Chemical Engineering R23 Structure

I Year Course structure

Semester - I

Course Code	Title of the course	Category	L	T	P	Credits	Sessional Marks	SEE Marks	Total Marks
23EN2101	Communicative English	HS	3	0	0	3	40	60	100
23MA1101	Linear Algebra and Multivariable Calculus	BS	2	1	0	3	40	60	100
23EE3101	Basics of Electrical and Electronics Engineering	ES	2	1	0	3	40	60	100
23ME3101	Computer aided Engineering Graphics	ES	1	0	4	3	50	50	100
23CH4101	Introduction to Chemical Engineering	PC	3	0	0	3	40	60	100
23EN2201	Communicative English Language Lab	HS	0	0	3	1.5	50	50	100
23IT3201	Engineering & IT Workshop	ES	0	0	3	1.5	50	50	100
23EC3201	IoT Lab	ES	0	0	3	1.5	50	50	100
23MC0102	Environmental Science	MC	2	0	0	0	100	0	100
	Total		13	2	13	19.5	460	440	900

Semester - II

Course Code	Title of the course	Category	L	T	P	Credits	Sessional Marks	SEE Marks	Total Marks
23MA1102	Ordinary Differential Equations and Numerical Methods	BS	2	1	0	3	40	60	100
23PY1101	Engineering Physics	BS	3	0	0	3	40	60	100
23CY1101	Engineering Chemistry	BS	2	1	0	3	40	60	100
23CS3101	Problem Solving and Programming using C	ES	2	1	0	3	40	60	100
23CH3101	Material Science for Chemical Engineers	ES	3	0	0	3	40	60	100
23PY1201	Engineering Physics Lab.	BS	0	0	3	1.5	50	50	100
23CY1201	Engineering Chemistry Lab	BS	0	0	3	1.5	50	50	100
23CS3201	Problem Solving and Programming using C lab.	ES	0	0	3	1.5	50	50	100
23MC0101	Universal Human Values and Professional Ethics	MC	2	0	0	0	100	0	100
	Total		14	3	9	19.5	450	450	900

II Year Course structure									
Semester - I									
Course Code	Title of the course	Category	L	T	P	Credits	Sessional Marks	SEE Marks	Total Marks
23MA1103	Vector Calculus and Statistical Methods	BS	2	1	0	3	40	60	100
23CH3102	Instrumentation and analytical techniques	ES	3	0	0	3	40	60	100
23CH3103	Biology for Engineers	ES	2	0	0	2	100	0	100
23CH4102	Chemical Process Calculations	PC	2	1	0	3	40	60	100
23CH4103	Momentum Transfer	PC	2	1	0	3	40	60	100
23CH4104	Mechanical Operations	PC	2	1	0	3	40	60	100
23CH4201	Momentum Transfer Lab	PC	0	0	3	1.5	50	50	100
23CH4202	Mechanical Operations Lab	PC	0	0	3	1.5	50	50	100
23CR9101	Logical Reasoning and Corporate skills	HS	0	0	2	1	50	50	100
23MC0104	Entrepreneurship and Intellectual Property Rights	MC	2	0	0	0	100	0	100
Total			15	4	8	21	550	450	1000
Semester - II									
Course Code	Title of the course	Category	L	T	P	Credits	Sessional Marks	SEE Marks	Total Marks
23MA1104	Complex Variables and Statistical Methods	BS	2	1	0	3	40	60	100
23ME3104	Design Thinking	ES	1	0	2	2	100	0	100
23CH4105	Chemical Engineering Thermodynamics	PC	2	1	0	3	40	60	100
23CH4106	Chemical Technology	PC	3	0	0	3	40	60	100
23CH4107	Heat transfer	PC	2	1	0	3	40	60	100
23CH9101	Artificial Intelligence for Chemical Engineers	SC	1	0	0	1	100	0	100
23CH511*	Professional Elective-I	PE	3	0	0	3	40	60	100
23CH4203	Heat Transfer Lab	PC	0	0	3	1.5	50	50	100
23CH9201	Artificial Intelligence Lab	SC	0	0	3	1.5	50	50	100
23CR9102	Numerical Ability and Professional Communication skills	HS	0	0	2	1	50	50	100
23MC0103	Financial literacy	MC	2	0	0	0	100	0	100
Total			16	3	10	22	650	450	1100

III Year Course structure									
Semester - I									
Course Code	Title of the course	Category	L	T	P	Credits	Sessional Marks	SEE Marks	Total Marks
	Open Elective- I	OE	3	0	0	3	40	60	100
23HS211*	Humanities elective	HS	2	0	0	2	40	60	100
23CH4108	Chemical Process Safety	PC	2	0	0	2	40	60	100
23CH4109	Mass Transfer-I	PC	2	1	0	3	40	60	100
23CH4110	Chemical Reaction Engineering-I	PC	2	1	0	3	40	60	100
23CH512*	Professional Elective-II	PE	3	0	0	3	40	60	100
23CH521*	Elective Lab	PE	0	0	3	1.5	50	50	100
23CH9202	Computational Lab	SC	0	0	3	1.5	50	50	100
23CR9103	Quantitative Aptitude and Effectual Communication skills	HS	0	0	2	1	50	50	100
23CH4401	Internship-I	PR	0	0	2	1	100	0	100
23MC0105	**Constitution of India**	MC	2	0	0	0	100	0	100
	Total		16	2	10	21	590	510	1100
Semester - II									
Course Code	Title of the course	Category	L	T	P	Credits	Sessional Marks	SEE Marks	Total Marks
	Open Elective- II	OE	3	0	0	3	40	60	100
23CH4111	Mass Transfer-II	PC	2	1	0	3	40	60	100
23CH4112	Chemical Reaction Engineering-II	PC	2	1	0	3	40	60	100
23CH4113	Transport Phenomena	PC	2	1	0	3	40	60	100
23CH4114	Chemical Process Economics and Equipment Design	PC	2	1	0	3	40	60	100
23CH513*	Professional Elective-III	PE	3	0	0	3	40	60	100
23CH4204	Mass Transfer Lab	PC	0	0	3	1.5	50	50	100
23CH4205	Chemical Reaction Engineering Lab	PC	0	0	3	1.5	50	50	100
23CR9104	High Level Reasoning and Employability skills	HS	0	0	2	1	50	50	100
	Total		14	4	8	22	390	510	900

IV Year Course structure									
Semester - I									
Course Code	Title of the course	Category	L	T	P	Credits	Sessional Marks	SEE Marks	Total Marks
	Open Elective- III	OE	3	0	0	3	40	60	100
23CH4115	Chemical Process utilities	PC	1	0	0	1	100	0	100
23CH4116	Process Dynamics and Control	PC	2	1	0	3	40	60	100
23CH9102	Process Modelling and Simulation	SC	2	1	0	3	40	60	100
23CH514*	Professional Elective –IV	PE	3	0	0	3	40	60	100
23CH515*	Professional Elective -V	PE	3	0	0	3	40	60	100
23CH4206	Process Dynamics and Control Lab	PC	0	0	3	1.5	50	50	100
23CH9203	Process Modelling and Simulation Lab	SC	0	0	3	1.5	50	50	100
23CH4402	Internship-II	PR	0	0	2	1	100	0	100
23CH4501	Project Phase – I	PR	0	0	6	3	100	0	100
Total			14	2	14	23	600	400	1000
Semester - II									
Course Code	Title of the course	Category	L	T	P	Credits	Sessional Marks	SEE Marks	Total Marks
	Open Elective- IV	OE	MOOCS			3	100	0	100
23CH4502	Project Phase – II	PR	0	0	18	9	100	100	200
Total			0	0	18	12	200	100	300

Table 1: List of Professional Electives					
Streams	PE-I	PE-II	PE-III	PE-IV	PE-V
Technology	Polymer Technology	Fertilizer Technology	Pharmaceutical Technology	Nanotechnology	Petrochemicals
Environmental & Sustainability	Introduction to sustainability	Industrial Pollution and Control	Water Treatment Technologies	Solid and Hazard Waste Management	Environment Impact Assessment
Energy	Energy Engineering	Electrochemical Engineering	Petroleum Refinery Engineering	Fuel Cell and Hydrogen Engineering	Energy Auditing and Management
Emerging technologies	Membrane Technology	Design of Experiments	Carbon Capture and Storage	Process Optimization	Biochemical Engineering
	*Any Emerging / required subject with pre-approval from internal BoS				

Table 2: List of Humanities Electives
Entrepreneur Engineering
Innovation and Incubation
Industrial Management
Managerial Economics and Financial Analysis
Operations Research

Table 3: List of Elective labs
Chemical Technology Lab
Environmental Engineering Lab
Chemical Analysis Lab

Table 4: List of Open electives (tentative) offered by Chemical Engineering Department
Principles of Safety Management
Industrial and Process Safety
Environmental Issues and Management
Bioinspired Designs in Engineering
Introduction to Bioinformatics
Biosensors
Food Biotechnology
Biomaterials for Engineering applications
Biomedical Engineering
Food Processing and Technology
Corrosion Engineering
Computational tools for Engineers

Table 5: List of Open electives (tentative) required for Chemical Engineering Students
Python programming
Renewable Energy
Physical and analytical Chemistry
Data Analytics
Internet of Things
Machine Learning
Database Management Systems
Robotics

COMMUNICATIVE ENGLISH

Code: 23EN2101   **Credits:3**
Instruction : 3 periods & 1 Tutorial/Week   Sessional Marks:40
End Exam : 3 Hours   End Exam Marks:60
Prerequisites: Basic English grammar

Course Objectives:
1. To develop awareness about the importance of LSRW skills
2. To implement verbal and nonverbal cues properly in their career and personal life
3. To prepare the students impress everyone with their effective communication skills
4. To familiarize the students with latest terminology and jargon.
5. To train them to attempt various vocabulary tests to get employment.

Course Outcomes:

1.	Comprehend LSRW skills and various linguistic aspects of multicultural milieu.**(L2)**
2.	Acquire verbal and nonverbal Communication skills through varied individual and team activities. **(L3)**
3.	Apply proper vocabulary and appropriate grammar to draft different types of writings collectively and separately for effective professional and personal communication**. (L3)**
4.	Analyze and relate advanced terminology in conceptual conversations, writings and in pronunciation. **(L4)**
5.	Distinguish and practice several kinds of vocabulary tests for better employability with competence. **(L4)**

CO-PO –PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1									M	M		M		2	
CO2									M	M		M		2	
CO3									M	M		M		2	
CO4									M	M		M		2	
CO5									M	M		M		2	

Correlation levels 1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO-PO- Justification
1	CO1 is not mapped with any PO as the topics should be explained by the teachers and students' previous knowledge and comprehension are tested.
2	CO2 is mapped with PO 9,10, and 12 as students do activities in teams and individually to get effective communication skills and learn new avenues of English language.
3	CO3 is mapped with PO 9,10, and 12 as effective writing skills and communication skills are developed through group activities and individual presentations.
4	CO4 is mapped with PO 9,10, and 12 as using new vocabulary or terminology is needed for collective and single performances
5	CO5 is mapped with PO 9,10, and 12 as language exercises are done in groups and in isolated tests which develop students' oral and written communication skills.

