



Evaluation Reforms NEP 2020
2nd Year Bachelor of Engineering
Chemical Technology
(Dyes & Pigment)

Shroff S R Rotary Institute of Chemical Technology,
Ankleshwar

EFFECTIVE FROM A.Y. 2026-2027

**Teaching Scheme for
Second Year Bachelor of
Chemical Technology (Dyes & Pigment)**

Semester-III - Chemical Technology (Dyes & Pigment) Structure

Course Code	Course	Teaching Scheme (hrs. / week)			Total Hr	Credit C	Examination Scheme				
		L	T	P			SEE	CCE	I/TW	V	Total
BDPPC301	Fundamentals of Dyes & Pigments	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 Chemical Technology (Dyes & Pigment) Structure

Course Code	Course	Teaching Scheme (hrs./week)			Total Hr	Credit C	Examination Scheme				
		L	T	P			SEE	CCE	I/TW	V	Total
BDPPC401	Chemistry & Technology of Colorants	3	0	2	5	4	50	50	25	25	150
BDPPC402	Synthetic Colorants	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	Dyes, Pigments and Intermediates 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
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Open Elective - I (Semester – IV)
(Open Electives for Chemical Technology students)

Sr.	Course Code	Course	Offered by (department)
1	BMEOE441	Basics of Maintenance Engineering	Mechanical Engineering
2	BEVOE441	Industrial Wastewater Treatment	Environmental Science & Technology
3	BCHOE441	Introduction to Chemical Industry	Chemical Engineering
4	BITOE441	IT for Sustainability	Information Technology
5	BCOOE441	Emerging Technologies in 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 (Dyes & Pigment) 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 Management	Environmental Management	Environmental Science & Technology
3	BCHMD451	Process Safety and Risk Management	Industrial Safety	Chemical Engineering
4	BITMD451	Fundamentals of Cloud and Virtualization	Cloud computing	Information Technology
5	BEEMD451	Basics of Measuring Instruments	Industrial Instrumentation and Automation	Electrical Engineering
6	BPTMD451	Pharmaceutical Science and Technology	Pharmaceutical Analysis	Pharmaceutical Technology
7	BGCMD451	Fundamentals of Materials Science and Engineering	Ceramics Engineering	Glass & Ceramics Technology
8	BPRMD451	Chemistry of Polymers	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
Fundamentals of Dyes & Pigments (BDPPC301)

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

COURSE OVERVIEW:

The main objective of this subject is to study introduction of dyes & pigments their classifications, chemistry of aromatics, colour and chemical constitution.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (60)
SECTION-A			
1	Introduction to Dyes: <ul style="list-style-type: none"> • Definition, practical difference between dyes and pigments, • Intermediates: Definition, Significance, • Important dyestuff intermediates • Classification of Dyes based on application • Classification of Dyes based on Chemical Structure 	1	10
2	Introduction to Pigments: <ul style="list-style-type: none"> • Introduction, Definition, classification(Organic, Inorganic, White pigments, coloured pigments, effect pigments, metal effect pigments, pearl luster pigments etc.), • General physical properties, • Industrial applications • Introduction to Extenders: Definition, general properties, significance, practical difference between extenders and pigments 	2	10
3	Historical Development of Dye & Pigment Industry: <ul style="list-style-type: none"> • Natural dyes and pigments • Discovery of synthetic dyes • Development of modern dye and pigment industries • Growth of global and Indian colorant industries 	3	10
SECTION-B			
4	Chemistry of Intermediates: <ul style="list-style-type: none"> • Introduction • Coal tar primaries like benzene, xylene, toluene • Classes of intermediates (aromatic, aliphatic, heterocyclic – brief) • Industrial importance and applications of intermediates 	4	10
5	Chemistry of Benzenoid Aromatics: <ul style="list-style-type: none"> • Introduction to Benzenoid aromatics • Electrophilic & Nucleophilic aromatic substitution, • Activating and deactivating groups (directive influence) • Concept of substituent effects 	5	10
6	Chemistry of Naphthalene: <ul style="list-style-type: none"> • Structure and reactivity of naphthalene 	6	10

