I SEMESTER SYLLABI
COMMON FOR ALL BRANCHES

Applicable to the students admitted to

R-2021: CBCS

Academic year 2021-2022
onwards

VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

An Autonomous Institution

#60, Avadi – Vel Tech Road, Vel Nagar,
Avadi, Tamil Nadu 600062

LIST OF ABBREVIATIONS

S. No.	Abbreviations	Detailed Description
1	**HSMC**	Humanities & Social Science including Management Courses
2	**BSC**	Basic Science Courses
3	**ESC**	Engineering Science Courses
4	**PCC**	Professional Core Courses
5	**PEC**	Professional Elective Courses
6	**OEC**	Open Elective Courses
7	**PROJ**	Project Work
8	**EEC**	Employability Enhancement Courses
9	**MC**	Mandatory Courses

Curriculum (R2021)

SEMESTER I										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21EN11T	Communicative English	HSMC	40	60	100	3	0	0	3
2	21MA12T	Matrices and Differential Calculus	BSC	40	60	100	3	1	0	4
3	21PH13T	Engineering Physics I	BSC	40	60	100	3	0	0	3
4	21CY14T	Engineering Chemistry	BSC	40	60	100	3	0	0	3
5	21CS15IT	Problem Solving and Python Programming	ESC	40	60	100	2	0	4	4
6	21ME16T	Engineering Graphics	ESC	40	60	100	4	0	0	4
PRACTICAL										
7	21BS17P	Physics and Chemistry Laboratory	BSC	40	60	100	0	0	4	2
8	21ME18P	Engineering Practices Laboratory	ESC	40	60	100	0	0	4	2
TOTAL										**25**

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Course code	21EN11T	Semester	I			
Category	HUMANITIES & SOCIAL SCIENCE INCLUDING MANAGEMENT COURSES (HSMC)		L	T	P	C
Course Title	COMMUNICATIVE ENGLISH (COMMON FOR ALL BRANCHES)		3	0	0	3

COURSE OBJECTIVES:

- To exhibit the students of Engineering and Technology to develop their listening and to recall the pattern of listening.
- To facilitate the learners to develop speaking skills to convey their ideas and views in the real context.
- To develop their reading skills and grasp the central ideas of the text.
- To expose them to acquire writing technique with basic grammar.
- To motivate the students to use appropriate vocabulary in academic and categorize the inferences in writings.

PREREQUISITE:

- Foundation of language with Basic English Grammar.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C101. 1	***Listen*** to different talks and lectures and understand them easily.	K1
C101. 2	***Communicate*** their thoughts confidently using communicative strategies	K2
C101. 3	***Read*** and grasp different genres of texts effortlessly	K2
C101. 4	***Write*** grammatically correct academic, business and technical texts	K3
C101. 5	***Apply*** the appropriate vocabulary to communicate efficiently in all forms of communication.	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C101. 1	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101. 2	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101. 3	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101. 4	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101. 5	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101. 6	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I BASIC GRAMMAR I AND READING FOR INFORMATION 9

PRACTICAL

LISTENING: Listening to short dialogues with good accent

SPEAKING : Introducing oneself - Exchanging personal information

TUTORIAL

READING : Reading short comprehension passages- practice skimming and scanning for specific information

WRITING: Parts of speech - Sentence patterns – Tenses – 'wh'- questions - Yes/No questions -Countable and Uncountable nouns

VOCABULARY AND GRAMMAR: Affixation – word formation - Synonyms and Antonyms.

UNIT II BASIC GRAMMAR II AND SHARING INFORMATION 9

PRACTICAL

LISTENING : Listening to documentaries - inspiring speeches of great leaders and practicing opinion sharing

SPEAKING : Self-introduction - peer introduction - picture description - JAM

TUTORIAL

READING: Note-making- Critical reading finding key information in a given text - shifting facts from opinions and paraphrasing

WRITING: Autobiographical writing (writing about one's leisure time activities, hometown - favourite place and school life) - Biographical writing (place, people)

VOCABULARY AND GRAMMAR: Compound Words – Guessing meaning of words contexts - One Word substitutes – Pronouns- Adjectives – Adverbs – Imperatives - Direct and Indirect questions.

UNIT III BASIC GRAMMAR III AND FREE WRITING 9

PRACTICAL

LISTENING : News Bulletins - Ted talks - telephonic conversations

SPEAKING : functions of Language - giving reasons - talking about future plans - comparing and contrasting - making suggestions

TUTORIAL

READING: Current Affairs - newspaper reading /magazines - loud in the classroom

WRITING: Coherence and cohesion in writing- cause and effect - compare & contrast and narrative & analytical paragraphs.

VOCABULARY AND GRAMMAR: Discourse marker - Reference words - Process description - Conjunctions – Prepositions - Articles - Degrees of comparison.

UNIT IV BASIC GRAMMAR IV AND FREE WRITING 9

PRACTICAL

LISTENING : Listen to audio/ Conversation from BEC/IELTS /TOFEL.

SPEAKING : Interpersonal Skills: Role play/group discussion/debate/ conduct of meeting

TUTORIAL

READING: Reading different types of texts /genres/ for comprehension and pleasure – related with human values.

WRITING: Letter writing (informal letters) and formal letters – rejecting and accepting Letters - Personal emails and etiquette.

VOCABULARY AND GRAMMAR: Single Word substitutes - Use of abbreviations Acronyms - Cloze reading - interpreting visual materials - Jumbled sentences - Subject verb agreement - Modal verbs - Phrasal verbs.

UNIT V BASIC GRAMMAR V AND LANGUAGE DEVELOPMENT 9

PRACTICAL

LISTENING : Listen to official meetings to know about the project proposal.

SPEAKING : Discussing the project and the proposals in the group - Creative writing and speaking - Poster making and description - project proposals.

TUTORIAL

READING: Reading comparison and contrast text with the deeper level of meaning **WRITING :** Essay writing - different types of essays - dialogue writing

VOCABULARY AND GRAMMAR: Word association (connotations) - Lexical items (fixed / semi fixed expressions) - Clause - Direct and indirect speech - Correction of errors.

Total: 45 Periods

Extensive Reading:

Kalam , Abdul. The Wings of Fire , Universities Press, Hyderabad. 19

LEARNING RESOURCES:

TEXT BOOKS:

1. Board of Editors, Department of English, Anna University, Chennai. Using English:A Course Book for Undergraduate Engineers and Technologists, Orient Black Swan: Chennai,2017.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Black Swan Publications, Chennai,2011.

REFERENCES:

1. Raman, Meenakshi & Sangeetha Sharma, Technical Communication: English Skills for Engineers. Oxford University Press, NewDelhi.2011.

2. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2006

3. Rizvi M, Ashraf. Effective Technical Communication. Tata McGraw- Hill Publishing Company Limited, New Delhi, 2007.

4. Rutherford, Andrea J. Basic Communication Skills for Technology. Pearson Edition (II Edition), NewDelhi, 2001.

5. Mandel, Steve. *Effective Presentation Skills*. New Delhi: Viva Books Pvt. Ltd., 2004.

6. Kilmet, Stephen. "The Resume and "The Computerized Resume." In Writing for Design Professionals.

7. Writing Cover Letters-Kilmet, Stephen. "Cover Letter, "and" Enclosures and Attachments." in Writing for Design Professionals New York.

Course code	21MA12T	Semester	I			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	MATRICES AND DIFFERENTIAL CALCULUS (COMMON FOR ALL BRANCHES)		4	0	0	4

COURSE OBJECTIVES:

- To apply advanced matrix knowledge to solve engineering problems
- To improve their ability in solving geometrical applications of differential calculus
- To familiarize with the application of differential equations

PREREQUISITE:

- Basic Mathematics skills at 12th level

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students are able to		
C102.1	***Solve*** Engineering problems using matrices.	K3
C102.2	***Use*** various test to discuss the convergence of infinite series.	K2
C102.3	***Apply*** the geometrical concepts to solve differential calculus.	K4
C102.4	***Compute*** partial derivatives of functions of several variables.	K2
C102.5	***Apply in Engineering many physical initial*** and boundary value problems can be described by ODE.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C102.1	3	3	-	-	-	-	-	-	-	-	-	-
C102.2	3	2	-	-	-	-	-	-	-	-	-	-
C102.3	3	3	-	-	-	-	-	-	-	-	-	-
C102.4	3	2	-	-	-	-	-	-	-	-	-	-
C102.5	3	2	-	-	-	-	-	-	-	-	-	-
C102	3	2	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 4**

UNIT I MATRICES 12

Matrix operations, special types of matrices, matrices as linear transformations, linear independence, Orthogonalization, Eigen values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley – Hamilton theorem, Orthogonal reduction of a symmetric matrix to diagonal form – Orthogonal matrices – Reduction of quadratic form to canonical form by orthogonal transformations- Nature of quadratic forms.

UNIT II INFINITE SERIES 12

Sequences of real numbers-Series-General properties of series-Comparison test- Integral test, D' Alemberts ratio test and Cauchy's root test- Power series, radius and interval of convergence of power series, Convergence of exponential, logarithmic and Binomial Series, Properties of uniformly convergence series

UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS 12

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelops – Evolute as envelope of normals

UNIT IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 12

Limits and Continuity –Partial derivatives –Homogeneous Functions-Total derivative –Change of variables –Jacobian and properties –Taylor's series for functions of two variables –Maxima and minima of functions of two variables –Lagrange's method of undetermined multipliers.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS 12

Second and Higher Order Equations, homogeneous and non-homogeneous linear equations and linear systems with constant coefficients, method of variation of parameters, method of undetermined coefficients, Equations reducible to linear equations with constant coefficients-Simultaneous linear equations with constant coefficients.

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Edition, 2015.

REFERENCES:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons. Singapore, 10thEdition, 2015.
2. M.K. Venkataraman, Engineering Mathematics- First Year, 2nd Edition, National Publishing., Chennai 2001.
3. T. Veerarajan, Engineering Mathematics-I, Tata McGraw Hill Publishing Co, New Delhi, 2017.

Course code	21PH13T	Semester	I			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	ENGINEERING PHYSICS I (COMMON FOR ALL BRANCHES)		3	0	0	3

COURSE OBJECTIVES:

- To understand the importance of polarization, optical fiber and Lasers
- To familiar the knowledge of electromagnetic waves oscillations
- To understand the importance of quantum physics
- To cognize the basics of heat and thermodynamics
- To express the basics of crystal physics

PREREQUISITE:

- High School Maths and Physics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C103.1	***Utilize*** the concepts of polarization, optical fiber and Lasers for engineering applications	K3
C103.2	***Apply*** the knowledge of electromagnetic waves oscillations	K3
C103.3	***Understand*** the importance of quantum physics.	K2
C103.4	***Cognize*** the basics of heat and thermodynamics	K2
C103.5	***Express*** the basics of crystal physics	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C103.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C103.2	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C103.3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C103.4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C103.5	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-
C103	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I PHOTONICS 9

Polarization and Fiber Optics: Electromagnetic waves - Production and analysis of linearly, elliptic and circularly polarized light-Polaroid and applications of polarization. Fiber optics - principle of operation – numerical aperture - acceptance angle and applications of fiber optics.

Optical Sources: Characteristics of Lasers - Spontaneous and Stimulated Emission of Radiation - Population Inversion - Einstein's Coefficients and Relation between them - Applications of Lasers.

UNIT II WAVES AND OSCILLATION 9

Oscillatory motion: Differential equation of SHM- Velocity and acceleration- Restoring Force- Frequency response - phase response and resonance-Analogy with LCR circuits and oscillators- Energy and energy loss- Damped oscillations- Significance in control systems - vibration and vibration isolation.

Wave motion: Definition of a plane progressive wave- Attenuation of waves- Phase Velocity- Introduction to numerical methods for solution of wave equation- Importance of spherical and plane wave fronts.

UNIT III QUANTUM MECHANICS 9

Need for Quantum Physics-Historical overviews - Matter waves - De-Broglie's concept of matter waves - Properties of matter waves - Photo electric effect - Heisenberg's uncertainty principle – Statement - Interpretation and application - Schrödinger's time dependent and time independent equations - Operators - Eigen values and Eigen functions - Expectation values -Physical significance of wave function-Quantum superposition and entanglement for Qbits (quantitatively)

UNIT IV HEAT AND THERMODYNAMICS 9

Heat and internal energy - Specific heat and calorimetry - Latent Heat coefficient of linear thermal expansion - Methods of measurement of thermal expansion - Thermal expansion -Applications - The bimetallic strip - Differential equation of one-dimensional heat flow - Lee's disc apparatus for determination of thermal conductivity - Thermal Insulation- Heat dissipation and heat sinking of electronic devices-solid state refrigerators (qualitatively)

UNIT V CRYSTAL PHYSICS 9

Introduction of Crystallography - Space Lattice - Unit Cell - Lattice Parameters – Crystal Systems - Bravais Lattices - Miller Indices and its applications - Crystal Planes and Directions- Inter Planar Spacing of Orthogonal Crystal Systems - Atomic Radius - Co-ordination Number and Packing Factor of SC, BCC, FCC – Crystal growth –Solution growth -Structure determination by x-ray diffraction method (cubic structure).

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Richard Wolfson, "Essential University Physics", Vols. 1 and 2. Pearson Education, Singapore, 2011.
2. Gaur R K, Gupta S L, "Engineering Physics", DhanpatRai Publications, 2013.

REFERENCES:

1. Halliday D., Resnick R. and Walker J., “Fundamentals of Physics”, Wiley Publications,2008.
2. Avadhanulu M. N., “Engineering Physics”, S. Chand & Co., 2007.
3. Purcell E. M., “Electricity and Magnetism – Berkeley Physics Course”, Vol. 2, Tata McGraw-Hill, 2008.
4. Paul A. Tipler and Geene Mosca, “Physics for Scientists and Engineers”, W.H. Freeman and Company, New York, 2004.

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Course code	21CY14T	Semester	I			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	ENGINEERING CHEMISTRY (COMMON FOR ALL BRANCHES)		3	0	0	3

COURSE OBJECTIVES:

- To make the students conversant with water quality parameters and treatment techniques.
- To get the basic idea about the polymers, electrochemistry and corrosion.
- To deal with the information about various types of fuels and energy sources.

PREREQUISITE:

- Basic Chemistry Skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students are able to		
C104.1	***Understand*** the water related problems and their treatment techniques.	K2
C104.2	***Explain*** the applications of polymers and reinforced plastics.	K2
C104.3	***Acquire*** knowledge on electrochemistry and corrosion.	K2
C104.4	***Summarize*** the types of fuels and its production process and calculate the CV values.	K2
C104.5	***Classify*** the non-conventional energy sources and its applications.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C104.1	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104.2	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104.3	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104.4	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104.5	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I WATER AND ITS TREATMENT 9

Introduction - characteristics - alkalinity - types and determination - hardness - types expression of hardness - units - estimation of hardness of water by EDTA - numerical problems -boiler feed water-requirements-boiler troubles – scale & sludge -disadvantages (wastage of fuels, decrease in efficiency, boiler explosion) -softening of hard water - external treatment process - demineralization and zeolite, internal treatment - boiler compounds (carbonate, phosphate, Calgon, sodium aluminate and colloidal conditioning methods) – desalination of brackish water –reverse osmosis.

UNIT II POLYMERS AND REINFORCED PLASTICS 9

Introduction - classification of polymers - Natural and synthetic - Thermoplastic and Thermosetting, Functionality - Degree of polymerization, Properties of polymers: Tg, Tacticity, Molecular weight - weight average, number average and polydispersity index. Types – addition, condensation and Copolymerization – free radical, cationic and anionic polymerization mechanism - Preparation, properties and uses of PVC, Nylon- 6,6, Teflon and Epoxy resin. Plastics - Compounding of plastics – moulding methods – injection, extrusion and compression – Engineering plastics-applications-fibre-reinforced plastics (FRP) – carbon and glass– applications.

UNIT III ELECTROCHEMISTRY AND CORROSION 9

Electrochemical cell - redox reaction, electrode potential- origin of electrode potential-oxidation potential-reduction potential - measurement and applications - electrochemical series and its significance - Nernst equation (derivation and problems). Corrosion- causes- factors- types: chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method. Paints- constituents and function Electroplating of Copper and electroless plating of nickel-Chemical conversion coatings-phosphate, chromate, chemical oxide, and anodized coatings.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum – refining- manufacture of synthetic petrol (Bergius process) – knocking - octane number- cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) – synthesis, advantages and commercial application of power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value –problems- ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Energy-Types- Non-renewable energy- Nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries - primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells - H_2-O_2 fuel cell.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. P.C. Jain and Monika Jain, Engineering Chemistry, DhanpatRai, Publishing Company (P) Ltd., New Delhi, 2015.
2. S.S Dara&S.S Umare, A Text book of Engineering Chemistry, S.Chand & Company Ltd., New Delhi, 2015.

REFERENCES:

1. S. Vairam,P. Kalyani and Suba Ramesh., Engineering Chemistry, Wiley India Pvt. Ltd, New Delhi, 2013.
2. B.K.Sharma, Engineering Chemistry, Krishna Prakasan Media (P) Ltd., Meerut, 2014.
3. Prasanta Rath, Engineering Chemistry, Cengage Learning India Pvt. Ltd, Delhi, 2015.
4. Shikha Agarwal, Engineering Chemistry-Fundamentals and Applications, Cambridge University Press, Delhi, 2015.
5. V.R.Gowariker, N.V.Viswanathan, J.Sreedhar, Polymer Science, New Age International (P) Ltd., Publishers, New Delhi, 2011.

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Course code	21CS15IT	Semester	I			
Category	ENGINEERING SCIENCE COURSE (ESC)		L	T	P	C
Course Title	PROBLEM SOLVING AND PYTHON PROGRAMMING (COMMON FOR ALL BRANCHES)		2	0	4	4

COURSE OBJECTIVES:

- To be familiar with the basics of algorithmic problem solving.
- To construct python programs with conditionals, loops and functions.
- To use python data structures-Lists, Tuples and Dictionaries.

PREREQUISITE:

- Basic Mathematics Skills and Computer Knowledge

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students will be able to		
C105. 1	***Develop*** algorithmic solutions to simple computational problems	K3
C105. 2	***Construct*** simple Python programs for solving problems.	K3
C105. 3	***Build*** Python programs with conditionals and loops.	K3
C105. 4	***Demonstrate*** a Python program into functions.	K2
C105. 5	***Show*** compound data using Python lists, tuples, and dictionaries.	K2
C105. 6	***Read*** and write data from/to files in Python Programs.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
C105. 1	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 2	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 3	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 4	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 5	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 6	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105	3	2	1	-	-	-	-	-	-	-	-	-	2	2

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 4**

UNIT- I ALGORITHMIC PROBLEM SOLVING AND BASICS OF PYTHON 8

Algorithms-building blocks of algorithms (statements, state, control flow, functions), simple Strategies for developing algorithms (iteration, recursion)-pseudo code- flow chart-programming language. Introduction to Python-Features of Python-Python Interpreter: Interactive and script mode- Values and types, variables, Keywords, Identifiers, operators, precedence of operators, expression, Comments.

UNIT-II CONTROL FLOW, FUNCTIONS 8

Conditional statements-Iterative statements, Functions: Built-in functions, user defined function-Function Arguments-Fruitful functions and void functions- local and global variable - function composition- recursion-Lambda Functions.

UNIT-III MODULES, PACKAGES, STRINGS 4

Modules-Packages-Strings-string operations, string functions and methods.

UNIT-IV LISTS, TUPLES, DICTIONARIES 5

Lists- list operations, list methods, list loop, mutability, aliasing, cloning lists-Tuples-Tuple assignment, Operations on Tuples, Tuple as return value- Dictionaries- operations and methods-Sets-Operations on sets.

UNIT-V FILES AND EXCEPTIONS 5

Files –Types of files, file operations, file methods, format operator-command line arguments-Errors and Exceptions, handling exceptions.

List of Experiments: 30 Periods

1. Write a python program to demonstrate basic data types in python.
2. Write a python program using conditional statements.
3. Write a python program using Iterative statements.
4. Write a python program using built-in and user defined functions.
5. Write a python program using lambda functions and recursions.
6. Write a python program to demonstrate Strings and its Operations.
7. Write a python program to demonstrate lists, tuples and its operations.
8. Write a python program to demonstrate Sets and its operations.
9. Write a python program to demonstrate Dictionaries and its operations.
10. Write a python program to demonstrate Files and its Operations.

30 Periods

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Reema Thareja, "Python Programming using Problem Solving Approach", OXFORD University Press, 2017.
2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.

REFERENCES:

1. Ashok Namdev Kamthane, Amit Ashok Kamthane, "Programming and Problem Solving with Python", Mc-Graw Hill Education, 2018.
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd, 2016.
3. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.

Sl. No.	Description of Equipment	Required numbers (For batch of 30 students)
1	Standalone desktops with Python [Open Source]	30 Nos

VEL TECH HIGH TECH

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Course code	21ME16T	Semester	I			
Category	ENGINEERING SCIENCE COURSE (ESC)		L	T	P	C
Course Title	ENGINEERING GRAPHICS (COMMON FOR ALL BRANCHES)		1	3	0	4

COURSE OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings.

