Bharati Vidyapeeth

(Deemed to be University)

College of Engineering, Pune

Department of Chemical Engineering

B. Tech. Chemical Curriculum- 2021

Bharati Vidyapeeth

(Deemed to be University)

Faculty of Engineering and Technology

Programme: B. Tech. (Chemical) (2021 Course)

Curriculum Structure (Semester I and II)

BharatiVidyapeeth
(Deemed to be University)
Faculty of Engineering and Technology

Program: B.Tech. (Chemical) Semester – I CBCS 2021 Course

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hours/week)			Examination Scheme (Marks)						Credits			
			L	P	T	UE	IA	TW	TW& OR	TW& PR	Total	L	P TW/OR/PR	T	Total
1		Algebra and Statistics	4	-	1	60	40	-	-		100	4	-	1	5
2		Organic Chemistry- I	4	2	-	60	40	25	-	25	150	4	1	-	5
3		Material and Wave Physics	4	2	-	60	40	25	-	25	150	4	1	-	5
4		Computer Aided Graphics	3	4	-	60	40	25	25	-	150	3	2	-	5
5		Chemical Engineering (Scope and Significance)	3	-	-	60	40	-	-	-	100	3	-	-	3
6		Data Structure (C Programming)	-	4	-	-	-	50	50	-	100	-	2	-	2
Total			**18**	**12**	**1**	**300**	**200**	**125**	**75**	**50**	**750**	**18**	**6**	**1**	**25**

Program: B.Tech. (Chemical) Semester – II CBCS 2021 Course

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hours/week)			Examination Scheme (Marks)						Credits			
			L	P	T	UE	IA	TW	TW & OR	TW & PR	Total	L	P TW/OR/PR	T	Total
1		Differential and Integral Calculus	4	-	1	60	40	-	-		100	4	-	1	5
2		Organic Chemistry- II	4	2	-	60	40	25	-	25	150	4	1	-	5
3		Inorganic Chemistry	3	2	-	60	40	25	-	25	150	3	1	-	4
4		Biological Science	3	4	-	60	40	25	25	-	150	3	2	-	5
5		Material and Energy Balance Calculations	4	-	-	60	40	-	-	-	100	4	-	-	4
6		Java Programming	-	4	-	-	-	50	50	-	100	-	2	-	2
Total			**18**	**12**	**1**	**300**	**200**	**125**	**75**	**50**	**750**	**18**	**6**	**1**	**25**

Bharati Vidyapeeth

(Deemed to be University)

Faculty of Engineering and Technology

Programme: B. Tech. (Chemical) (2021 Course)

Syllabi of Semester I to Semester II Courses

Programme: B. Tech
Chemical (2021) Sem –I
(Chemical)

ALGEBRA AND STATISTICS		
Designation: Mathematics		
Pre-requisite Courses: Basic knowledge of mathematics		
Teaching Scheme	**Examination Scheme**	**Credits Allotted**
Lectures : 04 Hours/Week	End Semester Examination : 60 Marks	Theory : 04
Tutorial : 01 Hours/Week	Continuous Assessment : 40 Marks	Tutorial : 01
Total : 05 Hours/Week	Total : 100 Marks	Total Credits : 05

Topics Covered

UNIT-I	**Matrices** Determinant, Adjoint, Rank, Inverse of matrix, Normal form, System of linear equations, Linear dependence and independence, Linear and Orthogonal transformations. Eigen Values, Eigen Vectors, Cayley – Hamilton Theorem, Application to problems in Engineering.	**(08Hours)**
UNIT-II	**Complex Numbers and Applications** Definition, Cartesian, Polar and Exponential forms, Geometrical representation of imaginary and complex numbers, De' Moivre's theorem and its application to find roots of algebraic equations., Hyperbolic functions, Logarithm of complex numbers, Separation into Real and Imaginary parts, Application to problems in Engineering.	**(08Hours)**
UNIT-III	**Statistics** Collection of data, Graphical representation of data, Measure of central tendency, Measures of dispersion, Coefficient of variation, Standard deviation, Correlation and coefficient of correlation, Standard error estimates, Rank correlation. Statistical test : t-test, F test, x^2 test Data fitting: Linear, Multilinear and nonlinear regression	**(08Hours)**
UNIT-IV	**Probability** Laws of probability and notations, Random variable, Probability distribution-normal, Binomial, Poison Weibull, Interpretation of failure data, Equal likely hood and Boolean algebra, Probability of union, Joint and marginal probability, Conditional probability, and Distribution function.	**(08Hours)**

UNIT-V	**Vector Algebra and Calculus** Vector, Space coordinates and mathematical operations, Physical applications, Differentiation of vectors, Identities involving gradient divergence curl and their physical meaning, Line and surface integrals, Green, Guass and Stoke's theorem.	**(08Hours)**
UNIT-VI	**Solid Geometry** Equation of line, Equation of plane, Conditions for line on plane, Coplanar lines, Intersection of three planes, Equation of sphere, Cone, Cylinder, Quadric surface, Surface of revolution, Combination of surfaces.	**(08 Hours)**

Project Based Learning	
1.	Find the Eigen values and Eigen vectors of any random matrix.
2.	Check the consistency of algebraic equations.
3.	Find roots of any algebraic equation.
4.	Separate into Real and Imaginary parts of complex numbers
5.	Collect the raw data, analyse it and plot it using graphs
6.	Find the stability of the data using coefficient of variation
7.	Use concept of correlation to find coefficient of correlation between different observation.
8.	Use Rank correlation to find correlation for qualitative data.
9.	Derive Spearman's Rank correlation.
10.	Data fitting using linear regression.
11.	Data fitting using nonlinear regression.
12.	Find work done using vector integral.