SYLLABUS

UNIT I   **CO1**   **10 Periods**
Listening: I have a dream by Dr. Martin Luther King Jr. (Motivational Speeches)
Speaking: Self Introduction – Introducing others
Reading: The Time Machine by H G Wells
Writing: Paragraph Writing - Letter Writing – Profile Building
Grammar: Types of Sentences – Assertive, Interrogative, Imperative and Exclamatory - Phrases &
          Clauses - Verb Forms
Vocabulary: Root words – Foreign words and Phrases – C2 Level Vocabulary

UNIT II   CO2, CO3   **10 Periods**
Listening: Speech of Howard Roark in The Fountainhead by Ayn Rand
          TED Talks - Can global food companies make the shift to regenerative agriculture?
Speaking: Basics of Communication - Verbal, Nonverbal - Oral talk on selected topics
          (Women empowerment and gender issues) - Extempore
Reading: Newspaper reading
Writing: Essay Writing – Narrative Essay and Descriptive Essay
Grammar: Tenses - Agreement: Subject-verb, Noun-pronoun – Articles – Prepositions
Vocabulary: One-word Substitutes – Word Associations – Portmanteau Words

UNIT III   **CO3**   **10 Periods**
Listening: "If" poem by Rudyard Kipling
          Leave This Chanting by Ravindranath Tagore
          Haikus
Speaking: Oral Presentation
Reading: Editorials reading
Writing: Argumentative Essays and Informative Essays on general topics
Grammar: Active and Passive Voice, Modifiers and Misplaced Modifiers
Vocabulary: Academic words– Synonyms and Antonyms

UNIT IV   **CO4**   **10 Periods**
Listening: Role-plays
Speaking: Debating Skills
Reading: Skimming and Scanning - Failure to Success Stories
Writing: Summary Writing – J. K. Rowling and Jadav Payeng
Grammar: Direct and Indirect Speech – Degrees of Comparison
Vocabulary: Homonyms & Homophones – Collocations – Etymology

UNIT V   **CO5, CO3**   **10 Periods**

Listening: News Bulletins- Recycle for Life: Karaikal's success in battling waste
Speaking: Mock Press, Floor Crossing
Reading: Cover Story - The role of Social Media Analytics in New-age Digital Market
Writing: Resume Writing – Dialogue Writing
Grammar: Quantifiers, Prescribed Phrases – Correction of Sentences
Vocabulary: Affixation – Commonly Confused Words in English – Acronyms – Word Building

PRESCRIBED TEXT BOOK:
   1. *Communicative English – A Pragmatic Approach to Language Learning*, **prepared by
      the Department of English, ANITS and published by Immortal Publications.**

REFERENCE BOOKS:

1. Bailey, Stephen. *Academic writing: A handbook for international students*, Routledge, 2014.
2. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
3. Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012(Student Book, Teacher Resource Book, CD & DVD).
4. Varma, Shalini. *Body Language: Your Success Mantra*. Amazon: India, 2005

E-Resources

Listening:
Unit-I-
https://www.ted.com/talks/steve_presley_can_global_food_companies_make_the_shift_to_regenerative_agriculture

Unit-V- https://www.youtube.com/watch?v=_YlNmkbsL74&t=2s

https://www.ourbetterworld.org/series/environment/story/working-hand-in-hand-for-change?utm_source=taboola&utm_medium=indianexpress-indianexpress&utm_content=Watch+Hand+In+Hand+India+Make+Waste+Work&utm_campaign=OBW_ENV_SERIES_2022#tblciGiBX-q8Y7DpgDlPlmvjD7pcLI4ECqb3eMNOy27aIpILTMiCPuj0ogbbDp9K5kf2cAQ

Reading:

Unit-V-The role of Social Media-
https://timesofindia.indiatimes.com/education/upskill/the-role-of-social-media-analytics-in-new-age-digital-marketing/articleshow/101944496.cms

1-language.com
http://www.5minuteenglish.com/
https://www.englishpractice.com/

Grammar/Vocabulary English Language Learning Online
http://www.bbc.co.uk/learningenglish/
http://www.better-english.com/
http://www.nonstopenglish.com/
https://www.vocabulary.com/

LINEAR ALGEBRA AND MULTIVARIABLE CALCULUS

23MA1101   **Credits:3**

Instruction : 3 periods & 1 Tutorial/Week   Sessional Marks:40

End Exam : 3 Hours   End Exam Marks:60

Prerequisites: Matrices, Differentiation, Integration and Functions.

Course Objectives:

To provide the students with sufficient knowledge in calculus and matrix algebra, this can be used in their respective fields.

Course Outcomes: By the end of the course, students will be able to

1. Apply elementary transformations to reduce the matrix into the echelon form and normal form to determine its rank and interpret the various solutions of system of linear equations.
2. Identify the special properties of a matrix such as the eigen value, eigen vector, employ orthogonal transformations to express the matrix into diagonal form, quadratic form and canonical form.
3. Equip themselves familiar with the functions of several variables.
4. Evaluate double and triple integrals techniques over a region in two dimensional and three dimensional geometry.
5. Express the given function in terms of sine and cosine.

CO-PO –PSO Mapping:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1							1	2			
CO2	3	2	1	1							1	2			
CO3	3	2	1	1							1	2			
CO4	3	2	1	1							1	2			
CO5	3	2	1	1							1	2			

Correlation levels   1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO-PO-PSO Justification
1	CO1 is a basic tool which is used to find a solution of a complex problem after reducing it into a system of linear equations in many areas of the engineering sciences.
2	CO2 deals with eigen values, eigen vectors of a square matrix which are widely used in all the engineering branches like communications systems, Designing bridges, Machine learning.
3	CO3 deals with partial derivatives which are widely used in all the branches of engineering sciences.
4	CO4 delas with the techniques of multiple integrals which are used to find the area, volume and other physical and geometrical parameters in all the areas of engineering sciences.
5	CO5 is used to represent the given periodic function as an infinite sum of cosine and sine terms.

SYLLABUS

UNIT I   **10 Periods**

Linear Equations : Rank of matrix - Normal form of a matrix - PAQ form - Gauss Jordan method of finding the inverse - Consistency of linear system of equations.

Sections: 2.7 and 2.10.

UNIT II   **10 Periods**

Linear transformations and Quadratic forms :   Eigen values - Eigen vectors - Properties of eigen values (without proofs) - Cayley Hamilton theorem (without proof) - Reduction of quadratic form to canonical form - Nature of the Quadratic form.

Sections: 2.13, 2.14, 2.15, 2.17 and 2.18.

UNIT III   **10 Periods**

Multivariable Calculus : Total derivatives - Chain rule - Change of variables - Jacobians - Taylor's series expansion of two variable function - Maxima and minima of functions of two variables - Method of Lagrange's multipliers.

Sections: 5.5, 5.6, 5.7, 5.9, 5.11 and 5.12.

UNIT IV   **10 Periods**

Multiple Integrals : Double integrals - Change of order of integration - Double integration in polar coordinates - Areas enclosed by plane curves - Triple integrals - Volumes of solids (by using double and triple integrals).

Sections: 7.1, 7.2, 7.3, 7.4, 7.5 and 7.6.

UNIT V   **10 Periods**

Fourier Series : Introduction - Euler's formulae (without proof) - Conditions for a Fourier expansion - Functions having points of discontinuity - Change of interval - Even and odd functions - Half range series.

Sections: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6 and 10.7.

TEXT BOOKS:

1. **B. S. Grewal**, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

REFERENCE BOOKS:

1. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. **N. P. Bali**, Engineering Mathematics, Lakshmi Publications.
3. **George B. Thomas, Maurice D. Weir and Joel Hass**, Thomas, Calculus, 13/e, Pearson Publishers, 2013.
4. **H. K. Dass**, Advanced Engineering Mathematics, S. Chand and complany Pvt. Ltd.
5. **Michael Greenberg**, Advanced Engineering Mathematics, Pearson, Second Edition.

BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING
(Common for CSE, CSE (AI & ML, DS), IT, Mechanical and Chemical)

Code: 23EE3101　　　　　　　　　　　　　　　　　　**Credits: 3**
Instruction: 3 Periods & 1 Tut/Week　　　　　　　　　Sessional Marks:40
End Exam: 3 Hours　　　　　　　　　　　　　　　End Exam Marks:60
Prerequisites: Basic Knowledge of electric current concepts from Intermediate

Course Objectives:

1. To analyze using basic network theorems and reduction techniques for DC circuits.
2. To understand behavior of magnetic circuits and operation of electrical machines.
3. To understand operation and phasor diagrams of various basic electronic components.

Course Outcomes: At the end of the course the student will be able to:

CO1	**Apply** network theorems and **calculate** various parameters of DC circuits.
CO2	**Analyze** the behavior of magnetic circuits and **calculate** the parameters of magnetic circuits
CO3	**Analyze** the construction and working of DC and AC machines
CO4	**Illustrate** the construction & working of PN Diode, Half wave and Full wave rectifiers.
CO5	**Explain** the construction &operation of Transistor and FET

CO- PO, PSO Matrix
Correlation levels 1: Slight (Low)　　2: Moderate (Medium)　　3: Substantial (High)

COs	Program Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	3		-
CO3	3	3	3	3	3	-	-	3	-	-	-	3	-	-
CO4	3	-	-	3	3	-	-	3	-	-	-	3	-	3
CO5	3	-	-	3	3	-	-	3	-	-	-	3	-	3

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO-PO-PSO Justification
1 01 deals with basic knowledge about different circuit elements; Ohm's and Kirchhoff's laws will be discussed. Also used to analyze the complex engineering problems using DC theorems. It is also used to design the solutions for complex engineering problems and needs life-long learning to solve the various problems related to DC theorems. To some extent can be used to design the experiments. So it is highly mapped to PO1, PO2, PO3 and PO12. Also mapped to PO4 with medium level.
2　CO2 deals with basic Knowledge of different terminologies in magnetic circuits, to analyze complex magnetic circuits using engineering sciences also needs life-long learning to update to the new technology. So highly mapped to PO1, PO2 and PO12. Up to some extent can be used to design the solutions for complex magnetic circuits and in design of experiments. So it can be mapped to PO3 and PO4 with medium level.

3	CO3 deals with knowledge of engineering fundamentals in construction, principles of DC & AC electrical machines, analyzing the problems related to electrical machines, design the solutions for complex engineering problems and can be used to research based experiments using modern tools like MATLAB, simulator etc. So it leads to go for life-long learning. It also deals with society, legal and health issues. Also need to consider professional ethics and responsibilities norms of engineering of engineering practice. So CO3 is highly mapped to PO1, PO2, PO3, PO4, PO5, PO6, PO8 and PO12. And is mapped to PSO2 with medium level as it deals with electrical drives and their control in research applications only.
4	CO4 deals with the construction & working of PN Diode, Half wave and Full wave rectifiers that require basic engineering sciences, used in research based applications, it can also be used in modern tools like simulators, MATLAB etc.. It leads to life-long learning to update to new technologies. Also need to consider professional ethics and responsibilities norms of engineering of engineering practice. It can also be used as power switching device and their control for industrial and research applications. So it is highly mapped to PO1, PO4, PO5, PO8, PO12 and PSO2.
5	CO5 deals with the construction & working of PN Diode, Half wave and Full wave rectifiers that require basic engineering sciences, used in research based applications, it can also be used in modern tools like simulators, MATLAB etc.. Also need to consider professional ethics and responsibilities norms of engineering of engineering practice. It leads to life-long learning to update to new technologies. It can also be used as power switching device and their control for industrial and research applications. So it is highly mapped to PO1, PO4, PO5, PO8, PO12 and PSO2.

SYLLABUS

UNIT-I   **[10 Periods]**
DC Circuits
Circuit Elements, Basic Laws, KCL, KVL, Linearity principle (Superposition), Mesh and Nodal analysis, Thevenin's and Norton's theorems.

UNIT-II   **[10 Periods]**
Magnetic Circuits
Definition of Magnetic circuit, Reluctance, Magneto-motive force, Magnetic flux, Simple problems on series magnetic circuits, Faraday's Law of Electromagnetic induction, statically and dynamically induced EMF.

UNIT-III   **[14 Periods]**
DC Machines
DC Generator construction, Working of DC generator, DC Motor working principle, significance of back EMF, Applications
AC Machines
Transformer construction, working principle, Three-phase induction motor construction, Three-phase induction motor working principle.

UNIT-IV   **[12 Periods]**
Semiconductor Diode and Rectifiers
Intrinsic and Extrinsic Semiconductors, PN Junction Diode-Forward and Reverse biases, Avalanche break down, Construction, Operation and Characteristics of Half wave rectifier, Full wave center tapped and bridge rectifiers.

