UPL UNIVERSITY
OF
SUSTAINABLE TECHNOLOGY

Evaluation Reforms NEP 2020

2nd Year Bachelor of Engineering

Chemical Engineering

Shroff S R Rotary Institute of Chemical Technology,

Ankleshwar

EFFECTIVE FROM A.Y. 2026-2027

Teaching Scheme for
Second Year Bachelor of Chemical Engineering

Semester-III (Chemical Engineering) Structure

Sub Code	Subject	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
BCHPC301	Fluid Flow Operation	3	0	2	5	4	50	50	25	25	150
BCHPC302	Material and Energy Balance Calculation	3	1	0	4	4	50	50	25	25	150
BCHPC303	Mechanical Operation	3	0	2	5	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	**14**	**2**	**10**	**26**	**21**	**250**	**250**	**150**	**150**	**800**

Semester-IV (Chemical Engineering) Structure

Sub Code	Subject	Teaching Scheme (hrs. / week)			Total	Credit	Examination Scheme				
		L	T	P	Hr.	C	SEE	CCE	I/TW	V	Total
BCHPC401	Chemical Engineering Mathematics	3	1	0	4	4	50	50	25	25	150
BCHPC402	Chemical Engineering Thermodynamics-I	3	1	0	4	4	50	50	25	25	150
BCHPC403	Process Heat Transfer	3	0	2	5	4	50	50	25	25	150
BCHVS404	Chemical Process Technology Lab	0	0	2	2	1	0	0	25	25	50
BCHPE405/ BCHPE406	Chemical Process Technology/ Sustainable Technology	3	0	0	3	3	50	50	0	0	100
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		**16**	**2**	**4**	**22**	**20**	**300**	**300**	**100**	**100**	**800**
BXXMD451	MDC-1	3	1	0	4	4	50	50	25	25	150

L	Lecture	SEE	Semester End Examination
T	Tutorial	CCE	Continuous and Comprehensive Examination
P	Practical	I	Internal
C	Credit	TW	Term Work
		V	Viva

Open Elective - I (Semester – IV)
(Open Electives for Chemical Engineering Students)

Sr.	Course Code	Course	Offered by (Department)
1	BCOOE441	Emerging Technologies	Computer Engineering
2	BCTOE441	Materials Engineering	Chemical Technology
3	BEEOE441	Fundamentals of Renewable Energy Technologies	Electrical Engineering
4	BEVOE441	Industrial Wastewater Treatment	Environmental Science & Technology
5	BMEOE441	Basics of Maintenance Engineering	Mechanical Engineering
6	BITOE441	IT for Sustainability	Information Technology

**Detailed syllabus separately available*

MDC - I (Semester – IV)
Multidisciplinary Minor Course (MDC-1) for Chemical Engineering Students

Sr.	Course code	MDC-1 (Semester-4)	Minors (Certification)	Offered by
1	BMEMD451	Boiler and Steam Utility Systems	Mechanical Aspects of Process Utilities	Mechanical Engineering Department
2	BEVMD451	Introduction to Environmental Management	Environmental Management	Environmental Science & Technology
3	BCOMD451	Fundamentals of Data Science	Data Science	Department of Computer Engineering
4	BITMD451	Fundamentals of Cloud and Virtualization	Cloud computing	Department of Information Technology
5	BEEMD451	Basics of Measuring Instruments	Industrial Instrumentation and Automation	Department of Electrical Engineering
6	BPRMD451	Fundamentals of Pharmaceutical	Pharmaceutical Engineering	Department of Pharmaceutical
7	BGCMD451	Fundamentals of Materials Science and Engineering	Ceramics Engineering	Department of Glass & Ceramics Technology
8	BDPMD451	Introduction to Paint and Coating Technology	Paint Technology	Department of Dyes & Pigments Technology
9	BPRMD451	Chemistry of Polymers	Polymer Science and Engineering	Department of Polymer & Rubber Technology

**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

COURSE OVERVIEW:
This course introduces second-year B.E. students to advanced mathematical techniques such as Laplace Transforms, Fourier series and Integrals, Double Integrals, and Complex Variables. It focuses on developing analytical and problem-solving skills for engineering applications. The course enables students to apply mathematical tools effectively in solving real-world engineering problems.

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
Fluid Flow Operations (BCHPC301)

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:

Fluid flow operations form a fundamental part of chemical engineering processes involving the transportation, measurement, and control of fluids. The course introduces the principles of fluid statics and fluid dynamics, flow through pipes and packed beds, and techniques for flow measurement. Students will develop the ability to analyse flow behavior, estimate pressure losses and energy requirements, and select appropriate fluid-moving equipment used in chemical process industries.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Introduction to Fluid Mechanics**: Fluid, Rheology: Fluid types, Thermodynamic properties, temperature dependency of viscosity. **Fluid statics and pressure measurement:** Pressure concepts-absolute, gauge and vacuum pressure, Hydrostatic equilibrium and hydrostatic law, Pressure variation in static fluids, Hydrostatic equilibrium in gravitational and centrifugal fields, Measurement of pressure using manometers, Applications of fluid statics in engineering systems	1	7
2	**Fluid Flow Phenomena:** Classification of fluid flow, Newton's law of viscosity and power law model for non-Newtonian fluid, Boundary layer theory and dimensional analysis, Buckingham π theorem and Rayleigh's method of dimensional analysis.	2	8
3	**Basic Equations of Fluid Flow:** Equation of continuity, Navier Stokes equation, Eulers Equation, Macroscopic momentum balance, kinetic energy and momentum correction factor, Bernoulli's equation, pump work in Bernoulli's equations.	3	6
	SECTION-B		
4	**Flow Through Pipes:** Shear stress and velocity distribution in fully developed laminar flow in pipes, Friction factor; Fanning and Darcy friction factor, Hagen Poiseulle equation; Turbulent flow: eddy viscosity, skin and form friction, Moody's chart, head losses in pipes and fittings. Flow of Compressible Fluids: Mach No, Sonic subsonic and supersonic flow.	4	10

