YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF SUBJECTS
DEPARTMENT OF CHEMICAL TECHNOLOGY
FIRST SEMESTER
ACADEMIC YEAR 2022-23 OF 2022-25 BATCH (CBCS)

Sl. No.	Part	Subject Code	Title of the Subject	Hours/ Week	Duration of semester exams	Marks			Credits
						Internal	External	Total	
1	I	EN18101	General English-I (AECC-I)	3	3	40	60	100	3
2	I	VE18101	Value Education and Personality Development (AECC-II)	2	3	40	60	100	2
3	II	CT18101	Mathematics-I (GE-1)	5	3	40	60	100	3
4	II	CT18102	Chemistry-I (Core-1)	7	3	40	60	100	4
5	II	CT22103	Physics-I (Core-2)	5	3	40	60	100	3
PRACTICALS									
6	II	CT18104	Engineering Graphics (SEC-1)	4	3	40	60	100	2
7	II	BS18070	Chemistry-I (Core-1)	2	3	40	60	100	1
8	II	CT22105	Physics-I (Core-2)	2	3	40	60	100	1
Total				**30**		320	480	800	**19**

* Ability Enhancement Compulsory Course (AECC)
* Generic Elective (GE)
* Skill Enhancement Course (SEC)

GENERAL ENGLISH -I

Credits : 3 **Semester: I**
Subject Code : EN18101 **No. of lecture hours: 45**

Objective: To enhance the learners' communication skills by giving adequate exposure in reading, writing, listening and speaking skills and the related sub-skills.

Outcome: Through an exposure to contemporary passages, the students would be able to have a grasp on the language of today, with specific emphasis on the Listening, Speaking, Reading and Writing skills. Through the components of a passage, vocabulary and grammar section, speaking component and writing segments, there is a holistic development for language proficiency and fluency.

- To distinguish between words which are either spelt or pronounced alike, yet render distinct meanings; imparting a sound clarity on everyday usage of language, and for developing the art of parallel listening and writing.
- To construct vocabulary and to gain understanding on the tense component, a pivotal constituent for language structuring and vocabulary building.
- To identify with economical word constructions, paying specific attention in constructing sound writing skills.
- To interpret functional grammar, the basic part involved in sentence constructing to improve linguistic skills.
- To develop communication skills to provide a platform for language efficiency for effective language delivery.

UNIT-I Wit and Humor **9**

From the text "A Tea Party" by Ruth Prawer Jhabvala

- Explanation of the text 3
- Grammar----Nouns, Articles 2
- Vocabulary---Homonyms, homophones, homographs 2
- Writing Skill--- Note- Making 2
- Speaking --- Role Plays 2

UNIT-II Risk Management **9**

From the text "Deadly Factory Fires in India."

Explanation of the text 3

- Grammar----Tenses – The Present Tense 2
- Vocabulary ---Synonyms 2
- Writing Skill---Information Transfer 2
- Speaking ---JAM 2

UNIT-III Human Values **9**

From the text" India's Contribution to World Unity"

- Explanation of the text 3
- Grammar--- Tenses- The Past Tense 2
- Vocabulary ---- Adjective and Adverb Suffixes 2
- Writing Skill--- Formal Letters. Curriculum Vitae 2
- Speaking ---Debates 2

UNIT-IV The Cyber Age **9**

From the text "Polymer Bank Notes"

Explanation of the text 3

- Grammar----Concord or Subject Verb Agreement 2
- Vocabulary -----Word Formation. Collocations. 2
- Writing Skill----References and Bibliographies. 2
- Speaking ---Presentations 2

UNIT-V Sports **9**

From the text "Sachin Tendulkar"

- Explanation of the text 3
- Grammar------Adjectives, Comparison of Adjectives 2
- Vocabulary-Common Errors, Commonly Mispelt Words, Commonly Confused Words 2
- Writing Skill- Technical Reports, Project Reports 2
- Speaking --- Group Discussions 2

ESSENTIAL READING:

Skills Annexe – Functional English for Success. Orient BlackSwan.

SUGGESTED READING:

1. Balasubramaniam, M. 1985. Business Communication. New Delhi: Vani Educational Books.
2. Krishna Mohan and Meera Banerjee. 1990. Developing Communication Skills. New Delhi: Macmillan India Ltd.
3. Krishnaswamy.N. and Sriraman, T. 1995. Current English for Colleges. Madras: Macmillan India Ltd.
4. Narayanaswamy, V.R. 1979. Strengthen Your Writing. New Delhi: Orient Longman
5. Sharma, R.C. and Krishna Mohan. 1978. Business Correspondence. New Delhi: Tata McGraw-Hill Publishing Co.

VALUE EDUCATION & PERSONALITY DEVELOPMENT

Credits : 2 **Semester: I**
Subject Code : VE18101 **No. of lecture hours: 30**

Objective:

- To produce intellectually competent, morally upright, socially committed, spiritually inspired citizens in the service of the nation and the world.
- To transform the students into conscientious citizens through holistic education and contribute to nation building.

Outcome:

- Students will be able to differentiate Accepted norms and Counter values and be able to identity the various Dimensions of Human Development.
- Students will be able to demonstrate Love and Experience of God and identify the Basic Issues of Life and Happiness as a life goal.
- They will able to understand the importance of Concern for others and critique the various problems that deter the growth of the society.
- The students will be able to recognize the traits of a good personality and practice Self-exploration.
- Students will be able to interpret the Purpose of Life and Goal Setting and demonstrate Self-management.

UNIT- I **No of hours: 6**

INTRODUCTION TO ETHICS

- Why Value Education?
- Reasons to have Ethics for Life
- Accepted Norms and Counter Values
- Dimensions of Human Development: Physical, Intellectual, Emotional, Moral, Spiritual and Social

UNIT-II **No of hours: 6**

APPROACH TO LIFE

- Conscience and Pseudo-Conscience
- Happiness as Life-goal
- Values revealed and lived in Religions
- Experience of God
- Love: The three components of Love
- Some of the basic stages and issues of Life: Family, Love, Sex, Marriage

UNIT-III **No of hours: 6**

CONCERN FOR OTHERS

- Self and Another
- Human Context
- Moral Problems of a Society / True Society: Social Desire, Social Fear, Social Silence, Social Indifference

UNIT-IV **No of hours: 6**

TRANSFORMATION OF SELF

- Definitions of personality
- Characteristics of personality
- Elements of personality
- Traits of good personality
- Self-Identity, self concept
- Self-Discovery, self-acceptance
- Self-Esteem

WORK SHEET (1): Self Estimation

UNIT-V **No of hours: 6**

LIFE ENRICHMENT SKILLS

- Purpose of life - Goal setting
- Characteristics of Goals
- Building Relationships
- Time Management
- Stress Management
- Emotional Management
- Conflict Management
- Team Management (Group Dynamics)

WORK SHEETS (1) & (2): 1) Anger Management
2) Team Management

ESSENTIAL READING:

1. Human Values - Development Programme - AIACHE
2. In Harmony

MATHEMATICS – I
(VECTOR CALCULUS, SOLID GEOMETRY AND MATRICES)

Credits : 4 **Semester: I**
Subject Code : CT18101 **No. of lecture hours: 75**

Objective: To help students to pursue higher studies in Mathematics and also helps to understand various applications in chemical technology.

Outcome: Students will be able to

- Construct the vector-valued functions of a real variable and their curves, Gradient vector fields and constructing potentials. Define the directional flow especially in the description of electromagnetic fields, fluid flow in physical sciences.
- Identify the importance of vector fields in day-to-day life. Calculate the mass, area and momentum and also measure the energy of steady flows using integrations.
- Develop factual knowledge including the mathematical notation and terminology in geometry; points, lines, and angles; planar figures.
- Describe the surface area of sphere - great circle and volume of sphere, cone.
- Apply matrix theory to solve homogeneous and non-homogeneous system. Define Eigen values and Eigen vectors.

UNIT-I **15Hrs**

VECTOR CALCULUS:

Vector differentiation (1)

- The necessary and sufficient conditions for a vector function to be constant, (ii) have a constant magnitude (iii) have a constant direction (2)
- Geometrical meaning of the derivative of a vector function (1)
- Vector integration – Gradient – Directional derivative of a scalar function (2)
- Related theorems (2)
- The equations of the tangent plane and normal to a surface (2)
- Divergence and curl – Definitions of harmonic function (1)
- Solenoidal and irrational vectors (2)
- Vector identities – simple problems there on. (2)

UNIT-II **15Hrs**

GREEN'S, GAUSS'S AND STOKE'S THEOREMS :

Statements of Greens's, Gauss's and Stoke's theorems (3)
(proof of these theorems is not required) Simple problems there on. (12)

UNIT-III **15Hrs**

STRAIGHT LINES (in 3-D space) :

Symmetrical form (or distance form) of the equations of a line (2)

- Two-point form (1)
- To reduce the equations $a_1 x + b_1 y + c_1 z + d_1 = 0$ and $a_2 x + b_2 y + c_2 z + d_2 = 0$ of a straight line to its symmetrical form (2)
- Distance of a point from a line (1)
- Image of a point in a line – point of intersection of a line with a plane (2)
- The condition for a line and a plane to be (I) Parallel (ii) Perpendicular (1)

- Image of a point in a plane- Angle between a line and a plane (2)
- Equation of a plane through a given line. (1)
- Condition for two lines to intersect (i.e. condition of coplanarity) (1)
- Shortest distance between two skew lines. (2)

UNIT-IV **15Hrs**

SPHERE :

- General equation of a sphere (1)
- Equation of a sphere passing through four points (2)
- Diameter form of the equation of a sphere (2)
- Condition for two spheres to touch each other (1)
- Plane section of sphere- Intersection of two spheres is a circle (1)
- Equation of any sphere through the circle of intersection of a given (1)
- Sphere and a given plane
- Great circle – Intersection of a sphere and a line (1)
- Condition for a plane to touch a sphere (2)
- Pole- Polar plane- Polar lines – conjugate points – conjugate planes (1)
- Angle between two intersecting spheres (2)
- Orthogonal spheres. (1)

UNIT-V **15Hrs**

MATRICES:

- **Rank of a matrix – Normal form – Echelon form** (2)
- Homogeneous and non- homogeneous system of linear equations (2)
- Trivial and non- trivial solutions – consistency and inconsistency solution of a system of homogenous and (2)
- Non – homogenous linear equations (using Echelon form). (3)
- Eigen values – Eigen vectors (2)
- Cayley – Hamilton theorem (proof is not required) (1)
- To find the inverse of a matrix using Cayley – Hamilton theorem. (3)

ESSENTIAL READING:

1. J.N. Sharma and A.R. Vasishtha. Vector calculus. Krishna Prakashan Mandir. (for units I and II)
2. N.P. Bali. Solid Geometry (Golden Maths series). (Lakshmi Publications) (for units III and IV)
3. M.D.Raisinghania and R.S.Aggarwal. Matrices. (S.Chand and Company Ltd.) (for unit V)

SUGGESTED READING:

1. Dr. T.K.V. Iyengar, Dr. B. Krishna Gandhi, S. Ranganathan, M.V.S.S.N. Prasad. Mathematical Methods. New Delhi-For unit-V: S. Chand and Company Ltd.

CHEMISTRY – I

Objective: Chemistry is a base for Chemical Technology. The student should have basic ideas and should learn the basic concepts in Chemistry. Keeping this in view the syllabus is designed in such way that, to cover all the necessary information including practicals.

Credits : 4 **I Year / I Semester**
Course Code : CT18102 **No. of lecture hours :105**

UNIT-I **19Hrs**

ATOMIC STRUCTURE

1.Plank's quantum radiation (1)
2.Black body radiation (1)
3.Photoelectric effect (2)
4.Compton effect (1)
5.De Broglies hypothesis (1)
6.Heisenberg's uncertainty principle, equation (2)
7.Schrodinger's wave equation and its importance (2)
8.physical interpretation of the wave function, significance of ψ and ψ^2 (1)

CHEMICAL BONDING

1. General properties of Ionic and covalent bonds (1)
2.Valence bond theory(VBT) (1)
3.Molecular orbital theory(MBT) (1)
4.Molecular orbital diagrams of eg.H_2, He_2; Li_2; Be_2; N_2; O_2; CO; NO (3)
5.Hybridization, VSEPR Theory (1)
6.Polarization of ions-Fajans rule (1)

UNIT-I **22Hrs**

A) PERIODIC PROPERTIES

1. Atomic, Ionic, Covalent vander walls radii (2)
2. Ionization energy, Electropositivity, basic nature, reducing behaviour, electron affinity.(3)
3. Electro negativity – methods of determination and evaluation. (2)
4. Diagonal relationship of Li-Mg, Be-A1, B-Si. (1)

B) S-BLOCK ELEMENTS

5. Comparative study of general properties of elements – IA, IIA, IIIA, IVA (2)
6. **OXIDES :-** Mono oxides, peroxides super oxides – basic nature, complexation tendencies, oxidizing nature (3)
7. **Hydrides :-** Ionic covalent, poly nuclear, complex hydrides, reducing nature. (2)
8. Halides : Comparative study (1)

C) P-BLOCK

9. Comparative study of general properties of elements – VA, VIA, VIIA (2)
10. **Oxides :-** Oxy-acids of nitrogen, phosphorous, sulphour and chlorine (2)
11. **Hydrides :-** Properties structures (2)
12. **Halides :-** Properties, structures (2)

UNIT-III **25Hrs**

A) CHEMISTRY OF NOBLE GASES

1. General preparation, structure, bonding and reactivity of xenon oxides, halides, oxy-halides. (3)

B) METALS

Theories of bonding in metals

2. Free electron theory – Thermal and electrical conductivity of metals (1)
3. Valence bond theory – Explanation of metallic properties and its limitations (2)
4. Bond theory – Explanation of metallic properties conductors
5. Semi conductors and insulators (3)

Metallurgy

General methods involved in extraction of metals

6. Minerals and ore (2)
7. Ore concentration – Electromagnetic separation, gravity separation, willfley table, leaching, froth flotation. (2)

c) Extraction of metal

8. Calcination, roasting, smelting (1)
9. Reduction of oxides, carbonates, halides, sulphides, sulphates auto-reduction, alumino thermite reduction, hydro metallurgy. (3)

d) Refining of metals

10. Liquation, distillation, zone reefing, cupellation, (1)
11. Bessemerisation, puddling, poling, electrolysis amalgamation. (1)

e) ALLOYS

12. Classification – Substitutional, interstitial solid solutions, intermetallic compounds, Hume – Rothory rules. (2)
13. Preparation of alloys – fusion, electrolytic reduction and Comparison, uses, ferrous and non-ferrous alloys. (2)

UNIT-IV **21Hrs**

IUPAC, NOMENCALURE OD ORGANIC MOLECULES (6)

BOND POLARIZATION

1. Application of inductive effect
   a) Basicity of amines, b) Acidity of carboxylic acids, c) Stability of carbonium ion (1)
2. Application of Mesomeric effect,
   a) Acidity of Phenols, b) Acidity of carboxylic acids. (2)
3. Hyper conjugation, its applications to stability of carbonium ion (1)
4. Free radicals and alkene (1)

Types of Organic reactions

5. Addition electrophillic, Nucleophillic and free radical reactions. (2)
6. Substitution electrophillic, Nucleophillic and free radical reactions. (2)
7. Elimination reactions. (1)

Alicyclic hydrocarbons

8. Nomenclature, Preparation, Properties, reactivity of Cyclopropane, Cyclobutane by comparing with alkane (2)
9. Stability of Cycloalkanes – Baeyer strain theory (2)
10. Conformational Structures of cyclobutane, Cyclopentane and cyclohexne (1)

UNIT-V **18Hrs**

CONCEPT OF AROMATICITY

1. Huckles rule-application of Benzonoid Benzene, Naphthalene, Anthracene, Phenantharacene and non Benzonoid compounds (Cyclopropenylcation, Cyclopenta di enylanion and triphenylcation)
2. Rind Activation and de Activation groups with examples. (2)
3. Mechanism of Halogination, Fridel Crafts alkylation, acylation,nitration, sulfonation. (4)
4. Arenes and poly nuclear aromatic hydrocarbons :Structure of naphthalene and Anthracene (molecular orbital diagram and resonance energy) reactivity towards electrophillic substitution.,Nitration and sulphonation as examples. (4)

TEXT BOOKS

1. Dr. O.P. Agarwal : Unified Course in Chemistry,Vol-1, Vol-2, Vol-3 & Vol-4,5th ed, Jay Prakash Nath Publications, New Delhi, 1990.

2. C.Parameshwara Murthy, SyedFazal Mehdi Ali, Promod Kumar Dubey, University Chemistry,Vol-1, Vol-2, Vol-3, 1st ed, New Age International publishers, New Delhi, 2000

BOOKS

1. P.L. Soni, Text Book of Inorganic Chemistry – Published by Sultan Chand & Sons 3rd Edition –1999
2. P.L.Soni & O.P. Dharmarsha Text Book of Physical Chemistry – published by Sultan Chand & Sons, 1stEdition – 2000
3. P.L. Soni : Text Book of Organic Chemistry , published by Sultan Chand & Sons, 1stEdition – 2000
4. J.C. Kuriacose and Rajaram : Latest Chemistry for Engineering students
5. Volume I & II.(Published by Tata Mac Hill –2nd Edition – 1984)

PHYSICS-I
(Mechanics & Oscillations)

Credits : 4 **Semester: I**
Subject Code : CT22103 **No. of lecture hours: 75**

Objective: To impart the basic ideas about mechanics related to particles, rigid body Dynamics, Central Forces, and its applications in orbits of planets, Einstein's special theory of relativity & its applications in relativistic mechanics. To give information about the various types of vibrations & its effect in resonance phenomena.

Outcome: Students will be able to

- Apply the laws of motion on variable mass systems and explain the conservation principles of mechanical energy and momentum
- Distinguish the mechanics of rigid bodies with respect to kinematics.
- Explain the mechanics of central forces & Einstein's special theory of relativity.
- Explain the fundamentals of vibrations & Applications.
- Compare Damped and forced oscillations & its effects on resonance.

UNIT-I **15Hrs**

MECHANICS OF PARTICLES:

- Laws of motion (2)
- Motion of a variable mass system (2)
- Motion of a rocket-multistage rocket (2)
- Expressions for kinetic energy and potential energy (2)
- Conservation of mechanical energy (1)
- Conservation of linear momentum (1)
- Conservation of angular momentum, torque (2)
- Collision- Elastic Collision in Two Dimensions (2)
- Concepts of Impact Parameter and Scattering Cross-Section (1)

UNIT-II **15Hrs**

(A) MECHANICS OF RIGID BODIES:

- Constrained motion of a rotating body (1)
- Definition of a rigid body-rotational kinematic relations (1)
- Rotation with constant angular acceleration (1)
- Relation between linear and angular kinematics of a particle in circular motion (1)
- Kinetic energy and angular momentum of a rotating body (1)
- Equation of motion of a rigid rotating body (1)
- Combined Translational and Rotational Motion of a Rigid Body (1)

(B) Central Forces:

- Central forces – definition and examples (1)
- Conservative nature of central forces (1)
- Conservative force as a negative gradient of potential energy (1)
- Equation of motion under a central force (2)
- Derivation of Kepler's laws (3)

UNIT-III **15Hrs**

Special Theory of Relativity:

- Galilean relativity, absolute frames (1)
- Michelson-Morley experiment (2)
- Postulates of special theory of relativity (2)
- Lorentz transformation (3)
- Time dilation & length contraction (2)
- Addition of velocities (2)
- Mass energy relation (3)

UNIT-IV **15Hrs**

Fundamentals of Vibrations & Waves-1:

- The simple harmonic oscillator solution of its differential equation of motion (2)
- Physical characteristics of SHM (2)
- Total energy of simple harmonic oscillator (1)
- Combination of two mutually perpendicular vibrations of equal frequency (2)
- Combination of two mutually perpendicular vibrations of unequal frequency (2)
- Lissajous figures (1)
- Velocity of a transverse wave along a stretched string (2)
- Modes of vibration of stretched string clamped at both the ends, Harmonics & overtones (3)

UNIT-V **15Hrs**

Damped, Forced Oscillations & Waves-2:

- Damped harmonic oscillator- solution of its differential equation of motion (2)
- Energy considerations, logarithmic decrement, relaxation time, Quality Factor (3)
- Forced harmonic oscillator -solution of its differential equation of motion (3)
- Amplitude resonance & velocity resonance (2)
- Velocity of Longitudinal wave in bar (2)
- Longitudinal vibrations of a bar fixed at both the ends (1)
- Longitudinal vibrations of a bar free at both the ends (1)
- Longitudinal vibrations of a bar fixed at one end & free at the other end (1)

ESSENTIAL READING:

1. Dr. S. L. Gupta & Sanjeev Gupta. 2009. Unified physics. vol-I:77th edition. Jai Prakash Nath Publications, Meerut.
2. First Year Physics - Telugu Academy.
3. Berkeley Physics Course. Vol.1, Mechanics by C. Kittel, W. Knight, M.A. Ruderman - Tata-McGraw hill Company Edition 2008.
4. Introduction to Physics for Scientists and Engineers. F.J. Ruche. McGraw Hill
5. Theory of relativity - Resnick

SUGGESTED READING:

6. Halliday, Resnick & walker. 2007. Fundamentals of physics. 6th edition. Delhi: Wiley India Pvt. Ltd.
7. H.S. Hans & S.P. puri. 2003. Mechanics. 35th edition. Delhi: Tata McGraw Hill publications.
8. R.G. Takwale & P.S. Puranik. 2000. Introduction to Classical Mechanics. Delhi: Tata McGraw Hill publications: Delhi, 2000.

ENGINEERING GRAPHICS
PRACTICALS

Credits : 2 **Semester: I**
Subject Code : CT18104 **No. of practical hours: 60**

Objective:

- To provide all aspects and detailed study of Engineering Drawing.
- To construct any structure correctly and methodically.
- To describe the shape, size, finish and construction of any object accurately and clearly

Outcome: Students will be to gain knowledge on how to draw lines, curves and objects in two dimensional views and can demonstrate the objects in three dimensional views.

