) and work function(A) • Gibb's Helmholtz equations	1,4	8

List of Practical: (Any Ten)

1. To study the relative strength in the hydrolysis of ester in presence of an acid.
2. To determine the solubility of Benzoic acid at different temperatures and calculate its heat of solution.

3. To study the first order reaction in the hydrolysis of ester in presence of an acid at two different initial concentrations
4. To standardize the solution of NaOH & HCl using 0.1 N oxalic acid.
5. To determine the strength of the given Hydrochloric acid using Sodium hydroxide pH metrically.
6. To Determine the turbidity of given sample in NTU unit by turbidity meter.
7. To determine the Phase Diagram for acetic acid, chloroform and water system. (three component system)
8. To determine λ_{max} and concentration of unknown solution of $KMnO_4/K_2Cr_2O_7$/ in 2 N H_2SO_4 using Colorimeter.
9. To determine the activation energy for the hydrolysis of methyl acetate.
10. To determine the strength of the given Hydrochloric acid using Sodium hydroxide Conducto metrically.
11. To study the effect of concentration of reactant on the rate of reaction between sodium Thiosulphate and hydrochloric acid
12. To study the effect of temperature of reactant on the rate of reaction between sodium Thiosulphate and hydrochloric acid
13. To study the VLab demo: Colorimeter

TEXT BOOKS/ REFERENCE BOOKS:

1. Physical Chemistry, 4th Edition, Silbey, Alberty and Bawendi, Wiley, 2006.
2. Physical Chemistry of surfaces,6th Edition, Arthur W.Adamson, Alice P. Gast, Wiley, 1997.
3. Essential of Physical Chemistry, G D Tuli, B S Bahl, ArunBahl, S.Chand Publisher, 2000. Physical Electrochemistry: Fundamentals, Techniques and Applications, EliezerGileadi, Wiley-VCH, 2011.
4. Physical Chemistry: A molecular approach, D. A. Mcquarrie& J.D. Simon,1998 Surfaces, Interfaces& Colloids: Principles & applications, Drew Myers, Wiley VCH, 2nd Ed., 1999
5. The Elements of Physical Chemistry, Peter Atkins, Oxford ,3rd Ed. ,2000
6. Introduction to Colloid & Surface Chemistry, Duncan J Shaw, Butterworth-Heinemann, 5th Ed.,1992
7. Physical Chemistry of Surfaces, Arthur W. Adamson, Alice P. Gast, John Wiley & Sons, Indian Ed.,1997
8. Chemical Kinetics & Catalysis, Masel R.J., John Wiley & Sons, 1st Ed, 2001
9. Chemical Kinetics & Reaction Dynamics, Houston P.H., McGraw Hill Book Company, 2nd Ed, 2001
10. Elements of Physical Chemistry, Atkins P., Oxford Press, 3rd Ed., 2000
11. Catalytic Chemistry, Gates B.C., John Wiley & Sons,2nd Ed., 1992
12. Principles & Practice of Heterogeneous Catalysis, Thomas J.M. & Thomas W.J., John Wiley & Sons, 1996

ONLINE RESOURCES:

Gaseous State & Thermodynamics Khan Academy MIT Open Course Ware Libre Texts Chemistry	Gas laws, thermodynamics, entropy, free energy Advanced thermodynamics and physical chemistry lectures Detailed theory on gases, surface chemistry, and thermodynamics

Interfacial Chemistry & Catalysis NPTEL Swayam	Surface chemistry, catalysis, adsorption, emulsions Courses on catalysis and industrial chemistry
Chemical Kinetics Chemguide YouTube (AK Lectures, Learn Chem E)	Rate laws, order of reaction, kinetics mechanisms Collision theory, reaction dynamics, temperature effects
Electrochemistry Coursera Libre Texts Chemistry	Electrochemistry fundamentals and applications Nernst equation, EMF, electrochemical cells
Phase Rule & Diagrams NPTEL Chemguide Swayam	Phase diagrams and Gibbs phase rule Simple explanation of phase equilibria