5	**Flow Past Immersed bodies:** Drag force, drag coefficient, Stoke's law and its application in viscosity measurement, terminal settling velocity.	5	4
6	**Transportation and Metering of Fluids Flow:** **Pipe, fitting and valves**: Nominal pipe size, Schedule no. and its calculation, tube size, BWG, selection of pipes, flow control valves. **Flow meters**: Local velocity measurement pitot tube, Orifice meter, flow nozzle, venture meter, Rota-meter, digital flow meters, weirs and notches. **Pumps:** Classification of pumps, selection of pumps, NPSH, cavitation, efficiency and performance curves, pump maintenance. Compressor, Fans, Blowers.	6	10

LIST OF PRACTICAL:

1. Determination of Reynolds number and identification of flow regimes.
2. Verification of Bernoulli's theorem.
3. Determination of friction factor in pipe flow.
4. Flow measurement using Venturimeter.
5. Flow measurement using Orifice meter.
6. Calibration of Rotameter.
7. Determination of minor losses in pipe fittings.
8. Characteristics of Centrifugal Pump.
9. Study of flow through packed bed.
10. Determination of equivalent length of pipe fittings.
11. Determination of viscosity by Stokes' law.
12. Flow measurement using notches.

TEXT BOOKS:

4. McCabe, W.L.; Smith. J.C.; Harriot, P. Unit Operations in Chemical Engineering, 7th Ed.; Tata McGraw Hill Publications: NY, 2017
5. Dr R.K. Bansal, Fluid Mechanics and Hydraulic Machines; 9th ed.; Laxmi Publications, New Delhi, 2010.

REFERENCE BOOKS:

1. Dr. A. K. Jain, Fluid Mechanics including hydraulic machines; 12th ed., Khanna Publishers, New Delhi, 2014.
2. A.P. Kulkarni, Chemical Engineering Fluid Mechanics, 4th ed., Nirali Prakashan, Pune, 2019
3. F. M. White, Fluid Mechanics, 9th Ed., McGraw Hill, 2022
4. G. K. Batchelor, An Introduction to Fluid Dynamics, 2nd Ed., Cambridge Univ Press, 2000.
5. V.V. Gupta, S. K. Gupta, Fluid Mechanics and Its Applications, 3rd Ed., New Age International Publ., 2015.

ONLINE RESOURCES:

- https://onlinecourses.nptel.ac.in/noc22_ce85/
- https://ocw.mit.edu/courses/16-01-unified-engineering-i-ii-iii-iv-fall-2005-spring-2006/pages/fluid-mechanics/
- https://fm-nitk.vlabs.ac.in/List%20of%20experiments.html

COURSE OUTCOMES

CO-1	**Understand** fluid properties, rheology, and analyze fluid statics and pressure measurement systems.
CO-2	**Classify** fluid flow and apply viscosity laws, boundary layer concepts, and dimensional analysis techniques.
CO-3	**Apply** fundamental equations (continuity, momentum, and energy balance) to analyze fluid flow systems.
CO-4	**Analyze** flow through pipes and compressible flow systems, including friction losses and flow regimes.
CO-5	**Evaluate** forces on immersed bodies and apply concepts like drag, settling velocity, and Stokes law.
CO-6	**Select** fluid transport systems, flow measuring devices, and pumps for engineering applications.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester III
Material and Energy Balance Calculation (BCHPC302)

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:

Chemical engineering focuses on the transformation of raw materials into useful products through chemical and physical processes. Stoichiometry, or material and energy balance calculations, forms a core component of this discipline. This course covers the qualitative and quantitative analysis of material and energy changes in chemical processes. Students will develop the ability to perform material and energy balance calculations required for the analysis and design of chemical reactors, process equipment, and overall chemical process systems.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Basic Chemical Engineering Calculation**: Role of material and energy balances in chemical industries, Process flow diagrams and process variables, Units and dimensions (SI system), Unit conversion methods, Significant figures and rounding, Basis of calculation, Density, specific gravity and related calculations	1	7
2	**Composition of Mixtures and Stoichiometry**: Mole concept and molecular weight, Composition of mixtures, Mass fraction, Mole fraction, Volume fraction, Concentration units (ppm, molarity, normality), Ideal gas law and gas mixtures, Partial pressure and Dalton's law, Basic stoichiometric calculations	2	8
3	**Material Balance on Non-reacting Systems:** Conservation of mass principle, General material balance equation, Steady state and unsteady state systems, Material balance on simple non-reactive processes, single unit process calculations, Material balance on multiple unit processes, Recycle, bypass and purge calculations	3	8
	SECTION-B		
4	**Material Balance on Reacting Systems:**: Limiting and excess reactants, Conversion, yield and selectivity, % Excess, Introduction to combustion, Calorific value, combustion calculations	4	7
5	**Energy Balance Thermo-Physics:** Law of conservation of energy Forms of energy in process systems, Heat and work interactions in chemical processes, General energy balance equation, Steady-state and unsteady-state energy balances, Energy balance for closed and open systems.	5	7

