

Chemical Engineering - (4 Year B.Tech Programme) - COURSE CURRICULUM R-19	Total Credits:160
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I Year Course structure

Semester - I

Code	Title of the Course	Category							Max. marks		Total Marks	Credits
			L	T	P	E	O	Total	Sess.	End. Exam		
CHE111	Engineering Mathematics – I	BS	3	0	0	1	6	10	40	60	100	3
CHE112	Engineering Physics	BS	3	0	0	1	4	8	40	60	100	3
CHE113	Engineering Chemistry	BS	3	0	0	1	4	8	40	60	100	3
CHE114	Introduction to Chemical Engineering	PC	3	0	0	1	4	8	40	60	100	3
CHE115	Engineering Drawing	ES	2	0	3	1	4	10	40	60	100	3.5
CHE116	Engineering Physics Lab	BS	0	0	3	0	1	4	50	50	100	1.5
CHE117	Engineering Chemistry Lab	BS	0	0	3	0	1	4	50	50	100	1.5
CHE118	Engineering Workshop	ES	0	0	3	0	1	4	50	50	100	1.5
CHE119	Human Values and Professional Ethics (Mandatory non-credit course)	MC	3	0	0	0	1	4	50	0	50	--
	Total		17	0	12	5	26	60	400	450	850	20

Semester - II

Code	Title of the Course	Category							Max. marks		Total Marks	Credits
			L	T	P	E	O	Total	Sess.	End. Exam		
CHE121	Engineering Mathematics – II	BS	3	0	0	1	6	10	40	60	100	3
CHE122	Communicative English	HS	3	0	0	1	4	8	40	60	100	3
CHE123	Physical and Analytical Chemistry	BS	3	0	0	1	5	9	40	60	100	3
CHE124	Basic Electrical and Electronics Engineering	ES	3	0	0	1	5	9	40	60	100	3
CHE125	Problem solving with C	ES	3	0	0	1	6	10	40	60	100	3
CHE126	English Language Lab	HS	0	0	3	0	1	4	50	50	100	1.5
CHE127	Problem solving with C Lab	ES	0	0	3	0	3	6	50	50	100	1.5
CHE128	Environmental Science (Mandatory non-credit course)	MC	3	0	0	0	1	4	50	0	50	--
	Total		18	0	6	5	31	60	350	400	750	18

II Year Course structure

Semester - I												
Code	Name of the Course	Category							Max. marks		Total Marks	Credits
			L	T	P	E	O	Total	Sess.	End. Exam		
CHE211	Engineering Mathematics – III	BS	3	0	0	1	6	10	40	60	100	3
CHE212	Organic Chemistry	BS	3	0	0	1	5	9	40	60	100	3
CHE213	Basic Mechanical Engineering	ES	3	0	0	1	5	9	40	60	100	3
CHE214	Chemical Process Calculations	PC	3	0	0	1	6	10	40	60	100	3
CHE215	Mechanical Operations	PC	3	0	0	1	6	10	40	60	100	3
CHE216	Organic Chemistry Lab	BS	0	0	3	0	1	4	50	50	100	1.5
CHE217	Mechanical Operations Lab	PC	0	0	3	0	1	4	50	50	100	1.5
	Total		15	0	6	5	30	56	300	400	700	18

Semester - II												
Code	Name of the Course	Category							Max. marks		Total Marks	Credits
			L	T	P	E	O	Total	Sess.	End. Exam		
CHE221	Engineering Mathematics – IV	BS	3	0	0	1	6	10	40	60	100	3
CHE222	Biology for Engineers	BS	3	0	0	1	3	7	100	--	100	3
CHE223	Momentum Transfer	PC	3	0	0	1	6	10	40	60	100	3
CHE224	Chemical Engineering Thermodynamics – I	PC	3	0	0	1	5	9	40	60	100	3
CHE225	Numerical Methods for Chemical Engineers	PC	3	0	0	1	5	9	40	60	100	3
CHE226	Professional Elective - I	PE	3	0	0	1	3	7	40	60	100	3
CHE227	Momentum Transfer Lab	PC	0	0	3	0	1	4	50	50	100	1.5
CHE228	Computational Lab	PC	0	0	3	0	1	4	50	50	100	1.5
	Total		18	0	6	6	30	60	400	400	800	21

III Year Course structure

Semester - I												
Code	Name of the Course	Category							Max. marks		Total Marks	Credits
			L	T	P	E	O	Total	Sess.	End. Exam		
CHE311	Open Elective - I	OE	3	0	0	1	2	6	40	60	100	3
CHE312	Chemical Engineering Thermodynamics – II	PC	3	0	0	1	4	8	40	60	100	3
CHE313	Heat Transfer	PC	3	0	0	1	4	8	40	60	100	3
CHE314	Mass Transfer - I	PC	3	0	0	1	4	8	40	60	100	3
CHE315	Chemical Technology	PC	3	0	0	1	4	8	40	60	100	3
CHE316	Professional Elective – II	PE	3	0	0	1	3	7	40	60	100	3
CHE317	Quantitative and Verbal Aptitude – I	HS	0	0	3	1	3	7	100	0	100	1.5
CHE318	Heat Transfer Lab	PC	0	0	3	0	1	4	50	50	100	1.5
CHE319	Chemical Technology Lab	PC	0	0	3	0	1	4	50	50	100	1.5
	Total		18	0	9	7	26	60	440	460	900	22.5

Semester - II												
Code	Name of the Course	Category							Max. marks		Total Marks	Credits
			L	T	P	E	O	Total	Sess.	End. Exam		
CHE321	Open Elective - II	OE	3	0	0	1	2	6	40	60	100	3
CHE322	Mass Transfer – II	PC	3	0	0	1	4	8	40	60	100	3
CHE323	Chemical Reaction Engineering – I	PC	3	0	0	1	4	8	40	60	100	3
CHE324	Process Dynamics and Control	PC	3	0	0	1	4	8	40	60	100	3
CHE325	Professional Elective - III	PE	3	0	0	1	3	7	40	60	100	3
CHE326	Professional Elective – IV	PE	3	0	0	1	3	7	40	60	100	3
CHE327	Quantitative Aptitude – II & Soft Skills	HS	0	0	3	2	3	8	100	0	100	1.5
CHE328	Mass Transfer Lab	PC	0	0	3	0	1	4	50	50	100	1.5
CHE329	Process Dynamics and Control Lab	PC	0	0	3	0	1	4	50	50	100	1.5
	Total		18	0	9	8	25	60	440	460	900	22.5

IV Year Course structure

Semester - I												
Code	Name of the Course	Category							Max. marks		Total Marks	Credits
			L	T	P	E	O	Total	Sess.	End. Exam		
CHE411	Open Elective – III	OE	3	0	0	1	2	6	40	60	100	3
CHE412	Chemical Reaction Engineering – II	PC	3	0	0	1	5	9	40	60	100	3
CHE413	Transport Phenomena	PC	3	0	0	1	6	10	40	60	100	3
CHE414	Process Modeling and Simulation	PC	3	0	0	1	5	9	40	60	100	3
CHE415	Chemical Process Economics and Equipment Design	PC	3	0	0	1	6	10	40	60	100	3
CHE416	Chemical Reaction Engineering Lab	PC	0	0	3	0	1	4	50	50	100	1.5
CHE417	Process Modeling and Simulation Lab	PC	0	0	3	0	1	4	50	50	100	1.5
CHE418	Project Phase – I	PR	0	0	3	0	3	6	100	-	100	2
CHE419	Summer Internship *	PR	0	0	0	0	1	1		100	100	1
	Total		15	0	9	5	30	59	400	500	900	21

*There is summer Internship (Industrial Training) at the end of III year II Semester for a minimum of three weeks during summer vacation.

Assessment for the same is made during IV year I semester.

Semester - II												
Code	Name of the Course	Category							Max. marks		Total Marks	Credits
			L	T	P	E	O	Total	Sess.	End. Exam		
CHE421	Open Elective – IV	OE	3	0	0	1	2	6	40	60	100	3
CHE422	Professional Elective – V	PE	3	0	0	1	3	7	40	60	100	3
CHE423	Professional Elective – VI	PE	3	0	0	1	3	7	40	60	100	3
CHE424	Project Phase – II	PR	0	0	9	0	9	18	100	100	200	8
	Total		9	0	9	3	17	38	220	280	500	17

* Open Elective can be interdisciplinary/ emerging subjects/ MOOCs that will be decided by the department

R -2019 regulations – List of electives

CHE 226 Professional Elective - I

CHE 226 (A)	Polymer Technology
CHE 226 (B)	Entrepreneur Engineering
CHE 226 (C)	Design Thinking

CHE 316 Professional Elective – II

CHE 316 (A)	Industrial safety
CHE 316 (B)	Fertilizer Technology
CHE 316 (C)	Pharmaceutical Technology

CHE 325 Professional Elective – III

CHE325 (A)	Industrial pollution and control
CHE325 (B)	Membrane technology
CHE325 (C)	Catalysis

CHE 326 Professional Elective – IV

CHE326 (A)	Material Science and Engineering
CHE326 (B)	Petroleum refinery Engineering
CHE326 (C)	Energy engineering

CHE 422 Professional Elective – V

CHE422 (A)	Petrochemicals
CHE422 (B)	Nanotechnology
CHE422 (C)	Industrial management

CHE 423 Professional Elective – VI

CHE423 (A)	Biochemical engineering
CHE423 (B)	Process optimization
CHE423 (C)	Computational fluid dynamics

CHE 311 Open Elective - I

CHE 321 Open Elective - II

CHE 411 Open Elective – III

CHE 421 Open Elective – IV

ENGINEERING MATHEMATICS-I

MATRIX ALGEBRA & MULTIVARIABLE CALCULUS

Common to all branches

Course Code - Category: CHE 111 - BS

Credits:3

L T P E O
3 0 0 1 6

Sessional Marks:40

End Exam: 3 Hours

End Exam Marks:60

Course Objective:

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

Course outcomes:

By the end of the semester, the student will be able to:	
CO1	Apply elementary transformations to reduce the matrix into the echelon form and normal form to determine its rank and interpret the various solutions of system of linear equations
CO2	Identify the special properties of a matrix such as the eigen value, eigen vector, employ orthogonal transformations to express the matrix into diagonal form, quadratic form and canonical form
CO3	Equip themselves familiar with the functions of several variables and mean value theorems
CO4	Evaluate double and triple integrals techniques over a region in two dimensional and three dimensional geometry
CO5	Familiarize with special functions to evaluate some proper and improper integrals using beta and gamma functions

CO – PO – PSO Matrix:

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

SYLLABUS

Unit - I: Linear Equations

10 Periods

Rank of matrix, normal form of a matrix, PAQ form, Gauss Jordan Method of finding the inverse, consistency of linear system of equations.

