SRI VENKATESWARA COLLEGE OF ENGINEERING,

(An Autonomous Institution, Affiliated to Anna University, Chennai – 600025)

B.Tech., Chemical Engineering

CURRICULUM AND SYLLABUS

REGULATION – 2022

CHOICE BASED CREDIT SYSTEM

Curriculum Revision No:	00	Board of Studies recommendation date :	19.09.2023	Academic Council Approved date:	18.10.2023
Salient Points of the revision	01.				
	02.				
	03.				
	04.				
	05.				

SRI VENKATESWARA COLLEGE OF ENGINEERING,

(An Autonomous Institution, Affiliated to Anna University, Chennai – 600025)

REGULATIONS 2022

B.Tech., CHEMICAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Equip students with the necessary skills and knowledge to prosper in their career in Chemical Engineering and related domains.

PEO 2: Encourage students to Pursue advanced learning and engage in research with internationally acclaimed institutions and foster professional growth.

PEO 3: Empower students with leadership qualities to succeed in diversified fields with ethical administrative acumen and adapt to the rapid technological advancements and innovations.

PROGRAM OUTCOMES (PO's)

PO GRADUATE ATTRIBUTES

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Apply the knowledge of science and mathematics in the field of various transport processes to accomplish the contemporary needs of chemical and allied industries.
2. Execute the chemical engineering principles and modern engineering tools to conduct experiments or design a system for developing quality chemical processes by considering the cost, safety and environmental aspects.

PEO's – PO's & PSO's MAPPING:

PO's	PEOs		
	I	II	III
1.	3	3	2
2.	3	3	3
3.	3	3	3
4.	3	3	2
5.	3	3	2
6.	2	3	3
7.	2	2	3
8.	2	1	2
9.	2	2	1
10.	1	2	1
11.	3	2	2
12.	1	1	2
13.	3	3	2
14.	2	2	3

1- Slight (Low), 2- Moderate (Medium) , 3- Substantial (High)

SRI VENKATESWARA COLLEGE OF ENGINEERING

(An Autonomous Institution, Affiliated to Anna University, Chennai – 600025)

REGULATIONS 2022

CHOICE BASED CREDIT SYSTEM

B.Tech., CHEMICAL ENGINEERING

CURRICULUM AND SYLLABI FOR SEMESTERS I TO IV

SEMESTER I

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK				Total Hours	Pre-requisite	Position
				L	T	P	C			
1	IP22151	Induction Program								
THEORY SUBJECTS										
2	HS22152	Communicative English (Common to all Branches)	HS	3	0	0	3	45		F
3	MA22151	Applied Mathematics I (Common to all Branches except MR)	BS	3	1	0	4	60		F
4	PH22153	Technical Physics (Common to BT and CH)	BS	3	0	0	3	45		F
5	CY22153	Technical Chemistry (Common to BT and CH& CE)	BS	3	0	0	3	45		F
6	ME22152	Basic Mechanical Engineering (Common to BT and CH)	ES	3	0	0	3	45		F
7	ME22151	Engineering Graphics (Common to BT and CH)	ES	2	0	2	3	60		F
8	HS22151	Tamil language and Heritage of Ancient Tamil Society (Common to all Branches)	MC	1	0	0	1	15		F
PRACTICAL SUBJECTS										
9	CY22161	Chemistry Laboratory (Common to all Branches)	BS	0	0	2	1	30		F
10	ME22162	Basic Mechanical Laboratory (Common to BT and CH)	BS	0	0	2	1	30		F
		TOTAL					**22**			

SEMESTER II

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK				Total Hours	Pre - requisite	Position
				L	T	P	C			
THEORY SUBJECTS										
1	HS22252	Technical English (Common to all Branches)	HS	3	0	0	3	45		F
2	MA22251	Applied Mathematics II (Common to all Branches except MR)	BS	3	1	0	4	60		F
3	EE22251	Basic Electrical and Electronics Engineering for Chemical Engineers	ES	3	0	0	3	45		F
4	IT22251	Computer Programming and Practice (Common to AE/BT/CE/CH/ME)	ES	2	0	2	3	60		F
5	CH22201	Introduction to Chemical Engineering	PC	3	0	0	3	45		F
6	HS22251	Science and Technology in Ancient Tamil Society (Common to all branches)	MC	2	0	0	2	30		F
PRACTICAL SUBJECTS										
7	EE22111	Basic Electrical and Electronics Engineering Laboratory (Common to all Branches)	ES	0	0	2	1	30		F
8	PH22161	Physics Laboratory (Common to all Branches)	BS	0	0	2	1	30		F
TOTAL							**20**			

SEMESTER III

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK				Total Hours	Pre - requisite	Position
				L	T	P	C			
THEORY SUBJECTS										
1	MA22351	Applied Mathematics III (Common to BT, CH, CE, EE, EC and ME)	BS	3	1	0	4	60		F
2	CH22301	Chemical Process Calculations	PC	2	1	0	3	45		F
3	CH22302	Momentum Transfer	PC	2	1	0	3	45		F
4	CH22303	Chemical Engineering Thermodynamics I	PC	3	0	0	3	45		F
5	CH22304	Mechanical Operations	PC	2	1	0	3	45		F
6	CH22305	Mechanics of Solids for Chemical Engineering	PC	2	1	0	3	45		F
PRACTICAL SUBJECTS										
7	CH22311	Environmental Engineering Laboratory	PC	0	0	4	2	60		F
8	CH22312	Technical Analysis Laboratory	BS	0	0	4	2	60		F
TOTAL							**23**			

SEMESTER IV

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK				Total Hours	Pre - requisite	Position
				L	T	P	C			
THEORY SUBJECTS										
1	MA22452	Numerical Methods (Common to CH and EE)	BS	3	1	0	4	60		F
2	CH22408	Chemical Engineering Thermodynamics II: Theory and Practice	PC	2	0	2	3	60		F
3	CH22401	Heat Transfer	PC	2	1	0	3	45		M
4	CH22402	Mass Transfer I	PC	2	1	0	3	45		F
5	CH22403	Chemical Reaction Engineering I	PC	2	1	0	3	45		F
6	CH22404	Instrumental Methods of Analysis	PC	3	0	0	3	45		M
7	GE22451	Environmental Science and Sustainability (Common to all branches)	MC	3	0	0	3	45		F
PRACTICAL SUBJECTS										
8	CH22411	Momentum Transfer Laboratory	PC	0	0	4	2	60		F
9	CH22412	Mechanical Operations Laboratory	PC	0	0	4	2	60		F
TOTAL							**25**			

SEMESTER I

HS22152	COMMUNICATIVE ENGLISH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. Enable learners to interact fluently on everyday social contexts.
2. Train learners to engage in conversations in an academic/scholarly setting.
3. Instil confidence in learners to overcome public speaking barriers.
4. Develop learners' ability to take notes and in the process, improve their listening skills
5. Enhance learners' reading skill through reading text passages for comprehension and contemplation.
6. Improve learners' skills to write on topics of general interest and drafting correspondences for general purposes.

UNIT I		9

Listening - short video clips - conversational scenes form movies, celebrities' speeches /interviews. Speaking - several ways of introducing oneself at several situations, introducing others at several situations, inviting people for several occasions, describing people and their places. Reading - short comprehension passages - making inferences, critical analysis. Writing - completing the incomplete sentences - developing hints from the given information. Grammar - Wh-Questions and Yes or No questions - Parts of speech. Vocabulary development - prefixes - suffixes - articles - countable / uncountable nouns.

UNIT II		9

Listening - customer care voice files, short narratives - identifying problems and developing telephone etiquettes. Speaking - speaking over skype/ whatsapp, making business calls, making self-recorded informative videos, inquiring about a concept/activity, describing a concept/activity. Reading - reading the headlines on news magazines - slogans and taglines from advertisements. Writing - free writing - writing - headlines, slogans and taglines individual inspirations. Grammar- conjunctions, idioms, phrases, quotes. Vocabulary development - guessing the meanings of words in different contexts.

UNIT III		9

Listening - courtroom scenes from movies, debates and talks from news channels, notes taking. Speaking- language and tone for arguments, discussion, deliberation, contemplation, expressing opinions, reacting to different situations in an alien country. Reading - language used in instruction manuals of household appliances, cookery and other basic instructions. Writing- understanding the structure of texts - use of reference words, discourse markers- coherence, rearranging the jumbled sentences. Grammar - adjectives - degrees of comparison, framing direct and indirect questions. Vocabulary development - concise approach, single word substitution.

UNIT IV		9

Listening - Sports commentaries, advertisements with users' criticisms; Speaking - for social causes, for promoting a concept, negotiating and bargaining; Reading - review of a product, movie, movement or a system; Writing - writing for advertisements, selling a product; Grammar – Tenses - Simple Past, Present and Future, Continuous - Past, Present and Future; Vocabulary Development - synonyms, antonyms and phrasal verbs.

UNIT V		9

Listening - video lectures, video demonstration of a concept; Speaking – presenting papers/concepts, delivering short speeches, discourses on health, suggesting natural home remedies, cleanliness, civic sense and responsibilities; Reading - columns and articles on home science; Writing - correspondences of requests, basic enquiry/observation and basic complaints; Grammar - modal verbs, perfect tenses - Vocabulary development - collocations.

TOTAL: 45 PERIODS

REFERENCES:

1. Department of English, Anna University, Mindscapes: English for Technologists and Engineers. Orient Black Swan, Chennai, 2017.

2. Downes and Colm,; Cambridge English for Job-hunting Cambridge University Press, New Delhi, 2008.

3. Murphy and Raymond, Intermediate English Grammar with Answers Cambridge University

4. Press, 2000. Thomson, A.J., Practical English Grammar 1& 2, Oxford, 1986.

Websites

1. http://www.usingenglish.com

2. http://www.uefap.com3

3. https://owl.english.purdue.edu/owl/

4. www.learnenglishfeelgood.com/esl-printables-worksheets.html

Software

1. Face 2 Face Advance – Cambridge University Press, 2014.

2. English Advance Vocabulary- Cambridge University Press.

3. IELTS test preparation – Cambridge University Press 2017.

4. Official Guide to the TOEFL Test With CD-ROM, 4th Edition.

5. Cambridge Preparation for the TOEFL TEST- Cambridge University Press**, 2017.**

OUTCOMES

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1	Acquire adequate vocabulary for effective communication	**3**
CO2	Listen to formal and informal communication and read articles and infer meanings from specific contexts from magazines and news papers.	**3**
CO3	Participate effectively in informal/casual conversations; introduce themselves and their friends and express opinions in English.	**4**
CO4	Comprehend conversations and short talks delivered in English.	**6**
CO5	Write short write-ups and personal letters and emails in English	**6**

COURSE ARTICULATION MATRIX

CO	PO's														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.										**3**			**3**		
2.										**3**			**3**		
3.										**3**			**3**		
4.										**3**			**3**		
5.										**3**			**3**		

MA22151	APPLIED MATHEMATICS I	L	T	P	C
	(Common to all Branches except MR)	**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

The Student should be made to:

1. Compute Eigen values and Eigen vectors and use in diagonalization and in classifying real quadratic forms.
2. Study differential calculus and its applications to relevant Engineering problems .
3. Compute derivatives using the chain rule or total differentials.
4. Understand the rotation of two dimensional geometry using definite integrals.
5. Acquaint with the Mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I	. **MATRICES**	**12**

Eigen values and Eigen vectors of a real matrix – Characteristic equation –Properties of Eigen values and Eigen vectors – Statement and Applications of Cayley-Hamilton Theorem – Diagonalization of matrices– Reduction of a quadratic form into canonical form by orthogonal transformation-Nature of quadratic forms

UNIT II	**APPLICATION OF DIFFERENTIAL CALCULUS**	**12**

Curvature and radius of Curvature– Centre curvature – Circle of curvature –Evolutes– Envelopes- Evolute as Envelope of Normals

UNIT III	**DIFFERENTIAL CALCULUS FOR SEVERAL VARIABLES**	**12**

Limits and Continuity - Partial derivatives – Total derivatives – Differentiation of implicit functions – Jacobians 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 IV	**APPLICATION OF DEFINTE INTEGRALS**	**12**

Integration by Parts-Bernoulli's formula for integration- Definite integrals and its Properties- Solids of Revolution- Disk Method- Washer Method- Rotation about both x and y axis and Shell method

UNIT V	**MULTIPLE INTEGRALS**	**12**

Double integrals in Cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves - Change of variables in double integrals – Triple integrals – Volume of solids

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Erwin Kreyszing, Herbert Kreyszing, Edward Norminton, "Advanced Engineering Mathematics", 10 Edition, John Wiley, (2015)
2. Grewal .B.S, Grewal .J.S "Higher Engineering Mathematics",43rd Edition, Khanna Publications, Delhi, (2015).

REFERENCES:

1. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Nineth Edition, Laxmi Publications Pvt.Ltd.,(2014).
2. Glyn James, "Advanced ModernEngineering Mathematics", 4thEdition, Pearson Education,(2016).
3. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2013).

Web Link:

https://home.iitk.ac.in/~peeyush/102A/Lecture-notes.pdfhttps://www.sydney.edu.au/content/dam/students/documents/mathematics-learning-entre/ integration-definite-integral.pdf

OUTCOMES

Upon successful completion of the course, students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1	Solve the Eigen value problems in matrices.	3
CO2	Apply the basic notion of calculus in Engineering problems and to tackle for different geometries	3
CO3	Perform calculus for more than one variable and its applications in Engineering problems	3
CO4	Apply definite integrals for design of three dimensional components	3
CO5	Evaluate multiple integral in Cartesian and polar coordinates	3

COURSE ARTICULATION MATRIX

CO	PO's														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	3	3	3	3								3	3		
2.	3	3										3	3		
3.	3	3	3	3								3	3		
4.	3	3										3	3		
5.	3	3	2	2								3	3		

PH22153	TECHNICAL PHYSICS	L	T	P	C
	(Common to BT and CH)	3	0	0	3

COURSE OBJECTIVES:

To enhance the fundamental knowledge in Physics and its applications relevant to various Streams of Engineering and Technology.

UNIT I	LASERS AND FIBER OPTICS	9

Lasers: population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG laser – CO_2 Laser – Dye lasers, Exceimer Lasers – Applications. **Fiber optics**: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, and mode) – losses associated with optical fibers–Fiber optic communication- fibre optic sensors: pressure and displacement- Endoscope.