6	**Energy Balance Thermo-Chemistry:** Forms of energy in chemical processes, Heat capacity, sensible heat calculations, Energy balance without and with chemical reaction, Heat of formation and combustion, Adiabatic process calculations, Hess's Law.	6	8

LIST OF TUTORIAL:

1. Introduction and unit conversion
2. Composition of Mixtures
3. Ideal gas law and gas mixtures
4. Fundamentals of Material Balance - theory
5. Fundamentals of Material Balance - numericals
6. Material balance on multiple unit processes
7. Material Balance with Chemical Reaction - theory
8. Material Balance with Chemical Reaction - numericals
9. Energy balance without reaction
10. Energy balance without reaction

TEXT BOOKS:

1. Bhatt, B. I. Vora, S. M., "Stoichiometry", Tata McGraw Hill, New Delhi, 2nd Ed., 2004.
2. Himmelblau, D. M., "Basic Principles and Calculations in Chemical Engineering", Prentice Hall of India, New Delhi, 8th Ed., 2012.
3. Felder, R. M., Rousseau, R. W., "Elementary Principles of Chemical Processes", John Wiley and Sons, 3rd Ed., 2005.

REFERENCE BOOKS:

1. Narayanan. K.V., Lakshmikutty. B., "Stoichiometry and Process Calculations", Prentice Hall of India, New Delhi, 2nd Ed., 2009.
2. Venkatramani, V., Ananatharaman, N., Begum, S., "Process Calculations", Prentice Hall of India, 2nd ed., 2011.
3. Hougen, O. A., Watson R. M., Ragatz R.A., "Chemical Process Principles Part I", CBS Publications, 2nd Ed., 1976.

ONLINE RESOURCES:

- https://nptel.ac.in/courses/102106069

COURSE OUTCOMES

CO1	**Recall** basic terms, units, physical properties, and laws used in chemical engineering calculations.
CO2	**Describe** different methods for expressing composition and concentration of mixtures.
CO3	**Explain** the principle of conservation of mass and formulate simple material balance equations.
CO4	**Solve** material balance problem with chemical reactions
CO5	**Outline** the basic concept of energy balance in chemical processes
CO6	**Evaluate** sensible heat requirements and heat capacity effects in chemical processes using appropriate thermodynamic relations

UPL University of Sustainable Technology

Shroff S R Rotary Institute of Chemical Technology
B.E. Semester III
Mechanical Operations (BCHPC303)

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:

Mechanical operations form a fundamental part of chemical engineering processes involving the handling and processing of solid particles and multiphase systems. The course covers operations such as size reduction, screening, filtration, sedimentation, mixing, and conveying of solids. Students will develop an understanding of the principles governing these operations and the construction and working of equipment used in chemical process industries, enabling them to analyse and select suitable equipment for solid handling and separation processes.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Characterization of solid particles:** Particle shape and size, Sphericity, Mixed Particle Sizes and size analysis, Differential and Cumulative Analysis, Specific surface of a mixture, Average particle size, Number of particles in mixture. Screen Analysis, Standard screen series, Capacity and Effectiveness of Screens, Ideal and Actual Screens, Screening Equipment.	1	8
2	**Size Reduction and Enlargement:** Principle of size reduction, Laws of Size reduction and Work Index, Crushing efficiency, Open and closed circuit grinding, Size-reduction equipment, Critical speed of ball mill, Angle of Nip, Introduction to size-enlargement, size-enlargement equipment.	2	7
3	**Fluidization:** Terminal settling velocity, Drag & Drag coefficient, Free settling and Hindered settling, Motion of spherical particles in Stoke's region, and Newton's region, Friction in flow through a bed of solid particles, Pressure drop calculations- Kozeny-Carman equation, Burke-Plummer, Ergun equation, Conditions for fluidization, Minimum fluidization velocity, types of fluidization, application of fluidization, Slurry and Pneumatic transport.	3	8
	SECTION-B		
4	**Solid-Liquid Separation:** Sedimentation, factors affecting the rate of sedimentation, Sedimentation Equipment: thickener, clarifier and settling tank: Principle, construction, and working. Cyclones.	4	8

	Filtration: Mechanism of filtration, Principles of cake filtration, filter medium resistance, types, factors affecting filtration rate, use of filter aids, Plate and frame filter press, rotary vacuum drum filter.		
5	**Mixing and Agitation:** Types of agitators, Flow patterns in agitated vessels, Concept of vortexing, Standard turbine design, Power consumption in agitated vessels. Principles of mixing, mixing index. Type of mixers: Principle, construction, working.	5	8
6	**Sampling, Storage and Conveying of Solids:** Sampling and storage of solids, Open and closed storage, Bulk and bin storage, Introduction of Conveyors and its various types.	6	6

LIST OF PRACTICAL:

1. Determine screen efficiency of the sample using sieve analysis.
2. Assess screen efficiency of the sample using a vibrating screen.
3. Determine various constant, and work index for a roll crusher.
4. Determine various constant, and work index for a jaw crusher.
5. Determine various constant, and work index with for a ball mill.
6. Calculate overall efficiency of a cyclone separator.
7. Perform batch sedimentation tests.
8. Perform a vacuum filtration operation.
9. Examine effect of filter media resistance on filtration rate in gravity filtration.
10. Study operation of a filter press.
11. Investigate minimum fluidization velocity.
12. Study material size reduction using a drop weight crusher.