UNIT-V   **[14 Periods]**
Transistor, FET/MOSFET Characteristics
The common base configuration, Input and Output characteristics, Construction of FET, Transfer and Drain characteristics, Construction of MOSFET, and Characteristics of enhancement and depletion modes.

TEXTBOOKS:
1. V.K. MEHTA & ROHIT MEHTA, "Principles of Electrical Engineering and Electronics", 2nd edition, S. Chand Publications

REFERENCE BOOKS:

1. J. B. Gupta, "A textbook of electrical Engineering", S.K Katari & Sons Publication.

COMPUTER AIDED ENGINERING GRAPHICS

(MECH, CHEM, CIVIL, CSD, CSM, EEE, ECE)

23ME3201   **Credits:3**

Instruction : 1 periods & 3 Practical/Week   Sessional Marks:50

End Exam : 3 Hours   End Exam Marks:50

Prerequisites: Nil

Course Objectives:

➢ The course is designed to introduce computer aided drafting skills and fundamentals of engineering drawing and further apply these principles to draw orthographic projections of points, planes, solids and isometric projections.

Course Outcomes:

By the end of the course, students will be able to

1.	**Draft** simple 2D drawings with dimensions using CAD software.
2.	**Draft** Engineering curves - conics , cycloids and involute using CAD software.
3.	**Project** orthographically points, lines and planes in various positions using CAD software.
4.	**Draw** orthographic projections of solids in various orientations using CAD software.
5.	**Construct** isometric views and isometric projections of simple Machine parts using CAD software.

CO-PO –PSO Mapping

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2			3			1		2		1		
CO2	2	2			3			1		2		1		
CO3	2	2			3			1		2		1		
CO4	2	2			3			1		2		1		
CO5	2	2			3			1		2		1		

Correlation levels 1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO-PO-PSO Justification
1	CO-1 satisfies two competencies (1.3&1.4) it is mapped to PO-1 at medium level. As CO-1 satisfies two competencies (2.2 & 2.4), it is mapped at medium level to PO-2. As CO-1 satisfies three competencies (5.1, 5.2 & 5.3), it is mapped at high level to PO-5. As CO-1 satisfies one competency (8.2), it is mapped at low level to PO-8. As CO-1 satisfies two competencies (10.1 & 10.3), it is mapped at medium level to PO-10. As CO-1 satisfies one competency (12.2), it is mapped at low level to PO-12 (Case Study using any of the Drafting Tools).

2	CO-2 satisfies two competencies (1.3&1.4) it is mapped to PO-1 at medium level. As CO-2 satisfies two competencies (2.2 & 2.4), it is mapped at medium level to PO-2. As CO-2 satisfies three competencies (5.1, 5.2 & 5.3), it is mapped at high level to PO-5. As CO-2 satisfies one competency (8.2), it is mapped at low level to PO-8. As CO-2 satisfies two competencies (10.1 & 10.3), it is mapped at medium level to PO-10. As CO-2 satisfies one competency (12.2), it is mapped at low level to PO-12 (Case Study using any of the Drafting Tools).
3	CO-3 satisfies two competencies (1.3&1.4) it is mapped to PO-1 at medium level. As CO-3 satisfies two competencies (2.2 & 2.4), it is mapped at medium level to PO-2. As CO-3 satisfies three competencies (5.1, 5.2 & 5.3), it is mapped at high level to PO-5. As CO-3 satisfies one competency (8.2), it is mapped at low level to PO-8. As CO-3 satisfies two competencies (10.1 & 10.3), it is mapped at medium level to PO-10. As CO-3 satisfies one competency (12.2), it is mapped at low level to PO-12 (Case Study using any of the Drafting Tools).
4	CO-4 satisfies two competencies (1.3&1.4) it is mapped to PO-1 at medium level. As CO-4 satisfies two competencies (2.2 & 2.4), it is mapped at medium level to PO-2. As CO-4 satisfies three competencies (5.1, 5.2 & 5.3), it is mapped at high level to PO-5. As CO-4 satisfies one competency (8.2), it is mapped at low level to PO-8. As CO-4 satisfies two competencies (10.1 & 10.3), it is mapped at medium level to PO-10. As CO-4 satisfies one competency (12.2), it is mapped at low level to PO-12 (Case Study using any of the Drafting Tools).
5	CO-5 satisfies two competencies (1.3&1.4) it is mapped to PO-1 at medium level. As CO-5 satisfies two competencies (2.2 & 2.4), it is mapped at medium level to PO-2. As CO-5 satisfies three competencies (5.1, 5.2 & 5.3), it is mapped at high level to PO-5. As CO-5 satisfies one competency (8.2), it is mapped at low level to PO-8. As CO-5 satisfies two competencies (10.1 & 10.3), it is mapped at medium level to PO-10. As CO-5 satisfies one competency (12.2), it is mapped at low level to PO-12 (Case Study using any of the Drafting Tools).

SYLLABUS

UNIT I : COMPUTER AIDED DRAFTING

Introduction, Applications, CAD software- AutoCAD, GUI, function keys, Drawing entities, Drafting aids(limits, layers, dimensioning, object snap, zoom), modify commands, Block, WBlock and insert, List of commands, Setting Isometric mode, Iso-planes, isometric commands.

Weekly Exercises:

Week 1: a) Limits, command line, command list, function keys- Ortho, polar, Osnap, Otrack etc.

b) Draw lines using dynamic input, Ortho & Polar, Line divide, construction line.

c) Drawings using coordinate system, arbitrary coordinate system.

d) Selection & Modify commands – offset, move, copy, rotate, trim, Scale.

Week 2: a) Layers, Match property, line types

b) Arcs and Circles

c) Fillet and Chamfer

d) Annotations and Dimensioning

Week 3: a) Symmetrical drawings using mirror

b) Rectangular Array

c) Polar and Path Array

d) Annotations and Dimensioning

Week 4: a) polygons

b) hatching

c) block, wblock, group, ungroup, explode

d) iso planes

UNIT II: ENGINEERING CURVES

Conic sections- General methods, Cycloids, epi-cycloid, hypocycloid, Involute of circle and polygon

Week 5: a) Ellipse

b) Parabola

c) Hyperbola

Week 6: a) Cycloid

b) Hypocycloid

c) Epi-Cycloid

Week 7: a) Involute of polygon

b) Involute of a Circle

UNIT III: ORTHOGRAPHIC PROJECTIONS – POINTS & LINES & PLANES

Orthographic projections – projections of points – projections of straight lines (lines parallel to both HP&VP, lines parallel to one and inclined to other, lines inclined to both the planes) Projections of regular polygon planes – inclined to one plane, inclined to both the planes.

Weekly Exercises:

Week 8: a) Projection of points

b) Shortest distance of points from principle plane

Week 9: a) A line parallel to both the planes

b) A line inclined one plane

c) A line inclined to both the planes

Week 10: Projection of plane inclined to one plane.

Week 11: Projection of planes inclined to both planes

UNIT IV: ORTHOGRAPHIC PROJECTIONS – SOLIDS

Projection of solids: Prisms – Cylinder– Pyramids &Cones –simple positions & axis inclined to one plane.

Weekly Exercises:

Week 12: Projection of solids in simple positions.

Week 13: Projection of solids inclined to one plane.

UNIT V: ISOMETRIC PROJECTIONS

Isometric projections –Isometric scale, Isometric view & projection of prisms, pyramids, cone, cylinder,sphere, and their combination, conversion of orthographic projection into isometric projection.

Weekly Exercises:

Week 14: Isometric Projection of Primitives

Week 15: Isometric Projection of combination of solids

TEXT BOOKS:

1. **Pradeep Jain** "Engineering Graphics & Design" ISBN 9789391505066, Khanna Book Publishing
2. **N. D. Bhatt** *"Engineering Drawing"* Charotar Publishing House Pvt. Ltd, 53rd Edition : 2014

REFERENCE BOOKS:

1. **K. L. Narayana & P. Kanniah** *"Engineering Drawing"*

2. **R. B. Choudary** *"Engineering Graphics* with Auto CAD"

3. **TrymbakaMurty** *"Computer Aided Engineering Drawing"*

4. **B.V.R. Gupta and M.Raja Roy** *"Engineering Drawing with Auto CAD"* ISBN-13 978-9384588960 I K   International Publishing House 3rd Edition : 2016

INTRODUCTION TO CHEMICAL ENGINEERING

23CH4101   **Credits:03**

Instruction: 3 periods/Week   Sessional Marks:40

End Exam: 3 Hours   End Exam Marks:60

Course Objectives:

1. To discuss the basics and necessity of Chemical Engineering.
2. To know the importance of units and dimensions and material and energy balances.
3. To gain knowledge in momentum and heat transfer.
4. To gain knowledge in mass transfer operations.
5. To acquire knowledge on chemical kinetics.

Course Outcomes:

By the end of the course, student will be able to:

1. Outline the basic Principles of Chemical Engineering
2. Identify different types of fluids and pumps
3. Describe the heat exchange Equipments
4. Illustrate absorption and distillation equipment
5. Express the rate expression for different chemical reactions

CO - PO - PSO Matrix:

		PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO	1	3				1							1	1	1
	2	3				1							1	1	1
	3	3				1							1	1	1
	4	3				1							1	1	1
	5	3				1							1	1	1

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO-PO-PSO Justification	
1	CO1 deals with basic mathematical equations and basic laws and principles. For this it is mapped with PO1, PO5, PSO1, PSO2.
2	CO2 will be attained by using conservation laws, principles of fluid flow and basics of pumps, so it is mapped with PO1, PO5, PSO1, PSO2.
3	CO3 provides knowledge on modes of heat transfer and heat transfer equipment, hence it is mapped with PO1, PO5, PSO1, PSO2.
4	CO4 gives familiarity on a range of mass transfer operations and fundamental laws, so it is mapped with PO1, PO5, PSO1, PSO2.
5	CO5 offers comprehension of rate of reaction, basics on rate equations and reactor types, hence it is mapped with PO1, PO5, PSO1, PSO2.

SYLLABUS

UNIT I   10 Periods

Introduction: Introduction, role of chemical engineer, unit operations, unit processes, types of chemical reactors, basic laws, mechanical separations, units and dimensions, energy, equivalent mass, solutions, material and energy balances.

UNIT II   10 Periods

Momentum Transfer: Introduction, nature of fluid, viscosity, flow field, conservation of mass and energy, fluidization, pumping of fluids, cavitation.

UNIT III   10 Periods

Heat Transfer: Conduction, convection, radiation, flow arrangements in heat exchangers, heat transfer equipment, evaporation

UNIT IV   10 Periods

Mass Transfer Operations: Diffusion, mass transfer operations, distillation, types of distillation, distillation equipment, absorption, absorption equipment.

UNIT V   10 Periods

Chemical Reaction Engineering: Introduction, thermodynamics review, rate equation, effect of temperature on reaction rate, reactors-batch reactor, plug flow reactor and mixed flow reactor

TEXT BOOK:

1. S. K. Ghosal, S. K. Sanyal and S. Dutt , " *Introduction to Chemical Engineering"* Tata- McGrawHill, New Delhi, 1993.

REFERENCE BOOKS:

1. Max S. Peters *"Elementary Chemical Engineering"* 2nd edition, Tata-McGraw-Hill, New Delhi.

2. J. T. Banchero and W. L. Badger *"Introduction to Chemical Engineering"* Tata McGraw Hill, New Delhi.

3. Warren L.McCabe, Julian C.Smith and Peter Harriot *"Unit Operations of Chemical Engineering"* 7th edition, Tata-McGraw Hill, New Delhi.