UNIT II	QUANTUM PHYSICS	9

Black body radiation – Planck's theory (derivation)- deduction of Wien's and Rayleigh Jean's law – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent wave equations – Finite potential wells - - particle in a one-dimensional - three dimensional potential box– Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

UNIT III	CRYSTAL PHYSICS	9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – interplanar distances- coordination number and packing factor for SC, BCC, FCC, HCP and diamond structure (qualitative) - crystal imperfections: point defects, line defects – Burger vectors, stacking faults.

UNIT IV	NEW ENGINEERING MATERIALS	9

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, Nanomaterials– Preparation -pulsed laser deposition – chemical vapor deposition – Applications –Classification of Biomaterials and its applications

UNIT V	PHYSICS OF SOUND	9

Classification of Sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting Acoustics of buildings and their remedies.

Production of ultrasonics by magnetostriction and piezoelectric methods - Acoustic grating –Non Destructive Testing – Pulse echo system through transmission and reflection modes - A,B and C –scan displays, Medical applications – Sonogram.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Gaur R.K. and Gupta S.L, "Engineering Physics", Dhanput Publications, 2015.
2. Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", Pearson, 2006.
3. Rajendran V, "Engineering Physics", Tata McGraw Hill, 2009.
4. Arumugam M, "Materials Science", Anuradha Publications, 2015.

5. Elementary Bio physics - An Introduction – P K Srivasthava, Narosa Pub.-2005

REFERENCES:

1. David Halliday, Robert Resnick, Jearl Walker, "Principles of Physics", 10th Edition, Wiley,2015.
2. Peter Atkins and Julio De Paula, "Physical Chemistry", 10th Edition., Oxford University Press, 2014
3. Arthur Beiser, Shobhit Mahajan and Rai Choudhury S, "Concepts of Modern Physics", 7th edition, McGraw Hill Education, 2017.
4. Raghavan V, "Materials Science and Engineering", PHI Learning Pvt. Ltd., 2010
5. Pandey B.K., Chaturvedi.S. "Engineering Physics", Cengage Learning India Pvt.Ltd, 2012

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1	Develop an understanding about photonics and Fiber Optic communication system	**2**
CO2	Acquire the knowledge of Quantum mechanics	**3**
CO3	Classify and demonstrate the fundamentals of crystals and their defects.	**3**
CO4	Acquire the knowledge of New Engineering Materials	**2**
CO5	Enable to explore how sound is produced and propagates in material medium	**3**

COURSE ARTICULATION MATRIX

CO	PO's														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.	**3**									**1**			**3**		
2.	**3**	**2**	**2**	**2**	**3**					**1**		**2**	**3**		
3.	**3**	**2**								**1**			**3**		
4.	**3**	**2**	**2**	**2**	**3**	**2**	**2**			**1**		**2**	**3**		
5.	**3**									**1**			**3**		

CY22153	TECHNICAL CHEMISTRY	L	T	P	C
	(*Common to BT, CH and CE*)	3	0	0	3

COURSE OBJECTIVES:

To make the student conversant with the

- Electrodes, Corrosion and Protective coatings
- Photochemical process
- Synthesis and applications of nanoparticles
- Characteristics and analysis of water
- Materials like polymers, composites and binding materials

UNIT I	ELECTROCHEMISTRY	9

Electrodes and electrochemical cells – electrode potential, standard electrode potential, single electrode potential and its determination, types of electrodes – calomel, quinhydrone and glass electrode. Nernst equation – determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Batteries – Primary (dry cell) and secondary batteries (Lead – acid storage battery and Lithium ion battery) and next generation batteries.

UNIT II	PHOTOCHEMISTRY	9

Laws of photochemistry – Grotthuss-Draper law, Stark–Einstein law and Lambert Beer Law – determination iron by spectrophotometer. Quantum efficiency – Photo physical processes - internal conversion, inter-system crossing, fluorescence, phosphorescence and photo-sensitization-Quenching of fluorescence and its kinetics, Stern-Volmer relationship. Applications of photochemistry

UNIT III	NANOCHEMISTRY	9

Basics and scale of nanotechnology, different classes of nanomaterials, Distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Synthesis of nanomaterials, fabrication (lithography) and its applications – Basics of nanophotonics and quantum confined materials (surface plasmon resonance).

UNIT IV	WATER TECHNOLOGY	9

Sources, impurities in water and their effects. WHO guideline and BIS guideline for drinking water. Water characteristics – Hardness – Types of hardness – Disadvantages of hard water. Boiler troubles: Scale, Sludge, Priming and Foaming, Caustic embrittlement and Boiler corrosion. Water softening methods - Internal treatment of water: Carbonate conditioning, Phosphate conditioning and Calgon conditioning - External treatment of water: Ion exchange process. Domestic water treatment. Water analysis: Hardness – determination by EDTA method, Alkalinity – determination by double indicator method, Determination of dissolved oxygen by Winkler's method and Determination of chloride by Mohr's method.

UNIT V	MATERIALS CHEMISTRY	9

Polymers: Introduction – Monomers, functionality and its significance, Free radical polymerization mechanism. Conducting polymers – mechanism of conduction in polyacetylene and applications.

Composites: Definition, need for composites. Constitution – Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of composites materials. Hybrid composites, Binding materials and its applications

TOTAL: 45 PERIODS

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry", DhanpetRai& Sons, New Delhi, 17th Edition, 2018.

2.S.S.Dara, "A Text Book of Engineering Chemistry", S.Chand& Co. Ltd., New Delhi, 12th Edition, 2016.

REFERENCES:

1. B.R. Puri, L.R. Sharma, M.S. Pathania., "Principles of Physical Chemistry" Vishal Publishing Company, 2008.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1	Identify electrochemical cells, corrosion and fundamental aspects of batteries	**2**
CO2	Interpret the photochemical reactions and make use of spectroscopic techniques	**2**
CO3	Realize the structures, properties and applications of nanoparticles.	**2**
CO4	Describe the hardness of water, the problems caused by the hard water and their removals methods.	**4**
CO5	Illustrate the significance of various materials like polymer, composites their composition, properties and applications.	**2**

COURSE ARTICULATION MATRIX

CO	PO's														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.	**3**	**3**	**3**	**2**								**3**	**3**		
2.	**3**	**3**				**3**	**3**					**3**	**3**		
3.	**3**	**3**	**3**			**3**	**3**	**3**				**3**	**3**		
4.	**3**	**3**		**2**		**3**	**3**	**3**				**3**	**3**		
5.	**3**	**3**	**3**			**3**	**3**	**3**				**3**	**3**		

ME22152	BASIC MECHANICAL ENGINEERING	L	T	P	C
	(Common to BT, CH)	3	0	0	3

COURSE OBJECTIVES:

1. To teach the fundamentals of various energy resources
2. To impart the concepts in internal combustion Engines
3. To make the students to understand the working principle of refrigeration and Air conditioning systems
4. To impart the various engineering materials and their processing methods.
5. To give an awareness about the recent trends in Mechanical engineering

UNIT I	ENERGY RESOURCES	10

Classification of Energy Resources - Non-renewable and renewable energy resources. Nonrenewable energy resources – Steam power plant, Nuclear power plant, Hydroelectric power plant, Gas Turbine power plant. Diesel Power plant

Renewable Energy resources – Solar Energy, Wind Energy, Bio energy, tidal energy, fuel cells

UNIT II	INTERNAL COMBUSTION ENGINES	9

Classification, I.C. Engines parts and their function, working of 2 Stroke and 4 stroke engines. Basic terms - Indicated power, brake power frictional power, thermal efficiency, mechanical efficiency (simple problems).

UNIT III	REFRIGERATION AND AIR CONDITIONING	9

Refrigeration: Types of refrigerants and properties of good refrigerant, Refrigerating effect and unit of Refrigeration (definition). Working principle of vapor Compression refrigeration and vapor absorption refrigeration (with a sketch). Applications areas of a refrigeration system. Basic Calculations

Air Conditioning: Definition, Types, Room air-conditioning working principle (with a sketch), Applications. Calculation of Tonnage requirement based on the room size

UNIT IV	MATERIALS AND MANUFACTURING PROCESSES	10

Engineering Materials: Classification – Properties – Alloys and their applications

Manufacturing Processes – classification – Casting – Pattern, Core, Green sand Mould preparation, Investment casting

Metal Joining Process – Arc welding and Gas welding process, Soldering and Brazing – introduction

Metal forming Process – Forging, rolling, Extrusion – introduction

Metal Removal process – Lathe, Milling, Drilling

UNIT V	RECENT TRENDS IN MECHANICAL ENGINEERING	7

Hybrid and Electric vehicle – layout and Principle

Additive Manufacturing – Introduction and types

Robotics – Introduction – Types of robot and applications

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dr Sadhu Singh, Elements of Mechanical Engineering, S. Chand Publishing, 2010
2. Basant Agrawal, C.M. Agrawal. Basic Mechanical Engineering, Wiley India Pvt Ltd, 2008
3. Pravin Kumar, Basic Mechanical Engineering, 2nd Edition Pearson India, 2018
4. R.K. Rajput, Basic Mechanical Engineering, Lakshmi Publications, 2007
5. Nag, P K, Basic Mechanical Engineering, McGraw-Hill Education (India) Pvt Limited, 2011

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1	Understand the various energy resources and the principle of their operations	**2**
CO2	Understand the principle of refrigeration and Air-conditioning	**2**
CO3	Identify the types of IC engines and will calculate the various parameters	**4**
CO4	Learn the various Engineering Materials and the manufacturing processes	**2**
CO5	Know the recent trends in I.C. engines and manufacturing	**2**

COURSE ARTICULATION MATRIX

CO	PO's														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.	**2**												**3**		
2.	**2**												**3**		
3.	**2**												**3**		
4.	**2**												**3**		
5.	**1**												**3**		

ME22151	ENGINEERING GRAPHICS	L	T	P	C
	(Common to BT, CH)	2	0	2	3

COURSE OBJECTIVES:

This course will introduce the students to build their ability to read drawings and interpret the position and form of simple geometries.

UNIT 0	CONCEPTS AND CONVENTIONS AND GEOMETRIC CONSTRUCTION (NOT FOR EXAM)	2

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	CONICS, CYCLOIDAL CURVES AND INVOLUTES	10

Geometric construction - Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Drawing of tangents and normal to the above curves - Construction of cycloid, epicycloid and hypocycloid- Drawing of tangents and normal to the above curves. Construction of involutes of square, pentagon and circle - Drawing of tangents and normal to the above involutes.

UNIT II	PROJECTION OF POINTS, LINES AND PLANE SURFACES	12

Orthographic projection – principles-Principalplanes - 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.

Projection of planes (polygonal and circular surfaces) inclined to one of the principal planes and perpendicular to other by rotating object method.

UNIT III	PROJECTION OF SOLIDS	12

Projection of simple solids like prisms, pyramids, cylinder, cone when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Projections of hollow prism and hollow cylinder with centrally drilled hole or square through its ends by rotating line method - axis is inclined to one of the principal planes and parallel to the other.

UNIT IV	BLOCK FLOW DIAGRAM USING CAD	12

Introduction to Computer Aided Drafting hardware - Overview of application software -2D drafting commands (AutoCAD) for simple shapes - Block flow diagrams - Dimensioning.

UNIT V	ORTHOGRAPHIC AND ISOMETRIC VIEWS USING CAD	12

Introduction to tolerance - Annotation in CAD - Isometric views - Orthographic views - 3D Modelling basics - 3D to 2D conversion.

TOTAL: 60 (30 L + 30 P)PERIODS

TEXT BOOKS:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House,53rd Edition, 2019.
2. Dhananjay M. Kulkarni, A.P. Rastogi, Ashoke K. Sarkar, “Engineering Graphics with AutoCAD”, PHI Learning Private Ltd., 2009.
3. Venugopal K. and Prabhu Raja V., “Engineering Drawing +AutoCAD", New Age International (P) Limited, 6th edition, 2022

REFERENCES:

1. Dhananjay A Jolhe, "Engineering Drawing with an Introduction to AutoCAD", Tata McGraw-Hill Publishing Company Limited., 2008
2. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.
4. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.

WEB RESOURCES:

1. Block flow diagram - https://media.ed.ac.uk/media/1_u4r3az7t
2. AutoCAD tutorials - https://www.thesourcecad.com/autocad-tutorials/
3. https://nptel.ac.in/courses/112105294
4. https://nptel.ac.in/courses/112103019

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1	***Construct*** conic sections and as per drawing standards.	3
CO2	***Obtain*** orthographic projections of lines and plane surfaces and simple solids in various positions.	3
CO3	***Obtain*** projections of simple and hollow solids.	3
CO4	***Employ*** the CAD software for drafting and modelling of simple components	3
CO5	***Construct*** 2D views from 3D models using CAD software.	3

COURSE ARTICULATION MATRIX

CO	PO's														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.										1			3		
2.										2			3		
3.										2			3		
4.					2				1	3			3		
5.					2				1	3			3		

HS 22151	தமிழ் மொழியும் தமிழர் மரபும் **Tamil Language and Heritage of Ancient Tamil Society**	L	T	P	C
	(Common to all branches)	1	0	0	1

பாடத்தின் நோக்கங்கள் :

- தமிழ் மொழியின் தோற்றம் பற்றியும் , திணை கருத்துக்கள் வாயிலாக வாழ்வியல் முறைகளைப்பற்றியும் கற்றுக் கொள்வார்கள் .
- இந்திய தேசிய சுதந்திர இயக்கத்தில் தமிழர்களின் பங்களிப்பு மற்றும் தமிழர்களின் மேலாண்மை முறைகளைபற்றியும் கற்றுக் கொள்வார்கள் .

அலகு1	தமிழுக்கும் தொழில்நுட்ப கல்விக்கும் உள்ள தொடர்பு	3

மொழி மற்றும் பாரம்பரியம் :: இந்தியாவில் உள்ள மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழில் செம்மொழி இலக்கியம் - உ.வே சுவாமிநாத ஐயர் ., ஆறுமுக நாவலர் ஆகியோரின் பங்களிப்பு - தொழில்நுட்ப கல்வியில் தமிழ் .

LANGUAGE AND HERITAGE: Language families in India – Dravidan Languages – Tamil as a Classical language – Classical Literature in Tamil – Contribution of U. Ve. Swaminathaiyar. Arumuka Navalar – Importance of Tamil language in technical education.