01-1	Drawing instruments and their uses: Drawing Board, Dry Sheet, Divider, Protractor French Curves, Mini Drafter, Pencils etc.	2
02-2	Importance of Dimensioning. Linen and lattering	6
03-5	Geometrical Construction: Bisecting a line, Bisecting angles, Regular polygon, Inscribing Circle in polygons.	8
06-8	Curves used in engg. Practice: Parabola, Ellipse, Hyperbola.	14
09-12	Conversion of Pictographic view to Orthographic views: Simple Figures (1^{st} angle).	10
09-13	Projection of points, lines and planes.	14
13-14	Isometric Views: Square Prism, Pyramids, Cylinders, Cone, Spheres and their combinations.	6

ESSENTIAL READING:

N.D. Bhatt and V M Phanchal. Engineering Drawing. ANAND GUJARAT: Charoter Publishing House Pvt. Ltd.

CHEMISTRY-I
PRACTICALS

Credits : 1 **Semester: I**
Subject Code : BS18070 **No. of practical hours: 30**

Objective: To impart the basic concepts in Chemistry as Chemistry is a base for Chemical Technology.

Outcome: Students will be able to identify Cations and anions present in the Sample.

Quantitative Semi-Micro Analysis of one anion and one cation from the following.

ANION :
Carbonate, Bicarbonate, Nitrite, Sulphide, Sulphite, Flouride, Thiosulphate, Chloride, Bromide, Iodide, Acetate, Oxalate, Tartarate, Chromate, Phosphate, Arsenate.

CATIONS :
Lead Bismuth Copper, Cadmium, Iron, Aluminium, Zinc, Manganese, Cobalt, Nickel, Calcium, Strontium, Barium, Potassium, Magnesium, and Ammonium.

PHYSICS-I
PRACTICALS

Credits : 1 **Semester: I**
Subject Code : CT22105 **No. of practical hours: 30**

Objective: To give ideas about using various measuring devices like vernier calipers, screw gauge, spherometer, spectrometer, travelling microscope and to strengthen lab skills.

Outcome: Students will be able to investigate the theoretical background to an experiment and to design experiments to test a hypothesis and to determine the value of unknown quantities.

LIST OF EXPERIMENTS:

Introduction	(4)
1. Compound pendulum	(1)
2. Torsional pendulum	(1)
3. Melde's experiment	(1)
4. Determine surface tension of a liquid by capillary rise	(1)
5. Error analysis	(1)
6. Viscosity By poisselli's method	(1)
7. Volume resonator	(1)
Calculations and revision	(4)

Reference books:

1. D.P. Khandelwal, "A laboratory manual for undergraduate classes" (Vani Publishing House, New Delhi).
2. S.P. Singh, "Advanced Practical Physics" (Pragati Prakashan, Meerut).
3. "Practical Physics" R.K Shukla, Anchal Srivastava
4. University Practical Physics -D.C.Tayal -Himalaya Publishing House
5. B.Sc. Practical Physics – C. L. Arora – S. Chand & Co.
6. Viva-voce in Physics – R.C. Gupta, Pragathi Prakashan, Meerut
7. B.Sc. practical physics – Subbi Reddy

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DEPARTMENT OF CHEMICAL TECHNOLOGY
SECOND SEMESTER
ACADEMIC YEAR 2022-23 OF 2022-25 BATCH (CBCS)

Sl. No.	Part	Subject Code	Title of the Subject	Hours/ Week	Duration of semester exams	Marks			Credits
						Internal	External	Total	
1	I	EN18201	General English-II (AECC-III)	3	3	40	60	100	3
2	I	IC19201	Indian Heritage & Culture (AECC-IV)	2	3	40	60	100	2
3	II	CT18201	Mathematics-II (GE-2)	5	3	40	60	100	3
4	II	CT18202	Chemistry-II (Core –3)	6	3	40	60	100	4
5	II	CT22203	Physics-II (Core-4)	5	3	40	60	100	3
PRACTICALS									
6	II	CT18204	Workshop (SEC-2)	4	3	40	60	100	2
7	II	BS18071	Chemistry-II (Core –3)	2	3	40	60	100	1
8	II	CT22205	Physics-II (Core-4)	2	3	40	60	100	1
9	III	PL18001	PLANET* (Outreach)	-	-	-	-	-	1
Total				29	-	320	480	800	19

* Ability Enhancement Compulsory Course (AECC)
* Generic Elective (GE)
* Skill Enhancement Course (SEC)
* Programme of Loyola Academy for Neighbourhood Empowerment & Transformation (PLANET)

GENERAL ENGLISH -II

Credits : 3 **Semester: II**
Subject Code : EN18201 **No. of lecture hours: 45**

Objective: To enhance the learners' communication skills by giving adequate exposure in reading, writing, listening and speaking skills and the related sub-skills.

Outcome: To enhance the learner's communication skills by giving adequate exposure to increase their proficiency in reading, writing, listening and speaking skills and the related sub skills.

- To identify a sound understanding on the formation of words and to demonstrate the functional grammatical component in the sentence.
- To paraphrase ideas and thoughts in a coherent, neat and organized manner in order to utilize the writing skills for sound writing propagandas.
- To create an understanding on Indian Literature, alongside to develop and chisel their communication skills.
- To recognize the moral element which underlies in the short story; an exposure to informal language.
- To develop listening and speaking skills through effective sentence constructions and efficient delivery.

UNIT-I Biography **9**

From the text "Mokshagundam Visvesvaraya"

Explanation of the text, 2
- Grammar –--- Conjunctions, Adverbs 2
- Vocabulary ----- Prefixes and Suffixes 2
- Writing Skill ------Paragraph Writing 1
- Speaking --- Role Plays 2

UNIT-II Health **9**

From the text "Three Days to See"

Explanation of the text 2
- Grammar -------Usage of Modal Auxiliary Verbs 2
- Vocabulary ---Collective Nouns ,Technical Vocabulary 2
- Writing Skill ------Report Writing 2
- Speaking ---- JAM 1

UNIT-III Short Story **9**

From the text "Leela's Friend" by R.K.Narayan
- Explanation of the text 2
- Grammar----Phrasal Verbs, Wh- Questions 2
- Vocabulary----Noun and Verb Suffixes 2
- Writing Skill------Writing a Narrative 2
- Speaking --- Debates 1

UNIT-IV Inspiration **9**

From the text "The Last Leaf" by O. Henry
- Explanation of the text 2

- Grammar----- Prepositions 2
- Vocabulary-----Idioms 2
- Writing Skill----- Précis Writing 2
- Speaking ---- Presentations 1

UNIT-V Human Interest **9**

From the text" The Convocation Speech"
Explanation of the text 2

- Grammar---- Active and Passive Voice 2
- Vocabulary-----One-word Substitutes 2
- Writing skill------ Essay Writing 2
- Speaking ------ Group Discussion 1

ESSENTIAL READING:

Epitome of Wisdom, Maruthi Publications.

SUGGESTED READING:

1. Krishna Mohan and Meera Banerjee, 1990. Developing Communication Skills. New Delhi: Macmillan India Ltd.
2. Krishnaswamy.N. and Sriraman, T. 1995. Current English for Colleges. Madras: Macmillan India Ltd.
3. Narayanaswamy, V.R. 1979. Strengthen Your Writing. New Delhi: Orient Longman
4. Sharma, R.C. and Krishna Mohan. 1978. Business Correspondence. New Delhi: Tata McGraw-Hill Publishing Co.

INDIAN HERITAGE & CULTURE

Credits : 2 **Semester: II**
Subject Code : IC19201 **No. of lecture hours: 30**

Objectives:

- To apprise the students with a sound background of Indian Culture.
- To equip the students with social & community problems of India.
- To prepare the student for civil service exams where Indian Heritage & Culture paper is compulsory for all the streams.

Outcome:

- The student can understand better about the origin of ancient Indian culture and the contributions of great rulers from both north and south India for Indian culture in ancient days
- Students will analyse how Persian culture entered into India and how it influenced the Fine Arts of Indian society like Classical Music, Dance and Architecture.
- Student can able to assess how the Indian orthodox society turn into modern and western society in the 19th century .It also edifies the students with spiritual doctrines of various Religions.
- Students will evaluate various challenges face by the youth and the evil affects of terrorism on society
- The topics in the unit create belongingness among the students by bringing awareness of the rights and duties to make the world a better place and it throw light on gender sensitization issues of women, Children and LGBT.

UNIT I **No of hours: 6**

INTRODUCTION – IMPACT OF GEOGRAPHY ON INDIAN CULTURE

- Meaning of culture – Characteristics of Indian Culture and Caste system
- Indus Valley Civilization and Vedic/Aryan Culture
- Golden Age of Indian Culture– Mauryas and Guptas, Satavahavas, Pallavas, Cholas.

UNIT II **No of hours: 6**

MEDIEVAL INDIA – INFLUENCE OF ISLAM ON INDIAN CULTURE

- Cultural Development under the Delhi Sultanate and Mughals
- Contribution of Sher Shah and Akbar to Indian Administrative System
- Cultural Achievements of Kakatiya and Vijayanagara rulers
- Indian Fine Arts –Painting, Music, Dance and Sculpture

UNIT III **No of hours: 6**

IMPACT OF WEST AND REFORM MOVEMENTS

- Influence of Western culture on Indian Society
- 19th century Socio Religious Reform Movement –Raja Ram Mohan,Ishwara Chandra Vidyasagar and Veerasalingam
- Rise of Subaltern Movements in India– Jyothirao Phule-Savitribai Phule,E.V Ramaswamy Naikar –Narayana Guru-Dr.B.R.Ambedkar
- Rise of Indian National movement-Moderate, Extremist and Gandhian Era

UNIT IV **No of hours: 6**

IMPACT OF RELIGION AND COSTITUTIONAL INSTITUTIONS

- Hinduism – Islam – Christianity – Jainism and Buddhism -Sikhism – Zoroastrianism
- Democratic system in India- -Parliament and Judiciary- Election Commission
- Impact of Press and Social Pressure groups on Indian Culture
- Know your Rights – Classification of Rights and Importance

UNIT V **No of hours: 6**

IMPACT OF CONTEMPORARY GENDER ISSUES

- Woman and Child rights - Violence against Women and Children
- Gender issues - LGBT
- Youth Unrest and Reasons- Alcoholism, Drug Addiction and other Addictions
- Terrorism - Causes and Consequences

REFERENCE BOOKS:

1. Jha, Dr K.N. 2006. **Studies in ancient & Medieval India**. COSMOS Book hive Ltd: Gurgaon.
2. Mahajan, V.D. 2008. **Ancient India**. S.Chand, New Delhi.
3. Manasseh, Dr P. 2010. **An Overview of Indian Culture**. Gamaleil Publishers, Hyderabad.
4. Malpani, Madanlal & Malpani, Shamsunder. 2014. **Indian Heritage and Culture**. Kalyani Publishers, Ludhiana.
5. Mhaske, Dr R.H. 2012. **Human Rights, Social Justice and Political Challenges**. Chandralok Prakashau, Kanpur.
6. Singh, Gurdip & Ahuja, V.K. 2012. **Human Rights in 21st Century**. Universal Law Publisher, New Delhi.

MATHEMATICS – II
(DIFFERENTIAL EQUATIONS, DIFFERENTIAL CALCULUS AND TESTS OF CONVERGENCE)

Credits : 4 **Semester: II**
Subject Code : CT18201 **No. of lecture hours: 75**

Objective: To help the students to pursue higher studies in Mathematics and also to understand various applications in chemical technology.

Outcome: Students will be able to

- Classify the differential equations with respect to their order and linearity. Solve differential equations of first order using numerical and analytical methods such as Integrating Factors.
- Solve higher order non- Homogeneous Equations with Constant Coefficients. Obtain exact and numerical solutions using differential equations technology.
- Solve higher order non- Homogeneous Equations with variable Coefficients. Obtain exact and numerical solutions using differential equations technology.
- Identify the relationship between a real function and its derivative at a point which in turn helps them solve the system using integrations.
- Identify different tests for convergence and divergence of a given series.

UNIT-I **15Hrs**

ORDINARY DEFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE

- Variables Separable (3)
- Linear equations (3)
- Bernoulli's equation (4)
- Exact equations – Integrating factors. (5)

UNIT-II **15Hrs**

LINEAR EQUATIONS OF HIGHER ORDER WITH CONSTANT COEFFICIENTS

- Evaluation of complementary function (4)
- Particular integrals of e^{ax}, Sin ax, Cos ax, x^n and V $e^{ax.}$ (11)
- (Differential equations of orders 2, 3 and 4 only).

UNIT-III **15Hrs**

LINEAR EQUATIONS WITH VARIABLE COEFFICIENTS

(i) Homogeneous linear equations:

(a) Cauchy's homogeneous linear equation of order 2 (4)
$(ax^2 y^{11} + bxy^1 + cy = X)$

(b) Cauchy – Euler equations of orders 3 and 4 (3)
$(ax^3 y^{111} + bx^2 y^{11} + cxy^1 + y = X$ &
$ax^4 y^{1111} + bx^3 y^{111} + cx^2 y^{11} + dxy^1 + ey = X)$

(c) Legendre's equation of order 2.
$(a(px+q)^2 y^{11} + b(px+q)y^1 + cy = X)$ (4)

(ii) Method of variation of parameters:

To solve a linear differential equation of order 2 (4)

UNIT-IV **15Hrs**

DIFFERENTIAL CALCULUS

- Rolle's Theorem (2)
- Lagrange's mean value theorem (2)
- Cauchy's mean value theorem (2)
  (With proofs)
- Simple problems thereon. (3)
- Taylor's and Maclaurin's expansions of a function with Lagrange's and Cauchy's form of remainders. (3)
- Power series expansions of only e^x, Sinx, Cosx, $(1+x)^m$ and log(1+x). (3)

UNIT-V **15Hrs**

TESTS OF CONVERGENCE

Only statements of p-test, comparison test, Ratio test and Cauchy's root test (Proofs of these tests are not required). (4)

Simple problems using the above tests for the convergence of a series of positive terms. (3)

- Definitions of the absolute convergence and conditional convergence. (2)
- Leibnitz's test for a series of alternately positive and negative terms.(Proof of this test is not required). (3)
- Simple problems on Leibnitz's test. (3)

ESSENTIAL READING:

1. S. Narayanan and T.K. Manicavachagom Pillay – S Viswanathan. Calculus. Integral Calculus and Differential equations. Vol-II. Printers and Publishers Pvt. Ltd. (For Units I, II and III)
2. J.N. Sharma and Dr. R.K. Gupta. Differential equations. Meerut: Krishna Prakasham Mandir) (For Unit II)
3. M.L. Khanna. Differential Equations. Meertu: Saiprakashanath and Company. (for Unit-I)
4. Shanti Narayanan. Differential Calculus (For Unit – IV)
5. Om Prakash. Sequences and Series. Lakshmi Publication (For Unit V)

SUGGESTED READING:

1. S. Narayanan. Algebra (For Unit-V)

CHEMISTRY – II

Objective: Chemistry is a base for Chemical Technology. The student should have basic ideas and should learn the basic concepts in Chemistry. Keeping this in view the syllabus is designed in such way that, to cover all the necessary information including practicals.

Credits : 4 **I Year / II Semester**

Course Code : CT18202 **No. of lecture hours: 105**

UNIT-I **22Hrs**

THERMODYNAMICS – I

- Introduction (2)
- language of thermodynamics heat, work energy (3)
- work done in an isothermal reversible expansion of an ideal gas. (2)
- The first law of thermodynamics (7)
- Thermo chemistry, application of-first law to ideal gas work done-in an adiabatic reversible expansion. (8)

UNIT-II **24Hrs**

THERMODYNAMICS – II

1.The second law of thermodynamics. [i.e thermo chemistry] (3)
2.Carnot's cycle (2)
3.Entropy changes in irreversible processes (3)
4.Gibb's free energy, helmotz equation (work – function), (4)
5.Gibb's – Helmholtz equation claussius – clapeyron equation, (6)
6.Vant – hoff isotherm, Third Law of Thermodynamics. (6)

UNIT-III **22Hrs**

COLLIGATIVE PROPERTIES

1.Relative Lowering of Vapour Pressure and Raoult's Law, molecular weight determination from RLVP (5)
2.Osmosis, Osmotic pressure(π), Reverse Osmosis, Isotonic solutions, Laws of Osmatic Pressure (4)
3.Elevation of boiling point (ΔTb) (derivation, molecular weight determination, Relation with other colligative properties) (2)
4.Depression in freezing point(ΔTf) (derivation, molecular weight determination, relation with other colligative properties) (2)
5.Experimental determination of all Colligative properties (3)
6.Abnormal molar mass. (2)
7.Vant's Hoff factor degree of dissociation and association of solutes. (4)

UNIT-IV **25Hrs**

GASEOUS STATE

1.Deviation of real gasses from ideal behavior (Vander wall's equation of state critical phenomena.) (5)
2.Pv-isotherms of real gases continuity of state, (3)
Andrew's isotherm of Co_2 the Vander wall's equation and the critical states (4)
3.Derivation and relationships between critical constants and Vander wall's constants (4)
4.experimental determination of critical constants. (2)
5.The law of corresponding states, reduced equation of state
6.Thomson effect and inversion temperature of a gas, liquefaction of gases (5)
A.Linda's method based on Joule Thomson- effect.
B.Claude's method based on adiabatic expansion of a gas.

UNIT-V **12Hrs**

PHASE RULE

1.Statement and meaning of the terms – Phase, component and degree of freedom, gibb's phase rule. (2)
2.Phase equilibria of -one component system – water system. (2)
3.Phase equilibria of two – component system
4.Simple eutectic; Pb – Ag System, desilverisation of lead. (3)

EVALUATION OF ANALYTICAL DATA

1.Accuracy and precision (1)
2.Errors – definition, classification of errors determinate and indeterminate errors; absolute and relative error, propagation of errors. (2)
3.Significant figures and their Mathematical operations – addition, subtraction, division and multiplication (2)

TEXT BOOKS

- Dr. O.P. Agaraal: Unified course in Chemistry – (Vol.1 to 3),Jai Prakashnath publications,1st ed, New Delhi-1990

REFERENCE BOOKS

- K.L. Kapoor: Textbook of Physical Chemistry Published by Sultan Chand & Sons 3rd Edition –1999
- S.Glasstone : Thermodynamics for Chemistry Published by Sultan Chand & Sons 3rd Edition –1999
- R.P. Rastogi & S.S. Misra – Chemical Thermodynamics Published by Sultan Chand & Sons 3rd Edition –1999
- P.L. Soni & O.P. Dharmah – Textbook of Phy Chemistry Published by Sultan Chand & Sons 3rd Edition –1999
- Arun Bhal and Bhal Essentials of Physical Chemistry Published by Sultan Chand & Sons 3rd Edition –1999
- Puri & Sharma Principles of Physical Chemistry ,Published by Sultan Chand & Sons 3rd Edition –1999

PHYSICS-II
(Electromagnetics Theory & Electronics-1)

Credits : 4 **Semester: II**
Subject Code : CT22203 **No. of lecture hours: 75**

Objective:
- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and technology.
- To provide the information about Electrostatics, Magnetostatics, Electromagnetic induction, Digital electronics, Electromagnetic Waves, varying Alternating currents & P-N Junction Diodes.

Outcome: Students will be able to
- Analyze Magnetic field due to straight wire and circular coil.
- Compare the effects of electromagnetic induction in electrical instruments, Study digital electronics of Logic Gates.
- Compare varying and alternating currents through L-R, L-C, C-R and L-C-R circuits.
- Use Gauss's Law principle to explain charged sphere, cylinder, and potential due to charged spherical conductor and Solve problems.
- Classify digital electronics of various number systems.

UNIT-I **15Hrs**

Electrostatics:
- Electric flux, Gauss's law (Integral & differential forms) (2)
- Applications of gauss law-uniformly charged sphere (1)
- Applications of gauss law -charged cylindrical conductor (2)
- Applications of gauss law -an infinite conducting sheet of charge (2)
- Deduction of coulumb's law from gauss law (1)
- Concepts of electric potential (2)
- Relation between electric potential & electric field (1)
- Equipotential surfaces (2)
- Potential due to a charged spherical conductor (2)

UNIT-II **15Hrs**

Magnetostatics & Electromagnetic Induction:
- Concept of magnetic field 'B' and magnetic flux (1)
- Force on a current carrying conductor placed in a magnetic field (1)
- Biot-Savart's law, B due to a straight current carrying conductor (2)
- Magnetic field along the axis of a circular coil (2)
- Torque on a current loop in a uniform magnetic field (1)
- Moving coil Ballistic Galvanometer (3)
- Electromagnetic Damping & Critical Damping (1)
- Faraday's laws of induction (differential and integral form), Lenz's law (1)
- Self-Induction, Self-Inductance of long solenoid (1)
- Energy stored & Energy Density in magnetic field (1)
- Mutual Induction, Mutual Inductance of two given coils (1)

UNIT-III **15Hrs**

Electromagnetic waves & Varying Alternating Currents:

- Displacement current, Maxwell equations in Integral & Differential Form (2)
- Maxwell's equations in vacuum and conducting medium – Skin depth (3)
- velocity of light in vacuum and in medium (1)
- Transverse nature of EM waves (1)
- Poynting's theorem (1)
- Growth and decay of currents in LR, CR and LCR circuits (2)
- Alternating current (1)
- Relation between current and voltage in pure R, C and L-vector diagrams (2)
- A.C Circuit containing L, C, R-Series Resonant circuit & Quality Factor (2)

UNIT-IV **15Hrs**

Band theory of P-N junction & Diodes:

- Energy band in solids (band theory) (1)
- Forbidden energy gap in solids, insulators, semiconductors (2)
- Pure or Intrinsic semiconductors and Impure or extrinsic semi-conductors (2)
- N-type semi-conductors, P-type semiconductors-Fermi level (2)
- P-N junction diode, Volt-Ampere characteristics of P-N Junction diode (2)
- Half-wave & full-wave rectifier (4)
- Zener diode & its characteristics, Zener diode as voltage regulator (2)

UNIT-V **15Hrs**

Digital Electronics & Logic gates:

- Binary number system, conversion of binary to decimal and vice-versa (2)
- Binary addition and subtraction (1's and 2's complement methods) (2)
- Hexadecimal number system, Conversion from binary to hexadecimal and vice-versa (2)
- Decimal to hexadecimal and vice-versa (1)
- OR, AND, NOT gates, truth tables, realization of these gates using discrete components (3)
- NAND, NOR as universal gates, Exclusive – OR gate (EX-OR) (2)
- De Morgan's Laws – Verification (3)

ESSENTIAL READING:

1. Dr.S.L. Gupta & Sanjeev Gupta: Unified physics. vol-III: 44th edition. Jai Prakash Nath publications: Meerut
2. B.Sc. Third Year Physics Telugu Academy
3. Electricity and magnetism by J.H. Fawkes& John Yarwood. Vol.I (Oxford Univ. Press, 1991).
4. Introduction to Electrodynamics, 3rd edition, by David J. Griffiths, (Benjamin Cummings,1998).