<ul style="list-style-type: none"> • Orientation in electrophilic substitution (α and β positions) • General applications of naphthalene derivatives in dye intermediates • Introduction to polycyclic aromatics: • Anthraquinone • Benzanthrone. • Reactions of anthraquinone, benzanthrone • Industrial significance in dyestuff chemistry 		
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TEXT BOOKS:

1. Dr. G. R. Chatwal, "Synthetic Dyes", Himalaya Publications, 2009.
2. G. Buxbaum, "Industrial Inorganic Pigments", ISBN 3-527-28878-3, 2nd Ed., 1998.
3. Venkatraman K., "Chemistry of Synthetic Dyes – Vol I", Academic Press, New York, 2009
4. Venkatraman K., "Chemistry of Synthetic Dyes – Vol II", Academic Press, New York, 2009
5. Venkatraman K., "Chemistry of Synthetic Dyes – Vol III", Academic Press, New York, 2009
6. W M Morgans, "Outlines of Paint Technology", CBS Publishers, 3rd Ed.

COURSE OUTCOMES:

CO1	To know about Colour & its Chemical Constitution
CO2	To illustrate the terminology of pigment and its classifications.
CO3	To impart the knowledge regarding classification of dyes based on application and chemical structure.
CO4	To know the chemistry of intermediates.
CO5	To describe the chemistry of Benzenoid Aromatics and its derivatives.
CO6	To understand the chemistry of naphthalene.

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 : 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		SEE	CCE	I/TW	V	Total
3	0	2	5	04	70	30	20	30	150

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

PREREQUISITES: Needs basic knowledge of Chemistry which will help students to understand the subject.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs. (45)
SECTION-A			
1	Gaseous state & Interfacial chemistry <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Significance of reaction kinetics • Rate law • Rate constants • Order of reaction • Reversible reactions • Equilibrium • Parallel • Consecutive reactions • Rate determining parameters • Chemical potential • Chemical reactions • Effect of temperature on reaction rates • Free energy of reaction • Collision theory 	2,5	8

3	Catalysis <ul style="list-style-type: none"> • Criteria for catalysis • Homogenous catalysis • Acid Base • Enzymatic Catalysis • Heterogeneous catalysis • Concept of promoters • Inhibitors • poisoning 	3,5	8
SECTION-B			
4	Electrochemistry <ul style="list-style-type: none"> • Equilibrium electrochemistry • Electrochemical cells • Half-cell reactions • Type of electrochemical cells • Free energy & EMF • Nernst equation • Relevance of electrochemical reactions 	3,4	7
5	Phase rule <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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	7

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 $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7/$ 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 Conductometrically.
11. To study the effect of concentration of reactant on the rate of reaction between sodium Thiosulphate and hydrochloric acid
12. To study the effect of temperature of reactant on the rate of reaction between sodium Thiosulphate and hydrochloric acid
13. To study the VLab demo: Colorimeter

TEXT BOOKS/ REFERENCE BOOKS:

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

ONLINE RESOURCES:

Gaseous State & Thermodynamics Khan Academy MIT Open Course Ware Libre Texts Chemistry	Gas laws, thermodynamics, entropy, free energy Advanced thermodynamics and physical chemistry lectures Detailed theory on gases, surface chemistry, and thermodynamics
Interfacial Chemistry & Catalysis NPTEL Swayam	Surface chemistry, catalysis, adsorption, emulsions Courses on catalysis and industrial chemistry
Chemical Kinetics Chemguide YouTube (AK Lectures, Learn Chem E)	Rate laws, order of reaction, kinetics mechanisms Collision theory, reaction dynamics, temperature effects
Electrochemistry Coursera Libre Texts Chemistry	Electrochemistry fundamentals and applications Nernst equation, EMF, electrochemical cells
Phase Rule & Diagrams NPTEL Chemguide Swayam	Phase diagrams and Gibbs phase rule Simple explanation of phase equilibria