அலகு 2	திணைகருத்துக்கள்	9

திணைகருத்துக்கள் : - ஐந்து வகைநிலங்கள் , தமிழர்களின் தாவரங்கள் மற்றும் விலங்கினங்கள் , கடவுள்கள் , தொழில்கள் , வாழ்க்கைமுறை , பண் , கூத்து , உணவுமுறை தொல்காப்பியம் மற்றும் சங்க இலக்கியங்களில் இருந்து அகம் மற்றும் புறம் கருத்து – தமிழ் அறம் கருத்து – சங்ககாலத்தில் கல்வி மற்றும் எழுத்தறிவு – பண்டைய நகரங்கள் மற்றும் சங்ககாலத்தில் துறைமுகங்கள் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - சோழமன்னர்களின் வெளிநாட்டு வெற்றிகள் .

Thinai concepts : -Five types of lands, animals, Gods, occupation, life styles, music, dance , food style, Flora and Fauna of Tamils - Agam and puram concept from Tholkappiyam and Sangam Literature – Aram concept of Tamil – Education and Literacy during Sangam Age – Ancient cities and Ports of Sangam Age – Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT II	தமிழரின் மரபு	3

இந்திய தேசிய சுதந்திர இயக்கம் மற்றும் இந்திய கலாச்சாரத்திற்கு தமிழர்களின் பங்களிப்பு :- சுப்ரமணிய பாரதி , வாஞ்சிநாதன் , சுப்பிரமணிய சிவா , வீரபாண்டிய கட்டபொம்மன் , வ.உசிதம்பரம் பிள்ளை , தீரன் சின்னமலை மருது பாண்டிய சகோதரர்கள் , பூலிதேவர் , திருப்பூர் குமரன் , வீரமங்கை வேலுநாச்சியார் - ,தமிழர் இலக்கியங்களில் மேலாண்மைகருத்துக்கள் (கி . மு. 500 முதல் கி . பி 200 வரை – அகநானூறு, புறநானூறு , திருக்குறள் ஆகியவற்றில் மேலாண்மைக் கருத்துக்கள் .

Contribution of Tamils to Indian National Freedom Movement and Indian Culture: Contributions of Subramanya Bharathi, Vanchinathan, Subramaniya Siva, Veerapandiya Kattabomman, V O Chidambaram Pillai, Dheeran Chinnamalai, The Maruthu Pandiyar, Puli Thevar, Tiruppur Kumaran, VeeraMangai Velunachiyar. Management in tamil literature (From 500 B.C to 200 A.D) – Agananooru, Puranaanooru and thirukkural.

TOTAL: 15 PERIODS

TEXT BOOKS:

1. பொன் முத்துகுமாரன் (2002), "தமிழ் மரபு ", காந்தளகம் , 68, அண்ணா சாலைசென்னை600 002
2. பி . டி . ஸ்ரீனிவாச ஐயங்கார் *(தமிழக்கமும் திறனாய்வும்)* புலவர் கா. கோவிந்தன் (1988), "தமிழர் வரலாறு (முதல் பகுதி)", திருநெல்வேலி தென்னிந்திய சைவசித்தாந்த நூற்பதிப்பு கழகம் , 154, TTK சாலை சென்னை18.
3. டாக்டர் .கே.கே.பிள்ளை (2009), "தமிழக வரலாறு மக்களும் பண்பாடும் ", உலக தமிழாராய்ச்சி நிறுவனம் , தரமணி சென்னை600113
4. முனைவர். ச . இராஜேந்திரன் (2004), "தமிழில் சொல்லாக்கம் ", தஞ்சாவூர் தமிழ் பல்கலைக்கழகம் வெளியீடு .

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1	மாணவர்கள் தமிழ்மொழித் தோற்றம் பற்றித் தெரிந்து கொள்வார்கள் . Students will learn about the origin of the Tamil language	1
CO2	தமிழர்களின் வாழ்வியல் முறைகளைத் தெரிந்து கொள்வார்கள் . They will know the ways of life of Tamils.	2
CO3	தமிழர்களின் சுதந்திர போராட்ட வீரர்களை பற்றியும் , மேலாண்மைகளைபற்றியும் தெரிந்து கொள்வார்கள் . They will know about the freedom fighters of Tamils and the management of Tamils	2

COURSE ARTICULATION MATRIX

CO	PO's														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.			3		3	3	2		3			2			
2.			3	2	3	3		1	3						
3.			3	2	3	3	2		3			2			

CY22161	CHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

The objective of the Chemistry Laboratory is to acquaint the students with the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and engineering field.

1. To appreciate the need and importance of water quality parameters for industrial and domestic use.
2. To gain the knowledge on electrochemical instrumentation techniques like potential and current measuring used in electrochemistry applications
3. To impart knowledge on separation of components using paper chromatography.
4. To enhance the thinking capability about polymer and properties like molecular weight.

LIST OF EXPERIMENTS (Minimum 8 Experiments)

1. Determination of DO content of water sample by Winkler's method.
2. Determination of strength of given hydrochloric acid using pH meter
3. Determination of strength of acids in a mixture using conductivity meter
4. Estimation of iron content of the water sample using spectrophotometer (phenanthroline/thiocyanate method)
5. Determination of total, temporary & permanent hardness of water by EDTA Method.
6. Estimation of iron content of the given solution using potentiometer.
7. Determination of alkalinity in water sample.
8. Determination of Single electrode potential.
9. Separation of components from a mixture of red and blue inks using Paper chromatography.
10. Determination of molecular weight of polymer by using Ostwald's/Ubbelohde viscometer.

TOTAL:15 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Common apparatus: Pipette, Burette, conical flask, porcelain tile, dropper (each 30 Nos.)

1.	Iodine flask	30 Nos
2.	pH meter	5 Nos
3.	Conductivity meter	5 Nos
4.	Spectrophotometer	5 Nos
5.	Oswald/UbbelohdeViscometer	30 Nos

REFERENCES:

1. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York 2001.
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel‟s Textbook of practical organic Chemistry", LBS Singapore 1994.
3. 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.

4. Kolthoff I.M., Sandell E.B. et al. “Quantitative chemical analysis”, Mcmillan, Madras 1980.

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1	Distinguish hard and soft water, solve the related numerical problems on water, purification and its significance in industry and daily life.	**3**
CO2	Interpret the knowledge of instruments to measure potential and current related parameters	**2**
CO3	Demonstrate the basic principle for separation of components using paper chromatography	**3**
CO4	Evaluate the molecular weight of polymer using Ostwald's/Ubbelohde viscometer.	**3**

COURSE ARTICULATION MATRIX

CO	PO’s														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.	**3**	**2**				**3**	**3**	**3**	**1**		**1**	**2**		**3**	
2.	**3**	**2**	**1**			**3**	**3**	**3**						**3**	
3.	**3**					**3**	**3**					**2**		**3**	
4.	**3**			**1**		**3**	**3**	**3**						**3**	
5.	**3**	**2**				**3**	**3**	**3**	**1**		**1**	**2**		**3**	

ME22161	BASIC MECHANICAL ENGINEERING LABORATORY	L	T	P	C
	(Common to AE, BT, CH)	0	0	2	1

COURSE OBJECTIVES:

To provide an exposure and hands on experience to the students on various basic mechanical Engineering processes.

LIST OF EXPERIMENTS

1. Welding - Butt joint and lap joint using Electric Arc and Gas welding.
2. Machining – Turning and facing using Centre Lathe.
3. Sheet metal work – Making of a cylinder using GI sheet and finishing using rivets.
4. Drilling and Tapping – Drilling of holes precisely and making internal threads by Tapping for various sizes.
5. Casting – Mould preparation using simple solid pattern and casting.
6. Plumbing – Making household pipeline PVC pipes, valves, taps, couplings, unions, reducers, elbows.
7. Fuel testing – Determination of Flash point and Fire point of fuels.
8. Refrigeration and Air Conditioning – Determination of Coefficient of Performance (COP) of refrigeration and air conditioning systems.
9. Automation – Basic pneumatic circuit using single and double acting cylinder.
10. 3D printing –Demonstration of printing of simple solids using Additive Manufacturing/3D printing.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Jeyachandran K., Natarajan S. & Balasubramanian S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
2. Jeyapoovan T., Saravanapandian M. & Pranitha S., "Engineering Practices Lab Manual", Vikas Publishing House Pvt.Ltd, 2006.
3. Bawa H.S., "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007.
4. Rajput. R.K., "Thermal Engineering", Laxmi Publications, Tenth Edition, 2017
5. Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
6. Anthony Esposito, Fluid Power with Applications, Pearson Education, 7th edition, 2009.
7. Mechanical engineering practices lab manual, SVCE, 2022.

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1	***Fabricate*** components by various manufacturing processes.	**3**
CO2	***Prepare*** pipeline for a given application.	**3**
CO3	***Evaluate*** the ignition properties of fuels	**5**
CO4	***Determine*** the efficiency of refrigeration and air conditioning Systems	**2**
CO5	***Understand*** the principles of low-cost automation using pneumatic circuits.	**2**
CO6	***Understand*** the principle of additive manufacturing/3D printing	**2**

COURSE ARTICULATION MATRIX

CO	PO's														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.	**2**													**3**	
2.	**2**													**3**	
3.	**2**													**3**	
4.	**2**													**3**	
5.	**1**				**2**									**3**	
6	**1**				**2**									**3**	

SEMESTER II

HS22152	TECHNICAL ENGLISH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. Enable learners to define and understand technical communication and scientific writing.
2. Expose learners to the technicalities of seminar presentation, group discussion, and public speaking.
3. Develop learners' writing skills for scientific and documenting purposes.
4. Improve learners' ability to draft correspondences for business purposes.
5. Cultivate learners' ability to holistically understand the nuances of job interviews and recruiting process.

UNIT I		9

Listening - AV files pertaining to manufacturing processes of products, scientific documentaries; Speaking - syllable division and word stress, intonation, sharing opinions; Reading - news articles related to science and technology; Writing - definitions, instruction, recommendation, data interpretation, resume; Grammar - tenses and their aspects, sentence connectors – discourse markers, sequential words, active and passive voice, subject-verb agreement.

UNIT II		9

Listening - AV pertaining to marketing strategies, peer reading and pronunciation; Speaking- turn taking, sharing opinions; conducting and attending a meeting, understanding the nuances of spoken communication among internal audience and external audience; Reading - analytical documents, descriptive documents; Writing - fliers, brochures, resume - letter of application, checklists; Grammar - modal verbs, clauses - types and uses, conditional clauses, articles.

UNIT III		9

Listening - AV related to how to use components, scientific description, Speaking - speaking for motivation and initiation, speaking at a seminar presentation; Reading - scientific journals, papers; Writing - Technical descriptions - process description, purpose and function, PowerPoint, Google forms, user manuals; Grammar - phrasal verbs, prepositions, technical and scientific affixes.

UNIT IV		9

Listening - scientific debates, crisis management; Speaking - handling conflicts, speaking about the loss of benefits, progress or decline of business, identifying the connotative meanings, Reading- documented evidences of uses and functions of a product, review of a product, Writing - memos, follow-up letters, reports - proposal, project, progress reports, sales reports, reports on industrial visits, executive summary. Grammar - reported speech and tag questions, sentence structure - comparative, imperative, cause and effect, infinitive of result.

UNIT V		9

Listening - AV of Group discussions, panel discussions, face to face interviews for recruitment purposes; Speaking- speaking at group discussions, interviewing a personality, answering at the interviews; Reading - WebPages of top notch engineering companies, Writing - blogging, e-mails, letter of complaint, minutes of the meeting; Grammar - one word substitution, collocations, better word/sentence substitution (rephrasing the content/improvising ideas).

TOTAL: 45 PERIODS

REFERENCES:

1. Department of English, Anna University. *Mindscapes: English for Technologists and Engineers.* Orient Blackswan, Chennai. 2012.
2. Downes, Colm, *Cambridge English for Job-hunting*, Cambridge University Press, New Delhi. 2008.
3. Murphy, Raymond, *Intermediate English Grammar with Answers*, Cambridge University Press 2000.
4. Thomson, A.J., *Practical English Grammar 1 & 2*, Oxford, 1986.
5. Herbert A J, *The Structure of Technical English*, Longman, 1965.

Websites

1. http://www.usingenglish.com
2. http://www.uefap.com3
3. https://owl.english.purdue.edu/owl/
4. www.learnenglishfeelgood.com/esl-printables-worksheets.html

Software

1. Face 2 Face Advance – Cambridge University Press, 2014.
2. English Advance Vocabulary- Cambridge University Press.
3. IELTS test preparation – Cambridge University Press 2017.
4. Official Guide to the TOEFL Test With CD-ROM, 4th Edition.
5. Cambridge Preparation for the TOEFL TEST- Cambridge University Press**,** 2017.

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1	Understand the nuances of technical communication and scientific writing	**3**
CO2	Present papers and give seminars	**6**
CO3	Discuss in groups and brainstorm	**6**
CO4	Draft business correspondences and write for documenting purposes	**6**
CO5	Face job interviews with confidence	**6**

COURSE ARTICULATION MATRIX

CO	PO's														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.										**3**			**3**		
2.										**3**			**3**		
3.										**3**			**3**		
4.										**3**			**3**		
5.										**3**			**3**		

MA22251	APPLIED MATHEMATICS – II	L	T	P	C
	(Common to all except Marine Engineering)	**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

The Student should be made to:

1. Acquire the concepts of vector calculus needed for problems in all engineering disciplines and compute different types of integrals using Green's, Stokes' and Divergence theorems.
2. Skilled at the techniques of solving ordinary differential equations that model engineering problems.
3. Extend their ability of using Laplace transforms to create a new domain in which it is easier to handle the problem that is being investigated.
4. Explain geometry of a complex plane and state properties of analytic functions.
5. Understand the standard techniques of complex variable theory so as to apply them with confidence in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.

UNIT I	VECTOR CALCULUS	12

Gradient, divergence and curl - Directional derivative - Vector identities – Irrotational and solenoidal vector fields - Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's theorem in a plane, Gauss divergence theorem and Stokes'theorem (excluding proofs) – Verification and application in evaluating line, surface and volume integrals.