4. Kenneth A. Solen, **John N.** Harb *"Introduction to Chemical Engineering"* 5th Edition, WileyIndia Pvt. Ltd., NewDelhi

COMMUNICATIVE ENGLISH LAB

ENG LAB: 23EN2201   **Credits:1.5**
Instruction : 3 periods   **Sessional Marks:50**
End Exam : 3 Hours   **End Exam Marks:50**
Prerequisites: Basic English Language Skills

Course Objectives:

To give idea about phonetics, linguistics and LSRW skills

To develop conversational skills among the students

To introduce different accents of English language through presentations

To train the students to do various exercises on vocabulary and grammar

Course Outcomes:

By the end of the course, students will be able to		
1.	Understand various linguistic, phonetic and communicative aspects	L2
2.	Apply general conversational activities in different socio-cultural contexts with logical thinking.	L3
3.	Analyze cultural diversity of several nations' languages through presentations.	L4
4.	Appraise and reframe various exercises for getting better employability	L4

CO-PO –PSO Mapping

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1									2	2		2			
CO2									2	2		2			
CO3									2	2		2			
CO4									2	2		2			

Correlation levels   1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)

Mapping of Course Outcomes with Program Outcomes:

CO-PO- Justification	
1.	CO1 is not mapped with any PO as it is in understanding level. Students can understand various accents of English language and they learn and practice individually and in
2.	CO2 is suitable to the POs 9, 10, 12 as it makes the students converse, understand and participate in various activities like JAM, Debate, Role-Play etc. Students perform singly and team-wise.

3.	CO3 is mapped with the POs 9, 10, 12. Students understand cultural diversity and give effective individual and team presentations.
4.	CO4 deals with POs 9, 10, 12 as students write and practice various exercises by using contemporary vocabulary.

SYLLABUS

UNIT I   CO-I   12 Periods

Introduction to Phonetics – IPA – RP – Phonetic Transcription – Word stress or accent

UNIT II   CO-2   9 Periods

Functional English – JAM – Debate – Situational Dialogues or Role Plays

UNIT III   CO-3   12 Periods

Presentations on various topics from academic contexts and on international issues

UNIT IV   CO-4   9 Periods

Discussing specific topics and practicing exercises and short structural talks

REFERENCE BOOKS:

1. Robert, J. Dixon. *Everyday dialogues in English*

2. Speak well - orient black swan.

3. Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking.* Heinley ELT; 2nd Edition, 2018.

4. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.

5. Hewings, Martin. *Cambridge Academic English* (B2). CUP, 2012

6. Jones, Daniel. *Cambridge English Pronouncing Dictionary*. Cambridge UP, 2011,

e-Resources & other digital material

Grammar/Listening/Writing

1-language.com

http://www.5minuteenglish.com/

https://www.englishpractice.com/

Listening

https://learningenglish.voanews.com/z/3613

http://www.englishmedialab.com/listening.html

Speaking

https://www.talkenglish.com/

BBC- Learning English

Pronunciation tips

Merriam Webster – Perfect pronunciation Exercises All Skills

https://www.englishclub.com/

http://www.world-english.org/

http://learnenglish.britishcouncil.org/

Online Dictionaries

Oxford learner's dictionaries

Cambridge dictionary online

MacMillan dictionary

Engineering and IT Workshop (R23)

(CHEM, CSD, CSM, EEE, IT)

23ME3202   **Credits:1.5**

Instruction : 3 Practical/Week   Sessional Marks:50

End Exam : 3 Hours   End Exam Marks:50

Prerequisites: Nil

Course Objectives:

- To provide training and hands on experience to the students on basic Engineering relatedskills like carpentry, fitting, tin smithy and house wiring
- Explain the internal parts of a computer, peripherals, I/O ports, connecting Cables.
- Demonstrate OS installation and Hardware Troubleshooting.
- Demonstrate Office Tools such as Word processors, Spread-sheets, and Presentation.

Course Outcomes:

By the end of the course, students will be able to

1.	**Produce** a variety of carpentry, fitting and Tin Smithy jobs.
2.	**Prepare** electrical circuits for Series & Parallel connection and Stair case wiring.
3.	**Demonstrate** the capability of OS installation, network connectivity and Hardware Troubleshooting
4.	**Draft, present** and **perform** analyses on a given problem using MS-office tools

CO-PO –PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2						1							
CO2	1	2						1							
CO3	1	2		2				1	1						
CO4	1	3			1			1	1	2		2			

Correlation levels 1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO-PO-PSO Justification	
1	CO-1 satisfies only competency-1.4, so it is mapped to PO-1 at low level. As CO-1 satisfies two competencies (2.3 & 2.4), it is mapped at medium level to PO-2. As CO-1 satisfies one competency (8.1), it is mapped at low level to PO-8.
2	CO-2 satisfies only competency-1.4, so it is mapped to PO-1 at low level. As CO-2 satisfies two competencies (2.3 & 2.4), it is mapped at medium level to PO-2. As CO-2 satisfies one competency (8.1), it is mapped at low level to PO-8.
3	CO-3 satisfies only competency-1.4, so it is mapped to PO-1 at low level. CO-3 satisfies two competencies- (2.1 & 2.2) so it is mapped to PO-2 at medium level. As CO-3 satisfies one competency-4.1& 4.3, it is mapped at medium level to PO-4. As CO-3 satisfies one competency (8.1), it is mapped at low level to PO-8. As CO-3 satisfies one competency-9.1, it is mapped at low level to PO-9.
4	CO-4 satisfies only competency-1.4, so it is mapped to PO-1 at low level. As CO-4 satisfies three competencies- (2.2, 2.3 & 2.4) it is mapped at high level to PO-2. As CO-4 satisfies one competency (5.1), it is mapped at low level to PO-5. As CO-4 satisfies one competency (8.1), it is mapped at low level to PO-8. As CO-4 satisfies one competency-9.1, it is mapped at low level to PO-9. As CO-4 satisfies two competencies-(10.1 & 10.2), it is mapped at medium level to PO-10. As CO-4 satisfies two competencies-(12.2 & 12.3) it is mapped at medium level to PO-12.

ENGINEERING WORKSHOP SYLLABUS

LIST OF EXPERIMENTS

Carpentry	1. Cross Lap Joint
	2. Dovetail Joint
Fitting	1. V Fit
	2. Square Fit
Tin Smithy	1. Taper Tray
	2. Square Box without lid
House Wiring	1. Parallel / Series Connection of three bulbs
	2. Stair Case wiring

Reference book:

1. **S.K.Hajra Choudhury** "*Elements of Workshop Technology" Vol I Manufacturing Processes,* ISBN:8185099146(2017).
2. **Lab Manual**

IT WORKSHOP SYLLABUS

Week 1: Introduction to PC Hardware   **CO3**

Types of Computing Devices such as PC, Laptops, Servers, Smart Phones, Tablets, other accessories, PC parts, Input/Output devices, I/O ports and interfaces, main memory, cache memory and secondary storage technologies, digital storage basics, networking components and speeds.

Week 2:   **CO3**

Task 1: OS Installation: Every student should individually install operating system like Linux or MS windows on the personal computer. The system should be configured as dual boot with both windows and Linux.

Task 2: Hardware Troubleshooting: Students have to be given a PC which does not boot due to improper assembly or defective peripherals. They should identify the problem and fix it to get the computer back to working condition.

Week 3:   **CO3**

Task 1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate how to access the websites and email.

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop-up blockers.

Week 4: MS word & PowerPoint Presentation   **CO4**

Task 1: Creating a Newsletter: Features to be covered: - Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs in word.

Task 2: create basic power point presentation: PPT Orientation, Slide Layouts, Inserting Text, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows, Hyperlinks, Inserting Images, Tables and Charts.

Week 5: Spreadsheet Orientation: **CO4**

Accessing, overview of toolbars, saving spreadsheet files, Using help and resources. Format Cells, Summation, auto fill, Formatting Text. Calculating GPA -. Features to be covered: - Cell Referencing, Formulae in spreadsheet – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, Sorting, Conditional formatting.

Case Study:

1. Create Department Newsletter of Latest academic year.
2. Create a presentation on short term goals vs long term goals.
3. Perform result analysis

Reference Books:

1. PC Hardware - A Handbook – Kate J. Chase PHI (Microsoft)
2. MOS Study Guide for Microsoft Word, Excel, Power point & Outlook by Joan Lambert & Joyce Cox

IOT LABORATORY	
(Common to Chemical and Mechanical)	
Code: 23EC4212	Credits:3
Instruction:3Periods &1E/Week	SessionalMarks:5
End Exam: 3Hours	End Exam

Course objectives:

- To Interface various input and output devices with Arduino Uno
- To Design the minimum system for sensor-based application.
- To solve the problems related to the primitive needs using IoT.

Course Outcomes: At the end of the course the student will be able to:

CO	BL	CO
CO1	BL-2	Make a basic electronic test circuit connection to familiarize with lab components
CO2	BL-3	Interface simple input/output devices to Arduino Uno
CO3	BL-3	Implement basic wired data communication using Arduino Uno
CO4	BL-3	Perform I/O operations over local wireless network
CO5	BL-3	Perform basic data sending and visualization operation using IoTCloud

Program Matrix

	Program Outcomes (POs)											
	Domain Specific POs					Domain Independent POs						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	2	-	-	-	1	-	-	-
CO2	2	1	2	-	2	-	-	-	1	-	-	-
CO3	2	1	2	-	2	-	-	-	1	-	-	-
CO4	2	1	2	-	2	-	-	-	1	-	-	-
CO5	2	2	2	-	2	-	-	-	1	-	-	-

List of Experiments

1. 1. Familiarization of Electronic lab tools and glow LED using simple circuit (CO1)

2. Familiarization of Arduino Uno, its Setup & Installation and control LED(CO1)

3. Interface and control Buzzer with Arduino Uno(CO2)

4. Interface push button/digital sensors with Arduino Uno(CO2)

5. Interface DHT sensor and read the humidity using Arduino Uno(CO3)

6. Perform Serial Communication and transmit "Hello World!"(CO3)

7. Interface HC-05 Bluetooth module to send data to PC applications (CO4)

8. Interface HC-05 Bluetooth module to receive data from PC applications (CO4)

9. Interface relay and remotely operate an electrical device (CO4)

10. Sending sensor data to Cloud and Visualization (CO5)

ENVIRONMENTAL SCIENCE

With effect from 2023-24
Mandatory (Non Credit) course for all branches

Course Code - Category: 23MC0102　　　　　　　　　　　**Credits:0**

Lecture hours : 3 per week　　　　　　　　　　　Sessional Marks:50

Prerequisites : +1 & +2

COURSE OBJECTIVES:
- Inculcating in students the awareness toward components in environment
- Understand the importance natural resources, Structure, and functions of an   ecosystem
- Inducing knowledge on Sources, effects, and methods to reduce environmental   pollution
- Able to know the meaning of sustainable development and correlate social issues related to   environment.

Course Outcomes:
By the end of the semester, the student will beable to:

CO.No.	Statement
CO-1	Identify the characteristics of various natural resources and can implement the conservation practices
CO-2	Realize the importance of Ecosystem and Biodiversity for maintaining ecological balance
CO-3	Classify, analyze various pollutants and can develop methods for solving problems related to environment
CO-4	Implement the environmental laws or defend issuesby getting awareness on legal aspects related to environmental issues
CO-5	Promote awareness on local environmental issues by participating in group activities, seminars, takingproject work

CO-PO-PSO Mapping   (Low-1, Medium-2, High-3)

PO/CO's	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1						1	2	1		1		1		
CO2						1	2	1		1		1		
CO3						2	2	1		1		1		
CO4						2	3	1		1		1		
CO5						2	2	1	3	2		1		

UNIT I
INTRODUCTION TO ENVIRONMENT AND NATURAL RESOURCES   8 Periods
Introduction: Definition, Multidisciplinary nature of environmental studies, Scope and Importance of Environmental Sciences, Need for public awareness.

Natural Resources: Renewable and Non-Renewable resources- Forest resources-use and overexploitation,deforestation, Water resources- aquifers, dams and benefits, conflicts over water; Food resources- effects of modern agriculture practices, Energy resources-conventional and non - conventional energy resources.