Learning outcome: At the end of this unit student will be able to

- Solve the system of equations using the rank.

Unit - II: Linear transformations and Quadratic forms

14 Periods

Linear transformations, orthogonal transformations, vectors (linearly independent & dependent), eigen values, eigen vectors, properties of eigen values, Cayley - Hamilton theorem (without proof), reduction to diagonal form, reduction of Quadratic form to Canonical form, nature of the Quadratic form.

Learning outcome: At the end of this unit, student will be able to

- Identify the special properties of a matrix such as the eigen values, eigen vectors, diagonal form and nature of the quadratic forms.

Unit - III: Single and Multivariable Calculus

12 Periods

Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem (All theorems without proof). Partial derivatives, total derivatives, chain rule, change of variables, Jacobians, Taylor's series expansion of two variable function, maxima and minima of functions of two variables, method of Lagrange's multipliers.

Learning outcome: At the end of the unit, student will be able to

- Analyze the behavior of functions by using mean value theorems.
- Estimate the maxima and minima of multivariable functions.

Unit - IV: Multiple Integrals

14 Periods

Double integrals, change of order of integration, double integration in polar coordinates, areas enclosed by plane curves, evaluation of triple integrals, volumes of solids, change of variables between cartesian cylindrical and spherical polar coordinates, calculation of mass, center of gravity.

Learning outcome: At the end of the unit, the student will be able to

- Evaluate double integrals of functions of several variables in two dimensions using Cartesian and polar coordinates.
- Apply double and triple integration techniques in evaluating areas and volumes bounded by a region.

Unit - V: Special functions

10 Periods

Beta and Gamma functions and their properties, relation between Beta and Gamma functions, evaluation of double and triple integrals by using Beta and Gamma functions, error function.

Learning outcome: At the end of this unit, the student will be able to

- conclude the use of special functions in multiple integrals.

Textbooks:

1. **B. S. Grewal**, "*Higher Engineering Mathematics*", 44/e, Khanna Publishers, 2017.
2. **Erwin Kreyszig**, "*Advanced Engineering Mathematics*", 10/e, John Wiley & Sons, 2011.

References:

1. **N. P. Bali**, "*Engineering Mathematics*", Lakshmi Publications.
2. **George B. Thomas, Maurice D. Weir and Joel Hass**, "*Thomas Calculus*", 13/e, Pearson Publishers, 2013.
3. **H. K. Dass**, "*Advanced Engineering Mathematics*", S. Chand and company Pvt. Ltd.
4. **Michael Greenberg**, "*Advanced Engineering Mathematics*", Pearson, Second Edition.

ENGINEERING PHYSICS

(Common to all branches)

Course Code - Category: CHE 112 - BS

Credits:3

L T P E O
3 0 0 1 4

Sessional Marks:40

End Exam: 3 Hours

End Exam Marks:60

Course Objectives

- To impart knowledge in basic concepts of physics relevant to engineering applications
- To introduce advances in technology for engineering applications

Course Outcomes

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

CO1	Interpret the relation between heat, work and entropy with thermodynamic laws.
CO2	Explain and analyze the relation between electric current and magnetic fields, production and applications of ultrasonics.
CO3	Apply the optical phenomena like Interference, Diffraction and Polarization to various fields.
CO4	Explain the working principle and applications of lasers and fiber optics.
CO5	Interpret the microscopic behavior of matter with quantum mechanics.

CO – PO – PSO Matrix:

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

SYLLABUS

UNIT – I

10 periods

Thermodynamics:

Heat and work, first law of thermodynamics and its applications, reversible and irreversible processes, heat engine, Carnot cycle and its efficiency, Carnot's theorem, second law of thermodynamics, entropy – entropy change in reversible and irreversible processes, entropy and second law, entropy and disorder, entropy and probability, third law of thermodynamics.

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the relation between heat and work.
- Recognize how much heat is converted into work.
- Identify the relation between entropy and different thermodynamic phenomena.

UNIT-II

10 periods

Electromagnetism:

Faraday's law of induction, Lenz's law, Integral and differential forms of Faraday's law, self-inductance, energy stored in electric and magnetic fields, Poynting vector, displacement current, Maxwell's equations in integral form (no derivation), wave equation, propagation of electromagnetic waves in free space.

Ultrasonics: Properties of ultrasonic waves, production of ultrasonic waves by magnetostriction and piezoelectric methods, applications of ultrasonics.

Learning Outcomes:

At the end of this unit the student will be able to

- Explain how to generate electric current by electromagnetic induction Phenomena.
- Evaluate Maxwell's displacement current and correction in ampere's law.
- Assess electromagnetic wave propagation in free space and its power.
- Recognize the properties and production of ultrasonics.
- Identify the use of ultrasonics in different fields.

UNIT-III

10 periods

Optics

Interference: Introduction, principle of superposition, coherence, Young's double slit experiment, conditions for interference, interference in thin films by reflection, wedge shaped film and Newton's rings

Diffraction: Introduction, Fresnel and Fraunhofer diffraction, diffraction at a single slit

Polarisation: Introduction, types of polarized light, double refraction in uniaxial crystals, Nicol's prism, quarter and half-wave plate, production and detection of plane, circular and elliptically polarized light.

Learning Outcomes:

At the end of this unit the student will be able to

- Explain various types of coherent sources.
- Outline the conditions for sustained interference.
- Analyze the differences between interference and diffraction.
- Illustrate the concept of polarization of light and its applications.
- Classify the production and detection of different polarized light.

UNIT-IV

10 periods

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

Fibre optics: Introduction to optical fibers, principle of propagation of light in optical fibers,, acceptance angle and acceptance cone, numerical aperture, types of optical fibers, modes of propagation and refractive index profiles, attenuation in optical fibers, advantages of optical fibers in communications, fiber optics communication system, applications of optical fibers, fiber optic sensors

Learning Outcomes:

At the end of this unit the student will be able to

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

UNIT-V

10 periods

Quantum mechanics:

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

Elements of Statistical mechanics: Elementary concepts of Maxwell-Boltzman, Bose-Einstein and Fermi-Dirac statistics (no derivation)

Learning Outcomes:

At the end of this unit the student will be able to

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

Text Books :

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

Reference Books:

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

ENGINEERING CHEMISTRY

Common for all branches

Course Code - Category: CHE 113 - BS

Credits:3

L T P E O
3 0 0 1 4

Sessional Marks:40

End Exam: 3 Hours

End Exam Marks:60

Course Objectives:

- To familiarize Engineering Chemistry and its applications
- To provide knowledge on problem associated with impure water and various treatment technologies
- To train the students on the principles and applications of electrochemistry,
- To introduce nano, smart and composite materials

Course Outcomes:

By the end of the semester, the student will be able to:	
CO1	Identify the problems associated with raw water in various applications and can adopt suitable technologies for domestic and industrial feed waters.
CO2	Understand the concepts of electro chemistry for design of suitable batteries and solar energy in view of environmental protection.
CO3	Select and design of suitable materials to prevent corrosion and to protect various parts from corrosion.
CO4	Generalize the properties of semiconducting and ceramic materials, can select suitable materials for specific applications.
CO5	Analyze the importance of nano, composite and smart materials.

CO – PO – PSO Matrix:

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

SYLLABUS

UNIT I

12 Periods

Water Chemistry: Introduction- Impurities in water; Hardness of water – types of Hardness, units and calcium carbonate equivalents, problems, disadvantages of hard water; Boiler troubles- Scale & Sludge formation, prevention- Internal treatment - (Phosphate, Carbonate and Calgon conditioning) ,Caustic embrittlement

Water treatment techniques: Softening of water by ion exchange method- Principle, Process, advantages; Desalination of water – Reverse Osmosis and Eelectrodialysis; WHO standards for drinking water, Municipal water treatment - Sedimentation, Coagulation, Chlorination-Break point chlorination.

Learning Outcomes:

At the end of this unit the student will be able to

- **List** the differences between temporary and permanent hardness of water (L1)
- **Illustrate** the problems associated with hard water (L2)
- **Explain** the principles of reverse osmosis, electrodialysis and municipal water treatment processes (L2)
- **Solve** problems associated with hard water - scale and sludge (L3)

UNIT-II

10 Periods

Electrochemical cells: Electrode potential, Nernst equation, reference electrodes-SHE and Calomel electrode, Electrochemical series, Electrochemical cell, Cell potential; Primary cells – Dry cell, alkaline

battery, hydrogen-oxygen, methanol fuel cells – working of the cells; Secondary cells – lead acid, lithium ion batteries- working of the batteries including cell reactions.

Solar Energy: Photovoltaic cell -Working & applications, Photo galvanic cells with specific examples

Learning Outcomes:

At the end of this unit the student will be able to

- **Apply** Nernst equation for calculating electrode and cell potentials (L3)
- **Explain** the theory and construction of battery and fuel cells (L2)
- **Identify** the applications of solar energy (L2)
- **Construct** different cells (L3)

UNIT – III

10 Periods

Corrosion Chemistry: Definition, Theories of corrosion-Chemical corrosion, metal oxide formation, Pilling Bedworth rule, Electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion; Factors affecting corrosion

Prevention and control: Protection- cathodic protection, Corrosion inhibitors, electroplating of Copper and electroless plating of Nickel, organic coatings-paint and varnish

Learning Outcome:

At the end of this unit the student will be able to

- **Apply** Pilling Bedworth rule for corrosion and corrosion prevention (L3)
- **Demonstrate** the corrosion prevention methods and factors affecting corrosion (L2)
- **Develop** the corrosion resistant materials for industrial and marine applications (L5)
- **Identify** different organic coatings (L3)

UNIT IV

10 Periods

Semiconducting Materials: Band theory of solids – band diagrams for conductors, semiconductors and insulators, Role of doping on band structures. Organic semiconductors and applications.