COURSE OUTCOMES:

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

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

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

COURSE OVERVIEW:

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

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (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	10
5	Energy balances: Heat capacity of gases and gaseous mixtures, liquids & solids, Sensible heat change in liquid & gases, enthalpy changes during phase transformation, enthalpy changes accompanied by chemical reactions, standard heat of reaction, Hess's law, Adiabatic reactions,	5	07

	Theoretical Flame temperature		
6	Fuel & Combustion: Types of fuels, calorific value of fuels, liquid fuels, gaseous fuel etc. Proximate and ultimate analysis, combustion calculations, Air requirement and flue gases.	6	08

TEXT BOOKS:

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

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

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		SEE	CCE	I/TW	V	Total
0	0	4	4	2	00	00	25	25	50

COURSE OVERVIEW: This course introduces yoga, asanas, and pranayama for improving physical and mental well-being. It covers techniques to prevent lifestyle diseases, enhance body balance, and develop mindfulness. The module also focuses on meditation practices and stress management through yoga, promoting a healthy, balanced, and disciplined lifestyle for overall personal development.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (60)
1	Yoga and Asana: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • Meaning, Definition and Importance of Yoga Meditation • Basic Meditation Techniques • Stress Management through Yoga 	3	20

LIST OF PRACTICALS:

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

ONLINE RESOURCES:

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

COURSE OUTCOMES:

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

UPL University of Sustainable Technology
Shroff S. R. Rotary Institute of Chemical Technology
B.E. Semester IV
Chemistry & Technology of Colorants (BDPPC401)

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:

The main objective of this subject is to study chemistry of dyes and pigments. Under technology part students is to study the various unit processes.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (45)
SECTION-A			
1	Chemistry of azo dyes <ul style="list-style-type: none"> • Mechanism of diazotization & coupling reactions. • Methods of diazotization, • Coupling position of various coupling components. • Azoic dyes. Monoazo & Disazo acid dyes. 		08
2	Chemistry & Technology of Dyestuff Intermediates-I <ul style="list-style-type: none"> • Basic Unit processes: • Sulphonation: • Reaction mechanism and conditions, • Sulphonating Agents and solvents, • Work up and Material of construction, • Halogenation: Basic nucleophilic and Electrophilic substitution, Reaction and Material of construction 		08
3	Chemistry & Technology of Dyestuff Intermediates-II <ul style="list-style-type: none"> • Basic Unit processes: • Nitration: Reaction phenomenon and condition, • Nitrating agents and solvents, Work up and Material of construction, substitution in benzene and substituted benzene, Plant and process flow, Safety and process control parameters, • Nitosation reaction, • Skraup's synthesis, • Fridel- craft's reaction. • Reduction: Reducing agents Reduction methods, Selection of best method for Benzene and substituent 		08
SECTION-B			
4	Chemistry & Technology of Azo Pigments <ul style="list-style-type: none"> • Azo pigments: Diazo components & its derivatives, • Coupling compounds and its derivatives, • Monoazo yellow and Orange pigments, • Bisazo pigments, • Naphthol pigments, • BONA Pigments, 		07

	<ul style="list-style-type: none"> • Benzimidazolone pigments, 		
5	Chemistry & Technology of Organic pigments-II <ul style="list-style-type: none"> • Polycyclic pigments • Phtahlocyanine pigments • Quinacridone pigments, • Perylene and Perinone pigments, • Thioindigo pigments, • Aminoanthraquinone pigments, • Dioxazine pigments 		07
6	Chemical and Physical Characterization of Pigments <ul style="list-style-type: none"> • Crystal Modification and Crystal Structure, • Tinctorial Strength, • Lightfastness and Weatherfastness, • Solvent and Migration Fastness • Specific Surface Area, Particle Size Distribution, • Determination by Electron Microscopy, • Color Depth, Color Differences, • Hiding Power, Fastness to Solvents, 		07