SUGGESTED READING:

5. Electricity and magnetism By Edward M. Purcell (McGraw-Hill Education, 1986)
6. Electricity and magnetism. By D C Tayal (Himalaya Publishing House,1988)
7. Principles of Electronics by V.K. Mehta – S. Chand & Co.
8. Digital Principles & Applications – A.P. Malvino and D.P. Leach

Basic Electronics – Bernod Grob.

WORKSHOP
PRACTICALS

Credits : 2 **Semester: II**
Subject Code : CT18204 **No. of practical hours: 60**

Objectives:

- To introduce the fundamentals of Manufacturing Process
- To understand / Familiar with the different processes
- To understand the process practically

Outcome: Students will be able to gain knowledge on pattern of working in factory on the subject of preparation of the objects, house wiring and welding technology.

Different Trades

1-6	FITTING: To make a rectangle M.S. Plate T-shape, L-shape, step cut and V-cut	20
7-8	HOUSE WIRING: Staircase wiring, parallel and series Bulb connection, Bell connection and Fan connection.	12
9-11	WELDING: Button joint, Lap joint, T-joint and Corner joint.	14
12-13	DRILLING: Drilling holes in M.S. Plate and tap the holes.	4
14-15	STUDY OF MACHINE TOOLS: Lathe, Drilling machines.	10

ESSENTIAL READING:

Media Promoters and Publishers Pvt. Ltd. Mumbai
Hajra Choudari – Work Shop Technology Vol – I & II

CHEMISTRY - II
PRACTICALS

Credits : 1 **Semester: II**
Subject Code : BS18071 **No. of practical hours: 30**

Objective: To apply the basic concepts in Chemistry practically as Chemistry is a base for Chemical Technology.

Outcome: Students will be able to explore Cations and Anions present in the given mixture.

Quantitative Semi-Micro Analysis of two anions and two cations from the following.

ANION :
Carbonate, Bicarbonate, Nitrite, Sulphide, Sulphite, Flouride, Thiosulphate, Chloride, Bromide, Iodide, Acetate, Oxalate, Tartarate, Chromate, Phosphate, Arsenate.

CATIONS :
Lead Bismuth Copper, Cadmium, Iron, Aluminium, Zinc, Manganese, Cobalt, Nickel, Calcium, Strontium, Barium, Potassium, Magnesium, and Ammonium.

PHYSICS—II
PRACTICALS

Credits : 1 **Semester: II**
Subject Code : CT22205 **No. of practical hours: 30**

Objective: To give ideas about basic operation of diode circuit, potentiometer and basic optics phenomenon like diffraction, polarization also to strengthen lab skills.

Outcome: Students will be able to investigate the theoretical background to an experiment and to design experiments to test a hypothesis and to determine the value of unknown quantities**.**

LIST OF EXPERIMENTS:

Introduction	(3)
1. Zener Diode	(1)
2. Volume resonator	(1)
3. Diffraction grating	(1)
4. Resolving power of telescope	(1)
5. Polarimeter	(1)
6. Surface tension	(1)
7. Dispersive power	(1)
8. Sonometer	(1)
9. Potentiometer	(1)
Calculations and revision	(3)

YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF SUBJECTS
DEPARTMENT OF CHEMICAL TECHNOLOGY
THIRD SEMESTER
ACADEMIC YEAR 2022-23 OF 2021-24 BATCH (CBCS)

Sl. No.	Part	Subject Code	Title of the Subject	Hours/ Week	Duration of semester exams	Marks			Credits
						Internal	External	Total	
1	II	G18CT1T	Solar Processing Technologies (GE-3) (ID)	2	3	40	60	100	2
2	II	CT18301	Mathematics-III (Numerical Analysis) (GE-4)(DS)	3	3	40	60	100	3
3	II	CT18302	Chemistry-III (Core-5)	5	3	40	60	100	4
4	II	CT18303	Physics-III (Core-6)	5	3	40	60	100	4
5	II	CT18304	Chemical Process Principles (Core-7)	5	3	40	60	100	4
6	II	CT19305	Chemical Technology-I (Core-8)	4	3	40	60	100	4
PRACTICALS									
7	II	G18CT1P	Solar Processing Technologies lab (GE-3) (ID)	2	3	40	60	100	1
8	II	BS18072	Chemistry-III (Core-5)	2	3	40	60	100	1
9	II	CT18306	Physics-III (Core-6)	2	3	40	60	100	1
Total				**30**		360	540	900	**24**

* Generic Elective (GE)
*Inter-Departmental/Inter-Disciplinary (ID)
*Discipline-Specific (DS)

GENERIC ELECTIVE
(INTER-DEPARTMENTAL/INTER-DISCIPLINARY)

UG COURSES

S.No.	Department	Subject
1.	Chemical Technology	Solar Processing Technologies
2.	Agri. Science & Rural Development	Fundamentals of Horticulture
3.	Biotechnology	Medical Lab Technology
4.	Food Technology	Food Processing & Quality Control
5.	Mathematics	Quantitative Aptitude
6.	Statistics	Data Analysis
7.	Multimedia &Animation	Creative Arts
8.	Computer Science & Engg.	Shell Programming
9.	Computer Systems & Engg.	PC Hardware, Installation and Networking
10.	B.Sc. Computer Data Science & Data Analytics Engg.	Python Programming
11.	B.Sc. Electronics Technology	Repair and Maintenance of Home Appliances
12.	Commerce (Honours)	Taxation
13.	Commerce (Advertising, Sales Promotion & and Sales Management)	Marketing Management
14.	Commerce (General)	Banking
15.	Commerce (Computers& IAF)	Accounting
16.	B.B.A.	Principles of Management
17.	Mass Communication	Photography
18.	Mass Communication	Film Appreciation
19.	English	Communication Skills
20.	English	Career Skills
21.	Psychology	Psychology for Living

SOLAR PROCESSING TECHNOLOGIES
(GE Inter-Departmental/Inter-Disciplinary)

Credits : 2 **Semester: III**
Subject Code : G18CT1T **No. of lecture hours: 30**

Objective: To impart knowledge regarding importance of saving conventional energy, benefits of solar energy, its applications.

Outcome: Students will be able to
- Identify different forms of energies, Describe transformation of energy
- Identify the need for energy conservation. Describe significance of solar energy
- Describe harnessing of solar energy
- Describe applications of solar energy
- Identify ISO standards for solar applications

UNIT-I **6Hrs**
- Definition of energy, Forms of energy (2)
- Transformations of energy, Energy conservation (4)

UNIT-II **6Hrs**
- Need for Non-conservational energy, Types of Non-conservational energy (4)
- Significance of solar energy, Concept of green energy (2)

UNIT-III **6Hrs**
- Energy from sun, harnessing solar energy (2)
- Flat plate collector; focusing type of collector, Applications of solar energy (4)

UNIT-IV **6Hrs**
- Solar water heating, solar lighting, solar cooking (4)
- Solar water treatment, Solar drying (2)

UNIT-V **6Hrs**
- Solar vehicles, solar applications in Agriculture & Horticulture (2)
- ISO standards for solar applications (4)

ESSENTIAL READING:
1. Rai G D. 2011. **Non-Conventional Sources of Energy**. 5th ed. New Delhi: Khanna Publishers.

SUGGESTED READING:
1. Giri N K. 2010. **Alternate Energy Sources and Applications**. 2nd ed. New Delhi: Khanna Publishers.
2. Rao S. and Parulekar. 2010. **Energy Technology - Non-Conventional, Renewable and Conventional.** 2nd ed. New Delhi: Khanna Publishers.
3. Rai G D. 2011. **Solar Energy Utilization**. 5th ed. New Delhi: Khanna Publishers.

MATHEMATICS – III
(NUMERICAL ANALYSIS)

Credits : 3 **Semester: III**
Subject Code : CT18301 **No. of lecture hours: 45**

Objectives:
- To understand the theoretical and practical aspects of the use of numerical methods
- To implement the numerical methods for a variety of multidisciplinary applications
- To establish the limitations, advantages, and disadvantages of numerical methods

Outcome: Students will be able to
- Categorize the theoretical and practical aspects of the use of numerical methods.
- Explain how the common numerical methods and are used to obtain approximate solutions to intractable mathematical problems.
- Develop numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyze and evaluate the numerical solution of algebraic equations.
- Develop numerical methods to fit a curve within the given points.

UNIT-I **9Hrs**

The Calculus of Finite Differences:
- Finite differences – Difference formulae- the difference table (2)
- To express any value of the function in the terms of leading terms and the leading differences of a difference table (2)
- The operator E-factorial notation (1)
- Method of representing any polynomial in factorial notation (2)
- Difference of zero – Examples (2)

UNIT-II **9Hrs**

Interpolation:
- **Interpolation with equal intervals-**
  Newton-Gregory forward and backward interpolation formulae (3)
- **Interpolation with unequal intervals**
  Divided difference only (definition) - Newton's divided difference interpolation formula - Lagrange's interpolation formula for unequal intervals (3)
  Central difference interpolation formulae – Gauss's interpolation formulae - Stirling's formula - Bessel's formula (3)

UNIT-III **9Hrs**

Numerical Differentiation:
- Determination of the first, second and third derivatives of tabulated functions using Newton's forward and backward interpolation formulae (5)
- Differentiation using central difference formulae (4)

UNIT-IV **9Hrs**

The Numerical Solution of Algebraic and Transcidential Equations:

- Bisection method (2)
- Regula - Falsi method (4)
- Newton - Raphson method (3)

UNIT-V **9Hrs**

Curve Fitting:

- Fitting a straight line $y = a+bx$ (2)
- Fitting a parabola $y = a+bx+cx^2$ (2)
- Fitting the curves:
  a) $y = a\,x^b$; (2)
  b) $y = a\,r^{bx}$; (2)
  c) $y = ax + (b/x)$ (1)

ESSENTIAL READING:

1. Dr. Gupta P and Malik C.S. **Calculus of the Finite Differences and Numerical Analysis**, Meerut: Krishna Prakashan Mandir.

SUGGESTED READING:

1. Goel and Mittal. **Numerical Analysis**. Meerut: Pragati Prakashan.
2. Dr. Iyengar T K V, Dr. Krishna Gandhi B, Ranganadhan S, Prasad M V S S N. **Mathematical Methods**. New Delhi: S. Chand and Company Ltd.
3. Shanker Rao G. **Numerical Analysis**. New Age International (P) Ltd Publishers.
4. Saxena H C. Finite Differences and Numerical Analysis. **New Delhi**: S. Chand and Company Ltd.

CHEMISTRY - III

Credits : 5 **Semester : III**

Course Code: CT18302 **No. of lecture hours: 75**

Objective: To enable the students to understand and acquire knowledge pertaining to Organic, Inorganic and Physical Chemistry.

Outcome : Students will be able to

- Explain synthesis and properties of Halogens, Alcohols, Phenols and Ethers.
- Compare the synthesis and properties of Aldehydes and Ketones
- Explain the preparation, properties of "d" and "f" Block elements
- Compare the electrical conductivites of various Conductors and their related Laws
- Evaluate Cell Potential, Compare various Electrodes and their functions.

ORGANIC CHEMISTRY

UNIT-I **15Hrs**

HALOGEN COMPOUNDS

1.Classification–Alkyl halides (1^o, 2^o and 3^o), Aryl halides. Nomenclature of Alkyl and Aryl halides. (1)

- Preparation of Alkyl halides:
  From Alkane (Halogenation of hydrocarbons)
  From Alkene and Alkyne (Addition of Hydrogen halides to alkene and alkyne).
  Markownikoff's Addition and Anti-Markownikoff's addition.
  From Alcohols (Using PCl_5, PCl_3, $SOCl_2$ and $HX/ZnCl_2$).
  Hunsdiecker reaction.
  Halide exchange reaction (Finkelstein reaction).
- Preparation of Aryl halides: (1)
  a) From diazonium salts b) Halogenation c) Aryl lithium compounds.
- Reaction of Alkyl halides: (1)
  S_N1 and S_N2 : Reaction, Mechanism and stereochemistry. Factors influencing S_N1 and S_N2 reaction. Distinguish between S_N1 and S_N2 reactions. Aliphatic Nucleophilic substitution: (Nucleophile: KCN, CH_3COOAg, AgCN, EtONa, NH_3, KONO).
- Reaction of Aryl halides: (1)
  a) Formation of Grignard reagent b) Ullmann reaction b) Wurtz-Fittig reaction d) Formation of DDT e) Liq. $NH_3/NaNH_2$ f) Reduction. g) Nucleophilic aromatic substitution: Elimination-addition reaction.
  Reactivity: Compare the reactivity of aryl, vinyl, allyl halides with alkyl halides based on S_N1 and S_N2 reaction; Compare the reactivity of Alkyl halides based on S_N1 and S_N2. Comparative study of physical properties (boiling point, dipole moment) for alkyl and aryl halides. (2)

- Poly halogen compounds: Chloroform (Synthesis using oxidation and chlorination method). Reaction of chloroform (oxidation, reduction, Hydrolysis, chlorination, Nitration (Chloropicrin synthesis), with silver and uses of chloroform. (1)

  Carbon Tetrachloride: Preparation (From carbon disulphide, From Methane).
  Reaction of carbon Tetrachloride: (Reaction with steam, reduction and HF). Uses of carbon tetrachloride. (1)

HYDROXYCOMPOUNDS

- Classification- Monohydric, dihydric and Trihydric-examples. Monohydric Alcohols – Nomenclature, classification (1^o, 2^o, 3^o). (2)
- Preparation of Monohydric Alcohols :
  a) Reduction of aldehydes and ketones b) Hydration of Alkenes c) Hydrolysis of Alkyl halides d) using Grignard reagent e) Hydroboration-oxidation of Alkene f) Oxymercuration-Demercuration of alkenes.
- Properties – Physical – Inter molecular hydrogen bonding (solubility in water, BP).
  Chemical Properties : a) Reaction with metals b) Reactions of –OH (PCl_3/PCl_5/$SOCl_2$/HX & $ZnCl_2$), c) Esterification (acid chlorides, acid anhydrides).
  Dehydration of Alcohols (1^o,2^o,3^o)-using Conc. H_2SO_4- Saytzeff rule-Mechanism.
- Identification of Alcohols: Distinguish test of 1^o, 2^o, 3^o Alcohols
  a) Lucas reagent b) Victor Meyer Test c) Oxidation using $Na_2Cr_2O_4/H_2SO_4$
  d) Cu/300^{o}C.
- Industrial Significance of methanol, ethanol, ethylene glycol, glycerol, Phenol.
- Phenols Nomenclature. (2)
- Preparation: a) from diazonium salts b) from $C_6H_5SO_3H$ c) from Cumene
- Physical Properties: - a) Intermolecular hydrogen bonding b) Intramolecular hydrogen bonding (solubility in water & BP).
  Chemical Properties – a) Acidity b) Effect of substituents on acidity C) with metals d) Williamson's synthesis – Formation of Anisole.
  Reaction of Phenols: a) Bromination b) Nitration c) Acylation, Benzoylation
  d) Kolbe-Schmidt reaction (Mechanism), e) Reimer-Teimann reaction (Mechanism),
  f) Azo coupling g) Paraformaldehyde.
  Poly hydric Alcohols: Pinacol-Pinacolone Rearrangement (Mechanism).
  Oxidative cleavage of polyhydric alcohols using a) Lead Acetate b) H_5IO_6.

ETHERS (2)

1) Ethers: Nomenclature. 2. Preparation: a) Williamson's synthesis (Mechanism) b) Dehydration of Alcohols. 3. Physical properties (dipole moment). 4. Chemical properties: a) Inert nature b) conc. H2SO4 c) Conc. HI.

UNIT-II **15Hrs**

ALDEHYDES AND KETONES (Carbonyl Compounds)

- Nomenclature of Aliphatic and Aromatic Aldehydes and ketones (1)
- Preparation of Aliphatic aldehydes and ketones : a) Oxidation b) Reduction of acid chlorides (Rosenmund Reduction)-only aldehydes c) using Grignard reagents d) Decarboxylation of carboxylic acid e) Hydrolysis of gem Dihalides f) From Alkynes g)

Ozonolysis h) Hydroboration-Oxidation i) Etard reaction (Only aldehydes) j) Stephens Reaction (using nitrile-aldehydes only). k) Organometallics –dialkylcadmium, Alkyl lithium, Lithium Dialkyl Cuprates (only Ketones). (5)

- Preparation of Aromatic Aldehydes and ketones : a) Rosenmund Reduction (Aromatic Aldehydes) b) Oxidation of Arene c) Gattermann-Koch Reaction (Aromatic Aldehydes) d) Etard Reaction (Aromatic Aldehydes) e) Friedel-crafts Acylation (Aromatic ketones) e) Grignard reagents f) Decarboxylation of calcium salts of carboxylic acids g) Hydrolysis of gem dihalides. (3)
- Physical properties: Keto-enol tautomerism, relative reactivity of aldehydes & ketones towards Nucleophilic addition reactions. Acidity of alpha hydrogens. (2)
- Reactions of Aldehydes and ketones: a) Oxidation b) Reduction (Pt/H_2 or Pd/H_2, $NaBH_4$, $LiAlH_4$) c) Nucleophilic addition reactions (HCN, $NaHSO_3$, RMgX, NH_3, RNH_2, NH_2OH, N_2H_4, $C_6H_5NHNH_2$, 2,4-DNP, Schiff's base) d) Reformatsky reaction e) MPV reduction f) Clemmensen reduction g) Wolfkishner reduction
- Base Catalyzed Reactions (Mechanisms): a) Aldol condensation b) Cannizaro reaction c) Benzoin condensation d) Perkin reaction e) Haloform reaction f) Knoevengael condensation. (3)
- Distinguishing Test for aldehydes and ketones. (1)

INORGANIC CHEMISTRY

UNIT-III **15Hrs**

CHEMISTRY OF ELEMENTS OF FIRST TRANSITION SERIES

1.Definition, Electronic configuration.
2.General Properties: Metallic nature, Atomic and Ionic Radii, Ionization Potential, Comparative study of 3d block elements. (2)
3.Oxidation state – relative stability of various oxidations states, Ionic and Covalent character,
4.Acidic and Basic nature, oxidizing and reducing nature of various oxidation states. (2)
5.Colour, Magnetic, Complex formation, Catalytic properties. (3)
.

CHEMISTRY OF LANTHANIDES

1.Definition, Electronic Configuration, Position in periodic table, Oxidation state, Atomic and ionic radii, Colour and Magnetic properties (2)
2.Lanthanide contraction – Cause and consequences, its applications (2)
3.General methods of separation of Lanthanides by 1. Ion exchange method 2. Solvent extraction.3) Fractional Crystallization. (2)
4.Actinides- Definition, Electronic configuration, Oxidation states, Comparison with lanthanides. (2)

PHYSICAL CHEMISTRY

UNIT-IV **15Hrs**

ELECTRO CHEMISTRY-I

1.Electrolysis, Faraday's laws of electrolysis, Conductance, Specific Conductance, Equivalent Conductance, Molecular conductivity, Measurement of Conductivity

2.Effect of dilution on conductance, Kohlrausch's law and its application, Debye Buckel's Theory of strong electrolytes-Debye Huckel Onsager equation (elementary treatment).(4)

3.Transport number-Definition-Hittorf Rule-Hittorf method to determine transport number of ions. Problems (4)

4.Conductometric Titrations – Definition-Explanation of principle, procedure & graphs for **a)** SA vs SB b) SA vs WB c) WA Vs SB d) WA Vs WB e) (SA+WA) vs SB f) $AgNO_3$ vs KCl. (3)

UNIT-V **15Hrs**

ELECTRO CHEMISTRY – II

1.Ionic Equilibria : Different Concepts of Acids and Bases, Scale of acidity and pH value Problems. (3)

2.Common ion effect (definition, application), Buffer solutions (Definition, examples, buffer action)**,** calculation of pH of buffer mixture (Henderson's equation), problem (3)

3.Electrochemical cells, representation of electrochemical cells, electrochemical series, cell potential (e.m.f) of cell (3)

4.Nernst equation – i) Calculation of Half-cell potential ii) calculation of cell potential and its applications- problems. (3)

5.Commercial cells (Lechanchi and lead storage cell).Reference electrodes - Definition, construction, (SHE and SCE). (3)

TEXT BOOKS s

1) R. T. Morrison and R. N. Boyd. 2010. 6th edition, Organic chemistry, UK.
2) Arun Bhal & Bhal 2005, Organic chemistry, 6th addition, New Delhi.
3. Dr. O.P. Agarwal - Unified Course in Chemistry, Vol-1, Vol-2, Vol-3 & Vol-4 –jay Prakash Nath Publications, 1st ed, New Delhi-1990
4. C. Parameshwara Murthy SyedFazal Mehdi Ali, Promod Kumar Dubey: University Chemistry – Vol-1, Vol-2, Vol-3, New Age International publishers, 2nd ed, New Delhi-1990

REFERENCE

1. P.L. Soni : Organic Chemistry, Published by Sultan Chand & Sons 3rd Edition –1999.

2. P.L. Soni.A Text Book of Physical Chemistry, Published by Sultan Chand & Sons 3rd Edition –1999.

3. Puri & Sharma : A Text Book of Physical Chemistry, Published by Sultan Chand & Sons 3rd Edition –1999.

PHYSICS-III

Credits : 5 **Semester: III**
Subject Code : CT18303 **No. of lecture hours: 75**

Objectives:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of engineering and technology.
- To provide the information about the Electrostatics, Magnetostatics, Electronics and this paper also deals with Nano technology which gives the ideas about recent technological developments.