UNIT II	ORDINARY DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS	12

Differential equations of first order – Equations of the first order and first degree – Linear equations – Higher order linear differential equations with constant coefficients - Method of variation of parameters - Cauchy's and Legendre's linear equations - Simultaneous first order linear equations with constant coefficients – Applications of Linear differential equations – Oscillatory electrical circuit – Deflection of beams

UNIT III	LAPLACE TRANSFORM	12

Conditions for existence - Transform of elementary functions - Transforms of unit step function and impulse functions – Basic properties – Shifting theorems - Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Initial and final value theorems - Transform of periodic functions. Inverse Laplace transforms - Convolution theorem – Application to solution of linear ODE of second order with constant coefficients using Laplace transformation techniques

UNIT IV	ANALYTIC FUNCTIONS	12

Analytic functions - Necessary and sufficient conditions (Cauchy-Riemann equations) - Properties of analytic function - Harmonic conjugates - Construction of analytic functions - Conformal mapping – Mapping by functions $W = Z + C$, CZ, $1/Z$, Z^2 – Joukowski's transformation- Bilinear transformation

UNIT V	COMPLEX INTEGRATION	12

Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series expansions - Singular points - Residues - Cauchy's Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi-circular contour

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Erwin Kreyszing, Herbert Kreyszing, Edward Norminton, "Advanced Engineering Mathematics",10 Edition, John Wiley, (2015).
2. Grewal .B.S, Grewal .J.S "Higher Engineering Mathematics",43rd Edition, Khanna Publications, Delhi, (2015).

REFERENCES:

1. Dass, H.K., and RajnishVerma, "Higher Engineering Mathematics", S.Chand Private Ltd., 2011.

2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2013).

3. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", 9th edition, Laxmi Publications(p) Ltd., 2014.

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1	Interpret the fundamentals of vector calculus and execute evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems.	**3**
CO2	Solve first order linear, homogeneous differential equations and use series solution method to solve second order differential equations.	**3**
CO3	Determine the methods to solve differential equations using Laplace transforms and Inverse Laplace transforms	**3**
CO4	Explain Analytic functions and Categorize transformations	**3**
CO5	Perform Complex integration to evaluate real definite integrals using Cauchy integral theorem and Cauchy's residue theorem.	**3**

COURSE ARTICULATION MATRIX

CO	PO's														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.	**3**	**3**										**3**	**3**		
2.	**3**	**3**	**2**									**3**	**3**		
3.	**3**	**3**	**2**									**3**	**3**		
4.	**3**	**3**										**3**	**3**		
5.	**3**	**3**										**3**	**3**		

EE22251	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING FOR CHEMICAL ENGINEERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts used in Electrical circuits and the principles of measuring instruments and sensors
- To introduce the fundamentals of power semiconductors devices and its applications.
- To study the different types of electrical machines and its starting methods.
- To study basics of Industrial Electrical Drives.
- To impart knowledge of application of electrical drives using modern control strategy in chemical process industries

UNIT I	ELECTRICAL CIRCUITS & MEASURMENTS	9

Ohm's Law – Kirchoff's Laws – Steady State Solution of DCCircuits (Mesh current analysis only) – Introduction to AC Circuits – Single Phase and Three Phase Balanced Circuits. Principle of measurement - Error Analysis, Static and dynamic characteristics of instruments – sensors – Temperature, Pressure, Flow and Level measurement.

UNIT II	SEMICONDUCTOR DEVICES	9

PN Junction Diode and Zener Diode - Static Characteristics, SCR, MOSFET - Static and Switching Characteristics, Applications of Power semiconductor devices - Uncontrolled Rectifiers, Phase controlled Rectifiers, DC Choppers, Concept of PWM in MOSFET

UNIT III	ELECTRICAL MACHINES	9

Construction and working of DC machines – types, Characteristics, Starting and braking of DC Motors. Construction and working of AC Induction motors – Slip-Torque Characteristics, Starting methods.

UNIT IV	INDUSTRIAL ELECTRICAL DRIVES	9

Basic Elements – Types of Electric Drives – Factors influencing the choice of electrical drives – Heating and Cooling curves – classes of duty - Maintenance of electrical drive systems - Industrial Hazards and Safety Measures.

UNIT V	APPLICATION OF ELECTRIC DRIVES (Block Diagram Representation Only)	9

Conventional and Solid State speed control of DC Motors - Conventional and Solid state speed control of AC Drive systems - Inverters, AC Voltage controllers, Slip power recovery schemes - Block diagram of different chemical process units - Computer based control of DC and AC Drive systems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Nagrath.I.J. &Kothari.D.P, "Electrical Machines", Tata McGraw-Hill,1998
2. Mittle V.N, Arvind Mittal "Basic Electrical Engineering", Tata McGraw Hill (India), Second Edition,2013
3. Gopal.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House,2001
4. Vedam Subrahmaniam, "Electric Drives (concepts and applications)", Tata McGraw- Hill, 2011
5. P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition,2003

REFERENCES:

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, “Basic Electrical, Electronics Engineering”, Tata McGraw Hill, 2013.
2. J.Nagrath and D.P. Kothari, “Basic Electrical Engineering”, Tata McGraw Hill ((India),Third Edition, 2010.
3. M.H.Rashid, „Power Electronics: Circuits, Devices and Applications“, Pearson Education, Third Edition, New Delhi, 2004 .
4. Mehta V K, “Principles of Electronics”, S.Chand& Company Ltd, 2010.
5. Pillai.S.K “A first course on Electric drives”, Wiley Eastern Limited, 1998.

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1	Apply basic electrical laws for the electrical circuits and understand sensors and measurement principles	**3**
CO2	Analyze the characteristics of various semiconductor devices and develop circuits for an application.	**4**
CO3	Analyze and select electrical machines for drive applications based oncharacteristics.	**4**
CO4	Identify the structure and types of Electrical drives for specificapplications.	**3**
CO5	Apply control methods for Electrical Machine andDrives in chemical process industries	**3**

COURSE ARTICULATION MATRIX

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

IT22251	COMPUTER PROGRAMMING AND PRACTICE	L	T	P	C
	(Common to AE/BT/CV/CH)	**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

To know the basics of algorithmic problem solving

To learn programming using a structured programming language.

To implement programs with basic features of C.

UNIT I	FUNDAMENTALS OF COMPUTING	6 + 3

Computing Devices – Identification of Computational Problems – Algorithms – Building Blocks of Algorithms - Pseudocodes and Flowcharts- Notion of memory, addresses, variables, instructions, execution of instructions- Operating system commands, file editing, compiling, linking, executing a program. Introduction to different programming languages.

Suggested Activities:

Practical - Use of operating system commands and file editing operations

UNIT II	BASICS OF C	6 + 9

Data types - constants, variables - operators - expressions - basic input/output. Statements and blocks - Selection - if-else construct - iteration - while - for constructs.

Suggested Activities

Practical

Demonstration of programs using data types, operators and basic input/output.

Demonstration of programs using if else, else-if, switch.

Demonstration of programs using, while, for do-while, break, continue

UNIT III	ARRAYS AND STRINGS	6 + 6

Array, declaration, initialization. Multi dimensional arrays. Strings and character arrays, string operations on arrays

Suggested Activities

Practical

Demonstration of programs using arrays and operations on arrays

Demonstration of programs implementing string operations on arrays

UNIT IV	FUNCTIONS AND STRUCTURES	6 + 6

Functions, definition, call, arguments, call by value. Call by reference. Recursion, Introduction to structures and unions.

Suggested Activities

Practical

Demonstration of programs using functions.

Demonstration of programs using recursion

Demonstration of programs using Structures and Unions

UNIT V	POINTERS AND FILE HANDLING IN C	6 + 6

Introduction to Pointers- pointers to basic variables, pointers and arrays. Pointers to strings Dynamic Memory Allocation, Files - binary, text - open, read, write, random access, close. Preprocessor directives

Suggested Activities

Practical

Demonstration of programs using pointers

Demonstration of programs using files

TOTAL: L 30 + P 30 PERIODS

TEXT BOOKS:

1. PradipDey, Manas Ghosh, " Programming in C ", First Edition, Oxford University Press, 2018.
2. R G Dromey, "How to Solve it using Computer", Pearson,2006.

REFERENCES:

1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.
2. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.
3. Byron S Gottfried, "Programming with C", Schaum's Outlines, Third Edition, Tata McGrawHill, 2010
4. ReemaThareja, "Programming in C", 2nd ed., Oxford University Press, 2016

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1	Understand the model of a computer, software design methodologies, and represent solutions to computational problems as algorithms	**3**
CO2	Analyze the problem scenarios and develop C programs using sequential, conditional, and iterative constructs	**4**
CO3	Appraise problem scenarios and develop C programs using complex storage structures	**4**
CO4	Design modularized solutions for larger problems	**3**
CO5	Inspect the storage structure in a computer and design C programs to access permanent storage	**4**

COURSE ARTICULATION MATRIX

CO	PO's													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO -1**	**PSO-2**
1.	2	3	3	2	2	1	0	1	3	2	0	2	0	1
2.	2	3	2	2	2	1	0	1	3	2	0	2	0	1
3.	2	3	2	2	2	1	0	1	3	2	0	2	0	1
4.	3	3	2	2	2	1	0	1	3	2	0	2	0	1
5.	1	1	1	1	2	1	0	1	3	2	0	2	0	1

CH22201	INTRODUCTION TO CHEMICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- Introduce and outline of the concepts of Chemical Engineering

UNIT I	OVERVIEW OF CHEMICAL ENGINEERING	9

Historical overview of Chemical Engineering; Chemical Engineering in day to day life; Greatest achievements in the field of Chemical Engineering, Paradigm shifts in Chemical Engineering; Opportunities and Future prospects of Chemical Engineering.

UNIT II	BASICS OF CHEMICAL ENGINEERING	9

Units and dimensions, Dimensional Analysis – Rayleigh's and Buckingham Pi methods, Gas calculations, First and Second law of Thermodynamics, Chemical Kinetics – Reaction rates and Reactor types.

UNIT III	MOMENTUM TRANSFER	9

Introduction: Nature of fluids, Concepts of Fluid flow, Properties of Fluid Flow, Pumps and Measuring devices –Variable and constant head meters.

UNIT IV	HEAT TRANSFER	9

Modes of Heat Transfer: Conduction, Convection and Radiation, Heat Transfer Equipments - Heat Exchanger and evaporators.

UNIT V	MASS TRANSFER	9

Diffusion - Absorption, Adsorption, Humidification and dehumidification, Mass Transfer Equipments – Absorbers, strippers and Dryers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", 6th Edition, TataMcGraw Hill, 1997.
2. Ghosal, S.K, Sanyal S.K. and Dutta.S, "Introduction to Chemical Engineering" TMH Publications, New Delhi, 1998.
3. Dryden, C.E., "Outlines of Chemicals Technology", Edited and Revised by Gopala Rao, M. and M.Sittig, 2nd Edition, Affiliated East-West press, 1993.
4. Randolph Norris Shreve, George T. Austin, "Shreve's Chemical Process Industries", 5thedition, McGraw Hill, 1984.

REFERENCES

1. McCabe, W.L., Smith, J. C. and Harriot, P. "Unit operations in Chemical Engineering", McGraw Hill Education, 7th Edition, 2017 ISBN-13: 978- 8184959635.
2. Pushpavanam, S, "Introduction to Chemical Engineering", PHI Learning Private Ltd, New Delhi, 2012, ISBN 13: 978-8120345775.

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Analyze the history and future prospects of Chemical Engineering.	4
CO2.	Apply the basic Chemical Engineering Principles.	3
CO3.	Construct the Concepts of Momentum Transfer.	3
CO4.	Explore the Heat Transfer concepts and understand the working principle of Heat transfer equipments.	3
CO5	Explain the Mass Transfer operations and its role in Chemical process industries.	3

COURSE ARTICULATION MATRIX

CO	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1.	2	2	1	1		1		2		1		2	2	2
2.	2	2	1	1		1		2		1		2	2	2
3.	3	2	2	2		2	1	2		1		3	3	3
4.	3	2	2	2		2	1	2		1		3	3	3
5.	3	2	2	2		2	1	2		1		3	3	3

HS22251	அறிவியல் மற்றும் தொழில்நுட்பத்தில் தமிழ் **Science and Technology in Ancient Tamil Society**	L	T	P	C
	(Common to all branches)	2	0	0	2

பாடத்தின் நோக்கங்கள் :

- அறிவியலில் தமிழின் பயன்பாடு பற்றி தெரிந்து கொள்வார்கள் .
- தொழில்நுட்பத்தில் தமிழ் பாரம்பரியத்தின் தாக்கம் பற்றி அறிந்து கொள்வார்கள் .

UNIT I	அறிவியல்தமிழ் :	5

கருவி உருவாக்கம் – ஆராய்ச்சி மேம்பாடு – கல்வி வளர்ச்சி – அறிவியல் தமிழ்சொற்கள் உருவாக்கம் .

Scientific Tamil : Tool Development - Research Development - Educational Development - Scientific Tamil words Creation.

UNIT II	தொழில்நுட்பத்தில் தமிழ்	25

வடிவமைப்பு மற்றும் கட்டுமான தொழில்நுட்பம் :சங்ககாலத்தில் கட்டுமானப் பொருட்கள் சோழர்களின் பெரியகோவில்கள் மற்றும் பிறவழிபாட்டு த தலங்கள் – பல்லவர்களின் சிற்பங்கள் மற்றும் கோவில்கள் (மாமல்லபுரம்) - நாயக் கன் கால கோவில்கள் (மதுரை மீனாட்சி அம்மன் கோவில்), திருமலைநாயக்கர் மஹால் செட்டிநாட்டு வீடுகள் .

Design and Construction Technology : Building materials in Sangam age – Great temples of Cholas and other workship places – Sculptures and Temples of Pallavas (Mamallapuram) – Temples of Nayakas period (Madurai Meenakshiamman temple), ThirumalaiNayakarMahal, Chetti Nadu Houses.

உற்பத்தி தொழில்நுட்பம் :கப்பல் கட்டும் கலைஉலோகவியல்ஆய்வுகள் , தங்கம் , தாமிரம் , இரும்பு பற்றிய அறிவு – தொல்பொருள் சான்றுகள் – சுட்டக் க ளிமண்மணிகள், சங்குமணிகள் , எலும்புமணிகள் .

Manufacturing Technology : Art of Ship building, Metallurgical studies, Knowledge about Gold, Copper, Iron – Archeological evidences – Terracotta beads, Shell beads, Bone beads.