Activities:

Need for Public Awareness (Campaign), Renewable vs. Non-Renewable Resources(Group Discussion), Deforestation and its Impact, Water Conflict(Case studies)

UNIT- II
ECOSYSTEM & BIO DIVERSITY   **8 Periods**
Ecosystem: Concept of an ecosystem-structure and function of an ecosystem Food chains, food webs and ecological pyramids, Energy flow in an ecosystem, Ecosystem regulation, Ecological succession.

Biodiversity: Definition, types, India as a Mega diversity Nation, Values of biodiversity, Hot spots ofbiodiversity, Threats to biodiversity, Endangered and endemic species, Conservation of biodiversity.

Activities:

Ecosystem (Field trip), Food chain and Food Web (Models), Endangered Species (Case Studies), Ecosystem regulation, Values of Biodiversity (Group Discussion), Endangered Species Awareness (Poster presentation).

UNIT -III
ENVIRONMETAL POLLUTION AND WASTE MANAGEMENT   **8 Periods**
Pollution: Sources, effects and control measures of Air pollution, Noise Pollution, Water Pollution, SoilPollution, Radio Active Pollution; Climate Change, Ozone depletion, Acid rains – causes and adverse effects.

Solid waste management: Sources and effects of municipal waste, bio-medical waste, Industrial waste, e- waste, Process of waste management-composting, sanitary landfills, incineration. Green Chemistry concepts,

Activities:

Pollution (Slogan writing), Pollution Control Measures (Group Discussion) ,Climate Change (Case Studies), Waste-to-Art (Poster presentation).

UNIT- IV
SOCIAL ISSUES AND ENVIRONMENTAL LEGISLATIONS   **8 Periods**
Social Issues and the Environment: Sustainable development, Environmental Impact Assessment, Rain water harvesting, water shed management. Resettlement and rehabilitation of people, Environmental ethics.

Legislational Acts: Importance of Environmental legislation, Air (Prevention and Control of Pollution) act, Water (Prevention and control of Pollution) act, Wildlife Protection act, Forest Conservation act.

Activities:

Sustainable Development, Environmental Ethics (Group Discussion), Environmental Impact Assessment (EIA), Resettlement and Rehabilitation (Case Studies), Rainwater Harvesting(Model), Environmental Legislation (Awareness Campaign).

UNIT- V
HUMAN POPULATION AND THE ENVIRONMENT   **5 Periods**
Human population and environment- Population growth, Population explosion; Family Welfare Programmes; Role of information technology on environment and human health; Value Education – HIV/AIDS – Women andChild Welfare

FIELD WORK/PROJECT: Visit to a local area to document environmental problem and submit a Record

Activities:

Population Growth, Role of Information Technology and Environment, Women Empowerment, Family Welfare Program (Awareness Campaign), Women and Child Welfare (Case Study), Population and Environment (Short film)

Prescribed Book

1. **Anubha Kaushik & C.P.Kaushik**, "*Perspertives of Environmental Studies"* by 5th edition New AgeInternational Publications, 2015.

2. **Erach Bharucha** *Text book of "Environmental Studies for Undergraduate Courses*", universities PressCommission, 2013.

3. **Palaniswamy**- "*Environmental Studies"*, 2nd edition, Pearson education 2015.

Reference Books

1. **S. Deswal, A. Deswal**, "*Basic course in Environmental studies"*, 2nd edition, Dhanpatrai Publications, 2008.

ORDINARY DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS

23MA1102   **Credits:3**

Instruction : 3 periods & 1 Tutorial/Week   Sessional Marks:40
End Exam : 3 Hours   End Exam Marks:60

Prerequisites: Matrices, Differentiation, Differential equations, Integration and Functions.

Course Objectives:
Create and analyze mathematical models using first and higher order differential equations to solve application problems such as electrical circuits, orthogonal trajectories and Newton's law of cooling and also familiarize the student in various topics in numerical analysis such as interpolation, numerical differentiation, integration and direct methods for solving linear system of equations.

Course Outcomes: By the end of the course, students will be able to

1.	Demonstrate solutions to first order differential equations by various methods and solve basic application problems related to electrical circuits, orthogonal trajectories and Newton's law of cooling.
2.	Discriminate among the structure and procedure of solving a higher order differential equations with constant coefficients and variable coefficients.
3.	Apply various numerical methods to solve linear and non-linear equations.
4.	Familiarize with numerical integration and differentiation.
5.	Understand Laplace transforms and its properties, and finding the solution of ordinary differential equations.

CO-PO –PSO Mapping:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1							1	2			
CO2	3	2	1	1							1	2			
CO3	3	2	1	1							1	2			
CO4	3	2	1	1							1	2			
CO5	3	2	1	1							1	2			

Correlation levels   1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO-PO-PSO Justification	
1	CO1 is widely used to solve complex engineering problems in all the areas like Fluid dynamics, Mass transfer, Signals and Systems, and Dynamics.

2	CO2 is widely used to solve complex engineering problems in all the areas like Fluid dynamics, Mass transfer, Signals and Systems, and Dynamics.
3	CO3 deals with the techniques that are used to find an approximate real root of the given algebraic and transcendental equations.
4	CO4 deals with the knowledge of interpolation, numerical differentiation and integration, which is used all the areas of engineering sciences.
5	CO5 deals with the knowledge of Laplace transforms which are widely used in all the areas of engineering sciences.

SYLLABUS

UNIT I   **10 Periods**
Ordinary differential equations of first order and its applications :   Linear equations - Bernoulli's equations - Exact differential equations - Equations reducible to exact equations - Orthogonal trajectories - Simple electric circuits (L –R circuit problems) - Newton's law of cooling.

Sections: 11.9, 11.10, 11.11, 11.12, 12.3, 12.5 and 12.6.

UNIT II   **10 Periods**
Higher order linear differential equations and its applications : Definitions - Operator D - Rules for finding the complementary function - Rules for finding the particular integral - Method of variation of parameters - Equations reducible to linear equations with constant coefficients: Cauchy's homogeneous linear equation - Legendre's linear equation. Applications**:** L – C – R circuit problems.

Sections: 13.1, 13.3, 13.4, 13.6, 13.8(I), 13.9, 14.5(ii).

UNIT III   **10 Periods**
Numerical solutions of algebraic and transcendental equations :
Solution of algebraic and transcendental equations: Bisection method - Regula-Falsi method - Newton-Raphson method.
Solution of linear simultaneous equations: Gauss elimination - Gauss Jordan - Gauss Seidel.

Sections: 28.2, 28.3, 28.5, 28.6(1,2), 28.7(2)

UNIT IV   **10 Periods**
Interpolation, Numerical Differentiation and Integration : Finite differences - Other difference operators - Relation between operators - To find one or more missing terms - Newton's interpolation formulae. Interpolation with unequal intervals: Lagrange's interpolation formula.

Numerical differentiation: Newton's forward and backward differences formula to compute first and second derivatives**.**

Numerical integration: Trapezoidal rule - Simpson's $1/3^{rd}$ and $3/8^{th}$ rules.

Sections: 29.1(1,2), 29.4(i), 29.5, 29.6(1,2), 29.9, 29.10, 30.2(1,2), 30.6, 30.7, 30.8.

UNIT V   **10 Periods**

Laplace Transforms and its applications : Introduction - Definitions - Transforms of elementary functions - properties of Laplace transforms - Transforms of periodic functions - Transforms of derivatives - Transforms of integrals - Multiplication by t^n - Division by t – (All properties without proofs) - Evaluation of integrals by Laplace transforms.

Inverse transforms – method of partial fractions - Other methods of finding inverse transforms - Convolution theorem (without proof) - Application's to differential equations - Unit step function and unit impulsive functions.

Sections: 21.1, 21.2, 21.3, 21.4, 21.5, 21.7, 21.8, 21.9, 21.10, 21.11, 21.12, 21.13, 21.14, 21.15, 21.17 and 21.18.

TEXT BOOKS:

1. **B. S. Grewal**, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

REFERENCE BOOKS:

1. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. **N. P. Bali**, Engineering Mathematics, Lakshmi Publications.
3. **George B. Thomas, Maurice D. Weir and Joel Hass**, Thomas, Calculus, 13/e, Pearson Publishers, 2013.
4. **H. K. Dass**, Advanced Engineering Mathematics, S. Chand and complany Pvt. Ltd.
5. **Michael Greenberg**, Advanced Engineering Mathematics, Pearson, Second Edition.

R- 23 - ENGINEERING PHYSICS (Common for ECE, EEE, Mechanical, Civil and Chemical)	
Course Code: 23PY1101	**Credits: 03**
Instruction**:** L - 3, T- 1 P – 0	Sessional Marks: 40
End Exam : 3 Hours	EndExam Marks: 60

Prerequisites: Basic concepts of Physics in 12th level

Course Objectives

1. To impart knowledge in basic concepts of physics relevant to engineering applications

2. To introduce advances in technology for engineering applications

Course Outcomes: At the end of the course the student will be able to:

CO	COURSE OUTCOMES	Bloom's Taxonomy	Bloom's Taxonomy Level
CO-1	**Interpret** the relation between heat, work, and entropy with thermodynamic laws.	**Interpret**	L3
CO-2	**Explain and analyze** the relation between electric field, electric current and magnetic fields, production and applications of ultrasonics	**Explain Analyze**	L2 L4
CO-3	**Apply** the optical phenomena like Interference, Diffractionand Polarization to various fields.	**Apply**	L3
CO-4	**Explain** the working principle and applications of lasers andfiber optics.	**Explain**	L2
CO-5	**Interpret** the microscopic behavior of matter with quantummechanics.	**Interpret**	L3

CO	Bloom's Level
CO1	Action Verb from Blooms Taxonomy- **Interpret** / Cognitive level- Analysis (BL-3)
CO2	Action Verb from Blooms Taxonomy- **Explain, Analyse** / Cognitive level- Application (BL-2, L-4)
CO3	Action Verb from Blooms Taxonomy- **Apply** /Cognitive level- Understand (BL-3)
CO4	Action Verb from Blooms Taxonomy-**Explain** /Cognitive level- Applying (BL-2)
CO5	Action Verb from Blooms Taxonomy-**Interpret** /Cognitive level- Understand (BL-3)

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									1
CO2	3	3	1	1		1						
CO3	3	2		1								
CO4	3			1	1	1				1	1	2
CO5	3	2										

Correlation levels1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping of Course Outcomes with Program Outcomes

	CO-PO Justification
1	CO1 deals with the fundamental concepts of thermodynamic laws and entropy, which are associated in all working instruments and machines in the development of components, **related to** engineering problems. All the Thermodynamics concepts are related to electrical and mechanical devices in terms of understanding heat and heat dissipation mechanisms in daily life. So mapped to PO1, PO2, PO3 and PO12
2	CO2 deals with the fundamental laws of electromagnetism give us **deep insight** of **working nature** for different electronic devices and instruments. The knowledge of electromagnetism allows them to design systems with minimal electromagnetic interference, leading to more reliable and robust engineering solutions. The knowledge of basic properties and applications of ultrasonic waves will allow their utility in all fields of industry. So mapped to PO1, PO2, PO3, PO4 and PO6.
3	CO3 gives the knowledge of polarization allows them to design antennas with specific polarization characteristics, matching requirements of wireless communication applications. The study of Interference and diffraction phenomenon will help to analyse the colours in thin films, non-reflective surfaces, refractive index of materials and importance of polaroid's. So mapped to PO1, PO2 and PO4.
4	CO4 deals with the lasers and optical fibre properties and their basic principle of working mechanisms. From this knowledge students can gain insight into emerging technologies in various fields. So mapped to PO1, PO4, PO5, PO6, PO10, PO11 and PO12.
5	CO5 deals with the basic knowledge of Quantum mechanics will help to understand Microscopic **behaviour** of matter which decides the macroscopic property of the system. The conceptual knowledge of Quantum mechanics is useful to **identify** and analyse the complex engineering aspects. So mapped to PO1 and PO2.