COURSE OUTCOMES:

CO1	To define concept of science to solve engineering problems.
CO2	To understand rate and order of various chemical reaction.
CO3	To apply this knowledge to other areas of the degree course to process development.
CO4	To explain the importance and relevance of different chemistry like thermoelectric and surface in designing projects.
CO5	To analyses various reaction kinetics, mechanism and systems to solve technical problems.
CO6	To devise the ideas (not overshadowed by mathematics) about the behavior of molecules and systems in order to be able to cope with experimental testing.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester III
Material & Energy Balance Calculations (BCTPC303)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	1	0	4	4	50	50	25	25	150

COURSE OVERVIEW: The main objective of course is to make a clear\ conceptualized knowledge regarding various unit operations carried out in Chemical Engineering. This will provide a background for applying these principles to industrial problems.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (48)
	SECTION-A		
1	**Units & Dimensions:** Dimensions & system of units, Fundamental and derived units, Unit conversion and its significance.	1	08
2	**Basic Chemical Calculations:** Concepts of atomic weight, equivalent weight and mole. Composition of solids, liquids and solutions (weight percent, mole percent, molarity, normality etc.), other expressions for concentration, Average molecular weight and density, Gaseous mixtures, Ideal gas laws, Real gas laws and their applications, Raoult's law, Henry's law, Amagat's Law & Dalton's law	2	08
3	**Material Balance without Chemical Reactions:** Introduction, Process flow sheet, Material balance with and without recycle; Bypass, Purge streams, Material around equipments related unit operations like absorber and stripper, Distillation towers. Extractors. Dryers, Evaporators, Crystallizers, Humidification and dehumidification towers. Material balance of unsteady state operations.	3	08
	SECTION-B		
4	**Material balances with Chemical reaction:** Concept of limiting and excess reactants, percentage conversion and yield. Material balance involving reactions with special reference to fertilizers, petrochemicals, dyestuffs, electrochemical industries. Complex material balances	4	08
5	**Energy balances:** Heat capacity of gases and gaseous mixtures, liquids & solids, Sensible	5	08

	heat change in liquid & gases, enthalpy changes during phase transformation, enthalpy changes accompanied by chemical reactions, standard heat of reaction, Hess's law, Adiabatic reactions, Theoretical Flame temperature		
6	**Fuel & Combustion:** Types of fuels, calorific value of fuels, liquid fuels, gaseous fuel etc. Proximate and ultimate analysis, combustion calculations, Air requirement and flue gases.	6	08

TEXT BOOKS:

1. Basic Principles & Calculations in Chemical Engineering, D. M. Himmelblau. 6th Ed., 2004
2. Stoichiometry, B. I. Bhatt & Thakore, Tata McGraw Hill Book Company, 5th Ed, 2010
3. Chemical Process Principles, Vol.1, O. A. Hougen, K. M. Watson, R. A. Ragatz., Indian print, CBS Publishers, 2nd Ed., 1995
4. Stoichiometry & Process Calculations, Narayanan K.V., & Lakshmikutti B., Prentice Hall, 2006
5. Process Calculations, V Venkataramani and N Anantharaman, PHI Learning, 2004
6. Chemical Process Calculations Manual, David Carr Igbinoghene, McGraw Hill Professional, 2004
7. Optimization of Chemical Processes, T F Edgar, D M Himmelblau and L S Lasden, Tata McGraw Hill, 2001

COURSE OUTCOMES:

CO-1	To identify different system of units and dimensions with conversion.
CO-2	To distinguish concepts for expressing compositions and behaviour of different gases and solutions.
CO-3	To demonstrate material balance in steady and unsteady state unit operations with and without recycle.
CO-4	To analyze Material balance involving Chemical reactions in fertilizer, Petrochemicals, dyestuff and electrochemical industries.
CO-5	To describe energy changes in liquid and gases accompanying various chemical reactions with terms used to associate energy changes in different phases.
CO-6	To evaluate fuel quality and to device requirement of gases in combustion