Outcome: Students will be able to

- Use Gauss's Law principle to explain charged sphere, cylinder, and potential due to charged spherical conductor and Solve problems.
- Analyze Nano science technology and survey different types of Nano materials, Synthesis of Nano particles and its applications.
- Compare various types of transistors and analyse CB-CE-CC configurations, Hybrid parameters.
- Explain the physics of Passive Electronic components and Magneto statics.
- Classify digital electronics of binary number system, its conversions and analyse different amplifiers, Oscillators.

UNIT-I **15Hrs**

Electrostatics:

- Introduction (1)
- Gauss law (2)
- Applications of gauss law-uniformly charged sphere (2)
- Applications of gauss law -charged cylindrical conductor (2)
- Applications of gauss law -an infinite conducting sheet of charge (2)
- Deduction of coulumb's law from gauss law (2)
- Mmechanical force on a charged conductor (2)
- Electrical potential -potential due to a charged spherical conductor (2)

UNIT-II **15Hrs**

Nano Technology:

- Introduction to Nano science & technology, nano particles & materials (2)
- Quantum well ,quantum wire, quantum dot (1)
- **Synthesis of nano particles:**

(a) Bal milling method (2)
(b) Sputtering /laser evaporation method (1)
(c) Radio frequency plasma method (1)
(d) Sol-gel method (1)

- Properties of nano particles (1)
- Creation and use of bucky balls (2)
- Carbon nano tubes (2)
- Properties of nano tubes (1)
- Applications of nano technology (1)

UNIT-III **15Hrs**

Basic Electronics-2:

- Transistors: PNP & NPN transistor (3)
- Current component in transistors (3)
- Transistor CB-CE-CC configurations (3)
- Hybrid parameter (3)
- Determination of H-parameter from static characteristics (3)

UNIT-IV **15Hrs**

(A) Physics of Passive Electronic Components:

- Circuit-Network-Passive &Active electronic components (2)
- Behaviour [or] function of inductor[L], Capacitor[C],Resistor[R] in a circuit (1)
- Growth & decay of current in series L-R circuit (2)
- Growth & decay of charge in series C-R circuit (2)
- Decay of condenser through inductor L-C circuit mechanism (2)

(B) Magnetostatics:

- Magnetic shell-potential due to Magnetic shell (2)
- Field due to Magnetic shell (1)
- Equivalent of electric circuit and magnetic shell (1)
- Magnetic induction,field,permeability-susceptability (1)
- Hysteresis loop (1)

UNIT-V **15Hrs**

(A) Digital Electronics-1:

- Binary Number System: Converting a Binary Number to Decimal and Vice versa (2)
- Binary addition&substractions[1's and 2'scompliment] (2)
- Hexa decimal Number system (2)
- Conversion from binary to Hexadecimal viceversa (2)
- Conversion from decimal to hexa decimal vice versa (1)

(B) Amplifiers:

- Transistor as an amplifier (1)
- Concept of negative feedback and positive feedback (2)
- Barkhausan criterian (1)
- RC-coupled amplifier (1)
- Phase shift Oscillator (Qualitative only) (1)

ESSENTIAL READING:

1. Dr. Guptha S.L. & Sanjeev Guptha. 2009. **Unified Physics**. vol-III. 35th edition. Meerut: Prakash Nath & Co.
2. Dr. Guptha S.L. & Sanjeev Guptha. 2009. **Unified Physics**. vol-IV. 35th edition. Meerut: Prakash Nath & Co.

SUGGESTED READING:

1. J.P. Agarwal & Amit Agarwal. 2012. **Unified Electronics**. 15th edition. Meerut: A.S. Prakashan & Co.
2. Halliday / Resnick / Walker. 2007. **Fundamentals of Physics.** 6th edition. Wiley India Pvt. Ltd.
3. Malvino A.P. & Leach D.P. & Gautham Saha. 2006. **Digital Principles & Applications**. 6th edition. Delhi: Tata McGraw Hill Education.

CHEMICAL PROCESS PRINCIPLES

Credits : 5 **Semester: III**
Subject Code : CT18304 **No. of lecture hours: 75**

Objective: To impart the knowledge necessary to do the basic chemical calculations to manufacture a product in a chemical industry. This includes calculation of composition of liquids and gaseous mixtures, material and energy balances.

Outcome: Students will be able to

- Solve problems to calculate composition of solids and fluids and density of gaseous mixtures.
- Apply Roult's Law and Dalton's Law to solve problems in gaseous mixtures
- Solve material balance problems with and without chemical reactions.
- Apply energy balance to calculate enthalpy changes
- Use energy balance to calculate enthalpy changes accompanying chemical reactions.

UNIT-I **15Hrs**

A) Units :

- Conversion of physical quantities and conversion of equations. (2)

B) Basic Chemical Calculations:

i) **Solids, liquids and solutions** :

- Calculation of mole % and weight %, (3)
- Calculation of molarity and molality. (3)

ii) **Gases:**

- Calculation of mole % and weight % (2)
- Calculation of average molecular weight (2)
- Calculation of density and specific gravity of gaseous mixtures. (3)

UNIT-II **15Hrs**

A) (i) Vapour Pressure:

- Effect of temperature on vapour pressure (calculation of vapour pressure at given temperature using clasius-clapeyron equation). (1)

(ii) Application of Roult's law and Dalton's law

- Calculation of total pressure and vapour composition when a solution is in contact with its vapour phase (4)

B) Humidity and Saturation:

- Calculation of relative saturation and percentage saturation. (4)
- Calculation of absolute humidity and molal humidity (2)
- Vapourization process (2)
- Condensation process (2)

UNIT-III **15Hrs**

Material Balance:

A) **Material Balance without chemical reactions**:

- Mixing (5)
- Evaporation without crystallization (4)
- Binary distillation. (4)

B) **Material Balance involving chemical reaction**. (Problems with recycling and purging are not included) (2)

UNIT-IV **15Hrs**

Energy Balance:

- Heat capacity, Heat capacity of gases at constant pressure. (2)
- Calculation of mean heat capacity of gases (Cpm and q) (7)
- Sensible heat changes in liquids (3)
- Enthalpy changes during phase transfer accompanied by sensible heat changes. (3)

UNIT-V **15Hrs**

Enthalpy Changes Accompanying Chemical Reactions:

- Calculation of Standard heat of formation (4)
- Calculation of standard heat of combustion (4)
- Calculation of standard heat of reaction from heat of formation data (4)
- Effect of temperature on heat of reaction (3)

ESSENTIAL READING:

1. For Units I, II (A), IV and V: B.I. Bhatt and S.M. Vora. 1997. **Stoichiometry**. 3rd Edition. New Delhi: Tata McGraw Hill Publishing Company Ltd.
2. For units II(B) and III: Olaph A. Hougen, Kenneth M. Watson and Roland A Ragatz. 1954. **Chemical Process Principles**. Part-I, 2nd Edition. Singapore: Wiely International Edition.

SUGGESTED READING:

1. David, Himmelblau M. 1992. **Basic Principles & Calculations in Chemical Engineering**. 5th Edition. New Delhi: Prentice-Hall India Publishers.

CHEMICAL TECHNOLOGY - I

Credits : 4 **Semester: III**
Subject Code : CT19305 **No. of lecture hours: 60**

Objective: To impart theoretical and technical knowledge applicable to various inorganic chemical industries e.g. Sulphuric Acid, Coke Oven Gas, Oxygen, Ammonia, Nitric Acid, Soda Ash, Chlorine and Cement.

Outcome: Students will be able to

- Describe a chemical industry. Explain manufacturing of sulphur and sulphuric acid
- Explain manufacture of industrial fuel gases. Explain manufacture of oxygen
- Explain manufacture of ammonia & urea. Explain manufacture of Nitric acid & Ammonium nitrate
- Explain manufacture of Chloro alkali industries
- Explain manufacture of cement. Explain manufacture of magnesium compounds from sea water

UNIT-I **12Hrs**

- General introduction for establishing a chemical industry. (2)
- Unit operation and unit process concepts. (2)
- Sulphur production: Frasch process (2)
- By oxidation-reduction of hydrogen sulphide from pyrites. (3)
- Sulphuric acid: Contact process and Double Contact Double Absorption process. (3)

UNIT-II **12Hrs**

- Fuel and industrial gases, Producer gas (1)
- Coke oven gas (2)
- Production synthesis gas: Partial combustion process. (1)
- Acetylene: Pyrolysis process, and from calcium carbide (2)
- Utilization of solar energy. (2)
- Cryogenics: Definition, Linde cycle, Claude cycle. (2)
- Oxygen, Nitrogen production from air by Kellogg process. (2)

UNIT-III **12Hrs**

- Nitrogen Industries : Ammonia, Nitric acid production (5)
- Nitrogeneous Fertilizers : Urea, Ammonium nitrate (5)
- Phosporous Industries : S.S.P. & T.S.P. Production. (2)

UNIT-IV **12Hrs**

- Electro chemical industries: Classification, Tetra Ethyl Lead production (2)
- Chlor Alkali Industries: Soda Ash production by Solvay process, Dual process, advantage and disadvantages (3)
- Chlorine–caustic soda production: Electrolytic process. (2)
- Water: Types of hardness of water, municipal water conditioning (2)
- Boiler feed water treatment, Industrial and sewage water treatment. (3)

UNIT-V **12Hrs**

- Chemicals from sea water: Magnesium compound from sea water (4)
- Manufacture of special glasses; Rock or Mineral (3)
- Cement Production: Definition of portland cement, production details, classification of portland cement and other types of cement. (5)

ESSENTIAL READING:

1. Charles E. Dryden. 1997. **Outlines of Chemical Technology**. 3rd ed. New Delhi: Affiliated East-West Press.

SUGGESTED READING:

1. Norris Shreeve R. 1986. **Chemical Process Industries**. 3rd ed. New Delhi: McGraw-Hill.
2. Shukla & Pandey. 1997. **Chemical Technology.** Vol.1, 2nd ed. New Delhi: Tata McGraw.

SOLAR PROCESSING TECHNOLOGIES
(GE Inter-Departmental/Inter-Disciplinary)
PRACTICALS

Credits : 1 **Semester: III**
Subject Code : G18CT1P **No. of practical hours: 30**

Objective: To impart knowledge regarding importance of applications of solar energy in food drying, saving conventional energy, benefits of solar energy applications.

Outcome: Students will be able to do assembly of solar power plant, applications of solar drying.

List of Experiments:

1. A study of solar dryer. (2)
2. Solar drying of four samples. (4)
3. A comparative study of conventional dryer verses solar dryer. (2)
5. A study of characteristics of solar panel. (2)
6. Installation of solar power plant. (3)
7. Green House. (2)

CHEMISTRY – III
PRACTICALS

Credits : 1 **Semester: III**
Subject Code : BS18072 **No. of practical hours: 30**

Objective: To provide a sound knowledge in Titrimetric.

Outcome: Students will be able to conduct experiments and analyse data and interpret results.

Qualitative Analysis

A. Titrimetric Analysis

- **Acidimetry & Alkalimetry:** (2)
  Preparation of standard solution of Sodium Carbonate, Standardization of acids, Estimation of sodium carbonate salt. Determination of sodium carbonate and sodium bicarbonate in washing soda.
  Estimation of acetic acid in commercial vinegar using NaOH.

- **Permanganometry:** (2)
  Preparation of standard oxalic acid solution, Standardisation of $KMno_4$ solution, Estimation of Calcium in Chalk.

- **Dichrometry:** (2)
  Preparation of a standard solution of Potassium Dichromate, Estimation of Ferrous and Ferric Ion in a mixture.

- **Iodometry:** (2)
  Preparation of a standard solution of potassium dichromate, standardization of Hypo, estimation of Copper sulphate.

- **Complexometric Titrations: EDTA Titrations:** (2)
  Estimation of Magnesium in Talcum Powder
  Estimation of Nickel.

- **Precipitation Titrations:** (2)
  Estimation of Zinc ion by Ferrocyanide

- **Gravimetry:** (3)
  Estimation of Nickel as Ni-dimethylglyoxime

PHYSICS-III
PRACTICALS

Credits : 1 **Semester: III**
Subject Code : CT18306 **No. of practical hours: 30**

Objective: To give ideas about operation and study V-I characteristics of various electronic components, and to understand the concepts like viscosity, mechanical equivalent of heat, magnetism also to strengthen lab skills.

Outcome: Students will be able to investigate the theoretical background to an experiment and also to design experiments to test a hypothesis and to determine the value of unknown quantities**.**

List of Experiments

Introduction	(3)
1. Thermistor-1	(1)
2. Thermistor-2	(1)
3. Meter bridge	(1)
4. Optical bench	(1)
5. Dip circle	(1)
6. Transistor – CE characteristics	(1)
7. Viscosity – Searles Viscometer	(1)
8. Jolli's Bulb Experiment- verification of pressure coefficient.	(1)
9. Transistor – CB characteristics	(1)
10. Calculations and revision	(3)

YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF SUBJECTS
DEPARTMENT OF CHEMICAL TECHNOLOGY
FOURTH SEMESTER
ACADEMIC YEAR 2022-23 OF 2021-24 BATCH (CBCS)

Sl. No.	Part	Subject Code	Title of the Subject	Hours/ Week	Duration of semester exams	Marks			Credits
						Internal	External	Total	
1	II	ES18201	Environmental Studies & Gender Sensitization (AECC-5)	3	3	40	60	100	3
2	II	CT18401	Mathematics-IV (Group theory & Fourier series) (GE-5)(DS)	4	3	40	60	100	4
3	II	CT18402	Chemistry-IV (Core-9)	4	3	40	60	100	4
4	II	CT18403	Physics-IV (Core-10)	4	3	40	60	100	4
5	II	CT18404	Fluid Mechanics (Core-11)	4	3	40	60	100	4
6	II	CT18405	Instrumentation & Process Control (Core-12)	4	3	40	60	100	4
PRACTICALS									
7	II	BS18073	Chemistry-IV (Core-9)	2	3	40	60	100	1
8	II	CT18406	Physics-IV (Core-10)	2	3	40	60	100	1
9	II	CT18407	Fluid Mechanics (Core-11)	2	3	40	60	100	1
TOTAL				**29**		360	540	900	**26**

* Ability Enhancement Compulsory Course (AECC)
* Generic Elective (GE)
*Discipline-Specific (DS)

ENVIRONMENTAL STUDIES & GENDER SENSITIZATION

Credits : 3 **Semester: IV**
Subject Code : ES18201 **No. of lecture hours: 45**

Objective:

- To understand the importance of ecological balance for Sustainable Development
- To understand the impacts of developmental activities and mitigation measures
- To understand the environmental policies and regulations.
- To develop students sensibility with regard to issues of gender in contemporary India
- To provide a perspective on the socialization of men and women
- To expose the students to debate on the politics and economic works and on gender violence

Outcome:

- Understand the importance of Environmental education, conservation of natural resources & Understand the importance of ecosystems and biodiversity
- Understand the pollution problems and Apply the environmental science knowledge on solid waste management, disaster management
- Apply the environmental science knowledge to Improve the resources and Evaluate and understand the sustainable environmental conditions and control methods
- Identify the interactions and intersections of identities (e.g., gender, race, ethnicity, class, sexuality, and so on) and assess the ways in which they contribute to instances of privilege and power dynamics across cultures, space, and time. And their problems
- Understand the gender problems and ways of addressing them, including interactions across local to global scales in communities and overcome inequalities with legislations

UNIT- I **9hrs**

NATURAL RESOURCES, ECOSYSTEMS, & BIODIVERSITY

- Definition, Scope and importance of environmental studies. Need for public awareness.
- Renewable & Non Renewable resources, Brief account on Forests, Water, Minerals and Energy (Solar, Wind, and Geo-thermal & Bio-energy).
- Definition of Ecosystem, Structure and functions-food chains, food webs, ecological pyramids, producers, consumers and decomposers.
- Energy flow and example ecosystems-Forest, Desert, Aquatic ecosystems.
- Definition of Biodiversity, types (Genetic, Species, Ecosystem), India- mega diversity Nation.
- Hotspots, Threats to biodiversity, Conservation of biodiversity (In-Situ and Ex-Situ).

UNIT-II **9hrs**

ENVIRONMENTAL POLLUTION

- Definition of Environmental pollution
- Brief account of causes, effects, prevention and control measures of
  (a) Air pollution
  (b) Water Pollution
  (c) Soil pollution
  (d) Noise pollution
  (e) Marine Pollution

- Solid Waste Management: Causes, Effects & Control measures of urban and industrial wastes
- Disaster Management: floods, Earth quakes, and Cyclones.

UNIT-III **9hrs**

Social Issues and Environment

- Rain-Water Harvesting, Water-shed Management, and From Unsustainable to Sustainable Development.
- Global Warming, Ozone depletion, and Acid rains
- Environmental Legislation: Air Act, Water Act, Environmental Protection Act, Forest Act, Wildlife Act.
- Environmental & Human Health---- HIV/AIDS
- Welfare Programs---- Family, Women & Child Welfare, Population Explosion
- Role of Information Technology in Environmental Studies.

UNIT-IV **9hrs**

Gender Studies

- Why should we study gender issues?
- Socialization- Making women and making men
- Being together as equals-Through the lens of gender
- Missing women: Gender selection and its consequences
- Health issues of Women

UNIT-V **9hrs**

Gender & Labour -Gender Violence & Law

- House work : The invisible labour- my mother doesn't work "share the load"
- Sexual harassment – say no eve teasing – the caste based violence –Nirbhaya Act
- Domestic violence - Is home a safe place? - Blaming the victim.-Domestic violence Act
- Forums of justice-Hindu Inheritance Act(2005)

Field Visit for Environmental Studies:

1. Visit to a local Polluted site- Industrial effluent plant/ Polluted Lake/Agricultural Land
2. Visit to any Ecosystem

ESSENTIAL READING (for Gender Sensitization)

1. A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu. 201. **Towards a World of Equals : A Bilingual Text on Gender**. Hyderabad: Telugu Akademi.

SUGGESTED READING
(for Environmental Studies)

1. Rajagopalan R. 2015. **Environmental Studies-from Crisis to Cure.** Third Edition. Chennai: Oxford University Press.
2. Dr D K Asthana and Dr Meera Asthana. 2014. **A Text Book of Environmental Studies** Revised Edition. New Delhi: S. Chand & Company.
3. Anubha Kaushik and C.P. Kaushik Published. 2016. **Perspectives in Environmental Studies.** Fifth Edition. New Delhi: New Age International.

(for Gender Sensitization)

4. Sen Amartya **More Than One Million Women Are Missing.** New York Review of Books 37.20 (20 December 1990). Print. **We Were Making History...Life Stories of Women in the Telangana People's Struggle**. New Delhi: Kali for Women. 1998.
5. Tripti Lahiri. **By the Numbers: Where Indian Women Work. Women's Studies Journal.** *(*14 November 2012). Available online at: <http://blogs.wsj.com/ India real time/2012/11/14/by – the numbers-where-Indian-women-work/>
6. K. Satyanarayana and Susie Tharu. Ed. **Steel Nibs Are Sprouting: New Dalit Writing From South India, Dossier 2: Telugu and Kanada** Code=3732.
7. Vimala. **Vantillu (The Kitchen)". Women Writing in India: 600 Bc to the Present. Volume II.** The 20th Century. Ed. Suise Tharu and K.Laltitha. Delhi: Oxford University Press, 1995.599-601.
8. Shatrughna, Veena. **Women's Work and its Impact on Child Health and Nutrition.** Hyderabad: National Institute of Nutrition, Indian Council of Medical Research .1993.

MATHEMATICS – IV
(Group theory & Fourier series)

Credits : 4 **Semester: IV**
Subject Code : CT18401 **No. of lecture hours: 60**

Objective: To help students for pursuing higher studies in mathematics and also to understand various applications of Chemical Technology.

Outcome: Students will be able to

- State the definition of a simple group, calculate composition factors and composition series of certain groups. Use the subgroup criterion to prove that various subsets are subgroups of some given group.
- Explain whether a given group is cyclic, and given a finite cyclic group, find a generator for a subgroup of a given order.
- Identify homomorphism in a group, determine whether or not they are isomorphic.
- **Analyse** the Fourier transform of elementary functions from the definition.
- Solve Wave, heat and Laplace equations using Fourier transform.

UNIT-I **12Hrs**

Group – Definition – Examples and elementary properties (cancellation law, identity element and the inverse of an element of a group are unique). (2)

- **Theorems:**

(i) If (G,o) is a group and $a,b \in G$ the equations $aox=b$ and $yoa=b$ have unique solutions in G.
(ii) $(aob)^{-1} = b^{-1}$ o a^{-1} for all $a,b \in G$
- Addition and multiplication tables. (2)

- **Theorems:**

(i) If every element of a group G is its own inverse, then G is abelian.
(ii) A group with 3 elements is necessarily abelian. Modulo System (1)

- **Theorems:**

(I) The relation congruence modulo n is an equivalence relation on the set of integers.
(II) The set {0,1,2,3,……, (n-1)} of n elements is a group under addition modulo n
(III) The non – zero residue classes modulo a prime p form a group with respect to multiplication of residue classes. (2)

- **Subgroups:** (2)

Definition and examples of a sub group.