Text Books/References	
1	P. N. Wartikar and J. N. Wartikar, Applied Mathematics (Volumes I and II), 7th Ed., Pune Vidyarthi Griha Prakashan, Pune, 2013.
2	B. S. Grewal, Higher Engineering Mathematics, 42nd Ed., Khanna Publication, Delhi, 2017.
3	B.V. Ramana, Higher Engineering Mathematics, 6th Ed., Tata McGraw-Hill, New Delhi, 2008.
4	E. Kreyszig, Advanced Engineering Mathematics, 10th Ed., John Wiley & Sons, Inc., 2015.
5	P. V. O'Neil Advanced Engineering Mathematics, 7th Ed., Cengage Learning, 2012.
6	M. Greenberg Advanced Engineering Mathematics, 2nd Ed., Pearson Education, 1998.

Syllabus for Unit Tests	
Unit Test I	Units I, II, and III
Unit Test II	Units IV, V, and VI

ORGANIC CHEMISTRY - I

Designation: Basic Science

Pre-requisite Courses: Basic knowledge of Chemistry, Stereoisomerism, Reactive intermediates.

Teaching Scheme	**Examination Scheme**	**Credits Allotted**
Lectures : 04 Hours/Week	End Semester Examination : 60 Marks	Theory : 04
Practical : 02 Hours/Week	Continuous Assessment : 40 Marks	Tutorial : -
Total : 06 Hours/Week	Term-work (TW) : 25 Marks	Practical : 01
	Practical/Oral : 25 Marks	Total Credits : 05
	Total : 150 Marks	

Course Outcomes

1	Understand the concept of generation, stability of intermediates and mechanisms of various named reactions.
2	Illustrate the principles of stereochemistry and study the skills for stereochemical assignment related to cycloalkane
3	Explain and illustrate the knowledge about the synthesis of alkanes, alkenes and alkynes with its chemical reactions
4	Explain and illustrate the knowledge about the synthesis of Haloalkanes and alcohols with its chemical reactions.
5	Understand and apply the knowledge about preparation reactions of Aldehydes, ketones and Phenols and their chemical reactions.
6	Understand importance of synthesis reactions for Carboxylic acids and derivatives and their chemical reactions.

Topics Covered

UNIT-I	**Structural effects and Reactive intermediates** Electron Displacement:- Effects-Inductive, Electromeric, Mesomeric and Hyperconjugative effects. **Reactive intermediates – Carbocations and Carbanions** Introduction, Classification of carbocations, Preparation of carbocations, Reactions of carbocations, Carbocations stabilisation, Introduction, Classification of carboanions, Preparation of carboanions, Reactions of carboanions, Carboanions stabilization, Kinetic and thermodynamic controls, Effect of solvent, temperature.	**(06 Hours)**
UNIT-II	**Stereoisomerism** Optical isomers with two chiral centres [A, A and A, B type], erythro, threo, meso, diastereomers, Stereo isomers in cycloalkanes – Baeyer's strain theory, heats of combustion and relative stability of cycloalkanes, Factors affecting the stability of conformation, Conformations of cyclohexane, equatorial and axial bonds in cyclohexane. Mono substituted cyclohexanes	**(06 Hours)**
UNIT-III	**Chemistry of alkanes, alkenes and alkynes** Introduction, Classification, Physical properties of alkanes, alkenes and alkynes ,Preparation of alkanes from hydrogenation of alkenes and alkynes,	**(06 Hours)**