TEXT BOOKS:

1. McCabe, W. L., Smith J. C., Harriott P., “Unit Operation in Chemical Engineering” 7th Ed., McGraw Hill, 2014.
2. Narayan, C. M., Bhattacharya, R. C., “Mechanical Operations for Chemical Engineers”, Khanna Publications, 2010.

REFERENCE BOOKS:

1. Perry, R. H., Chilton, C.H., “Chemical Engineers Handbook”, McGraw Hill., 7th Ed. 2018.
2. Patil, K.D., “Mechanical Operations Fundamental Principles and Applications”, Nirali Prakashan, 2016.
3. Richardson, J. F., Harker, J. H., “Coulson and Richardson’s Chemical Engineering”, Vol. 2. Butterworth-Heinemann Pub, 5th Ed., 2002.

ONLINE RESOURCES:

- https://onlinecourses.nptel.ac.in/noc22_ch64/preview

COURSE OUTCOMES

CO1	**Characterize** particles and study the size analysis of particles to meet the needs of chemical industries.
CO2	**Describe** the size reduction equipment for solid-solid operations along with their applicability.
CO3	**Discuss** the flow of particles through fluids.
CO4	**Evaluate** the parameters of sedimentation and filtration
CO5	**Understand** the various mixing and agitation operations and to evaluate the power requirements.
CO6	**Explain** the concept of sampling, storage & conveying of solids.

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

COURSE OVERVIEW: The rationale of the curriculum is to help students to express their original ideas in English and also develop interest in language and literature with a focus on comprehension, and reading, speaking and writing skills.

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:

2. Lata and Kumar, Communication Skills, OUP, New Delhi, 2018.
3. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 2014.
4. Mohapatra and Sreejesh S., Case Studies in Business Ethics and Corporate Governance, Pearson, UP, 2013.
5. Ramesh and Ramesh, the Ace of Soft Skills, Pearson, UP, 2019.
6. 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

COURSE OVERVIEW:

This course is designed to provide a comprehensive understanding of the principles and practices of Yoga for overall well-being. It integrates theoretical knowledge with practical training in Asanas, Pranayama, and Meditation to promote physical fitness, mental balance, and emotional stability. The course emphasizes the role of Yoga in preventing and managing lifestyle diseases, enhancing concentration, reducing stress, and developing a healthy daily routine. Through regular practice and conceptual learning, students will cultivate self-discipline, body awareness, and a holistic approach toward health and well-being.

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 AND TERM WORK (9 to 10 Experiments/TW)

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

- https://www.ayush.gov.in/
- https://svyasa.edu.in/
- https://www.artofliving.org/
- 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
Chemical Engineering Mathematics (BCHPC401)

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:

Chemical Engineering Mathematics provides the mathematical foundation required for modeling and solving chemical engineering problems. The course introduces analytical and numerical techniques for solving algebraic equations, differential equations, and engineering models commonly encountered in transport phenomena, reaction engineering, and process design. Students will develop the ability to apply appropriate mathematical methods to analyse and solve problems arising in chemical engineering systems.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Linear algebraic equations:** Solution of linear algebraic equations by Gauss elimination, Gauss Seidel and Gauss Jordan methods.	1	7
2	**Nonlinear algebraic equations:** Solution of nonlinear algebraic equations by graphical, Newton Raphson, secant, bisection, and false position methods.	2	8
3	**Finite differences and Interpolation:** Finite differences, interpolation (with and without) With- Newton's Forward and backward interpolation, central differences Unequal- Lagrange's and Newton's divided interpolation. Inverse Interpolation.	3	7
	SECTION-B		
4	**Curve Fitting and Regression:** Co-efficient of variance and determination, regression analysis, Method of least squares, fitting of straight line, second degree curve, exponential curve and geometric curve, power law, saturation growth rate model and polynomial equations.	4	9
5	**Numerical Differentiation and Integration:** Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rule, Numerical Differentiation: Derivative formula for equal and unequal intervals	5	7
6	**Numerical Solution of Ordinary Differential Equations** Types of errors and Stability Single-Step Methods: Taylor Series, Euler's Method, Improved Euler's Method (Heun's Methods), Runge-Kutta Method Multi-step Methods: Milne's Method	6	7

LIST OF TUTORIAL:

1. Solve problems on matrix algebra and eigenvalues.
2. Apply numerical methods for solving linear algebraic equations.
3. Apply numerical methods for solving nonlinear equations.
4. Work on interpolation and regression problems.
5. Use least squares method and saturation growth rate model.
6. Implement numerical integration techniques.
7. Perform curve fitting and regression analysis.
8. Carry out numerical differentiation.
9. Solve ODEs using Taylor Series, Euler's Method, Heun's Method, and Runge–Kutta Method.
10. Analyze case studies on chemical engineering mathematical models.