விவசாயம் மற்றும் நீர்ப்பாசன தொழில்நு ட்பம் :அணைகள் ஏரிகள் , குளங்கள் , மதகுகள் , சோழர்கால குமுழி தூம்பு ஆகியவற்றின் முக்கியத்துவம் – கால்நடை பராமரிப்பு , கால்நடைகளின் பயன்பாட்டிற்காக வடிவமைக்கப்பட்ட கிணறுகள் . விவசாயம் மற்றும் வேளாண்செயலாக்கம் – கடல் பற்றிய அறிவு – மீன் பிடித்தல் , முத்து குளித்த ல் , சங்கு சேகரித்தல் .

Agriculture and Irrigation Technology: Dams, Tank, ponds, sluice, Significance of KumuzhiThoompu of Cholas period- Animal Husbandry, Wells designed for cattle use. Agriculture and Agro processing, -

Knowledge about Sea – Fisheries, Pearl, Conche diving.

தமிழ்கணினி : அறிவியல் தமிழ் வளர்ச்சி – தமிழ் கணினி, தமிழ் புத்தகங்களின் டிஜிட்டல் மயமாக்கல் , தமிழ் டிஜிட்டல் நூலகம் , தமிழ் மென்பொருள் உருவாக்கம் – தமிழ் மெய்நிகர் அகாடமி – சொற்குவை திட்டம் .

Tamil Computing : Development of Scientific Tamil – Tamil Computing, Digitization of Tamil books, Tamil Digital Library, Development of Tamil Softwares – Tamil virtual Academy – Sorkuvai project.

தமிழின் எதிர்காலமும் தகவல் தொழில்நுட்பமும் - உலகமயமாக்கலும் தகவல் தொழில்நுட்பமும் – கணினிக்கு தமிழ் கற் றுகொடுத்தல் - தமிழ்மொழித் தொழில்நுட்பத்தில் வளங்கள் .

Future of Tamil and Information Technology- Globalization and Information Technology-Teaching Tamil for Computer-Resources in Tamil Language Technology.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. டாக்டர் , வா.செ .குழந்தைசாமி (1985), " அறிவியல்தமிழ் " , பாரதிபதிப்பகம் , 126/108, உஸ்மான்சாலை,தியாகராயநகர் , சென்னை600017

2. சுப . திண்ணப்பன் , (1995), "கணினியும் தமிழ் கற்பித்தலும் ", புலமை வெளியீடு , 38-Bமண்ணத்நதோட்டத்தெரு , ஆழ்வார்பேட் , சென்னை 600018

3. மு. பொன்னவைக்கோ (2003), "வளர்தமிழில்அறிவியல் - இணையத்தமிழ்", அனைத்திந்திய அறிவியல் தமிழ்க்கழகம் , தஞ்சாவூர் 615 005.

4. துரை. மணிகண்டன், (2008), "இணையமும் தமிழும் ", நல்நிலம் பதிப்பகம் , 7-3, சி மேட்லிசாலை, தியாகராயநகர் , சென்னை600 017

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	அறிவியலில் தமிழ்மொழியின் பயன்பாடு பற்றி தெரிந்து கொள்வார்கள்	2
CO2.	பல்வேறு தொழில்நுட்பத்தில் தமிழ்மொழியின் தாக்கம் பற்றி அறிந்து கொள்வார்கள்	2

COURSE ARTICULATION MATRIX

CO	PO's														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	2			2	2							2			
2.	2	1	1	2	2	1			1	1	1	2			

EE22111	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

1. To provide exposure to the students with hands on experience in basic of Electrical and Electronics wiring connection and measurements.
2. To introduce the students to Electrical Machines and basic laws of Electrical Circuits.

LIST OF EXPERIMENTS

1. Wiring – Residential house wiring and Stair case wiring.
2. (a) AC Analysis- Measurement of electrical quantities–voltage, current, power, and power factor using RLC.
(b) Study of three phase system.
3. Energy conservation - Measurement and comparison of energy for incandescent lamp and LED lamp.
4. (a) Identification of circuit components (Resistor, Capacitor, Diode and BJT) and soldering practice.
(b) Signal Measurement- Measurement of peak to peak, RMS, average, period, frequency of signals using CRO.
5. (a) VI Characteristics of Solar photovoltaic panel.
(b) Design of Solar PV Array and Battery sizing for Residential solar PV system.
6. Design a 5V/12V Regulated Power Supply using FWR and IC7805/IC7812.
7. DC Analysis- Verification of Ohm's Law and Kirchhoff's Laws.
8. Study of Transformer and motor characteristics.

TOTAL: 30 PERIODS

REFERENCES:

1. Mittle V.N, Arvind Mittal, "Basic Electrical Engineering", Tata McGraw Hill (India), 2nd Edition, 2013.
2. Sedha R.S., "A Text Book of Applied Electronics", S.Chand& Co., 2014.

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Wiring of basic electrical system and measurement of electrical parameters.	4
CO2.	Verify the basic laws of Electric circuits and select various Electrical Machines.	4
CO3.	Construct electronic circuits and design solar photovoltaic system.	4
CO4.	Apply the concept of three-phase system.	4
CO5	Construct a fixed voltage regulated power supply.	4

COURSE ARTICULATION MATRIX

CO	PO's														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	3	3	3	3					2			2		3	
2.	3	3	3	3					2			2		3	
3.	3	3	3	3					2			2		3	
4.	3	3	3	3					2			2		3	
5.	3	3	3	3					2			2		3	

PH 22161	PHYSICS LABORATORY	L	T	P	C
	Common to all Branches	0	0	2	1

COURSE OBJECTIVES:

To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

LIST OF EXPERIMENTS: (Any EIGHT Experiments)

1. a) Determination of Wavelength, and particle size using Laser.
   b) Determination of acceptance angle in an optical fiber.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
3. Determination of wavelength of mercury spectrum – spectrometer grating.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of Young's modulus by Non uniform bending method.
6. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge.
7. Determination of Rigidity modulus of a given wire -Torsional Pendulum
8. Energy band gap of a Semiconductor
9. Determine the Hysteresis loss of a given Specimen
10. Calibration of Voltmeter & Ammeter using potentiometer

TOTAL: 30 PERIODS

REFERENCES:

Physics Laboratory practical manual", 1st Revised Edition by Faculty members, 2018.

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Analyze the physical principle involved in the various instruments; also relate the principle to new application. materials.	4
CO2.	Comprehend the Experiments in the areas of optics, mechanics and thermal physics to nurture the concepts in all branches of Engineering.	3
CO3.	Apply the basic concepts of Physical Science to think innovatively and also improve the creative skills that are essential for engineering	3
CO4.	Evaluate the process and outcomes of an experiment quantitatively and qualitatively	3
CO5	Extend the scope of an investigation whether or not results come out as expected	3

COURSE ARTICULATION MATRIX

CO	PO's														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	3	3	2	3	2				3	1		2		3	
2.	3	3		3		2			3	1		2		3	
3.	3	3	2	3	2	2			3	1		2		3	
4.	3	3		3					3	1		2		3	
5.	3	3		3	2				3	1		2		3	

MA22351	APPLIED MATHEMATICS III	L	T	P	C
		2	1	0	3

COURSE OBJECTIVES:

The student should be

- Competent in solving applications of ordinary differential equations using analytical methods to obtain their exact solutions.
- Find the solution of 1st & higher order PDEsusing analytical methods.
- Introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- Acquire the knowledge of using Fourier series techniques in Boundary value problems.
- Achieve an understanding of the basic concepts of the Fourier transform and Z-transform techniques and its application in Engineering.

UNIT I	APPLICATIONS OF ORDINARY DIFFERENTIAL EQUATIONS	9 + 3

Applications of Differential Equations of First Order-Geometrical Applications-Orthogonal Trajectories-Physical Applications-Application of Linear Differential Equations-Simple Harmonic Motions-Deflection of Beams-Applications of Simultaneous Linear Differential Equations.

UNIT II	PARTIAL DIFFERENTIAL EQUATIONS	9 + 3

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation – Linear homogeneous partial differential equations of second and higher order with constant coefficients.

UNIT III	FOURIER SERIES	9 + 3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series –Parseval's identity – Harmonic Analysis.

UNIT IV	BOUNDARY VALUE PROBLEMS	9 + 3

Classification of PDE – Method of separation of variables - Solution of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian and polar coordinates).

UNIT V	FOURIER AND Z -TRANSFORMS	9 + 3

Fourier transform pair – Fourier sine and cosine transforms – Properties (without proof) – Convolution theorem – Parseval's identity. Z- Transforms – Elementary properties – Inverse Z - transform (using partial fraction) – Convolution theorem – Solution of difference equations using Z - transform.

(L:45+T:15):60 PERIODS

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10 th Edition, Wiley India, 2011.
2. Grewal. B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi 2017.
3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah. G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt. Ltd. 1998.

REFERENCES:

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications PvtLtd , 2007.
2. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2011.
3. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2012.
4. LurryC.Andrews, "Special Functions of Mathematics for Engineers", 2nd Edition, McGraw Hill International Edition, 1992.

WEB LINKS:

1. Engg Mathematics-3 - APPLICATION OF ORDINARY DIFFERENTIAL EQUATIONS - 111 3 Application of Ordinary - Studocu .
2. FS_PDES_2016.dvi (ox.ac.uk)
3. Introduction to Fourier Series (purdue.edu)
4. Applications of Partial Differential Equations (nitk.ac.in)

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Develop skills in dealing with problems on ordinary differential equations and apply knowledge of LDE to solve the problems in Chemical engineering.	**4**
CO2.	Classify, formulate and solve the first order and second order linear, non-linear partial differential equations and apply the knowledge of partial differential equations to solve the engineering problems.	**3**
CO3.	Achieve an understanding of the basic concepts of periodic function and method of solving problems in Fourier series.	**4**
CO4.	Analyze and evaluate various partial differential equations such as wave equation, one- and two-dimensional heat flow equations.	**4**
CO5	Develop the skill of conversion between time domain to frequency domain using the concept of Fourier Transforms and Z-transform.	**4**

COURSE ARTICULATION MATRIX

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

CH22301	CHEMICAL PROCESS CALCULATIONS	L	T	P	C
		2	1	0	3

COURSE OBJECTIVES:

- To impart knowledge on the basic fundamentals of process calculations.
- To enable the students to perform material balances on various unit operations and processes.
- To enable the students to understand the concepts and calculations associated with gases and other combustion operations in industry which involves two phases.
- To enable the students to perform energy balance calculations on various unit operations and processes.
- To impart knowledge on unsteady state material and energy balances and enable the students to solve problems using process simulators.

UNIT I	UNITS AND DIMENSIONS	9

Base and derived Units - Conversion of units and conversion factors, Dimensional consistency Composition of Mixture and solutions - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculations.

UNIT II	MATERIAL BALANCE WITH AND WITHOUT CHEMICAL REACTIONS	9

Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallisation, drying etc., multicomponent systems species analysis and Degree-of-Freedom Analysis Material balance with chemical reaction - Limiting and excess reactants - recycle - bypass and purging - Unsteady state material balances.

UNIT III	HUMIDITY AND SATURATION	9

Basic of humidity and application of psychrometric chart - Use of humidity in condensation and drying – application of air water systems - cooling tower, types and basic calculations.

UNIT IV	ENERGY BALANCE WITH AND WITHOUT CHEMICAL REACTIONS	9

Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction -Energy balance for systems with and without chemical reaction - Unsteady state energy balances.

UNIT V	FLUE GAS ANALYSIS	9

Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from Orsat technique, Combustion processes – Flue gas analysis, Ultimate and Proximate analyses of coal. Application of Process simulators and excel solver tool in energy and material balance problems.

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Interpret the data presented in different unit systems and apply various gas laws to calculate the unknowns in a given system.	4
CO2.	Develop knowledge on various unit operations and unit processes and analyze the material balances for steady and unsteady state chemical systems.	4
CO3.	Discuss humidification operations and its applications for known systems.	3
CO4.	Perform and analyze energy balance calculations for steady and unsteady state chemical processes.	4
CO5	Explicate various methods used for analyzing combustion processes and demonstrate the ability to understand process simulators.	4

TEXT BOOKS:

1. David M. Himmelblau, "Basic Principles and Calculations in Chemical Engineering", Eighth Edition, Prentice Hall of India, New Delhi, 2012
2. Bhatt B.I. and Vora S.M., "Stoichiometry", Second Edition, Tata McGraw Hill, New Delhi, 2004
3. Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes", Third Edition, John Wiley & Sons, New York, 2005

REFERENCES:

1. Hougen O A, Watson K M and Ragatz R A, "Chemical process principles" Part I, Second Edition, CBS publishers, 1976.
2. Venkatramani. V, Anatharaman. N and Meera Shariffa Begam "Process Calculations" Prentice Hall of India, New Delhi, 2011.

COURSE ARTICULATION MATRIX

CO	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1.	3	3	3	3	2	2	1	1	1	2	3	3	3	3
2.	3	3	3	3	2	2	2	2	1	3	3	3	3	3
3.	3	3	3	3	2	1	1	1	1	2	2	3	3	3
4.	3	3	3	3	2	2	2	2	1	3	3	3	3	3

5.	3	3	3	3	3	2	2	2	1	3	3	3	3	3

CH 22302	MOMENTUM TRANSFER	L	T	P	C
		2	1	0	3

COURSE OBJECTIVES:

To impart to the student knowledge on fluid properties, fluid statics, dynamic characteristics for through pipes and porous medium, flow measurement and fluid machineries

UNIT I	FUNDAMENTALS OF FLUID AND FLUID FLOW	9

Fluid – properties of fluid – Continuum concept of fluid – Newton‟s law of viscosity, pressure and temperature dependence – classification of fluids – Newtonian fluid – Non-Newtonian fluid and their classification. Classification of fluid flow – Incompressible and Compressible flow – Steady, Unsteady, Uniform and Non – Uniform flow. Flow visualization – streamline, pathline, streak line, velocity and stress field.

UNIT II	FLUID STATICS AND FLUID KINEMATICS	9

Fluid statics – Pressure concept, Hydrostatic equilibrium, Manometer and their types. Fluid flow - Differential analysis of fluid motion – Conservation of mass – Equation of continuity and Equation of motion - Euler‟s equation, Bernoulli equation and with correction for fluid friction – correction for pump work, Navier- Stokes Equations and Applications

UNIT III	FLOW THROUGH CONDUITS, FIXED AND FLUIDIZED BEDS	9

Reynolds number, experiment and significance, Hagen Poiseuelle equation and Darcy-Weisbach equation; internal flow - flow through pipes and conduits – Moody diagram – friction factor – friction factor chart – head loss due to friction, sudden expansion and contraction. External flows - Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds - Kozeny Carman equation – Blake Plummer equation and Ergun equation.

