Evaluation Reforms NEP 2020

2nd Year Bachelor of Engineering

Chemical Technology
(Glass & Ceramic)

Shroff S R Rotary Institute of Chemical Technology,

Ankleshwar

EFFECTIVE FROM A.Y. 2026-2027

Teaching Scheme for
Second Year Bachelor of Chemical Technology
(Glass & Ceramic)

Semester-III (Glass & Ceramic) Structure

Course Code	Course	Teaching Scheme (hrs. / week)			Total	Credit	Examination Scheme				
		L	T	P	Hr	C	SEE	CCE	I/TW	V	Total
BGCPC301	Processing of Ceramic Raw materials	4	0	0	4	4	50	50	0	0	100
BUNBS311	Mathematics-III	3	1	0	4	4	50	50	25	25	150
BCTPC302	Physical Chemistry	3	0	2	5	4	50	50	25	25	150
BCTPC303	Material & Energy Balance Calculations	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 (Glass & Ceramic) Structure

Course Code	Course	Teaching Scheme (hrs/week)			Total	Credit	Examination Scheme				
		L	T	P	Hr	C	SEE	CCE	I/TW	V	Total
BGCPC401	Introduction to fundamentals of Refractories	3	0	2	5	4	50	50	25	25	150
BGCPC402	Introduction to Glass Science	3	0	0	3	3	50	50	0	0	100
BCTPC403	Material Science & Engineering	4	0	0	4	4	50	50	0	0	100
BCTPE404	Basics of Fluid Flow	3	0	2	5	4	50	50	25	25	150
BCTVS405	Processing of Ceramic Raw materials laboratory	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	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 Engineering	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 (Glass & Ceramic) Students

Sr.	Course code	MDC-1 (Semester-4)	Minors	Offered by (department)
1	BMEMD451	Boiler and Steam Utility Systems	Mechanical Aspects of Process Utilities	Mechanical Engineering
2	BEVMD451	Introduction to Environmental	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	Fundamentals of Pharmaceutical	Pharmaceutical Engineering	Pharmaceutical Technology
7	BDPMD451	Introduction to Paint and Coating Technology	Paint Technology	Dyes & Pigments Technology
8	BPRMD451	Chemistry of Polymers Polymer Science and Engineering	Polymer Science and Engineering	Polymer & Rubber 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
Processing of Ceramic Raw Materials (BGCPC301)

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: The course is aimed to introduce the methods of material recovery by quarrying. Describe the various processes involved in making the quarried raw material into fine, fractioned powders. Discuss the means of mixing, conveying and storage of the processed raw materials.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs. (60 hrs.)
	SECTION-A		
1	**Quarrying** • Winning of clays • quarrying of non-plastic materials, transportation • Clay purification methods – wet and dry methods • Weathering of clay • Beneficiation of non-plastic materials	1	10 hrs.
2	**Atomic Structure and Bonding in Ceramics** • Atomic structure and electronic configuration. • Types of bonding in ceramics: ionic, covalent, mixed bonding. • Bond energy, bond length, and coordination number. • Pauling's rules. • Effect of bonding on properties (melting point, hardness, brittleness, thermal stability.	1,2	10 hrs.
3	**Crystal Structure and Defects in Ceramics** • Crystallography basics: unit cell, lattice parameters • Common ceramic crystal structures: NaCl, CsCl, ZnS, Perovskite, Spinel, Fluorite • Polymorphism and allotropy. • Point defects, Schottky and Frenkel defects • Non-stoichiometry in ceramics. • Effect of defects on electrical and diffusion properties.	2,3	10 hrs.

	SECTION-B		

4	**Ceramic Raw Materials – Classification and Sources**
	• Classification of ceramic raw materials:
	  • Plastic and non-plastic raw materials
	  • Oxide and non-oxide raw materials
	  • Natural and synthetic raw materials
	• Geological occurrence and beneficiation.
	• Physical and Chemical characteristics of raw materials.
	• Role of impurities and additives.
		3,4	10 hrs.