Ceramic Materials: Cement – raw materials, Manufacturing process, Setting and hardening of cement (hydration and hydrolysis equations); Refractories- classification; engineering applications of ceramics

Learning Outcome:

At the end of this unit the student will be able to

- **Explain** the manufacturing of portland cement (L2)
- **Enumerate** the reactions at different temperatures in the manufacture of cement (L2)
- **Describe** the mechanism of conduction in conducting polymers (L2)
- **List out** the applications of ceramics (L2)

UNIT V

10 Periods

Nanomaterials: Introduction to Nanomaterial- nanoparticles, nanocluster, carbon nanotube (CNT); Chemical synthesis of nanomaterials- sol-gel method; Characterization- Principle and applications of Scanning electron microscope (SEM) and Transmission electron microscope (TEM).

Polymer Composites: Definition, constituents of composites, types - Fiber Reinforced Plastics, Particulate composites, Layer composites, engineering applications of composites;

Smart polymers: Introduction, types of smart polymers and applications

Learning Outcome:

At the end of this unit the student will be able to

- **Classify** nanomaterials (L2)
- **Explain** the synthesis and characterisation of nanomaterials (L2)
- **Explain** the different types of composites and their applications (L2)
- **Identify** different types of smart materials (L2)

Prescribed Text Book

1. **P.C. Jain and M. Jain** “*Engineering Chemistry*” 16th edition, - DhanapathiRai& Sons, Delhi. 2015.
2. **S.S. Dara** “*A text book of Engineering Chemistry*” 15th edition, S. Chand& Co. New Delhi, 2014.

Reference books

1. **O.G.Palanna** “*Engineering Chemistry*” Tata McGraw Hill Education pvt ltd, New Delhi, 2009.
2. **V.Raghavan** “*A Material Science and Engineering*” 5th edition, Printice Hall India Ltd, 2011.

INTRODUCTION TO CHEMICAL ENGINEERING

Elementary treatment only

Course Code - Category: CHE 114 - PC

Credits:3

L T P E O
3 0 0 1 4

Sessional Marks:40

End Exam: 3 Hours

End Exam Marks:60

Course Objectives:

- To discuss the basics and necessity of Chemical Engineering.
- To know the importance of units and dimensions and material and energy balances.
- To gain knowledge in momentum and heat transfer.
- To gain knowledge in mass transfer operations.

Course Outcomes:

By the end of the course, student will be able to:	
1	Apply the basic Principles of Chemical Engineering in industries
2	Apply the principles involved in Momentum Transfer
3	Apply the principles involved in Heat Transfer
4	Apply the principles of diffusion, absorption, distillation involved in Mass Transfer
5	Apply the principles of extraction, drying involved in Mass Transfer

CO – PO – PSO Matrix:

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

SYLLABUS

UNIT I

10 Periods

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

UNIT II

10 Periods

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

UNIT III

10 Periods

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

UNIT IV

10 Periods

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

UNIT V

10 Periods

Mass Transfer Operations – II: Liquid-liquid extraction, extraction schemes, extraction equipments, drying, equipment for drying.

TEXT BOOK:

1. **S. K. Ghosal, S. K. Sanyal and S. Dutt** “*Introduction to Chemical Engineering*” Tata-McGraw Hill, New Delhi, 1993.

REFERENCE BOOKS:

1. **Max S. Peters** “*Elementary Chemical Engineering*” 2nd edition, Tata-McGraw-Hill, New Delhi.
2. **J. T. Banchero and W. L. Badger** “*Introduction to Chemical Engineering*” Tata-McGraw Hill, New Delhi.
3. **Warren L. McCabe, Julian C. Smith and Peter Harriot** “*Unit Operations of Chemical Engineering*” 7th edition, Tata-McGraw Hill, New Delhi.
4. **Kenneth A. Solen, John N. Harb** “*Introduction to Chemical Engineering*” 5th Edition, Wiley India Pvt. Ltd., New Delhi

ENGINEERING DRAWING

(Common for all branches)

Course Code - Category: CHE 115 - ES

Credits:3.5

L T P E O
2 0 3 1 4

Sessional Marks:40

End Exam: 3 Hours

End Exam Marks:60

Course Objectives:

- The course is designed to introduce fundamentals of engineering drawing and apply the principles to draw engineering curves, orthographic projections and isometric projections.

Course Outcomes:

By the end of the course, the student will be able to:	
CO1	Draw conic sections by different methods and construct cycloidal and involute curves.
CO2	Project orthographically the points and lines in various positions.
CO3	Produce orthographic projections of plane surfaces
CO4	Draw orthographic projections of solids in various orientations.
CO5	Construct isometric views and isometric projections of simple solids.

CO – PO – PSO Matrix:

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

SYLLABUS

UNIT I

Introduction to Engineering drawing & basics of geometrical construction. General Construction of conic sections, Ellipse - concentric circle and arcs of circle method, Parabola- rectangle and tangential method Hyperbola - Rectangle hyperbola, Construction of cycloidal curves (cycloid, epicycloid, and hypocycloid), Involute(thread length equal to circumference/ perimeter) - circle and regular polygon.

UNIT II

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

UNIT III

Projections of regular polygon planes – inclined to one plane, inclined to both the planes.

UNIT IV

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

UNIT V

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

TEXT BOOK:

1. N. D. Bhatt “Engineering Drawing” Charotar Publishing House Pvt.Ltd, 53rd Edition : 2014

REFERENCE BOOKS:

1. K. L. Narayana& P. Kanniah “Engineering Drawing”
2. R. B. Choudary “Engineering Graphics with Auto CAD”
3. TrymbakaMurty “Computer Aided Engineering Drawing”

ENGINEERING PHYSICS LAB

Common for all branches

Course Code - Category: CHE 116 - BS

Credits:1.5

L T P E O
0 0 3 0 1

Sessional Marks:50

End Exam: 3 Hours

End Exam Marks:50

Course Objectives

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

Course Outcomes

At the end of this course, the students will be able to	
CO1	Design and conduct experiments as well as to analyze and interpret data
CO2	Apply experimental skills to determine the physical quantities related to heat, electromagnetism and optics

CO – PO – PSO Matrix:

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

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

1. Determination of coefficient of thermal conductivity of a bad conductor- Lee's method.
2. Determination of radius of curvature of a convex lens - Newton's rings.
3. Determination of wavelengths of spectral lines in mercury spectrum-using diffraction grating in normal incidence position.
4. Determination of Cauchy's constants of the material of the prism using spectrometer.
5. Determination of thickness of a thin paper by forming parallel interference fringes-Wedge method.
6. Study of variation of magnetic field along the axis of a current carrying circular coil – Stewart and Gee's apparatus.
7. Calibration of a low-range voltmeter using potentiometer.
8. Verification of laws of resistance and determination of specific resistance of wire by using Carey-Foster's bridge.
9. Determination of refractive indices o-ray and e-ray in quartz crystal (double refraction)
10. Determination of the frequency of an electrically maintained tuning fork - Melde's experiment.
11. Determination of Rydberg constant using hydrogen discharge tube.
12. Characteristics of photo cell and determination of Planck's constant –Photoelectric effect.
13. Determination of e/m of an electron by Thomson's method
14. Determination of band gap of semiconductor.

Learning Outcomes:

The students will be able to

- **Handle** optical instruments like microscope and spectrometer
- **Determine** thickness of a hair/paper with the concept of interference
- **Estimate** the wavelength and resolving power of different colors using diffraction grating
- **Plot** the intensity of the magnetic field of circular coil carrying current with varying distance
- **Determine** the band gap of a given semiconductor
- **Determine** thermal conductivity of good and bad conductors
- **Determine** resistance and resistivity of the given material
- **Determine** the accuracy of low range voltmeter using potentiometer
- **Evaluate** the refractive index using double refraction phenomena
- **Determine** frequency of electrical tuning fork

Prescribed Book

1. *“Physics Laboratory Manual”* Prepared by Department of Physics ANITS

Reference books

1. **D.P Siva Ramaiah and V. Krishna Murthy** *“Practical physics”* Maruti book Depot
2. **A.R Vegi** *“Comprehensive practical Physic”s* by Vegi Publishers Pvt.Ltd.

ENGINEERING CHEMISTRY LAB

Common for all branches

Course Code - Category: CHE 117 – BS

Credits:1.5

L T P E O
0 0 3 0 1

Sessional Marks:50

End Exam: 3 Hours

End Exam Marks:50

Course Objectives:

- To improve skills in analyzing samples through titration procedures
- To get an idea over instrumental methods of analysis for more accuracy

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

CO1	Apply experimental skills in analysing samples through titration procedures
CO2	Select and use a suitable instrumental technique for the quantitative analysis for more accuracy

CO – PO – PSO Matrix:

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

List of Experiments (any ten experiments)

- i) Preparation of primary standard solution.
ii) Preparation and Standardization of Hydrochloric acid solution.
- Determination of total Hardness present in the given water sample.
- Estimation of Iron(II) by permanganate.
- Estimation of amount of calcium present in the Portland cement by titrimetrically.
- Estimation of amount of Zinc by EDTA.
- Estimation of amount of Copper by using Sodium thiosulphate.
- Determine the strength of acid (lead acid battery) by titrating with strong base using **pH meter**.
- Estimate the individual strength of acids present in the acid mixture by titrating with strong base using **conductivity meter**.
- Estimate the amount of Mohr's salt present in the given solution by titrating with potassium dichromate using **potentiometer**.
- To determine the viscosity of liquid by Ostwald viscometre
- Spectrophotometric** estimation of Fe(III) by Potassium thiocyanate.

Demo Experiments

- Thin layer chromatography and Gas chromatography
- Preparation of Bakelite

3. Particle size distribution by PSD analyser(Demo-Outsource)
4. Elemental analysis by ICPMS (Demo-Outsource)
5. Introduction of Reaction colourimetry (for Chemical Engineering)

Learning Outcomes:

1. Measure the strength of an acid present in secondary batteries
2. Calculate the hardness of water sample
3. Determine the Potential and conductance of solutions
4. Analyse the cement for Iron and Calcium contents
5. Prepare polymer materials

Prescribed Books

1. **S.K. Bhasin and SudhaRani** “*Laboratory manual on Engineering chemistry*” third edition; DhanpatRai Publishing Company.

Reference Books

1. **S.S. Dara** “*Experiments and calculations in Engineering chemistry*” 9th edition; S. Chand & Company ltd.