- **Theorems:**

(i) A non- empty subset H of a group G is a subgroup of G iff
(1) $a,b \in H \Rightarrow ab \in H$ and (2) $a \in H$ implies that $a^{-1} \in H$.
(ii) A finite subset H of a group G is a sub group of G iff $a,b \in H$ implies that $ab^{-1} \in H$. (1)
(iii) The intersection of two sub groups of a group G is a sub group of G
(iv) The union of two sub groups of a group G is a sub group of G iff one of them is contained in the other. (2)

UNIT-II **12Hrs**

(Cyclic Groups, Permutation Groups and Cosets)

Order of an element of a group-Definition of a cyclic group (4)

- **Theorems:**

(i) Every cyclic group is abelian
(ii) If 'a' is a generator of group G, the a^{-1} is also a generator of G
(iii) The order of a cyclic group is same as the order of its generator.
(iv) Every subgroup of a cyclic group is cyclic.
(v) Any group of order 3 is cyclic

Permutation Groups: Definition of a permutation - Product of permutations. (4)

- **Theorem:**

The n ! permutations of n objects form a group with respect to multiplication of permutations.
Definition of a circular permutation - simple problems on circular permutations.

- **Cosets** (4)

Definition of Coset.

- **Theorems:**

(i) If H is a sub group of a group G, then any two left (right) cosets of H are either identical or disjoint.
(ii) If H is a sub group of a group G, then there exists a one to one correspondence between the set of left cosets of H in G to the set of right cosets of H in G.
(iii) Lagrange's Theorem: -
The order of the sub group of a finite group divides the order of the group.
(iv) Every group of prime order is cyclic.

UNIT-III **12Hrs**

- **Normal Sub Group:** (5)

Definition of a normal sub group.

- **Theorems:**

(i) H is a normal subgroup of a group G iff $g H g^{-1} \in H$ for all $g \in G$
(ii) The sub group H of a group G is a normal sub group of G iff every left coset of H is a right coset of H in G
(iii) A subgroup H of a group G is a normal subgroup of G iff the product of two right cosets of H in G is again a right coset of H in G.
(iv) The intersection of two normal subgroups of a group G is a normal sub group of G.
(v) The set of all right cosets of a normal sub group N in a group G forms a group under coset multiplication.

- **Homomorphism:** (5)

Definition of homomorphism - Examples

- **Theorem:**

If $f: G \rightarrow G^1$ is a homomorphism and e and e^1 are the identity elements of G and G^1 respectively, then

- $f(e) = e^1$
- $f(a^{-1}) = [f(a)]^{-1}$ where $a \in G$

Definitions of isomorphism and automorphism - Examples. (2)

Cayley's Theorem:

Every finite group G is isomorphic to a permutation group.

UNIT-IV **12Hrs**

- **Fourier Series:**

Fourier series - Euler's formula - Bernoulli's generalized rule of integration by parts.
Examples of obtaining Fourier series of given functions in the interval 2 Π - Fourier series of functions having arbitrary period - consine series - sine series.

UNIT-V **12Hrs**

- **Partial Differential Equations:** (Application of Fourier Series)

Derivation of the general solutions of the following equations by the method of separation of variables:

(i) Wave equation: (4)

$$\frac{\partial^2 y}{\partial t^2} = a^2 \frac{\partial^2 y}{\partial x^2}$$

(ii) One - dimensional heat flow equation: (4)

$$\frac{\partial u}{\partial t} = a^2 \frac{\partial^2 u}{\partial x^2}$$

(iii) Laplace's heat equation in two –dimensions: (4)

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$$

(Note: Derivation of the formation of the above partial differential equations is not required - Simple boundary value problems there on using sine and cosine series only).

ESSENTIAL READING:

1. A text book of B.Sc., **Mathematics** (Vol.II) for Units I, II and III - By Venkateshwara Rao V. V., Krishna Murthy N, Sharma B.V.S.S. and Anjaneyasastry S. New Delhi: S. Chand & Company Ltd.
2. Dr. Venkataraman H K. **Engineering Mathematics**. Third Year part B Madras: The National Publishing Co. (for Units IV&V)

SUGGESTED READING:

1. Sharma H S and Seth S S. **Modern Algebra**. Ram Prasad & Sons for Units I, II, & III.
2. Dr Iyengar T K V., Dr. Krishna Gandhi B, Ranganathan S, Prasad M V S S N. **Mathematical Methods** for Unit-V. New Delhi: S. Chand and Company Ltd.

CHEMISTRY – IV

Credits : 4 **Semester : IV**

Course Code : CT18402 **No. of lecture hours: 60**

Objective: To acquire Knowledge about the basic concepts of chemistry and mechanisms involved in various catalysis.

Outcome : Students will be able to

- Compare Preparation and properties of Aliphatic and Aromatic carboxylic acids.
- Compare Synthesis and properties of Nitro compounds and Heterocyclic compounds
- Synthesis and structural analysis of Carbohydrates and Amino acids.
- Interpret Metal Complexes based on LFT, CFT, MOT
- Apply Catalyst, Reaction mechanism of complexes and OMC, preparation and properties.

ORGANIC CHEMISTRY

UNIT-I 12Hrs

MONO CARBOXYLIC ACIDS & THEIR DERIVATIVES

1.Carboxylic acids: Mono Carboxylic acids- Nomenclature. (3)
2.Preparation (Aliphatic mono carboxylic acid) : 1) Hydrolysis of a) Nitriles b) Esters c) Amides 2) Carbonation of GR (With Mechanism) 3) Oxidation of primary alcohols (or) aldehydes 4) Arndt–Eistert Reaction.
3.Preparation of Aromatic carboxylic acid: i) Oxidation of side chain of benzene ii) Hydrolysis of nitriles iii) Hydrolysis of benzotrichloride iv) using Grignard reagents.
4.Properties/ Physical: Intermolecular hydrogen bonding (Solubility in water, BP), Chemical Properties: Acidity, (4)
Reaction involving the –OH group: 1) NaOH/Na_2CO_3/$NaHCO_3$ 2) PCl_5/PCl_3/$SOCl_2$
3) Amide formation 4) Acid Anhydride formation 5) Ester Formation: a) Fischer esterification b) with diazomethane
b) Reaction involving the –CO group: i) Decarboxylation 2) Hunsdiecker reaction 3) Reduction
c) Reaction involving aliphatic moiety: I) Oxidation 2) HVZ reaction.
Ester Hydrolysis: i) Acid Catalyzed ii) Base Catalyzed (With Mechanisms).
Industrial significance of Urea. (2)
Active Methylene Compounds: Sources and generation of Carbanions, Comparison of stability – i) EAA ii) diethyl malonate iii) Acetyl Acetone. Keto-Enol Tautomerism (acid & base catalyzed)- Evidences supporting keto & Enol forms.
EAA-Preparation-Claisen-ester Condensation (Mechanism).
Synthetic Application of EAA: Formation of Acetic acid and Isobutyric acid, Synthesis of Succinic acid and Glutaric acid. Synthesis of ketones (Acetone, 2-pentanone, Methyl isopropyl ketone), Synthesis of 4-Methyl Uracil. (3)
Diethyl Malonate –Preparation from acetic acid. Synthetic Application of Diethyl Malonate: Mono carboxylic acids (propionic acid, Isobutyric acid, Cyclopropane carboxylic acid),

Dicarboxylic acids (Succinic acid, Adipic acid), Unsaturated acids – Crotonic acid, Cinnamic acid), Amino acid – Glycine, Barbituric acid.

UNIT-II **12Hrs**

NITROGEN COMPOUNDS

1.Nitro alkanes – Preparation, physical properties, chemical properties- Halogenation, reaction with HNO_2, reduction, Hydrolysis-NEF reaction, reaction with aldehydes & ketones, Mannich reaction. (1)

2.Aromatic Nitro compound, Nitro benzene: Preparation, physical properties and chemical properties – i) Nitration ii) Reaction with KOH and NH_3 iii) Reduction (Sn/HCl, Pt/H_2, $LiAlH_4$, Zn/NH_4Cl, Zn/NaOH, Selective reduction, Electrolytic reduction). Conversion of TNT into TNB. (1)

3.Cyanides – Nomenclature, Preparation from i) Alkyl halides ii) amides iii) Aldoximes. Properties: i) Basic character ii) Hydrolysis iii) Addition of NH_3 iv) Addition of GR v) Reduction. Isocyanides: preparation from i) Alkyl halides ii) primary amines iii) isocyanates. Properties: i) Isomerization ii) Hydrolysis iii) Reduction iv) Addition of Cl_2, S, HgO. (1)

4.Amines – Nomenclature, Classification into 1^o, 2^o, 3^o Amines and Quaternary ammonium compounds. Preparation: i) Ammonolysis of alkyl halides ii) Gabriel synthesis iii) Hoffman's Degradation of Amides (Mechanism) iv) Reduction of Amides v) Leuckart Reaction. Separation methods of Amines. 2^o Amine – Preparation – i) Reduction of Amides ii) Reduction of isocyanides iii) Reductive Amination. 3^0 Amine – Preparation – Reductions of Di-Substituted Amides. (1)

5.Separation methods of 1^0, 2^0, 3^0 amines by i) Fractional distillation ii) Hoffman method iii) Hinsberg method.

6.Physical properties: Basicity of Aliphatic Amines, Chemical properties: i) Alkylation ii) Acylation Reaction with HNO_2 iii) Carbylamine Reaction iv) Hoffmann Mustard Oil Reaction v) Salt formation. (1)

7.Arene - Diazonium salts – Diazotization-preparation
Synthetic Applications- formation of i) phenol ii) Halo benzene iii) Cyano Benzene iv) Benzene v) Nitrobenzene vi) Azo dyes. (1)

HETEROCYLIC COMPOUNDS

1.Preparation of Pyrrole: (Paal Knorr Synthesis, from Ammonium mucate, from succinimide), Furan (Paal Knorr Synthesis, from pentose sugar), Thiophene (Paal Knorr synthesis, from sodium succinate, from butane). (1)

2.Aromatic nature of i) Pyrrole ii) Furan iii) Thiophene. (1)
Reactivity of Pyrrole, Furan & Thiophene –Comparision with benzene towards ESR.(1)
Properties (Physical – i) Basic character (Pyrrole, furan), ii) Acidic character (Pyrrole): Chemical properties: i) Nitration ii) Sulfonation iii) Halogenation, iv) Friedel craft's (1) Acylation, v) n-BuLi, Reimer vi) Tiemann Formylation (Pyrrole), vii) Diels-Alder reaction (Furan), viii) Vilsmeier formylation, ix) Dields Alder reaction : (Thiophene)
Pyridine – Preparation : i) Hantzsch synthesis ii) from Nictonic acid (2)
Physical properties: Comparison of basicity of Pyrrole, Pyridine and Piperidine. Chemical Properties: i) Nitration ii) Sulfonation iii) Bromination iv) Friedel craft's reaction, v) Chichibabin reaction (nucleophilic), vi) n-BuLi, vii) Oxidation and Reduction.

UNIT-III **12 Hrs**

CARBOHYDRATES AND AMINOACIDS

1.Introduction, Classification. Structure elucidation of glucose – Evidence for straight chain pentahydroxy aldehyde structure (Acylation, reduction to n-hexane, cyanohydrin formation, reduction of TR & FR; Oxidation to gluconic acid and glucaric acid). Absolute configuration (proof not required) Cyclic structure of D (+) glucose-ring determination (methylation, hydrolysis & Oxidation Reactions). (2)

2.Structure elucidation of fructose-ring structure-Haworth form (formation of penta acetate, cyanohydrin & its hydrolysis oxidation). (2)

3.Chemical Properties of glucose & fructose – i) Acetylation ii) reaction with $Ca(OH)_2$ iii) CH3OH iv) Reduction v) oxidation- a) Br_2/H_2O b) HNO_3 vi) NH_2OH vii) $PhNHNH_2$ viii) HCN, Hydrolysis reaction ix) alkali. (2)

4.Typical Inter conversions: - i) glucose to fructose ii) fructose to Glucose iii) Glucose to Mannose (Epimerization) iv) Arabinose to Glucose (Killiani's synthesis) v) glucose to Arabinose a) wohl's synthesis b) Ruff degradation. Basic introduction of Sucrose, starch, cellulose. (2)

5.Amino acids: Definition, classification & preparation methods for Amino acids (Glycine, Alanine, Valine & Leucine) i) Halogenated carboxylic acids ii) Malonic ester synthesis iii) Strecker's synthesis. (2)

Physical properties – Zwitter ion, Isoelectric point. (1)

Chemical Properties: - Reaction of – COOH : i) NaOH ii) Esterification iii) Decarboxylation iv) $LiAlH_4$. Reaction of – NH_2 : i) HCl ii) Aceylation iii) Benzoylation iv) HNO_2 v) HCHO, vi) 2,4-DNB. Reaction of both –COOH & NH_2 i) Heat ii) Methylation iii) Reaction with Ninhydrin iv) formation of sydnone v) Cu_2O (2)

Basic knowledge of protein classification and structures.

UNIT-IV **12Hrs**

CO-ORDINATION CHEMISTRY

1.Definition of terms used in co-ordination compounds

2.IUPAC Nomenclature of co-ordination compounds. (1)

3.Werner theory – postulates, experimental evidences. (1)

4.Sidwick's theory – Calculation of EAN, limitations. (1)

METAL – LIGAND BONDING IN TRANSITION METAL COMPLEXES

1.VALENCE BOND THEORY: postulates, geometries of coordination number 4-(tetrahedral and square planar) and 6 (octahedral). (1)

2.CRYSTAL FIELD THEORY – Features, splitting of d-orbitals in octahedral, tetrahedral and square planar complexes. (1)

3.Crystal field stabilization theory (elementary treatment – diagram only).

MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES

1.Types of magnetic behavior spin only formula, calculation of magnetic moments. (1)

2.Electronic spectra of metal complexes – d-d transitions (1)

3.Determination of composition of complexes – jobs method, mole ratio method. (1)

4.Stability constants, factors affecting stability of complexes. (1)

ISOMERISM IN CO-ORDINATION COMPOUNDS

1.Structural : ionization, hydrate, linkage, coordination, coordination position and polymerization isomerism (1)
2.Stereo isomerism – geometrical and optical isomerism (2)

UNIT-V **12Hrs**

CATALYSIS

- Introduction, Characteristics of Catalysts, classification and mechanisms of catalyzed reaction, Homogeneous catalysts (2)
- Acid – Base catalysts, Enzyme catalysis Autocatalysis. (2)
- Enzyme kinetics : Michaelis Menten Equation derivation (2)

INORGANIC REACTION MECHANISMS

- Classification of reactions : Dissociation and Association,
- Electron transfer, Elimination, Chain and Polymerization reaction (examples only).
- Substitution reactions – SN^1 and SN^2 (2)
- Lability and Inertness of complexes, factors affecting liability
- Hydrolysis of silicon halides and phosphorous oxides. (1)

ORGANO METALLIC COMPOUNDS

- Definition nomenclature and classification of Organo Metallic Compounds based on metal carbon bond - ionic, sigma and pi-covalent. (1)
- Preparation properties and applications of alkyl and aryls Organo Metallic Compounds of Li, Mg, Al and Cd (2)

TEXT BOOKS

3) R. T. Morrison and R. N. Boyd. 2010. Organic chemistry (6^{th} edition), UK.
4) Arun Bhal & Bhal 2005, Organic chemistry, 6^{th} addition, New Delhi.
5. Dr. O.P. Agarwal - Unified Course in Chemistry, Vol-1, Vol-2, Vol-3 & Vol-4 –jay Prakash Nath Publications, 1^{st} ed, New Delhi-1990
6. C. Parameshwara Murthy SyedFazal Mehdi Ali, Promod Kumar Dubey: University Chemistry – Vol-1, Vol-2, Vol-3, New Age International publishers, 2^{nd} ed, New Delhi-1990

REFERENCE

1. P.L. Soni : Organic Chemistry, Published by Sultan Chand & Sons 3^{rd} Edition –1999.

2. P.L. Soni.A Text Book of Physical Chemistry, Published by Sultan Chand & Sons 3^{rd} Edition –1999.

3. Puri & Sharma : A Text Book of Physical Chemistry, Published by Sultan Chand & Sons 3^{rd} Edition –1999.

PHYSICS-IV

Credits : 4 **Semester: IV**
Subject Code : CT18403 **No. of lecture hours: 60**

Objective:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and technology.
- To provide the information about the Electromagnetic induction, Digital electronics, Quantum mechanics & Nuclear physics.

Outcome: Students will be able to

- Analyze moving charge in electric and magnetic field, Identify it's role in particle accelerators, magnetic field due to straight wire and circular coil.
- Compare the effects of electromagnetic induction in moving conductors, solenoid, Transformers and survey digital electronics of Logic Gates.
- Compare varying and alternating currents through L-R, L-C, C-R and L-C-R circuits.
- Apply the Principles of Quantum mechanics and wave mechanics in solving quantum problems.
- Analyze Nuclear structure, Binding energy, nuclear forces and survey different nuclear models.

UNIT-I **12Hrs**

Moving Charge in Electric & Magnetic Fields:

- Motions of a charged particle in electric and magnetic fields (2)
- Hall effect (2)
- Cyclotron (2)
- Synchrotron (1)
- Synchrocyclotron (1)
- Force on a current carrying conductor placed in a magnetic field & force and torque on a current loop (2)
- Biot - savart law calculation of 'B' due to long straight wire (1)
- Magnetic field along the axis of a circular coil (1)

UNIT-II **12Hrs**

(A) Electromagnetic Induction:

- Faraday's law – Lenz's law (1)
- Expressions for induced E.M.F (1)
- Self-induction- calculation of self-induction of a solenoid (1)
- Energy stored in a magnetic field (1)
- Transformer- Construction working (1)
- Energy losses & efficiency (1)

(B) Digital Electronics-2:

- Logic gates: OR, AND, NOT gates- truth tables (1)
- Realization of these gates using discrete components (1)
- NAND, NOR as a universal gates (1)
- Exclusive OR gate (1)
- De Morgan laws- statement & proof (2)

UNIT-III **12Hrs**

Varying and Alternating Currents:

- Introduction to A.C current (2)
- A.C through pure inductor(L), pure capacitor (C), pure resistor (R), vector diagrams (2)
- A.C through series L-R circuit (2)
- A.C through series C-R circuit (2)
- A.C through series L-C circuit (2)
- Series LCR circuit with corresponding vector diagrams (2)

UNIT-IV **12Hrs**

(A) Quantum Mechanics:

- Black body, spectrum of black body radiations (1)
- Weins displacement law, Rayleigh jeans law plancks law, Deduction of weins law, Rayleigh jeans law from plancks law (2)
- Photo electric effect (1)
- Compton effect (1)

(B) Wave Mechanics:

- Wave particle dual nature of light -debroglie hypothesis (1)
- Davisson -germer experiment (1)
- Heisenberg uncertainity principle and its experimental illustration (1)
- Wavefunction , its properties & significance (1)
- Postulates of quantum mechanics (1)
- Schroedinger's time dependent and independent wave equations (1)
- Finding expressions for energy & wave functions of a particle in a 1-d box (1)

UNIT-V **12Hrs**

Nuclear Physics:

- Nuclear structure: Basic properties of nucleus- size, charge, mass, spin (1)
- Magnetic dipolemoment. and electric Quadrupolemoment (1)
- Binding energy of nucleus (2)
- Deuteron binding energy (2)
- P-p and n-p scattering (1)
- Nuclear forces (1)
- Nuclear models- liquid drop model (2)
- Shell model (2)

ESSENTIAL READING:

1. Dr. Guptha S.L & Sanjeev Guptha. 2014. **Unified Physics**. vol-III: 35th edition. Meerut: Prakash Nath & Co.
2. Dr. Guptha S.L. & Sanjeev Guptha. 2009. **Unified Physics**. vol-IV, 35th edition. Meerut: Prakash Nath & Co.

SUGGESTED READING:

1. Halliday / Resnick / Walker. 2007. **Fundamentals of Physics**, 6th edition. Wiley India Pvt. Ltd.
2. Malvino A P & Leach D P, Gautham Saha. 2006. Digital Principles & Applications. 6th edition. Delhi: Tata McGraw Hill Education.
3. Irvin Kaplan. 2002. **Nuclear Physics**. 19th edition. Delhi: Narosa Publishing House Pvt. Ltd.
4. Arul das. 2004. **Quantum Mechanics**. Delhi: Prentice Hall of India.
5. Arthur Beiser, Mahajan S, Choudhray R. 2012. **Modern Physics**. 6th edition. Delhi: Tata McGraw Hill.

FLUID MECHANICS

Credits : 4 **Semester: IV**
Subject Code : CT18404 **No. of lecture hours: 60**

Objective: To impart theoretical and technical knowledge applicable to various chemical industries regarding pressure measurement, types of flows, applications of Bernoulli's principal, flow through beds, measurement of flow parameters, piping systems.

Outcome: Students will be able to

- Understand of basic unit and dimensions in fluid mechanics. Describe basic principles of fluid mechanics
- Identify fluid flow problems with the application of the momentum and energy equations. Describe friction and losses in fluid flows.
- Analyze pressure drops in packed bed. Knowledge of fluidization.
- Measure flow. Knowledge of flow meters.
- Describe piping layout. Describe equipment's in transportation of fluids

UNIT-I **12Hrs**

Introduction

- Dimensional Analysis, Rayleigh's method (1)
- Buckingham's Π theorem (1)

Fluid Statistics and its Application

- Nature of Fluids, Pressure concept (1)
- Hydrostatic equilibrium (In a stationary mass only) (1)
- Manometers (simple, differential and inclined manometers) (2)

Fluid Flow Phenomena

- The velocity field, laminar flow, velocity gradient and rate of shear (1)
- The shear stress field, Newtonian and non-Newtonian fluids (1)
- Viscosity and momentum flux, viscosities of gases and liquids (1)
- Flow in boundary layers (1)
- Laminar and turbulent flow in boundary layer (1)
- Boundary layer formation in straight tubes, boundary layer separation and wake formation (1)

UNIT-II **12Hrs**

Basic Equations of Fluid Flow

- Mass Balance, average velocity, mass velocity (2)
- Macroscopic momentum balance, momentum of total stream (1)
- Momentum correction factor, momentum balance in potential flow (1)
- The Bernoulli equation without friction factor, mechanical energy equation (2)
- Bernoulli equation correction for effects of solid boundaries (1)
- Correction of Bernoulli equation for fluid friction, application of Bernoulli equation (Calculation of horse power of pump) (2)

Flow of Incompressible Fluids in Conduits

- Laminar flow of Newtonian fluid (2)
- The friction factor chart (1)

UNIT-III **12Hrs**

- Drag, Drag coefficient, drag coefficient of typical shapes
  Form drag and stream lining (3)

Friction in Flow through Beds of Solids:

- Calculation of pressure drop using empirical equation *(Ergun, Kozney-corman, Blake-Plummer) (3)
- Terminal velocity (Calculation using empirical equation) (2)

Fluidization

- Conditions for fluidization (Pressure drop and bed height vs. superficial velocity for a bed of solids) (3)
- Applications of fluidization (1)

UNIT-IV **12Hrs**

Measurement of Flow By

- Venturimeter (4)
- Orificemeter (4)
- Rotameter (2)
- Pitot tube (2)

UNIT-V **12Hrs**

- Qualitative treatment of (construction and working only)
- Fittings (screwed pipe fitting and flanged pipe fittings) (3)
- Valves (gate, globe and check valves) (3)
- Pumps (positive displacement pumps, centrifugal pumps and vacuum pumps) (3)
- Fans, blowers and compressors (3)

ESSENTIAL READING:

1. Warren L. McCabe, Julian C. Smith and Peter Hariott. 1993. **Unit Operations of Chemical Engineering.** 5th ed. New York: McGraw Hill, Inc.