	Wurtz Reaction, Reactions of alkanes - and Halogenation ,Preparation of alkenes from alkyl halides and alcohols, Reactions of alkenes - Electrophilic additions their mechanisms (Markownikoff/Anti-Markownikoff addition), oxymercuration-demercuration. Preparation of alkynes - calcium carbide, vicinal dihalides, Reactions of alkynes - Electrophilic and Nucleophilic additions	
UNIT-IV	**Haloalkanes, alcohols** Introduction, Classification, Nomenclature of alkyl halides ,Preparation of alkyl halides from alkanes and by addition of HX to alkenes, Reactions of alkyl halides- Substitution and Elimination reactions, Introduction, Classification, Nomenclature of alcohols, Preparation of alcohols- Hydrolysis of alkyl halides and Reduction of aldehydes and ketones, Reactions of alcohols- Hydrogen halides and Dehydration of Alcohols	**(06 Hours)**
UNIT-V	**Aldehydes, ketones and Phenols** Structure of carbonyl group, Nomenclature of aldehydes and ketones and physical properties, Preparation of aldehydes from primary alcohols and methyl benzenes ,Preparation of ketones from secondary alcohols and friedal craft acylation, Reactions of aldehydes and ketones – Aldol condensation, reduction- Clemmenson's, Cannizaro's reaction, Preparation of phenols from laboratory method, Reactions of phenols – Nitration and Sulphonation	**(06 Hours)**
UNIT-VI	**Carboxylic acids and derivatives** Structure, classification, Nomenclature and physical properties, Preparation of carboxylic acids from primary alcohols and oxidation alkyl benzene, Reactions of carboxylic acids – acidity, salt formation, Acid derivatives – Structure and Nomenclature, Preparations and properties of acid chlorides.	**(06 Hours)**
Project based learning		
• Prepare and give the composition and role of ingredients in dry hand sanitizer.		
• Prepare a safe way to make fruit vinegar at home.		
• Write a review paper based on the role of terpenes and derivatives in the cosmetic, food, and pharmaceutical industries and get it published in reputed journal (eg. Google Scholar).		
• With the help of extraction from cinnamon/discharge essential oil. How to present and introduce cinnamon/lemongrass essential oil products?		
• Prepare a hardware model based on a simple automatic handwashing device.		
• Write a review paper based on organic compounds are used as explosives in practice and get it published in reputed journal (eg. Google Scholar).		
*Students in a group of 3 to 4 shall complete any one project from the above list.		
Term work		
Term work will consist of the experiments listed below, which are to be performed in laboratory by the students		
1	Purification of organic compounds by crystallization using the following solvents: **1.** Water **2.** Alcohol **3.** Alcohol-Water	
2	Effect of impurities on the melting point – mixed melting point of two unknown organic compounds.	
3	Determination of boiling point of liquid compounds. (boiling point lower than and more than	

	100 °C by distillation and capillary method)
Text Books/References:	
1	R. Macy, Organic Chemistry Simplified, 2nd Ed., Chemical Publishing Company, New York 1995.
2	J. J. Li, C.Limberakis, D. A. Pflum, Modern Organic Synthesis, Oxford University Press, New York, 2007.
3	J. Clayden, Organic Chemistry, Oxford University Press, New York, 2000.
4	R. T. Morrison, R. N. Boyd, Organic Chemistry, 6th Ed., Pearsons Publications, New York, 1992.
5	B. S. Furniss, A. J. Hannaford, P.W. G. Smith, A. R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, 5th Ed., Longman Scientific & Technical, Harlow 2001.

Syllabus for Unit Tests	
Unit Test I	Units I, II, and III
Unit Test II	Units IV, V, and VI

MATERIAL AND WAVE PHYSICS

Designation: Basic Science

Pre-requisite Courses: Students are expected to have a basic understanding of physics and calculus.

Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lectures	: 04 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 04
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	TW/OR/PR	: 01
Total	: 06 Hours/Week	Term-work (TW)	: 25 Marks	Total Credits	: 05
		Practical/Oral	: 25 Marks		
		Total	: 150 Marks		

Course Objective: To impart knowledge of basic concepts in physics relevant to engineering applications in a broader sense with a view to lay foundation for the Chemical Engineering.

Course Outcomes

1	Appraise the atomic spectra of one and two valance electron atoms and the change in behavior an external applied electric and magnetic field.
2	Solve quantum physics problems to micro level phenomena and solid state physics.
3	Summarise the arrangement of atoms in solids and its influence the properties of matter.
4	Use the knowledge of nanoscience to develop new materials with tunable properties.
5	Connect the problems associated with defects and use ultrasonic as a tool in industry form on destructive testing.
6	Infer the wave nature of light and apply it to measure stress, pressure and dimension etc.

Topics Covered

UNIT-I	**Atomic and Molecular Physics** Inroduction - JJ Thomson and Bohr, Sommerfeld and Vector Models, Origin of quantum numbers, Vector model for two valance electrons atom, LS and JJ coupling, origin of spectra (Electronic, atomic and molecular), Stark effect.	**(08 Hours)**
UNIT-II	**Quantum Mechanics** Dual nature of matter, concept of wave packet, group and phase velocity and relation between them, Physical significance of wave function, Schrodinger's time dependant and time independent wave equation, Application of Schrodinger's time independent wave equation to the problems of Particle in a rigid box, step potential and potential barrier (analytical discussion), tunnelling effect.	**(08 Hours)**
UNIT-III	**Crystallography** Introduction-Lattice, basis, Unit cell and Bravais lattice, cubic system, lattice planes and Miller indices, packing factor, inter planar distances, Bragg's law (Statement only), Origin of Line and Continuous Spectrum of X-ray, Mosley's law, Crystal defects (1.Point defects vacancies, interstitial defects, substitution defects, 2. Line defect-screw dislocation, edge dislocation, 3.surface defects-material surface, grain boundaries).	**(08 Hours)**
UNIT-IV	**Nanoscience** Introductions of nanoparticals, properties of nanoparticals (Optical, electrical,	**(08 Hours)**