ENGINEERING WORKSHOP

Common for all branches except for ECE

Course Code - Category: CHE 118 - ES

Credits:1.5

L T P E O
0 0 3 0 1

Sessional Marks:50

End Exam: 3 Hours

End Exam Marks:50

Course Objectives:

- To provide training and hands on experience to the students on basic Engineering related skills like carpentry, fitting, tin smithy, house wiring and soldering.

Course Outcomes:

By the end of the course, student will be able to:	
CO1	Make different carpentry joints.
CO2	Make simple fitting jobs.
CO3	Make simple jobs like funnel, elbow etc. using sheet metal.
CO4	Understand and build circuits for different types of applications like stair case wiring, godown wiring.
CO5	Make simple circuits on bread board using soldering kit

CO – PO – PSO Matrix:

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

LIST OF EXPERIMENTS

Minimum of two exercises has to be conducted from each trade.

Trade:

Carpentry

1. Cross Lap Joint
2. Dovetail Joint
3. Mortise and Tennon Joint
4. Bridle Joint

Fitting

1. V Fit
2. Square Fit
3. Half Round Fit
4. Dovetail Fit

Tin Smithy

1. Taper Tray
2. Square Box without lid
3. Elbow
4. Funnel

House Wiring

1. Parallel / Series Connection of three bulbs
2. Stair Case wiring
3. Godown wiring

Soldering

1. LED bulb
2. Dc motor with pot
3. De soldering PCB

Reference book:

1. **S.K.Hajra Choudhury** “*Elements of Workshop Technology*” Vol I Manufacturing Processes, ISBN: 8185099146(2017)

Human Values & Professional Ethics

Common to all branches

Course Code - Category: CHE 119 - MC

Credits: 0

L T P E O
3 0 0 0 1

Sessional Marks:50

Course Objectives:

- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values and Loyalty
- To appreciate the rights of others.
- To create awareness on assessment of safety and risk

Course outcomes:

By the end of the semester, the student will be able to:	
CO1	Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field
CO2	Identify the multiple ethical interests at stake in a real-world situation or practice
CO3	Articulate what makes a particular course of action ethically defensible
CO4	Assess their own ethical values and the social context of problems
CO5	Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human
CO6	Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work integrate, synthesize, and apply knowledge of ethical dilemmas and resolutions in academic settings, including focused and interdisciplinary research

CO – PO – PSO Matrix:

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

SYLLABUS

Unit I: HUMAN VALUES:

Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others – Living Peacefully –Caring –Sharing –Honesty –Courage-Cooperation–Commitment – Empathy –Self Confidence Character –Spirituality-Case Study.

LEARNING OUTCOMES:

1. learn about morals, values & work ethics.
2. learn to respect others and develop civic virtue.
3. develop commitment
4. learn how to live peacefully

Unit II: ENGINEERING ETHICS:

Senses of 'Engineering Ethics-Variety of moral issued –Types of inquiry –Moral dilemmas –Moral autonomy –Kohlberg's theory-Gilligan's theory-Consensus and controversy –Models of professional roles-Theories about right action-Self interest -Customs and religion –Uses of Ethical theories –Valuing time –Co operation –Commitment-Case Study

LEARNING OUTCOMES:

1. learn about the ethical responsibilities of the engineers.
2. create awareness about the customs and religions.
3. learn time management
4. learn about the different professional roles.

Unit III: ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering As Social Experimentation –Framing the problem –Determining the facts –Codes of Ethics –Clarifying Concepts –Application issues –Common Ground -General Principles –Utilitarian thinking respect for persons-Case study

LEARNING OUTCOMES:

1. demonstrate knowledge to become a social experimenter.
2. provide depth knowledge on framing of the problem and determining the facts.
3. provide depth knowledge on codes of ethics.
4. develop utilitarian thinking

UNIT IV: ENGINEERS RESPONSIBILITY FOR SAFETY AND RISK:

Safety and risk –Assessment of safety and risk –Risk benefit analysis and reducing risk-Safety and the Engineer-Designing for the safety-Intellectual Property rights(IPR)-.

LEARNING OUTCOMES:

1. create awareness about safety, risk & risk benefit analysis.
2. engineer's design practices for providing safety.
3. provide knowledge on Intellectual Property Rights.

UNIT V: GLOBAL ISSUES

Globalization –Cross culture issues-Environmental Ethics –Computer Ethics –Computers as the instrument of Unethical behavior –Computers as the object of Unethical acts –Autonomous Computers-Computer codes of Ethics –Weapons Development -Ethics and Research –Analyzing Ethical Problems in research-Case Study

LEARNING OUTCOMES:

1. Develop knowledge about global issues.
2. Create awareness on computer and environmental ethics
3. Analyze ethical problems in research.
4. Give a picture on weapons development.

Text Books:

1. **M.Govindarajan, S.Natarajanad, V.S.SenthilKumar** “*Engineering Ethics includes Human Values*” -PHI Learning Pvt. Ltd-2009
2. **Harris, Pritchard and Rabins** “*Engineering Ethics*”, CENGAGE Learning, India Edition, 2009.
3. **Mike W. Martin and Roland Schinzinger** “*Ethics in Engineering*” Tata McGraw-Hill–2003.
4. **Prof.A.R.Aryasri, DharanikotaSuyodhana** “*Professional Ethics and Morals*” Maruthi Publications.
5. **A.Alavudeen, R.KalilRahman and M.Jayakumaran** “*Professional Ethics and Human Values*” -LaxmiPublications.
6. **Prof.D.R.Kiran** “*Professional Ethics and Human Values*”
7. **PSR Murthy** “*Indian Culture, Values and Professional Ethics*” BS Publication

ENGINEERING MATHEMATICS-II

Ordinary Differential Equations & Numerical Methods
Common for all branches

Course Code - Category: CHE 121 - BS

Credits:3

L T P E O
3 0 0 1 6

Sessional Marks:40

End Exam: 3 Hours

End Exam Marks:60

Course Objective:

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

Course outcome:

By the end of the semester, the student will be able to:	
CO1	Demonstrate solutions to first order differential equations by various methods and solve basic application problem related to electrical circuits, orthogonal trajectors and
CO2	Discriminate among the structure and procedure of solving a higher order differential equations with constant coefficients and variable coefficients
CO3	Apply various numerical methods to solve linear and non-linear equations
CO4	Familiar with numerical integration and differentiation
CO5	Understand Laplace transforms and its properties and finding the solution of ordinary differential equations

CO – PO – PSO Matrix:

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

Unit - I: Ordinary Differential equations of first order and its applications

12 Periods

First order linear differential equations, Bernoulli’s equations, exact differential equations, equations reducible to exact equations, orthogonal trajectories, simple electric circuits (L –R circuit problems), Newton’s law of cooling.

Learning outcome: At the end of this unit, the student will be able to

- Solve the first order differential equations and solve basic application problems described by first order differential equations.

Unit - II: Higher order Linear Differential Equations and its applications **10 Periods**

Definitions, rules for finding the complementary function, rules for finding the particular integral, method of variation of parameters, equations reducible to linear equations with constant coefficient, Cauchy's homogeneous linear equation, Legendre's linear equation. Applications: L – C – R circuit problems.

Learning outcome: At the end of this unit, the student will be able to

- Solve the complete solution of linear differential equations with constant coefficient
- Solve basic application problems described by second order linear differential equations with constant coefficients.

Unit - III: Numerical solutions of algebraic and transcendental equations **10 Periods**

Solution of algebraic equation by Bisection method, Newton-Raphson, Regula-Falsi methods. Solution of simultaneous linear algebraic equations, Gauss elimination, Gauss Jordan, Gauss Seidel.

Learning outcome: At the end of this unit, the student will be able to

- Find numerical solution to a system of equations by using different methods.

Unit - IV: Interpolation, Numerical Differentiation & Integration **12 Periods**

Interpolation, Newton forward and backward interpolation formula, Lagrange's formula for unequal intervals. Numerical differentiation - Newton's forward and backward differences to compute first and second derivatives. Numerical integration - Trapezoidal rule, Simpson's one third rule and three eighth rules.

Learning outcome: At the end of this unit, the student will be able to

- Find derivative and integral of a function by using different numerical methods.

Unit - V: Laplace Transforms and its application **16 Periods**

Introduction, definitions, transforms of elementary functions, properties of Laplace transforms, transforms of periodic functions, transforms of derivatives, transforms of integrals, Multiplication by t, division by t, evaluation of integrals by Laplace transforms. Inverse Laplace transforms – other methods of finding inverse transforms (excluding residue method), Convolution theorem (without proof), application's to differential equations, unit step function (without proof) and unit Impulsive functions (without proof).

Learning outcome: At the end of this unit, the student will be able to

- Examine the properties of Laplace transformation.
- Apply the Laplace and inverse Laplace transformations for different types of functions.
- Evaluate ordinary differential equations by using Laplace transformation technique.

Textbooks:

1. **B. S. Grewal** “*Higher Engineering Mathematics*” 44/e, Khanna Publishers, 2017.
2. **Erwin Kreyszig** “*Advanced Engineering Mathematics*” 10/e, John Wiley & Sons, 2011.

References:

1. **R. K. Jain and S. R. K. Iyengar** “*Advanced Engineering Mathematics*” 3/e, Alpha Science International Ltd., 2002.
2. **George B. Thomas, Maurice D. Weir and Joel Hass, Thomas** “*Calculus*” 13/e, Pearson Publishers, 2013.

COMMUNICATIVE ENGLISH

Common for all branches

Course Code - Category: CHE 122- HS

Credits:3

L T P E O
3 0 0 1 4

Sessional Marks:40

End Exam: 3 Hours

End Exam Marks:60

Prerequisites:

Basic English language skills- LSRW at (10+2) / Intermediate Level

Course Objectives

- To focus on appropriate reading strategies for comprehension of various forms of texts.
- To instruct effective strategies for good writing and exhibit the same in writing well organized passages, reports and other forms of business communication
- Provide knowledge of grammatical structures and vocabulary to be used appropriately in their writing.

Course Outcomes

By the end of the course, the student will be able to:	
CO1	Comprehend, interpret and analyze text and answer questions based on passages.
CO2	Demonstrate good writing skills for effective paraphrasing, argumentative essays and formal correspondence.
CO3	Construct grammatically correct sentences and apply proper vocabulary in speech and writing.