PREREQUISITE:

- Engineering Drawing Skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students are able to		
C106.1	***Familiarize*** with the fundamentals and standards of Engineering graphics.	K2
C106.2	***Develop*** freehand sketching of basic geometrical constructions and multiple views of objects.	K3
C106.3	***Draw*** orthographic projection of lines and plane surfaces.	K3
C106.4	***Construct*** projection of solids, Section and development of surfaces.	K3
C106.5	***Visualize*** isometric and perspective projections	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C106. 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C106. 2	3	3	-	-	-	-	-	-	-	-	-	1	1	-	-	-
C106. 3	3	3	2	-	-	1	-	1	-	1	-	1	1	-	-	-
C106. 4	3	3	2	-	-	1	-	1	-	1	-	1	1	-	-	-
C106. 5	3	3	2	-	-	1	-	1	-	1	-	1	1	-	-	-
C106	3	3	2	-	-	1	-	1	-	1	-	1	1	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 4**

CONCEPTS AND CONVENTIONS (Not for Examination) 1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREEHAND SKETCHING 7+12

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square, Triangle and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views– Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection– principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method. Applications – Drawing interpretation and process planning, circuit design.

UNIT III PROJECTION OF SOLIDS 5+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method, auxiliary plane method. Applications – Engineering design, automotive modelling, X-rays.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Applications – Design of piping, Fabrication, body building, defect analysis.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6 + 12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones– combination of two solid objects in simple vertical positions – Perspective projection of simple solids–Prisms, pyramids and cylinders by visual ray method and vanishing point method. Applications–constructions, photography, animation and image processing.

Total: 90 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2010.
2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 51th Edition, 2019.

REFERENCES:

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited,2015.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 3rd Edition, 2013.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to Semester End Examination on Engineering Graphics:

1. There will be five questions, each of either-or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. Students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

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Course code	21BS17P	Semester	I			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	PHYSICS AND CHEMISTRY LABORATORY (COMMON FOR ALL BRANCHES)		0	0	4	2

COURSE OBJECTIVES:

- To test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To encourage the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.

PREREQUISITE:

- Basic measurement skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C107.1	***Estimate*** the various water quality parameters like alkalinity, hardness (total, temporary, & permanent), dissolved oxygen content, and chloride content.	K2
C107.2	***Investigate*** the metals and ions present in any given sample using various analytical techniques.	K2
C107.3	***Analyze*** the properties such as conductance of solutions, and redox potentials.	K2
C107.4	***Determine*** various moduli of elasticity and also various thermal and optical properties of materials.	K2
C107.5	***Determine*** the velocity of ultrasonic waves, band gap determination and viscosity of liquids.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C107.1	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107.2	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107.3	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107.4	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107.5	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

PHYSICS LABORATORY
LIST OF EXPERIMENTS
(Any SIX Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus
3. Lee's disc Determination of thermal conductivity of a bad conductor
4. Laser- Determination of the wave length of the laser using grating, Estimation of laser parameters
5. Optical fibre -Determination of Numerical Aperture and acceptance angle
6. Ultrasonic interferometer - determination of the velocity of sound and compressibility of Liquids
7. Determination of Band gap of a semiconductor
8. Spectrometer- Determination of wavelength using gating

Total: 30 Periods

REFERENCES:

1. Physics Practicals, Department of Physics, Vel Tech High Tech Dr.Rangarajan Dr.Sakunthala Engineering College 2021
2. Wilson J.D. and Hernandez C.A., "Physics Laboratory Experiments", Houghton Mifflin Company, New York 2005

Lab Requirements

Sl. No.	Description of Equipment	Required numbers (For batch of 30 students)
1.	Torsional Pendulum, stop clock, suspension metallic wire: two different thickness, two identical cylindrical mass, screw gauge, wooden scale	5
2.	Uniform bending: 1-meter wooden scale, two-knife edges, travelling microscope, two weight hanger with slotted weights, screw gauge, Vernier calliper, pin	5
3.	Non-uniform bending: 1 meter wooden scale, two-knife edges, travelling microscope, weight hanger with slotted weights, screw gauge, Vernier calliper, pin	5
4.	Diode laser (green or red), fiber optic cable, movable arrangement with a screen for measuring spot size (zig), meter scale, stand	5
5.	He-Ne/Diode laser (red), Green diode laser, Grating, Screen, Iron stand (3 Nos), 1m wooden scale, thread.	5
6.	Ultrasonic interferometer apparatus with high frequency wave generator, cell, micrometer, PZ crystal, water or other liquids	5
7.	450 inclined glass plate set-up, two optically plane glass plates, sodium vapour lamp, travelling microscope, thin wire/thin strip of paper	5
8.	Post office box, 5V power supply, thermometer, galvanometer, semiconductor (thermistor), variable temperature bath set-up (oil, temperature controller, vessel, hot plate.	5

CHEMISTRY LABORATORY
LIST OF EXPERIMENTS
(Any SIX Experiments)

1. Determination of permanent, total and temporary hardness of water sample.
2. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
3. Determination of DO Content of water sample by Wrinkler's method.
4. Determination of chloride content of water sample by Argentometric method.
5. Determination of strength of given HCl using pH meter.
6. Estimation of Fe^{2+} by Potentiometric titration.
7. Determination of molecular weight of PVA using Ostwald viscometer.
8. Estimation of Iron content in water sample using spectrophotometer (1,10 – Phenanthroline/thiocyanate method).
9. Conductometric titrations of strong acid Vs strong base.
10. Determination of strength of acid in a mixture using conductivity meter.
11. Corrosion experiment-weight loss method.
12. Estimation of sodium and potassium present in water using flame photometer.

Total: 30 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Jeffery G.H., Bassett J., Mendham J. and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
2. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.
3. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook ofpractical organic chemistry", LBS Singapore (1994).

Lab Requirements

Sl. No.	Description of Equipment	Required numbers (For batch of 30 students)
1.	PH meter	10 nos
2.	Conductivity meter	10 nos
3.	Potentiometer	10 nos
4.	Flame photometer	2 nos
5.	Electronic Balance (Four digit)	1 no
6.	Hot Air Oven	1 no
7.	Spectrophotometer	2 nos
8.	Magnetic stirrer	2 nos

Course code	21ME18P	Semester	I			
Category	ENGINEERING SCIENCE COURSE (ESC)		L	T	P	C
Course Title	ENGINEERING PRACTICES LABORATORY (COMMON FOR ALL BRANCHES)		0	0	4	2

COURSE OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

PREREQUISITE:

- Basic knowledge of engineering skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students will be able to		
C108. 1	Demonstrate on Smithy operations, Foundry operations models and machine assembly practice of centrifugal pump and air-conditioner	K2
C108. 2	Experiment with pipe connections and plumbing works	K3
C108. 3	Make use of welding equipment to join the structures.	K3
C108. 4	Explain carpentry components, for the joint used in roofs, doors, windows and furniture.	K5
C108. 5	Develop sheet metal models, fitting models and do basic machining operations	K6

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C108. 1	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108. 2	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108. 3	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108. 4	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108. 5	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

I CIVIL ENGINEERING PRACTICE 12

Buildings:

a) Study of plumbing and carpentry components of residential and industrial buildings, Safety aspects.

Plumbing Works:

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers and elbows in household fittings.
b) Study of pipe connections requirements for pumps and turbines.
c) Preparation of plumbing line sketches for water supply and sewage works.
d) Hands-on-exercise:

   Basic pipe connections-Mixed pipe material connection-Pipe connections with different joining components
e) Demonstration of plumbing requirements of high-rise buildings

Carpentry using Power Tools only:

a) Study of the joints in roofs, doors, windows and furniture.
b) Hands-on-exercise:

   Wood work, joints by sawing, Planning and cutting.

II MECHANICAL ENGINEERING PRACTICE 18

Welding:

a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
b) Gas welding practice

Basic Machining:

a) Simple Turning and Taper turning
b) Drilling Practice

Sheet Metal Work:

a) Forming & Bending:
b) Model making – Trays and funnels.
c) Different type of joints.

Machine assembly practice:

a) Study of centrifugal pump
b) Study of air conditioner

Demonstration on:

a) Smithy operations, upsetting, swaging, setting down and bending. Example –Exercise – Production of hexagonal headed bolt.
b) Foundry operations like mould preparation for gear and step cone pulley.
c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

Total: 30 Periods

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE **14**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.

2. Fluorescent lamp wiring.

3. Stair case wiring

4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.

5. Measurement of energy using single phase energy meter.

6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE **16**

1. Study of Electronic components and equipments – Resistor, colour coding

measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.

2. Study of logic gates AND, OR, EX-OR and NOT.

3. Generation of Clock Signal.

4. Soldering practice – Components Devices and Circuits – Using general purpose

PCB.

5. Measurement of ripple factor of HWR and FWR.

Total: 30 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Chapman, W.A.J. Workshop Technology, Edward Arnold, 2001.

REFERENCES:

1. Raghuwanshi B.S., Workshop Technology Vol. I & II, DhanpathRai & Sons.
2. Kannaiah P. and Narayana K.L., Workshop Manual, 2 Edn, Scitech publishers.
3. John K.C., Mechanical Workshop Practice. 2nd Edn. PHI 2010.
4. JeyapoovanT. and Pranitha S., Engineering Practices Lab Manual, 3rd Edn. Vikas Pub.2008

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl.No.	Description of Equipment	Required Numbers (for batch of 30 students)
Part I: Civil Engineering Practices		
(a)	**Plumbing Work:**	
1)	Pipe Vice	15 Nos.
2)	Die Holder with Die set	15 Nos.
(b)	**Wood Work**	
1)	Tri Square	15 Nos.
2)	Hand Saw	15 Nos.
3)	Carpentry bench wise	15 Nos.
4)	Firmer Chisel	15 Nos.
5)	Motrin Chisel	15 Nos.
6)	Iron Jack	15 Nos.
7)	Mallet	15 Nos.
8)	Bench hold fastens	15 Nos.
9)	Wooden Bench Hook	15 Nos.
10)	Wood Cutting Machine	2 Nos.
Part II: Mechanical Engineering Practices		
(a)	**Welding Work:**	
1)	Arc welding unit	5 Nos.
2)	Gas welding unit	2 Nos.
(b)	**Basic Machining Work:**	
1)	Lathe Machines	5 Nos.
2)	Drilling Machines	5 Nos.
(c)	**Assembly Work:**	
1)	Centrifugal pump	2 Nos.
2)	Air-conditioner unit	2 Nos.
3)	Household mixer	2 Nos.
(d)	**Sheet Metal Work:**	
1)	Steel rule	2 Nos.
2)	Bend snips	5 Nos.
3)	Straight snips	5 Nos.
4)	Scriber	5 Nos.
5)	Divider	5 Nos.
6)	Trammel	5 Nos.
7)	Prick Punches	5 Nos.
8)	Centre punches	5 Nos.
9)	Pliers	5 Nos.
10)	Ball pean hammer	5 Nos.
11)	Raising hammer	5 Nos.
12)	Riverting hammer	5 Nos.
13)	Square free hammer	5 Nos.
14)	Anvil	3 Nos.
15)	Swage block	3 Nos.
16)	Wige gauges	2 Nos.
(e)	**Foundry Work**	
1)	Cope and Drag Box	5 Nos.
2)	Pattern	5 Nos.
3)	Solid pattern	5 Nos.
4)	Split pattern	5 Nos.
5)	Runner	5 Nos.

6)	Riser	5 Nos.
7)	Sprue	5 Nos.
8)	Sand reamer	5 Nos.
9)	Trowel	5 Nos.
PART-III Electrical Practices		
1)	Assorted electrical components for house wiring	15 sets
2)	Electrical measuring instruments	10 sets
3)	Study purpose items: Iron box, fan and regulator, emergency lamp	One each
4)	Megger (250V/500V)	1 No.
5)	Power Tools: (a) Range Finder (b) Digital Live-wire detector	2 Nos 2 Nos
PART-IV Electronics Practices		
1)	Soldering guns	10 No.
2)	Assorted electronic components for making circuits	50 No.
3)	Small PCBs	10 No.
4)	Multi Meters	10 No.
5)	Study purpose items: Telephone, FM radio, low-voltage power supply	2 each

CURRICULUM AND
II SEMESTER SYLLABI

Applicable to the students admitted to

B.TECH-CHEMICAL ENGINEERING

R-2021: CBCS

Academic year 2021-2022
onwards

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R-2021: CBCS CURRICULA

II SEMESTER SYLLABI

LIST OF ABBREVIATIONS

S. No.	Abbreviations	Detailed Description
1	**HSMC**	Humanities & Social Science including Management Courses
2	**BSC**	Basic Science Courses
3	**ESC**	Engineering Science Courses
4	**PCC**	Professional Core Courses
5	**PEC**	Professional Elective Courses
6	**OEC**	Open Elective Courses
7	**PROJ**	Project Work
8	**EEC**	Employability Enhancement Courses
9	**MC**	Mandatory Courses

Category Based Credit Split-Up – Semester Wise

Semester	HSMC	BSC	ESC	PCC	PEC	OEC	Project /EEC	MC	Total Credit
1	3	12	10	-	-	-	-	-	25
2	3	12	5	3	-	-	-	-	23
3	-	4	5	12	-	-	-	0	21
4	-	12	-	10	-	-	1	0	23
5	-	-	-	16	3	3	1	-	23
6	-	-	-	17	3	-	2	-	22
7	-	-	-	11	3	3	2	-	19
8	-	-	-	-	6	-	6	-	12
Total Credits	**6 3.57%**	**40 23.8%**	**20 11.91%**	**69 41.1%**	**15 8.93%**	**6 3.57%**	**12 7.14%**	**0 0%**	**168**

B.Tech. - Chemical Engineering Curriculum (R2021)

SEMESTER I										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21EN11T	Communicative English	HSMC	40	60	100	3	0	0	3
2	21MA12T	Matrices and Differential Calculus	BSC	40	60	100	3	1	0	4
3	21PH13T	Engineering Physics I	BSC	40	60	100	3	0	0	3
4	21CY14T	Engineering Chemistry	BSC	40	60	100	3	0	0	3
5	21CS15IT	Problem Solving and Python Programming	ESC	40	60	100	2	0	4	4
6	21ME16T	Engineering Graphics	ESC	40	60	100	4	0	0	4
PRACTICAL										
7	21BS17P	Physics and Chemistry Laboratory	BSC	40	60	100	0	0	4	2
8	21ME18P	Engineering Practices Laboratory	ESC	40	60	100	0	0	4	2
TOTAL										**25**

SEMESTER II										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21EN21T	Technical English	HSMC	40	60	100	3	0	0	3
2	21MA22T	Vector Calculus and Complex Integration	BSC	40	60	100	3	1	0	4
3	21PH23T	Engineering Physics II	BSC	40	60	100	3	0	0	3
4	21CY24T	Organic Chemistry	BSC	40	60	100	3	0	0	3
5	21CH25T	Principles of Chemical Engineering	PCC	40	60	100	3	0	0	3
6	21IT26T	Programming in C	ESC	40	60	100	3	0	0	3
PRACTICAL										
7	21CY27P	Organic Chemistry Laboratory	BSC	40	60	100	0	0	4	2
8	21IT28P	Programming in C Laboratory	ESC	40	60	100	0	0	4	2
TOTAL										**23**

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SEMESTER III										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21CH31T	Chemical Process Calculations	PCC	40	60	100	3	1	0	4
2	21HM32T	Basic Applied Engineering for Chemical Engineers	ESC	40	60	100	3	0	0	3
3	21CH33T	Fluid Mechanics for Chemical Engineers	PCC	40	60	100	3	0	0	3
4	21MA34T	Series, Transforms and Partial Differential Equations	BSC	40	60	100	3	1	0	4
5	21CH35T	Chemical Process Industries	PCC	40	60	100	3	0	0	3
6	21MC01T	Constitution of India	MC	40	60	100	2	0	0	0
PRACTICAL										
7	21CH37P	Fluid Mechanics Laboratory	PCC	40	60	100	0	0	4	2
8	21HM38P	Basic Applied Engineering Laboratory	ESC	40	60	100	0	0	4	2
TOTAL										**21**

SEMESTER IV										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21CH41T	Chemical Engineering Thermodynamics I	PCC	40	60	100	3	0	0	3
2	21CH42T	Physical Chemistry	BSC	40	60	100	3	0	0	3
3	21CH43IT	Particle Mechanics	PCC	40	60	100	2	0	4	4
4	21MA44T	Numerical Methods	BSC	40	60	100	4	0	0	4
5	21CH45T	Instrumental Methods of Analysis	BSC	40	60	100	3	0	0	3
6	21CH46T	Environmental Science and Engineering	BSC	40	60	100	3	0	0	3
7	21MC03T	Essence of Indian Traditional Knowledge	MC	40	60	100	2	0	0	0
PRACTICAL										
8	21CH48P	Chemical and Technical Analysis Laboratory	PCC	40	60	100	0	0	4	2
9	21EE01P	Mini Project I	EEC	40	60	100	0	0	2	1
TOTAL										**23**

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SEMESTER V										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21CH51T	Heat Transfer	PCC	40	60	100	3	0	0	3
2	21CH52T	Mass Transfer I	PCC	40	60	100	3	0	0	3
3	21CH53T	Chemical Reaction Engineering I	PCC	40	60	100	3	0	0	3
4	21CH54T	Process Instrumentation, Dynamics and Control	PCC	40	60	100	3	0	0	3
5	-	Professional Elective I	PEC	40	60	100	3	0	0	3
6	-	Open Elective I	OEC	40	60	100	3	0	0	3
PRACTICAL										
7	21CH57P	Heat Transfer Laboratory	PCC	40	60	100	0	0	4	2
8	21CH58P	Process Control Laboratory	PCC	40	60	100	0	0	4	2
9	21EE03P	Technical Seminar	EEC	100	-	100	0	0	2	1
TOTAL										**23**

SEMESTER VI										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21CH61T	Chemical Engineering Thermodynamics II	PCC	40	60	100	3	0	0	3
2	21CH62T	Mass Transfer II	PCC	40	60	100	3	0	0	3
3	21CH63T	Chemical Reaction Engineering II	PCC	40	60	100	3	0	0	3
4	21CH64T	Biochemical Engineering	PCC	40	60	100	3	0	0	3
5	21CH65T	Process Modeling and Simulation	PCC	40	60	100	3	0	0	3
6	-	Professional Elective II	PEC	40	60	100	3	0	0	3
PRACTICAL										
7	21CH66P	Mass Transfer Laboratory	PCC	40	60	100	0	0	4	2
8	21CH67P	Internship	EEC	100	-	100	0	0	0	1
9	21CH68P	Mini Project II	EEC	40	60	100	0	0	2	1
TOTAL										**22**

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SEMESTER VII										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21CH71T	Transport Phenomena	PCC	40	60	100	3	1	0	4
2	21CH72T	Process Equipment Design	PCC	40	60	100	3	0	0	3
3	-	Professional Elective III	PEC	40	60	100	3	0	0	3
4	-	Open Elective II	OEC	40	60	100	3	0	0	3
PRACTICAL										
5	21CH73P	Computational Programming Laboratory for Chemical Engineers	PCC	40	60	100	0	0	4	2
6	21CH74P	Chemical Reaction Engineering Laboratory	PCC	40	60	100	0	0	4	2
7	21CH75P	Project Work (Phase I)	PROJ	40	60	100	0	0	4	2
TOTAL										**19**

SEMESTER VII										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	-	Professional Elective V	PEC	40	60	100	3	0	0	3
2	-	Professional Elective VI	PEC	40	60	100	3	0	0	3
PRACTICAL										
3	21CH83P	Project Work – Phase - II	PROJ	40	60	100	0	0	12	6
TOTAL										**12**

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List of Professional Elective Courses

S. No.	Course Code	Engineering Stream Courses
Professional Elective-I		
1	21CH551PT	Petroleum Refining and Petrochemicals
2	21CH552PT	Food Technology
3	21CH553PT	Electro Chemical Engineering
4	21CH554PT	Fundamentals Of Nanotechnology
5	21CH555PT	Fertilizer Technology
Professional Elective-II		
6	21CH651PT	Air Pollution and Control
7	21CH652PT	Energy Management and Audit
8	21CH653PT	Bio-Fuel Technology
9	21CH654PT	Wastewater Treatment Technology
10	21CH655PT	Waste Management
Professional Elective-III		
11	21CH751PT	Environmental Impact Assessment
12	21CH752PT	Project Engineering
13	21CH753PT	Material Technology
14	21CH754PT	Pulp and Paper Technology
15	21CH755PT	Industrial Safety Management
Professional Elective-IV		
16	21CH811PT	Total Quality Management
17	21CH812PT	Optimization of Chemical Processes
18	21CH813PT	Modern Separation Techniques
19	21CH814PT	Professional Ethics
20	21CH815PT	Polymer Technology
Professional Elective-V		
21	21CH821PT	Piping and Instrumentation
22	21CH822PT	Pharmaceutical Technology
23	21CH823PT	Process Plant Utilities
24	21CH824PT	Enzyme Engineering
25	21CH825PT	Hydrocarbon Engineering

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LIST OF OPEN ELECTIVE COURSES

S.NO.	COURSE CODE	COURSE TITLE
1	21CH01OT	Principles of Chemical Engineering
2	21CH02OT	Process Modelling and Simulation
3	21CH03OT	Energy Management and Audit
4	21CH04OT	Process Plant Utilities

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Course code	21EN21T	Semester	II			
Category	HUMANITIES & SOCIAL SCIENCE INCLUDING MANAGEMENT COURSES (HSMC)		L	T	P	C
Course Title	TECHNICAL ENGLISH (Common for all Branches)		3	0	0	3

COURSE OBJECTIVES:

- To make the students of engineering and technology to enhance their ability on reading and comprehencing the different texts
- To improve their creative and critical thinking so as to use in demanding contexts
- To equip the learners with the skills of writing convincing job Applications and effective reports
- To develop their speaking skills to make technical presentations and participate in group discussions
- To facilitate them to hone their soft skills

PREREQUISITE:

- Technical writing and basic English grammar.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C201. 1	***Read*** and understand general and technical texts	K2
C201. 2	***Apply*** creative and critical thinking and communicate their ideas efficiently	K2
C201. 3	***Participate*** in group discussions and deliver short speeches effectively	K3
C201. 4	***Write*** effectively and persuasively in academic and workplace contexts	K3
C201. 5	***Experiment with*** the future challenges confidently and successfully	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C201. 1	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201. 2	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201. 3	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201. 4	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201. 5	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

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SYLLABUS **No. of Credits: 3**

UNIT-I TECHNICALWRITING AND VISUAL CONVERSION 9

PRACTICAL

LISTENING : Listening to pronunciation of longer words.