	Magnetic, structural, mechanical), synthesis of nanoparticals (Physicaland chemical), synthesis of colloids, growth of nanoparticals, synthesis of nanoparticals by colloidal route, applications, quantum dots – wide band semiconductors, direct/indirect band gap semiconductors	
UNIT-V	**Ultrasonics** Introduction to ultrasonics, Production of ultrasonics by magnetostriction and piezoelectric methods - acoustic grating –Non Destructive Testing – pulse echo system through transmission and reflection modes - A, B and C–scan displays, Medical applications – Sonogram, emulsification, cavitation, thickness measurement, flaw detection,	**(08 Hours)**
UNIT-VI	**Wave Optics Interference** Interference of waves, interference due to thin film (Uniform and non-uniform), Applications of interference (optical flatness, interference filter, non-reflecting coatings. **Diffraction** Introduction, Classes of diffraction, Diffraction at a single slit (Geometrical method), Conditions for maximum and minimum, Plane diffraction grating, Conditions for principal maxima andminima **Polarisation** Introduction, Double refraction and Huygen'stheory, Positive and negative crystals, Nicol prism, Dichroism.	**(08 Hours)**

Term Work	
Term work will consist of the experiments listed below, which are to be performed in laboratory by the students. (Any Eight of the Following)	
1	Determination of Planck's Constant by photo electric effect
2	To study Hall effect and determine the Hall voltage
3	Calculation of conductivity by four probe method
4	Synthesis of metal oxide nanoparticles (ZnO/ZnS/Gold)
5	UV-VIS spectra of synthesised semiconductor nanoparticles
6	Determination of radius of plan convex lens/wavelength of light/Flatness testing by Newton's rings
7	Determination of wave length of light using diffraction grating
8	Determination of resolving power of telescope
9	Determination of thickness of a thin wire by air wedge
10	Determination of refractive index for O-ray and E-ray
11	Determination of velocity of sound in liquid by ultrasonic interferometer
12	Ultrasonic probe-a study
Project Based Learning	
1	Design and simulation of automatic solar powered time regulated water pumping
2	Solar technology: an alternative source of energy for national development
3	The study on the effect of length on the resistance of a copper wire (verification of ohms law R directly proportional to l)
4	Possible effects of electromagnetic fields (emf) on human health
5	Design and construction of digital distance measuring instrument using ultrasonics
6	Measurement /simulation of reverberation time
7	Study of vibration of bars

8	Determination of absorption coefficient of sound absorbing materials
9	Determination of velocity of O-ray and E-ray in different double refracting materials
10	Quantum confinement effect in wide band semiconductors
11	Need of medium for propagation of sound wave
12	Small wind turbines as a source of electricity
13	Tesla Coil
14	Thin film interference in soap film-formation of colours
15	LiFi- wireless data transfer system using light
Text Books/References	
1	A Textbook of Engineering Physics, M N Avadhanulu, P G Kshirsagar and T V S Arun Murthy, S. Chand Publishing(2018)
2	Engineering Physics, R K Gaur and S L Gupta, Dhanpat Rai Publishing Co Pvt Ltd (2015)
3	Concepts of Modern Physics, Arthur Beiser, Shobhit Mahajan and S.Rai Choudhury, McGraw Hill Education (2017)
4	Fundamentals of Physics, Jearl Walker, David Halliday and Robert Resnick, John Wiley and Sons (2013)
5	Optics, Francis Jenkins and Harvey White, Tata Mcgraw Hill (2017)
6	Principles of Physics, John W. Jewett, Cengage publishing (2013)
7	Introduction to Solid State Physics, C. Kittel, Wiley and Sons (2004)
8	Principles of Solid State Physics, H. V. Keer, New Age International (1993)
9	Laser and Non-Linear Optics, B. B. Laud, New Age International Private Limited (2011)
10	Nanotechnology: Principles and Practices, Dr. S. K. Kulkarni, Capital Publishing Company (2014)
11	Science of Engineering Materials- C. M. Srivastava and C. Srinivasan, New Age International Pvt. Ltd. (1997)
12	Introduction to Electrodynamics–David R. Griffiths, Pearson(2013)
Syllabus for Unit Tests	
Unit Test I	Units I, II, and III
Unit Test II	Units IV, V, and VI

Computer Aided Graphics					
Designation: Engineering Science					
Pre-requisite Courses: Fundamentals of Mathematics					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lectures	: 3 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 4 Hours/ Week	Internal Assessment	: 40 Marks	TW/OR/PR	: 02
Total	: 7 Hours / Week	Term-work (TW)	: 25 Marks	Total Credits	: 05
		Practical/Oral	: 25 Marks		
		Total	: 150Marks		

Course Objectives:

To understand the basic principles of engineering drawing and highlight the importance of Computer Aided Drafting in engineering

To develop the graphical skills for communication of concepts & idea through technical drawings

Course Outcomes:

After completion of the course students would be able to:

1	**Understand** the fundamental concepts of CAD Drawing, its applications, different types of lines, curves and dimension technique with practical application.
2	**Understand** the concept of Orthographic projections and **apply** it to draw detail views by using 1st angle projection method
3	**Understand** the concept of isometric projection and **apply** it to construct 3D view of a component.
4	**Understand** the concept of projections of Point, Line and plane; and **apply** to draw its projection by using 1st angle projection method and to locate its traces
5	**Understand** the concept of projections of different types of solids and sectioned solids; and **apply** to draw its projection by using 1st angle projection method
6	**Understand** the concept of Development of Lateral surfaces; and **apply** to development of simple and sectioned Solids.