CO – PO – PSO Matrix:

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

SYLLABUS

UNIT- I

10 Periods

Reading: 1. Skimming and Scanning to get the main idea of a text and look for specific information- On the Conduct of Life: *William Hazlitt* 2. If- *Rudyard Kipling* –CO1

Writing: Paragraph writing (specific topics) using suitable cohesive devices – Unity, logical order, coherence, opening and closing statements. CO2

Grammar: Clauses and Sentences: Sentence structures, use of phrases and clauses in sentences CO3

Vocabulary: The concept of word formation, Acquaintance with prefixes and suffixes CO3

UNIT –II

10 Periods

Reading: 1. Reading for inferential comprehension- The Brook: *Alfred Tennyson* 2. How I Became a Public Speaker: *George Bernard Shaw* CO1

Writing: Formal letter writing. Letters of complaint, enquiry, report, invite, placing orders, acknowledgment and follow-up letters. CO2

Grammar: Punctuation: importance of proper punctuation in texts, Articles CO3

Vocabulary: Word building using foreign roots CO3

UNIT – III**10 Periods****Reading: 1.** Comprehend complex texts identifying the author’s purpose-The Death Trap: *Saki* 2. On Saving Time: *Seneca* **CO1****Writing ::** Reports (Structure and content of a project report) **CO2****Grammar :** Noun-Pronoun Agreement, Subject –Verb agreement, Tenses **CO3****Vocabulary:** Idiomatic expressions **CO3****UNIT –IV****10 Periods****Reading: 1.** Identifying claims, evidences, views, opinions and stance/position.-Chindu Yellama 2. Muhammad Yunus **CO1****Writing Skills: 1.** Writing structured essays (persuasive and argumentative) using suitable claims and evidences **CO2****Grammar:** Misplaced Modifiers, adjectives, adverbs **CO3****Vocabulary:** Synonyms & Antonyms **CO3****UNIT –V****12 Periods****Reading:** Developing advanced reading skills for deeper understanding of the textPolitics and the English Language: *George Orwell* 2. The Dancer with aWhite Parasol: *Ranjana Dave* **CO1****Writing :** Précis writing (Summarizing-identifying main idea and rephrasing the text), Applying for internship/Writing job applications: Resume and C.V with cover letter **CO2****Grammar:** Prepositions, correction of sentences. **CO3****Vocabulary:** Phrasal verbs **CO3****Prescribed book:****Board of Editors** “*Language and Life*” 1st edition, Oriental Black Swan 2018.**Reference Books:**

1. **Sanjay Kumar and Pushpa lata** “*Communication skills*” Oxford University Press. 2011
2. **Meenakshi Raman and Sangeetha Sharma** “*Technical communication*” Oxford University Press.
3. **Kulbushan Kumar** “*Effective communication skills*” Khanna Publishing House, Delhi.

PHYSICAL AND ANALYTICAL CHEMISTRY

(For Chemical Engineering)

Course Code - Category: CHE 123 - BS

Credits:3

L T P E O
3 0 0 1 5

Sessional Marks:40

End Exam: 3 Hours

End Exam Marks:60

Course Objectives

- To understand the concept of Homogenous and heterogeneous chemical equilibrium with its importance in industrial process.
- To get an idea about the Surface chemistry and its characterization.
- To give a knowledge on basic quantitative techniques of Titrimetry and Gravimetry.
- To inculcate the concept of various Electro-analytical techniques.
- To give an awareness on various Separation techniques.

Course Outcomes

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

CO1	Apply the Homogeneous and heterogeneous Chemical equilibria laws in various systems and Develop Optimum conditions for these systems in Industrial Processes
CO2	Familiarize in the concepts of surface characterisation by using X-Ray diffraction and stabilization of colloids and nanomaterials.
CO3	Get Knowledge on the Quantitative determination of various samples either by using Titrimetry or gravimetry with least error.
CO4	Get adept in Computing pH, Potential and conductance by electro analytical methods
CO5	Separate impurities by Applying Solvent extraction and Gas chromatography Techniques

CO – PO – PSO Matrix:

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

SYLLABUS

UNIT-1

12 periods

Chemical Equilibrium: Reversible and irreversible reactions, concept of equilibrium, Law of Mass action, Equilibrium constant, Factors influencing equilibrium constant, apply law of mass action to homogeneous gaseous and liquid systems, Le-Chatelier principle- applications, Effect of temperature on equilibrium constant -derivation

Phase rule: Definition-explanation of terms-Derivation of Phase Rule-One component system (water system)-Two component system (Ag-Pb), Eutectic mixture-its significance.

Learning Outcomes:

At the end of the unit the student will be able to

- list the differences between Reversible and Irreversible reactions (L1)
- Apply the law of Mass action to different homogeneous and heterogeneous systems (L2)

- **State** Le-chatlier principle(L1)
- **Develop** Optimum conditions for few Industrial process reactions(L5)

UNIT-II

10 periods

Surface Chemistry: Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, method of preparation of nanomaterials by Chemical Vapour deposition methods, stabilization of colloids and nanomaterials by stabilizing agents.

Characterization of surfaces - X-ray diffraction-Principle & Instrumentation; Adsorption-B.E.T equation (no derivation), Surface area-importance and Determination by B.E.T method, Applications of colloids and nanomaterials.

Learning Outcomes:

At the end of the unit the student will be able to

- **Illustrate** the role of an stabilizing agents in stabilization of colloids and nano material (L2)
- **Explain** the principles and instrumentation of X – Ray Diffraction (L2)
- **Apply** BET equation in measuring surface area(L3)

UNIT-III

10 periods

Introduction to Chemical analysis –Quantitative analysis, classification of errors-accuracy, precision-minimization of errors; Titrimetric Analysis, Classification of reactions in titrimetric analysis-Standard solutions- Primary and Secondary standards, Theory of Indicators(Acid Base, Redox, Complexometric & precipitation Titrations); Gravimetric analysis-process of precipitation, contamination of precipitates (co-precipitation & post precipitation)

Learning Outcomes:

At the end of the unit the student will be able to

- **Describe** different ways of minimization of errors(L2)
- **Explain** the theories behind different types of indicators (L2)
- **Analyse** the amount of Nickel present in the given sample(L4)

UNIT-IV

10periods

Electro-analytical Methods: Potentiometry-introduction, instrumentation and potentiometric titration (Redox); introduction to pH, determination of pH, pH metric titrations. Conductometry- conductance and types of conductance, Conductmetric Titrations (Acid-base), variation of conductance with temperature, Kohlrausch's law and applications- calculation of equivalent conductance and degree of dissociation of weak electrolytes.

Learning Outcomes:

At the end of the unit the student will be able to

- **Define** electrode potential (L1)
- **Explain** the Instrumentation of Potentiometry(L2)
- **Compute** the strength of Acids and basesby pH meter (L3)
- **Apply** the Kohlrausch's law in measurement of equivalent conductance of weak electrolytes (L4)

UNIT-V

10 periods

Basics of Industrial SeparationTechniques:

Distribution law-partition coefficient, Solvent extraction-multiple extractions; Chromotography-principle, RF value, resolution and retention time, types of chromotography-Thin layer and gas chromatography-instrumentation.

Learning Outcomes:

At the end of this unit the student will be able to

- **State** Distribution Law (L1)
- **Explain** the efficiency of multiple extractions (L2)
- **Separate** impurities from an analyte using Gas chromatography (L4)

Prescribed text books

1. **Arun Bhal, B.S.Bhal and G.D.Thuli** “*Essentials of Physical chemistry*” S.Chand and company ltd. 2009.
2. **Chatwal and Anand;** “*Instrumental Methods of Chemical Analysis*” 5th edition, Himalaya Publishing Company.

Reference books

1. **Peter Atkins & Julio de Paula** “*Physical Chemistry*” 7th edition, oxford university
2. **B.R.Puri and L.R.Sharma** “*Principles of Physical Chemistry*”, 44th edition press vishal publishing company, New Delhi.
3. **Vogel** “*Text book of Quantitative Chemical Analysis*” 6th edition, Pearson, 2014.

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

Course code – Category: CHE124 – ES

Credits: 3

L T P E O

3 0 0 1 6

End Exam: 3 Hours

Sessional Marks: 40

End Exam Marks: 60

Prerequisite: Nil

Course Objective:

To make the students to understand the basic concept of electrical and magnetic circuits, principle and construction, operation of both AC&DC machines and apply them to some practical applications. To make the students to understand the basic concept of Electronics devices like Diode, Zener Diode and Transistor.

Course Outcomes:

1.	Able to understand the basic concepts of Magnetic circuits and electromagnetic induction.
2.	Able to understand the basic concepts of Electrical circuits .
3.	Able to understand the construction and working principle of DC Generator,DC Motor and Transformer
4.	Able to analyzed the performance of Three phase induction motor, and Regulation methods of Alternator
5.	Able to understand the basic concepts of electronic components like diode, zener diode and transistor.

UNIT I

10 Periods

Magnetic circuits: Definitions of magnetic circuit, reluctance, magneto motive force (mmf), magnetic flux, simple problems on magnetic circuits, hysteresis loss, Faraday's laws of electromagnetic induction, induced E.M.F.

UNIT II

Electrical Circuits: R,L,C parameters, Ohms Law, series & parallel combinations of resistances, KVL & KCL, Mesh Analysis, Nodal Analysis (simple problems), Concept of Phasors, Apparent Power, Real & Reactive power ,Power factor.

UNIT III

D.C generator principle, construction of D.C generator,E.M.F equation of D.C generator, D.C motor principle, working of D.C motors, significance of back E.M.F, torque equation of D.C motors, types of D.C motors, applications of D.C motors.

Transformer principle, EMF equation of transformer, voltage regulation of transformer, losses in a transformer, calculation of efficiency and regulation.

UNIT IV

Induction motor working principle, construction of 3-phase induction motor, principle of operation, types of 3-phase induction motor, power stages of induction motor, Alternator working principle, EMF equation of alternator, voltage regulation by Synchronous impedance method.

UNIT V

Principles of Electronics: Semiconductors materials, p-n junction, properties of p-n junction, Semiconductor Diode, Zener Diode, Transistor construction, operation and their configurations.

Text books:

1. V.K. Mehta, "Elements of Electrical Engineering & Electronics", S. Chand & Co., 2010.
2. Robert L. Boyiastad, Louis Nashelsky, "Electronic Devices and Circuit Theory" 11th ed., Pearson, 2015.