TEXT BOOKS:

1. Chapra, S. C., Applied Numerical Methods with MATLAB for Engineers and Scientists, McGraw-Hill.
2. Gupta, S. K., Numerical Methods for Engineers, New Age International.
3. Shah R.C. Numerical Methods in Chemical, Mechatronics and Robotics & Automation, Books India Publication.

REFERENCE BOOKS:

1. Constantinides, A. and Mostoufi, N., Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall.
2. Kreyszig, E., Advanced Engineering Mathematics, Wiley.
3. Beers, K. J., Numerical Methods for Chemical Engineering Applications in MATLAB, Cambridge University Press.

ONLINE RESOURCES:

- https://nptel.ac.in/courses/127106019

COURSE OUTCOMES:

CO1	**Apply** matrix algebra and linear algebra concepts to solve engineering problems.
CO2	**Analyze** and solve algebraic equations using numerical methods.
CO3	**Estimate** missing data using interpolation and finite difference methods.
CO4	**Develop** regression and curve fitting models for experimental data.
CO5	**Use** numerical integration and differentiation techniques.
CO6	**Solve** ODEs and BVPs using numerical methods.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Chemical Engineering Thermodynamics – I (BCHPC402)

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:

Chemical engineering involves the transformation of materials and energy through physical and chemical processes. Thermodynamics provides the fundamental principles required to analyse these transformations. This course introduces the basic concepts and laws of thermodynamics and their application to engineering systems. It covers energy interactions, behavior of pure substances, thermodynamic property relations, and selected applications such as refrigeration, liquefaction, and heat effects of chemical reactions. The knowledge gained provides a foundation for advanced topics in chemical engineering thermodynamics and process design.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Basic Concepts and First Law of Thermodynamics**: Scope and importance of thermodynamics in chemical engineering, Thermodynamic systems: open, closed and isolated, Intensive and extensive properties, State and path functions, Zeroth law of thermodynamics and temperature scales, Forms of energy, heat and work, First law of thermodynamics for closed systems, Internal energy, enthalpy and heat capacities	1	8
2	**First Law for Flow Processes**: Control volume concept, Flow work and shaft work, Steady flow energy equation (SFEE), Energy balance for open systems, Throttling process and Joule–Thomson effect (conceptual), Nozzles and diffusers	2	7
3	**P–V–T Behaviour of Pure Substances:** Ideal gas equation of state, Compressibility factor and Z-charts, Real gas equations of state (Van der Waals, Virial equation of state. Redlich–Kwong equation, Soave–Redlich–Kwong (SRK) equation, Other cubic equations of state), Principle of corresponding states, Critical properties of fluids	3	8
	SECTION-B		
4	**Second Law of Thermodynamics:** Limitations of the first law, Kelvin–Planck and Clausius statements, Heat engines and Carnot cycle, Entropy and entropy change, Reversible and irreversible processes, T-S diagrams	4	7

5	**Thermodynamic Property Relations:** Fundamental property relations for thermodynamic systems, Gibbs, Helmholtz free energies, Maxwell relations, Application of Maxwell relations, Clapeyron and Clausius–Clapeyron equations, Calculation of ΔH and ΔS for real substances, Thermodynamic diagrams.	5	8
6	**Applications of Thermodynamics**: Heat effects accompanying chemical reactions, Principles of refrigeration, Heat pump, Liquefaction of gases, Choice of refrigerant, Coefficient of Performance (COP), Vapor compression cycle, Absorption refrigeration, Air refrigeration, Applications of thermodynamic laws in chemical processes.	6	7

LIST OF TUTORIAL:

1. Introduction to thermodynamics
2. First law of thermodynamics for closed system
3. First Law for flow processes
4. PVT behaviour and equation of states
5. Comparison of EoS – numerical and virtual study
6. Second Law of Thermodynamics
7. Concept of entropy and calculation of entropy change
8. Thermodynamic Property Relations - theory
9. Calculation of thermodynamic properties
10. Applications of Thermodynamics

TEXT BOOKS:

1. Smith, J. M., Vanness H. C., Abbott, M. M., Swihart, M. T., "Introduction to Chemical Engineering Thermodynamics", McGraw- Hill Companies, Inc. 8th Ed., 2018.
2. Narayanan, K. V., "A textbook of Chemical Engineering Thermodynamics", 2nd Ed., Prentice-Hall of India Pvt. Ltd., 2013.

REFERENCE BOOKS:

1. Kyle, B.G., "Chemical and Process Thermodynamics"; Prentice-Hall Inc. 1992.
2. Rao, Y. V. C., "Introduction to Thermodynamics", 2nd Ed., Wiley Eastern Limited, 2004.
3. Elliot, J. R., Lira, C.T., "Introductory Chemical Engineering Thermodynamics", 2nd Ed., Prentice-Hall Inc. 2012.
4. Jefferson W. Tester and Michael Modell, "Thermodynamics and Its Applications", 3rd Ed., Prentice Hall, 1997.
5. Robert C. Reid, John M. Prausnitz, and Bruce E. Poling, "The Properties of Gases and Liquids"; 2nd Ed., McGraw-Hill, New York, 1966.