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester III
English Proficiency Course (BUNAE321)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
2	0	2	4	3	50	50	25	25	150

PREREQUISITES: Students should have a basic understanding of Communication Skills, including reading, writing, and speaking in English. Familiarity with grammar, vocabulary, and sentence structure is important. Basic awareness of interpersonal communication and professional behaviour will be helpful. Students should also possess a willingness to participate in discussions, presentations, and group activities. No advanced technical knowledge is required, but an interest in self-development, ethics, and effective communication will support better learning outcomes.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (30)
	SECTION-A		
1	**Dynamics** of Communication: Definition and process Kinesics Proxemics Paralinguistic features Importance of Interpersonal and Intercultural Communication in today's organizations	1	6
2	Technical Writing: Report writing Technical proposal Technical description Business letters(sales, order, complaint, adjustment, inquiry, recommendation, appreciation, apology, acknowledgement, cover letter) Agenda of meeting, Minutes of meeting, Resume writing	2	4
3	**Technical Communication:** Public speaking, Group discussion, Presentation strategies, Interview skills, Negotiation skills ,Critical and Creative thinking in communication	3	5
	SECTION-B		
4	**Ethics in Engineering:** Scope of engineering ethics, Accepting and sharing responsibility , Resolving ethical dilemmas, Making moral choices	4	4
5	**Etiquettes**: Telephone etiquettes, Etiquettes for foreign business trips, Etiquettes for small talks, Respecting privacy, Learning to say NO, Time management.	5	5
6	**Self-development and Assessment:** Change, Grow, Persist, Prioritize, Read, Learn, Listen, Record, Remember, Asses, Think, Communicate, Relate, Dream	6	6

LIST OF PRACTICALS AND TERM WORK (9 to 10 Experiments/TW)

1. Role Play
2. Letter Writing
3. Group Discussion

4. Presentation
5. Book Review (Preferably related to self- development)
6. Mock Interview
7. Report Writing
8. Case studies related to unit 4, 5 and 6
9. Conducting meeting with Agenda
10. Minutes of the Meeting

TEXT BOOKS:

1. Raman and Sharma, Technical Communications, OUP, New Delhi, 2017

REFERENCE BOOKS:

1. Lata and Kumar, Communication Skills, OUP, New Delhi, 2018
2. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 2014
3. Mohapatra and Sreejesh S., Case Studies in Business Ethics and Corporate Governance, Pearson, UP, 2013
4. Ramesh and Ramesh, The Ace of Soft Skills, Pearson, UP, 2019
5. Sherfield, Montgomery and Moody, Cornerstone: Developing Soft Skills, UP, 2009

ONLINE RESOURCES:

- https://www.scu.edu/ethics/focus-areas/more/engineering-ethics/engineering-ethics-cases

COURSE OUTCOMES:

CO1	Define and describe dynamics of verbal and non-verbal aspects of communication.
CO2	Associate with various formal documents of technical and professional communication
CO3	Interpret communication of diverse formal situations taking place in organizations.
CO4	Illustrate and examine the knowledge of ethical aspects of engineering
CO5	Establish and explain social and professional etiquettes.
CO6	Recommend self -development and self - assessment.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester III
Yoga for Well Being (BUNVA331)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		CEE	M	I	V	Total
0	0	4	4	2	00	00	25	25	50

PREREQUISITES:

No prior yoga experience is required; the course is open to all interested in improving physical, mental, and emotional well-being. Participants should be medically fit for moderate activity, and those with existing health conditions must consult a doctor and inform the instructor in advance. Regular attendance, discipline, and willingness to learn are essential.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (60)
1	**Yoga and Asana** • Meaning, Definition and Importance of Yoga • Meaning, Definition and Importance of Asana • Asanas for Prevention of Lifestyle Diseases	1	20
2	**Pranayama and Body Balance** • Meaning, Definition and Importance of Pranayama • Various Types of Pranayama • Importance of Pranayama for Balanced Body and Mind	2	20
3	**Yoga Meditation and Stress Management** • Meaning, Definition and Importance of Yoga Meditation • Basic Meditation Techniques • Stress Management through Yoga	3	20

LIST OF PRACTICALS:

1. Performance and viva of minimum 1-**topic** including explanation of benefits.
2. Demonstration of **skills, techniques, and basic rules** of any 5 selected Asana),
3. Any one of the Topic as specialization.
4. Asana Practical.