5	**Important Ceramic Raw Materials** • Clay Minerals: Kaolinite, Illite, Montmorillonite Structure, properties and uses • Silica Materials: Quartz, cristobalite, tridymite • Feldspars: Alkali and alkaline earth feldspars • Alumina and Bauxite • Carbonates: Limestone, Dolomite • Fluxes and Modifiers • Raw materials for glass, whitewares, refractories, and structural ceramics • Sustainable Raw Materials: Use of industrial waste (fly ash, slag) in ceramic production (geo-polymers, construction ceramics)	4,5	10 hrs.
6	**Raw Material Characterization Techniques** • Chemical analysis (wet and instrumental) • Particle size analysis • Thermal analysis (DTA, TGA) • X-ray diffraction (XRD) • Role of characterization in quality control	5,6	10 hrs.

TEXT BOOKS:

1. Elements of ceramics ,Norton F.H, Longman higher education, 2nd Ed, 2001
2. Introduction to ceramics, Barsoum, Institute of Physics Publishing (gb) 2002
3. Introduction to Ceramics, Kingery W.D,. Wiley New York :, 2nd Ed, 1976
4. Material Science ,Smith, Mcgraw Hill Higher Education, 4th Ed,2005
5. Industrial ceramics ,Singer & Singer, , Oxford &Ibh (From Technip), 1st Ed.,2008

ONLINE RESOURCES:

Introduction to Ceramic Materials (Wiley sample)	Foundational overview of ceramics, structures, classifications, and properties.
Ceramic Materials: Processes, Properties and Applications	Covers wide range of ceramic types, processing and applications.
An Introduction to Ceramic Engineering Design (e-book)	Good for basic engineering perspectives on ceramics.
Introduction to Ceramics (AZoM article)	Good conceptual overview of ceramic materials, bonding, properties, and production steps.
DoITPoMS Materials Science (Open online educational site)	Materials science tutorials useful for basics of structure, bonding, and processing.

COURSE OUTCOMES:

CO1	Explain the classification, structure, bonding, and basic properties of traditional and advanced ceramic materials.
CO2	Identify and evaluate ceramic raw materials and their role in controlling composition, processing behavior, and final properties.
CO3	Apply fundamental concepts of phase diagrams and structure–property relationships to simple ceramic systems.
CO4	Describe basic ceramic processing steps including powder preparation, forming techniques, drying, and sintering.
CO5	Analyze the influence of processing parameters on microstructure and performance of ceramic products.
CO6	Select suitable ceramic materials and processing routes for elementary engineering and industrial applications.

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
Physical Chemistry (BCTPC302)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		E	M	I	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 equilibrium 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 hrs.)
	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	2,5	8

	• Free energy of reaction • 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 equilibrium

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. (45)
	SECTION-A		
1	**Units & Dimensions:** Dimensions & system of units, Fundamental and derived units, Unit conversion and its significance.	1	05
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 heat change in liquid & gases, enthalpy changes during phase	5	10

	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	07

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
Introduction to fundamentals of Refractories (BGCPC401)

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: A first course on refractories covering raw materials, classification, properties, manufacturing methods (shaped & unshaped), testing, selection and application of refractories in metallurgical and high-temperature industrial processes (steel, glass, cement, non-ferrous metallurgy, kilns). Also covers failure modes, causes, and basic repair/maintenance practices.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs. (45 hrs.)
	SECTION-A		
1	**Introduction & Classification of Refractories** • Definition and functions of refractories • Requirements of an ideal refractory • Classification based on: Chemical nature (acidic, basic, neutral),Form (shaped, unshaped/monolithic),Service temperature and application • Uses of refractories in iron & steel, glass, cement and other industries	1	8 hrs.
2	**Refractory raw materials** • Important natural raw materials: fireclay, silica, magnesite, dolomite, chromite, alumina sources. • Synthetic raw materials: tabular alumina, fused magnesia, high-alumina materials, zirconia, silicon carbide. • Role of particle size distribution, mineralogy, and impurities. • Mineralogical composition and impurities • Effect of raw material selection on refractory properties	1,2	8 hrs.
3	**Properties & Testing of Refractories** • Physical: bulk density, apparent porosity, permeability, shrinkage. • Mechanical: cold crushing strength, modulus of rupture, abrasion resistance. • Thermal: thermal expansion, thermal conductivity, thermal shock resistance, refractoriness under load, creep at high temperature. • Chemical: corrosion by slags, alkalis, carburization, oxidation, slag penetration.	2,3	8 hrs.