Reference books:

1. 'A first course in Electrical Engineering' by Kothari.
2. V.K. Mehta, "Principles of Electronics", 11th ed., S. Chand & Co., 2008

Problem Solving With C

(Common to all branches)

Course Code - Category: CHE 125 - ES

Credits: 3

L T P E O
3 0 0 1 6

Sessional Marks:40

End Exam: 3 Hours

End Exam Marks:60

Prerequisite: No specific prerequisites are needed

Course Objectives:

- This course aims to provide exposure to problem-solving through programming in C. It aims to train the student, the concepts of C-Programming Language. This course involves a lab component which is designed to give the student hands-on experience with the concepts.

Course Outcomes:

After completion of this course, a student will be able to:	
CO1	Gain knowledge in problem solving and steps in Program development.
CO2	Apply the basic concepts of C
CO3	Implement different operations on arrays and string to solve any given problem.
CO4	Demonstrate pointers and modularization
CO5	Apply structures and unions and Implement file Operations in C programming for any given application

CO – PO – PSO Matrix:

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

SYLLABUS

UNIT I

10 Periods

Introduction to Computer Problem-solving : Introduction ,The Problem-solving Aspect, Top-Down Design, Implementation of Algorithms, Program Verification (Text Book 3 Page 1-29 or Reference material 1)

Computer Science as a Career Path : Why Computer Science May be the Right Field for You, The College Experience: Computer Disciplines and Majors to Choose From Career Opportunities.

Electronic Computers Then and Now, Computer Hardware, Computer Software, The Software Development Method, Applying the Software Development Method, Professional Ethics for Computer Programmers. (Text Book 2 Page 1-39)

Computer Languages, Writing Editing compiling and linking programs, Program Execution, System Development, Flowcharting, Introduction to C Language – Background, C Programs, Identifiers, Types, Variables, Constants, Coding Constants, Formatted Input / Output. (Text Book 1)

Learning Outcomes : At the end of this Unit the student will be able

- To gain knowledge in the concepts of problem solving
- Identify the steps in Program development
- Learn number system.

UNIT II

10 Periods

Number systems-Binary, Decimal, Hexadecimal and Transformations, storing integers and floats. Program – expressions, precedence and Associativity, Side effects, evaluating expressions, mixed type expressions, statements.

Selection –Making Decisions – Logical data and operators, Bitwise Operators- logical bitwise operators, shift operators, bitwise use, Two way selection, Multi way selection

Repetition – concept of a loop, pretest and posttest loops, initialization and updating, event controlled and counter controlled loops, loops in C, loop examples, other statements related to looping, looping applications
(Text Book 1)

Learning Outcomes : At the end of this Unit the student will be able to

- Apply decision making in c programming for problem solving
- Apply controlled structures in c programming for problem solving

UNIT III

10 Periods

Arrays – Concepts, using arrays in C, array applications, linear search, and Bubble sort, two – dimensional arrays, multidimensional arrays .

Strings – Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulation functions
(Text Book 1)

Learning Outcomes : At the end of this Unit the student will be able to

- Implement different operations on arrays
- Use string functions
- Apply string manipulation operations for problem solving.

UNIT IV

10 Periods

Functions-Designing Structured Programs, Functions in C, user defined functions, standard library functions, scope, Recursion

Storage classes-auto, register, static, extern

Pointers – Pointer Applications – Arrays and Pointers, pointer arithmetic and arrays, passing an array to a function, understanding complex declarations, memory allocation functions, array of pointers, programming application selection sort.
(Text Book 1)

Learning Outcome : At the end of this Unit the student will be able to

- Know what a pointer is
- How to modularize a program
- Parameter passing techniques
- Write a recursive functions

UNIT V

10 Periods

Derived Types Enumerated, Structure and Union Types – The Type Definition (typedef), Enumerated types, Structures, accessing structures, Complex structures, arrays of structures, structures and functions ,unions

Text Files – Concept of a file, files and streams, input / output functions, formatting input/output functions, character input/output functions, character input/output examples

Binary files – classification of files, using binary files, standard library functions for files, converting file type, file program examples. **(Text Book 1)**

Learning Outcome : At the end of this Unit the student will be able to

- Write a structure and union
- Create and manage a file
- Use structure and union in files

Text Books:

- (1) **B. A. Forouzan and R. F. Gilberg** “*Cengage Learning , Computer Science: A Structured Programming Approach Using C*” Third Edition.
- (2) **Jeri R. Hanly , Elliot B .Koffman** , “*Problem solving and program Design in C*” , 7th Edition
- (3) **R.G.Dromey** , “*How to solve it by computer, Prentice-Hall International Series in Computer Science*” C.A.R. Hoare Series Editor

Reference Books:

- (1) “*An Introduction to Computer Science and problem solving*” - IT Department Material
- (2) “**Dietal & Deital**” , “*C How to Program 7/E*” ,PHI Publications
- (3) **Yashavant Kanetkar** , “*Let Us C*” , 16th Edition
- (4) **Brian W. Kernighan and Dennis M.Ritchie**, “*The C Programming Language*”, Prentice Hall of India

English Language lab

Course Code - Category: CHE 126 – HS

Credits:1.5

L T P E O
0 0 3 0 1

Sessional Marks:50

End Exam: 3 Hours

End Exam Marks:50

Prerequisites:

Basic English language skills- LSRW at Intermediate Level

Course Objectives

1. To improve fluency in spoken English and to practice correct pronunciation.
2. To introduce the techniques of presentation skills
3. Help improve speaking skills through participation in activities such as role plays, discussions, and structured talks/ oral presentations

Course Outcomes

By the end of the course, the student will be able to:	
CO1	Speak English with proper pronunciation and intonation
CO2	Make effective oral presentations by interpreting and analysing data, pictures and videos and participate in Group Discussion on general topics
CO3	Make meaningful conversations and follow logical flow of thought; answer questions on key concepts after listening to extended passages.

CO – PO – PSO Matrix:

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

Syllabus

Module- I

The sounds of English CO1

1. Practicing correct Pronunciation through IPA, Stress, Intonation, Rhythm

Module –II

Group Discussions CO2

1. Purpose, Different roles for participants, Etiquette in a structured GD - Practice GDs

Module –III

Interpersonal Skills CO3 (Role plays)

1. Introduction of self and others, making announcements
2. Getting Someone’s Attention, and Interrupting Conversations
3. Making Requests and Responding to them, asking for directions

Module –IV

Listening Skills CO3

1. Listening to unknown passages – for global understanding, identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

Module –V

Presentation skills CO2

1. Oral Presentations (JAMs) 2. Describing and analysing videos and pictures.3. Interpreting and analysing data from graphs and charts

Prescribed book:

Oriental Black Swan. “*Language and Life*” 1st edition, 2018 Board of Editors. .

Reference Books:

1. **J.K. Gangal.** “*A Practical Course in Effective English Speaking Skills*”. Prentice Hall India Learning Private Limited 2012.

Problem Solving with 'C' Lab

(Common to all branches)

Course Code - Category: CHE 127 - ES

Credits:1.5

L T P E O
0 0 3 0 3

Sessional Marks:50

End Exam: 3 Hours

End Exam Marks:50

Prerequisite: Concepts of Problem Solving & Computer Programming in C

Course Objective:

- The course aims at translating given algorithms to a working and valid program

Course Outcomes:

After completion of this course, a student will be able to:	
CO1	Develop C programs using operators
CO2	Write C programs using conditional structures
CO3	Write C programs using iterative structure arrays and strings
CO4	Inscribe C programs that use Pointers to and functions
CO5	Develop a c program for implementing user defined types and file processing

CO – PO – PSO Matrix:

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

SYLLABUS

MINIMUM SET OF SAMPLE PROGRAMS

1. CONVERTING MILES TO KILOMETERS

PROBLEM STATEMENT: Your summer surveying job requires you to study some maps that give distances in kilometers and some that use miles. You and your coworkers prefer to deal in metric measurements. Write a program that performs the necessary conversion.

Problem Input: miles /* the distance in miles*/

Problem Output: kms /* the distance in kilometers */

Relevant Formula: 1 mile = 1.609 kilometers

Design algorithm, flow chart, program using the above data requirements for the given problem.

Try the sample test cases given below :

SAMPLE TEST CASES	INPUT	OUPUT
Test case 1	10	16.09
Test case 2	2	3.218

2. SUPERMARKET COIN PROCESSOR

PROBLEM STATEMENT : You are drafting software for the machines placed at the front of supermarkets to convert change to personalized credit slips. In this draft, the user will manually enter the number of each kind of coin in the collection, but in the final version, these counts will be provided by code that interfaces with the counting devices in the machine.

Problem Inputs

```
char first, middle, last /* a customer's initials */
int dollars /* number of dollars */
int quarters /* number of quarters */
int dimes /* number of dimes */
int nickels /* number of nickels */
int pennies /* number of pennies */
```

Problem Outputs

```
int total_dollars /* total dollar value */
int change /* leftover change */
```

Additional Program Variables

```
int total_cents /* total value in cents */
```

Design algorithm, flow chart, program using the above data requirements for the given problem. Try the sample test cases given below :

TESTING TIP :

To test this program, try running it with a combination of coins that yield an exact dollar amount with no leftover change. For example, 1 dollar, 8 quarters, 0 dimes, 35 nickels, and 25 pennies should yield a value of 5 dollars and 0 cents. Then increase and decrease the quantity of pennies by 1 (26 and 24 pennies) to make sure that these cases are also handled properly.

SAMPLE TEST CASES	INPUT	OUTPUT
Test case 1	Type in your 3 initials and press return> JRH JRH, please enter your coin information. Number of \$ coins > 2 Number of quarters > 14 Number of dimes > 12 Number of nickels > 25 Number of pennies > 131	JRH Coin Credit Dollars: 9 Change: 26 cents
Test case 2	Type in your 3 initials and press return> JRH JRH, please enter your coin information. Number of \$ coins > 3 Number of quarters > 12 Number of dimes > 14 Number of nickels > 50 Number of pennies > 175	JRH Coin Credit Dollars: 11 Change: 26 cents

3. WATER BILL PROBLEM

PROBLEM STATEMENT : Write a program that computes a customer's water bill. The bill includes a \$35 water demand charge plus a consumption (use) charge of \$1.10 for every thousand gallons used. Consumption is figured from meter readings (in thousands of gallons) taken recently and at the end of the previous quarter. If the customer's unpaid balance is greater than zero, a \$2 late charge is assessed as well.