SPEAKING : Making out meaning of pictorial and graphical representations.

TUTORIAL

READING : Understanding logic and sequencing in reading inferring the exact meaning of text

WRITING : Extended Definition- Writing Instructions, Checklists & Recommendations- Reading short technical text from Journal.

VOCABULARY: Technical vocabulary- Regular and Irregular verbs.

UNIT- II TECHNICAL WRITING AND GUIDELINES PREPARATION 9

PRACTICAL

LISTENING : Comprehensive listening - Listening to telephonic conversations – short and long conversations from different domains, listening to various pre-recorded conversations and speeches.

SPEAKING : Delivering short speeches in the class.

TUTORIAL

READING : Technical reading on innovations and innovators.

WRITING : Conditional clauses, Numerical adjectives, Process Description

VOCABULARY: Collocation, Verbal Analogies.

UNIT-III TECHNICAL PROCESS WRITING 9

PRACTICAL

LISTENING : Listening to documentaries and making notes.

SPEAKING : Basic speaking practice based on BEC, IELTs, and TOFEL.

TUTORIAL

READING : longer text both general and technical –practice in speed reading

WRITING : Purpose statements, words are used as nouns and verbs- describing a process – use of sequence word - Interpretation of Graphs and Charts.

VOCABULARY: Sequence words –Misspelled words -Embedded sentences.

UNIT- IV TECHNICAL WRITING AND BUSINESS LETTERS 9

PRACTICAL

LISTENING : listening to native accents.

SPEAKING : Group Discussions - Process, Skills, Guidelines, Evaluation, Oral Presentation - Planning, Preparing, Organizing and Presenting.

TUTORIAL

READING : Reading for detailed comprehension.

WRITING : Cause and effect, impersonal passive voice, idioms and phrases, - Letter writing, job application, business correspondence (letters) – calling for quotations, placing order, complaint letters, preparing a memo, notice and e-mail itinerary.

VOCABULARY: clauses and If conditionals.

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UNIT-V TECHNICAL WRITING AND REPORT WRITING 9

PRACTICAL

LISTENING : TED /ink talks

SPEAKING : Starting a Career — vision statement, preparing logo and tagline, making short term and long-term goals, setting plans.

TUTORIAL

READING : Reading and understanding technical articles.

WRITING : Degrees of comparison, editing, Email etiquette, Mispronounced words – Report writing survey, feasibility, industrial visit, reporting various incidents and accidents, Minutes of meeting.

VOCABULARY: Reported speech.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Department of English, Anna University, Chennai. Mindscapes: English for Technologists and Engineers. Orient Black Swan, Chennai.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Black Swan Publications, Chennai, 2011.

REFERENCE BOOKS:

1. Rizvi, M. Ashraf, "Effective Technical Communication", Tata McGraw— Hill,2006.
2. Ibbotson, Mark, "Cambridge English for Engineering", Cambridge University Reference Press, 2008
3. Richard Johnson-Sheehan, "Technical Communication Today"4th EditionBooks Longman Publishing Group, 2011.
4. Richard Johnson-Sheehan, "Technical Communication Today"4th EditionBooks Longman Publishing Group, 2011
5. Porter, Patricia A., and Margaret Grant, "Communicating Effectively in English: Ora1 Communication for Non-Native Speakers", 2nd Edition, Wadsworth, 1992.
6. Gopalaswamy, Ramesh & Ramesh Mahadevan. ACE of Soft Skills: Attitude, Communication and Etiquette for Success, New Delhi: Pearson, 2010.

Extensive Reading:

Wells, H G. The Time Machine, Peacock, India, 2008.

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Course code	21MA22T	Semester	II			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	VECTOR CALCULUS AND COMPLEX INTEGRATION (Common for all Branches)		3	1	0	4

COURSE OBJECTIVES:

- To improve their ability in vector calculus
- To expose to the ideas of analytic functions
- To solve differential equation using the concept of Laplace Transform.

PREREQUISITE:

- Mathematics skills at Sem-I level

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C202.1	***Apply*** the vector calculus concepts to solve engineering problems.	K3
C202.2	***Apply*** the concept of mapping to solve Linear equation.	K3
C202.3	***Apply*** the complex integration problem ideas to solve engineering problems.	K3
C202.4	***Understand*** the concepts of multiple integrals.	K2
C202.5	***Apply*** the concepts of Laplace transformation to solve Differential Equations.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C202.1	3	2	-	-	-	-	-	-	-	-	-	-
C202.2	3	2	-	-	-	-	-	-	-	-	-	-
C202.3	3	2	-	-	-	-	-	-	-	-	-	-
C202.4	2	2	-	-	-	-	-	-	-	-	-	-
C202.5	3	2	-	-	-	-	-	-	-	-	-	-
C202	3	2	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

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SYLLABUS **No. of Credits: 4**

UNIT I VECTOR CALCULUS 12

Gradient, divergence, curl – Solenoidal and irrotational fields – Vector identities– Directional derivatives – Line, surface and volume integrals –Green's, Gauss divergence and Stoke's theorems (without proof) .

UNIT II ANALYTIC FUNCTIONS 12

Limit of a complex functions-Derivative of f(z)-Definition of Analytic Function – Cauchy Riemann equations – Properties of analytic functions - Determination of harmonic conjugate – Milne-Thomson's method – Conformal mappings: 1/z, az , az+b and bilinear transformation.

UNIT III COMPLEX INTEGRATION 12

Line integral – Cauchy's integral theorem (statements only) – Cauchy's integral formulae and its applications – Taylor's and Laurent's expansions (statements only) – Singularities – Poles and Residues – Cauchy's residue theorem (statement only) – Contour integration – Unit circle and semicircular contour.

UNIT IV MULTIPLE INTEGRALS 12

Double integration in Cartesian and polar coordinates – Change of order of integration – Area as double integral – Triple integration in Cartesian coordinates – Conversion from Cartesian to polar – Volume as a double and Triple Integral.

UNIT V LAPLACE TRANSFORMS 12

Definition-Conditions for existence- Transforms of elementary functions – Properties of Laplace Transform-Transforms of periodic functions – Transforms of derivatives and integrals– Inverse transforms – Convolution theorem– Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients only- Unit step function and Unit impulse function [simple problems only]

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. B. S. Grewal, Higher **Engineering Mathematics**, Khanna Publishers, New Delhi, 42nd Edition, 2012.

REFERENCES:

1. E. Kreyszig, **Advanced Engineering Mathematics**, John Wiley & Sons. Singapore, 10thEdition, 2012.
2. M.K. Venkataraman, Engineering **Mathematics: Vol I and II**, National Publishing., Chennai 2001.
3. T. Veerarajan, **Engineering Mathematics**, Tata McGraw Hill Publishing Co, New Delhi, 2004.

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Course code	21PH23T	Semester	II			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	ENGINEERING PHYSICS II Common for (CSE, IT, ECE, CHEMICAL, CIVIL, AI&DS)		3	0	0	3

COURSE OBJECTIVES:

- To equip the students with the knowledge of carrier concentration and doping in semiconductors.
- To familiarize the basics of Magnetic and Superconducting materials.
- To empower the students in understanding the importance of fluid properties.
- To elucidate the physics and instrumentation of spectrometry

PREREQUISITE:

- High School Maths and Physics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C203.1	***Understand*** basics of electronic states and energy band structure formation	K2
C203.2	***Understand*** the importance of carrier concentration and doping in semiconductors	K2
C203.3	***Understand*** physics of magnetic and superconducting materials.	K2
C203.4	***Understand the*** importance of fluid properties.	K2
C203.5	***Understand*** the physics of spectrometry and its instrumentation.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C203.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C203.2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C203.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C203.4	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C203.5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C203	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

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SYLLABUS **No. of Credits: 3**

UNIT I SOLID STATE ELECTRONICS 9

Band theory of solids - Classification of solids on the basis of band theory - Classical free electron theory - expression for electrical conductivity - thermal conductivity - Wiedemann-Franz law - electrons in metals - Fermi-Dirac probability function - Position of Fermi level Temperature variation of carrier concentration - density of energy states - electron effective mass - concept of hole.

UNIT II SEMICONDUCTING MATERIALS AND DEVICES 9

Elemental and compound semiconductors - Intrinsic and extrinsic semiconductors - Properties. Carrier concentration in intrinsic, n-type and p-type semiconductors. Hall effect - experimental determination of Hall coefficient. Application - Hall and Peltier devices - Formation of p-n junctions - position of Fermi level in equilibrium - forward and reverse bias - p-n junction diode: I-V characteristics in forward and reverse bias - Photodiode - LDR, LED, and solar cell.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9

Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis. Soft and Hard magnetic materials - Anti-ferromagnetic materials - Ferrites, magneto resistance material Superconducting phenomena - properties of superconductors - Meissner effect and isotope effect. Type-I and Type-II superconductors, High TC superconductors - Magnetic levitation and SQUIDS.

UNIT IV FLUID MECHANICS 9

Introduction to ideal and real fluids- Basic concepts of density and pressure in a fluid-Newtonian fluids, Non-Newtonian fluids - Capillarity – Surface tension - Experimental determination of surface tension by capillary rise method – Viscosity - Coefficient of viscosity - Role of temperature on surface tension and viscosity - Measurement of pressure by strain-gauge diaphragms.

UNIT V SPECTROMETRY 9

Theory of Infrared absorption spectrometry – Quantum treatment– Instrumentation – Infrared sources and detectors. Applications – Theory of Raman spectroscopy – excitation mechanism. Instrumentation – Sources and detectors. Nuclear Magnetic Resonance – Relaxation process in NMR – Free induction decay – Chemical Shift – Instrumentation and components of NMR.

Total: 45 Periods

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LEARNING RESOURCES:

TEXT BOOKS:

1. N.Garcia, A. Damask and S.Schwarz "Physics for Computer Science Students", SpringerVerlag, 2012.
2. Umesh Mishra and Jasprit Singh, "Semiconductor Device Physics and Design", Springer, 2008.
3. C. Kittel , Introduction to solid state physics, Wiley. 2004
4. Yunus a. Çengel, john m. Cimbala Fluid Mechanics: fundamentals and applications Fourth edition Mc Graw Hill 2018
5. Aruldas Molecular Structure and Spectroscopy Prentice Hall 2007.

REFERENCES:

1. Arthur Beiser Concepts of Modern Physics; Tata McGraw – Hill Edition. 2003
2. Steven H. Simon, The Oxford Solid State Basics 1st Edition Oxford 2013
3. S O Pillai, Solid State Physics, New Age International 2006
4. Willard H H, Meritt L L Dean J A and Settle F A, "Instrumental Methods of Analysis", CBS Publishers and Distributions, New Delhi, 2001.
5. C.N.Banwell Fundamentals of Molecular Spectroscopy , Fourth edition Tata Mc.Graw Hill
6. Bruce R. Munson, Alric P. Rothmayer, Theodore H. Okiishi, Wade W. Huebsch Fundamentals of fluid mechanics Wiley, 2012

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Course code	21CY24T	Semester	II			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	ORGANIC CHEMISTRY		3	0	0	3

COURSE OBJECTIVES:

- To learn the type of components in which organic reactions take place.
- To know the preparation of the essential organic compounds.

PREREQUISITE:

- Basic knowledge of organic chemistry.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C204.1	***Understand*** various organic reaction mechanism, preparation of organic compounds and their properties.	K2
C204.2	***Classify*** carbohydrates, starch and cellulose based on its structure and properties.	K2
C204.3	***Outline*** the classification of polynuclear aromatics, preparation, properties and uses of heterocyclic compounds.	K2
C204.4	***Explain*** the classification, preparation and properties of dyes.	K2
C204.5	***Acquire*** knowledge on the classification, synthesis and mode of action of drugs.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
C204.1	3	1	-	-	-	-	1	-	-	-	-	-
C204.2	3	1	-	-	-	-	1	-	-	-	-	-
C204.3	3	1	-	-	-	-	1	-	-	-	-	-
C204.4	2	1	-	-	-	-	1	-	-	-	-	-
C204.5	3	1	-	-	-	-	1	-	-	-	-	-
C204	3	1	-	-	-	-	1	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

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SYLLABUS **No. of Credits: 3**

UNIT I ORGANIC REACTIONS 9

Electrophilic addition and substitution reactions- Friedel Crafts alkylation and acylation reactions; Reimer-Tiemann reaction; Nucleophilic addition and substitution reactions -Perkin reaction, Claisen condensation, Dieckmann condensation; Free radical substitution reaction, Halogenation of alkane, Addition of HBr on alkene in presence of peroxide; Allylic halogenation using N-bromosuccinamide (NBS),Thermal halogenation of alkene (CH_3-CH=CH_2); cyclo- additions-Rearrangements -Hofmann rearrangement, pinacol rearrangement.

UNIT II CARBOHYDRATES 9

Nomenclature, Classification of Carbohydrates, Structure, general reactions and uses of Glucose and Fructose. Interconversions – aldo pentose to aldo hexose – aldo hexose to aldo pentose – aldose to isomeric ketose – ketose to isomeric aldose – aldose to epimer, mutarotation. Polysaccharides-sources and structures (no elucidation) of starch and cellulose- Applications of cellulose derivatives.

UNIT III HETEROCYCLIC COMPOUNDS 9

Preparation, physical and chemical properties and uses of Furan-Furfural-Thiophene-Pyrrole-Pyridine-Indole- Quinoline–Isoquinoline- Conversion of THF into Nylon 6,6.

UNIT IV DYE CHEMISTRY 9

Colour and constitutions – Witt's theory and Modern theory of colours. Classification of dyes based on structure and mode of dyeing. Synthesis of some important azo dyes (Methyl orange, Methyl red and Congo red), triphenylmethane dye (Alizarin), phthalein dyes (Phenolphthalein and Fluorescein).

UNIT V PHARMACEUTCAL CHEMISTRY 9

Drugs-Classification-Synthesis and mode of action of anti-bacterial drugs (Sulphanilamide andSulphapyridine) - anti-malarial drug (Primaquine and Chloroquine)-antiviral drugs (Amantidine Hydrochloride and Methisazone)

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. B.S.Bhal and Arun Bhal, "A Text Book of Organic Chemistry", 17th Ed., S Chand & Co. New Delhi, 2005.
2. R.T. Morrison and R.N. Boyd "Organic Chemistry", 7th Ed., Prentice Hall Inc. USA, 2010.

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REFERENCES:

1. Jonathan Clayden, Nick Greeves, Staurt Warren and Peter Wothers, “Organic Chemistry”, Oxford University Press, 2nd Ed., New Delhi, 2013.
2. K.S. Tiwari, N.K. Vishnoi, S.N. Mehrotra, “A Text Book of Organic Chemistry”, Vikas Publishing House, 2nd Ed., New Delhi, 2006.
3. Jerry March, Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 4th Edition, John Wiley & Sons, New York, 2006.
4. J. Shore, “Colourants and Auxiliaries: Volume II Auxiliaries”, Wood head Publishing Ltd., 2002.
5. V. A.Shenai, “Chemistry of Dyes and Principles of Dyeing”, Sevak Publications, Mumbai, 1995.
6. I.L. Finar, “Organic Chemistry (Vol.1)”, 6th Edition, Pearson Education, New Delhi, 2006.7. I.L. Finar, “Organic Chemistry (Vol.2)”, 5th Edition, Pearson Education, New Delhi, 2006.

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Course code	21CH25T	Semester	II			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	PRINCIPLES OF CHEMICAL ENGINEERING		3	0	0	3

COURSE OBJECTIVES:

- To understand the overall view of the chemical engineering subjects

.

PREREQUISITE:

- Basics in physics, Chemistry and Mathematics

COURSE OUTCOMES:

CO. No.	Course Outcome	Blooms level
On successful completion of this Course, students will be able to		
C205.1	To ***acquire*** knowledge on what is Chemical Engineering	K2
C205.2	***Understand*** the basic concepts in Chemical engineering	K2
C205.3	***Acquire*** knowledge on unit operations and fluidization	K2
C205.4	***Acquire*** knowledge on Heat and Mass transfer	K3
C205.5	***Know*** the scope and opportunities in the field of chemical engineering	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO. No.	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
C205.1	3	2	-	-	-	-	-	-	-	-	-	1	1	1	1
C205.2	3	2	-	-	-	-	-	-	-	-	-	1	1	1	1
C205.3	3	2	-	-	-	-	-	-	-	-	-	1	1	1	1
C205.4	3	2	-	-	-	-	-	-	-	-	-	1	1	1	1
C205.5	3	2	-	-	-	-	-	-	-	-	-	1	1	1	1
C205	3	2	-	-	-	-	-	-	-	-	-	1	1	1	1

Note: 1: Slight, 2: Moderate, 3: Substantial

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SYLLABUS **No. of Credits: 3**

UNIT-I INTRODUCTION TO CHEMICAL ENGINEERING 9

Definition of Chemical Engineering and Chemical Engineers; Chemical Engineering –a general purpose study, Relationship between Chemical Engineering and Science of Chemistry, Historical Development of Chemical Engineering, History and Personalities of Chemical Engineering; Greatest achievements of Chemical Engineering.

UNIT –II BASIC CONCEPTS OF CHEMICAL ENGINEERING 9

Components of Chemical Engineering: Role of Mathematics, Physics, Chemistry and Biology; Basic Concepts of Chemical Engineering: Basic Stoichiometric relations, Thermodynamics of Chemical reactions, Chemical reaction Engineering and its applications, Separation processes, Process dynamics, design and control and its applications. Anatomy of Chemical Engineering Plant; visit to chemical industry.

UNIT-III UNIT OPERATIONS AND UNIT PROCESSES 9

Physico-Chemical Calculations; Concept of Unit processes and Unit operations; Conservation of mass and energy ; Fluids - Fluid Static's and application in chemical Engineering- laminar and turbulent flow- Fluidization.

UNIT-IV HEAT TRANSFER AND MASS TRANSFER 9

Heat transfer - conduction, convection and radiation –conduction problems- heat transfer equipment; Diffusion - Mass transfer operation Relative volatility- Distillation - Terminology for Gas-Liquid mass transfer operations –Adsorption

UNIT-V SCOPE AND OPPORTUNITY IN CHEMICAL ENGINEERING 9

Role of Computer in Chemical Engineering; Process control systems in Chemical Engineering; Traditional vs. modern Chemical Engineering; Relation between Chemical Engineering and other engineering disciplines- Food, Medical, Energy, Environmental, Biochemical, Electronics etc. Opportunities for Chemical Engineers; Future of Chemical Engineering.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Salil K. Ghosal, Siddhartha Datta "Introduction to Chemical Engineering" Tata McGraw-Hill Education
2. Badger W.L. and Banchero J.T., “Introduction to Chemical Engineering”, 6th Edition, Tata McGraw Hill, 1997.
3. Introduction to Chemical Engineering by ‘Uche P Nnaji’ –Wiley Publications,2019.
4. Dryden, C.E., “Outlines of Chemicals Technology”, Edited and Revised by Gopala Rao, M. And M.Sittig, 3rd Edition, Affiliated East-West press, 2010.

REFERENCES:

1. McCabe, W.L., Smith, J. C. and Harriot, P. “Unit operations in Chemical Engineering”, McGraw Hill, 7th Edition, 2001.
2. Finlayson, B. A., Introduction to Chemical Engineering Computing, John Wiley & Sons, New Jersey, 2006.

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VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

An Autonomous Institution

Approved by AICTE-New Delhi, Affiliated to Anna University, Chennai

Accredited by NBA, New Delhi & Accredited by NAAC with "A" Grade & CGPA of 3.27

Course code	21IT26T	Semester	II			
Category	ENGINEERING SCIENCE COURSE (ESC)		L	T	P	C
Course Title	PROGRAMMING IN C (Common for CSE, IT, ECE, BIOTECH, CHEM, CSE(AI&ML))		3	0	0	3

COURSE OBJECTIVES:

- To learn Introduction of Algorithm and Basic Structure of C Programming.
- To gain knowledge on Implementation of Arrays and Strings concept in C Programming.
- To understand the Basic functions and Pointer declaration in C Programming.
- To apply the concepts of Structures and Unions in an example program.
- To write a sample C program to implement file handling and accessing Graphic Library function.