TEXT BOOKS:

1. Yoga Education – NCERT (National Council of Educational Research and Training)
2. Common Yoga Protocol – Ministry of AYUSH, Government of India
3. Yoga for Healthy Living – Swami Ramdev / Baba Ramdev's Yoga Textbook

REFERENCE BOOKS:

1. The Heart of Yoga – T.K.V. Desikachar
2. Yoga for Wellness – Yoga Journal Books
3. Light on Yoga – B.K.S. Iyengar
4. Yoga: Its Meaning, Theory and Practice – Swami Digambarji

ONLINE RESOURCES:

1. https://www.ayush.gov.in/
2. https://svyasa.edu.in/
3. https://www.artofliving.org/
4. https://nimhans.ac.in/

COURSE OUTCOMES:

CO1	Understand the fundamentals of Yoga, Asanas, Pranayama, and Meditation for holistic health and mental well-being.
CO2	Develop practical skills to perform Asanas and Pranayama with correct posture and breathing.
CO3	Apply yogic practices for improving fitness, managing stress, and preventing lifestyle-related diseases.
CO4	Build self-discipline through log-book and project work, and track personal health and fitness progress.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Chemistry of Polymer & Rubber (BPRPC401)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	0	2	5	4	50	50	25	25	150

COURSE OVERVIEW:

This course emphasizes advanced polymer reaction chemistry, polymer modification reactions, kinetics, rubber chemistry, biopolymers, and rubber compounding chemistry for engineering applications.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (45)
	SECTION-A		
1	**Advanced Polymer Structure–Property Relationship** • Detailed molecular architecture and its effect on properties, Tactility and stereo regularity, Crystallization thermodynamics, LCST & UCST, Polymer solution behavior, Flory–Huggins theory (basic concept), Structure–property engineering correlation	1	8
2	**Polymer Reaction Chemistry** • Hydrolysis of polymers, Acidolysis & aminolysis, Hydrogenation of polymers, Addition and substitution reactions of polymer chains, Cyclization reactions, Crosslinking reactions, Functional group modification, Graft modification techniques	2	8
3	**Kinetics of Polymerization** Rate equations in free radical polymerization, Degree of polymerization vs conversion, Chain transfer reactions, Auto-acceleration (gel effect), Engineering significance of kinetics, Reactor design considerations (basic overview)	3	8
	SECTION-B		
4	**Chemistry of Natural & Synthetic Rubbers** • Chemistry of natural rubber (cis-1,4 polyisoprene), Chemical reactions of rubber, Neoprene chemistry, Butyl rubber chemistry, Nitrile rubber chemistry, Synthetic elastomer chemistry, Structure–property relationships	4	6
5	**Chemistry of Natural Polymers & Biopolymers** • Cellulose chemistry, Starch chemistry, Lignin structure, Chitin &	5	7

	Chitosan, Proteins as polymers, Biodegradable polymers, engineering applications of biopolymers		
6	**Rubber Mastication & Compounding Chemistry** • Chemistry of mastication, Role of mechanical degradation, Compounding ingredients: Fillers, Plasticizers, Accelerators, Activators, Antioxidants, Vulcanization chemistry, Curing chemistry and crosslink structures	6	8

LIST OF PRACTICALS:

1. Identification of given polymeric samples.
2. To find out Acid value of a given sample.
3. Determination of Viscosity Average Molecular Weight of Polymer.
4. To find out Amine Value of a given sample.
5. Determination of Iodine Value of the oil Sample.
6. To determine the ester value of given sample.
7. To determine the epoxy equivalent weight of given sample.
8. Molecular weight determination of polymers.
9. Techniques of ensuring end capping polymerization.
10. Softening point and temperature stability testing of polymers.