Topics covered

UNIT-I	**Fundamentals of CAD and Engineering Curves** **Introduction** to Engineering Drawing, Types of lines and Dimensioning, Layout and size of drawing sheets, Scales. **Engineering Curves**-Ellipse drawing by Focus-Directrix Circle Method and Concentric Circle Method, Involutes of a circle, Cycloid, Archimedean Spiral, Helix on cone and Cylinder. Fundamentals of Computer Aided Drafting (CAD) and its applications, Various softwares for Computer Aided Drafting. AutoCAD initial setting and AutoCAD commands	**(08 Hours)**
UNIT-II	**Orthographic Projection** Basic principle planes of Projections, First and Third angle method of Projection, Orthographic Projections of given Pictorial view by first angle projection method only, Sectional orthographic Projection. Orthographic Drawing by using AutoCAD.	**(08 Hours)**
UNIT-III	**Isometric Projections** Principles of Isometric Projections-Isometric Scale, Isometric Axes, Isometric Projections and Isometric Drawing. Constructions of Isometric view from given Orthographic Views and given origin. Isometric Drawing by using AutoCAD.	**(08 Hours)**

UNIT-IV	**Projection of Points, Lines and Plane Surfaces** Projections of Points, Projections of Oblique lines in First Quadrant, Traces. **Projections of Planes-** Projection of perpendicular and oblique planes (polygonal and circular surfaces), Obtaining true shape of plane surface. Projection of Points, Lines and Plane Surfaces by using AutoCAD.	**(08 Hours)**
UNIT-V	**Projection of Solids and Sectioned Solids** Introduction of solids-Types of solids, Projection of solid inclined both references plane, Projection of common solids such as prism, pyramid, cylinder and cone. Projection of solids cut by AIP and AVP, obtaining true shape of a section. Projection of Solids and Sectioned Solids by using AutoCAD.	**(08 Hours)**
UNIT-VI	**Development of Lateral Surfaces** Development of the lateral surfaces of solids like Prisms, pyramids, cylinders and cones. Development of cut solids. Development of Lateral Surfaces by using AutoCAD.	**(08 Hours)**

Project Based Learning

Following is the list topic for project based learning (Not Limited to) based on the syllabus contents:

1	To obtain industrial drawings to identify the types of lines, dimensioning methods and method of projection.
2	To develop the model/charts based on engineering curves
3	To prepare model/chart for identification of engineering curves in nature for industrial, societal, etc application
4	To demonstrate different methods of orthographic projection.
5	To demonstrate projection of Points
6	To demonstrate projection of Lines
7	To demonstrate projection of Planes.
8	To demonstrate projection of Solids
9	To demonstrate developments of surfaces for solids
10	To demonstrate industrial application of development of surfaces such as steam carrying pipes, Ducts of air conditioning systems, etc.
11	To demonstrate Isometric projection method through model of a cube

*Students in a group of 3 to 4 shall complete any one project from the above list.

Term Work

Term work shall consist of **seven** A2 size (594 mm x 420 mm) sheets using **AutoCAD.**

1	Types of lines, Dimensioning practice, 1st and 3rd angle methods symbol
2	Engineering Curves
3	Orthographic Projections
4	Isometric views
5	Projections of Points and Lines and planes
6	Projection of Solids and Section of solids
7	Development of Lateral surfaces

Text Books:

1	"Elementary Engineering Drawing", N.D. Bhatt, Charotar Publishing house, Anand India.
2	"Text Book on Engineering Drawing", K.L.Narayana & P.Kannaiah, Scitech Publications, Chennai.

References:

1	"Fundamentals of Engineering Drawing", Warren J. Luzzader, Prentice Hall of India, New Delhi.
2	"Engineering Drawing and Graphics", Venugopal K., New Age International publishers.