	• Standard test methods and interpretation.		
	SECTION-B		

4	**Manufacture of Shaped refractories**
	• Batch preparation and particle size distribution
	• Forming methods:
	  • Dry pressing
	  • Semi-dry pressing
	  • Extrusion
	  • Casting
	• Drying and firing of refractory products
	• Quality control and defects in refractory bricks
		3,4	6 hrs.

5	**Unshaped refractories(monolithics)** • Introduction and advantages of monolithics • Types: castables, ramming mixes, gunning mixes, plastics, mortars • Binders and additives • Installation techniques and curing • Applications of monolithic refractories	4,5	7 hrs.

6	**Applications, Failure & Maintenance of Refractories**
	• Refractories for:
	  • Blast furnace, coke oven
	  • LD converter, electric arc furnace
	  • Ladles, tundish, continuous casting
	• Refractories for glass, cement and non-ferrous industries
	• Failure mechanisms: spalling, corrosion, erosion, thermal shock
	• Maintenance, repair and life improvement of refractory linings
	• Sustainability in Refractories: Recycling of used refractories, energy-efficient linings, and reducing CO2 footprint in manufacturing
		5,6	8 hrs.

LIST OF PRACTICALS:

- Determination of bulk density and porosity
- Cold crushing strength test
- Refractoriness and RUL test
- Abrasion resistance test
- Preparation and testing of a castable
- Pyrometric Cone Equivalent (PCE) Test of Refractory Material
- Thermal Shock Resistance Test of Refractories
- Permanent Linear Change (PLC) Determination after Firing
- Measurement of Apparent Porosity, Water Absorption, and Bulk Density by Boiling Method
- Slag Resistance Test of Refractory Materials

TEXT BOOKS:

- A.K. Datye & S.C. Deevi, Refractories Handbook
- Chester H. Schacht, Refractories Handbook
- O.P. Gupta, Elements of Fuels, Furnaces and Refractories
- NPTEL Lecture Notes on Refractories and High-Temperature Materials

ONLINE RESOURCES:

NPTEL Course Page — Fuels, Refractory & Furnaces	Lectures Contain syllabus, lecture list and downloadable notes & videos.
NPTEL Video Lectures (DIGIMAT platform)	Lecture videos such as Energy Resources, Refractory materials & applications, etc.
NPTEL Syllabus PDF	Full course outline showing topics on refractory classification, service properties, manufacturing, etc.

COURSE OUTCOMES:

CO1	Define and classify common refractories and explain roles of major raw materials.
CO2	Explain physical, mechanical, thermal and chemical properties relevant to refractory performance and how they are measured.
CO3	Describe manufacturing routes for shaped and unshaped refractories and understand quality control tests.
CO4	Select appropriate refractories for furnace/lining components in steel, glass, cement and allied industries.
CO5	Diagnose common failure mechanisms of refractory linings and recommend remedial/maintenance measures.
CO6	Correlate manufacturing processes of shaped and unshaped refractories with their microstructure and performance

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Introduction to Glass Science (BGCPC402)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		E	M	I	V	Total
3	0	0	3	03	50	50	0	0	100

COURSE OVERVIEW: This course provides fundamental knowledge of the glassy state, glass-forming systems, structure–property relationships, and basic processing techniques. It familiarizes students with commercial and specialty glasses and their applications. The course forms a core foundation for higher studies and industry-oriented courses in glass and ceramic technology.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs. (45 hrs.)
	SECTION-A		

1	**Introduction and Classification of Glass**
	• Definition of glass; historical development of glassmaking
	• Difference between crystalline solids and glassy state
	• Glass vs. supercooled liquid
	• Classification of glasses:
	  • Oxide and non-oxide glasses
	  • Silicate, borate, phosphate, Chalcogenide glasses
	• Glass-forming regions and ternary diagrams (introductory)
	• Applications of glass in modern technology
		1	7 hrs.

2	**Glass Structure and Theories of Glass** • Atomic and molecular structure of glasses • Random Network Theory (Zachariasen) • Modified Random Network Theory • Role of network formers, modifiers, and intermediates • Structural units in silicate, borate, and phosphate glasses • Structural defects in glass	2,3	7 hrs.