ONLINE RESOURCES:

- https://nptel.ac.in/courses/103104151

COURSE OUTCOMES

CO1	**Identify** basic thermodynamic terms, systems, properties, and laws used in engineering analysis.
CO2	**Describe** the first law of thermodynamics and identify different forms of energy interactions in closed and open systems.
CO3	**Explain** the P–V–T behaviour of pure substances and the basic concepts of equations of state.
CO4	**Interpret** the second law of thermodynamics and the concept of entropy for engineering processes.
CO5	**Outline** thermodynamic property relations and their significance in engineering calculations.
CO6	**Solve** thermodynamic problems in refrigeration and reaction heat analysis for efficient energy use.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Process Heat Transfer (BCHPC403)

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

COURSE OVERVIEW:

Process Heat Transfer deals with the principles governing heat transfer in chemical engineering processes. The course introduces the basic modes of heat transfer (conduction, convection, and radiation) and their application in engineering systems. It also covers the analysis of heat transfer processes and the operation of common heat transfer equipment used in chemical industries. Students will develop the ability to understand heat transfer mechanisms and apply this knowledge to analyse and design heat transfer systems in process industries.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Conduction**: Modes of Heat Transfer, Fourier's law, Thermal conductivity, Steady state conduction of heat through a composite solid, Steady state heat conduction through a Variable area, Thermal Insulation, Critical radius of insulation. Unsteady state heat transfer, Lumped heat capacity analysis.	1	8
2	**Convection**: Classification of convection, Concept of heat transfer coefficients, Dimensionless numbers, Boundary layers theory, Heat transfer correlations for free convection & forced convection from different shapes, Correlations for the heat transfer coefficient: Internal flows and External flows, Momentum and heat transfer analogies.	2	8
3	**Heat exchangers:** Heat transfer equipment, Classification of Heat exchangers, Flow arrangement in heat exchangers, fouling factor, LMTD, Overall heat transfer coefficient, Construction of Shell & Tube heat exchangers, Double pipe heat exchangers, Plate Heat exchangers, heat transfer from extended surfaces- The fins. Effectiveness-NTU method of heat exchanger analysis.	3	8
	SECTION-B		
4	**Boiling and Condensation:** Boiling phenomenon, Hysteresis in the Boiling Curve, Mechanism of nucleate Boiling, Correlations for pool boiling heat transfer, The condensation phenomenon, Film condensation on vertical surface, Effect of non-condensable gases, Drop-wise condensation.	4	7
5	**Radiation:** Basic laws of radiation, transmissivity, Absorptivity, Reflectivity, Emissivity of black bodies and gray bodies. Application	5	7

	of thermal radiation: Radiation Transfer between surfaces, view factor.		
6	**Evaporation**: Principle of evaporation and evaporators, Types of evaporators, Single effect evaporator calculation, Multiple effect evaporators, Vapor recompression.	6	7

LIST OF PRACTICAL:

1. Overall thermal conductivity of composite wall
2. Thermal conductivity of metal rod
3. Critical heat flux in pool boiling
4. Heat transfer coefficient in double pipe heat exchanger
5. Radiation heat transfer and emissivity of test plate
6. Performance of shell-and-tube heat exchanger
7. Performance of plate-type heat exchanger (U, effectiveness, flow rate effects)
8. Heat transfer coefficient for bare pipe and fins; heat exchanger study
9. Radiation heat transfer by black body; Stefan–Boltzmann constant
10. Comparative study of horizontal and vertical condenser.
11. Heat Transfer in Natural Convection
12. Heat Transfer in Forced Convection

TEXT BOOKS:

1. Dutta, B. K., "Heat Transfer-Principles & Applications", PHI Learning Pvt. Ltd., 1st Ed., 2006.
2. Kern, D. Q., "Process Heat Transfer", McGraw Hill, 1950.

REFERENCE BOOKS:

1. Holman, J. P., "Heat Transfer", McGraw-Hill, 10th Ed., 2010.
2. McCabe, W. L, Smith, J. C., Harriott, P., "Unit Operations of Chemical Engineering", 7th Ed., McGraw-Hill Book Co, 2005.

ONLINE RESOURCES:

- https://nptel.ac.in/courses/103105140

COURSE OUTCOMES:

CO1	**Identify** the different modes of heat transfer and conduction heat transfer.
CO2	**Understand** the concept of convection to operate heat exchangers.
CO3	**Choose** proper heat transfer equipment for various applications.
CO4	**Apply** boiling and condensation phenomenon to various applications.
CO5	**Determine** the amount of heat transfer by radiation effect.
CO6	**Explain** the concept of evaporation with various evaporators.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester III
Chemical Process Technology Lab (BCHVS404)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
0	0	02	02	01	00	00	25	25	50

COURSE OVERVIEW:

The Chemical Process Technology Laboratory provides students with practical exposure to selected chemical manufacturing processes at the laboratory scale, with emphasis on safe laboratory practices. The course introduces small-scale preparation of selected organic and inorganic chemical products. Through these activities, students develop essential practical skills in handling chemicals and laboratory glassware, observing process steps and analysing the outcomes of chemical processes.