SUGGESTED READING:

1. Badger W L and Julius Banchero T. 1993. **Introduction to Chemical Engineering**. 5th ed. McGraw Hill International Edition.

* Wherever it is mentioned as calculation using empirical equation, derivation of those equations is not there. Only application of equations to problems.

INSTRUMENTATION AND PROCESS CONTROL

Credits : 4 **Semester: IV**
Subject Code : CT18405 **No. of lecture hours: 60**

Objective: To impart knowledge on various instruments like Temperature, Pressure and Flow meters and also to include fundamentals of Automatic process control and Feedback system, which is useful to operate and control the process-Safely and efficiently.

Outcome: Students will be able to
- Explain the qualities of measurement
- Choose a suitable thermometer for a given application and describe the methods for composition analysis of moisture in gases
- Explain various pressure and vacuum measurement instruments and process instrumentation
- Describe the role of process dynamics and control
- Describe controllers and final controller elements

UNIT-I **12Hrs**

Qualities of measurement:
- The meaning of instrument, the elements of instrument (2)
- Static and dynamic characteristics (2)
- Expansion thermometers. Bimetallic thermometer, pressure spring thermometers (3)
- Thermo electric temperature measurement, Industrial Thermocouples (2)
- Lead wires (1)
- Materials of construction, specifications, applications of various thermometers (2)

UNIT-II **12Hrs**
- Resistance Thermometers
- Industrial resistance thermometer
- Bulbs, calendar Griffith, bridge circuit (2)
- Radiation Temperature measurement
- Laws of Radiation, Radiation receiving elements Radiation pyrometer (3)
- Optical pyrometer and photo electricpyrometer (2)
- Specifications, application of various thermometers (1)

Methods for composition analysis of moisture in gases :
- Hygrometer method (1)
- ph concentration measurement (1)
- Special methods of analysis : Hydrogen sulfide detection system (1)
- Oxygen analysis cell based on paramagnetic effect (1)

UNIT-III **12Hrs**
- Measurement of pressure and vacuum (1)
- Pressure, vacuum and head relation (1)
- Measurement elements for gauge pressure and vacuum eg. Pressure spring gauge, bellows gauge, diaphragm gauge (1)
- Pirani vacuum gauge, thermocouple vacuum gauge (1)
- Measurement of Head and Level : Float and shaft unit (1)

- Hydraulic remote transmission of liquid level, bubble system for liquid level measurement (1)
- Flow metering : Velocity meter eg. Propeller meter quantity meters: (1)
- Piston meter, Nutating disc meter. (1)

Process Instrumentation:

- Recording Instruments, circular chart and strip recording chart (1)
- Use of signaling system. (1)
- Control center: Central layout and unit layout (1)
- Purpose of instrumentation diagram (1)

UNIT-IV **12Hrs**

The roll of process dynamics and control

- Control system: Response of first order systems (3)
- Transfer function for stirred tank heater, mixing tank and level control (3)
- Block diagrams (2)
- Feedback control : (2)
- Negative Feedback and Positive Feedback (2)
  (Theoretical Approach Only)

UNIT-V **12Hrs**

Controllers and Final control elements

- Control valve and mechanism of control valve (2)
- P- Control (1)
- P-D-Control (2)
- P-I- Control, P-I-D control (2)
- Mechanism of all three controllers by pneumatic force (1)
  (Theoretical Treatment only) (2)
- Controller Tuning (2)
- Selection modes

ESSENTIAL READING:

1. Donald P Eckman. 2004. **Industrial Instrumentation**. New Delhi: CBS Publishers & Distributors Reprint. (for units I, II & III)
2. Coughanowr & Koppel. 1991. **Process System Analysis and Control**. 2nd edition. McGraw Hill International Editions. (for units IV & V)

SUGGESTED READING:

1. George Stephanopoulos. 2010. **Chemical Process Control**. New Delhi: PHI Learning Private Limited.

CHEMISTRY-IV
PRACTICALS

Credits : 1 **Semester: IV**
Subject Code : BS18073 **No. of practical hours: 30**

Objective: To impart knowledge and skill of how to identify the functional group present in an Organic compound and its physical properties.

Outcome: Students will be able to recognize the functional group present in an Organic compound.

Organic Qualitative Analysis

1. Criteria of purity of solid and liquid compounds. Determination of melting point, Boiling point, crystallisation and filtration. Detection of nitrogen, sulphur and halogens in organic compound.

2. Identification of unknown substances from the following classes of organic Compounds, phenols, aldehydes, Ketones, Carbohydrates, acids, esters, amides, nitro compounds, amines hydrocarbons and their halogen derivatives.

PHYSICS-IV
PRACTICALS

Credits : 1 **Semester: IV**
Subject Code : CT18406 **No. of practical hours: 30**

Objective: To give ideas about various electronics components, basic magnetism concepts and to strengthen and lab skills.

Outcome: Students will be able to investigate the theoretical background to an experiment and also to design experiments to test a hypothesis and to determine the value of unknown quantities**.**

List of Experiments:

1. Introduction (3)
2. Carey faster's bridge (1)
3. Variation of magnetic field (1)
4. LCR series circuit (1)
5. Liquid lens (1)
6. U.J.T characteristics (1)
7. FET characteristics (1)
8. Joules calorimeter (1)
9. Oscilloscope (1)
10. Determination of M & Bh (1)
11. Calculations and revision (3)

FLUID MECHANICS
PRACTICALS

Credits : 1 **Semester: IV**
Subject Code : CT18407 **No. of practical hours: 30**

Objective: To impart practical knowledge regarding types of flow, estimation of friction in pipe flows, application of Bernoull's equation.

Outcome: Students will be able to determine flow regimes, establishing Bernoulli's principle, estimation of friction and head losses, calibration of flow measuring devices, estimation of pressure drop and study of fluidization.

List of Experiments:

1. Introduction (3)
2. Reynolds Experiment (1)
3. Flow through straight pipes (Estimation of Friction) (1)
4. Flow through Packed bed (1)
5. Determination of Co efficient of Venturimeter (1)
6. Determination of Co efficient of Orificemeter (1)
7. Calibration of Rotameter (1)
8. Flow through Fluidized bed (1)
9. Beronoull's Experiment (1)
10. Loss due to pipe fitting (1)
11. Calculation and revision (3)

YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF SUBJECTS
DEPARTMENT OF CHEMICAL TECHNOLOGY
FIFTH SEMESTER
ACADEMIC YEAR 2022-23 OF 2020-23 BATCH (CBCS)

Sl. No.	Part	Subject Code	Title of the Subject	Hours/ Week	Duration of semester exams	Marks			Credits
						Internal	External	Total	
1	II	CT18501	Mass Transfer Operations-I (Core-13)	4	3	40	60	100	4
2	II	CT18502	Heat Transfer (Core-14)	4	3	40	60	100	4
3	II	CT18503	Chemical Technology-II (Core-15)	4	3	40	60	100	4
4	II	CT18504	Chemistry-V (Core-16)	4	3	40	60	100	4
5	II	CT18505	Mechanical Unit Operations (Core-17)	4	3	40	60	100	4
6	II	CT18506 A	Mathematical Statistics (DSE-1)	4	3	40	60	100	4
	II	CT18506 B	Industrial Management (DSE-1)						
7	II	CT18507	Project (DSE-2)	2	3	40	60	100	6
PRACTICALS									
8	II	CT18508	Heat Transfer (Core-14)	2	3	40	60	100	1
9	II	CT18509	Chemical Technology Lab (Core-15)	2	3	40	60	100	1
10	II	CT18510	Chemistry-V (Core-16)	2	3	40	60	100	1
11	II	CT18511	Mechanical Unit Operations Lab (Core-17)	2	3	40	60	100	1
Total				**34**	**-**	440	660	1100	**34**

* Discipline-Specific Elective (DSE)

MASS TRANSFER OPERATIONS – I

Credits : 4 **Semester: V**
Subject Code : CT18501 **No. of lecture hours: 60**

Objective: To impart knowledge of purification and separation of complex homogeneous solutions into individual products and also about process design and Engineering skills.

Outcome: Students will be able to

- Describe the principles of diffusion
- Explain the principle of distillation and types of distillation
- Analysis of fractionating column by Mecab Thiele Method
- Explain the principle and applications of Leaching process
- Explain the principles of extraction and extraction equipment

UNIT-I **12Hrs**

PRINCIPLES OF DIFFUSION

Role of diffusion in Mass Transfer	(2)
Molal flow rate, velocity and flux	(1)
Relations between diffusivities and diffusion	(3)
Fick 1st law Diffusivity in gases	(2)
Diffusivity in liquids	
Mass transfer coefficients and two resistance theory	(2)
Experimental Measurement of Mass Transfer coefficient by wetted wall Column	(2)

UNIT-II **12Hrs**

DISTILATION

Vapour liquid equilibrium	(1)
Relative volatility and Boiling point diagram.	(1)
Raoults law and Henrys law concept.	(1)
Types of distillation : Batch distillation, Rayleighs equation	(2)
Flash distillation : operating line equation	(1)
Continuous distillation : details of the Rectification column.	(2)
Material and Energy Balance	(2)
Steam distillation. Principle and working details	(2)

UNIT-III **12Hrs**

ANALYSIS OF FRACTIONATING COLUMN BY MECABE THIELE METHOD

Feed line : conditions of Feed	(2)
Enriching line and stripping line	(1)
Calculation of number of Ideal Stages	(2)
Partial and total condensers use	(1)

TYPES OF REFLUX RATIO

Details of minimum of reflux ratio	(1)
Total Reflux and optimum Reflux Ratio	(2)
Types of Efficiencies : Overall column efficiency	(1)
Murphree plate efficiency	(2)
Factors influencing plate efficiency	

UNIT-IV **12Hrs**

LEACHING OPERATION

Industrial application (1)
Types of Leaching Heep leaching, Intermediate size particles leaching (2)
Fine Particles leaching
Leaching equipment : stationary solid bed, Moving Bed Extractor (1)
Boollman Extractor; Hildebrand extractor (2)
Dispersed solid leaching
Principles of continuous counter current Leaching (1)
Ideal stage and equilibrium in Leaching (2)
Operating line equation (1)
Constant and variable underflow, Number of ideal stages
for constant under flow and variable under flow (2)

UNIT-V **12Hrs**

Extraction equipment : Mixer settlers (1)
Spray and packed extraction towers, perforated plate towers, baffle towers (2)
Principles of extraction : equilibrium and phase compositions, Triangular diagram, equilibrium
Line, plait point. Single stage extraction, multistage cross current extraction (2)
for miscible system (2)
Insoluble liquids : single stage extraction (2)
Continuous counter current multistage extraction (3)
problems solving

ESSENTIAL READING:

1. Robert E Treybal. Mass Transfer Operations. Third edition, New Delhi: McGraw Hill International Edition.

SUGGESTED READING:

1. Warren L.Me Cable, Julian C. Smith and Peter Harriot. 1993. Unit Operations of Chemical Engineering. 5th Edition. New Delhi: McGraw Hill International edition.
2. Badger and Banchero. 1955. Introduction to Chemical Engineering. New Delhi: McGraw Hill International Edition.

HEAT TRANSFER

Credits : 4 **Semester: V**
Subject Code : CT18502 **No. of lecture hours: 60**

Objectives:
- To study the modes of HT, conduction, convection and radiation and to learn the calculation of rate of heat transfer by these mechanisms.
- To study construction and working of heat exchangers and evaporators.

Outcome: Students will be able to
- Apply Fourier's law of heat conduction to calculate rate of heat transfer by conduction in solids.
- Apply the different equations for different situations to calculate the rate of heat transfer through fluids without phase change by convection.
- Explain heat transfer to fluids with phase change.
- Explain the construction and working of Heat Exchangers.
- Explain the construction and working of evaporators.

UNIT-I **12Hrs**

Introduction: Modes of heat transfer (1)

Heat Transfer by Conduction in Solids:
- Fourier's law of heat conduction (1)
- Steady state heat conduction through walls (single and multiple layers) (4)
- Steady state heat flow through a cylinder (4)
- Steady state heat flow through a sphere. (2)

UNIT-II **12Hrs**
- Typical heat exchange equipment (1)
- Counter and parallel flows in Double Pipe Heat Exchanger (2)
- Energy balance for heat exchanger (1)
- Overall heat transfer coefficient (2)
- Calculation of overall coefficient from individual coefficient (1)

Heat Transfer to Fluids without Phase Change :
- Dimensional analysis (1)
- Heat transfer by natural convection (calculations by the use of emperical relations) (2)
- Heat transfer by forced convection (calculations by the use of emperical relations) (2)

UNIT-III **12Hrs**

Heat Transfer to Fluids with Phase Change

1) Heat Transfer from Condensing Vapours :
- Dropwise and film type condensation (3)
- Coefficients for film type condensation (3)
- Practical use of Nusselt equation (1)

2) Heat Transfer from Boiling Liquids :

Pool Boiling of saturated liquid :

- Nucleate boiling, Maximum flux and critical temperature drop (3)
- Minimum heat flux and film boiling (2)

UNIT-IV **12Hrs**

Radiation Heat Transfer :

- Fundamentals of radiation (1)
- Black body radiation, laws of black body radiation, Kirchoffs law (2)
- Radiant heat exchange between Non-black surfaces (2)
- Combined heat transfer by conduction, convection and radiation. (1)

Heat Exchange Equipment :

Construction and working of Heat Exchangers:

- Single pass 1-1 heat exchanger (3)
- 1-2 parallel counter flow heat exchanger (2)
- Correction of LMTD for cross – flow. (1)

UNIT-V **12Hrs**

Evaporation :

- Single – Effect Evaporation (Including calculations) (3)
- Multiple – effect Evaporation (only theoretical treatment) (1)
- Methods of Feeding (2)

Types of Evaporators :

- Forced circulation evaporation (2)
- Long – tube vertical evaporators (2)
- Agitated – film evaporators. (2)

ESSENTIAL READING:

1. Mc.Cabe and Smith. 2000. Unit Operations of Chemical Engineering. Sixth Edition. New Delhi: Tata McGraw Hill Publishing Company Ltd.

SUGGESTED READING:

1. Walter L. Badger and Julius T. Banchero. 1997. Introduction to Chemical Engineering. First Edition. New Delhi: Tata McGraw Hill Publishing Company Ltd.

CHEMICAL TECHNOLOGY – II

Credits : 4 **Semester: V**
Subject Code : CT18503 **No. of lecturer hours : 60**

Objective: This paper deals with natural product production units, which gives ideas about How to operate these units, Major Engineering problems encountered with and also utilization and storage of these products safely.

Outcome: Students will be able to
- Explain Nuclear materials
- Explain natural product industries, soaps and detergents
- Describe microware, biotechnology, isolation, cultivation and growth of micro organisms
- Explain pulp and paper industry
- Explain food industry

UNIT-I **12Hrs**

NUCLEAR MATERIALS

Nuclear Raw materials: Introduction
Reasons for study of Nuclear Energy: Energy spectrum for India (1)
Economic justification for nuclear power (1)
Nuclear Agro Industrial Complex (1)
Energy via Nuclear Fission Reaction. (1)
Role of Chemical Engineering in Nuclear Engineering:
Important components of a nuclear fission Reactor:
Fuels, Fertile fuels, structural components: Moderators, Absorbents, Coolent and Fuel cell (1)
Methods of Production: Concentration: Purification & conversion of ore (1)

EXPLOSIVE AND PROPELLANTS

Energy System for Air space Vehicles: (1)
Introduction: Propulsion fundamentals: classification of chemical
Energy Systems (1)
Basic Chemicals reactants characteristic solid propellants, Liquid propellants, Hybrid propellant. (1)
Basic considerations in developing high performance chemical propellant systems; Burning Rate control (1)
Handling Storage and utilization of propellants: Safety requirements (1)
Nuclear Propulsion system. High-energy chemicals:
Hydrazine and Boron Hydrogen compounds production details. (1)

UNIT-II **12Hrs**

NATURAL PRODUCT INDUSTRIES

Oils, Soaps, Detergents, glycerin, edible oils:
Chemical compositions and physical properties: Fats & Oils: (1)
Consumption pattern: Types of fats and oils available
Vegetable source and Animal source (1)
End uses: Methods of extracting vegetable oil
Mechanical and solvents extraction process: (1)

Hydrogenation of oils: (1)
Raw materials required for Hydrogenation of oils: Quantitative
Requirements: Process Description: Major engineering problem (2)

SOAPS & DETERGENTS
Introduction: Classification of cleaning compounds
Anionic: Cationic: nonionic surfactants (1)
Detergent Builders: Use Pattern: (1)
Methods of Soap production:
Batch Process: continuous hydrolysis and saponification process (2)
Reference flow chart: chemical reaction: Process description
Methods of Detergents manufacturing sulfated Fatty alcohol's sodium reduction of coconut oil:
sulfation of Fatty Alcohols: Alkyl aryl sulfonates: (1)
Detergent Vs Soap,.
Natural and synthetic Glycerine Manufacturing methods (1)

UNIT-III **12Hrs**
MICROBIAL BIOTECHNOLOGY
Diversity of Microorganisms: Eukaryotes versus prokaryotes: (1)
General Characteristics and biotechnological applications of (2)
Protozoa, Algae, Fungi, Bacteria and Virus.

ISOLATION, CULTIVATION & GROWTH OF MICRO ORGANISMS
General methods of isolation and purification of micro-organisms (2)
Aerobic and anaerobic cultivation of micro–organisms, nutrition and nutritional types of microbes (2)
Growth of micro-organisms- Growth curve and stages.
Fermentation; production of Industrial Alcohol (1)
Microorganism as Single cell protein and its production (2)
Biogas production
The biochemical changes- taking place during methanation, microorganisms involved and the process details. (2)

UNIT-IV **12Hrs**
PULP AND PAPER
Introduction: Cellulose Raw materials: (2)
Pulp definitions: Methods of production of pulp1hr (2)
Production pattern: Sulphate pulp process description (2)
Chemicals recovery from Black liquor (2)
Bleaching of pulp
Paper products: Definition: Types of paper products: (1)
Raw materials required for paper manufacturing
Production details and Flow chart (3)

UNIT-V **12Hrs**
FOOD INDUSTRY
Reasons to study and develop food industry
Food storage: Food processing: Food transport: Food preservation: (1)
Food storage and transport: Engineering aspects of Cold Storages (1)

Dairy Industry: Pasteurization of milk. (1)
Food Irradiation: Application (1)
Food Additives. Types and application (1)

CORROSION AND ITS PREVENTION

Introduction: (1)
Dry corrosion; Wet corrosion; mechanism (2)
Protective Measures against corrosion (2)
other forms of corrosion. (2)

TEXT BOOK :

Charles E.Dryden : Outlines of Chemical Technology
Second Edition Edited by: M.Gopal Rao and Marshal Sitting.

REFERENCE BOOKS :

1. SHREVE.R.NERVES and BRINKJOSEPH.A; Chemical Process Industries .
2. Pelzar, Reid and Chan., Microbiology; Tata-McGraw-Hill Publishing Company Ltd.1990
3. Casida; Industrial Microbiology; Tata-McGraw-Hill Publishing, 1990
4. C.Kuriacose and J.Rajaram. Chemistry in Engineering and Technology Vol. (2) McGraw-Hill, 1988.

CHEMISTRY-V

Credits : 4 **Semester: V**
Subject Code : CT18504 **No. of lecture hours: 60**

Objective: To make the students understand the use of modern instrumentation (Spectroscopy) and efficient problem solving skills in the areas of Physical Chemistry.