TEXT BOOKS:

1. Dr. G. R. Chatwal, "Synthetic Dyes", Himalaya Publications, 2009.
2. G. Buxbaum, "Industrial Inorganic Pigments", ISBN 3-527-28878-3, 2nd Ed., 1998.
3. Lubs H.A., Robert E, "Chemistry of Synthetic Dyes", Krieger Publishing Company NewYork, 1st Ed., 1995.
4. Heinrich Zollinger, Wiley-VCH, "Color Chemistry: Syntheses, Properties and Applications of Organic Dyes and Pigments", 2nd Ed, 1991.
5. Venkatraman K., "Chemistry of Synthetic Dyes – Vol I", Academic Press, New York, 2009.
6. Venkatraman K., "Chemistry of Synthetic Dyes – Vol II", Academic Press, New York, 2009.
7. Venkatraman K., "Chemistry of Synthetic Dyes – Vol III", Academic Press, New York, 2009.
8. W M Morgans, "Outlines of Paint Technology", CBS Publishers, 3rd Ed., 1996

List of Practicals:

1. Preparation of Fluorescein
2. Preparation of Indophenol blue
3. Preparation of Mordant Yellow.
4. Preparation of Malachite Green Dye
5. Preparation of Rosaniline Dye
6. Preparation of Phenolphthalein Dye
7. Preparation of Alizarin
8. Preparation of Methyl orange
9. Preparation of Azo pigment
10. Preparation of Polycyclic pigment

COURSE OUTCOMES:

CO1	To know the Chemistry of azo dyes.
CO2	To develop the knowledge of Chemistry & Technology of Dyestuff Intermediates.
CO3	To learn about the heterocyclic intermediates
CO4	To illustrate the Chemistry & Technology of Azo Pigments
CO5	To understand the Chemistry & Technology of Organic pigments-II
CO6	To Chemical and Physical Characterization of Pigments

UPL University of Sustainable Technology
Shroff S. R. Rotary Institute of Chemical Technology
B.E. Semester IV
Synthetic Colorants (BDPPC301)

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

COURSE OVERVIEW:

The main objective of this subject is to study the synthesis of various types of dyes and pigments used in the colourant industries.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (60)
SECTION-A			
1	<ul style="list-style-type: none"> • Properties and Applications of: • Acid azo dyes: Methyl orange, Methyl red, Orange dyes, Fast red A, Metanil yellow • Basic Azo dyes: Aniline yellow, Butter yellow, Chrysodine G, Bismark brown, Acid red. • Direct or Substantive Azo dyes: Congo red, Direct deep black, Benzopurpurin, Rosanthrene O • Mordant Azo Dyes: Diamond black F, Chromotrope 2B, Erichrome Black T, Erichrome Red B etc. • Solvent Dyes 	1	10
2	Reactive Dyes <ul style="list-style-type: none"> • Introduction and concept of Reactive Systems • Classification • Chemistry of reactive dyes • Synthesis & applications 	2	10
3	Disperse Dyes <ul style="list-style-type: none"> • Introduction and Classification: • Chemical Constitution: Azo Anthraquinone and Other Chromophores • Synthesis & applications. • Chemistry of disperse dyes • Dispersant free disperse dyes. • Replacement of anthraquinone disperses dyes -Heterocyclic diazo & coupling components. 	3	10
SECTION-B			
4	Organic pigments-I (Azo pigments) <ul style="list-style-type: none"> • Introduction to pigments vs dyes • Diazo components and derivatives • Coupling components and derivatives • Monoazo pigments (yellow, orange) • Bisazo pigments • Naphthol pigments 	4	10