PREREQUISITE:

- Basic Mathematics Skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C206.1	***Explain*** the data types, syntax and control structures for solving different problems.	K2
C206.2	***Apply*** the concepts of Arrays, Strings in 'C' language for user defined problems	K3
C206.3	***Make use of*** functions and concepts of pointers in 'C' language	K3
C206.4	***Organize*** data using structures and unions in 'C' Programs.	K3
C206. 5	***Develop*** and implement applications using File handling Process and Graphics.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C206.1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-
C206.2	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-	-
C206.3	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-	-
C206.4	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-	-
C206. 5	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-	-
C206	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

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SYLLABUS **No. of Credits: 3**

UNIT-I INTRODUCTION TO PROGRAMMING 9

Basic Organization of a Computer - Introduction to Algorithm, Pseudo code, Flow Chart. Structure of 'C' program, compilation and linking processes - C Tokens: Keywords, Data Types, Constants, Variables - Declaration –Operator: precedence and associativity -Expressions - Input/Output statements -Assignment statements – Decision making statements Switch statement - Looping Statements-Bitwise operations- pre-processor-Syntax and Logical Errors in compilation solving simple scientific and statistical problems.

UNIT-II ARRAYS AND STRINGS 9

Arrays: Declaration, Initialization - One dimensional array: Assigning an array to another array – Equating an array with another array –Two dimensional Arrays: Declaration – usage of two-dimensional arrays – reading, storing and accessing elements in two dimensional arrays –String operations: Initialization of Strings – string library functions - command line arguments – Searching and Sorting of Strings.

UNIT-III FUNCTIONS AND POINTERS 9

Introduction to functions: Classification of functions – function definition – function call –function with inputs and outputs - recursive function –example programs: copy one string to another string using recursion, binary search using recursion -Pointer Fundamentals: Pointer Declaration – Passing Pointers to a Function- Operations on pointers: Pointer Arithmetic - Pointer comparisons -Array of pointer: Pointers and one-dimensional arrays- Pointers and multi-dimensional arrays.

UNIT-IV STRUCTURES AND UNIONS 9

Introduction to Structures: Defining structures - initializing structures -Array of Structures – Nested structures - Introduction to union Creating and using union variables - memory allocation of union – example programs: Store and display N employees information using Union- Dynamic memory allocation: Allocating and freeing memory, Allocating memory for arrays.

UNIT-V FILE HANDLING AND GRAPHICS 9

Files: Introductions - Data hierarchy - Types of file processing- Sequential access: Reading data from sequential access file - Updating sequential access file - Random access: Reading data from random access file - Writing data randomly to random access file –C Graphics: libraries and functions – 2D shapes – 3D shapes – Examples.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Sumitabha Das, "Computer Fundamentals & C Programming", McGraw Hill, 2018.
2. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
3. Yashavant Kanetkar" Let usC", 15th edition.

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REFERENCES:

1. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Byron S Gottfried and Jitendar Kumar Chhabra, “Programming with C”, Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
3. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006.
4. Ashok N. Kamthane, “Computer programming”, Pearson Education, 2007.

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VEL TECH HIGH TECH

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An Autonomous Institution

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Course code	21CY27P	Semester	II			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	ORGANIC CHEMISTRY LABORATORY		0	0	4	2

COURSE OBJECTIVE:

- To learn basic principles involved in analysis and synthesis of different organic derivatives.

PREREQUISITE:

- Basic skills in Organic Chemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C207.1	***Demonstrate*** mastery of basic experiments to identify the classes and functional group of organic compounds.	K2
C207.2	***Demonstrate*** the analysis of carbohydrates and proteins	K2
C207.3	***Demonstrate*** the ability in preparation of organic compounds using synthetic procedures.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
C207.1	2	1	-	-	-	-	-	-	-	-	-	1
C207.2	2	1	-	-	-	-	-	-	-	-	-	1
C207.3	2	1	-	-	-	-	-	-	-	-	-	1
C207	2	1	-	-	-	-	-	-	-	-	-	1

Note: 1: Slight, 2: Moderate, 3: Substantial

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SYLLABUS **No. of Credits: 2**

LIST OF EXPERIMENTS

1. Quantitative analysis of organic compounds – Identification of aliphatic/aromatic, saturated/unsaturated compounds.

a) Identification and characterization of various functional groups by their characteristic reactions: a) alcohol, b) aldehyde, c) ketone, d) carboxylic acid, e) ester, f) primary, secondary and tertiary amines and g) nitro compounds.

2. Analysis of an unknown organic compound and preparation of suitable solid derivatives (Benzoic acid from Benzaldhehyde, hydrolysis of ester and meta- dinitrobenzene from nitrobenzene) .
3. Analysis of carbohydrates.
4. Analysis of proteins.
5. Introduction to organic synthetic procedures:
   i. Acetylation – Preparation of acetanilide from aniline.
   ii. Hydrolysis – Preparation of salycilic acid from methyl salyciliate.
   iii. Substitution – Conversion of acetone to iodoform.
   iv. Nitration – Preparation of m-dinitrobenzene from nitrobenzene.
   v. Oxidation – Preparation of benzoic acid from benzaldehyde/ benzyl alcohol

LEARNING RESOURCES:

REFERENCES:

1. Organic Chemistry Lab Manual, Chemistry Division, Chemical EngineeringDepartment, A.C.Tech, Anna University, 2007.
2. Vogels'sText Book of Practical Organic Chemistry, Fifth Edition, Longman Singapore Publishers Pte. Ltd., Singapore, 1989.

S. No	Description of the equipment	Quantity
	Essential	
1.	Bunsen burners	30 Nos.
2.	LPG Cylinder in each row of the Laboratory	1 Nos.
3.	Hot Air Oven	2 Nos.
4.	Hot Plate	6 Nos.
5.	Water Bath	6 Nos.
6.	Deep freezer	1 Nos.
7.	Magnetic Stirrers	6 Nos.
8.	Mechanical Stirrers	6 Nos.
9.	Refluxion Set up	30 Nos.
10.	Sharp Knives to cut sodium	6 Nos.
11.	Balance I. Rough balance II. Four-digit Balance	 2 Nos. 1 Nos
Desirable		
	Melting Point apparatus	4 Nos

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VEL TECH HIGH TECH

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Course code	21IT28P	Semester	II			
Category	ENGINEERING SCIENCE COURSE (ESC)		L	T	P	C
Course Title	PROGRAMMING IN C LABORATORY (Common for CSE, IT, ECE, BIOTECH, CHEM, CSE(AI&ML))		0	0	3	2

COURSE OBJECTIVES:

- To develop programs in C using basic constructs.
- To develop applications in C using strings, pointers, functions, structures
- To develop applications in C using file processing, Graphics

PREREQUISITE:

- Basic Mathematics Skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C208.1	***Utilize*** decision making and looping statements for problem solving.	K3
C208.2	***Apply*** the concepts of Arrays and String to solve problem statements.	K3
C208.3	***Examine*** the dynamic behaviour of memory by the use of pointers.	K4
C208.4	***Develop*** simple applications using Structures and unions.	K3
C208.5	***Design*** and develop simple applications using File Processing and Graphics.	K6

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
C208.1	3	2	1	-	-	1	-	-	1	-	1	1	1	2
C208.2	3	2	1	-	-	1	-	-	1	-	1	1	2	1
C208.3	3	3	2	1	-	1	-	-	1	-	1	1	2	1
C208.4	3	2	1	-	-	1	-	-	1	-	1	1	2	1
C208.5	3	3	3	3	2	1	-	-	1	-	1	1	2	1
C208	3	2	2	3	2	1	-	-	1	-	1	1	2	1

Note: 1: Slight, 2: Moderate, 3: Substantial

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LIST OF EXPERIMENT **No. of Credits: 4**

1. a) Write a C program to perform input / output of all basic data types.

   b) Write a C program using decision making construct.

   c) Write a program that finds if a given number, is a prime number.

2. a) Write a program to find whether the given year is a leap year or not?
   (Hint: not every Centurion year is a leap. For example, 1700, 1800 and 1900 is not a leap year)
   b) Write a program using looping statements.

   c) Write a program to use swapping operations.

3. a) Write a C program for print pyramids and patterns.

   b) Write a C program to generate Fibonacci series.

4. a) Write a C program to shut down or turn off the computer.

   b) Write a C program to perform sorting operations.

5. Write a program using one dimensional and two-dimensional arrays.

6. From a given paragraph perform the following using built-in functions:
   a) Count total number of vowels and consonants.
   b) Capitalize the first word of each sentence.
   c) Replace a given word with another word.

7. Write a program using user defined functions and recursive functions.

8. Write a C program using pointers functions.

9. Write a program using structures and unions.

10. Write a program using text files and binary files.

11. Write a program using string functions.

12. Write a program using dynamic memory allocation.

Total: 60 Periods

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LEARNING RESOURCES:

TEXT BOOKS:

1. Sumitabha Das, “Computer Fundamentals & C Programming”, McGraw Hill, 2018.
2. ReemaThareja, “Programming in c”, Oxford University Press, Second Edition, 2016
3. Yashavant P. Kanetkar, “Let Us C”, Sixteenth Edition, BPB Publications, 2018.

REFERENCES:

1. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Byron S Gottfried and Jitendar Kumar Chhabra, “Programming with C”, Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
3. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, “Computer programming”, Pearson Education, 2007.

Sl. No.	Description of Equipment	Required numbers (For batch of 30 students)
1.	Systems with Linux Operating System with GNU compiler[Open Source]	30

3rd SEMESTER
CURRICULUM & SYLLABI

Applicable to the students admitted to

B.TECH-CHEMICAL ENGINEERING

R-2021: CBCS

Academic year 2021-2022

Onwards

VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

An Autonomous Institution

#60, Avadi – Vel Tech Road, Vel Nagar,

Avadi, Tamil Nadu 600062

VEL TECH HIGH TECH

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B.TECH. – CHEMICAL ENGINEERING

R-2021: CBCS CURRICULUM

SEMESTER III										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21CH31T	Chemical Process Calculations	PCC	40	60	100	3	1	0	4
2	21HM32T	Basic Applied Engineering for Chemical Engineers	ESC	40	60	100	3	0	0	3
3	21CH33T	Fluid Mechanics for Chemical Engineers	PCC	40	60	100	3	0	0	3
4	21MA34T	Series, Transforms and Partial Differential Equations	BSC	40	60	100	3	1	0	4
5	21CH35T	Chemical Process Industries	PCC	40	60	100	3	0	0	3
6	21MC01T	Constitution of India	MC	40	60	100	2	0	0	0
PRACTICAL										
7	21CH37P	Fluid Mechanics Laboratory	PCC	40	60	100	0	0	4	2
8	21HM38P	Basic Applied Engineering Laboratory	ESC	40	60	100	0	0	4	2
TOTAL										**21**

Dean Academics **Principal**

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Course code	21CH31T	Semester	III			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	CHEMICAL PROCESS CALCULATIONS		3	1	0	4

COURSE OBJECTIVES:

- The objective of the course is to introduce Chemical Engineering students to the basic principles and calculation techniques used in the Chemical Industries.
- To acquaint them with the fundamentals of the Material and Energy balances as applied to chemical engineering processes and used to solve the problems.

PREREQUISITE:

- Basic Mathematics and Principles of Chemical Engineering

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C301.1	***Use*** stoichiometry to balance chemical equations by using variable parameters temperature, Pressure etc.,	K3
C301.2	***Apply*** the Stoichiometric principles for all unit operations, recycle - bypass and purging and unsteady state material balances.	K3
C301.3	***Apply & make use of*** standard heat systems operations and Orsat techniques for calculation of energy balance for systems with and without chemical reaction.	K3
C301.4	To ***calculate*** the quantities of compounds produced or consumed in a chemical reaction.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C301.1	3	2	-	-	1	-	-	-	-	-	-	1	2	1	1
C301.2	3	2	-	-	1	-	-	-	-	-	-	1	2	1	1
C301.3	3	2	-	-	1	-	-	-	-	-	-	1	2	1	1
C301.4	3	2	-	-	1	-	-	-	-	-	-	1	2	1	1

Note: - 1: Slight 2: Moderate 3: Substantial

SYLLABUS **No. of Credits: 4**

UNIT I BASIC CHEMICAL CALCULATIONS 12

Units and dimensions – physical quantities in Chemical Engineering, Conversion factors, Methods of expressing composition of mixtures and solutions, stoichiometric principles. Use of partial pressure and pure component volume in gas calculations using Ideal gas law-Dalton's law, Amagat's law -Raoult's law and Henry's law. Applications of real gas relationship in gas calculation.

UNIT II MATERIAL BALANCE 12

Material Balance: Introductions to unit operations like Distillation, Extraction, Evaporation, Crystallization, Drying, Mixing etc. Material Balance: With chemical reaction, concept of limiting, excess reactants, fractional conversion and percentage of conversion, percentage yield, Material Balances with recycle, bypass and purge, Unsteady state material balances.

UNIT III HUMIDIFICATION AND VAPOR PRESSURE 10

Humidity and saturation- Absolute humidity, molal humidity, relative humidity and percentage humidity, Relative and percentage saturation–Wet bulb temperature and Dry bulb temperature-Humidity chart, dew point. Vapor pressure and liquids – Antoine equation, Vapor pressure of immiscible liquids and ideal solutions.

UNIT IV ENERGY BALANCE 14

Energy balance, heat capacity, estimation of heat capacities, problems involving sensible heat and latent heats, evaluation of enthalpy. Thermochemistry, Hess's law of summation- heat of formation, reaction, combustion, solution and mixing, calculation of theoretical flame temperature-Energy balance for systems with and without chemical reaction - enthalpy change with and without phase change.

UNIT V COMBUSTION AND MULTI UNIT SYSTEMS 12

Calorific value determination, Orsat analysis, ultimate and proximate analysis of fuels, excess air, air-fuel ratio calculations, Material and energy balance analysis for multi-unit processes - Case studies with simple process flow sheets.

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Bhatt, B.L., Vora, S.M., "Stoichiometry ", 5th Edition, Tata McGraw-Hill (2010).
2. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", EEE Eighth Edition, Prentice Hall Inc., 2012.

REFERENCES:

1. Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes",3rdEdn., John Wiley & Sons, New York, 2000.
2. Hougen O A, Watson K M and Ragatz R A, "Chemical process principles" Part II, CBS publishers (2004).

Course Code	21HM32T	Semester	III			
Category	ENGINEERING SCIENCES COURSE (ESC)		L	T	P	C
Course Title	BASIC APPLIED ENGINEERING FOR CHEMICAL ENGINEERS		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to impart knowledge on:

- Design of support columns, beams, pipelines, storage tanks and reaction columns.
- Working principles of Electrical Machines and Various electronic devices and measuring instruments.

PREREQUISITE:

- Engineering Mechanics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C302.1	Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes	K2
C302.2	Draw the shear force and bending moment diagrams for various beamsand compute bending stress, and shear stress at various points in beams	K3
C302.3	Apply basic equation of simple torsion in designing of shafts and helical spring, Calculate the slope and deflection in beams using different methods	K3
C302.4	Infer and relate the working and applications of various electronics devices and circuits.	K2
C302.5	Understand the laws of electrical circuits and some specific instruments for electrical measurements.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C302.1	3	2	-	-	-	1	-	-	-	-	-	1	1	1	-
C302.2	3	2	-	-	-	1	-	-	-	-	-	1	1	1	-
C302.3	3	2	-	-	-	1	-	-	-	-	-	1	1	1	-
C302.4	2	2	-	-	-	-	-	-	2	-	1	1	1	1	-
C302.5	3	2	-	-	-	1	-	-	-	-	-	1	1	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I STRESS, STRAINAND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – forces on solids and supports – equilibrium and stability – strength and stiffness – tension, compression and shear stresses – Hooke's law and simple problems– compound bars – thermal stresses – elastic constants and poission's ratio.

UNIT II TRANSVERSE LOADING ON BEAMS 9

Beams –support conditions–types of Beams –transverse loading on beams–shear force and bending moment in beams–analysis of can tilevers, simply – supported beams and over hanging beams –relationships between loading, S.F. and B.M.Inbeams and their applications– S.F.& B.M. diagrams. Macaulay's method for computation of slopes and deflections in beams.

UNIT III STRESSES IN BEAMS AND TORSION 9

Theory of simple bending – assumptions and derivation of bending equation (M/I=F/Y= E/R)– analysis of stresses in beams–loads carrying capacity of beams–proportioning beam sections – leaf springs stresses in helical springs–deflection of springs–spring constant. Torsion of circularshafts – derivation of torsion equation ($T/J = fs/R = C\theta/L$) – stress and deformation in circular and hollow shafts.

UNIT IV ELECTRONIC DEVICES & CIRCUITS 9

Types of Materials – Silicon & Germanium - PN Junction diodes – Structure, Operation and Characteristics – Display devices-LED, Laser diodes – Zener diode - Bipolar Junction Transistor – Characteristics and applications –Amplifiers - Basics, types and applications, Oscillators-Basics, types and its applications—D/A and A/D converters.

UNIT V CIRCUITS, MEASUREMENTS AND INSTRUMENTATION 9

Ohm's Law, Kirchhoff's Law - Introduction to AC circuits – single and three phase balanced circuits – Three phase power measurement - Moving coil and Moving iron ammeter and voltmeter – Dynamometer type wattmeter - Classification of Transducers: Resistive, Inductive, Capacitive, Piezoelectric and Photoelectric transducers.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Junarkar, S. B., Mechanics of Structure Vol.1, 21st Edition, Character Publishing House, Anand, Indian, (1995).
2. William A.Nash, Theory and Problems of Strength of Materials, Schaum's Outline Series. McGraw Hill International Editions, Third Edition, 1994.
3. Bansal, R.K, Strength of Materials, Laxmi Publications(P) Ltd., Fourth Edition 2010
4. D P Kothari and I.J Nagarath, ―Basic Electrical and Electronics Engineering, McGraw Hill Education (India) Private Limited, Third Reprint ,2016

REFERENCES:

1. Elangovan A. ,Thinma VisaiIyal (Mechanics of Solids in Tamil), Anna University,Madras, 1995.
2. David A. Bell, "Electronic devices and circuits", Oxford University higher education, 5th Edition 2008.

Course code	21CH33T	Semester	III			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	FLUID MECHANICS FOR CHEMICAL ENGINEERS		3	0	0	3

COURSE OBJECTIVE:

- To acquire conceptual knowledge on fluid properties, fluid statics, fluid dynamics, fluid kinematics, flow measurement, pressure measurement, fluid flow devices and fluid machineries.

PREREQUISITE:

- Mechanics (Physics)
- Engineering mathematics (Differential and Integral calculus; Ordinary differential equations)

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C303.1	***Understand*** the fundamental properties of fluids and to ***apply*** the knowledge in flow analysis	K3
C303.2	***Apply*** the concept of fluid statics in pressure measurement using manometers	K3
C303.3	***Develop*** correlations for fluid motion and to apply in flow measurement while conveying and metering fluids	K3
C303.4	***Solve*** problems using empirical correlation developed using dimensional analysis and model analysis.	K3
C303.5	***Develop*** governing equations to laminar and turbulent flow conditions for internal and external flow.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C303.1	3	2	1	-	-	-	-	-	-	-	1	1	1	1	1
C303.2	3	2	1	-	-	-	-	-	-	-	1	1	1	1	1
C303.3	3	2	1	-	-	-	-	-	-	-	1	1	1	1	1
C303.4	3	2	1	-	-	-	-	-	-	-	1	1	1	1	1
C303.5	3	2	1	-	-	-	-	-	-	-	1	1	1	1	1

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION TO FLUID MECHANICS 9

Introduction to fluid mechanics, Properties of fluid, Viscosity based fluid classification, Continuum hypothesis, Properties of the Velocity Field, Basic flow analysis and techniques - Laminar, Turbulent, Compressible, Incompressible, Flow patterns, Introduction to Rheology.

UNIT II FLUID STATICS AND PRESSURE MEASUREMENT 9

Basic equation of fluid statics, Pressure-Depth relation, Pressure forces of surfaces, Buoyancy and Stability, Pressure measuring devices and Manometers – Simple manometers, Differential manometers.

UNIT III KINEMATICS & DYNAMICS OF FLUID FLOW 9

Mass balance, Continuity equation, Equation of motion, Bernoulli equation, Navier- Stokes equation, Pitot tube, Venturimeter, Orifice meter, Rotameter, Ultrasonic flow meter, Valves, Pumps and compressors.

UNIT IV DIMENSIONAL ANALYSIS AND MODEL ANALYSIS 9

Dimensional homogeneity, Dimensional analysis, Rayleigh method, Buckingham pi theorem, Forces acting in fluid flow and Dimensionless numbers, Similitude, Types of similarity, Model Laws.

UNIT V PRESSURE DROP MEASUREMENT AND FLUIDIZATION 9

Pressure drop, Viscous flow through circular pipe, Reynolds experiment, Major and Minor losses, laminar and turbulentboundary layer, Drag and friction factor, Flow around submerged objects, Flow through packed and fluidized bed, Introduction to CFD, Solving fluid flow problems using ASPEN HYSYS.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Noel de Nevers, "Fluid Mechanics for Chemical Engineers ", 3rd Edition, McGraw Hill, 2004.
2. White, F.M., "Fluid Mechanics ", 8th Edition, McGraw Hill, 2016.
3. Warren McCabe, Julian Smith, Peter Harriott, 'Unit operations in Chemical Engineering', 7th Edition, McGraw Hill 2014.