UNIT IV	TRANSPORTATION OF FLUIDS	9

Flow measurement –classification flow measuring devices – Principle and working of Orifice meter, Venturi meter, Pitot tube and Rotameter. Brief introduction to non-conventional methods: Laser Doppler velocimetry, Particle image velocimetry, ultrasonic flow meters, electromagnetic flow meters. Valves, Types and characteristics of Valves; Pumps – Classification and working of Centrifugal pumps and Reciprocating pumps, Centrifugal pump: Cavitation and priming – performance characteristics – Net positive suction head – factors influencing selection of pump. Introduction to compressors, fans and blowers.

UNIT V	TURBULENCE AND SIMILARITY	9

Introduction to turbulence: Structure of turbulence, visualization of turbulence, Reynolds decomposition. Fundamental dimension of quantities, dimensional homogeneity – dimensional analysis: Physical significance of dimensionless numbers, Geometric – Kinematic and Dynamic Similarity

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Analyze the fluid properties and flow behaviour of fluids.	**3**
CO2.	Apply various equations governing fluid statics and fluid kinematics.	**4**
CO3.	Discuss the pressure drops during the flow of fluids through different physical systems like pipes, valves, fixed and fluidized beds.	**4**
CO4.	Analyze several machineries used to transport the fluid and their performance including the flow measurements.	**3**
CO5	Compare the fluid flow characteristics during the turbulent conditions using the analogies.	**4**

TEXT BOOKS:

1. McCabe W.L, Smith, J C and Harriot. P "Unit Operations in Chemical Engineering", McGraw Hill, Seventh Edition, 2005.
2. White, F.M., "Fluid Mechanics ", McGraw-Hill Inc., Seventh Edition, 2011.

REFERENCES:

1. Robert W. Fox and Alan T. McDonald, "Introduction to Fluid Mechanics" John Wiley & Sons, Inc, Fifth Edition, 2009.

2. Noel de Nevers, "Fluid Mechanics for Chemical Engineers ", McGraw-Hill, Third Edition, 2005.

3. J. O. Wilkes, Fluid Mechanics for Chemical Engineers, Prentice Hall (1999).

4. R. B. Bird, W. L. Stewart and E. L. Lightfoot, Transport Phenomena (Second edition), Wiley Singapore (2002).

5. M. M. Denn, Process Fluid Mechanics, Prentice Hall (1980).

COURSE ARTICULATION MATRIX

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

CH22303	CHEMICAL ENGINEERING THERMODYNAMICS – I	L	T	P	C
		2	1	0	3

COURSE OBJECTIVES:

- To apply the principles and application of first and second law of thermodynamics, and phase equilibria.

UNIT I	INTRODUCTION	9

Introduction- scope of thermodynamics, Dimensions and Units, Temperature, Pressure, Work, Energy, Heat, Energy conservation & first law of thermodynamics; State functions; Equilibrium; Phase Rule; Reversible process; Constant P,V,T processes; Mass and energy balances for open systems

UNIT II	SECOND LAW OF THERMODYNAMICS	9

Statements of the second law; Heat engines, Carnot‟s theorem, Thermodynamic Temperature Scales; Entropy; Entropy changes of an ideal gas; Mathematical statement of the second law, Entropy balance for open systems; Calculation of ideal work, Lost work

UNIT III	PVT BEHAVIOUR OF FLUIDS	9

Phases, phase transitions, PVT behaviour; description of materials – Ideal gas law, vanderWaals, virial, and cubic equations of state; Reduced conditions & corresponding states theories; correlations in description of material properties and behaviour. Heat effects-latent heat, sensible heat, standard heats of formation, reaction, and combustion

UNIT IV	THERMODYNAMIC PROPERTIES OF PURE FLUIDS	9

Thermodynamic property of fluids- Helmholtz free energy, Gibb’s free energy,Thermodynamic property relations- Maxwell relations, Residual properties,2-phase systems, graphs, Thermodynamic property diagrams – P-H, H-T, T-S, H- S and Thermodynamic property diagrams with its constructions.

UNIT V	REFRIGERATION AND LIQUIFACTION, COMPRESSOR WITH INTERCOOLING	9

Application of thermodynamics to flow processes-pumps, compressors, and turbines. Thermodynamic analysis of steam power plants; Rankine cycle; Internal combustion engine, Otto engine; Diesel engine; Jet engine. The Carnot refrigerator; Vapour-compression cycle; Absorption refrigeration cycle. Compressors, Types of Compressors with design calculation. Thermodynamic analysis of steam power plants; Liquefaction processes.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M. Smith, H.C. Van Ness and M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, Seventh edition, McGraw-Hill International Edition,2005.

REFERENCES:

1. K. V. Narayanan, A Textbook of Chemical Engineering Thermodynamics, Prentice Hall of India,2001
2. B. G. Kyle, Chemical and Process thermodynamics. Second Edition., Prentice Hall of India,2000
3. M J Moran, H N Shapiro, D Boettner and M B Bailey, Principles of Engineering Thermodynamics, 8th Edition, Wiley, 2000

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Apply concepts of heat, work and energy conversion and mass and energy balances to close and open systems	**3**
CO2.	Envisage the entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.	**3**
CO3.	Evaluate the properties of non-ideal gases.	**4**
CO4.	Illustrate the inter relations between measurable and non measurable properties.	**4**
CO5	Examine the process of liquefaction, refrigeration and different power cycles	**4**

COURSE ARTICULATION MATRIX

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

CH22304	MECHANICAL OPERATIONS	L	T	P	C
		2	1	0	3

COURSE OBJECTIVES:

To learn characterization of solids, size reduction, techniques of solid – fluid separation, mixing and conveying of solids.

UNIT I	PARTICLE CHARACTERIZATION AND MEASUREMENT	9

Particle shape and size, different ways of expression of particle size, shape factor, sphericity. Mixed particle size analysis, standard screens, Differential and cumulative size analysis, specific surface of mixture of particles, number of particles in a mixture. Screens, ideal and Actual screens, Effectiveness of screen, Standard Screen Series, sub sieve analysis – air permeability method.

UNIT II	PARTICLE SIZE REDUCTION AND SIZE ENLARGEMENT	9

Introduction – types of forces used for comminution, Criteria for comminution, Characteristics of comminuted products, Laws of size reduction, Work Index, Energy utilization, methods of operating crushers – Free and choke feeding, open circuit grinding, Closed circuit grinding, wet and dry grinding, Equipment's for size reduction & its operation– Jaw crusher, Roll crusher, Hammer mill, Ball mill, Fluid energy mill. Principles and importance of Size enlargement.

UNIT III	PARTICLE SEPARATION (GAS-SOLID AND LIQUID-SOLID SYSTEM)	9

Mechanics of particle motion, Equation for one dimensional motion of particles through a fluid in gravitational and centrifugal field, Terminal velocity, drag coefficient, Motion of spherical particles in Stoke's region, Newton's region, and Intermediate region, Criterion for settling regime, Hindered settling, Modification of equation for hindered settling. Equipment's for particle separation and its operation – Gravity settling, double cone classifier, rake classifier and surface area estimation for thickener. Centrifugal separation principle -cyclones and hydro cyclones.

UNIT IV	FILTRATION AND FILTRATION EQUIPMENTS	9

Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filter aids. Filtration equipment's - selection, operation and optimum cycle of operation, Principle of operation – plate and frame filter press, leaf filter, bag filter, electrostatic precipitator.

UNIT V	MIXING AND PARTICLE HANDLING	9

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

TOTAL: 45 PERIODS

TEXT BOOKS:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.

2. Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", Tata McGraw Hill, 1997.

3. Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., "Principles of Unit Operations", 2nd Edn., John Wiley & Sons, 1994.

4. Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. II, 4th Edn., Asian Books Pvt. Ltd., India, 1998.

REFERENCES:

1. 1. Hiroaki Masuda , KoHigashitani and Hideto Yoshida, Powder Technology Handbook, 4th Edition. Taylor & Francis, 2006

2. Christie J. Geankoplis, Transport processes and unit operations, Prentice Hall, 2018.

3. Sunggyu Lee, Kimberly H. Henthorn, Particle Technology and Applications, CRC Press, 2017.

4. Martin Rhodes, Introduction to Particle Technology, Second Edition, John Wiley & Sons, 2008.

5. Unit Operations-I, Fluid Flow & Mechanical Operation, K.A Gavhane, Nirali Prakashan, 2016.

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Applying the basic knowledge on the solid handling characteristics and mixed particle size analysis through screening.	3
CO2.	Examine the various comminution equipment's for size reduction operations and to understand the principles of size enlargement techniques	4
CO3.	Make use of various solid separation techniques through settling and basic knowledge on such equipment design.	3
CO4.	Analyse the various types of filtration process in mineral processing industries.	4
CO5	Apply knowledge to practice various mixing processes and particles storage & conveying.	3

COURSE ARTICULATION MATRIX

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

CH22305	MECHANICS OF SOLIDS FOR CHEMICAL ENGINEERING	L	T	P	C
		2	1	0	3

COURSE OBJECTIVES:

- To learn fundamental concepts of stress, strain and deformation of solids with applications to bars, beams, columns, thin cylinders and spherical shells.
- To know the mechanism of load transfer in beams, the induced stress resultants and deformations under axial and transverse loading.
- To analyze the forces and stresses on pressure vessel.

UNIT I	STRESS, STRAIN AND DEFORMATION OF SOLIDS	9

Stress and strain - tension, compression, reaction forces and shear stresses in simple and compound bars- Hooke's law –Thermal stresses - Relationship among elastic constants and Poisson's ratio – Stress strain diagrams for engineering materials – Factor of safety.

UNIT II	TRANSVERSE LOADING ON BEAMS	9

Beams – support conditions – types of Beams - forces on solids and supports – transverse loading on beams - shear force and bending moment in beams - analysis of cantilevers, simply supported beams and over hanging beams with reaction force - relationships between loading, S.F. and B.M. In beams - S.F.& B.M. diagrams – Location of point of contraflexure and maximum B.M.

UNIT III	DEFLECTION OF BEAMS	9

Double integration method, Macaulay's method, Moment-Area theorems and conjugate beams method for computation of slopes and deflections in simply supported and cantilever beams.

UNIT IV	STRESSES IN BEAMS & COLUMNS	9

Theory of simple bending – assumptions and derivation of bending equation - analysis of bending stresses in beams under transverse loading – loads carrying capacity of beams – proportioning beam sections - shear stress distribution in beams - determination of shear stress distribution in symmetrical and unsymmetrical sections with reaction force.Columns: Euler‟s theory of long columns and critical loads for columns with different end conditions.

UNIT V	DESIGN OF PRESSURE VESSELS	9

Codes & Standards, Vessels operating at low temperatures and elevated temperatures, design conditions and stress, design of shell and its components, supports, stress from local loads and thermal gradients, thermal stresses in cylindrical shell. Features of high pressure vessels – solid walled vessel, vessel closures, jackets.

TOTAL: 45 PERIODS

TEXTBOOKS:

1) R. K. Bansal, Strength of Materials, Fifth Edition, Laxmi Publications, 2012.

2) R. C. Hibbeler, Mechanics of Materials, Sixth Edition, Pearson Education, Inc., 2005

3) E. P. Popov, Engineering Mechanics of Solids, Prentice Hall, 1998.

4) F. P. Beer, E. R. Johnston (Jr.) and J.T. DeWolf, Mechanics of Materials, Tata McGraw Hill, 2005.

5) M. V. Joshi, Process Equipment Design, Macmillan, 1976.

REFERENCES:

1) S. H. Crandall, N. C. Dahl, and T. J. Lardner, An Introduction To The Mechanics Of Solid, 2nd Ed., Tata McGraw Hill, 2008.

2) S. P. Timoshenko, Strength of Materials, Vols. 1 & 2, CBS Publishers, 1986.

3) H. Shames and J. M. Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India, 2003.

4) J. M. Gere, Mechanics of Materials, Thomson Brooks/Cole, 2006.

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Recognize the fundamental concepts of stress and strain in mechanics of solids and structures.	**3**
CO2.	Apply the knowledge on types of beams and loads and investigate the shear force and bending moment diagrams.	**3**
CO3.	Utilizing various techniques to infer the deflection of beams.	**3**
CO4.	Develop the models to analyze the principle stresses in beams and columns.	**3**
CO5	Apply the knowledge of principle stresses to design the pressure vessels.	**3**

COURSE ARTICULATION MATRIX

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

CH22311	ENVIRONMENTAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

At the end of the course, the student will be aware of the standard procedures for quantification of quality parameter of wastewater, soil and air.

LIST OF EXPERIMENTS:

1. Estimation of the Total Solids for a given sample of water.
2. Permeability determination of solid sample.
3. Direct shear test in cohesionless soil.
4. Determination of chromium traces in tannery effluents.
5. Determination of the metal concentration in solid samples.
6. Determination of viscosity of oil samples using Brookfield Viscometer.
7. Determination of pH range of indicator solutions.
8. Determination of the COD of the given liquid sample.
9. Determination of the BOD of the given liquid sample.
10. Determination of total coliforms in water.
11. Determination of corrosion rate of the given sample.
12. Determination of air quality for indoor and outdoor environments.