3	**Glass Composition and Raw Materials**
	• Role of glass constituents:
	  • Network formers (SiO_2, B_2O_3, P_2O_5)
	  • Modifiers (Na_2O, K_2O, CaO, MgO)
	  • Intermediates (Al_2O_3, PbO, ZnO)
	• Glass batch calculations (basic concepts)
	• Glass raw materials:
	• Silica sand, soda ash, limestone, dolomite, feldspar, borax
		3,4	8 hrs.

	• Fining agents, colorants, decolorizers, and opacifiers		
	SECTION-B		
4	**Thermal Behavior and Physical Properties of Glass** • Glass transition temperature (T_g) • Viscosity–temperature relationship • Working range of glass • Thermal expansion and thermal shock resistance • Density and molar volume • Electrical and optical properties (basic concepts)	4,5	8 hrs.
5	**Glass Melting, Forming and Heat Treatment** • Fundamentals of glass melting reactions • Types of glass furnaces (tank furnace, pot furnace) • Melting stages: batch reaction, fining, homogenization • Glass forming methods: • Blowing, pressing, drawing, rolling, float glass process • Annealing and stress in glass • Basic defects in glass products	5	7 hrs.
6	**Commercial Glasses and Applications** • Soda-lime-silica glass • Borosilicate glass • Lead glass • Aluminosilicate glass • Safety glass, optical glass, fiber glass • Introduction to specialty and advanced glasses (bio-glass, glass-ceramics) • Environmental aspects and recycling of glass	6	8 hrs.

TEXT BOOKS:

1. A. K. Varshneya & J. C. Mauro, Fundamentals of Inorganic Glasses, Elsevier
2. E. B. Shand, Engineering Glasses, Academic Press
3. R. H. Doremus, Glass Science, Wiley

ONLINE RESOURCES:

Core Text & Reference Material	James E. Shelby, *Introduction to Glass Science and Technology* – widely recommended intro textbook for UG courses. You can preview chapters or find a PDF version online for study/reference (introductory content includes glass formation, properties, structure, processing, and applications).
Open Courseware & Online Lecture Content	MIT OCW – Introduction to Glasses / Amorphous Materials – section in MIT Open Course Ware *Solid State Chemistry* that explains amorphous materials including glasses.

Supplementary Online Resources	DoITPoMS Materials Science Resources – free educational site with modules on materials science topics (amorphous/glass concepts can be applied).

COURSE OUTCOMES:

CO1	Explain the nature of the glassy state and classify different types of glasses based on composition and applications.
CO2	Describe the atomic structure of glasses and explain the major theories of glass formation and structure.
CO3	Identify glass-forming constituents and raw materials and explain their roles in determining glass composition and properties.
CO4	Analyze the thermal, physical, and basic electrical and optical properties of glass and relate them to structure and composition.
CO5	Explain the fundamental steps involved in glass melting, forming, annealing, and heat treatment processes.
CO6	Distinguish between major commercial and specialty glasses and relate their properties to industrial and technological applications.

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 behavior 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	1,2	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	2,3	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
Processing of Ceramic Raw materials Laboratory (BCTVS405)

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. Clay purification
2. Non-plastic Raw material purification by froath flotation
3. Size reduction by Jaw Crusher
4. Size reduction in ball milling with respect to time, speed and grinding media size
5. Size separation by Sieves
6. Calculating screen effectiveness of sieves
7. Separation of solids by sedimentation method
8. Separation of solid from liquid by filter press
9. Granule formation by spray drying
10. Separating magnetic particles by magnetic separator
11. Solid mixing by pan mixer
12. Liquid mixing by agitators

COURSE OUTCOMES:

CO1	To purify various raw materials and reduce them to required size using appropriate technique.
CO2	To evaluate screen effectiveness of sieves.
CO3	To be able to separate solid from other solids or liquids using suitable.

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	Relate themselves with the surroundings (family, society, nature)
CO2	Explain sustainable solutions with respect to problems, keeping in mind the correlation between human relationships and human nature.
CO3	Apply what they have learnt, into various day to day schedule.
CO4	Distinguish between ethical and unethical practices and start working out the strategy in order to materialize a harmonious environment in the work place.
CO5	Justify their commitment with respect to their understanding regarding human values, relationship and society.
CO6	Develop the understanding of the intricacy of the problem and design appropriate solution