COURSE CONTENT

Sr. No.	Topics	Hrs. (30) Practical
1	**Chemical Laboratory Practices:** **Glassware, Equipment, Safety and Waste Management:** Importance of glassware in chemical laboratories, Common Laboratory Glassware, Laboratory Instruments and Apparatus, Cleaning methods, Handling fragile glassware, Use of PPE, General lab safety rules, Hazard identification, Purpose and importance of MSDS, Waste disposal methods.	6
2	**Inorganic Chemical Processes**: Solvay Process for Sodium Bicarbonate, Preparation of Inorganic Compounds, Dye and Pigment Preparation, Water and Solid Waste-Based Processes, Process Parameters and Analysis.	12
3	**Organic Chemical Processes:** Introduction to Organic Chemical Processes, Transesterification reaction, Fermentation process, Oil Analysis Experiments, Process Calculations and Results.	12

LIST OF PRACTICAL:

1. Identification and Use of Personal Protective Equipment (PPE)
2. Fire Safety and Use of Fire Extinguishers
3. Chemical Hazard Identification (Labeling & MSDS Study)
4. Manufacturing of Sodium Bicarbonate ($NaHCO_3$) – Solvay process.
5. Preparation of mordant yellow.
6. Handmade Paper Sheet Formation.
7. Pulp Formation from Waste Paper.
8. Extraction of Sugar Crystals from Sugarcane Juice.

9. Determination of Saponification Value of Oil Sample.
10. Determine the %Purity of Given Sample of Aspirin.
11. Production of Bioethanol through Fermentative Method.
12. Determination of Acid Value of oil Sample.

TEXT BOOKS:

1. Dryden, C. E., of Chemical East West Press. Pvt. Ltd., New Delhi, 3rd Ed., 1997.
2. Austin, G. T., Chemical Process McGraw Hill, 5th Ed., 1984.

REFERENCE BOOKS:

1. Chemical Process Industries, 4th Ed. by R. Norris Shreve & J. A. Brink, Jr. International Student's Edition.
2. Pollution Control in Chemical Process Industries, 1st Ed. By S. P. Mahajan Tata McGraw Hill Publications, New Delhi

ONLINE RESOURCES:

1. https://www.digimat.in/nptel/courses/video/103105680/L58.html
2. https://biotech01.vlabs.ac.in/exp/saponification-value-fats-oils/
3. https://biotech01.vlabs.ac.in/exp/iodine-value-fats-oils/

COURSE OUTCOMES:

CO-1	**Perform** chemical process experiments using standard laboratory procedures.
CO-2	**Analyze** experimental data to determine process parameters
CO-3	**Apply** principles of reaction engineering and chemical process technology in laboratory-scale operations.
CO-4	**Identify** experimental errors and troubleshoot issues in chemical process operations.
CO-5	**Operate** laboratory equipment and modern tools safely while following standard safety practices and protocols.
CO-6	**Work** effectively in teams and communicate experimental results through proper laboratory reports and presentations.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Chemical Process Technology (BCHPE405)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	0	0	3	3	50	50	00	00	100

COURSE OVERVIEW:

Chemical Process Technology introduces students to important industrial processes used for the large-scale manufacture of chemicals and materials. The course covers key chemical unit processes along with their industrial applications. It also discusses the manufacturing of major inorganic chemicals, fertilizers, fine chemicals, pharmaceuticals, dyes, and products from industries such as cement, glass, sugar, fermentation, and pulp and paper. Students will develop an understanding of process flows, manufacturing technologies, and associated engineering considerations in chemical industries.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (45)
	SECTION-A		
1.	**Mechanisms and Recent Advances of Following Unit Processes:** Alkylation and Acylation, e.g. alkylation of benzene, phenols, etc. Halogenation, e.g. chlorination of toluene, Nitration and Sulfonation, e.g. nitration, sulfonation of benzene, etc. Hydrogenation and Reductive Alkylation, e.g. hydrogenation of nitrobenzene, reductive alkylation reactions of anilines, Oxidation, e.g. oxidation of xylenes, etc.	1	10
2	**Sulphur, Sulphuric Acid Fertilizer Industries:** Mining and manufacturing of Sulphur, Manufacture of Sulphuric acid by DCDA process and its applications. Sulphur trioxide, Sodium Sulphate, Sodium Thiosulphate, Manufacturing technologies & associated Engineering problems. Introduction to Fertilizer industries, manufacturing processes of Ammonia, Urea, Nitric acid, Phosphoric acid their uses and applications, major engineering problems, NPK fertilizer.	2	8
3	**Chloro-Alkali and Heavy Inorganic Industry:** Manufacturing of Caustic Soda and Chlorine by membrane cell, mercury & diaphragm process, Manufacturing of Sodium Bicarbonate.	3	5
	SECTION-B		
4	**Fine Chemicals, Pharmaceuticals, and Dyes:** **Fine Chemicals & Pharmaceuticals:** Classification of pharmaceuticals, Manufacturing of important drugs – salicylic acid, methyl salicylate, aspirin, antibiotics, vitamins **Dyes & Intermediates:** Industrial production and applications of dyes, Application of dyes in textiles, polymers, and coatings, Sustainable dyeing technologies	4	9