*Minimum 10 experiments shall be performed

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS:

1. COD Digester
2. Atomic Absorption Spectroscopy
3. Brookfield Viscometer
4. Dissolved Oxygen meter
5. Conductivity meter
6. Carbon dioxide (CO_2) sensor
7. Constant head permeameter
8. Shear box assembly

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Analyse the characteristics of waste water using standard procedures.	**4**
CO2.	Conduct tests to determine the permeability and shear strength of soils.	**3**
CO3.	Characterise metals affected by corrosion.	**4**
CO4.	Analyse the air quality present in the surrounding environment.	**4**

CO5	Perform coliform analysis.	**3**

COURSE ARTICULATION MATRIX

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

CH22312	TECHNICAL ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

To learn basic principles involved in estimation and characterization of industrially important materials

LIST OF EXPERIMENTS:

I. Soap Analysis
- a. Estimation of total fatty acid
- b. Estimation of percentage alkali content

II. Oil Analysis
- a. Estimation of free acid
- b. Determination of Saponification value
- c. Determination of iodine value

III. Cement Analysis
- a. Estimation of Silica content
- b. Estimation of mixed oxide content
- c. Estimation of calcium oxide content
- d. Estimation of calcium oxide by rapid method

IV. Coal Analysis
- a. Estimation of Sulphur present in coal
- b. Ultimate analysis of coal
- c. Proximate analysis of coal

V. Analysis of Bleaching Powder
- a. Estimation of available chlorine

VI. Analysis of Glycerol
- a. Estimation of purity of glycerol

VII. Analysis of fuels
- a. Flash point
- b. Fire point
- c. Cloud point
- d. Pour point
- e. Aniline point.

TOTAL: 60 PERIODS

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Estimate the alkali and total fatty acid content of soap.	2
CO2.	Determine the acid value, iodine value and cloud & pour point of oil.	3
CO3.	Apply the principle of gravimetry to estimate the quantity of analyte.	3
CO4.	Determine the purity of glycerol	2
CO5	Analyze the available chlorine and residual chlorine in water sample	3
CO6	Analyze sulphate and turbidity in water sample.	2

COURSE ARTICULATION MATRIX

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

MA22452	NUMERICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

The Student should be made to:

- Learn the solution of algebraic, transcendental equations, system of linear equations
- Understand the concept of Interpolation and approximation.
- Learn how to apply numerical differentiation and Integration
- Familiarize in solving IVP
- Understand how to solve BVP in ODE and PDE

UNIT I	SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS	12

Introduction to computation software for numerical methods solution of algebraic and transcendental equations – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method, Solution of Tri-diagonal system of equations – Gauss Seidel iterative method - Matrix Inversion by Gauss Jordan method - Eigen values of a matrix by Power method and Jacobi Method for symmetric matrix. Solving equations and Eigen value problems using computational tools.

UNIT II	INTERPOLATION AND APPROXIMATION	12

Finite difference operators and its relations - Interpolation with equal intervals - Newton's forward and backward difference formulae - Interpolation with unequal intervals - Lagrange's interpolation - Newton's divided difference interpolation. Interpolation and Approximation using computational tools

UNIT III	NUMERICAL DIFFERENTIATION AND INTEGRATION	12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule, Romberg's Method - Two point and three-point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules. Application of computational tools for numerical differentiation and integration.

UNIT IV	INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS	12

Single Step methods - Taylor's series method, Modified Euler's method – Fourth order Runge Kutta method for solving first order equations, second order equations and simultaneous first order equations - Multi step methods - Milne's and Adams- Bash forth predictor corrector methods for solving first order equations. Solving Initial value problems using computational tools.

UNIT V	BOUNDARY VALUE PROBLEMS	12

Finite difference solution of ODE. Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method. Solving Boundary value problems using computational tools.

TOTAL: 60 PERIODS

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Have the fundamental knowledge of solving an algebraic or transcendental equation, linear system of equations.	**2**
CO2.	Appreciate the numerical techniques of interpolation in various intervals	**3**
CO3.	Apply the numerical techniques of differentiation and integration for engineering problems.	**3**
CO4.	Solve initial value problems using an appropriate numerical technique.	**3**
CO5	Solve boundary value problems using finite difference method.	**3**

TEXT BOOKS:

1) Grewal. B.S., Numerical Methods in Engineering & Science with Programs in C, C++ & MATLAB, Khanna Publishers, 11th Edition, New Delhi, 2013.
2) Jain M.K., Iyengar. S.R.K., and Jain. R.K, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, New Delhi, 2015.
3) Chapra. S.C., and Canale.R.P., Numerical Methods for Engineers, Tata McGraw Hill,7th Edition, New Delhi, 2015.

REFERENCES:

1) Sankara Rao. K., Numerical methods for Scientists and Engineers, Prentice Hall of India, 3rd Edition, New Delhi, 2007.
2) Gerald. C. F., and Wheatley. P. O., Applied Numerical Analysis, Pearson Education, Asia, New Delhi, 2009.
3) Venkataraman. M.K. Numerical Methods in Science and Engineering, National Publishers, 2001.
4) Kandasamy. K., Thilagavathy. K., and Gunavathi. K., Numerical Methods, S. Chand & Company Ltd., New Delhi, 2008.
5) Sastry, S.S., "Introductory Methods of Numerical Analysis", Prentice Hall of India, 2010.

WEBLINKS:

1. https://nptel.ac.in/courses/111/107/111107105/
2. https://nptel.ac.in/courses/111/107/111107063/

COURSE ARTICULATION MATRIX

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

CH22401	HEAT TRANSFER	L	T	P	C
		2	1	0	3

COURSE OBJECTIVES:

- To enable the students to learn the fundamental concepts of heat transfer conduction, convection, radiation, boiling, evaporation, and condensation.

- To use these fundamentals in typical engineering applications in heat transfer equipments like evaporator and heat exchangers.

UNIT I	HEAT TRANSFER BY CONDUCTION	9

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer – Fourier's law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder, spheres - Heat conduction through a series of resistances - Thermal conductivity measurement; effect of temperature on thermal conductivity; Heat transfer in extended surfaces.

UNIT II	HEAT TRANSFER BY CONVECTION	9

Concepts of heat transfer by convection - Natural and forced convection, Buckingham Pi Theorem, Dimensional analysis in heat transfer, heat transfer coefficient for flow through a pipe, flow past flat plate, and flow through packed beds. Application for developing semi - empirical non- dimensional correlation for convection heat transfer.

UNIT III	HEAT TRANSFER WITH PHASE CHANGE	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, Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling.

UNIT IV	EVAPORATION AND RADIATION HEAT TRANSFER	9

Theory of evaporation - single effect and multiple effect evaporation Thermal design calculation for single and multiple effect evaporation. Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzman law, Plank's law, radiation between surfaces – Concepts of shape factor, Heat exchange between grey bodies – Radiation exchange between non-black surfaces, radiation shields.

UNIT V	DESIGN OF HEAT EXCHANGERS	9

Classification of heat exchangers - overall and individual film coefficients heat transfer coefficient and fouling factor - Concepts of LMTD, and NTU methods - plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; - Chart for different configurations - Fouling factors.

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Impart knowledge on the various modes of heat transfer and apply conduction heat	3

	transfer concept	
CO2.	Apply convective heat transfer concept to fluids without phase change	**3**
CO3.	Develop the ability to model and analyze heat transfer processes with phase change	**4**
CO4.	Apply the concepts of evaporation to estimate steam economy, capacity of single and multiple effect evaporators	**3**
CO5	Apply thermal analysis of heat exchanger using LMTD and NTU method and design heat exchanger	**4**

TEXT BOOKS:

1) Binay K. Dutta, "Heat Transfer Principles and applications" Prentice Hall of India Pvt.Ltd.
2) Holman, J. P., „Heat Transfer", Eighth Edition., Tata McGraw Hill, 1997
3) Coulson, J.M. and Richardson, J.F., "Chemical Engineering", Vol. I, Fourth Edition., Asian Books Pvt. Ltd., India, 1998.

REFERENCES:

1. Kern, D.Q., "Process Heat Transfer ", McGraw-Hill, 1999
2. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", Seventh Edition., McGraw-Hill, 2005.

COURSE ARTICULATION MATRIX

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

CH22402	MASS TRANSFER I	L	T	P	C
		2	1	0	3

COURSE OBJECTIVES:

1. To understand the diffusion mechanism in fluids and solids.
2. To understand the role of mass transfer coefficients in design calculations.
3. To understand the mechanism of humidification operations.
4. To understand the drying operations used in chemical and allied industries.
5. To design a crystallizer for a suitable purpose.

UNIT I	DIFFUSION	9

Molecular diffusion in gases and liquids, measurement and calculation of diffusivities, steady state diffusion in multicomponent mixtures.

Diffusion in solids, molecular and Knudsen diffusion in porous solids, unsteady state diffusion in solids.

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, humidification operations; theory and types of cooling tower, dehumidifiers and humidifiers using enthalpy transfer unit concept.

UNIT IV	DRYING	9

Drying Theory and Mechanism, Drying Characteristics, Estimation of Drying time, drying rate curve, Classification of Driers, Through circulation driers design, Design of driers, Description and Application of Driers, Analysis of continuous driers.

UNIT V	CRYSTALLISATION	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

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Apply the principles of diffusion in measuring diffusivity.	3
CO2.	Calculate different types of Mass transfer co-efficient and identify the relation between them.	3
CO3.	Apply mass transfer concepts in designing humidification units.	3
CO4.	Calculate rate of drying using Mass transfer concepts.	3
CO5	Apply mass transfer concepts in designing crystallization units.	3

TEXT BOOKS:

1. Treybal, R.E., “Mass Transfer Operations”, Third Edition, McGraw-Hill, 1981.
2. McCabe, W.L., Smith, J.C., and Harriot, P., “Unit Operations in Chemical Engineering”, Seventh Edition., McGraw-Hill, 2005.
3. Geankoplis, C.J., “Transport Processes and Separation Process Principles Includes Unit Operations”, Fourth Edition, Prentice Hall Inc., New Jersey, 2003

REFERENCES:

1. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. I and II, Fourth Edition, Asian Books Pvt. Ltd., India, 1998
2. Foust A.S, “Principles of Unit Operations”, Second Edition, John Wiley, 2008
3. Seader J.D & Henley E.J, “Separation Process Principles”, Second Edition, John Wiley, 2006.
4. E.L. Cussler, “Diffusion, Mass Transfer in Fluid Systems”, Second Edition, Cambridge University Press, 1997

COURSE ARTICULATION MATRIX

CO	**PO’s**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.	3	3		1									3	3	
2.	3	3		2									3	3	
3.	3	3		3		2	2	2				2	3	3	
4.	3	3		3		2	2	2				2	3	3	
5.	3	3	2	3		2	2	2				2	3	3	

CH22403	CHEMICAL REACTION ENGINEERING I	L	T	P	C
		2	1	0	3

COURSE OBJECTIVES:

- To study the kinetics of chemical reactions and the analysis of kinetic data
- To design a suitable reactor for single and multiple reaction schemes
- To study the non-isothermal operation of reactors
- To impart knowledge on residence time distribution studies in non-ideal flow reactors

UNIT I	KINETICS AND ANALYSIS OF EXPERIMENTAL KINETIC DATA	9

Overview of Chemical Reaction Engineering - Kinetics of homogeneous reactions - Elementary and Non-elementary reactions - Theories on reaction rates - Temperature dependence of rate constants- Activation Energy and Arrhenius Equation - Kinetics of Bio-Chemical Reactions: Michaelis Menton model; Auto-catalytic reactions. , Analysis of experimental kinetics data, integral and differential analysis.

UNIT II	IDEAL REACTOR DESIGN FOR HOMOGENEOUS SINGLE REACTIONS	9

Performance equations for ideal batch, Plug flow, Back-mix flow and semi batch reactors for isothermal condition, Size comparison of single reactors, Multiple-reactor systems, Recycle reactor.

UNIT III	MULTIPLE REACTIONS	9

Parallel reactions of different orders: Yield and selectivity, Product distribution and design for single and multiple reactors - Series reactions: first-order reactions and zero-order reactions.

UNIT IV	TEMPERATURE EFFECTS FOR SINGLE AND MULTIPLE REACTIONS	9

Thermal stability of reactors and optimal temperature progression for first order reversible reactions – Equilibrium conversion - Adiabatic and heat regulated reactors, Multiple Steady States in Continuous Stirred Tank Reactor (CSTR) - Design of non-isothermal reactors.

UNIT V	NON – IDEAL FLOW REACTORS	9

Concept of residence time distribution (RTD), Measurement and moments of RTD, RTD in batch reactors, Plug Flow Reactor and CSTR. Zero Parameter Model: One parameter model: Tanks in series model and Dispersion Model.

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Analyze kinetic data and determine the rate of the reaction.	4
CO2.	Design ideal reactors for homogeneous reactions	6
CO3.	Evaluate reactor systems to carry out multiple reactions and recommend reactor/combination of reactors for the yield of desired product.	5
CO4.	Discuss the temperature effects and design non-isothermal reactors	6
CO5	Develop mathematical models for conversion in non-ideal flow reactors	6

TEXT BOOKS:

1) H.S. Fogler,*Elements of Chemical Reaction Engineering*, Prentice Hall of India Ltd., 2016.
2) O. Levenspiel,*Chemical Reaction Engineering*,Wiley Eastern Ltd., 2006.

REFERENCES:

1) J.M. Smith, *Chemical Engineering Kinetics*,McGraw Hill, 1981.
2) Keith, J. Laidler,*Chemical Reaction kinetics*, Pearson Education Asia,2004.
3) G. F. Froment, K. B. Bischoff and J. De Wilde,*Chemical Reactor Analysis and Design*, John Wiley &Sons, 1979.
4) M.E.Davis, R.J.Davis,*Fundamentals of Chemical Reaction Engineering***,** McGraw Hill, 2003.

COURSE ARTICULATION MATRIX

CO	**PO's**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.	**3**	**3**	**3**	**3**	**3**	**3**	**3**			**1**	**1**	**1**	**3**	**3**	
2.	**3**	**3**	**3**	**3**	**3**	**3**	**3**			**1**	**1**	**1**	**3**	**3**	
3.	**3**	**3**	**3**	**3**	**3**	**3**	**3**			**1**	**1**	**1**	**3**	**3**	
4.	**3**	**3**	**3**	**3**	**3**	**3**	**3**			**1**	**1**	**1**	**3**	**3**	
5.	**3**	**3**	**3**	**3**	**3**	**3**	**3**			**1**	**1**	**1**	**3**	**3**	

CH22404	INSTRUMENTAL METHODS OF ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to acquire knowledge in the field of various instrumentswhich are used in the analysis of products in various chemical industries.

UNIT I	FUNDAMENTALS OF SPECTRAL ANALYSIS	9

Spectral Analysis: principle, electromagnetic radiation-regions, properties and interaction with matter, classification of instrumental methods based on physical properties; Colorimetric analysis: Beer-Lambert's Law, Instrumentation, Real Limitations, Apparent ChemicalDeviations,Application,Nesslerimetry and Duboscq colorimetry, Estimation of inorganic ions such as Ni and Nitrite by Colorimetry; UV-Visible and IR spectroscopy: Instrumentation and application, Solvent effects, Various electronic transitions involved in organic molecules, Characterization, Chromophore concept, Effects of auxochromes and effects of conjugation on the absorption maxima, Modes of molecular vibrations, Mull and Pressed Pellet Technique;Woodward-Fischer rules for the calculation of absorption maxima.