SYLLABUS

UNIT – I   10 periods
Thermodynamics:
Heat and work, first law of thermodynamics and its applications, reversible and irreversible processes, heat engine, Carnot cycle and its efficiency, Carnot's theorem, second law of thermodynamics, entropy – entropy change in reversible and irreversible processes, entropy and second law, entropy and disorder, entropy and probability, third law of thermodynamics.
A text book of Engineering Physics   --   M.N.Avadhanulu & P.G.Kshirasagar, S.Chand Publications
Learning Outcomes:
The students will be able to
- Explain the relation between heat and work.
- Recognize how much heat is converted into work.
- Identify the relation between entropy and different thermodynamic phenomena.

UNIT-II   10 periods
ELECROMAGNETISM
Electric charge, electric flux, experimental law of Coulomb, electric field intensity (E), electric flux density (D), electric Potential (V).
Magnetic flux, magnetic field intensity (H), magnetic flux density (B), Biot-Savart's law, current density (J), first form of Ohm's law.
Electromagnetic induction - Faraday's law of induction,
Properties of Dielectrics and its classifications (Polar, Non-Polar), Electric dipole, polarization,
Properties of magnetic materials and classification (Dia, Para, Ferro), magnetic dipole, magnetization
Physics   - Resnick & Halliday Volume II Wiley India Publications
Ultrasonics: Properties of ultrasonic waves, production of ultrasonic waves by Magnetostriction and Piezoelectric methods, Applications of ultrasonics.
A text book of Engineering Physics   --   M.N.Avadhanulu & P.G.Kshirasagar, S.Chand Publications

Learning Outcomes:

The students will be able to
- Explain how to generate electric current by electromagnetic induction Phenomena.
- Recognize the properties and production of ultrasoncs.
- Identify the use of ultrasonics in different fields.

 UNIT–III
OPTICS & OPTICAL DEVICES   **[10 periods]**
Interference: Parallel and wedge-shape thin films, Newton rings-Measurement of wavelength and refractive index, Applications as Non-reflecting coatings,.
Diffraction: Fraunhoffer Diffraction at a single slit, Applications - Dispersive and Resolving Powers.
Polarization: Double refraction, Nicol's prism, Production, detection, Applications – Anti-glare automobile headlights, Adjustable tint windows.

A text book of Engineering Physics M.N.Avadhanulu & P.G.Kshirasagar, S.Chand Publications.

Learning Outcomes:

The students will be able to
- Explain various types of coherent sources.
- Outline the conditions for sustained interference.
- Aanalyze the differences between interference and diffraction.
- Illustrate the concept of polarization of light and its applications.
- Classify the production and detection of different polarized light.

UNIT–IV   10 periods

Lasers: Introduction, characteristics of a laser beam, spontaneous and stimulated emission of radiation, population inversion, He-Ne laser, Nd – YAG, CO_2 and semiconductor laser, applications of lasers

Optical Fibres: Principle and working of optical fibre, structure, types, advantages of optical fibre, acceptance angle and acceptance cone, numerical aperture, applications of optical fibres

Modern Engineering Physics - S.L.Gupta & Sanjeev Gupta, Dhanpat Rai Publications

 Learning Outcomes:

The students will be able to
- Explain the working principle and properties of lasers
- Analyze the production and applications of lasers.
- Explain the working principle of optical fibers and its classification based on refractive index profile and mode of propagation.
- Identify the applications of optical fibers in medical, communication and other fields.

UNIT–V   10 periods

Quantum mechanics:

Planck's hypothesis, wave-particle duality, introduction to quantum theory, de-Broglie concept of matter waves, Heisenberg's uncertainty principle, Schrodinger's time independent and time dependent wave equations, physical significance and properties of the wave function ψ , Application of Schrodinger wave equation for a particle in one dimensional well – Eigen wave functions and energy Eigen values of the particle and Quantum mechanical tunnelling- Potential Barrier

Elements of Statistical mechanics: Elementary concepts of Maxwell-Boltzman , Bose-Einstein and Fermi-Dirac statistics (no derivation)
Modern Engineering Physics -- S.L.Gupta & Sanjeev Gupta, Dhanpat Rai Publications
Engineering Physics   --   M.N.Avadhanulu & P.G.Kshirasagar, S.Chand Publications

Learning Outcomes:

The students will be able to
- Explain the dual nature of radiation and matter.
- Realize de Broglie concept of matter waves and Heisenberg uncertain principle.
- Identify Schrodinger wave equation to solve the problems.
- Explain the importance of fundamentals of statistical mechanics.

Text Books :
1. M.N.Avadhanulu & P.G.Kshirasagar, "A Text Book of Engineering Physics" – IX Edition, S.Chand Publications, 2014.
2. S.L.Gupta & Sanjeev Gupta, "Modern Engineering Physics" -- Dhanpat Rai Publications, 2011.

Reference Books:

1. V. Rajendran, "Engineering Physics" , McGrawHill Education Private Ltd, 2011.
2. S.O.Pilai, Sivakami , "Engineering Physics" – IV Edition, New Age International Publishers , 2011.
3. Young & Freedman, "University Physics" – XI Edition, Pearson Education, 2004.
4. A.Marikani, "Engineering Physics" - PHI Learning Private Limited, 2009.
5. Resnick & Halliday, "Physics" Volume II – VI Edition,WileyIndia Publications 2001.
6. R K Gaur, S L Gupta, "Engineering Physics" – VIII Edtion, Dhanpat Rai Publications, 2001.
7. D.K.Bhattacharya, Poonam Tandon, "Engineering Physics" – Oxford University Press, 2010.

ENGINEERING CHEMISTRY
(Mech, ECE, Chemical)
WEF 2023-24

Course Code: 23CY1101/1102   **Credits**: 3
Instruction: 3 periods/ 1 Tutorial per week   **Sessional marks**: 40
End exam: 3 hours   **End exam marks**: 60
Prerequisites: Chemistry at +1 and +2 level

Course Objective:
Emphasizing fundamental principles and key concepts in engineering chemistry course enables students to:
- Attain a deep comprehension of the course's core objectives.
- Equips students to adeptly address dynamic challenges in the evolving engineering industry.

Course Outcomes:
By the end of the course, students will be able to

CO	Statement
1	Show a strong understanding of fundamental concepts in water quality, treatment; electrochemical devices, solar cells; corrosion, corrosion protection; fuels, combustion, petroleum processing; plastics, and their properties & manufacturing processes. (L2)
2	Apply acquired knowledge and skills in water quality and treatment; electrochemical devices and solar cells; corrosion and corrosion protection methods; fuels, combustion, petroleum processing and plastics, to effectively address practical scenarios, make informed decisions, and solve complex problems. (L3)
3	Assess water quality and treatment; Critically analyze principles and technologies related to electrochemical devices and solar cells; Evaluate intricate concepts and strategies in corrosion and corrosion protection and scrutinize complex concepts and processes in fuels, combustion, petroleum processing, as well as intricate applications in plastics and polymer technology. (L4)
4	Refine advanced analytical and decision-making skills across diverse areas, including water quality, treatment; electrochemical devices, solar cells; corrosion and corrosion protection; fuels, combustion, petroleum processing; plastics, and polymer technology, demonstrating expertise in principles, technologies, and practical applications. (L5)
5	Cultivate advanced problem-solving skills and creativity by synthesizing innovative solutions and strategies across diverse domains: water quality, treatment, electrochemical devices, solar cells, corrosion control, fuels, combustion, petroleum processing, and plastics and polymer technology. (L6)

UNIT-I Water Technology   **10 Periods**

Impurities in water - Specifications of water for domestic use (ICMR and WHO) - Hardness-Types, units of hardness, Numerical problems on hardness, Disadvantages in using hard water; Boiler troubles- Sludge & Scale formation, Internal Treatment (Carbonate, Phosphate & Calgon conditioning methods), Boiler corrosion.

Water softening method - Ion exchange resin process, advantages & disadvantages; Desalination methods - Reverse Osmosis & Electrodialysis. Municipal water treatment - Sedimentation with coagulation, Sterilisation - Chlorination (break point chlorination), UV treatment.

Learning Outcomes:

➢ Identify and differentiate water hardness types, understand drawbacks of hard water, and make informed decisions on water quality for domestic and industrial settings. (L1)

➢ Solve numerical problems on water hardness, accurately calculate hardness concentrations, and assess their potential impact on different water systems. (L2)

➢ Apply ion exchange resin process for water softening, ensuring cleaner water for specific uses, and understand benefits and limitations of softening techniques. (L3)

➢ Evaluate and compare desalination methods for potable water production, enabling informed selection based on efficiency, cost-effectiveness, and environmental impact. (L4)

UNIT-II Energy Storage Systems   10 periods

Introduction to Electrode potentials, Electro Chemical Series; Batteries - Primary battery - Dry Cell, Secondary battery - Lead Acid battery, Lithium-ion batteries; Fuel cells - Hydrogen -Oxygen fuel cells, Applications.

Advanced batteries for Electrical vehicles - Lithium iron phosphate, Solid state battery -advantages & applications; Solar cells – Types - Polycrystalline and Thin film Solar cells, Principle, Working and Applications.

Learning Outcomes:

➢ Recall and identify key concepts of electrode potentials, electrochemical series, primary and secondary batteries, and fuel cells. (L1)

➢ Explain the principles, working mechanisms, and characteristics of batteries, fuel cells, and solar cells, showcasing a comprehensive understanding of their functions and applications. (L2)

➢ Analyse and compare advanced batteries in terms of advantages and applications, enabling their suitability assessment for specific requirements and contexts. (L3)

➢ Evaluate and synthesize knowledge of electrode potentials, battery technologies, fuel cells, and solar cells, applying critical thinking to propose innovative solutions for advancements in energy storage and sustainable energy applications. (L4)

UNIT-III Corrosion and its prevention   10 Periods

Corrosion & detrimental effects on buildings, machines, equipment's -Theories of corrosion - Dry and wet corrosion; Types of corrosion - Galvanic corrosion, Concentration cell corrosion, Illustrations; Factors Influencing corrosion.

Corrosion protection - Cathodic protection – sacrificial anodic and impressed current cathodic protection methods; Metallic coatings - electroplating of copper and electroless Nickel plating, Basic Concepts of Physical Vapour Deposition coating (PVD) and Chemical Vapour Deposition coating (CVD).

Learning Outcomes:

➢ Recognize corrosion principles and distinguish between dry and wet corrosion, identifying various types. (L1)

➢ Explain corrosion theories and influential factors. Outline cathodic protection techniques and the process of electroplating copper and electroless nickel plating. (L2)

- Critically assess the efficiency of corrosion protection methods and advanced coating technologies. Formulate suitable corrosion protection strategies for a variety of structures and applications based on the evaluation. (L3)

UNIT-IV Fuels and Combustion   10 periods

Introduction; Calorific Value – Lower Calorific Value, Higher Calorific Value, Determination of Calorific Value of solid fuel using Bomb Calorimeter and Gaseous fuel using Boy's Calorimeter - Numerical Problems on Combustion.

Petroleum- Refining of petroleum - Synthetic petrol - Bergius process – Fischer-Tropsch process -Biodiesel.

Learning Outcomes:

- Retrieve fundamental knowledge about calorific value, methods for determining the calorific value of solid and gaseous fuels, and the process of petroleum refining. (L1)
- Understand the principle and working of Bomb Calorimeter and Boy's Calorimeter for determining calorific values and explain process for producing synthetic petrol. (L2)
- Apply the formulas and calculations to solve numerical problems related to combustion. (L3)
- Critically evaluate the challenges and potential solutions in the production and utilization of biodiesel. (L4)

UNIT-V Polymer Technology   10 Periods

Introduction - Distinction between Thermoplastics and Thermosetting plastics; Preparation, Properties & Engineering applications of plastics – Poly Vinyl Chloride (PVC), Teflon, Bakelite, and Acrylo Butadiene Styrene (ABS).