Outcome: Students will be able to

- Determine the Extraction, structure and uses of Alkaloids, Terpenoids, Steroids and Dye stuffs
- Application of Polymers, development of Polymers and Rubbers
- Classify Drugs, demonstrate drugs and explain their action
- Explain the Fundamental concepts of Spectroscopic techniques
- Evaluate Order and Molecularity of reactions, application of Photo chemical reactions

ORGANIC CHEMISTRY

UNIT-I **12Hrs**

ALKALOIDS – TERPENOIDS AND STEROIDS

- Definition Isolation and structural determination of alkaloids, terpenoids and steroid. (2)
- Properties and constitution of Nicotine, citral and cholesterol. (3)

DYE STUFFS AND DYEING

- Introduction and classification Color in relation to structure. (1)
- Synthesis of following dyes.
- Azodye: Methyl Orange, Congo red, Bismark Brown. (2)
- Triphenyl methane dyes; Para rosaniline; Crystal violet. (2)
- Phthalein dyes; Phenolphthalein; Fluorescene. (1)
- Indigo and Alizarin (1)

UNIT-II **12Hrs**

POLYMERS

- Definition – Polymer and Polymerization – Mechanism of Polymerization (Acid, Base Free radical) (1)
- Types of Polymers; Synthetic and natural polymers. (1)

SYNTHETIC FIBERS

- Preparation of acetate rayon, Cuprommonium rayon, nylon and properties. (1)
- Manufacture of Dacron and terylene, their properties, (1)
- Synthesis and properties of teflon, polyester and polyurethane. (1)

PLASTICS

- Definition and classification
- Method of formation of thermosetting materials (1)
- Manufacture of Urea formaldehyde, Phenol – formaldehyde – Bakelite (1)
- manufacture of polythene and polyvinyl chloride (PVC) celluloid derivatives as plastics. (1)

RUBBER

- Natural and Synthetic**.**
- Natural Rubber – Coagulation of latex, Chemical and physical properties of rubber, Vulcanization of rubber, compounding of rubber. (2)
- Synthetic Rubber – manufacture of GRS rubber (Hot and cold process) and manufacture of Neoprene rubber, GRT rubber or Butyl rubber.
  Properties and uses of synthetic rubber. (2)

UNIT-III **12Hrs**

SYNTHETIC DRUGS

- Introduction – Constitution and physiological action (Elementary Treatment) Classification of the drug, structural formulae (3)
- synthesis and uses of representative drugs – one each of the following :
- Antimalaria's (Chloroquine), Antipyretics (paracetomol, aspirin) and Analgesis (phenacetin) (3)
- Antiseptics (Iodoform) (2)
- Sulpha drugs (Sulphanilamide) (2)
- Anti biotics (Chloramphenicol) (2)

UNIT-IV **12Hrs**

SPECTROSCOPY

- Ultraviolet and Visible Spectroscopy, Principle, instrumentation and applications (2)
- Infrared spectroscopy; Principle, instrumentation and applications. (3)
- N.M.R. Spectroscopy, Principle, Chemical shifts, tentative representation of proton N.M.R spectrum, spin coupling, applications of proton N.M.R. Spectroscopy. (4)
- Mass Spectroscopy, Principles, types of peaks in mass spectrum, nitrogen rule, retero diel's alder fragmentation, Mc. Lafferty fragmentation. (3)

UNIT-V **12Hrs**

CHEMICAL KINETICS

Rate of reaction – factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, bight and catalyst. (2)

- order and molecularity – Zero order, first order, second order, pseudo first order, half-life and mean life. (1)
- Determination of order of a reaction – differential method, method of integration, half-life method and isolation method. (2)
- Arrhenius equation Theories of reaction rates (Collision and hard sphere model) (1)

PHOTOCHEMISTRY

- Interaction of radiation with matter, differences between thermal and photo chemical process. (1)
- Laws of photo chemistry : Grothus – Draper law, Stark-Einstein law, Quantum yield, photo chemical combination of H_2-Cl_2, H_2-Br_2. (1)
- Joblonski diagram depicting various processes occurring in the excited state. (1)
- Qualitative description fluorescence, phosphorescence, non-rediative processes (internal conversion, inter system crossing). (1)
- Photosensitized reactions – energy transfer process (single examples) (2)

ESSENTIAL READING:

1. Dr. O.P. Agarwal. 1990. Unified Course in Chemistry. Vol-1, Vol-2, Vol-3 & Vol-4. 1st ed. New Delhi: Jay Prakash Nath publications.
2. Syed Fazal Mehdi Ali, Promod Kumar Dubey. 1990. University Chemistry. Vol-1, Vol-2, Vol-3. 2nd ed. New Delhi: New Age International publishers.

SUGGESTED READING:

1. P.L. Soni. 1999. Organic Chemistry. 3rd Edition. New Delhi: Sultan Chand & Sons.
2. P.L. Soni. 1999. Physical Chemistry. 3rd Edition. New Delhi: Sultan Chand & Sons.
3. P.L. Kalsi. 1990. Organic Spectroscopy. 1st Edition. New Delhi: Jay Prakash Nath publications.

MECHANICAL UNIT OPERATIONS

Credits : 4 **Semester: V**
Subject Code : CT18505 **No. of lecture hours: 60**

Objective: To impart theoretical and technical knowledge applicable to various chemical industries regarding mixing of liquids and pastes, determination of sizes of irregular particles, transportation of solids, size reduction equipments, separations of solids, filtration, and crystallization.

Outcome: Students will be able to

- Explain agitation equipment, flow patterns and design of power required for agitation equipment. Explain mixers for pastes and free flowing solids
- Identify the need for screen analysis and storage of solids. Explain conveying systems.
- Explain size reduction equipment's. Capability of problem solving pertaining to size reduction equipment's
- Identify the need for size separations. Explain screening equipment's
- Explain centrifugal separation process. Explain crystallization equipment.

UNIT-I **12Hrs**

AGITATION AND MIXING OF LIQUIDS

Agitation equipment, flow patterns in agitated vessels (2)
Power consumption in agitated vessels (3)
Theory of blending and mixing (2)
Motionless mixers, gas dispersion (1)

MIXING OF SOLIDS AND PASTES

- Types of mixers, Mixers for pastes and plastic masses (1)
- Mixers for dry powders (Ribbon Blenders and Tumbling mixers) (2)
- Mixing index in blending granular solids (1)

UNIT-II **12Hrs**

CHARACTERIZATION OF SOLID PARTICLES

Particle shape, particle size, mixed particle sizes (3)
screen analysis (differential and cumulative) (3)
storage of solids (bulk storage and Bin Storage) (3)

TRANSPORTATION OF SOLIDS (CONVEYING)

Belt, Chain, Screw and Pneumatic conveyors (3)

UNIT-III **12Hrs**

SIZE REDUCTION

Principles of Communication, criteria for communication (1)
Characteristics of comminuted products, Energy and power requirements in communication (2)
Communication laws (3)
Size Reduction equipment (5)
Open – circuit and closed – circuit grinding (1)

UNIT-IV **12Hrs**

MECHANICAL SEPARATIONS

SCREENING

Screening equipment: Stationary screens and grizzlies (2)
Gyration screens, Vibrating screens, Centrifugal sifter (2)
comparison of ideal and actual screens, capacity and effectiveness of screens (2)

FILTRATION

FILTRATION EQUIPMENT

Plate and Frame filter press, continuous rotary filters (3)
suspended batch centrifuge, leaf filter (3)

UNIT-V **12Hrs**

SEPERATION BASED ON THE MOTION OF PARTICLES THROUGH FLUIDS

GRAVITY SETTLING PROCESSES

Gravity classifiers, sorting classifiers (Sink and float method; Differential settling method) (3)
Clarifiers and thickeners (flocculation and sedimentation) (2)

CENTRIFUGAL SETTING PROCESS

Cyclone separators, Tubular centrifuge and Disc centrifuge (2)

CRYSTALLIZATION

Crystal geometry, Theoretical treatment of principles of crystallization (2)
Crystallization equipment, vacuum crystallizers (continuous crystallizers and DTB), Swenson walker crystallizer (3)

ESSENTIAL READING:

1. Warren L. McCabe, Julian C.Smith., and Peter Hariott. 1993. Unit Operations of Chemical Engineering. 5th ed. Inc. New York: McGraw-Hill.

SUGGESTED READING:

1. W.L. Badger and Julius T. Banchero. 1993. Introduction to Chemical Engineering. 5th ed. international edition. New Delhi: McGraw- Hill.

MATHEMATICAL STATISTICS

Credits : 4 **Semester: V**
Subject Code : CT18506A **No. of lecture hours: 60**

Objective : Concept and applications of statistical methods and techniques to the problems and facts of real life situations.

Outcome: Students will be able to

- Distinguish between the probability mass and density functions of random variables and then to calculate mean and variance.
- Identify the characteristics of different discrete and continuous distributions like binomial, Poisson and Normal distributions.
- Analyze hypothesis tests of means, proportions and variances using both one-and two-sample data sets.
- Differentiate between the test statistics to be used for dependent and independent samples.
- Construct control charts for variables and control charts for attributes

UNIT-I **12Hrs**

MATHEMATICAL EXPECTION, CORRELATION AND REGERESSION :

MATHEMATICAL EXPECTATION :

Concepts of p.m.f, p.d.f and mathematical expectation

– Addition and multiplication theorems of expectation covariance. (5)

CORRELATION AND REGRESSION :

Scatter Diagram (1)
Karl Pearson's coefficient of correlation (2)
Rank correlation
(Non- repeated and repeated ranks) (1)
Correlation coefficient for a bivariate frequency distribution. (1)
Regression lines – Properties of regression coefficients. (2)

UNIT-II **12Hrs**

THEORETICAL DISTRIBUTIONS

DISCRETE DISTRIBUTIONS :

Bernoulli distribution. (1)
Binomial distribution, Poisson distribution (as the limiting case of a binomial distribution) - Derivation of only mean, variance and m.g.f of these distributions – Fitting of binomial and Poisson distributions – Simple problems there on. (6)

NORMAL DISTRIBUTION :

Chief characteristics of normal distribution – Area property - Fitting of normal distribution – Simple problems thereon. (5)

UNIT-III **12Hrs**

SAMPLING AND LARGE SAMPLE TESTS :

Types of sampling (Purposive sampling, random sampling, simple sampling and stratified sampling) ….. (2)
Null hypothesis- Type I and Type II errors – Critical region – Level of significance – confidence intervals. (3)

TESTS OF SIGNIFICANCE FOR LARGE SAMPLES :

Test of significance for Single proportion (1)
Test of significance for difference of proportions (2)
Test of significance for single mean. (1)
Test of significance for difference of means (2)
Test of significance for difference of standard deviations. (1)
(Derivations of these formulae are not required) Simple problems thereon

UNIT-IV **12Hrs**

CHI-SQUARE TEST, t-TEST AND F-TEST

Chi – square test:

Chi – square test for goodness of fit (3)
Chi-square for independence of attributes (2)

(i) **t-test:**

t-test for single mean (1)
t-test for difference of means – paired t- test (only tests without proof)- simple problems thereon. (5)

(iii) **F-test:**

F-test (without proof) and simple problems thereon. (1)

UNIT-V **12Hrs**

STATISTICAL QUALITY CONTROL:

Process control – Product control – control limits. (3)

CONTROL CHARTS:

Mean chart (2)
Range chart (1)
Sigma chart (2)
Fraction defective chart (P-chart) (2)
np-chart (1)
control chart for number of defects per unit (c-chart) (1)
(only graphs of these charts are sufficient).

PRESCRIBED BOOKS :

1. Fundamentals of Mathematical Statistics – By S.C.Gupta and V.K.Kapoor : Sultan Chand & Sons Publishers)
2. Statistical Quality Control – By R.C.GUPTA (Kanna Publications)

REFERENCE BOOKS :

1. S.C.Gupta and V.K.Kapoor, Fundamentals Mathematical Statistics, Sultan Chand & Sons Publishers.
2. H.C.Sinha and L.S.Varshoy, Mathematical Statistical, Jaiprakash Nath and Co.Publishers, Meerut.
3. Statistical Quality Control – By R.C.Gupta (Kanna Publications) **(For Unit-V)**

INDUSTRIAL MANAGEMENT

Credits : 3 **Semester: V**
Subject Code : CT18506B **No. of lecture hours: 60**

Objective: To acquaint students with principles and practices of management

Outcome: Students will be able to
- Understand managerial activities.
- Apply organizational skills.
- Evaluate relation between management & labour
- Identify total quality management principles & objectives
- Explain the significance of small scale industries

UNIT- I **12Hrs**

GENERAL MANAGEMENT:

Concept of management - Definition – features	(1)
Nature – objectives	(1)
Levels	(1)
Functions	(1)
Principles	(1)
Universality of the principles of management	(2)
Taylor's and Fayol's contributions	(5)

UNIT – II **12Hrs**

ORGANISATION:

Concept – Importance	(1)
Nature - steps – principles	(3)
Organisation structure	(3)
Leadership - concept – characteristics	(2)
Importance - Qualities of an effective leader	(2)
Styles – Theories	(1)

UNIT – III **12Hrs**

INDUSTRIAL RELATIONS:

Introduction - objectives - weapons of industrial dispute	(2)
Causes of industrial dispute - Methods and machinery for settlement of industrial dispute	(4)
Wages and industrial relations - several components of wages - wages components	(2)
Methods of wage payment - Methods of wage fixation	(2)
other factors contributing to wage fixation	(2)
problems and issues of wage determination	(2)

UNIT – IV **12Hrs**

TOTAL QUALITY MANAGEMENT:

Introduction - Need for TQM	(2)
Principles of TQM - objectives of TQM - process of TQM	(5)
Six sigma - Meaning - Methodology – Elements	(5)

UNIT – V **12Hrs**

SMALL SCALE INDUSTRIES:

Introduction - Role – Importance (3)
Problems faced by SSI - sources of finance for SSI (5)
Entrepreneurship in relation to SSI (4)

ESSENTIAL READING:

1. R.S. Gupta, B.D. Sharma & N.S Bhalla. Principles & practice of management.
2. L.M Prasad. Organisational behavior.
3. Arun Monappa. Industrial relations. New Delhi: Tata McGraw hill.
4. S.D. Bagade. Total quality management. Himalaya publishing house**.**
5. S.K. Mandal. Total quality management principles & practice. Vikas publisher.
6. Amit Singh Sisodiya. Six sigma concepts & cases. ICFAI university press.

HEAT TRANSFR
PRACTICALS

Credits : 1 **Semester: V**
Subject Code : CT18508 **No. of practical hours: 30**

Objective: To understand the different modes of heat transfer experimentally and to learn the calculation of rate of heat transfer in conduction, connection and radiation.

Outcome: Students will be able to calculate the quantity of heat lost / gained in different heat transfer equipments.

Introduction	(1)
1. Coil Heat Exchanger	(2)
2. Open pan Evaporator	(2)
3. Double pipe Heat Exchanger	(2)
4. Emissivity Measurement	(2)
5. Thermal conductivity Measurement	(2)
6. Natural Convection	(2)
7. Heat transfer Through Composite Wall.	(2)

CHEMICAL TECHNOLOGY
PRACTICALS

Credits : 1 **Semester: V**
Subject Code : CT18509 **No. of practical hours: 30**

Objective: To provide the skills to practice preparation and analysis of various products at bench scale level.

Outcome: Students will be able to acquire skills to work with quality control labs in various chemical industries like pharma, paints, cement and fertilizers.

I - PREPARATRION OF CHEMICALS (4)
A. Soap
B. Azo dye
C. Meta di Nitro Benzene
D. Acetanilde

II - ESTIMATION OF OILS (4)
A. Acid value test
B. Saponification value

III - WATER ANALYSIS (3)
A. Total hardness and permanent hardness analysis
B. Estimation of chlorides
C. Dissolved solids

IV - DETERMINATION OF MOLECULAR WEIGHT OF AN ACID (2)

V- ESTIMATION OF GLUCOSE IN THE GIVEN SAMPLE (2)

CHEMISTRY-V
PRACTICALS

Credits : 1 **Semester: V**
Subject Code : CT18510 **No. of practical hours: 30**

Objective: To understand the usage of instruments in chemical analysis.

Outcome: Students will be able to use the important instruments in chemical analysis.

I. Distribution Law 2

i. Determination of molecular status and partition coefficient of benzoic acid in Toluene and water.

II. Electrochemistry 3

1. Determination of dissociation constant (K_a) of acetic acid by conductivity measurements.
2. Determination of solubility and solubility product of BaSO4.
3. Determination of redox potentials of Fe^{2+} / Fe^{3+} by potentiometric titration of ferrous ammonium sulphate vs. potassium dichromate.

III. pH metry 3

- Preparation of phosphate buffer solutions.
- pH metric titration of weak acid, acetic acid with strong base NaOH and calculation of dissociation constant.

IV. Colorimetry / UV Visible Spectrophotometry 4

- Verification of Beer-Lambert law for $KMnO_4$, $K_2Cr_2O_7$ and determination of concentration of the given solution.
- Verification of Beer-Lambert for $CuSO_4$ and determination of concentration of the given solution.
- Composition of complex of Cu^{2+} - EDTA disodium salt.

V. Adsorption 3

- Surface tension and viscosity of liquids.
- Adsorption of acetic acid on animal charcoal, verification of Freundlich isotherm.

MECHANICAL UNIT OPERATIONS PRACTICALS

Credits : 1 **Semester: V**
Subject Code : CT18511 **No. of practical hours: 30**

Objective: To impart practical knowledge regarding estimation of power consumed for mixing of liquids and pastes, determination of sizes of irregular particles, and verifying crushing laws, separations of solids, filtration.

Outcome: Handling and estimation of power requirements of size reduction equipment's, and agitation equipment.

LIST OF EXPERIMENTS:

Introduction		1
1.	Sieve analysis	2
2.	Roll Crusher	2
3.	Jaw Crusher	2
4.	Ball Mill	2
5.	Sedimentation	2
6.	Plate and frame filter press	2
7.	Estimation of power consumption in agitated vessel	2

YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF SUBJECTS
DEPARTMENT OF CHEMICAL TECHNOLOGY
SIXTH SEMESTER
ACADEMIC YEAR 2022-23 OF 2020-23 BATCH (CBCS)

Sl. No.	Part	Subject Code	Title of the Subject	Hours/ Week	Duration of semester exams	Marks			Credits
						Internal	External	Total	
1	II	CT18601	Mass Transfer Operations-II (Core-18)	5	3	40	60	100	4
2	II	CT21602	Chemical Technology-III (Core-19)	4	3	40	60	100	4
3	II	CT18603	Chemical Reaction Engineering (Core-20)	4	3	40	60	100	4
4	II	CT18604	Environmental Engineering & Safety (SEC-3)	4	3	40	60	100	4
5	II	CT18605 A	Non-Conventional Energy Sources (DSE-3)	4	3	40	60	100	4
	II	CT18605 B	Refractory Technology (DSE-3)						
6	II	CT18606 A	Pesticide Chemistry (DSE-4)	4	3	40	60	100	4
	II	CT18606 B	Organic Surface Coating Technology (DSE-4)						
PRACTICALS									
7	II	CT18607	Mass Transfer Operations (Core-18)	2	3	40	60	100	1
8	II	CT18608	Chemical Reaction Engineering (Core-20)	2	3	40	60	100	1
Total				**29**	**-**	320	480	800	**26**

* Skill Enhancement Course (SEC)
* Discipline-Specific Elective (DSE)

MASS TRANSFER OPERATIONS - II

Credits : 4 **Semester: VI**
Subject Code : CT18601 **No. of lecture hours: 75**

Objective: To get the knowledge about the absorbers, dryers and membrane process which provide them to learn about major chemical industrial separation processes and to improve engineering skills.

Outcome: Students will be able to

- Explain the principle and applications of absorption and will be able to design packed column
- Describe humidity and its measurement and equipment for humidification operations
- Choose drying equipment and will be able to do calculations in drying
- Choose suitable equipment to carry out adsorption
- Explain membrane separation process and will be able to classify membranes

UNIT-I **15Hrs**

GAS ABSORPTION

Introduction, Industrial use of absorption	(2)
Types of tower packing: regular and random packing	(1)
Contact between liquid and gas, loading and flooding	(1)
Types of packing material and requirement of packing material	(2)
Principles of absorption, choice of the solvent for absorption	(1)
Material balance for absorption coloumn.	(1)
Design of packed column	(2)
Calculation of Packed height of the column	(2)
Number of transfer units, Height of transfer unit, for lean gas	(1)
Absorption of rich Gases,*	(1)
Absorption with chemical reaction.*	(1)

* refers only theoretical treatment

UNIT-II **15Hrs**

HUMIDIFICATION OPERATIONS

Humidity, saturated gas, relative humidity	(2)
percentage humidity, humid heat, humid volume, dew point	(3)
Humidity chart, wet bulb temperature and measurement of humidity	(3)
Principle of adiabatic saturation	(2)
Principle of wet bulb thermometry, Lewis relation	(3)
equipment for humidification operation, Natural draft cooling tower.	(2)

UNIT-III **15Hrs**

DRYING OF SOLIDS

Classification of dryers- with the nature of the substance and type of heat transfer	(2)
Principles of drying, heat transfer in dryers	(1)
Mass Transfer in Dryers	(1)
equilibrium moisture curves	(1)
Mechanism of porous substance drying	(1)
calculation of drying time under constant Drying conditions	(2)

Drying equipment, tray dryer rotary dryers, Fluidized bed dryer, spray dryer, drum dryers	(3)
Calculation of drying rate constant, heat duty in dryers	(2)
Drying of non-porous substances: shrinkage and case hardening	(2)

UNIT-IV **15Hrs**

Adsorption operation

Industrial use of adsorption	(1)
Types of Adsorbents	(1)
Physical Adsorption and Chemisorption	(2)
Adsorption Isotherm	
Principles of adsorption, application of Freundlich equation	(2)
Fixed bed adsorbers, stirred tank adsorbers, continuous adsorbers	(2)
Break through curves scale up, length of unused bed	(2)
effect of feed concentration.	(2)
Problem Solving	(3)

UNIT-V **15Hrs**

Membrane Process Technology

Industrial use	(2)
Introduction to Membrane	(2)
Types of Membranes and their classifications	(2)
Separation of gases: Binary mixture	(2)
Separation of Liquids: Dialysis	(3)
Flow pattern in Membrane separation	(2)
Reverse Osmosis: Principle and Application	(2)
Conclusion	

ESSENTIAL READING:

1. Warren L. Mc. Cabe, Julian C.Smith, Peter Hartiott. Unit operations In Chemical Engineering. Fifth Edition, McGraw Hills International Edition.

SUGGESTED READING:

1. Robert E. Treybal. 1993. Mas Transfer Operations. Third Edition. New Delhi: McGraw Hills International Edition.
2. Badger and Branchero. Introduction to Chemical Engineering. New Delhi: McGraw Hills International Edition.

CHEMICAL TECHNOLOGY-III

Credits : 4 **Semester: VI**
Subject Code : CT21602 **No. of lecture hours: 60**

Objective: To impart theoretical and technical knowledge applicable to various petrochemical and polymer industries, such as methanol, acetone, styrene, butadiene, polyvinyl chloride, viscose rayon, nylon.