REFERENCES:

1. A Textbook of Fluid Mechanics and Hydraulic Machines, Revised 9th Edition, R.K.Bansal, Lakshmi Publications (P) Ltd.
2. https://nptel.ac.in/courses/103/103/103103147/
3. https://nptel.ac.in/courses/103/104/103104044/

Course code	21MA34T	Semester	III			
Category	BASIC SCIENCE COURSE(BSC)		L	T	P	C
CourseTitle	SERIES,TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (Common to Mechanical, Civil, Chemical & Biotechnology)		3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To develop Z transform techniques for discrete time systems.

PREREQUISITE:

- Mathematics skills at Sem-II level

COURSE OUTCOMES:

CO. No	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C304.1	***Understand*** how to solve the given standard partial differential equations.	K2
C304.2	***Solve*** differential equations using Fourier series analysis which plays a vital role in engineering applications.	K3
C304.3	***Appreciate*** the physical significance of Fourier series techniques in solving one- and two-dimensional heat flow problems and one-dimensional wave equations.	K2
C304.4	***Understand*** the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.	K2
C304.5	***Use*** the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C304.1	3	3	-	-	-	-	-	-	-	-	-	-
C304.2	3	2	-	-	-	-	-	-	-	-	-	-
C304.3	3	2	-	-	-	-	-	-	-	-	-	-
C304.4	3	2	-	-	-	-	-	-	-	-	-	-
C304.5	3	3	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 4**

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Introduction-Formation of partial differential equations Solutions of a partial differential equation-Linear Equations of the first order– Nonlinear equations of the first order Charpit's method Linear partial Differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 12

Introduction - Euler's Formulae - Conditions for a Fourier Expansion-Functions having points of discontinuity-Change of interval – Odd and even functions–Half range sine series–Half range cosine series–Parseval's Formula-Complex form of Fourier series–Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Introduction - Method of separation of variables–Vibrations of a stretched string-Wave equation [Fourier Series Method Only]– One dimensional equation of heat conduction–Steady state solution of two-dimensional equation of heat conduction - Laplace's equation in polar coordinates.

UNIT IV FOURIER TRANSFORMS 12

Introduction-Statement of Fourier integral theorem–Fourier transforms – Properties of Fourier transforms–Convolution theorem–Parseval's identity for Fourier transform-Relation between Fourier and Laplace transforms.

UNIT V TRANSFORMS AND DIFFERENCE EQUATIONS 12

Introduction – Definition of Z-transforms – Some standard Z-transforms–Damping rule-Some standard results-Shifting to the right and left – Multiplication by n-Initial and Final value theorem –Inverse Z-transform (using partial fraction and residues) – Convolution theorem–Convergence of Z-transforms-Evaluation of inverse Z-transforms [using partial and residue method only]-Application of difference equations.

Total:60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES:

1. Erwin Kreyszig,"Advanced Engineering Mathematics ",10th Edition, John Wiley, India, 2016.
2. B.V.Ramana, "Higher Engineering Mathematics", McGrawHill Education Pvt. Ltd, New Delhi, 2016.
3. Wylie, R.C.and Barrett,L.C.,"Advanced Engineering Mathematics",Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

Course code	21CH35T	Semester	III			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	CHEMICAL PROCESS INDUSTRIES		3	0	0	3

COURSE OBJECTIVES:

- This course aims at giving adequate exposure to students on the various inorganic and organic chemicals Producing industries

PREREQUISITE:

- Basic Chemistry and Principles of Chemical Engineering

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C305.1	***Understand*** the objectives of various chemical reactions, Unit operation and processes involved in the processes of Organic and In-organic Chemicals.	K2
C305.2	***Identify*** the process Flowsheet and the major engineering problems encountered in the processes.	K2
C305.3	***Understand*** and acquire thorough knowledge about chloro-alkali, Sulfur, Cement Fertilizer, and natural product industries.	K2
C305.4	***Understand*** and acquire thorough knowledge about petroleum and petrochemical industries, fuel and industrial gases.	K2
C305.5	***Understand*** and acquire thorough knowledge about fuels and industrial gases	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C305.1	3	2	-	-	-	-	-	-	-	-	-	1	1	-	-
C305.2	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-
C305.3	3	2	-	-	-	-	-	-	-	-	-	1	1	-	
C305.4	3	2	-	-	-	-	-	-	-	-	-	1	-	-	1
C305.5	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I CHLOROALKALI ,SULFUR, SULFURIC ACID AND CEMENT INDUSTRIES EXPLOSIVE INDUSTRIES, FIBRE INDUSTRIES 9

Chloro - alkali Industries: Manufacture of Soda ash, Manufacture of caustic soda and chlorine - common salt. Sulphur and Sulphuric acid: Mining of Sulphur and manufacture of sulphuric acid Cement – properties of Cement – Methods of production, Polyvinyl Chloride and copolymers-Nylon and Rubber-Manufacturing methods-liquid and solid propellants-hydrazine production.

UNIT II FERTILIZER INDUSTRY 9

Nitrogen Fertilizers; Synthetic ammonia, nitric acid, Urea, Phosphorous Fertilizers: Phosphate rock, phosphoric acid, single super phosphate (SSP) and Triple Super phosphate (TSP), Potassium: Potassium chloride, Potassium Sulphate.

UNIT III NATURAL PRODUCT INDUSTRIES 9

Production of pulp and paper, Manufacture of sugar, starch and starch derivatives- Refining of edible oils and fats, fatty acids, Food and Diary industries-maize production.

UNIT IV PETROLEUM AND PETRO CHEMICAL INDUSTRIES 9

Petroleum – Chemical Composition, Classification of crude petroleum, Petroleum Refinery products Petrochemicals – methanol, chloro methanol, Acetylene and ethylene, Isopropanol, Butadiane – Chemicals from Aromatics - Benzene, Toluene and Xylene.

UNIT V FUEL AND INDUSTRIAL GASES 9

Fuel Gases – Producer gas, Water gas, Coke oven gas, Natural gas, Liquefied natural gas – Industrial gases – Carbon dioxide, hydrogen, nitrogen and oxygen-Green Fuel Technologies.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Dryden, C.E., "Outlines of Chemicals Technology", Edited and Revised by Gopala Rao, M. And M.Sittig, 3rd Edition, Affiliated East-West press, 2010.
2. Moulin, J.A., M. Makkee, and Diepen, A.V., Chemical Process Technology, Wiley, 2001.

REFERENCES:

1. Austin, G.T., Shreve's "Chemical Process Industries", 5th ed., McGraw-Hill, 1998.
2. Srikumar Koyikkal, "Chemical Process Technology and Simulation", PHI Learning Ltd.

Course code	21MC01T	Semester	III			
Category	MANDATORY COURSE (MC)		L	T	P	C
Course Title	CONSTITUTION OF INDIA		2	0	0	0

COURSE OBJECTIVES:

- To understand the importance of constitution.
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court, controller and auditor general of India and election commission of India.

PREREQUISITE:

- Civic Knowledge.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C001.1	***Understand*** historical background of the constitutional making and its importance for building a democratic India, the structure of Indian government, the structure of state government, the local Administration	K2
C001.2	***Understand*** the directive principle of state policy, and strengthening of the constitutional institutions.	K2
C001.3	***Analyze*** the role of Governor and Chief Minister, role of state election commission, the decentralization of powers.	K2
C001.4	***Understand*** the Public Election Process.	K2
C001.5	***Know*** the Special Provisions for Various category of People.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C001.1	-	-	-	-	-	3	-	2	-	-	-	1	-	-	-
C001.2	-	-	-	-	-	2	-	2	-	-	-	1	-	-	-
C001.3	-	-	-	-	-	2	-	2	-	-	-	1	-	-	-
C001.4	-	-	-	-	-	1	-	2	-	-	-	1	-	-	-
C001.5	-	-	-	-	-	1	-	2	-	-	-	1	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 0**

UNIT I INTRODUCTION TO INDIAN CONSTITUTION 6

The Necessity of the Constitution, The Societies before and after the Constitution adoption. **Introduction to the Indian constitution,** The Making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India.

UNIT II FUNDAMENTAL RIGHTS AND DIRECTIVE PRINCIPLES 6

Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building. Directive Principles of State Policy (Art. 36-51).

UNIT III UNION EXECUTIVE AND STATE EXECUTIVE 6

Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Parliamentary Terminologies**.** Supreme Court of India, State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts.

UNIT IV ELECTIONS, AMENDMENTS AND EMERGENCY PROVISIONS 6

Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments Important Constitutional Amendments. Emergency Provisions, types of Emergencies and its consequences.

UNIT V DIRECTIVE PRINCIPLES & FUNDAMENTAL DUTIES 6

Fundamental Duties (Art. 51A), Basic Features of Constitution & Constitutional **special provisions:** Special Provisions for SC and ST, OBC, Women, Children and Backward Classes.

Total: 30 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. N. Shukla, Constitution of India, Eastern Book Agency, 2014.
2. P. Jain, Indian Constitutional Law, Lexis Nexis, 2013.
3. M. Seervai, Constitutional Law of India, Universal Law Publishing Co., Reprint 2013.

REFERENCES:

1. Glanville Austin, Indian Constitution – cornerstone of the Nations, Oxford University Press, 1999.
2. M. Bakshi, The Constitution of India, Universal Law Publishing Co., 2014.
3. D. Basu, Shorter Constitution of India (14^{th} Ed. 2008, reprint 2010).

Course code	21CH37P	Semester	III			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	FLUID MECHANICS LABORATORY		0	0	4	2

COURSE OBJECTIVE:

- To acquire practical knowledge on flow measurement, pressure measurement with the help of measuring devices and fluid machineries.

PREREQUISITE:

- Fluid Mechanics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C307.1	***Experiment with*** flow meters to verify discharge coefficients	K3
C307.2	***Determine*** energy losses for fluid flowing through pipes and packed columns	K3
C307.3	***Make use of*** empirical correlation to find power required	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C307.1	3	2	1	-	-	-	-	-	-	-	1	1	1	1	1
C307.2	3	2	1	-	-	-	-	-	-	-	1	1	1	1	1
C307.3	3	2	1	-	-	-	-	-	-	-	1	1	1	1	1

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 2**

LIST OF EXPERIMENTS

1. Finding discharge coefficient for flow of water through Venturimeter.
2. Finding discharge coefficient for flow of water through orifice meter.
3. Finding friction coefficient for flow of water through vertical annular pipe.
4. Finding friction coefficient for flow of water through helical coil and spiral coil.
5. Finding frictional losses for flow of water through long horizontal pipes.
6. Finding minor losses for flow of water through long horizontal pipes.
7. Calculating the power required to pump fluid using a centrifugal pump.
8. Calculating the power required to pump fluid using a reciprocating pump.
9. Pressure drop studies in packed column to verify Ergun equation.
10. Hydrodynamic studies in a fluidized bed column.
11. Verifying Bernoulli equation.
12. Calibrating a Rotameter.
13. Solving fluid flow problems using ASPEN HYSYS.

LEARNING RESOURCES:

TEXT BOOKS:

1. Noel de Nevers, "Fluid Mechanics for Chemical Engineers ", 3rd Edition, McGraw Hill, 2004.
2. White, F.M., "Fluid Mechanics ", 8th Edition, McGraw Hill, 2016.
3. Warren McCabe, Julian Smith, Peter Harriott, 'Unit operations in Chemical Engineering', 7th Edition, McGraw Hill 2014.

REFERENCES:

1. A Textbook of Fluid Mechanics and Hydraulic Machines, Revised 9th Edition, R.K.Bansal, Lakshmi Publications (P) Ltd.

LIST OF EQUIPMENT REQUIRED

S. No	Description of the equipment	Quantity
1.	Venturimeter	1 Nos.
2.	Orifice meter	1 Nos.
3.	Vertical annular pipe	1 Nos.
4.	Helical coil and Spiral coil	1 Nos.
5.	Frictional losses through long horizontal pipes	1 Nos.
6.	Minor through long horizontal pipes	1 Nos.
7.	Centrifugal pump	1 Nos.
8.	Reciprocating pump	1 Nos.
9.	Packed bed column	1 Nos.
10.	Fluidized bed column	1 Nos.
11.	Bernoulli apparatus	1 Nos.
12.	Rotameter	1 Nos.
Software		
1.	ASPEN HYSYS	30 Users

Course code	21HM38P	Semester	III			
Category	ENGINEERING SCIENCES COURSE (ESC)		L	T	P	C
Course Title	BASIC APPLIED ENGINEERING LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- To understand test procedures in testing material for engineering applications.
- To understand the Input and output Characteristics of diodes and Transistors.
- To measure electrical and physical quantities using meters and transducers.

PREREQUISITE:

- Engineering Physics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C308.1	***Identify*** material properties, their behavior under different kinds of loading and testing can be visualized	K3
C308.2	***Experiment*** with diodes and Transistor to understand their characteristics	K3
C308.3	***Analyze*** the electrical circuits and measure the electrical parameters.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO. No	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
C308.1	2	1	-	-	-	-	-	-	1	-	-	-	2	1	-
C308.2	2	1	-	-	-	-	-	-	1	-	-	-	2	1	-
C308.3	2	1	-	-	-	-	-	-	1	-	-	-	2	1	-

Note: 1: Slight 2: Moderate 3: Substantial

List of Experiments **No. of Credits: 2**

1. Tension test on a mild steel rod using UTM Machine.
2. Deflection test on beams.
3. Hardness test on metals – Brinell and Rockwell Hardness Number.
4. Torsion test on mild steel rod.
5. Impact test on metal specimen- Charpy method and Izod method.
6. Spring test- Compression test on the open Coil Helical Spring.
7. V-I Characteristics of PN junction diode and Zener Diode.
8. Characteristics of Photo Transistor.
9. Input and output characteristics of CE, CB and CC configurations.
10. Verification of ohm's law and Kirchhoff's law
11. Measurement of Strain gauge.
12. Measurement of Displacement using LVDT.

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. William A.Nash, Theory and Problems of Strength of Materials, Schaum's Outline Series. McGraw Hill International Editions, Third Edition, 1994.
2. D P Kothari and I.J Nagarath, ―Basic Electrical and Electronics Engineering‖, McGraw Hill Education(India) Private Limited, Third Reprint ,2016.

REFERENCES:

1. Dr.C.Balamurugan & Dr.K.Umamaheswari, Basic Electrical Electronics and Instrumentation Engineering, Sruthi Publishers, Chennai.

LIST OF EQUIPMENT REQUIRED

S.No.	Description of the equipment	Quantity
1	Universal tensile testing machine with double 1 shear attachment	1 No.
2	Torsion testing machine (60 NM Capacity)	1 No.
3	Impact testing machine (300 J Capacity)	1 No.
4	Brinell hardness testing machine	1 No.
5	Rockwell hardness testing machine	1 No.
6	Deflection testing machine	1 No.
7	Spring testing machine for tensile and compressive loads (2500 N)	1 No.
8	Resistors, Capacitors, Inductors, BJT Transistors, PN Junction diode, Zener diode, Photo diode, Photo transistor, Bread Boards (Sufficient quantities)	15 Nos. Each
9	LVDT 20 mm core length movable type	1 No.
10	Strain gauge Kit with handy lever beam	1 No.
11	Regulated power supply: 0 – 15 V D.C/Distributed power source	10 Nos.
12	AC/DC - Voltmeters, Ammeters and Multi-meters	10 Nos. Each
13	Decade resistance box, Decade inductance box, Decade capacitance box	10 Nos. Each

IV & V SEMESTER
CURRICULUM AND SYLLABI

Applicable to the students admitted to

B. TECH-CHEMICAL ENGINEERING

R-2021: CBCS

Academic year 2021-2022
onwards

VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

An Autonomous Institution

#60, Avadi – Vel Tech Road, Vel Nagar,
Avadi, Tamil Nadu 600062

VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

An Autonomous Institution

Approved by AICTE-New Delhi, Affiliated to Anna University, Chennai

Accredited by NBA, New Delhi & Accredited by NAAC with "A" Grade & CGPA of 3.27

B.Tech- Chemical Engineering (R2021)

SEMESTER IV										
S.No	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21CH41T	Chemical Engineering Thermodynamics I	PCC	40	60	100	3	0	0	3
2	21CH42T	Physical Chemistry	BSC	40	60	100	3	0	0	3
3	21CH43IT	Particle Mechanics	PCC	40	60	100	2	0	4	4
4	21MA44T	Numerical Methods	BSC	40	60	100	4	0	0	4
5	21CH45T	Instrumental Methods of Analysis	BSC	40	60	100	3	0	0	3
6	21CH46T	Environmental Science and Engineering	BSC	40	60	100	3	0	0	3
7	21MC03T	Essence of Indian Traditional Knowledge	MC	40	60	100	2	0	0	0
PRACTICAL										
8	21CH48P	Chemical and Technical Analysis Laboratory	PCC	40	60	100	0	0	4	2
9	21EE01P	Mini Project I	EEC	40	60	100	0	0	2	1
									TOTAL	**23**

VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

An Autonomous Institution

Approved by AICTE-New Delhi, Affiliated to Anna University, Chennai

Accredited by NBA, New Delhi & Accredited by NAAC with "A" Grade & CGPA of 3.27

Course code	21CH41T	Semester	IV			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	CHEMICAL ENGINEERING THERMODYNAMICS I		3	0	0	3

COURSE OBJECTIVES:

- Students will learn PVT behaviour of fluids, laws of thermodynamics, Thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.

PREREQUISITE:

- Engineering Mathematics, Engineering Chemistry, Physical Chemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C401.1	***Understand*** chemical engineering principles and zeroth law of thermodynamics.	K2
C401.2	***Apply*** equation of states and PVT behavior in fluids.	K3
C401.3	***Apply*** first law, second law and third law for open and closed systems.	K3
C401.4	***Apply*** thermodynamic relations and properties in chemical engineering.	K3
C401.5	***Apply*** the laws of thermodynamics to interpret the performance of power cycles.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C401.1	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C401.2	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
C401.3	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
C401.4	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
C401.5	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION TO THERMODYNAMICS 7

Scope of Thermodynamics, Work, Energy, Heat, System and Processes, Surroundings, Control volume, State and Path function, Equilibrium, Heat Reservoir and Heat Engine, Zeroth law.

UNIT II FIRST LAW AND PVT BEHAVIOUR 8

Joule's experiment, Internal energy, Enthalpy, Heat Capacity, First law for non-flow process, First law for flow process, PVT behavior of fluids; Equations of state and Ideal gas, Process involving ideal gasses, Equations of state for real gasses, Compressibility chart.

UNIT III SECOND LAW AND THIRD LAW 10

Second law of thermodynamics – Statements and Limitations, Carnot Principle, Heat engine, Thermodynamic temperature scale, Entropy and Entropy Calculation, Third law of thermodynamics.

UNIT IV THERMODYNAMIC PROPERTIES 10

Thermodynamic Properties, Helmholtz free energy, Gibbs free energy, Thermodynamic property relations - Exact Differential Equations, Fundamental Property Relations, Maxwell relations, Clapeyron Equation, Entropy–Heat Capacity Relation, Differential Equations for Entropy, Jacobian method.

UNIT V THERMODYNAMIC CYCLES 10

Pipe flow, Joule–Thomson Expansion, Refrigeration - Vapour-compression Cycle, Air-refrigeration Cycle, Liquefaction Processes, Steam-Power Plant - Rankine Cycle, Reheat Cycle, Regenerative Cycle.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Smith, J.M., Van Ness, H.C and Abbot M.M "Introduction to Chemical Engineering Thermodynamics ", McGraw Hill Publishers, VI edition, 2003
2. Narayanan, K.V. A Textbook of Chemical Engineering Thermodynamics Prentice Hall India, 2004.

REFERENCES:

1. Kyle, B.G., "Chemical and Process Thermodynamics III Edition", Prentice Hall of India Pvt. Ltd., 1999.
2. Elliott J.R., Lira, C.T., "Introductory chemical engineering thermodynamics", Prentice Hall, 1998
3. Rao, Y.V.C., "Chemical Engineering Thermodynamics" Universities Press,2005.

VEL TECH HIGH TECH

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Course code	21CH42T	Semester	IV			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	PHYSICAL CHEMISTRY		3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge in the fields of electrochemistry, phase equilibria, chemical reaction kinetics towards different applications.
- Use of catalyst and also the reactions stages involved in particular process operations.

PREREQUISITE:

- Engineering Chemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C402.1	***Understand*** the basic concepts in the field of electrochemistry and its applications.	K2
C402.2	***Relate*** the phase equilibria to different types of system and to study its significance.	K2
C402.3	***Enumerate*** the basic concept of distribution law and its applications.	K2
C402.4	***Understand*** basic principles involved in chemical reaction engineering.	K2
C402.5	***Explain*** the basic concept of adsorption and applications of catalyst in industries.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C402.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C402.2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C402.3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C402.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C402.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note:1: Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 3**

UNIT I ELECTROCHEMISTRY **9**

Electrical Resistance and Conductance – Specific Resistance and conductance – Equivalent conductance– Variation with dilution – Kohlrausch's law – Galvanic cells – EMF and its measurement – Reference electrode – Standard Hydrogen electrode – Nernst equation – Electrochemical series – Applications of EMF measurements.