3	M.B. Shah and B. C. Rana, "Engineering Drawing", 1st Ed, Pearson Education, 2005
4	P. S. Gill, "Engineering Drawing (Geometrical Drawing)", 10 Edition, S. K. Kataria and Sons, 2005
5	P. J. Shah, "Engineering Drawing", C. Jamnadas and Co., 1 Edition, 1988

Syllabus for Unit Test:	
Unit Test : I	Units : I, II, and III
Unit Test : II	UNIT : IV, V, and VI

CHEMICAL ENGINEERING: SCOPE AND SIGNIFICANCE					
Designation: Basic Science					
Course Pre-requisites: Basic Chemistry					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lectures	: 03 Hours/Week	End Semester Examination	: 60Marks	Theory	: 03
		Internal Assessment	: 40Marks	Total credits	: 03
		Total	: 100Marks		
Course Outcomes					
After completion of the course students will be able to					
1.	Appraise the importance of chemical engineering and related processes				
2.	Select unit operations and processes for desired application				
3.	Justify the importance of chemical engineering in Petroleum and Petrochemical industries				
4.	Justify the importance of chemical engineering in Food and Pharmaceutical industries				
5.	Justify the importance of chemical engineering in agricultural industries				
6.	Design a pathway to face todays and upcoming challenges using knowledge of chemical engineering				
Topics Covered					
UNIT - I	**Introduction** Chemical Engineering: Origin and development; Definition of Chemical Engineering; Major components and scope of Chemical Engineering; Role of Chemical Engineer in Chemical and allied industries; Chemical Engineering and national economy				**(06 Hours)**
UNIT - II	**Unit operations and Unit processes** Definition of unit operations and unit processes; Unit operations: fluid flow, heat and mass transfer, and mechanical operations; Unit processes: Addition, condensation, substitution; Application of unit operations and unit processes: industrial case studies.				**(06 Hours)**
UNIT - III	**Petroleum and Petrochemical Industry** Overview of petroleum and petrochemical industry; Major petroleum and petrochemical products; Unit operations and processes in petroleum and petrochemical industry; Economical impact.				**(06 Hours)**
UNIT - IV	**Food and Pharmaceutical Industry** Overview of food and pharmaceutical industries; Unit operations involved in food and pharmaceutical industries; Application of Chemical Engineering: industrial case studies; Role of Chemical Engineers; Economical impact.				**(06 Hours)**
UNIT - V	**Agro-chemical Industry** Significance of agro-chemicals; Role of chemical engineer in synthesis of agro-chemicals; Value added products: biofertilizers, biofuel, bioadsorbents, etc.; Fertilizers, pesticides, herbicides, crop growth enhancers, etc.; Social and economical importance of agricultural chemicals				**(06 Hours)**

UNIT - VI	**Chemical Engineering and challenges** ***(i) Energy:*** Sources of energy and constraints; Need for renewable energy ***(ii)Air:*** Sources of air pollution; Air quality parameters; Air pollution control ***(iii)Water:*** Water quality parameters; Water recycle and reuse; Water treatment methodologies Role of Chemical Engineer in Energy, Air and Water sectors; Economical impact.	**(06 Hours)**

Text Books/ References:	
1	Watcher: Kirk OthmerEncyclopaedia of Chemical Technology, 4th Ed, Jonh Wiley and Sons, New York, 2000
2	F.Ullmann: Ullmann'sEncyclopaedia of Industrial Chemistry, 16th Ed, Wiley VCH, Edinberg, 2016
3	R. H. Perry, D. W. Green: Perry's Chemical Engineering's Handbook, 9th Ed., McGraw Hill, New York, 2018
4	I. D. Wilson: Encyclopaedia of Separation Science,3rd Ed., Wiley VCH Edinberg, 2007
5	R. Trebal: Mass Transfer operations, McGraw Hill Publications 1997
6	McCabe, Smith, Harriot: Unit Operations of Chemical Engineering, McGraw Hill Publications, 1997

Project based learning: Below is the list of possible topics, which is for guidance faculty can design and provide relevant topics in addition to these

1	Study and prepare a report on the activities and roles carried out by chemical engineers in different industries
2	Study and prepare a report on the chemical and allied industries and their importance in national economy and social upliftment
3	Study and prepare a report on the fluid flow operations used in any one chemical industry and their importance on overall processing
4	Investigate and prepare a report on the heat transfer operations used in any one chemical industry and their importance on overall processing
5	Investigate and prepare a report on the mass transfer operations used in any one chemical industry and their importance on overall processing
6	Investigate and prepare a report on the mechanical operations used in any one chemical industry and their importance on overall processing
7	Investigate and prepare a report on the unit processes used in any one chemical industry and their importance on overall operation
8	Study the life and work of eminent chemical engineer from India and prepare a report on the economical and societal impact of their work
9	Investigate and prepare a report on formation, processing, life cycle, application and role of chemical engineering in any one petroleum product and its societal and economical impact, along with the role of chemical engineer
10	Investigate and prepare a report on formation, processing, life cycle, application and role of chemical engineering in any one petrochemical product and its societal and economical impact
11	Investigate and prepare a report on formation, processing, life cycle, application and role of chemical engineering in any one processed food product and its societal and economical impact
12	Investigate and prepare a report on formation, processing, life cycle, application and role of chemical

	engineering in any one processed pharmaceutical product or drug and its societal and economical impact
13	Investigate and prepare a report on formation, processing, life cycle, application and role of chemical engineering in any agrochemical and its societal and economical impact
14	Investigate and prepare a report on the challenges of air and water pollution, its effects and role of chemical engineering in overcoming the same
15	Investigate and prepare a report on the challenges in energy sector, its effects and role of chemical engineering in overcoming the same