Compounding of plastics, Fabrication of plastics - Compression moulding (Mobile Phone Cases), Injection moulding (Car parts, bottle caps), Transfer moulding, Extrusion moulding (Pipes Hoses), Battery Trays), blown film moulding (PET bottles); Fibre Reinforced Polymer Composites (FRPC) - Applications of polymers in sensors, self-cleaning windows.

Learning Outcomes:

- Recognize differences between thermoplastics and thermosetting plastics and identify plastic fabrication methods. (L1)
- Understand the properties and applications of specific plastics like PVC, Teflon, Bakelite, and ABS, the concept of Fiber Reinforced Polymer Composites (FRPC) (L2)
- Apply the knowledge of plastics and their properties to select appropriate materials for specific engineering applications and principles of plastic fabrication techniques to design and manufacture products. (L3)
- Apply the understanding of Fiber Reinforced Polymer Composites (FRPC) to propose innovative applications in the field of sensors and self-cleaning windows. (L3)

Prescribed books
1. P. C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai & Sons, New Delhi.
Reference books
1. S.S.Dara ,"A text book of Engineering Chemistry" S.Chand & Co.New Delhi.
2. Dell, Ronald M Rand, David A J , "Understanding Batteries",. ,Royal society of Chemistry**.**

Problem Solving and Programming Using C	
(Common to CSE, IT, Civil, EEE, ECE, Mechanical and Chemical)	
Code: 23CS3101	**Credits : 03**
Instruction **:** 3 Periods/Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Course Objectives:
1. To learn how to solve a given problem.
2. To illustrate the basic concepts of C programming language.
3. To discuss the concepts of Functions, Arrays, Pointers and Structures.
4. To familiar with Dynamic memory allocation concepts.
5. To apply concepts of structures and files to solve real word problems.

Course Outcomes
After course completion, the students will be able to:

1	Demonstrate the ability to analyze complex problems and apply appropriate problem-solving techniques to devise effective solutions.
2	Apply control structures to solve programming problems effectively
3	Design efficient algorithms involving arrays, demonstrating a clear understanding of array data structures.
4	Solve programming problems that require the use of pointers, including pointer arithmetic and manipulation.
5	Demonstrate the ability to declare structure variables and define their member data types.

CO-PO –PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	2				2						
CO2	3	3	3	3	2				2	2					
CO3	3	3	3	3	2	1	1	1	2		1	1			
CO4	3	3	3	3	2	1	1	1	2	1	2	1			
CO5	3	3	3	3	2	1	1	1	2	1	2	1			

Correlation levels 1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)

SYLLABUS

UNIT-1:   **10 Periods**
Introduction to Problem Solving: Problem Solving Aspect, Problem Identification, Problem Understanding, Algorithm Development, Solution Planning, Flowcharts, flowgorithm.

Overview of C: History of C, C Language Elements, Basic Structure of C Program, C Tokens- Variables and Data Types, Operators, Expressions and Type Conversions.

UNIT-2:   **10 Periods**
Control Statements: Selection Statements- if and switch statements.
Iterative Statements: for, while and do-while statements.
Jump Statements: break and continue statements.

UNIT-3:   **10 Periods**
Arrays: Declaration, accessing array elements, Storing values, Operations on arrays, Multi-dimensional arrays.
Functions: Introduction, Using Functions, Function declaration, Function definition and Functioncall, Parameter passing, Passing arrays to functions, Recursion, Storage classes.

UNIT-4:   **10 Periods**
Pointers: Declaration and Initialization of pointer variables, Pointer arithmetic, Pointers and arrays,Pointer to pointer, Array of pointers, Pointers and functions, Dynamic Memory Allocation.
Strings: Introduction to Strings, String handling functions, Preprocessor Directives.

UNIT-5:   **10 Periods**
Structures: Introduction, Nested Structures, Array of Structures, Structures and Functions, Unions.**Command-Line Arguments:** Command-line Arguments
Files: Introduction, File Operations

Text Books:
1. B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3/e, Cengage Learning, 2007.
2. Reema Thareja, Programming in C, Oxford University Press, AICTE Edition, 2018.
3. R.G. Dromey, "How to Solve it by Computer". 2014, Pearson.

Reference Books:
1. Jeri R. Hanly, Ellot B. Koffman, Problem Solving and Program Design in C, 5/e, Pearson
2. Brian W Kernighan and Dennis M Ritchie, The C Programming Language, Second Edition, Prentice Hall Publication.
3. Paul Deitel, Harvey Deitel -C How to Program with an introduction to C++,Eighth Edition

MATERIAL SCIENCE FOR CHEMICAL ENGINEERS

23CH3101   **Credits:3**

Instruction : 3 periods & 1 Tutorial/Week   Sessional Marks:40

End Exam : 3 Hours   End Exam Marks:60

Prerequisites: Engineering Physics, Engineering Chemistry

Course Objectives:

1. To provide an understanding on various crystal structures and their determination
2. To impart knowledge on various imperfections in crystals and their importance.
3. To furnish ability on mechanical properties of materials and failure mechanisms
4. To cater enlightenment on composite materials in present day scenario
5. To acquire knowledge on phase diagrams for alloy systems

Course Outcomes:

By the end of the course, students will be able to

1.	Depict the crystal structure and their properties based on the structure.
2.	Calculate the imperfections in a crystal
3.	Analyze the mechanical properties of engineering materials
4.	Determine the type of fracture and the importance of composite materials in engineering design
5.	Analyze the phase transformations to obtain required mechanical properties for a given alloy

CO-PO –PSO Mapping

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1							1	1		1	1	1
CO2	3	1							1	1		1		
CO3	3	1							1	1		1		
CO4	3	1							1	1		1	1	1
CO5	3	1							1	1		1	1	1

Correlation levels 1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO-PO-PSO Justification	
1	Unit 1 gives an overview of crystal structures and determination techniques
2	Unit 2 deals with the imperfections and estimation of imperfections
3	Unit 3 deals with the mechanical properties of the material
4	Unit 4 gives an overview of fractures in materials and types of composite materials usage in industry
5	Unit 5 gives an overview of phase diagrams of various mixtures and effect of time and temperature curves.

SYLLABUS

UNIT I   **12 Periods**

Atomic Structure and Inter Atomic Bonding: Electrons in atoms: Rutherford model, Bohr atomic model, wave mechanical model; bonding forces and energies, primary inter atomic bonds: ionic bonding, covalent bonding, metallic bonding; secondary bonding: Van der Waals bonding, Hydrogen bonding. **Structure of Crystalline Solids:** Unit cells, metallic crystal structures, density computations, crystal systems, crystallographic points, directions and planes, X-ray diffraction and Bragg's law.

UNIT II   **12 Periods**

Imperfections: Point imperfections: Vacancy, Interstitial, Frenkel and Schotkey defects, Line imperfections: Burgers circuit and Burgers vector, dislocation reaction, edge, screw and mixed dislocations; surface defects: grains grain boundary and stacking faults; Volume defects: introduction to precipitates, dispersants, inclusions and voids.

UNIT III   **12 Periods**

Mechanical Properties of Materials: Concepts of stress and strain, elastic compliances, stress-strain diagrams for ductile and brittle materials, elastic behaviour, plastic deformation, hardness: Rockwell hardness test, Brinell hardness test, Knoop and Vickers hardness test; critical resolved shear stress (CRSS), cold working and hot working, anelasticity, viscoelasticity, viscoelastic models.

UNIT IV   **12 Periods**

Fracture Mechanism: Ductile fracture, brittle fracture, creep mechanism and fatigue mechanism.

Composite Materials: Classification and applications: particulate reinforced composites, fiber reinforced composites and structural composites.

UNIT V   **12 Periods**

Phase Diagrams and Transformations: Phase rule, unary, binary phase diagrams, thermal equilibrium diagrams, eutectic and eutectic phase diagrams, peritectic and peritectic phase diagrams, Cd-Bi, Pb-Sn, Cu-Ni, Ag-Cu, Fe-C or Fe-Fe3C-phase transformations, time temperature, transformation curves for eutectoid steels, plain carbon steels, effect of addition of alloying elements on the properties of steels, types of steels used in chemical industries.

TEXT BOOKS:

1. William D. Callister Jr., Material Science and Engineering,7th ed., 2007, John Wiley & Sons.

REFERENCE BOOKS:

1. V. Raghavan, Materials Science & Engineering, 5th edition, 2015, Prentice Hall of India Ltd, New Delhi
2. Manas Chanda, Science of Engineering Materials, Vols.1-3, McMillan Company of India, Delhi.

R-23- ENGINEERING PHYSICS LAB
(Common for ECE, EEE, Mechanical, Civil and Chemical)

Course Code: 23PY1201   **Credits: 1.5**

Instruction**:** L - 0, T- 0 P – 3   Sessional Marks: 50

End Exam : 3 Hours   EndExam Marks :50

Course Objectives:

To enable the students to acquire skill, technique and utilization of **the** Instruments

Course Outcomes:

At the end of this course, the students will be able to

	COURSE OUTCOMES
CO-1	**Apply** the theoretical knowledge as working principles of Laboratory experiments related to Optics, Mechanics, Electromagnetic and Electronics. (**L3**)
CO-2	**Adopt** the experimental procedure to perform the experiments for Data procurement / Acquisition. (**L3**)
CO-3	**Compute** the required parameters by suitable formula using experimental values (observed values) in Mechanics, Optics, Electromagnetic and Electronics. (**L3**)
CO-4	**Analyze** the experimental data and obtain the results through graphical interpretation. (**L4**)
CO-5	**Perform** effectively as an individual or as a team and be Accountable / Responsible to the work rendered. (**L4**)

CO-PO Mapping:

COs	Program Outcomes (POs)												PSOs	
	Domain Specific POs					Domain Independent POs								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3				1	2						3		
CO2		2	1											
CO3				2				1						
CO4	1			3									1	
CO5								2	3	1	2			

List of experiment (any eight to ten experiments have to be completed)

1. Estimation of thickness of a thin paper by forming parallel interference fringes-Wedge method.

2. Newton's rings- determination of radius of curvature of a convex lens

3. Find out the wavelengths of spectral lines in mercury spectrum-using diffraction grating in normal incidence position.

4. Evaluation of refractive indices o-ray and e-ray in quartz crystal (double refraction)

5. Calculation of Cauchy's constants of the material of the prism using spectrometer.

6. Determination of band gap of semiconductor (thermistor) by varying resistance with temperature

7. Verification of laws of resistance and determination of specific resistance of wire by using Carey- Foster's bridge.

8. Calibration of a low-range voltmeter using potentiometer.

9. Study of variation of magnetic field along the axis of a current carrying circular coil – Stewart and Gee's apparatus

10. Evaluation of moment of inertia by using Flywheel

11. Estimation of rigidity modulus and moment of inertia using Torsional pendulum

12. Find the Numerical aperture of a given optical fibre

13. Determination of the velocity of ultrasound in liquids by using the phenomenon of diffraction of light by ultrasound

14. Estimation of the wavelength of diode laser using a transmission grating

15. Determination of Planck's constant

Beyond the Syllabus Experiments:

1. Determination of the particle size of micro particles (lycopodium powder) using laser diffracting grating.

2. Measurement of dielectric constant with temperature variation (Ba TiO_3)

3. Magnetic Hysteresis curve experiment (B-H curve)

4. Determination of Resolving power of the Grating

5. Determination of the frequency of an electrically maintained tuning fork - Meldi's experiment.

Learning Outcomes:

The students will be able to

- **Handle** optical instruments like microscope and spectrometer
- **Determine** thickness of a hair/paper with the concept of interference
- **Estimate** the wavelength and resolving power of different colors using diffraction grating
- **Plot** the intensity of the magnetic field of circular coil carrying current with varying distance
- **Determine** the band gap of a given semiconductor
- **Evaluate** the acceptance angle of an optical fiber and numerical aperture
- **Determine** resistance and resistivity of the given material
- **Plot** the accuracy / correction of low range voltmeter using potentiometer
- **Evaluate** the refractive index using double refraction phenomena

- **Determine** frequency of electrically maintained tuning fork
- **Evaluate** the loss of energy in magnetic materials

Prescribed Book

Physics Laboratory Manual   Prepared by Department of Physics ANITS

Reference books

1. D.P Siva Ramaiah and V. Krishna Murthy, "Practical Physics", Marutibook Depot, 2000.

2. A.R Vegi, "Comprehensive Practical Physics", Vegi Publishers Pvt.Ltd., 2004.

Engineering Chemistry Lab Syllabus
(EEE, ECE, MECH, Chemical)
WEF 2023-24

Course Code: 23CY1201/1202

L	T	P	E	O	Credits	Semester marks	Sessional
-	-	3	-	-	1.5	50	50

L- Lecture hour, T- Tutorial, P-Practical.