UNIT II PHASE EQUILLIBRIA **9**

Phase - Components - Degrees of freedom - The Gibbs Phase rule - Derivation of the Phase rule - One Component system - The water System - The Sulphur System - Two Component system - Simple Eutectic System - Thermal analysis - cooling curves - Lead-Silver System - Desilverisation of Lead - Congruent and Incongruent Melting points.

UNIT III THE DISTRIBUTION LAW **9**

Distribution co-efficient - Distribution Law — Conditions for the validity of the Distribution law – I_2– CCl_4–H_2O System – Nature of interaction of the solute with one of the solvents – Dissociation- Association – Applications of Distribution law – Process of Extraction.

UNIT IV CHEMICAL KINETICS **9**

Rate equations – order of reaction – first order – second order – third order – zero order – pseudo order reactions – effect of temperature on reaction rate – concept of activation energy chain reactions – reactions in solutions – influence of ionic strength in rates of reactions.

UNIT V ADSORPTION AND CATALYSIS **9**

Physical and chemical adsorption – Types of adsorption isotherm, BET method, Gibbs equation, Homogeneous catalysis – Heterogeneous catalysis, acid – base catalysis, Enzyme catalysis – Applications of catalysis in industries.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Kund and Jain, Physical Chemistry, S. Chand and Company, New Delhi (2016).
2. Puri B. H. Sharma L.R. and M.S. Prathma, " Principles of Physical Chemistry", S. Chand and Company, New Delhi (2016)
3. B.S.Bahl, ArunBahl and G.D. Tuli, "Essentials of Physical Chemistry", S.Chand and Company, New Delhi (2020).

REFERENCES:

1. Gordon M. Barrow, Physical Chemistry, Sixth Edition, Tata McGraw Hill (2006).
2. Peters Atkins & Julio de Paula, Atkins' Physical Chemistry, 11th Edition, Oxford university press. (2018).

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Course code	21CH43IT	Semester	IV			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	PARTICLE MECHANICS		2	0	4	4

COURSE OBJECTIVE:

- To impact knowledge in the field of particle size reduction and also deals with the detail construction and working of equipment's used for mechanical operations.

PREREQUISITE:

- Principles of Chemical Engineering

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C403.1	***Understand*** the concept of size analysis, screening methods and equipment in chemical process industries.	K2
C403.2	***Classify*** the size reduction techniques of solids by selecting proper equipment such as crushers, grinders, etc.	K2
C403.3	***Apply*** the working principle differences of gravity settling tank, cyclone separators, filters and other mechanical separation devices.	K3
C403.4	***Explain*** the filtration equipment used for various chemical and its allied industries.	K2
C403.5	***Illustrate*** mixing and agitation equipment, power calculation for selection of mixing equipment, Storage and handling of particles.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C403.1	2	1	-	-	-	-	-	-	-	-	-	-	1	1	1
C403.2	2	1	-	-	-	-	-	-	-	-	-	-	1	1	1
C403.3	3	1	-	-	-	-	-	-	-	-	-	-	1	1	1
C403.4	2	1	-	-	-	-	-	-	-	-	-	-	1	1	1
C403.5	2	1	-	-	-	-	-	-	-	-	-	-	1	1	1

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 4**

UNIT I PARTICLE CHARACTERIZATION AND MEASUREMENT 6

General characteristics of solids, Particle shape and Particle size, shape factor, surface area determination, estimation of particle size. Advanced particle size analysis techniques.

UNIT II PARTICLE SIZE REDUCTION AND SIZE ENLARGEMENT 6

Laws of size reduction, energy relationships in size reduction, methods of size reduction, classification of equipments, crushers, grinders, disintegrators for coarse, intermediate and fine grinding, power requirement, work index; Advanced size reduction techniques - Nano particle fabrication.

UNIT III MECHANICAL SEPARATIONS (Gas-Solid and Liquid-Solid System) 6

Determination of Terminal settling velocity of particle, Gravity settling, sedimentation, thickening, elutriation, double cone classifier, rake classifier, bowl classifier. Centrifugal separation - continuous centrifuges, super centrifuges, design of basket centrifuges; industrial dust removing equipment.

UNIT IV FILTRATION AND FILTRATION EQUIPMENTS 6

Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipments - selection, operation and design of filters and optimum cycle of operation, filter aids.

UNIT V MIXING AND PARTICLE HANDLING 6

Mixing and agitation - Mixing of liquids (with or without solids), mixing of powders, selection of suitable mixers, power requirement for mixing. Storage and Conveying of solids - Bunkers, silos, bins and hoppers, transportation of solids in bulk.

Total: 30 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7thEdn., McGraw-Hill, 2005.
2. Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", Tata McGraw Hill,1997

REFERENCES:

1. Coulson, J.M. and Richardson, J.F. Chemical Engineering, Vol. II, 4th Edn., Asian Books Pvt. Ltd., India, 1998.
2. K.A.Gavhane.,"Unit Operation 1: Fluid Flow and Mechanical Operations ,25th Edition",2015

PARTICLE MECHANICS LABORATORY

LIST OF EXPERIMENTS:

1. Determination of Efficiency of screens
2. Size separation using Sub-Sieving
3. Determination of Reduction ratio in Jaw Crusher
4. Determination of Reduction ratio in Ball mill
5. Determination of Reduction ratio in Roll crusher
6. Determination of Reduction ratio in Drop weight crusher
7. Characteristics of batch Sedimentation
8. Separation characteristics of Cyclone separator
9. Separation characteristics of Elutriator
10. Batch filtration studies using a Leaf filter
11. Batch filtration studies using a Plate and Frame Filter press
12. Filtration studies using a Rotary drum Filter

Total: 60 Periods

OUTCOME:

Students would gain the practical knowledge and hands on various separation techniques like filtration, sedimentation, screening, elutriation, and centrifugation

LIST OF EQUIPMENTS:

Sl. No.	Description of Equipment	Quantity required
1	Sieve shaker	1
2	Jaw Crusher	1
3	Ball Mill	1
4	Roll Crusher	1
5	Drop Weight Crusher	1
6	Sieves	1
7	Sedimentation Jar	1
8	Cyclone Separator	1
9	Elutriator	1
10	Leaf filter	1
11	Plate and Frame Filter Press	1
12	Rotary drum filter	1

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Course code	21MA44T	Semester	IV			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	NUMERICAL METHODS (Common to CSE, Chemical and Civil)		3	1	0	4

COURSE OBJECTIVES:

- To provide the necessary basic concepts of a few numerical methods.
- To provide procedures for solving numerically different kinds of problems
- occurring in the field of Engineering and Technology.
- To acquaint the knowledge of various techniques and methods of solving ordinary
- differential equations.

PREREQUISITE:

- Basic knowledge of ordinary differential equations.
- Multivariable calculus.

COURSE OUTCOME:

CO No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C404.1	***Solve*** algebraic equations that arise during the study of Engineering problems	K3
C404.2	***Use*** various interpolation techniques for solving problems in Engineering.	K3
C404.3	***Apply*** the numerical techniques of differentiation and integration for engineering problems.	K3
C404.4	***Solve*** initial value problems numerically that arise in Science and Engineering.	K3
C404.5	***Solve*** boundary value problems that encounter in different fields of Engineering study	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
C404.1	2	1	1	1	-	-	-	-	-	-	-	-	-	-
C404.2	2	1	-	1	-	-	-	-	-	-	-	-	-	-
C404.3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C404.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C404.5	2	1	-	-	-	-	-	-	-	-	-	-	-	-

Note: - 1: Slight 2: Moderate 3: Substantial

SYLLABUS **No. of Credits: 4**

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT II INTERPOLATION AND APPROXIMATION 9+3

Interpolation with unequal intervals – Lagrange's interpolation – Inverse interpolation using Lagrange's method-Newton's divided difference interpolation –Interpolation with equal intervals – Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule and Simpson's 3/8 rule– Romberg's Method – Two point and three point Gausian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9+3

Taylor's series method - Picard's - Euler's method - Modified Euler's method -Runge - Kutta method - Milne's and Adams-Bashforth predictor corrector methods for solving first order equations

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9+3

Finite difference methods for solving second order two – point linear boundary value problems – Finite difference techniques for the solution of two dimensional Laplace's and Poison's equations on rectangular domain – One dimensional heat flow equation – Bender - Schmidt recurrence relation - Crank - Nicolson method – One dimensional wave equation by explicit method.

TOTAL: 60 PERIODS

LEARNING RESOURCES:

TEXT BOOKS:

1. Numerical methods with C++ programming by Nita H. Shah, PHI. 2009.
2. Grewal,B.S.,andGrewal,J.S.,"NumericalMethodsinEngineeringandScience",Khanna Publishers,10th Edition,NewDelhi,2015.
3. Burden,R.LandFaires,J.D,"NumericalAnalysis",9thEdition,CengageLearning,2016.

REFERENCES:

1. Numerical methods for engineers and scientists by Joe D. Hoffman. Marcel Dekker, Inc. 2001.
2. Numerical methods with programs in C by T. Veerarajan and T. Ramachandran. Tata McGraw-Hill. 2006.
3. SankaraRao.K.,"NumericalMethodsforScientistsandEngineers",PrenticeHallofIndiaPvt.Ltd ,3rdEdition,NewDelhi,2007.
4. Sastry,S.S,"IntroductoryMethodsofNumericalAnalysis",PHILearningPvt.Ltd,5thEdition,2015.

Course code	21CH45T	Semester	IV			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	INSTRUMENTAL METHODS OF ANALYSIS		3	0	0	3

COURSE OBJECTIVES:

- To make the students understand the working principles of different types of analytical instruments and their applications.

PREREQUISITE:

- Engineering Chemistry, Engineering Physics, Organic Chemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C405.1	***Understand*** the basic laws and components in spectrophotometer.	K2
C405.2	***Understand*** the principles of absorption and emission spectrometry.	K2
C405.3	***Understand*** the principles of UV and visible spectroscopy.	K2
C405.4	***Interpret*** various absorption and emission spectroscopic analysis.	K2
C405.5	***Understand*** various purification procedures using chromatographic techniques.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C405.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1
C405.2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1
C405.3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1
C405.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1
C405.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1

Note:1: Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION TO INSTRUMENTAL METHODS 9

Classification of instrumental basic function and its Techniques - Beer-Lambert's law, limitations, deviations (real, chemical, instrumental), estimation of inorganic ions such as Fe, Ni and estimation of nitrite using Beer -Lambert's law, multicomponent analysis (no overlap, single way overlap and two way overlap)

UNIT II ABSORPTION AND EMISSION SPECTROMETRY 9

Properties of electromagnetic radiation- wave properties – components of optical instruments –Sources of radiation. Molecular absorption spectrometry – Measurement of transmittance and absorbance – Instrumentation, applications and theory of fluorescence and Phosphorescence, Infrared spectrometry, Raman spectroscopy. Lasers- Nuclear and Electron spin behaviour.

UNIT III UV AND VISIBLE SPECTROCOPY 9

Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – types of optical instruments – Principle of Fourier Transform optical Measurements**.** UV and Visible Spectroscopy: Instrumentation (Source, Optical parts and Detectors) - Photometric titration-Quantitative methodology.

UNIT IV SPECTROSCOPIC METHODS OF ANALYSIS 9

Principles, instrumentation, interference and applications of Flame Photometry, Polarimetry, Refractometry, Nephelometry and Turbidimetry, Thermogravimetric Analysis (TGA), Atomic Absorption Spectroscopy (AAS) Inductively Coupled Plasma Atomic Emission Spectroscopy (ICPAES)

UNIT V CHROMATOGRAPHIC METHODS 9

Principle and theory of Chromatographic methods - Types (column, Thin layer, paper, Gas, High performance liquid Chromatographic methods)

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Sivasankar B., "Instrumental Methods of Analysis", Oxford University Press, 2012.
2. Instrumental Methods of Analysis. D.A. Skoog, F. James Holler, Stanky, R.Crouch . Cengage Learning – 2007.

REFERENCES:

1. Willard H.H, Merritt L.L, Dean J.A and Settle F.A, Instrumental method of analysis, 7th edition, Wadsworth Publishing Company, 1988.
2. Gurdeep R. Chatwal, Sharma K. Anand, Instrumental methods of Chemical Analysis, Himalaya Publishers, New Delhi, 2016
3. John R Dyer, Applications of Absorption Spectroscopy of Organic Compounds, Prenticehall of India Pvt. Ltd., 2012.

Course code	21CH46T	Semester	IV			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	ENVIRONMENTAL SCIENCE AND ENGINEERING (Only for Chemical Engineering)		3	0	0	3

COURSE OBJECTIVES:

- To study the nature, interrelationship between living organism and environment, biodiversity, natural resources, pollution control and waste management.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To appreciate the importance of environment by assessing its impact on the human world.

PREREQUISITE:

- Basic awareness on environment.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C406.1	***Illustrate*** the interrelationship between living organism and environment.	K2
C406.2	***Classify*** the dynamic processes and the features of natural resources.	K2
C406.3	***Relate*** public awareness, environmental pollution and its problem.	K2
C406.4	***Measure*** the development and improvement in standard of living.	K2
C406.5	***Summarize*** the knowledge about human health and welfare.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C406.1	1	-	-	-	-	-	1	-	-	-	-	-
C406.2	1	-	-	-	-	-	1	-	-	-	-	-
C406.3	2	-	-	-	-	-	1	-	-	-	-	-
C406.4	1	-	-	-	-	-	2	1	-	-	-	1
C406.5	1	-	-	-	-	-	1	1	-	-	-	1

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

Definition, scope and importance of environment-need for public awareness-concept of an ecosystem-structure and function of an ecosystem-producers, consumers and decomposers-energy flow in the ecosystem-ecological succession-food chains, food webs and ecological pyramids-Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)-Introduction to biodiversity definition: genetic, species and ecosystem diversity-biogeographical classification of India-value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values-Biodiversity at global, national and local levels-India as a mega-diversity nation-hot-spots of biodiversity-threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts-endangered and endemic species of India-conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Bio diversity and Health. Field study of common plants, insects, birds, etc., Field study of simple ecosystems -pond, river, hill slopes, etc.

UNIT II NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, Deforestation, Governance, case studies-timber extraction, mining, dams and their effects on forests and tribal people-Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems-Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies-Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies-Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies -Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification-role of an individual in conservation of natural resources. Field study of local area to document environmental assets-river/forest/grassland/hill/mountain.

UNIT III ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT 8

Definition-causes, effects and control measures of: (a) Air pollution (b) Water pollution(c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards, accidents and holocaust-solid waste management: causes, effects and control measures of municipal solid wastes-E waste and Scrap tyres-Recycling of Plastic, Glass and Paper wastes-role of an individual in prevention of pollution-pollution case studies-disaster management: floods, earthquake, cyclone and landslides- case studies. Field study of local polluted site-Urban/Rural/Industrial/Agricultural.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 8

From unsustainable to sustainable development-Equitable use of resources for sustainable lifestyles-urban problems related to energy-water conservation, rain water harvesting, watershed management-resettlement and rehabilitation of people; its problems and concerns, case studies-role of nongovernmental organization- environmental ethics: Issues and possible solutions-principles of green chemistry-climate change, global warming, acid rain, ozone layer depletion, case studies-wasteland reclamation-consumerism and waste products-environment protection act-Air

(Prevention and Control of Pollution) act-Water(Prevention and control of Pollution) act-Wildlife protection act-Forest conservation act-environmental impact assessment- enforcement machinery involved in environmental legislation-central and state pollution control boards-Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT **7**

Population growth, variation among nations-population explosion-family welfare programme-environment and human health-human rights-value education-women and child welfare-HIV/AIDS-SARS-Covid-19-role of information technology in environment and human health-Case studies.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill, New Delhi, 2014.
2. Anubha Kaushik, and Kaushik, C. P., Environmental Science and Engineering, New Age International Publishers, 6thEdition, 2019.

REFERENCES:

1. ErachBharucha, Textbook of Environmental Studies for Undergraduate Courses, 2nd Edition, University Grants Commission, Universities Press, 2013.
2. Gilbert Masters, Wendell Ela, Introduction to Environmental Engineering and Science, 3rdEdition, Pearson Education, 2015.
3. Tyler Miller, G., and Scott E. Spoolman, Environmental Science, Cengage Learning India Pvt. Ltd, Delhi, 2014.

Course code	21MC03T	Semester	IV			
Category	MANDATORY COURSE (MC)		L	T	P	C
Course Title	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE		2	0	0	0

COURSE OBJECTIVES:

- To get a knowledge for students about Indian Culture, Indian Languages and Literature religion and philosophy and the fine arts in India.
- Explore the Science and Scientists of Ancient, Medieval and Modern India.
- Understand education systems in India

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C003.1	***Understand*** philosophy of Indian culture.	K2
C003.2	***Infer*** the Indian languages and literature.	K2
C003.3	***Understand*** the philosophy of ancient, medieval and modern India	K2
C003.4	***Illustrate*** the information about the fine arts in India.	K2
C003.5	***Understand*** the contribution of scientists of different eras and education systems in India	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C003.1	-	-	-	-	-	3	-	-	2	-	-	1	-	-	-
C003.2	-	-	-	-	-	3	-	-	2	-	-	1	-	-	-
C003.3	-	-	-	-	-	3	-	-	2	-	-	1	-	-	-
C003.4	-	-	-	-	-	3	-	-	2	-	-	1	-	-	-
C003.5	-	-	-	-	-	3	-	-	2	-	-	1	-	-	-

Note:1: Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 0**

UNIT I INTRODUCTION TO CULTURE **6**

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India

UNIT II INDIAN LANGUAGES AND LITERATURE **6**

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature.

UNIT III RELIGION AND PHILOSOPHY **6**

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

UNIT IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) **6**

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India.

UNIT V EDUCATION SYSTEM IN INDIA **6**

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India.

Total: 30 Periods

LEARNING RESOURCES:

REFERENCES:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014.

Course code	21CH48P	Semester	IV			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	CHEMICAL AND TECHNICAL ANALYSIS LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- To train the students on basic principles involved in estimation and characterization of industrially important materials.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C408.1	***Estimate*** the various properties soap, oil cement and coal	K2
C408.2	***Estimate*** the various properties of fuels and quality of water and glycerol.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO. No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C408.1	3	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C408.2	3	-	-	-	-	-	-	-	-	-	-	-	1	1	1

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 2**

LIST OF EXPERIMENTS

1. Estimation of total fatty acid in given soap sample.
2. Estimation of percentage alkali content in given soap sample.
3. Estimation of free acid in given oil.
4. Determination of Saponification value and iodine value in given oil.
5. Estimation of Silica content in cement.
6. Estimation of mixed oxide content in cement.
7. Estimation of calcium oxide content in cement.
8. Estimation of Sulphur present in coal.
9. Estimation of available chlorine in bleaching powder.
10. Determination of Flash point and Fire point in given sample.
11. Determination of Cloud point and Pour point in given sample.
12. Determination of Aniline point for given sample.
13. Determination of molecular weight of the polymer by viscometry.
14. Estimation of purity of glycerol by dichromate method.
15. Determination of calorific value using bomb calorimeter.

Total: 60 Periods

***Minimum 12 experiments shall be offered**

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity required
1	Silica Crucible	5
2	Heating Mantle	4
3	Muffle Furnace	1
4	Hot air oven	1
5	Desiccator	3
6	Reflux Condenser	4
7	Pensky martens closed cup apparatus	1
8	Cleveland open cup apparatus	1
9	Cloud point apparatus	1
10	Aniline point apparatus	1
11	Saybolt / Redwood Viscometer	1
12	Bomb Calorimeter / Junkers gas Calorimeter	1

LEARNING RESOURCES:

REFERENCES:

1. Environmental pollution analysis, S.M.Khopkar, New age international. 2011
2. Manual of environmental analysis, N.C Aery, Ane books. 2014
3. Vogel's Textbook of Quantitative Chemical Analysis, J Mendham & M Thomas, Pearson Publications, 2015.

Course code	21EE01P	Semester	IV			
Category	EMPLOYABILITY ENHANCEMENT COURSE (EEC)		L	T	P	C
Course Title	MINI PROJECT – I		0	0	2	1

COURSE OBJECTIVES:

- To introduce project based learning

PREREQUISITE:

- All Core Courses

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C001.1	***Evaluate*** specific problem statements for ill-defined real-life problems with reasonable assumptions and constraints.	K5
C001.2	***Perform*** literature search and / or patent search in the area of interest	K3
C001.3	***Conduct*** experiments / design and analysis / solution iterations and document the results/ Perform error analysis	K4
C001.4	***Synthesize*** the results and arrive at scientific conclusions / products / solution	K4
C001.5	***Document*** the results in the form of technical report / presentation	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C001.1	3	3	2	2	2	1	1	1	3	2	2	2	2	2	2
C001.2	3	3	2	2	2	1	1	1	3	2	2	2	2	2	2
C001.3	3	3	2	2	2	1	1	1	3	2	2	2	2	2	2
C001.4	3	3	2	2	2	1	1	1	3	2	2	2	2	2	2
C001.5	3	3	2	2	2	1	1	1	3	2	2	2	2	2	2

Note: 1: Slight; 2: Moderate; 3: Substantial

DOMAINS

Students are advised to carryout the projects in the following domains, but not limited with

- Bioprocess engineering
- Biofuel
- Waste water treatment
- Petroleum and Petrochemicals
- Electrochemical
- Pharmaceutical
- Drug discovery
- Waste management
- Biofertilizer
- Colloids
- Green chemistry
- Design
- Chemical safety and security program.