5	**Cement & Glass Manufacturing:** Limestone beneficiation, Types and manufacturing of cement, Types and manufacturing of glass. **Electrolytic Processes:** Electrolytic manufacturing of aluminum and magnesium.	5	6
6	**Sugar & Fermentation Industries:** Manufacturing of Sugar. Fermentation, Industrial Alcohol, Absolute Alcohol, Beers, Wines and Liquors, Manufacturing of Butyl Alcohol & Citric acid by fermentation. **Introduction to pulp and paper industries:** Pulp manufacturing by Kraft process, Difference between sulphate & sulphite process, Manufacturing of Paper.	6	7

TEXT BOOKS:

1. Dryden, C. E., "Outlines of Chemical Technology", East West Press. Pvt. Ltd., New Delhi, 3rd Ed., 1997.
2. Austin, G. T., "Shreve's Chemical Process Industries", McGraw Hill, 5th Ed., 1984.

REFERENCE BOOKS:

1. Chemical Process Industries, 4th Ed. by R. Norris Shreve & J. A. Brink, Jr. International Student's Edition.
2. Kent, J. A., "Riegel's Handbook of Industrial Chemistry", Springer Publication, 1992.
3. Rao, M. G., Sittig, M., "Outlines of Chemical Technology", Affiliated East West Press. Pvt. Ltd., 3rd Ed., 2005.

ONLINE RESOURCES:

- https://archive.nptel.ac.in/courses/103/103/103103217/
- https://archive.nptel.ac.in/courses/103/103/103103218/
- https://archive.nptel.ac.in/courses/103/107/103107082/
- https://archive.nptel.ac.in/courses/103/102/103102022/

COURSE OUTCOMES

CO1	**Explain** the mechanisms of major organic unit processes.
CO2	**Discuss** the production processes of fertilizers.
CO3	**Interpret** process parameters and operational challenges in heavy inorganic chemical industries.
CO4	**Understand** the environmental and sustainability concerns in fine chemical and pharmaceutical manufacturing and industrial dyeing process.
CO5	**Describe** the production processes of cement, glass products using process flow diagrams and basic chemical principles.
CO6	**Identify** the process flow and key engineering problems in pulp, paper, sugar, and starch industries.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Sustainable Technology (BCHPE406)

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

COURSE OVERVIEW:
Sustainable Technology focuses on the principles and practices required to achieve environmentally responsible and resource-efficient industrial development. The course introduces concepts of sustainability, sustainable development and global environmental challenges along with tools such as carbon footprint assessment, circular economy, and life cycle analysis. It also covers techniques for sustainable production, including source reduction, waste minimization, recycling, and energy efficiency. Students will develop an understanding of technologies and strategies for carbon reduction, renewable energy utilization, and sustainable industrial practices.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs (45)
	SECTION-A		
1	**Scope of Sustainability:** Need and concept of sustainability, pillars of sustainability, sustainable development and challenges, nexus between technology and sustainable development, Global Environmental Issues.	1	7
2	**Sustainable Resource and Carbon Management:** 5R concept, clean development mechanism (CDM). Circular economy, Carbon footprint, Carbon trading, Carbon Emission Scope (1, 2 and 3).	2	7
3	**Environmental Management Standards:** ISO 14000 series, Life Cycle Analysis (LCA) -scope and goal, bio-mimicking, Environment Impact Assessment (EIA).	3	7
	SECTION-B		
4	**Source reduction Techniques for Sustainable Production:** Process Modification Techniques, Raw material Substitution, Technology Up-gradation, Good Housekeeping Practices, Energy & Water Efficiency Techniques, Product Modification.	4	8
5	**Waste Recycling and Reuse Techniques for Sustainable Production:** Water Conservation Techniques, Waste Minimization Techniques, On-site Reuse and Recycling, Energy recovery from waste.	5	8
6	**Carbon Reduction Techniques:** Carbon Capture and Storage, Harnessing solar and wind energy, Hydrogen and fuel cells, Usage of AI in Industries.	6	8

TEXT BOOKS:

1. A. S Bradley, A. O. Adebayo, P. Maria, Engineering application in sustainable design and development, 1st Edition, CL Engineering, 2015.
2. Paul M. R., "Engineers Guide to Cleaner Production Technologies", Technomic Publishing, 1st Ed, 1996.

REFERENCE BOOKS:

1. Sinha R K, Herat S, "Cleaner Production: Greening of Industries for Sustainable Development", 1st Edition, Pointer Publishers, 2005.
2. Samantaraj S K, Rath B, Rout J, "Green Technology: An Innovative Solution for Environmental Sustainability, Newredmars Edu. Pvt. Ltd., 1st Edition, 2025.

ONLINE RESOURCES:

- https://onlinecourses.nptel.ac.in/noc21_ce47/

COURSE OUTCOMES

CO1	**Understand** need and scope of sustainable technology.
CO2	**Establish** a clear understandings of the carbon management.
CO3	**Describe** environmental management standards and impact assessment.
CO4	**Discuss** the methods of source reduction techniques for sustainable growth.
CO5	**Explain** the methods of waste recycle and reuse for sustainable growth.
CO6	**Classify** carbon reduction techniques for sustainability.

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	50	50	0	0	100

COURSE OVERVIEW:
This course introduces second-year B.E. Course helps the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings

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. Pandit Sunderlal, "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.