Course Objectives:
1. To impart students with practical knowledge and hands-on experience in analytical chemistry and its engineering applications.
2. To enhance students proficiency in utilizing instrumental analysis techniques for industrial and environmental applications.

By the end of the course, students will be able to

CO	Statement
1	Apply volumetric analysis and titration principles to prepare standard solutions, standardize acids with strong bases, and assess water quality, food, and soil samples.
2	Proficiently employ diverse analytical methods (spectrophotometric, pH metric, conductometric, and potentiometric) to estimate chemical properties of substances and accurately interpret data results.
3	Cultivate problem-solving and critical thinking skills through practical application of analytical methods and instrumentation in engineering design and decision-making.

List of Experiments:

1. Preparation of Standard solutions and Standardisation of Secondary standard solution.

2. Determination of Hardness, pH, TDS in ground water sample.

3. Estimation of Zinc in food samples by Complexometric method.

4. Analysis of Cement sample for Lime content to test the quality.

5. Estimation of available chlorine content in potable water using Iodometric method.

6. Estimation of Iron in an iron ore using potassium thiocyanate by Spectrophotometric method.

7. Determination of Strength of an acid in Lead acid battery by pH metric method

8. Estimate the strength of acids in an acid mixture by using Conductometric method.

9. Estimation of Chromium in Dichromate by using Potentiometric method.

10. Determination of Viscosity of various liquid fuels using Ostwald's Viscometer.

Demonstration Experiments

11. Determination of Dissolved Oxygen in a water sample using Iodometric method.

12. Synthesis of Bakelite a thermosetting polymer.

13. Determination of rate constant of ester hydrolysis.

Prescribed Textbooks:

1. Vogel's text book of Quantitative analysis, 5th edition, G.H.Jeffery, J.Bassett, J.Mendham, R.S.Denney.
2. Vogel's A text book of Macro and semi micro Inorganic analysis, revised by G.Svehla

Problem Solving and Programming Using C Lab	
(Common to CSE, IT, Civil, EEE, ECE, Mechanical and Chemical)	
Code: 23CS3201	**Credits : 1.5**
Instruction **:** 3 Periods Practical/Week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Course Objectives:
1. To learn how to solve a given problem.
2. To illustrate the basic concepts of C programming language.
3. To discuss the concepts of Functions, Arrays, Pointers and Dynamic MemoryAllocation.
4. To understand and implement Structures and Unions.

Course Outcomes

After course completion, the students will be able to:

1	Develop an algorithm and flowchart by applying various control structures to solve real world problems
2	Apply iterative statements, arrays and modular programming to solve the complex problems
3	Implement Programs using pointers and String handling Functions.
4	Develop code for complex applications using structures, unions and file handling features

CO-PO –PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	3								2	
CO2	3	3	3	3	3	3								2	
CO3	3	3	3	3	3	3								2	
CO4	3	3	3	3	3	3								2	

Correlation levels 1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)

SYLLABUS

Sr. No	Module Name	Name of Program
1.	**Familiarization with programming environment** Introduction to Programming, Writing of Algorithms, Introduction to Drawing flow Charts /Preparation of Flowchart/ Steps for Writing Code in C/ Turbo C.	1. First Basic Program-Writing a Single Statement. 2. Writing a Program to print your Basic details Multi statements.

2	**Variable types and type conversions**	1. WAP to perform simple Input-Output Operations in C. 2. WAP to add two numbers. 3. WAP to perform simple arithmetic operations in C (Addition, Subtraction, Multiplication, Division, Modulus). 4. Write a simple program that print the result of all the operators available in c (including pre/ post increment, bitwise and logical). 5. WAP to find area and perimeter of circle. 6. WAP to find area and perimeter of rectangle. 7. Given the values of three variable entered by user, write a program to compute and display the value of x, where x=a/(b-c). 8. Write a program to convert one data type to another using auto conversion and casting. Take the value from user input.
3	**Branching and logical expressions**: Use of If, if- else,Else if, nested if statements andoperators with them and switch case statement	1. WAP to find whether a given number is positive or not. 2. WAP to find greatest of two numbers. 3. WAP to find greatest of three numbers using nested if/else if statements only. 4. WAP to find greatest of three numbers using & operator. 5. WAP to find whether a given number is even or odd. 6. Given the marks of a student studying five different subject. Calculate average marks of students and assign him/her Grade based on following: Marks is equal or greater than 90 – Grade A Marks equal or more than 75 and less than 90 –Grade B Marks equal or more than 60 and less than 75 –Grade C Marks equal or more than 50 and less than 60 –Grade D Marks less than 50 –Grade F 7. WAP to find roots of a quadratic equation: ax2+bx+c=0 8. WAP to print day of a week using switch case statement 9. WAP to design a simple calculate using switch-case statements
4.	**Loops: do, while and for loops:** Use of while loop, do while, and for loop:their Syntax	1. WAP to print counting 1 to 10 using all loop 2. WAP to print table of any number. 3. WAP to print the factorial of given number. 4. WAP to print the sum of digits of a given number.

	Using Loops:	1. WAP to print the Fibonacci series up to 10 level. 2. WAP to find whether the given number is Armstrong or Not. 3. WAP to find whether the given number is Palindrome or Not. 4. WAP to find whether the given number is prime or not. 5. WAP to reverse the digits of a given number.
5.	1D Arrays, 2D array Declaration of arrays, syntax, semantics, Operations on Arrays.	1. Program to insert 5 elements into array and print elements of array. 2. WAP to merge two sorted array in one sorted array. 3. WAP to add two matrices in 2-D array 4. WAP to multiply two matrices in 2-D array. 5. WAP to find transpose of a Matrix. 6. WAP to find average of 10 numbers using array. 7. WAP to print the following numbers in reverse order using array.
6.	**Functions** Simple function declaration, definition, functions with return type, call by value.	1. WAP to create function display a simple message. 2. WAP to create function to add two numbers. 3. WAP to create a function to swap two numbers using call by value. 4. WAP to generate Fibonacci series using recursive function. 5. WAP to swap two integers using call by value and call by reference method of passing arguments to a function.
7.	**Pointers** Pointer declaration, use of pointers in array, functions, call by reference, recursive functions	1. WAP to understand basic use of pointers. 2. WAP to implement call by reference for swapping of two numbers. 3. WAP to calculate factorial of a number using recursion. 4. WAP to Fibonacci series up to 20 using recursive functions
8.	**Structures and Unions** Basics of Structure Union and accessing data of structure**.**	1. WAP for user defined data type namely Student and implement it using Structure 2. WAP for user defined data type namely Book and implement it using Structures 3. WAP to create an array of structure. 4. WAP to Create an Union and perform operations.
9	**File Operations:** File opening modes, creation of files, reading and writing data files.	1. WAP to read a simple file using file handling. 2. WAP to write data in file. 3. WAP to append data in existing file.
10.	**Searching and sorting:** Various searching and sorting algorithms.	1. WAP to implement linear search 2. WAP to implement binary search 3. WAP to implement selection sort. 4. WAP to implement insertion sort. 5. WAP to implement quick sort. 6. WAP to implement merge sort. 7. WAP to implement bubble sort.

Text Books:
1. B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3/e, Cengage Learning, 2007.
2. Reema Thareja, Programming in C, Oxford University Press, AICTE Edition, 2018.
3. R.G. Dromey, How to Solve it by Computer, 1/e, Pearson Education, 2006.

Reference Books:
1. Pradip Dey, Manas Ghosh, Programming in C, Oxford University Press, AICTE Edition,
2. B. Gottfried, Programming with C, 3/e, Schaum's outlines, McGraw Hill (India), 2017.
3. Jeri R. Hanly, Ellot B. Koffman, Problem Solving and Program Design in C, 5/e, Pearson.

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

(Common for All Branches except CE, CSE-AIML, DS)

Course Code – Category: MC - HSC   **Credits: 0**

L	T	P
2	**0**	**0**

Sessional Marks: 40

End Exam: 3 Hours   End Exam Marks: 60

Prerequisites:

None.

Course objectives:

The objective of the course is to enable the student in

1. Development of a holistic perspective based on self-exploration about him/her (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course outcomes:

By the end of the course, students are expected to
1. Articulate Basic human aspirations and requirements for their fulfilment and identify the Role and process of Value education
2. Articulate the needs and activities of the self and body and frame program for self-regulation and health for harmony of the self and body
3. Recognize the value of Relationship and the nine feelings in Relationship for fulfilment of relationship for harmony in the family
4. Identify human goals and articulate systems for their fulfilment leading to harmony in the society; Also identify the characteristics of four orders of nature and mutually fulfilling interaction for harmony in nature.
5. Identify the nature of existence and the role of human being for harmony in existence; Also articulate ethical human conduct, humanistic constitution and holistic Criteria for Technologies, production systems and management models for Universal human order.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	1						2	2	3				2			
	2								3				2			
CO	**3**								3				2			
	4						2	3	3	2			2			
	5							2	3				2			

SYLLABUS

UNIT – I   12 Periods

Introduction – Fulfillment of Basic Human Aspirations: Need for value education – Process of Value Education – Self-Exploration – Its content and process – Natural Acceptance and Experiential Validation – Basic Human Aspirations – Basic requirements for fulfillment of aspirations – Right understanding, Relationship and Physical Facility- Priority – Human Consciousness – Role of Education-Sanskar – Understanding Happiness and Prosperity – Programme for perpetual happiness and prosperity.

UNIT – II   12 Periods

Harmony in the Self: Human being as co-existence of Self and Body - Needs of Self and Body – Distinguishing Self and Body –Imaginations and its sources – Self-organized /Enslaved behavior - Harmony of the Self and body – Programme for self-regulation and health – Prosperity – Identification of physical facilities.

UNIT – III   12 Periods

Harmony in the Family: Human relationship – Feelings in Relationship – Trust – Intention and competence – Respect as right evaluation– Other feelings in Relationship – Love.

Harmony in the Society: Human Goals – Systems for fulfillment of human goals - Education-Sanskar - Health-Self regulation - Production-Work - Justice-Preservation - Exchange-Storage - Undivided Society, Universal Human Order.

UNIT – IV   10 Periods

Harmony in the Nature: Four Orders of Nature – Characteristics of the four orders – Mutually fulfilling interaction - Understanding the harmony in the Nature

Harmony in the Existence: Existence as Units in Space – Submergence of Units in Space – Existence as Co-existence - Development in the Existential Sense – Role of Human being in Existence

UNIT – V   10 Periods

Universal Human Values and Ethical Human Conduct: Natural acceptance of human values - Definitiveness of Ethical Human Conduct - Humanistic Constitution and Humanistic Universal Order - Holistic Criteria for Technologies, production systems and management models - Holistic Community Model - Journey towards Universal Human Order.

TEXT BOOKS

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

REFERENCES

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.