TEXT BOOKS:

1. Rubber Materials and their components, by J. A. Brydson
2. Rubber Technology : by Maurice Morton
3. Natural Rubber Science and Technology, by Roberts
4. Handbook of Rubber Projects, Technology and Product Formulations, by SBP Consultants & Engineers (P) Ltd.
5. Raw Materials for Industrial Polymers , H Ulrich, Hanser Publication
6. Principles of Polymer Science, Bahadur&Sastry, Narosa Publishing Houses, 2002

COURSE OUTCOMES:

CO1	To know about the structure and properties relation of polymers.
CO2	To be able to utilize the knowledge for the polymerization reaction of polymers.
CO3	To be able to apply this knowledge for understanding the kinetics of polymers.
CO4	To be able to understand chemistry of rubber and its intermediates.
CO5	To be able to compare various biopolymers.
CO6	To be able to modified rubber material with the help of mastication process.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Polymer Processing Technology (BPRPC402)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		E	M	I	V	Total
3	0	0	3	3	50	50	0	0	100

COURSE OVERVIEW:

This course provides a comprehensive understanding of polymer processing techniques used in the manufacture of plastic and rubber products. It covers the rheological behavior of polymer melts, principles of extrusion, injection molding, compression molding, blow molding, thermoforming, calendaring, and processing of elastomers. The course also introduces processing defects, troubleshooting, and selection of appropriate processing methods for different polymeric materials and applications.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (45)
	SECTION-A		
1	**Introduction to Polymer Processing** Classification of polymer processing methods, thermoplastics and thermosets, polymer additives, compounding ingredients, process flow diagrams, selection criteria for processing techniques.	1	7
2	**Polymer Rheology and Melt Behavior** Viscosity, Newtonian and non-Newtonian flow, shear thinning, melt elasticity, viscoelasticity, temperature dependence of viscosity, rheological measurements and significance in processing.	3	7
3	**Extrusion Technology** Single screw extruder components, screw design, melting mechanism, die design, film extrusion, pipe and profile extrusion, process variables and defects.	4	8
	SECTION-B **Properties and Rubber Basics**		
4	**Injection and Compression Molding** Injection molding cycle, mold components, process parameters, defects; compression and transfer molding of thermosets and rubber compounds.	4	8
5	**Blow Molding, Thermoforming and Calendaring** Extrusion blow molding, injection blow molding, thermoforming techniques, calendaring of PVC and rubber sheets, applications.	5	7
6	**Rubber Processing and Troubleshooting** Mixing equipment (two-roll mill, internal mixer), vulcanization, curing, common processing defects, quality control and safety practices in polymer processing plants.	6	8

TEXT BOOKS:

1. Rauwendaal, C., Polymer Extrusion, Hanser Publishers.
2. Rosato, D. V. and Rosato, M. G., Injection Molding Handbook, Springer.
3. Tadmor, Z. and Gogos, C. G., Principles of Polymer Processing, Wiley.
4. Crawford, R. J., Plastics Engineering, Butterworth-Heinemann.
5. Manas Chanda and Salil K. Roy, Industrial Polymers, Specialty Polymers and Their Applications, CRC Press.
6. White, J. L., Rubber Processing: Technology, Materials and Principles**,** Hanser Publishers.
7. Morton, M., Rubber Technology, Springer.

COURSE OUTCOMES:

CO1	Explain the fundamentals of polymer processing methods and material characteristics.
CO2	Interpret rheological properties of polymer melts and their impact on processing behavior.
CO3	Describe the construction, working, and applications of extrusion processes.
CO4	Analyze injection molding and compression molding operations and optimize processing parameters.
CO5	Select suitable techniques such as blow molding, thermoforming, and calendaring for specific products.
CO6	Identify processing defects, troubleshoot problems, and apply quality and safety practices in polymer processing.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Material Science & Engineering (BCTPC403)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		E	M	I	V	Total
4	0	0	4	04	50	50	0	0	100