Problem Constants

DEMAND_CHG 35.00 /* basic water demand charge */
PER_1000_CHG 1.10 /* charge per thousand gallons used */
LATE_CHG 2.00 /* surcharge on an unpaid balance */

Problem Inputs

int previous /* meter reading from previous quarter in thousands of gallons */
int current /* meter reading from current quarter */
double unpaid /* unpaid balance of previous bill */

Problem Outputs

double bill /* water bill */
double use_charge /* charge for actual water use */
double late_charge /* charge for nonpayment of part of previous balance */

Relevant Formulas

water bill = demand charge + use charge + unpaid balance + applicable late charge

Design algorithm, flow chart, program using the above data requirements for the given problem. Try the sample test cases given below:

SAMPLE TEST CASES	INPUT	OUTPUT
Test case 1	<p>This program figures a water bill based on the demand charge (\$35.00) and a \$1.10 per 1000 gallons use charge.</p> <p>A \$2.00 surcharge is added to accounts with an unpaid balance.</p> <p>Enter unpaid balance, previous and current meter readings on separate lines after the prompts. Press <return> or <enter> after typing each number.</p> <p>Enter unpaid balance> \$71.50 Enter previous meter reading> 4198 Enter current meter reading> 4238</p>	<p>Bill includes \$2.00 late charge on unpaid balance of \$71.50 Total due = \$152.50</p>
Test case 2	<p>This program figures a water bill based on the demand charge (\$35.00) and a \$1.10 per 1000 gallons use charge.</p> <p>A \$2.00 surcharge is added to accounts with an unpaid balance.</p> <p>Enter unpaid balance, previous and current meter readings on separate lines after the prompts. Press <return> or <enter> after typing each number.</p> <p>Enter unpaid balance> \$51 Enter previous meter reading> 4198 Enter current meter reading> 4137</p>	<p>Bill includes \$2.00 late charge on unpaid balance of \$71.50 Total due = \$102.00</p>

4. PRIME NUMBER

PROBLEM STATEMENT : Given a positive integer N, calculate the sum of all prime numbers between 1 and N (inclusive).

Input:

The first line of input contains an integer **T** denoting the number of test cases. T testcases follow. Each testcase contains one line of input containing **N**.

Output:

For each testcase, in a new line, print the sum of all prime numbers between 1 and N.

Constraints:

$$1 \leq T \leq 100$$

$$1 \leq N \leq 10^6$$

Design algorithm , flow chart ,program using the above data requirements for the given problem Try the sample test cases given below :

SAMPLE TEST CASES	INPUT	OUPUT
Test case 1	2 5 10	10 17
Test case 2	2 7 10	17 17

5. BUBBLE SORT

PROBLEM STATEMENT :The task is to complete bubble function which is used to implement Bubble Sort

Input:

First line of the input denotes the number of test cases 'T'. First line of the test case is the size of array and second line consists of array elements.

Output:

Sorted array in increasing order is displayed to the user.

Constraints:

$$1 \leq T \leq 100$$

$$1 \leq N \leq 1000$$

$$1 \leq arr[i] \leq 1000$$

Design algorithm , flow chart ,program using the above data requirements for the given problem Try the sample test cases given below :

SAMPLE TEST CASES	INPUT	OUPUT
Test case 1	2 5 4 1 3 9 7 10 10 9 8 7 6 5 4 3 2 1	1 3 4 7 9 1 2 3 4 5 6 7 8 9 10
Test case 2	1 5 8 9 3 2 0	0 2 3 8 9

6. TEXT EDITOR

PROBLEM STATEMENT: Design and implement a program to perform editing operations on a line of text. Your editor should be able to locate a specified target substring, delete a substring, and insert a substring at a specified location. The editor should expect source strings of less than 80 characters.

Problem Constant MAX_LEN 100 /* maximum size of a string */

Problem Inputs

char source[MAX_LEN] /* source string */

char command /* edit command */

Problem Output

char source[MAX_LEN] /* modified source string */

Design algorithm , flow chart ,program using the above data requirements for the given problem Try the sample test cases given below :

SAMPLE TEST CASES	INPUT	OUPUT
Test case 1	Enter the source string: > Internet use is growing rapidly. Enter D(Delete), I(Insert), F(Find), or Q(Quit)> d String to delete> growing	New source: Internet use is rapidly
Test case 2	Enter D(Delete), I(Insert), F(Find), or Q(Quit)> F String to find>.	'.' found at position 23

7. ARITHMETIC WITH COMMON FRACTIONS

PROBLEM STATEMENT:You are working problems in which you must display your results as integer ratios; therefore, you need to be able to perform computations with common fractions and getresults that are common fractions in reduced form. You want to write a program thatwill allow you to add, subtract, multiply, and divide several pairs of common fractions.

Design algorithm, flow chart, program using the above data requirements for the given problem Try the sample test cases given below :

SAMPLE TEST CASES	INPUT 1	OUPUT
Test case 1	Enter a common fraction as two integers separated by a slash> 3/-4	Input invalid—denominator must be positive
Test case 2	Enter a common fraction as two integers separated by a slash> 3/4 Enter an arithmetic operator (+,-,*, or /) > + Enter a common fraction as two integers separated by a slash> 5/8 Entering find_gcd with n1 = 44, n2 = 32 Do another problem? (y/n)>n	gcd of 44 and 32?> 4 find_gcd returning 4 3/4 + 5/8 = 11/8

8. FACTORIAL OF A NUMBER

PROBLEM STATEMENT:Find factorial of a given number n.

Design algorithm , flow chart ,program using the above data requirements for the given problem Try the sample test cases given below :

SAMPLE TEST CASES	INPUT 1	OUPUT
Test case 1	Enter a number to find factorial>2	Factorial of 2 is 4
Test case 2	Enter a number to find factorial>3	Factorial of 3 is 6

9. COLLECTING AREA FOR SOLAR-HEATED HOUSE – FILES AND FUNCTIONS

PROBLEM STATEMENT :An architect needs a program that can estimate the appropriate size for the collecting area of a solar-heated house. Determining collecting area size requires consideration of several factors, including the average number of heating degree days for the coldest month of a year (the product of the average difference between inside and outside temperatures and the number of days in the month), the heating requirement per square foot of floor space, the floor space, and the efficiency of the collection method. The program will have access to two data files. File hdd.txt contains numbers representing the average heating degree days in the construction location for each of 12 months. File solar.txt contains the average solar insolation (rate in BTU/day at which solar radiation falls on one square foot of a given location) for each month. The first entry in each file represents data for January, the second, data for February, and so on.

Problem Inputs

Average heating degree days file

Average solar insolation file

heat_deg_days /* average heating degree days for coldest month */

coldest_mon /* coldest month (number 1 .. 12) */

solar_insol /* average daily solar insolation (BTU/ft²) for coldest month */

heating_req /* BTU/degree day ft² for planned type construction */

efficiency /* % of solar insolation converted to usable heat */

floor_space /* square feet */

Program Variables

energy_resrc /* usable solar energy available in coldest month (BTUs obtained from 1 ft² of collecting area) */

Problem Outputs

heat_loss /* BTUs of heat lost by structure in coldest month */

collect_area /* approximate size (ft²) of collecting area needed */

The formula for approximating the desired collecting area (A) is :

$$A = \text{heat loss} / \text{energy resource}$$

Design algorithm , flow chart ,program using the above data requirements for the given problem

Try the sample test cases given below :

SAMPLE TEST CASES	INPUT	OUPUT
Test case 1	What is the approximate heating requirement (BTU / degree day ft ²) of this type of construction? =>9 What percent of solar insolation will be converted to usable heat? => 60 What is the floor space (ft ²)? => 1200	To replace heat loss of 11350800 BTU in the coldest month (month 12) with available solar insolation of 500 BTU / ft ² / day, and an efficiency of 60 percent, use a solar collecting area of 1221 ft ² .
Test case 2	What is the approximate heating requirement (BTU / degree day ft ²) of this type of construction? =>10 What percent of solar insolation will be converted to usable heat? => 60 What is the floor space (ft ²)? => 1200	To replace heat loss of 12612000 BTU in the coldest month (month 12) with available solar insolation of 500 BTU / ft ² / day, and an efficiency of 60 percent, use a solar collecting area of 1221 ft ² .

Q10. UNIVERSAL MEASUREMENT CONVERSION

PROBLEM STATEMENT:Design a program that takes a measurement in one unit (e.g., 4.5 quarts) and converts it to another unit (e.g., liters). For example, this conversion request 450 km miles would result in this program output Attempting conversion of 450.0000 km to miles . . . 450.0000km = 279.6247 miles . The program should produce an error message if a conversion between two units of different classes (e.g., liquid volume to distance) is requested. The program should take a database of conversion information from an input file before accepting conversion problems entered interactively by the user. The user should be able to specify units either by name (e.g., kilograms) or by abbreviation (e.g., kg).

Structured Data Type

unit_members :

```
name    /* character string such as "milligrams"    */
abbrev  /* shorter character string such as "mg"     */
class   /* character string "liquid_volume", "distance", or "mass" */
standard /* number of standard units that are equivalent to this unit */
```

Problem Constants

```
NAME_LEN  30 /* storage allocated for a unit name    */
ABBREV_LEN 15 /* storage allocated for a unit abbreviation */
CLASS_LEN  20 /* storage allocated for a measurement class */
MAX_UNITS  20 /* maximum number of different units handled */
```

Problem Inputs

```
unit_t units[MAX_UNITS] /* array representing unit conversion factors database */
double quantity /* value to convert */
charold_units[NAME_LEN] /* name or abbreviation of units to be converted */
charnew_units[NAME_LEN] /* name or abbreviation of units to convert to */
```

Problem Output

Message giving conversion.