Syllabus for Unit Test:	
Unit Test : I	UNIT : I, II, and III
Unit Test : II	UNIT : IV, V, and VI

DATA STRUCTURE (C PROGRAMMING)					
Designation: Computational					
Pre-requisite Courses: Basic knowledge of computers					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Practical	: 04 Hours/Week	Term-work (TW)	: 50 Marks	TW/OR/PR	: 02
Total	: 04 Hours/Week	Practical/Oral	: 50 Marks	Total Credits	: 02
		Total	: 100 Marks		

Course Outcomes	
1	Apply the knowledge of constant, variables, data types and various standard input output functions to write C-programs.
2	Design a flow chart and write C-programs using control constructs and looping statements and arrays.
3	Develop C-programs using string and pointers.
4	Elucidate the basic concepts of Data structure
5	Clarify dynamic store management.
6	Plot graphs using C- Programming

Topics Covered	
UNIT-I	**C-Programming Language** Introduction; Character sets; Constant; Variables and Data Types: integer, float, double, char, string; Operators: arithmetic, relational, logical, increment and decrement, assignment, conditional; Standard input-output functions: printf ( ), scanf ( ), getch ( ) or getchar( );Programs using if statement, if-else statement, goto statement, etc.; Programs based on standard input-output functions used in C-Programming. 1. Programs based on if-else statements. 2. Programs based on goto statements. 3. Programs based on switch-case statements
UNIT-II	**Loops and Arrays** Programs using while loop; do-while loop and for loop; Single dimensional and multi-dimensional arrays. 4. Programs based on while loop. 5. Programs based on do-while loop. 6. Programs based on for loop. 7. Write algorithm and flowchart for array. 8. Programs based on single dimensional arrays. 9. Programs based on multi-dimensional arrays.
UNIT-III	**String and Pointers** Programs using string; String functions: strlen( )/ strcpy( )/ strrev( )/ strcat ( )/strlwr ( )/ strupr ( )/ strcmp ( ); Programs using pointers; Use of * and & operators; Pointer arithmetic's; Use of pointers; Pointer and function: parameter passing to function by

	reference and by value; File handling; Linked list. 10. Programs based on strings and string functions. 11. Programs based on pointers and function.
UNIT-IV	**Introduction to data structures** Storage structure for arrays; Sparse matrices, Stacks and Queues: Representation and application; Linked lists: Single linked lists, linked list representation of stacks and Queues; Operations on polynomials; Double linked list; circular list. 12. Programs based on Array implementation of stack and queues. 13. Programs based on Linked list implementation of stack and queues
UNIT-VI	**Dynamic storage management** Garbage collection and compaction; Infix to post fix conversion; postfix expression evaluation; Trees: Tree terminology, Binary tree, Binary search tree. 14. Programs based on checking balanced parentheses in an expression. 15. Programs based on implementation of tree and tree traversal. 16. Programs based on implementation of binary search tree.
UNIT-VI	**Graphs**: Graph terminology; Representation of graphs; path matrix; BFS (breadth first search); DFS (depth first search); Topological sorting;Warshall's algorithm (shortest path algorithm.); Sorting and Searching techniques : Bubble sort, selection sort, Insertion sort, Quick sort, merge sort, Heap sort, Radix sort. Linear and binary search methods. 17. Programs based on bubble sort, insertion sort, quick sort, merge sort 18. Programs based on implementation of linear and binary search methods
In addition to these above stated programs / practical's concern faculty member may design his/her own programs / practical's.	
Term Work	
Term work will consist of the programs/practical's listed above, out of which any ten programs/practical's are to be performed in laboratory by the students.	
Text Books/References	
1	Y. C. Kanetkar, Let Us C, 15th edition, BPB Publications, New Delhi, 2016.
2	M. Cooper, The Spirit of 'C': An Introduction to Modern Programming, First edition , Jaico Publishing House, 1998
3	Rajaraman V, Adabala N, Fundamentals of Computers, 6th edition, Prentice Hall India Learning Private Limited, 2014.
4	R. Thareja, Data Structures Using C, 2nd edition, Oxford University Press India, 2014.
5	A. N. Kamthane, Introduction to Data Structures in C, Pearson India, 2010
6	A. K. Sharma, Data Structure Using C, Pearson India, 2010

Programme: B. Tech
Chemical (2021)Sem –
II(Chemical)