COURSE OVERVIEW:

This course introduces the fundamental principles of structure– property–processing–performance relationships in engineering materials, based on Foundations of Materials Science and Engineering. It covers atomic structure, bonding, crystal systems, defects, and diffusion, followed by phase diagrams and transformations. Students learn the mechanical behaviour of materials, major classes of materials (metals, ceramics, polymers, composites), and key aspects of corrosion and degradation, with emphasis on applications in chemical industries.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs. (48 hrs.)
	SECTION-A		
1	**Unit 1: Introduction & Atomic Structure** • Classification of materials (metals, ceramics, polymers, composites) • Structure–property–processing relationship • Atomic structure and periodic table • Interatomic bonding: ionic, covalent, metallic, van der Waals	1	8
2	**Unit 2: Crystal Structure and Imperfections** • Crystal systems and unit cells • FCC, BCC, HCP structures • Atomic packing factor, density • Miller indices (planes & directions) • Imperfections: point, line (dislocations), surface defects • Slip systems and plastic deformation basics		8
3	**Unit 3: Diffusion and Phase Diagrams** • Diffusion mechanisms (vacancy, interstitial) • Fick's First and Second Laws • Temperature dependence of diffusion • Phase diagrams: unary and binary systems • Isomorphous and eutectic systems • Lever rule		8

	SECTION-B		
4	**Unit 4: Mechanical Properties and Deformation** • Stress–strain behavior • Elastic and plastic deformation • Hardness, toughness, ductility • Strengthening mechanisms • Creep, fatigue, fracture	3,4	8
5	**Unit 5: Materials: Metals, Ceramics, Polymers, Composites** • Ferrous and non-ferrous alloys • Ceramics and glasses • Polymers: thermoplastics, thermosets, elastomers • Composite materials • Structure–property–application relationships	4,5	8
6	**Unit 6: Corrosion, Degradation and Applications** • Electrochemical corrosion • Types of corrosion (galvanic, pitting, etc.) • Oxidation and degradation • Prevention techniques • Materials selection in chemical industries	5,6	8

TEXT BOOKS:

1. Materials Science and Engineering - Callister W.D.
2. The Science and Engineering of Materials - Askeland & Phule
3. Introduction to Materials Science - Shackelford

ONLINE RESOURCES:

NPTEL	Video lectures, notes, assignments
MIT Open Courseware	Lecture notes, assignments, exams
edX/MITx	Online courses (MOOCs)
Youtube Channel	Video lectures
Nano Hub	Simulations, tools, tutorials

COURSE OUTCOMES:

CO1	Explain the fundamentals of atomic structure, bonding, and classification of engineering materials.
CO2	Describe crystal structures, defects, and diffusion mechanisms, and relate them to material behavior.
CO3	Interpret phase diagrams and phase transformations for analyzing material processing and stability.
CO4	Analyze mechanical properties and deformation mechanisms of materials under different loading conditions.

CO5	Evaluate corrosion, degradation, and failure mechanisms in engineering materials and suggest preventive measures.
CO6	Select appropriate materials for engineering applications based on structure– property relationships and service requirements.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Basics of Fluid Flow (BCTPE404)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	0	2	5	4	50	50	25	25	150

COURSE OVERVIEW:

This course provides the foundation for understanding the fluid behavior in engineering processes. It emphasizes the fundamental underlying fluid mechanical principles and application of those principles to solve real life problems. It will be imparting knowledge to enable efficient design, optimization, and sustainability of systems involving fluid flows.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (48)
	SECTION-A		
1	**Fluid Static and Its Application:** Properties of fluids and its classification, Pressure – Hydrostatic Equation, Pressure scales and Measurement, Manometers – different types of manometers	1	05
2	**Fluid Flow Phenomena and Its Basic Equations:** Types of flow, Mass velocity; average velocity; potential flow; streamlines, stream tubes, Reynolds number and its significance, Fluid flow over a flat plate, Boundary layer, Transition length, Wake formation, Continuity equation, Bernoulli's equation, Correction factors in Bernoulli's Equation, Pump Work	1,2	09
3	**Flow of Incompressible Fluids in Conduits and Thin Layers:** Shear stress distribution, relation between skin friction and wall shear, friction factor, Hagen Poiseuille Equation, effect of roughness, friction factor chart, Flow through noncircular cross sections, Equivalent diameter, Hydraulic radius, friction loss from sudden expansion or contraction of cross section and fittings and valves, Form friction and skin friction.	2,3	09
	SECTION-B		
4	**Flow Past Immersed Bodies:** Drag, Drag Coefficients, Stream lining, Stagnation pressure. Flow of fluid through a bed – Fluidization, Types of fluidization and applications. Motion of particles through fluids	3,4	08
5	**Transportation and Metering of Fluids:** Pipes, tubes, joints and fittings selection of pipe size, Valves like Gate, Globe, Plug cocks, Ball, Check valves Introduction to fluid flow measuring instruments like venturimeter, orifice meter, area meters like Rota meter, target meters, coriolis meters, magnetic meters etc., insertion meters like pitot tubes.	4,5	09

6	**Fluid Flow Through Machinery:** Pumps, its characteristics like developed head, power requirement, suction lift and cavitations; positive displacement pumps like reciprocating, rotary pumps, centrifugal pump, fans, blowers like positive displacement, centrifugal blowers, compressor, vacuum pumps, jet ejectors, comparison of devices for moving fluids.	5,6	08

LIST OF PRACTICAL / TUTORIALS:

1. To observe Reynolds's number and flow pattern in Reynolds Apparatus.
2. To study and verify Bernoulli's Theorem
3. Centrifugal Pump testing and characteristic curves.
4. To calibrate an Orifice meter and obtain it's coefficient of discharge.
5. To study a Rotameter and obtain it's coefficient of discharge.
6. To Study Notched Weirs Apparatus and obtain its discharge coefficient.
7. Pressure drop in various size of circular pipes.
8. Pressure drop and friction factor measurement in bend, valves and different fittings.
9. Estimation of viscosity of fluid by Stoke's law
10. Frictional pressures drop in annular pipe.

TEXT BOOKS:

1. L. W. McCabe, J. C. Smith, and P. Harriott, "Unit Operations of Chemical Engineering", Tata McGraw-Hill publication
2. Dr. R. K. Bansal, Fluid Mechanics and Hydraulic Machines, 9th Ed., Laxmi Publications.

REFERENCE BOOKS:

1. J. M. Coulson and J. F. Richardson, Chemical Engineering, Vol-1: Fluid Flow, Heat Transfer and Mass Transfer, Pergamon Press.
2. Gupta, V., Gupta, S. K., "Fundamentals of Fluid Mechanics," New Age International.
3. "Fluid Dynamics and Heat Transfer", James G. Knudson and Donald L. Katz, Mc Graw Hill Publication.
4. "Fluid Mechanics for Chemical Engineers" by James O. Wilkes, Prentice Hall, 2nd Edition.

ONLINE RESOURCES:

NPTEL (National Programme on Technology Enhanced Learning) video lectures
MIT Open Course Ware (OCW) – Lectures on Fluid Dynamics

COURSE OUTCOMES:

CO1	To explain the fundamental principles of fluid statics and dynamics.
CO2	To apply fluid laws and analyze fluid flow problems.
CO3	To predict flow of incompressible fluid in conduits and thin layers with frictional losses encountered in flow situations.
CO4	To analyze flow of fluids past immersed bodies with industrial applications of Fluidization.
CO5	To estimate the performance of various fluid transport and metering device.
CO6	To interpret working principles, select and evaluate fluid machinery.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Polymer Processing Technology – Practical (BPRVS405)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		E	M	I	V	Total
0	0	2	2	1	0	0	25	35	50

List of Practical: (Any Ten)

1. Determination of melt flow index (MFI) of thermoplastic materials.
2. Study of capillary rheometer and viscosity measurement.
3. Demonstration and operation of single screw extruder.
4. Preparation of standard specimens by injection molding.
5. Compression molding of thermosetting polymer.
6. Transfer molding of thermoset or rubber compound.
7. Identification and analysis of common molding defects.
8. Rubber compounding on a two-roll mill.
9. Determination of cure characteristics using a moving die rheometer.
10. Thermoforming of polymer sheets.
11. Preparation and testing of blown film or cast film samples.
12. Industrial visit to a polymer processing unit and submission of a report.