Total: 30 Periods

ONLINE RESOURCES

1. https://swayam.gov.in/nc_details/NPTEL
2. https://www.sciencedirect.com/
3. https://www.elseivert.com/
4. https://www.pubs.acs.org/

VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

An Autonomous Institution

Approved by AICTE-New Delhi, Affiliated to Anna University, Chennai

Accredited by NBA, New Delhi & Accredited by NAAC with "A" Grade & CGPA of 3.27

SEMESTER V										
S. No	**Course Code**	**Course Title**	**Category**	**CIE Marks**	**SEE Marks**	**Total marks**	**Credits**			
							L	**T**	**P**	**C**
THEORY										
1	21CH51T	Heat Transfer	PCC	40	60	100	3	0	0	3
2	21CH52T	Mass Transfer I	PCC	40	60	100	3	0	0	3
3	21CH53T	Chemical Reaction Engineering I	PCC	40	60	100	3	0	0	3
4	21CH54T	Process Instrumentation, Dynamics and Control	PCC	40	60	100	3	0	0	3
5	-	Professional Elective I	PEC	40	60	100	3	0	0	3
6	-	Open Elective I	OEC	40	60	100	3	0	0	3
PRACTICAL										
7	21CH57P	Heat Transfer Laboratory	PCC	40	60	100	0	0	4	2
8	21CH58P	Process Control Laboratory	PCC	40	60	100	0	0	4	2
9	21EE03P	Technical Seminar	EEC	100	-	100	0	0	2	1
									TOTAL	**23**

Course code	21CH51T	Semester	V			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	HEAT TRANSFER		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to learn heat transfer by conduction, convection and radiation and heat transfer equipments like evaporator and heat exchangers.

PREREQUISITE:

- Engineering Mathematics, Fluid Mechanics.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C501.1	***Solve*** numerical problems on conduction and extended surface heat transfer applying steady state heat conduction equations.	K3
C501.2	***Solve*** numerical problems on convection heat transfer over flat plates, for flow through pipes and packed beds.	K3
C501.3	***Solve*** numerical problems on condensation and boiling heat transfer using governing equations.	K3
C501.4	***Solve*** numerical problems on radiation heat transfer between surfaces using the governing laws & equations.	K3
C501.5	***Apply*** heat transfer laws and equations for equipments used in process industries.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3
C501.1	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
C501.2	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
C501.3	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
C501.4	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
C501.5	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 3**

UNIT I CONDUCTION **9**

Steady state conduction – Fourier's law, thermal conductivity, conduction through composite multilayer plane walls, cylindrical walls, insulation and critical thickness of insulation, heat conduction in rods with heat generation. Heat transfer in extended surfaces - equation for heat transfer in rectangular fins, fin effectiveness and fin efficiency.

UNIT II CONVECTION **9**

Principles of heat transfer in fluids - laminar flow and boundary layer theory in heat transfer, heat transfer in turbulent flow, eddy thermal diffusivity, prandtl mixing length theory. Dimensional analysis in heat transfer. heat transfer coefficient for flow through a pipe, flow through a non circular conduit, flow past flat plate and flow through packed beds. Heat transfer by natural convection.

UNIT III CONDENSATION AND BOILING **9**

Heat transfer to fluids with phase change - heat transfer from condensing vapours, drop wise and film wise condensation, Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours, effect of non-condensable gasses on rate of condensation. Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling.

UNIT IV RADIATION **9**

Radiation heat transfer - Emissive power, Black body radiation, Emissivity, Stefan - Boltzmann law, Plank's law, radiation between surfaces, View factor calculations - view factor for infinitely parallel grey planes, view factor from a plane to a hemisphere, Radiation in absorbing gases.

UNIT V HEAT TRANSFER EQUIPMENTS **9**

Heat exchange equipments - Double pipe and shell and tube heat exchangers, concept of Log Mean Temperature Difference (LMTD), LMTD correction factor, overall heat transfer coefficient, dirt factor, heat exchanger effectiveness. Evaporators - single effect and multiple effect evaporators, boiling point rise, capacity and economy of multiple effect evaporators, evaporation equipments.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Holman, J. P., 'Heat Transfer ', 8th Edn., McGraw Hill, 1997.
2. Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill, 1984
3. Kern, D.Q., "Process Heat Transfer ", McGraw-Hill, 1999

REFERENCES:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 6th Edn., McGraw-Hill, 2001.
2. Coulson, J.M. and Richardson, J.F., "Chemical Engineering "Vol. I, 4th Edn., Asian ooks Pvt. Ltd., India, 1998.

Course code	21CH52T	Semester	V			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	MASS TRANSFER I		3	0	0	3

COURSE OBJECTIVES:

- Students will learn to determine mass transfer rates under laminar and turbulent conditions.

PREREQUISITE:

- Engineering Mathematics, Principles of Chemical engineering, Chemical Process Calculations.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C502.1	***Apply*** the principles of law of diffusion to estimate rate of mass transfer and mass transfer coefficients	K3
C502.2	***Understand*** the theories of mass transfer, different transport analogies and Inter phase mass transfer	K2
C502.3	***Utilize*** the concepts of humidification in mass transfer operations.	K3
C502.4	***Identify*** suitable drier for industrial applications using rate of drying.	K3
C502.5	***Apply*** mass and energy balance calculations in crystallization	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3
C502.1	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
C502.2	2	1	-	-	-	-	-	-	-	-	-	-	3	3	3
C502.3	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
C502.4	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
C502.5	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 3**

UNIT I MOLECULAR DIFFUSION **9**

Introduction to mass transfer operations; Molecular diffusion in gases, liquids and solids,diffusivity measurement and prediction; multi-component diffusion.

UNIT II MASS TRANSFER COEFFICIENTS **9**

Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients. NTU and NTP concepts, Stage-wise and differential contractors.

UNIT III HUMIDIFICATION **9**

Humidification – Equilibrium, humidity chart, adiabatic and wet bulb temperatures; humidification operations; theory and design of cooling towers, dehumidifiers and humidifiers using enthalpy transfer unit concept.

UNIT IV DRYING **9**

Drying– Equilibrium; classification of dryers; batch drying – Mechanism and time of cross through circulation drying, continuous dryers – material and energy balance; determination of length of rotary dryer using rate concept.

UNIT V CRYSTALLIZATION **9**

Crystallization - Equilibrium, classification of crystallizers, mass and energy balance; kinetics of crystallization – nucleation and growth; design of batch crystallizers population balance model and design of continuous crystallizers.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Treybal, R.E., “Mass Transfer Operations”, 3rd Edn, McGraw-Hill, 1981.
2. Geankoplis, C.J., “Transport Processes and Unit Operations”, 4th Edition, Prentice Hall Inc., New Jersey, 2003.
3. McCabe, W.L., Smith, J.C., and Harriot, P., “Unit Operations in Chemical Engineering”, 7th Edn., McGraw-Hill, 2005.

REFERENCES:

1. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. I and II, 4th Edition, Asian Books Pvt. Ltd., India, 1998.
2. J.D. Seader and E.J. Henley, “Separation Process Principles”, 2nd Ed., John Wiley, 2006.
3. Binay K. Dutta, ”Principles of Mass Transfer and Separation Processes”, PHI Learning Ltd, 2013.

Course code	21CH53T	Semester	V			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	CHEMICAL REACTION ENGINEERING I		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on different types of chemical reactors, the design of chemical reactors under isothermal and non-isothermal conditions

PREREQUISITE:

- Engineering Mathematics, Chemical Process Calculations, Physical Chemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C503.1	***Classify*** the elementary reaction from a non-elementary reaction and perform analysis of kinetic data	K2
C503.2	***Apply*** the different type of reactors design in the combination of ideal reactors.	K3
C503.3	***Make use of*** multiple reactions for the design of reactors.	K3
C503.4	***Develop*** the design of non-isothermal homogeneous reactors	K3
C503.5	***Solve*** residence time distribution functions and model non-ideal flow reactors	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3
C503.1	2	1	-	-	-	-	-	-	-	-	-	-	3	3	3
C503.2	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
C503.3	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
C503.4	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
C503.5	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 3**

UNIT I KINETICS OF HOMOGENEOUS REACTIONS 9

Rate equation, elementary, non-elementary reactions, theories of reaction rate and Prediction; Design equation for constant and variable volume batch reactors, analysis of experimental kinetics data, integral and differential analysis.

UNIT II IDEAL REACTORS 9

Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors, Comparison of different size of CSTRs and PFRs in series and parallel.

UNIT III MULTIPLE REACTIONS 9

Multiple reactions - consecutive, parallel and mixed reactions - factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield.

UNIT IV NON ISOTHERMAL REACTORS 9

Non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges in different reactors, operation of batch and continuous reactors, optimum temperature progression.

UNIT V RTD STUDIES 9

Residence time distribution factor of performance, functions and relationship between them in reactor; basic models for non-ideal flow-Dispersion model; conversion in non-ideal reactors.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Levenspiel O, “Chemical Reaction Engineering”, Wiley Eastern Ltd., Third Edition, 2006.
2. Smith, J.M, “Chemical Engineering Kinetics”, McGraw Hill, III Edition, 1981.
3. Fogler. H. S., “Elements of Chemical Reaction Engineering”, Prentice Hall of India Ltd., Fifth Edition, 2016.

REFERENCES:

1. Froment. G.F. & K.B.Bischoff, “Chemical Reactor Analysis and Design”, John Wiley and Sons, 2010.

Course code	21CH54T	Semester	V			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	PROCESS INSTRUMENTATION, DYNAMICS AND CONTROL		3	0	0	3

COURSE OBJECTIVES:

- To introduce open and closed loop systems and its responses, control loop components and stability of control systems along with instrumentation.

PREREQUISITE:

- Engineering Mathematics and Principles of Chemical Engineering.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C504.1	***Understand*** the constructional details, principle of operation, and performance of different unit operations and their Instrumentation.	K2
C504.2	***Apply*** Laplace transformation in process control system and transportation lag.	K3
C504.3	***Use*** block diagrams to help determine system response characteristics and stability of control systems	K3
C504.4	***Apply*** frequency response techniques and methods of controller tuning.	K3
C504.5	***Outline*** the process control strategies for advanced control systems.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3
C504.1	2	-	-	-	1	-	-	-	-	-	-	-	2	2	2
C504.2	3	2	-	-	1	-	-	-	-	-	-	-	2	2	2
C504.3	3	2	-	-	1	-	-	-	-	-	-	-	2	2	2
C504.4	3	2	-	-	1	-	-	-	-	-	-	-	2	2	2
C504.5	2	-	-	-	1	-	-	-	-	-	-	-	2	2	2

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INSTRUMENTATION **9**

Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rare, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

UNIT II OPEN LOOP SYSTEMS **9**

Laplace transformation and its application in process control. First order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.

UNIT III CLOSED LOOP SYSTEMS **9**

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability.

UNIT IV FREQUENCY RESPONSE **9**

Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, bode diagram, stability criterion, tuning of controllers Z-N tuning rules, C-C tuning rules.

UNIT V ADVANCED CONTROL SYSTEMS **9**

Introduction - Feedback control of systems with dead time and inverse response. Control systems with multiple loops. Advanced Control Schemes, Feed forward, ratio control. Control of distillation towers and heat exchangers.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Coughnowr, D., " Process Systems Analysis and Control ", 3rd Edn., McGraw Hill, New York, 2008.
2. Stephanopoulos, G., "Chemical Process Control", Prentice Hall of India, 2003.

REFERENCES:

1. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp , Process dynamics and control I - 2nd ed. John Wiley & Sons, Inc.
2. Marlin, T. E., " Process Control ", 2nd Edn, McGraw Hill, New York, 2000.
3. Smith, C. A. and Corripio, A. B., "Principles and Practice of Automatic Process Control", 2nd Edn., John Wiley, New York, 1997.
4. Donald P. Eckman, "Automatic Process Control", Wiley India Pvt Ltd, 2009.

Course code	21CH551PT	Semester	V			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	PETROLEUM REFINING AND PETROCHEMICALS		3	0	0	3

COURSE OBJECTIVES:

- Students will gain knowledge about petroleum refining process and production of petrochemical products.

PREREQUISITE:

- Chemical Process Industries

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5501.1	***Develop*** overview of petroleum processing and know about the origin, composition, formation and fractionation of crude in to useful petroleum products.	K2
C5501.2	***Describe*** various thermal and catalytic cracking operations.	K2
C5501.3	***Demonstrate*** different techniques used for treatment of various products.	K2
C5501.4	***Enumerate*** and distinguish among the different reforming Processes.	K2
C5501.5	***Illustrate*** and explain the production of various petrochemicals from refining by-products	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3
C5501.1	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5501.2	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5501.3	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5501.4	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5501.5	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION TO PETROLEUM REFINING 9

Origin, Formation and Evaluation of Crude Oil. Testing of Petroleum Products. Refining of Petroleum – Atmospheric and Vaccum Distillation.

UNIT II CRACKING PROCESS 9

Cracking, Thermal Cracking, Vis-breaking, Catalytic Cracking (FCC), Hydro Cracking, Coking and Air Blowing of Bitumen.

UNIT III TREATMENT PROCESSES 9

Treatment Techniques: Removal of Sulphur Compounds in all Petroleum Fractions to improve performance, Solvent Treatment Processes, Dewaxing, Clay Treatment and Hydrofining.

UNIT IV SECONDARY PROCESSES 9

Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylene, Isobutylene and Butadiene. Production of Acetylene from Methane, Catalytic Reforming of Petroleum Feed Stocks and Extraction of Aromatics.

UNIT V PETROCHEMICAL PROCESSES 9

Production of Petrochemicals like Dimethyl Terephathalate (DMT), Ethylene Glycol, Synthetic Glycerine, Linear Alkyl Benzene (LAB), Acrylonitrile, Methyl Methacrylate (MMA), Vinyl Acetate Monomer, Phthalic Anhydride, Maleic Anhydride, Phenol and Acetone, Methanol, Formaldehyde,Acetaldehyde, Pentaerythritol and Production of Carbon Black.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Nelson, W. L., “Petroleum Refinery Engineering”, 4th Edn., McGraw Hill, New York, 1985.
2. Bhaskara Rao, B. K., “Modern Petroleum Refining Processes”, 2nd Edn., Oxford and IBH Publishing Company, New Delhi, 1990.

REFERENCES:

1. Wiseman. P., Petrochemicals, UMIST Series in Science and Technology.
2. Bhaskara Rao, B. K. “A Text on Petrochemicals”, 1st Edn., Khanna Publishers, New Delhi, 1987

Course code	21CH552PT	Semester	V			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	FOOD TECHNOLOGY		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to learn to design processing equipments for Food Industries.

PREREQUISITE:

- Chemical Process Industries

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5502.1	***Understand*** about the general aspects of food industry, world food needs.	K2
C5502.2	***Demonstrate*** about food constituents, quality and deteriorative factors and their control.	K2
C5502.3	***Describe*** about general engineering aspects and processing methods incorporated in food industries.	K2
C5502.4	***Enumerate*** about various techniques involved in food preservation.	K2
C5502.5	***Understand*** about the production and utilization of food products.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PS01	PSO2	PSO3
C5502.1	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5502.2	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5502.3	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5502.4	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5502.5	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 3**

UNIT I AN OVERVIEW **9**

General aspects of food industry; world food needs and Indian situation.

UNIT II FOOD CONSTITUENTS, QUALITY AND DERIVATIVE FACTORS **9**

Constituents of food; quality and nutritive aspects; food additives; standards; Properties of food, deteriorative factors and their control.

UNIT III GENERAL ENGINEERING ASPECTS AND PROCESSING METHODS **9**

Preliminary processing methods; conversion and preservation operations.

UNIT IV FOOD PRESERVATION METHODS **9**

Preservation by heat and cold; dehydration; concentration; drying irradiation; microwave heating; sterilization and pasteurization; fermentation and pickling; packing methods.

UNIT V PRODUCTION AND UTILISATION OF FOOD PRODUCTS **9**

Cereal grains; pulses; vegetables; fruits; spices; fats and oils; bakery; confectionery and chocolate products; soft and alcoholic beverages; dairy products; meat; poultry and fish products

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Heid J.L. Joslyn M.A., Fundamentals of Food Processing Operation, The AVI publishing Co., West port 1967.
2. Potter N.N., Food Science, The AVI publishing Co., Westport, 1963.

REFERENCES:

1. Heldman D.R., Food Process Engineering, The AVI publishing co., 1975.
2. Charm S.E., The Fundamentals of Foods Engineering, The AVI Publishing Co., Westport, 1963.

Course code	21CH553PT	Semester	V			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	ELECTRO CHEMICAL ENGINEERING		3	0	0	3

COURSE OBJECTIVES:

- Students will gain knowledge about electrochemical process and its application.

PREREQUISITE:

- Engineering Chemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5503.1	***Understand*** the basics of electro chemistry and electrochemical process.	K2
C5503.2	***Understand*** the application of mass transfer in electrochemical process.	K2
C5503.3	***Describe*** different types of corrosion and its control methods.	K2
C5503.4	***Enumerate*** various types electrochemical processes	K2
C5503.5	***Demonstrate*** types of electrodes used in various industries	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PS01	PSO2	PSO3
C5503.1	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5503.2	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5503.3	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5503.4	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5503.5	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 3**

UNIT I BASICS PRINCIPLES AND LAWS IN ELECTROCHEMISTRY 9

Review basics of electrochemistry: Faraday's law - Nernst potential –Galvanic cells – Polarography, The electrical double layer: 94It's role in electrochemical processes – Electrocapillary curve – Helmoltz layer – Guoy –Steven's layer – fields at the interface

UNIT II MASS TRANSPORT 9

Mass transfer in electrochemical systems: diffusion controlled electrochemical reaction –the importance of convention and the concept of limiting current. over potential, primary-secondary current distribution –rotating disc electrode.

UNIT III CORROSION PROBLEMS 9

Introduction to corrosion, series, corrosion theories derivation of potential-current relations of activities controlled and diffusion controlled corrosion process. Potential-pH diagram, Forms of corrosion definition, factors and control methods of various forms of corrosion-corrosion control measures industrial boiler water corrosion control –protective coatings –Vapor phase inhibitors – cathodic protection, sacrificial anodes –Paint removers

UNIT IV ELECTROCHEMICAL APPLICATIONS 9

Electro deposition – electro refining – electroforming – electro polishing – anodizing –Selective solar coatings, Primary and secondary batteries –types of batteries, Fuel cells.

UNIT V ELECTRODES 9

Electrodes used in different electrochemical industries: Metals-Graphite –Lead dioxide –Titanium substrate insoluble electrodes –Iron oxide – semi conducting type etc. Metal finishing-cell design. types of electrochemical reactors, batch cell, fluidized bed electrochemical reactor, filter press cell, Swiss roll cell, plug flow cell, design equation, figures of merits of different type of electrochemical reactors.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Picket, " Electrochemical Engineering ", Prentice Hall. 1977.
2. Newman, J. S., " Electrochemical systems ", Prentice Hall, 1973.

REFERENCES:

1. Barak, M. and Stevenge, U. K., " Electrochemical Power Sources - Primary and Secondary Batteries" 1980
2. Mantell, C., " Electrochemical Engineering ", McGraw Hill, 1972.

VEL TECH HIGH TECH

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Course code	21CH554PT	Semester	V			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	FUNDAMENTALS OF NANOTECHNOLOGY		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to learn about basis of nanomaterial science, preparation method, types and application

PREREQUISITE:

- Engineering Chemistry and Engineering Physics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5504.1	***Understand*** the fundamentals of Nanoscience and technology	K2
C5504.2	***Understand*** the general method of preparing nanomaterials.	K2
C5504.3	***Classify*** nanomaterials based on properties and applications.	K2
C5504.4	***Interpret*** characterization of nanomaterials using various techniques.	K2
C5504.5	***Extend*** the applications of nanomaterials in various domains.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PS01	PSO2	PSO3
C5504.1	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5504.2	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5504.3	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5504.4	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5504.5	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION **9**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering Classifications of nano structured materials- nano particles- quantum dots, nano wires-ultra-thin films-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.

UNIT II GENERAL METHODS OF PREPARATION **9**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS **9**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides- ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites.

UNIT IV CHARACTERIZATION TECHNIQUES **9**

X-ray diffraction technique, Scanning Electron Microscopy – environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS Nano indentation.

UNIT V APPLICATIONS **9**

Nano InfoTech: Information storage- nano computer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging – Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp (Editor), “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia (Editor),“The Hand Book of Nano Technology,Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

VEL TECH HIGH TECH

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Course code	21CH555PT	Semester	V			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	FERTILIZER TECHNOLOGY		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to learn the fertilizer manufacturing including new or modified fertilizer products and new techniques.

PREREQUISITE:

- Chemical Process Industries

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5505.1	***Understand*** various methods of production of nitrogenous fertilizers	K2
C5505.2	***Explain*** the manufacturing methods of nitrogen and phosphate fertilizers	K2
C5505.3	***Explain*** the production methods of potassium fertilizers	K2
C5505.4	***Explain*** the production methods of complex and NPK fertilizers	K2
C5505.5	***Understand*** manufacturing techniques of mixed and bio fertilizers	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PS01	PSO2	PSO3
C5505.1	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5505.2	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5505.3	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5505.4	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
C5505.5	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 3**

UNIT I NITROGENOUS FERTILISERS **9**

Methods of production of nitrogenous fertilizer-ammonium sulphate, nitrate, urea and calcium ammonium nitrate; ammonium chloride and their methods of production, characteristics and specifications, storage and handling.