	<ul style="list-style-type: none"> • BONA and Benzimidazolone pigments 		
5	Organic pigments-II (Advanced Pigments) <ul style="list-style-type: none"> • Polycyclic pigments • Phtahlocyanine pigments • Quinacridone pigments, • Perylene and Perinone pigments, • Thioindigo pigments, • Aminoanthraquinone pigments, • Dioxazine pigments 	5	10
6	Heterocyclic Intermediates <ul style="list-style-type: none"> • Introduction to heterocyclic systems • Important industrial intermediates: Ethylene oxide, Epichlorohydrin • Pyrazolone and derivatives • Pyridine and derivatives • Applications in colorant synthesis • Concept of Luminescence: Fluorescence, Phosphorescence etc. 	6	10

TEXT BOOKS:

1. Synthetic Dyes, Dr. G. R. Chatwal, Himalaya Publications, 2009.
2. Industrial Organic Pigments, Second, G. Buxbaum (Ed.), ISBN 3-527-28878-3, 1998.
3. Industrial Organic Chemistry, Arpe H.J.VCH, Weinheim, Weissermal K.1993.

COURSE OUTCOMES:

CO1	To study the synthesis of azo dyes.
CO2	To introduce the chemistry and synthesis of reactive dyes.
CO3	To know the chemistry and synthesis of disperse dyes.
CO4	To understand the synthesis and applications of Organic pigments
CO5	To be able to utilize this knowledge in industries
CO6	To build a bridge between theoretical and practical concept used in industry.

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 <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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:

NPTL	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 behaviour 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	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.	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	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.	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,	6	08

centrifugal blowers, compressor, vacuum pumps, jet ejectors, comparison of devices for moving fluids.		
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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 its coefficient of discharge.
5. To study a Rotameter and obtain its 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
Dyes, Pigments and Intermediates 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. Study of physical and chemical properties of important azo dyes (Methyl Orange, Metanil Yellow, Congo Red, Chrysodine G)
2. Determination of dye solubility in different solvents
3. Measurement of dye bath pH and its effect on shade
4. Preparation and dyeing performance evaluation of an acid azo dye on wool/silk fabric
5. Solubility and solvent compatibility study of solvent dyes in organic media
6. Determination of λ_{max} of azo dye using UV-Visible spectrophotometer
7. Comparative exhaustion study of direct and reactive dyes
8. Exhaust dyeing of cotton using reactive dyes and evaluation of fixation efficiency
9. Preparation of reactive dye bath and study of effect of pH, salt, and alkali on dye uptake
10. Determination of percentage dye fixation on cotton
11. Dyeing of polyester fabric using disperse dyes by HTHP or carrier dyeing method
12. Preparation and dispersion stability study of monoazo pigment or phthalocyanine pigment
13. Spot test identification of acid, basic and direct dyes
14. Determination of dispersibility of disperse dyes
15. Determination of tinctorial strength of dyes

COURSE OUTCOMES:

CO-1	Analyze the physical, chemical, and spectroscopic properties of dyes, pigments, and intermediates using standard laboratory techniques such as solubility studies, pH analysis, spot tests, and UV-Visible spectroscopy.
CO-2	Perform dyeing operations on different textile substrates using acid, reactive, disperse, and direct dyes, and evaluate dyeing performance parameters such as exhaustion, fixation efficiency, dispersibility, and tinctorial strength.
CO-3	Prepare dye baths and pigment dispersions, investigate the influence of process variables (pH, salt, alkali, solvent, temperature) on dye uptake and stability, and interpret experimental results for industrial dyeing applications.

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 complementarity 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 कुटुम्बकम्- one earth one family. Fostering Universal brotherhood and unity, collaborative problem solving, respecting cross cultural communication. Famous anecdote and relevant case studies	6	5

TEXT BOOKS:

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

REFERENCE BOOKS:

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

ONLINE RESOURCES:

- <https://www.uhv.org.in>
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw

COURSE OUTCOMES:

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