Outcome: Students will be able to

- Identify basic refinery operations. Explain manufacturing of Methanol, Vinyl chloride
- Explain the manufacturing of Acetone, Acrylonitrile. Explain the manufacture of Isoprene, Butadiene.
- Explain the manufacture of aromatic hydrocarbons.
- Explain the manufacture of pesticides.
- Explain the manufacture of polymers.

UNIT-I **12Hrs**

INTRODUCTION:

Petroleum refinery product classification flow chart of refinery operations (2)
Petrochemicals; Raw materials; Pyrolysis & Cracking; (1)
Chemicals from C_1 compounds; Methanol (2)
Chloro Methanes (1)
Chemicals from C_2 compounds; Acetylene and Ethylene by steam cracking of hydrocarbons (2)
Vinyl chloride (2)
Ethanolamines (2)

UNIT-II **12Hrs**

Chemicals from C3 compounds: Acetone (2)
Acrylonitrile (2)
Isoprene (2)
Chemicals from C4 compounds; Butadiene (a) By dehydrogenation of Butane (3)
(b) By Oxydehydrogenation (3)

UNIT-III **12Hrs**

CHEMICALS FROM AROMATES:

Hydro dealkylation (1)
Phenol from cummene (1)
Phenol from Toluene oxidation (2)
Phenol from Raschig processes (2)
Styrene from Benzene and Ethylene (2)
Phthalic Anhydride (2)
Maleic anhydride production (2)

UNIT-IV **12Hrs**

INTORODUCTION TO AGROCHEMICALS

Production details pesticides	(2)
Parathion manufacturing	(3)
2,4-D manufacture	(2)
Chemicals from Alcohol : Ethylene, Acetone, Acetic acid and acetaldehyde	(5)

UNIT-V **12Hrs**

POLYMERIZATION TECHNOLOGY

Ethinic polymers; Eg. Poly Vinyl chloride and copolymers	(3)
Poly condensation; Phenol Formaldehyde	(3)

ELASTOMERS:

Butadiene - styrene copolymers	(2)

FIBERS: CELLULOSE

Viscose Rayon production	(2)
Polyamides: 6.6 Nylon polyesters	(2)

ESSENTIAL READING:

1. Charles E. Dryden. 1997. Outlines Of Chemical Technology. 3rd ed. New Delhi: Affiliated East-West Press.

SUGGESTED READING:

1. R. Norris Shreeve. 1986. Chemical process Industries. 3rd ed. New Delhi: McGraw-Hill.

CHEMICAL REACTION ENGINEERING

Credits : 4 **Semester: VI**
Subject Code : CT18603 **No. of lecture hours: 60**

Objective: To study the various types of reactions, determination of reaction rate constant and order of reaction and to study the performance of ideal steady state reactors.

Outcome: Students will be able to

- Classify chemical reactions, define rate equation and can test mechanism.
- Explain the dependency of rate constant on temperature from different theories and Calculate rate constant
- Use rate equation to calculate the specific rate constant and the order of the reaction for irreversible reactions in case of constant volume Batch Reactor.
- Use rate equation to calculate the rate constant for reversible reactions in case of Constant Volume Batch Reactor and rate constant in case of Variable Volume Batch Reactor.
- Use the performance equation to design single ideal reactors.

UNIT-I **12Hrs**

Introduction:

- Classification of reactions (1)
- Variables affecting the rate of reaction, Definition of reaction rate (1)
- Calculation of equilibrium constant for simple reversible reactions ($A \rightleftarrows R$ & $A+B \rightleftarrows R+S$) (1)
- Variation of equilibrium constant with temperature (Vant Hoff equation) (1)

Kinetics of Homogeneous Reactions :

Concentration–Dependent Term of Rate Equation :

- Single and multiple reactions (1)
- Elementary and non-elementary reactions (1)
- Molecularity and order of reaction (1)
- Rate constant, representation of an elementary reaction (1)
- Representation of a non-elementary reaction (1)
- Kinetic models for non-elementary reactions (1)
- Testing kinetic models (search for the reaction mechanism). (2)

UNIT-II **12Hrs**

Temperature - Dependent Term of a Rate Equation :

- Temperature dependency of rate constant from arrheniu's law (6)
- Significance of activation energy, activation energy and temperature dependency (2)
- Temperature dependency of rate constant from thermodynamics (1)
- Temperature dependency of rate constant from Collision theory (1)
- Temperature dependency of rate constant from Transition – state theories (1)
- Comparison of theories with Arrhenius law. (1)

UNIT-III **12Hrs**

Interpretation of batch reactor data :

Constant volume batch reactor :

- Analysis of total pressure data obtained in a constant volume system (1)

Integral method of analysis of kinetic data for

- Irreversible unimolecular-type first-order reactions (2)
- Irreversible bimolecular-type second–order reactions (2)
- Empirical rate equations of the n^{th} order (1)
- Zero-order reactions (1)
- Overall order of irreversible reactions from half–life (2)
- Irreversible reactions in parallel, Homogeneous catalyzed reactions (1)
- Auto-catalytic reaction (1)
- Irreversible reactions in series. (1)

UNIT-IV **12Hrs**

- First-order reversible reaction (4)
- Second – order reversible reactions (1)
- Reactions of shifting order (1)
- Differential method of analysis of data (1)
- Partial and complete analysis of rate equation (1)
- Varying volume batch reactor. (4)

UNIT-V **12Hrs**

Single Ideal Reactors :

- Single ideal batch reactor (2)
- Space time and space velocity (1)
- Steady state back mix flow reactor (4)
- Steady-state plug flow reactor (4)
- Holding time and space time for flow systems. (1)

ESSENTIAL READING:

1. Octave Levenspiel. 2008. Chemical Reaction Engineering. Third Edition, Singapore: John Wiley & Sons.

SUGGESTED READING:

1. K.A. Gavhane. 2009. Chemical Reaction Engineering. First Edition, Pune: Nirali Prakashan Publications.
2. S.D. Dawande. 2001. Principles of Reaction Engineering. First Edition. Nagpur: Central Techno Publications.

ENVIRONMENTAL ENGINEERING & SAFETY

Credits : 4 **Semester: VI**
Subject Code : CT18604 **No. of lecture hours: 60**

Objective:

- To study the treatment methods available to reduce environmental pollution caused by industrial liquid effluents wastes, gaseous effluents and solid waste.
- To impart the knowledge necessary to run a chemical industry safely.

Outcome: Students will be able to

- Classify the industrial effluents and Oxygen Demands.
- Select a suitable equipment and treatment process to control pollution caused by industrial liquid wastes.
- Select a suitable equipment and treatment process to control pollution caused by industrial gaseous effluents and solid waste.
- Explain the safety aspects of a chemical industry such as hazards involved in the chemical industry and preventive measures to be taken.
- Identify the effects of toxic agents on human health and will be able to understand how to handle flammable materials in chemical industries

UNIT-I **12Hrs**

- Types of emissions from Chemical Industries and their effects on environment (2)
- Characterization of effluent streams (1)
- Processes affecting dissolved oxygen (DO) content of aquatic systems, oxygen sag curve (4)
- Oxygen demands and their determination (BOD, COD and TOC) (4)
- Management of waste generation. (1)

UNIT-II **12Hrs**

Liquid effluents :

Primary Treatment : Screening, Sedimentation, Floatation and Neutralization (4)

Secondary Treatment :

Activated sludge process, Tricking filters, stabilization ponds and anaerobic digestion (4)

Tertiary Treatment :

Chemical coagulation, Carbon adsorption, Ion exchange, Reverse Osmosis, Electrodyalisis, Chlorination and Ozonation (4)

UNIT-III **12Hrs**

Gaseous Effluents :

- Equipment for removal of particulate matter (2)
- Methods of control and removal of

1) Sulfur dioxide (3)
2) Oxides of nitrogen (2)
3) Organic vapours (1)

Solid Waste :

- Sources, Disposal methods (2)
- Recycling Techniques (2)

UNIT-IV **12Hrs**

- Introduction to Industrial safety and general hazards. (3)
- Hazards of commercial chemical plant operations.
  - i) Petrochemicals (1)
  - ii) Pharmaceutical (Case Study : Ciproflacxin; Ibuprofen) (1)
  - iii) Fertilizer Industries (1)
- Workers Safety. (3)
- Safety education and training. (3)

UNIT-V **12Hrs**

- Effect of toxic agents on human health (3)

Flammable materials

- Definition, flammable limits, fire triangle (2)
- Precautions to be taken with flammable materials (2)
- Fire detection system (1)

Health hazards of commercial chemical plants

- Petrochemicals (1)
- Pharmaceutical (case study : Ciproflacxin; Ibuprofen) (2)
- Fertilizer industries (1)

ESSENTIAL READING:

1. Fawcett H.H. and W.S. Wood. 1965. “Safety and Accident prevention in Chemical Operations”. Singapore: John Wiley and Sons Inc.
2. S.P. Mahajan. 1985. “Pollution Control in Process Industries”. First Edition. New Delhi: Tata McGraw- Hill Publishing Company Ltd.
3. C.S. Rao. 1999. “Environmental Pollution Control Engineering”. First Edition. New Delhi: New age International Pvt. Ltd. Publishers.

SUGGESTED READING:

1. Industrial Safety & Pollution Control Handbook - By A Joint Publication of National Safety Council and Associate Publishers P. Ltd.
2. Metcalf and Eddy, Inc. 2003. “Waste Water Engineering, Treatment and Reuse”, Fourth Edition, New Delhi: Tata McGraw-Hill Publishing Company Ltd.

ELECTIVE: NON-CONVENTIONAL ENERGY SOURCES

Credits : 4 **Semester: VI**
Subject Code : CT18605A **No. of lecture hours: 60**

Objective: To impart knowledge regarding Non-conventional energy sources, their importance, power generation and storage.

Outcome: Students will be able to

- Describe different types of energy sources. Describe method for estimating solar radiation.
- Identify solar energy storage systems. Explain applications of solar energy.
- Describe production of electrical energy from wind energy. Describe generation of energy from biomass.
- Describe production of electrical energy from geothermal energy. Describe classification of geothermal fields.
- Describe production of electrical energy fuel cells. Describe production of energy from hydrogen.

UNIT-I	**12Hrs**
An introduction to energy sources	(1)
Types of energy sources	(3)
Energy consumption as a measure of prosperity	(1)
World energy future	(1)
Energy sources and their availability	(2)
Renewable energy sources	(2)
Estimation of average solar radiation	(1)
Flat plate collectors, Focusing type of collectors	(1)

UNIT-II	**12Hrs**
Solar Energy Storage	(2)
Solar energy storage systems	(1)
Extraction of Thermal energy	(2)
Applications of solar energy	(2)
Solar water heating, Space cooling	(2)
Solar distillation Solar pumping	(1)
Solar green house	(2)

UNIT-III	**12Hrs**
Wind Energy: Introduction	(1)
Basic principles of wind energy conversion	(2)
Wind data and energy estimation (Theoretical Treatment only)	(1)
Site selection considerations	(2)
Energy from Biomass: Introduction	(1)
Biomass conversion technologies (Wet & Dry Processes)	(2)
Biogas generation, biogas from plant waste	(1)
Community biogas plants, selection of site for biogas generation	(2)

UNIT-IV	**12Hrs**
Geothermal Energy: Introduction	(2)
Estimation of geothermal power	(3)
Nature of geothermal fields	(3)
Geothermal sources	(2)
Applications of geothermal energy	(2)

UNIT-V	**12Hrs**
Chemical Energy Sources: Fuel cells	(2)
Classification of fuel cells, Types of fuel cells	(1)
Applications of fuel cells	(2)
Hydrogen Energy: Introduction	(1)
Hydrogen production (Electrolysis, Thermochemical Methods, Fossil fuel method, Solar energy method.)	(3)
Hydrogen storage, transportation, utilisation of Hydrogen gas	(2)
Hydrogen as an alternative fuel for motor vehicles	(1)

ESSENTIAL READING:

G.D.Rai:Non-Conventional Sources of Energy, 5th ed, Khanna Publishers. New Delhi, 2011.

SUGGESTED READING:

1. N.K. Giri. 2010. Alternate Energy Sources and Applications. 2nd edition. New Delhi: Khanna Publishers.
2. S. Rao and Parulekar. 2010. Energy Technology-Non-Conventional, Renewable and Conventional. 2nd ed. New Delhi: Khanna Publishers.
3. G D Rai. 2011. Solar Energy Utilization. 5th ed. New Delhi: Khanna Publishers.

ELECTIVE: REFRACTORY TECHNOLOGY

Credits : 4 **Semester: VI**
Subject Code : CT18605B **No. of lecture hours: 60**

Objective: To impart knowledge about the properties, manufacturing procedure and applications of different types of refractory materials.

Outcome: Students will be able to

- Classify and select the refractory materials
- Describe the manufacturing procedure, properties and uses of some important refractory materials.
- Identify the refractory's used in Iron and Steel, Glass and Cement industries.
- Explain the testing procedures for some important properties of refractory materials and describe the properties and uses of insulating refractories.
- Choose the special refractories for specified applications and describe refractory cement.

UNIT-I **12Hrs**

- Importance and scope of Refractory technology, Definition of refractories (1)
- Classification of refractories (1)
- Important properties of refractories (3)
- General method of manufacture of refractory (4)
- Requisites of a good refractory for a particular job (2)
- Selection of refractories (1)

UNIT-II **12Hrs**

Description of Important Refractories:

Manufacture, properties and uses of

- Fire-clay refractories (4)
- Silica refractories (3)
- Graphite refractories (2)
- Magnesite chrome refractories (3)

UNIT-III **12Hrs**

Refractories used in industries:

(a) Iron and Steel Industry: Blast Furnace, Hot Metal Mixer and Open Hearth Furnace. (4)
(b) Glass Industry: Refractories used in glass melting tank furnace. (4)
(c) Cement Industry: Refractories used in rotary kilns. (4)

UNIT-IV **12Hrs**

- **Testing of Refractories:** Testing methods for the properties of refractory materials- Refractoriness, Refractoriness under load (RUL), Porosity, Bulk density and Permeability (7)
- **Insulating refractories**: Raw materials for insulating refractories, desired properties of good insulating refractories. Uses of insulating refractories (5)

UNIT-V **12Hrs**

- **Special Refractories**: Raw materials, properties and uses of some special refractories such as super refractories, silicon carbide refractories, sialon refractories, cermet and fused and electro cast refractories. (7)
- **Refractory Cement/Mortars**: Raw materials, characteristics and uses of refractory cements. (5)

ESSENTIAL READING:

1. OM Prakash Gupta. 1994. “Elements of Fuels, Furnaces and Refractories”. Third Edition. Delhi. Khanna Publishers.

PESTICIDE CHEMISTRY

Credits : 4 **Semester: VI**
Subject Code: CT18606A **No. of lecture hours: 60**

Objective: To impart knowledge to the students on different agricultural chemicals used in agriculture.

Outcome: Students will be able to

- Differentiate organic compounds and inorganic compounds
- Classify inorganic insecticides with examples
- Illustrate various organic, natural and synthetic insecticides
- Understands various organochlorine, carbamate and phosphorus compounds
- Analyzes various fungicides and pesticide residues influence on environment

UNIT-I **12Hrs**

Organic Chemistry-Theory of Vitalism-classification of Organic compounds-functional groups-Homologous series- Differences between organic and inorganic compounds. 4
IUPAC Nomenclature of Organic compounds (Aliphatic, Alicyclic, Aromatic) 4
Isomerism- Structural, Optical and Geometrical. 4

UNIT-II **12Hrs**

Classification of Agricultural chemicals based on their use. 4
Classification of insecticides based on the mode of action, toxicity, chemical nature and mode of entry 4
Inorganic insecticides – arsenicals, Fluorides. Oils- essential oils, vegetable oils, mineral oils as pesticides. 4

UNIT-III **12Hrs**

Organic Naturally occurring insecticides Nicotine, Rotenone and Pyrethrum. 5
Synthetic pyrethroides – Cypermethrin, Decamethrin, Deltamethrin. 7

UNIT-IV **12Hrs**

Organo chlorine insecticides- i) characteristics synthesis and properties of BHC and lindane. ii) Cyclo-di-ene compounds – characteristics – synthesis and properties of Endosulfon. 4
Carbamates: synthesis and properties of Carbaryl and Carbofuron. 4
Organo phosphorus compounds – Discovery, mode of action, classification, synthesis and properties of DDVP, Phosphomidon, Methylparathion, Diazinon and Malathion. 4

UNIT-V **12Hrs**

Fungicides – classification based on chemical nature – systemic and non-systemic, synthesis and properties of copperoxychloride, zinab, Phenyl Mercuril Acetate (PMA), Chloranil, Benzimidaazole, Topsin-M and Carboxin. 5
Pesticide residues – their influence on soil, water, air, animals and human beings. 7

SUGGESTED READING

1. Thomson, WT. 1980. **Agricultural Chemicals-Fungicides (Vol.5).** USA: Thomas publications.
2. Worthington, CA. 1985. **The Pesticide Manual British Crop Protection**. UK: A world Compendium Council.
3. Nene, YL. and Thapliyal, PN. 1993. **Fungicides in plant disease control**. New Delhi: Oxford & IBH Pub. Co.
4. Sree Ramulu, US. 1991. **Chemistry of insecticides and fungicides**. New Delhi: Oxford & IBH Pub. Co.
5. Rao, VS. 1992. **Principles of Weed Science**. New Delhi: Oxford & IBH Pub. Co.

ELECTIVE: ORGANIC SURFACE COATINGS TECHNOLOGY

Credits : 4 **Semester: VI**
Subject Code : CT18606B **No. of lecture hours: 60**

Objective: To understand the production of various surface coatings and testing methods.

Outcome: Students will be able to
- Describe the organic surface coatings.
- Explain pigments and extruders.
- Explain resins, plasticizers and additives.
- Explain paints with reference to testing and applications.
- Select coatings for different applications in chemical industries.

UNIT-I **12Hrs**
Importance of organic surface coatings (1)
Decorative and protective functions (2)
Major components of surface coatings: Film formers, pigments, extenders and additives. (2)
Differences between paints, varnishes, lacquers and industrial coatings (2)
Principles of Natural and synthetic drying oil; Eg: Linseed oil, Tung oil, Soya bean oil. (2)
General properties of oils and their characteristics: Acid value, Iodine value, saponification value and their importance. (3)

UNIT-II **12Hrs**
Pigments: Important pigments and their properties (2)
Eg: Titanium dioxide, Zinc oxide, carbon black, Red lead (3)
Prussian blue, Phthalocyanine green and Blue, lead chrome, barium and Potassiumchromates (4)
Extenders: Important properties and their contribution to film properties.
Eg. China clay, gypsum, mica and talc. (3)

UNIT-III **12Hrs**
Natural Resins: Rosin and Shellac (1)
Synthetic Resins: Alkyd resins, Phenolic resins, epoxies (2)
Chlorinated rubber, vinyl resins. Solvents and its blends properties (2)
Criteria for their selection (3)
Plasticizers: properties, types and their applications.
Additives: driers, dispersing agents, anti-skinning agents and leveling agents. (4)

UNIT-IV **12Hrs**
Application of paint: Viscosity consideration, brush application (2)
Spray application and electro static spray application. (3)
Testing of paints: wet paint and dry paint testing, film thickness (3)
Dispersion test, colour matching test (2)
Defects in paints and their remedies (2)

UNIT-V **12Hrs**

Specialty coatings:

High solids, powder coatings, water soluble coatings	(2)
Heat resistant coatings, Automotive coatings, Marine coatings	(3)
Fire resistant coatings, coatings for swimming pools	(2)
Space and air craft coatings.	(3)
Coatings for chemical industries	(2)

ESSENTIAL READING:

1. Turnrer GPA. 1988. Chapman and Hall. Principles of paint technology.
2. W.M. Morgans. 1990. Introduction to paint chemistry. London: Edward Arnold Publishers.

SUGGESTED READING:

1. Oil and chemist Association, 1972. Vol- I to Vol-VIII, Paint Technology Manuals Chapman and Hall.
2. C.Patton, A Wiley. 1973. Pigment Hand Book. Vol-I to Vol-VIII. Temple Inter science Publications.
3. F.G Dunkleyand C.W Collier. 2000. The Testing of Paints. Vol- V. Paint Technology Manual, Chapman and Hall.
4. Hess Manfred. 1958. Paint Film Defects and their remedies. London: Chapman and Hall Ltd.

MASS TRANSFER OPERATIONS
PRACTICALS

Credits : 1 **Semester: VI**
Subject Code : CT18607 **No. of practical hours: 30**

Objective: To understand the working of equipments – distillation, extraction, drying and humidification used in chemical industries.

Outcome: Students will be able to work with distillation, extraction, drying and humidification units at bench scale level.

LIST OF EXPERIMENTS:

1. Simple Distillation (2)
2. Steam Distillation (2)
3. Air Cabinet Dryer (2)
4. Packed Column (2)
5. Liquid – Liquid Extraction (1)
6. Air vapour diffusivity (2)
7. Vapor Liquid Equilibrium (2)
8. Adsorption phenomenon (2)

CHEMICAL REACTION ENGINEERING PRACTICALS

Credits : 1 **Semester: VI**
Subject Code : CT18608 **No. of practical hours: 30**

Objective: To understand how the kinetic data required to calculate the reaction rate constant can be collected in laboratory and to learn how to calculate the value of rate constant.

Outcome: Students will be able to operate different reactors and will be able to calculate rate constant value and activation energy for the given reaction.

LIST OF EXPERIMENTS:

1) Introduction (3)
2) Determination of reaction rate constant for the given system by integral method of analysis using batch reactor. (2)
3) Determination of reaction rate constant for the given system by differential method of analysis using batch reactor. (2)
4) Determination of Activation energy for the given system using batch reactor. (2)
5) Determination of reaction rate constant for the given system using BMR. (2)
6) Determination of reaction rate constant for the given system using PFR. (2)
7) Revision (2)

B.Sc. (Chemical Technology)

Syllabus for the Academic Year 2022 to 2023

Rev. Fr. DR. L. Joji Reddy SJ
Principal

DR. B. Rama
Dean of Academics

DR. K. Vijaya Lakshmi
Dean of Science

DR. Zakir Hussain
Head of the department