Data file units.txt:

```
miles      mi      distance  1609.3
kilometers km      distance  1000
yards      yd      distance  0.9144
meters     m       distance  1
quartsqtliquid_volume 0.94635
liters     l       liquid_volume 1
gallons   gal      liquid_volume 3.7854
milliliters ml      liquid_volume 0.001
kilograms kg       mass      1
grams     g       mass      0.001
slugsslugs mass    0.14594
poundslb  mass    0.43592
```

Design algorithm , flow chart ,program using the above data requirements for the given problem

Try the sample test cases given below :

SAMPLE TEST CASES	INPUT 1	OUPUT
Test case 1	Enter a conversion problem or q to quit. To convert 25 kilometers to miles, you would enter > 25 kilometers miles or, alternatively,	>450 km miles Attempting conversion of 450.0000 km to miles . . . 450.0000km = 279.6247 miles

	> 25 km mi	
Test case 2	Enter a conversion problem or q to quit. > 2.5 qt l Attempting conversion of 2.5000 qt to l . . . 2.5000qt = 2.3659 l Enter a conversion problem or q to quit.	> 100 meters gallons Attempting conversion of 100.0000 meters to gallons . . . Cannot convert meters (distance) to gallons (liquid_volume)

ADDITIONAL PROGRAMS

Problem solving programs:

1. **Chocolate feast** : Little Bob loves chocolates, and goes to a store with \$N in his pocket. The price of each chocolate is \$C. The store offers a discount: for every M wrappers he gives to the store, he gets one chocolate for free. How many chocolates does Bob get to eat? Note : Evaluate the number of wraps after each step. Do this until you have enough wraps to buy new chocolates.
2. **Angry Professor** :The professor is. Given the arrival time of each student, your task is to find out if the class gets cancelled or conducting a course on Discrete Mathematics to a class of N students. He is angry at the lack of their discipline, and he decides to cancel the class if there are less than K students present after the class startsnot.
3. **Divisible Sum Pairs** : You are given an array of n integers and a positive integer, k. Find and print the number of (i,j) pairs where $i < j$ and $a_i + a_j$ is evenly divisible by k.
4. **Sherlock And Valid String**: A “valid” string is a string S such that for all distinct characters in S each such character occurs the same number of times in S. Note :The logic of the solution is as follows: count the character counts for each character. Note : if they are all equal – it means that all characters occur exactly N times and there is no removal needed .if 2 or more have less or more characters – there is no way to fix the string in just 1 removal . if exactly 1 char has a different count than all other characters – remove this char completely and S is fixed.
5. **Ice Cream Parlor** :Sunny and Johnny together have M dollars they want to spend on ice cream. The parlor offers N flavors, and they want to choose two flavors so that they end up spending the whole amount. You are given the cost of these flavors. The cost of the ith flavor is denoted by c_i . You have to display the indices of the two flavors whose sum is M.
6. **‘Missing Numbers’** :Numeros, the Artist, had two lists A and B, such that B was a permutation of A. Numeros was very proud of these lists. Unfortunately, while transporting them from one exhibition to another, some numbers from A got left out. Can you find the numbers missing?
7. **Alternating Characters**: John likes strings in which consecutive characters are different. For example, he likes ABABA, while he doesn’t like ABAA. Given a string containing characters A and B only, he wants to change it into a string he likes. To do this, he is allowed to delete the characters in the string.
8. **Game Of Thrones** : I : Dothraki are planning an attack to usurp King Robert’s throne. King Robert learns of this conspiracy from Raven and plans to lock the single door through which the enemy can enter his kingdom door. But, to lock the door he needs a key that is an anagram of a palindrome. He starts to go through his box of strings, checking to see if they can be rearranged into a palindrome.For example, given the string $s=[aabbccdd]$ one way it can be arranged into a palindrome is $abcdcdba$.
9. **Life and everything** : Your program is to use the brute-force approach in order to find the Answer to Life, the Universe, and Everything. More precisely... rewrite small numbers from input to output. Stop processing input after reading in the number 42. All numbers at input are integers of one or two digits.
input: 1 2 23 22 42
output: 1 2 23 22
10. **Filling Jars** :Animesh has N empty candy jars, numbered from 1 to N, with infinite capacity. He performs M operations. Each operation is described by 3 integers a, b and k. Here, a and b are indices of the jars, and k is the number of candies to be added inside each jar whose index lies between a and b (both inclusive). Can you tell the average number of candies after M operations?

Reference Books:

- (1) Jeri R. Hanly , Elliot B .Koffman , Problem solving and program Design in C , 7th Edition
- (2) Computer Science: A Structured Programming Approach Using C, B. A. Forouzan and R. F. Gilberg, Third Edition, Cengage Learning.
- (3) Dietal&Deital , C How to Program 7/E ,PHI Publications

Web References :

- <https://www.spoj.com/>
- <https://projecteuler.net/>
- <https://www.hackerearth.com/practice/>
- <https://www.codechef.com/>
- <https://onlinecourses.nptel.ac.in/>

Instructions to the instructor:

This lab course consists of two set of programs

- 1) Minimum set of sample programs
- 2) Additional set of programs

Minimum set of sample programs are designed unit wise covering all the topics in the theory .
Additional set of programs are designed basing on problem solving

Sessional marks : 50 marks

- 1) Daily Evaluation (Includes Record, Observation & regular performance) – 30 marks
- 2) Attendance – 5 marks
- 3) Internal Exam – 10 marks
- 4) Viva Voce – 5 marks

Daily Evaluation (30 marks)

- Every Student must execute minimum set of sample programs to secure 60% of marks in Daily Evaluation i.e. 18 Marks and to appear in external examination.
- In addition to that if a student finishes the minimum set and 5 programs from additional set of programs would secure 80% of marks in Daily Evaluation i.e. 24 Marks.
- If a student finishes all the programs in both the set s will secure 100% of marks in Daily Evaluation

Internal Exam (10 marks)

- Every student is given 4 questions in the internal exam out of which the difficulty level of 2 questions is easy / medium and 2 questions of difficulty level is high
- Each easy / medium level question carries 20% of marks and difficulty level question carries 30% of marks

External Exam (50 marks)

- Viva voce – 10 marks
- Write up + Execution – 40 marks

Write up + Execution (40 marks)

- Every student is given 4 questions in the external exam out of which the difficulty level of 2 questions is easy / medium and 2 questions of difficulty level is high
- Each easy / medium level question carries 30% of marks and difficulty level question carries 20% of marks.

ENVIRONMENTAL SCIENCE

Mandatory (Non Credit) course for all branches

Course Code - Category: CHE 128 - MC

Credits:0

L T P E O
3 0 0 0 1

Sessional Marks:50

COURSE OBJECTIVE:

- To Make the students get awareness on environment
- To understand the importance of protecting natural resources, ecosystems for future generations
- To know about the causes of pollution due to the day to day activities of human life
- To get an idea about the measures for sustainable development

Course Outcomes:

By the end of the semester, the student will be able to:	
CO1	Identify the characteristics of various natural resources and can implement the conservation practices
CO2	Realize the importance of Ecosystem and Biodiversity for maintaining ecological balance
CO3	Classify, analyze various pollutants and can develop methods for solving problems related to environment
CO4	Get awareness on various environmental laws and methods for sustainable development of environment
CO5	Understand the impact of population growth on human health and environment

CO – PO – PSO Matrix:

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

SYLLABUS

UNIT I

INTRODUCTION TO ENVIRONMENT AND NATURAL RESOURCES

8 Periods

Introduction: Definition, Multidisciplinary nature of environmental studies, Scope and Importance of Environmental Sciences, Need for public awareness.

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

LEARNING OUTCOMES

- Students will be able to know the scope and importance of environment.
- Students will be able to explain natural resources and their associated problems.

- Students will be able to articulate basic understanding of effects of modern agriculture practices on environment.
- Students will be able to recognise the importance of alternative sources of energy.

UNIT- II

ECOSYSTEM & BIO DIVERSITY

8 Periods

Ecosystem: Concept of an ecosystem-structure and function of an ecosystem Food chains, food webs and ecological pyramids, Energy flow in an ecosystem, Ecosystem regulation, Ecological succession.

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

LEARNING OUTCOMES

- Students will get a clear picture on structure and functions of ecosystems.
- Students will be able to explain the energy and matter flow in ecosystems.
- Students will be able to identify the threats to biodiversity and conservation methods to protect biodiversity.
- Students will be able to understand the importance of endemic species.

UNIT -III

ENVIRONMENTAL POLLUTION AND WASTE MANAGEMENT

8 Periods

Pollution: Sources, effects and control measures of Air pollution, Noise Pollution, Water Pollution, Soil Pollution, Radio Active Pollution; Climate Change, Ozone depletion, Acid rains –causes and adverse effects.

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

LEARNING OUTCOMES

- Students will be able to understand sources, effects and control measures of various types of pollutions.
- Students will be able to understand about solid waste management.
- Students will explain the ill effects of climatic change.

UNIT- IV

SOCIAL ISSUES AND ENVIRONMENTAL LEGISLATIONS

8 Periods

Social Issues and the Environment: Sustainable development, Environmental Impact Assessment, Rain water harvesting, water shed management. Resettlement and rehabilitation of people, Environmental ethics.

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

LEARNING OUTCOMES

- Students will be able to know the measures to achieve sustainable development.
- Students will have knowledge about watershed management and environmental ethics
- Students will be able to explain the enforcement of Environmental legislations.

UNIT- V

HUMAN POPULATION AND THE ENVIRONMENT

5 Periods

Human population and environment- Population growth, Population explosion; Family Welfare

Programmes; Role of information technology on environment and human health; Value Education – HIV/AIDS – Women and Child Welfare

FIELD WORK/PROJECT: Visit to a local area to document environmental problem;

LEARNING OUTCOMES

- Students will know the impacts of population on human health and environment.
- Students will understand the role of IT on Environment.
- Students will be able to prepare a detailed report on a particular environmental issue.

AWARENESS AND OTHER ACTIVITIES

1. Planting trees
2. Listing out water bodies and discuss the problems associated with it
3. Poster making of ecological pyramids and food chain and food web of different ecosystems like forest, grassland and aquatic system
4. Prepare list of endangered endemic and extinct species
5. Preparation of models
6. Cleanliness drive (Swatch Bharath)
7. Group discussion about waste management
8. Slogan making

Prescribed Book

1. **Anubha Kaushik & C.P.Kaushik**, “*Perspectives of Environmental Studies*” by 5th edition New Age International Publications, 2015.
2. **Erach Bharucha** *Text book of “Environmental Studies for Undergraduate Courses”*, universities Press Commission, 2013.
3. **Palaniswamy**- “*Environmental Studies*”, 2nd edition, Pearson education 2015.

Reference Books

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