UNIT II PHOSPHATIC FERTILISERS **9**

Raw materials; phosphate rock, sulphur; pyrites etc., processes for the production of sulphuric and phosphoric acids; phosphates fertilizers – ground rock phosphate; bone meal-single superphosphate, triple superphosphate, triple superphosphate, thermal phosphates and their methods of production, characteristics and specifications.

UNIT III POTASSIC FERTILISERS **9**

Methods of production of potassium chloride, potassium schoenite, their characteristics and specifications.

UNIT IV COMPLEX AND NPK FERTILISERS **9**

Methods of production of ammonium phosphate, sulphate diammonium phosphate, nitrophosphates, urea, ammonium phosphate, mono-ammonium phosphate and various grades of NPK fertilizers produced in the country.

UNIT V MISCELLANEOUS FERTILISERS **9**

Mixed fertilizers and granulated mixtures; biofertilisers, nutrients, secondary nutrients and micro nutrients; fluid fertilizers, controlled release fertilizers, controlled release fertilizers.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. "Handbook of fertilizer technology", Association of India, New Delhi, 1977.
2. Menno, M.G.; "Fertilizer Industry - An Introductory Survey", Higgin bothams Pvt. Ltd., 1973.

REFERENCES:

1. Sauchelli, V.; "The Chemistry and Technology of Fertilizers", ACS MONOGRAPH No. 148, Reinhold Publishing Cor. New York, 1980.
2. Fertiliser Manual, "United Nations Industrial Development Organisation", United Nations, New York, 1967.
3. Slack, A.V.; Chemistry and Technology of Fertilisers, Interscience, New York, 1966.

VEL TECH HIGH TECH

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Course code	21CH01OT	Semester	V			
Category	OPEN ELECTIVE COURSES (OEC)		L	T	P	C
Course Title	PRINCIPLES OF CHEMICAL ENGINEERING		3	0	0	3

COURSE OBJECTIVES:

- To understand the overall view of the chemical engineering subjects.

PREREQUISITE:

- Engineering chemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C001.1	***Acquire*** knowledge on what is Chemical Engineering	K2
C001.2	***Understand*** the basic concepts in Chemical engineering	K2
C001.3	***Acquire*** knowledge on unit operations and fluidization	K2
C001.4	***Acquire*** knowledge on Heat and Mass transfer	K2
C001.5	***Know*** the scope and opportunities in the field of chemical engineering	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PS01	PSO2	PSO3
C001.1	3	2	-	-	-	-	-	-	-	-	-	1	1	1	1
C001.2	3	2	-	-	-	-	-	-	-	-	-	1	1	1	1
C001.3	3	2	-	-	-	-	-	-	-	-	-	1	1	1	1
C001.4	3	2	-	-	-	-	-	-	-	-	-	1	1	1	1
C001.5	3	2	-	-	-	-	-	-	-	-	-	1	1	1	1

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits:3**

UNIT I INTRODUCTION TO CHEMICAL ENGINEERING 9

Definition of Chemical Engineering and Chemical Engineers; Chemical Engineering –a general purpose study, Relationship between Chemical Engineering and Science of Chemistry, Historical Development of Chemical Engineering, History and Personalities of Chemical Engineering; Greatest achievements of Chemical Engineering.

UNIT II BASIC CONCEPTS OF CHEMICAL ENGINEERING 9

Components of Chemical Engineering: Role of Mathematics, Physics, Chemistry and Biology; Basic Concepts of Chemical Engineering: Basic Stoichiometric relations, Thermodynamics of Chemical reactions, Chemical reaction Engineering and its applications, Separation processes, Process dynamics, design and control and its applications. Anatomy of Chemical Engineering Plant; visit to chemical industry.

UNIT III UNIT OPERATIONS AND UNIT PROCESSES 9

Physico-Chemical Calculations; Concept of Unit processes and Unit operations; Conservation of mass and energy ; Fluids - Fluid Static's and application in chemical Engineering- laminar and turbulent flow- Fluidization.

UNIT IV HEAT TRANSFER AND MASS TRANSFER 9

Heat transfer - conduction, convection and radiation –conduction problems- heat transfer equipment; Diffusion - Mass transfer operation Relative volatility- Distillation - Terminology for Gas-Liquid mass transfer operations –Adsorption

UNIT V SCOPE AND OPPORTUNITY IN CHEMICAL ENGINEERING 9

Role of Computer in Chemical Engineering; Process control systems in Chemical Engineering; Traditional vs. modern Chemical Engineering; Relation between Chemical Engineering and other engineering disciplines- Food, Medical, Energy, Environmental, Biochemical, Electronics etc. Opportunities for Chemical Engineers; Future of Chemical Engineering.

Total: 45 Periods

LEARNING RESOURCES

TEXT BOOKS

1. Salil K. Ghosal, Siddhartha Datta "Introduction to Chemical Engineering" Tata McGraw-Hill Education
2. Badger W.L. and Banchero J.T., “Introduction to Chemical Engineering”, 6th Edition, Tata McGraw Hill, 1997.
3. Introduction to Chemical Engineering by ‘Uche P Nnaji’ –Wiley Publications,2019.
4. Dryden, C.E., “Outlines of Chemicals Technology”, Edited and Revised by Gopala Rao, M. And M.Sittig, 3rd Edition, Affiliated East-West press, 2010.

REFERENCES

1. McCabe, W.L., Smith, J. C. and Harriot, P. “Unit operations in Chemical Engineering”, McGraw Hill, 7th Edition, 2001
2. Finlayson, B. A., Introduction to Chemical Engineering Computing, John Wiley & Sons, New Jersey, 2006.

VEL TECH HIGH TECH

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Course code	21CH02OT	Semester	V			
Category	OPEN ELECTIVE COURSES (OEC)		L	T	P	C
Course Title	PROCESS MODELING AND SIMULATION		3	0	0	3

COURSE OBJECTIVES:

- To give an overview of various methods of process modeling, different computational techniques for simulation.

PREREQUISITE:

- Engineering Mathematics and Principles of chemical engineering

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C002.1	***Describe*** principles of models for simple systems in Chemical Engineering.	K2
C002.2	***Apply*** modeling in steady state lumped systems	K3
C002.3	***Analyse*** simulation on unsteady state lumped systems	K3
C002.4	***Analyse*** steady state distributed system.	K3
C002.5	***Analyse*** unsteady state distributed system & other modelling approaches.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PS01	PSO2	PSO3
C002.1	2	1	-	-	1	-	-	-	-	-	-	-	2	2	2
C002.2	3	2	-	-	1	-	-	-	-	-	-	-	2	2	2
C002.3	3	2	-	-	1	-	-	-	-	-	-	-	2	2	2
C002.4	3	2	-	-	1	-	-	-	-	-	-	-	2	2	2
C002.5	3	2	-	-	1	-	-	-	-	-	-	-	2	2	2

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits:3**

UNIT I INTRODUCTION **9**

Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT II STEADY STATE LUMPED SYSTEMS **9**

Degree of freedom analysis, single and network of process units, systems yielding linear and non-linear algebraic equations, flow sheeting – sequential modular and equation-oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.

UNIT III UNSTEADY STATE LUMPED SYSTEMS **9**

Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.

UNIT IV STEADY STATE DISTRIBUTED SYSTEM **9**

Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT V UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES **9**

Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor, hierarchy in model development, classification and solution of partial differential equations. Empirical modeling, parameter estimation, population balance and stochastic modeling.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Ramirez, W.; " Computational Methods in Process Simulation ", 2nd Edn., Butterworths Publishers, New York, 2000.
2. Luyben, W.L., " Process Modelling Simulation and Control ",2nd Edn, McGraw-Hill Book Co., 1990

REFERENCES:

1. Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes", John Wiley, 2000.
2. Franks, R. G. E., "Mathematical Modeling in Chemical Engineering", John Wiley, 1967.
3. Amiya K. Jana, "Process Simulation and Control Using ASPEN", 2nd Edn, PHI Learning Ltd (2012).

SOFTWARES:

- Aspen plus, Aspen hysys, Matlab, DWSIM, PROSIM.

Course code	21CH03OT	Semester	V			
Category	OPEN ELECTIVE COURSES (OEC)		L	T	P	C
Course Title	ENERGY MANAGEMENT AND AUDIT		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to understand the energy management, different energy systems, and energy auditing.

PREREQUISITE:

- Environmental science and Engineering

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C003.1	***Understand*** energy management policies, methods and planning.	K2
C003.2	***Summarize*** energy audit and economic analysis.	K2
C003.3	***Demonstrate*** the assess energy management control schemes	K2
C003.4	***Outline*** energy utilization in various utility systems.	K2
C003.5	***Understand*** and select energy security and reliability methods	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PS01	PSO2	PSO3
C003.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C003.2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C003.3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C003.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C003.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits:3**

UNIT I INTRODUCTION **9**

The value of Energy management, suggested principles of energy management. Effective Energy Management: Energy Policy and planning.

UNIT II ENERGY AUDITING AND ECONOMIC ANALYSIS **9**

Energy auditing services, Basic components of an energy audit, Carbon audit, Industrial, commercial and residential audits, General characteristics of capital investments, project measures of worth. Boilers and fired systems, Steam and condensate systems, Cogeneration, Waste heat recovery.

UNIT III ENERGY SYSTEMS **9**

Energy management control systems, System integration, recent development, energy systems maintenance – Material handling maintenance.

UNIT IV ENERGY CONSERVATION IN MAJOR UTILITIES **9**

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V ENERGY SECURITY AND RELIABILITY **9**

Risk analysis methods, economics of energy security and reliability, links to energy management.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Energy Management, Murphy W.R and Mckay G., Elsevier, 2007.
2. Energy Management Handbook, Wayne C. Turner, Steve Doty, CRC Press., 2007, 6thEdition.

REFERENCES:

1. Energy Engineering and Management, Amlan Chakrabarti, PHI, Eastern Economy Edition, 2018, 2nd Edition.
2. Energy Management Principles, Craig B. Smith Kelly Parmenter, Elsevier, 2015, 2ndEdition.

Course code	21CH04OT	Semester	V			
Category	OPEN ELECTIVE COURSES (OEC)		L	T	P	C
Course Title	PROCESS PLANT UTILITIES		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to understand the process plant utilities and optimization techniques to optimize various parameters in chemical industries.

PREREQUISITE:

- Chemical Engineering Thermodynamics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C004.1	***Understand*** the methods of treatment of water and Effects of impure Boiler feed water.	K2
C004.2	***Explain*** the Properties of Steam, Types of Steam Generator and Accessories	K2
C004.3	***Compare*** and explain the Refrigeration Cycles, Methods of Refrigeration used in Industry and Refrigerants	K2
C004.4	***Illustrate*** the working of Compressors, Equipment's used for Humidification, Dehumidification and Cooling Towers.	K2
C004.5	***Describe*** the types of Fuel used in Chemical Process Industries for Power Generation and waste disposal	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PS01	PSO2	PSO3
C004.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C004.2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C004.3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C004.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C004.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits:3**

UNIT I IMPORTANT OF UTILITIES **9**

Hard and Soft water, Requisites of Industrial Water and its uses. Methods of water Treatment such as Chemical Softening and Demineralization, Resins used for Water Softening and Reverse Osmosis. Effects of impure Boiler Feed Water.

UNIT II STEAM AND STEAM GENERATION **9**

Properties of Steam, problems based on Steam, Types of Steam Generator such as Solid Fuel Fired Boiler, Waste Gas Fired Boiler and Fluidized Bed Boiler. Scaling and Trouble Shooting. Steam Traps and Accessories.

UNIT III REFRIGERATION **9**

Refrigeration Cycles, Methods of Refrigeration used in Industry and Different Types of Refrigerants such as Mono Chlorodifluro Methane, Chlorofluro Carbons and Brins. Refrigerating Effects and Liquefaction Processes.

UNIT IV COMPRESSED AIR **9**

Classification of Compressor, Reciprocating Compressor, Single Stage and Two Stage Compressor, Velocity Diagram for Centrifugal Compressor, Silp Factor, Impeller Blade Shape. Properties of Air –Water Vapors and use of Humidity Chart. Equipments used for Humidification, Dehumidification and Cooling Towers.

UNIT V FUEL AND WASTE DISPOSAL **9**

Types of Fuel used in Chemical Process Industries for Power Generation such as Natural Gas, Liquid Petroleum Fuels, Coal and Coke. Internal Combustion Engine, Petrol and Diesel Engine. Waste Disposal.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Eckenfelder, W. W, Jr. “Industrial Water Pollution Control” McGraw-Hill: New York, 1966.
2. P. L. Ballaney, “Thermal Engineering”, Khanna Publisher New Delhi, 1986.
3. Perry R. H. Green D. W. “Perry’s chemical Engineer’s Handbook”, McGraw Hill, New York, 2007.

REFERENCES:

1. P. N. Ananthanarayan, “Basic Refrigeration & Air conditioning”, Tata McGraw Hill, New Delhi, 2007.

Course code	21CH57P	Semester	V			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	HEAT TRANSFER LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- To enable the students to develop a sound working knowledge on different types of heat transfer equipments.

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PREREQUISITE:

- Heat Transfer, Chemical Process Calculations

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C507.1	***Determine*** thermal conductivity, heat transfer coefficients and emissivity for heat transfer equipments.	K3
C507.2	***Determine*** and compare heat transfer rate for heat exchangers, evaporators, condensers, packed bed columns, helical coils and agitated vessels.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PS01	PSO2	PSO3
C507.1	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
C507.2	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3

Note:1:Slight,2: Moderate,3:Substantial

SYLLABUS **No. of Credits: 2**

LIST OF EXPERIMENTS

1. Determine heat transfer coefficient for a double pipe heat exchanger.
2. Determine heat transfer coefficient for a shell and tube heat exchanger.
3. Determine heat transfer coefficient for a finned tube heat exchanger.
4. Determine thermal conductivity heat transfer rate for a composite wall.
5. Determine heat transfer rate during forced / natural convection.
6. Determine Stefan Boltzmann constant during heat transfer by radiation.
7. Determine emissivity during heat transfer by radiation.
8. Determine heat transfer rate for a open pan evaporator
9. Determine heat transfer rate for a single effect evaporator.
10. Determine heat transfer coefficient during boiling heat transfer.
11. Determine heat transfer coefficient for a packed bed column.
12. Determine heat transfer coefficient for a condenser.
13. Determine heat transfer rate in a helical Coil.
14. Determine heat transfer coefficient for agitated vessel.

Total: 60 Periods

*Minimum 12 experiments shall be offered

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl.No.	Description of Equipment	Quantity required
1	Double Pipe Heat Exchanger	1
2	Shell and Tube heat exchanger	1
3	Bare and Finned Tube Heat Exchanger	1
4	Composite wall set up	1
5	Natural convection set up or Forced convection set up	1
6	Stefan Boltzmann Apparatus	1
7	Emissivity measurement set up	1
8	Open Pan Evaporator	1
9	Single effect evaporator or Multiple effect evaporator	1
10	Boiler	1
11	Packed Bed	1
12	Vertical Condenser or Horizontal Condenser	1
13	Helical Coil	1
14	Agitated Vessel	1
15	Jacketed vessel	1

LEARNING RESOURCES:

REFERENCES:

1. Kern, D.Q., “Process Heat Transfer “, McGraw-Hill, 1999
2. Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill, 1984

Course code	21CH58P	Semester	V			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	PROCESS CONTROL LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- To determine experimentally the methods of controlling the processes including measurements using process simulation techniques.

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PREREQUISITE:

- Process Instrumentation, Dynamics and Control

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C508.1	***Develop*** and use of right type of control dynamics for process control under different operative conditions.	K3
C508.2	***Determine*** experimentally various controlling process measurements using process simulation techniques.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PS01	PSO2	PSO3
C508.1	3	2	-	-	2	-	-	-	-	-	-	-	2	2	2
C508.2	3	2	-	-	2	-	-	-	-	-	-	-	2	2	2

Note:1:Slight, 2: Moderate,3:Substantial

List of Experiment **No. of Credits: 2**

LIST OF EXPERIMENTS

1. Response of first order system
2. Response of second order system
3. Response of Interacting and Non-Interacting level system
4. Response of Interacting level system
5. Open loop study on a thermal system
6. Closed loop study on a level system
7. Closed loop study on a flow system
8. Closed loop study on a thermal system
9. Tuning of a level system
10. Tuning of a pressure system
11. Tuning of a thermal system
12. Flow co-efficient of control valves
13. Characteristics of different types of control valves
14. Closed loop study on a pressure system
15. Closed loop response of cascade control system
16. Optimum Controller Tuning using Ziegler Nichols method

Total: 60 Periods

*Minimum 12 experiments shall be offered

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity required
1	U tube manometer with controller	1
2	Interacting Tank	1
3	Non Interacting Tank	1
4	Open loop control system	1
5	Closed loop control system	1
6	ON/OFF controller	1
7	Control valve characteristics	1
8	Pressure Tuner	1
9	Temperature Tuner	1
10	Proportional Controller	1
11	Flow Transmitter	1
12	Level Transmitter	1
13	Cascade control system	1

LEARNING RESOURCES:

REFERENCES:

1. Coughnowr, D., “Process Systems Analysis and Control “, 3rd Edn., McGraw Hill, New York, 2008.
2. Stephanopoulos, G., “Chemical Process Control“, Prentice Hall of India, 2003.

Course code	21EE03P	Semester	V			
Category	EMPLOYABILITY ENHANCEMENT COURSE (EEC)		L	T	P	C
Course Title	TECHNICAL SEMINAR		0	0	2	1

COURSE OBJECTIVES:

- To inculcate the habit of critical thinking
- To emphasise the importance of reading and effective writing
- To expose meta-disciplinary research works
- To cultivate a scholarly habit

PREREQUISITE:

- Professional Communication Skill and Technical Writing Skill

COURSE OUTCOMES:

CO. No.	Course Outcome	Blooms level
On successful completion of this Course, students will be able to		
C003.1	***Define*** a compelling and viable problem, question, or project by exploring the purpose and philosophy on topics in technology	K2
C003.2	***Learn*** to infuse material from primary and secondary sources with their own ideas in research papers	K2
C003.3	***Understand*** the stages of writing process which strengthens the technical and workplace writing tasks	K2
C003.4	***Demonstrate*** ability to synthesize and assess arguments in scholarly articles and monographs professionally	K3
C003.5	***Develop*** Presentation and Communication skills.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PS01	PSO2	PSO3
C003.1	2	2	-	-	-	-	-	-	3	2	-	2	2	2	2
C003.2	2	2	-	-	-	-	-	-	3	2	-	2	2	2	2
C003.3	2	2	-	-	-	-	-	-	3	2	-	2	2	2	2
C003.4	2	2	-	-	-	-	-	-	3	2	-	2	2	2	2
C003.5	2	2	-	-	-	-	-	-	3	2	-	2	2	2	2

Note: 1: Slight; 2: Moderate; 3: Substantial

Students are advised to carry out Presentation in the following domains, but not limited with

- Bioprocess engineering
- Biofuel
- Waste water treatment
- Electrochemical
- Pharmaceutical
- Drug discovery
- Waste management
- Biofertilizer
- Colloids
- Green chemistry
- Design
- Chemical safety and security program.

Total: 30 Periods

ONLINE RESOURCES

1. https://swayam.gov.in/nc_details/NPTEL
2. https://www.sciencedirect.com/
3. https://www.elseivert.com/
4. https://www.pubs.acs.org/

List of Professional Elective Courses

S. No.	Course Code	Engineering Stream Courses
Professional Elective-I		
1	21CH551PT	Petroleum Refining and Petrochemicals
2	21CH552PT	Food Technology
3	21CH553PT	Electro Chemical Engineering
4	21CH554PT	Fundamentals Of Nanotechnology
5	21CH555PT	Fertilizer Technology
Professional Elective-II		
6	21CH651PT	Air Pollution and Control
7	21CH652PT	Energy Management and Audit
8	21CH653PT	Bio-Fuel Technology
9	21CH654PT	Wastewater Treatment Technology
10	21CH655PT	Waste Management
Professional Elective-III		
11	21CH751PT	Environmental Impact Assessment
12	21CH752PT	Project Engineering
13	21CH753PT	Material Technology
14	21CH754PT	Pulp and Paper Technology
15	21CH755PT	Industrial Safety Management
Professional Elective-IV		
16	21CH811PT	Total Quality Management
17	21CH812PT	Optimization of Chemical Processes
18	21CH813PT	Modern Separation Techniques
19	21CH814PT	Professional Ethics
20	21CH815PT	Polymer Technology
Professional Elective-V		
21	21CH821PT	Piping and Instrumentation
22	21CH822PT	Pharmaceutical Technology
23	21CH823PT	Process Plant Utilities
24	21CH824PT	Enzyme Engineering
25	21CH825PT	Hydrocarbon Engineering

LIST OF OPEN ELECTIVE COURSES

S.NO.	COURSE CODE	COURSE TITLE
1	21CH01OT	Principles of Chemical Engineering
2	21CH02OT	Process Modelling and Simulation
3	21CH03OT	Energy Management and Audit
4	21CH04OT	Process Plant Utilities