COURSE OUTCOMES:

CO1	Perform basic polymer processing experiments such as melt flow index determination, rheological measurements, extrusion, injection molding, compression molding, and thermoforming.
CO2	Analyze the effect of processing parameters on product quality, identify common processing defects, and interpret curing characteristics of rubber compounds.
CO3	Demonstrate safe handling of polymer processing equipment and prepare technical reports based on experimental observations and industrial visits.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Universal Human Values (BUNVA431)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
2	0	0	2	2	25	25	0	0	50

PREREQUISITES: Students should have a basic awareness of human values, ethics, and social responsibilities. An openness to self-reflection, critical thinking, and willingness to explore personal beliefs and behavior is essential. Familiarity with interpersonal relationships, communication skills, and societal issues will be helpful. No advanced technical knowledge is required, but a positive attitude toward learning about harmony at individual, family, societal, and global levels will support better understanding of the course content.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (30)
	SECTION-A		
1	**Introduction to Value Education :** Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity–the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity–Current Scenario, Method to Fulfill the Basic Human Aspirations.	1	5
2	**Harmony with self:** Importance of self-awareness: Self-reflection. Who am I? – Imagination & Action. Understanding & exploring needs of self and body. Self -Exploration – A Process of Fundamental Human Desires – Happiness, Peace and Contentment for Material, Behavioral and Intellectual well Being. Holistic understanding of mind & body. The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Program to ensure self-regulation and Health	2	5
3	**Harmony in the Family:** Harmony in the Family – the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation.	3	5
	SECTION-B		
4	**Harmony in the Society:** Understanding Harmony in the Society: Resolution, Prosperity, fearlessness (trust) and co-existence as Comprehensive human goals, Visualizing a universal harmonious order in society.	4	5
5	**Harmony in the Nature/ Existence:** Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at all levels, The Holistic perception of Harmony in Existence.	5	5
6	**Harmony for Global peace:** Understanding global peace. Concept of वसुधैव कुटुम्बकम- one earth one family. Fostering Universal brotherhood and unity, collaborative problem solving, respecting cross cultural communication. Famous anecdote and relevant case studies	6	5

TEXT BOOKS:

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-47-1.
2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2.

REFERENCE BOOKS:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi,, Human Values, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book)
4. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
5. E. F Schumacher, "Small is Beautiful".
6. Cecile Andrews, "Slow is Beautiful".
7. J C Kumarappa, "Economy of Permanence"
8. PanditSunderlal, "Bharat Mein Angreji Raj"
9. Dharampal , "Rediscovering India"
10. Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
11. Maulana Abdul Kalam Azad , "India Wins Freedom"
12. Romain Rolland, "Vivekananda" (English)
13. Romain Rolland, "Gandhi" (English)

ONLINE RESOURCES:

- https://www.uhv.org.in
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

COURSE OUTCOMES:

CO1	Understand and analyze the concept of value education, self-exploration, and the basic human aspirations of continuous happiness and prosperity, along with methods to achieve them.
CO2	Develop self-awareness through self-reflection and explore the harmony between self and body for achieving holistic well-being and self-regulation.
CO3	Inculcate values such as trust and respect to strengthen harmony in family and interpersonal relationships.
CO4	Evaluate the role of individuals in building a harmonious society based on resolution, prosperity, fearlessness, and co-existence.
CO5	Understand the interconnectedness in nature and apply the principles of mutual fulfillment and co-existence for sustainable living.
CO6	Develop a global perspective by promoting universal brotherhood, cultural harmony, and collaborative problem-solving for achieving global peace.