UNIT II	ELECTROMETRIC METHODS	9

Conductometric Titrations: Instrumentation, Types, Limitations, Specific-Equivalent-Molecular conductance,Advantages& Application; Potentiometric Titrations: Instrumentation, Types, Advantages & Application; Measurement of pH: Instrumentation, Calibration method, Applications; Ion selective electrodesand types: Electrode setup - Applications; Amperometric titrations: Principle, instrumentation, Application.

UNIT III	IMPORTANT SPECTROSCOPIC METHODS OF ANALYSIS	9

Atomic Absorption Spectroscopy (AAS): Principle, Instrumentation, absorbance-concentration relationship, Interference and Applications;Emission Spectroscopy: Flame Photometry and Inductively coupled Plasma Atomic Emission spectroscopy (ICP-AES)- Principle, Instrumentation, Advantages& Applications; Polarimetry: Principle, Instrumentation and Applications; Refractometry: Principle, Snell's law, Instrumentation, Types and Applications;Nephlometry and Turbidimetry: Principle, Instrumentation and Applications.

UNIT IV	MAGNETIC RESONANCE SPECTROSCOPY & MASS SPECTROMETRY	9

Absorption spectrum-emission spectrum; Magnetic resonance spectroscopy: Theory of NMR, environmental effect on NMR spectra, Modes of Nuclear Spin, Chemical shift, NMR spectrometers, applications of 1H and 13C NMR, Application; Molecular Mass Spectrum: Ion sources, Mass spectrometer, applications of molecular mass spectrometry, Electron Paramagnetic Resonance (EPR) – g values, instrumentation and applications.

UNIT V	X-RAY METHODS AND SURFACE MICROSCOPY	9

Mosley law, Continuous and Discontinuous spectra, X-ray instrumentation, X-ray detection and measurement, The Laue method of analysis, Bragg‟s law, Diffraction of X-rays, Production and detection of X-rays – Debye Scherrer method. Study of surfaces: Scanning electron Microscopy, Transmission Electron Microscopy (TEM), Energy Dispersive X-ray (EDX) microanalyzer, Scanning probe microscopes, Scanning Tunnelling Microscope (STM) and Atomic Force Microscope (AFM).

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Apply knowledge on the fundamental concepts and various terms in electromagnetic radiations and absorption spectroscopy.	3
CO2.	Arrive at the knowledge in the various analytical instruments which are based on electrical property of compounds.	4
CO3.	Obtain familiarity on various properties of liquid materials and the instruments used	3

	to measure these properties	
CO4.	Investigate the applications of spectroscopic techniques in Chemical Industry.	**4**
CO5	Analyze the modern techniques which are used in nanoscience.	**3**

TEXT BOOKS:

4) D.A.Skoog, D.M.West, F.J.Holler and S.R.Crouch, "Fundamentals of Analytical Chemistry", Ninth Edition, Brooks / Cole, Cenage Learning, 2014.
5) B.K.Sharma, "Instrumental Methods of Chemical Analysis", Twenty Eighth Edition, Goel Publishing House, 2012.

REFERENCES:

6) H.H.Willard, I.I.Merritt, J.A.Dean and F.A.Settle, "Instrumental Methods of Analysis", Seventh Edition, Pearson Education, 2002.
7) H.Kaur, "Instrumental Methods of Chemical Analysis", Eighth Edition, Pragati Prakashan Publishers, 2012.

COURSE ARTICULATION MATRIX

CO	**PO's**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.	2	1	1	1	3	2	1	1	1	1	1	2	2	2	
2.	3	1	3	2	3	-	-	1	1	1	-	2	1	1	
3.	2	2	3	1	3	2	-	-	1	-	-	1	1	1	
4.	2	1	1	1	1	1	1	-	1	-	1	2	1	1	
5.	3	3	1	1	3		2	1	1	1	1	1	2	2	

CH22408	CHEMICAL ENGINEERING THERMODYNAMICS II: THEORY AND PRACTICE	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Determine thermodynamic properties of gaseous mixtures, Solutions and also to evaluate heat effects involved in industrial chemical processes

UNIT I	SOLUTION THERMODYNAMICS	6 + 6

Fundamental property relation, Chemical potential, Partial properties, The ideal gas mixture model, The ideal solution model, Excess properties.

Practical - Prediction of Heat of solution by solubility method.

UNIT II	APPLICATIONS OF SOLUTION THERMODYNAMICS	6 + 6

Activity coefficient, Excess Gibbs Energy, Models for the excess Gibbs energy, Property changes of mixing, Heat effects of mixing process. Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity.

Practical – Vapour liquid equilibrium studies of an Ideal Binary system

UNIT III	PHASE EQUILIBRIUM	6 + 6

Application of phase rule - vapour-liquid equilibrium, phase diagrams for homogeneous systems and for systems with a miscibility gap - effect of temperature and pressure on azeotrope composition - liquid-liquid equilibrium - ternary liquid-liquid equilibrium.

Practical – Prediction of azeotropic composition and VLE data by vanlaar model

UNIT IV	CORRELATION AND PREDICTION OF PHASE EQUILIBRIA	6 + 6

Activity coefficient-composition models - thermodynamic consistency of phase equilibria - application of the correlation and prediction of phase equilibria in systems of engineering interest particularly to distillation and liquid extraction processes.

Practical – Validating Thermodynamic consistency test using othmer VLE still

UNIT V	CHEMICAL REACTION EQUILIBRIA	6 + 6

Standard free energy change and reaction equilibrium constant - evaluation of reaction equilibrium constant - prediction of free energy data - calculation of equilibrium compositions for homogeneous chemical reactors.

Practical – Determination of equilibrium constant

TOTAL: L 30 + P 30 PERIODS

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Identify the partial Molar property of solutions upon mixing.	3
CO2.	Envisage the equilibrium between phases in multicomponent systems and Excess property of solutions.	4
CO3.	Explore and generate the phase diagram data to find the effect of temperature and pressure on azeotropic conditions.	4
CO4.	Apply knowledge on various models used to evaluate the equilibrium data to test the thermodynamic consistency.	4
CO5	Identify and calculate the equilibrium constant for various systems	4

TEXT BOOKS:

1. M. Smith, H.C. Van Ness and M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, Seventh edition, McGraw-Hill International Edition,2005.

REFERENCES:

1. K. V. Narayanan, A Textbook of Chemical Engineering Thermodynamics, Prentice Hall of India,2001
2. B. G. Kyle, Chemical and Process thermodynamics. Second Edition., Prentice Hall of India,2000
3. M J Moran, H N Shapiro, D Boettner and M B Bailey, Principles of Engineering Thermodynamics, Eighth Edition, Wiley

COURSE ARTICULATION MATRIX

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

GE22451	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize the biodiversity of India and its conservation.

To impart knowledge on the causes, effects and control or prevention measures of environmental pollution.

To study and understand the various types of renewable sources of energy and their applications.4

To familiarize the concept of sustainable development goals, economic and social aspects of sustainability, recognize and analyze climate changes, and environmental management challenges.

To inculcate and embrace sustainability practices, develop a broader understanding of green materials and energy cycles, and analyze the role of sustainable urbanization.

UNIT I	ENVIRONMENT AND BIODIVERSITY	9

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– food chains, food webs and ecological pyramids, ecological succession. Biodiversity- types- genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: fragmentation and habitat loss, poaching of wildlife, human-wildlife conflicts – endangered and endemic species of India –conservation of biodiversity: In-situ and ex-situ.

UNIT II	ENVIRONMENTAL POLLUTION	9

Definition, causes, effects and preventive measures of air, water and soil pollution. Marine and thermal pollution - causes, effects and control measures. Light and noise pollution - effect on flora and fauna. Nuclear pollution- Sources, effects and control measures. Disposal of radioactive wastes (Nuclear hazards). Pollution case studies. Role of an individual in the prevention of pollution. Solid, hazardous and E-waste management. Occupational health and safety management system (OHASMS). Environmental protection, Environmental protection acts, categorization of spices according to IUCN.

UNIT III	RENEWABLE SOURCES OF ENERGY	9

Energy resources: Growing energy needs, Nonrenewable resources – types, uses. Energy management and conservation - New energy sources, Need of new sources - geo suitability of establishing renewable energy sources, different types new energy sources. Applications of hydrogen energy, ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy. Role of an individual in conservation of energy.

UNIT IV	SUSTAINABILITY AND MANAGEMENT	9

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability- from unsustainability to sustainability-millennium development goals, and protocols, Sustainable Development

Goals-targets, indicators and intervention areas - Principles of green chemistry, Climate change- Global, Regional and local environmental issues and possible solutions-case studies - Role of non-governmental organization, Concept of carbon credit, carbon footprint - Environmental management in industry - A case study

UNIT V	SUSTAINABILITY PRACTICES	9

Zero waste and R concept, circular economy, ISO 18000 series, material life cycle assessment, environmental impact assessment. Wasteland reclamation, Sustainable habitat: green buildings, green materials, energy efficiency and energy audit, sustainable transports. Energy cycles, carbon cycle, emission and sequestration, Green engineering: sustainable urbanization- socio-economical and technological change. Rainwater harvesting, watershed management, environmental ethics: Issues and possible solutions.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 7th Edition, New Age International Publishers, 2022.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Pearson. 2011.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, CL Engineering, 2015.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES:

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Recognize the fundamental role of ecosystems and suggest an appropriate method for the conservation of biodiversity.	3
CO2.	Describe the different types of pollution, their effects and strategies to control pollution.	3
CO3.	Identify the various renewable energy resources and use the appropriate one thereby conserving non-renewable resources for future generation.	3
CO4.	Explain the various goals of sustainable development applicable to suitable technological advancement and societal development.	2
CO5	Summarize the various sustainability practices, green materials, energy cycles, and the role of green engineering in sustainable urbanization.	2

COURSE ARTICULATION MATRIX														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3					3	3	2		2		1		
CO2	3					3	3	2		2		2		
CO3	3		1			3	3	1		2		1		
CO4	3					3	3	3		2		2		
CO5	3					3	3	3		2		2		

CH22411	MOMENTUM TRANSFER LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- The students will learn experimentally to calibrate flow meters
- Find pressure loss for fluid flows across various pipes beds
- Determine Performance characteristics of different types of pumps.

LIST OF EXPERIMENTS:

1) Calibration of Orifice and Venturimeter
2) Calibration of Rotameter
3) Calibration of V-Notch
4) Efflux time test rig – Open drum orifice and draining time
5) Flow through straight pipe
6) Flow through annular pipe
7) Flow through helical coil
8) Flow Through spiral coil
9) Losses in pipe fittings and valves
10) Performance characteristics of Centrifugal pump
11) Performance characteristics of Reciprocating pump
12) Performance characteristics of Gear pump
13) Pressure drop studies in packed column
14) Hydrodynamics of fluidized bed
15) Drag coefficient of solid particle
16) Velocity Measurement using Pitot Tube
17) Reynolds Experiment

***Minimum of 10 Experiments to be offered**

TOTAL: 30 PERIODS

LIST OF EQUPMENTS:

1) Orificemeter
2) Venturimeter
3) Rotameter
4) V-Notch
5) Efflux time test rig
6) Straight pipe
7) Annular pipe
8) Helical coil
9) Spiral coil
10) Fittings and valves
11) Centrifugal pump
12) Reciprocating pump
13) Gear pump
14) Packed column
15) Fluidized bed
16) Drag Column
17) Pitot Tube
18) Reynolds Experiment

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Demonstrate practical understanding of various theoretical fluid flow properties	3
CO2.	Utilize basic flow and pressure measurement techniques for fluid flow	3
CO3.	Demonstrate practical understanding of friction losses in internal flows	3
CO4.	Discuss the differences among measurement techniques, their relevance and applications	3
CO5	Compare the results of analytical models with the actual behavior of real fluid flows	3

COURSE ARTICULATION MATRIX

CO	**PO's**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.	3	3	2	1	1	2	1	1	3	1	2	1	3	3	
2.	3	2	1	3	2	2	1	1	2	1	2	1	3	3	
3.	2	3	2	2	1	2	1	1	2	2	2	1	3	3	
4.	3	3	3	2	2	2	2	2	3	2	1	2	3	3	
5.	2	3	2	3	2	2	2	1	1	1	2	1	3	3	

CH22412	MECHANICAL OPERATIONS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

To enable the students to develop a sound working knowledge on different types of crushing equipment and separation studies using different mechanical filters and separators

LIST OF EXPERIMENTS:

1.Screen Effectiveness
2. Size Analysis
3. Jaw Crusher
4. Ball mill
5. Roll Crusher
6. Drop weight crusher
7. Leaf filter
8. Plate and Frame Filter press
9. Batch Sedimentation Test
10. Sub- Sieve Analysis - Beaker decantation
11. Cyclone separator
12. Air Elutriator
13. Air Permeability
14. Mixing Index

*Minimum 10 experiments shall be performed

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS

1. Gyratory Sieve shaker & Sieves
2. Air Permeability apparatus.
3. Jaw Crusher
4. Ball Mill
5. Roll Crusher
6. Drop Weight Crusher
7. Leaf filter
8. Plate and Frame Filter Press
9. Cyclone Separator
10. Air Elutriator

OUTCOMES:

Upon successful completion of the course, the students should be able to

SL.NO	STATEMENT	RBT LEVEL
CO1.	Apply knowledge of various mechanical operations	3
CO2.	Analyse the practical importance of crushing, grinding and size separation in inorganic process industry	4
CO3.	Relate the theoretical and practical concepts used in industry	4
CO4.	Evaluate the working of equipment used for mechanical operations.	5
CO5	Develop the skill to operate filter, screens, sedimentation tank, crusher, mill.	6

COURSE ARTICULATION MATRIX															
CO	**PO's**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.	3	2	2	3	2	1	2	1	1	1	1	1	3	3	
2.	3	3	3	3	3	1	2	1	1	2	1	1	3	3	
3.	3	3	2	2	2	1	1	1	1	1	2	2	3	3	
4.	2	2	3	2	1	1	1	1	1	3	2	2	2	2	
5.	3	3	3	3	2	1	1	1	1	3	2	2	2	2	