DIFFERENTIAL AND INTEGRAL CALCULUS					
Designation: Mathematics					
Pre-requisite Courses: Basic knowledge of mathematics					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lectures	: 04 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 04
Tutorial	: 01 Hours/Week	Continuous Assessment	: 40 Marks	Tutorial	: 01
Total	: 05 Hours/Week	Total	: 100 Marks	Total Credits	: 05
Topics Covered					
UNIT-I	**Ordinary Differential Equations** Formation of the ordinary differential equations(ODEs), Solution of an ordinary differential equation, Equations of the first order and first degree, Linear differential equation, Bernoulli's equation, Exact differential equations, Equations reducible to exact equations, Ordinary differential equation of higher order with constant and variable coefficients.				**(08 Hours)**
UNIT-II	**Partial Differential Equations** Functions of two or more variables, Partial derivatives, Homogeneous functions, Euler's theorem, Total derivative, Change of variables, Jacobians - Geometrical interpretation: Tangent plane and normal to a surface.				**(08 Hours)**
UNIT-III	**Applications of Ordinary and Partial Differential Equations** Taylor's theorem for two variables, Errors and approximations, Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers, Differentiation under the integral Sign, Leibnitz's rules. Solution of Higher order ODE with constant and variable coefficients and its applications, Series solution of differential equations, Bessel functions, Legendre Polynomials, Error function. Applications of partial differential equations to chemical engineering problems.				**(08 Hours)**
UNIT-IV	**Integral Calculus** Beta and Gamma functions, Change of order of integration, Differentiation under the integral sign, Surface integrals, Volume integrals, Error functions, Double and Triple integrations.				**(08 Hours)**
UNIT-V	**Applications of Integral Calculus** Applications to Area, Volume, Mean and Root Mean Square Values.				**(08 Hours)**
UNIT-VI	**Fourier and Laplace Transforms** Fourier series: Trigonometric series, Even and odd functions, Half-range series, Parseval`s identity, Complex form, Fourier integrals, Fourier sine and cosine integrals. Fourier transform: Fourier sine and cosine transforms and				**(08 Hours)**

	their elementary properties. Convolution theorem, Application of Fourier transforms to boundary value problems. **Laplace Transform** Laplace and inverse Laplace transform of some standard functions, Shifting theorems, Laplace transform of derivatives and integrals. Convolution theorem, Initial and final value theorem. Laplace transform of periodic functions, Error functions, Heaviside unit step function and Dirac delta function. Applications of Laplace transform.	

Project Based Learning

Term work will consist of the experiments listed below, which are to be performed in laboratory by the students.

1.	Formation of differential equation
2.	Evaluate the electric circuit problem using differential equations.
3.	Evaluate the heat conduction in 1-D using differential equations.
4.	Find the error using the concept of total derivative.
5.	Solving the wave equation using partial differential equations.
6.	Solving the heat equation in 2-D using partial differential equations.
7.	Find Maxima and Minima of functions of two variables.
8.	Use differentiation under the integral Sign to solve integrals.
9.	Find root mean square values using integrals.
10.	Find the volume using triple integrals.
11.	Find work done using Green's theorem.
12.	Find scalar potential using vectors.
13.	Evaluating integrals using Green's theorem, Gauss's and stoke's theorem.
14.	Use Laplace transform to solve differential equations.
15.	Use Laplace transform to solve integrals equations.

Text Books/References

1	P. N. Wartikar and J. N. Wartikar, Applied Mathematics (Volumes I and II), 7th Ed., Pune Vidyarthi Griha Prakashan, Pune, 2013.
2	B. S. Grewal, Higher Engineering Mathematics, 42th Ed., Khanna Publication, Delhi, 2017
3	B.V. Ramana, Higher Engineering Mathematics, 6th Ed., Tata McGraw-Hill, New Delhi, 2008.
4	E. Kreyszig, Advanced Engineering Mathematics, 10th Ed., John Wiley & Sons, Inc., 2015.
5	P. V. O'Neil Advanced Engineering Mathematics, 7th Ed., Cengage Learning, 2012.
6	M. Greenberg Advanced Engineering Mathematics, 2nd Ed., Pearson Education, 1998.

Syllabus for Unit Tests

Unit Test I	Units I, II, and III
Unit Test II	Units IV, V, and VI

Organic Chemistry- II

Designation: Basic Science

Pre-requisite Courses: Basic knowledge of chemistry

Teaching Scheme	**Examination Scheme**	**Credits Allotted**
Lectures : 4 Hours/Week	End Semester Examination : 60 Marks	Theory : 04
Practical : 2 Hours/ Week	Internal Assessment : 40 Marks	TW/OR/PR : 01
Total : 6 Hours / Week	Term-work (TW) : 25 Marks	Total Credits : 05
	Practical/Oral : 25 Marks	
	Total :150Marks	

Course Objectives:

To develop the interest among the students regarding chemistry and their applications in engineering

To develop confidence among students about chemistry, how the knowledge of chemistry is applied in technological field.

The student should understand the concepts of chemistry to lay the groundwork for subsequent studies in the field such as Chemical Engineering.

Course Outcomes:

After completion of the course students would be able to:

1	Understand the fundamentals of reaction kinetics for nucleophilic substitution reactions and apply the knowledge to determine reaction mechanisms.
2	Understand and apply the concept of reaction kinetics for elimination reactions and determine reaction mechanisms.
3	Explain and illustrate the knowledge about the synthesis of haloalkanes and haloarenes with its chemical reactions.
4	Explain the importance of ionic liquids with synthesis and structural determination of natural products.
5	Apply the knowledge about the synthesis, properties and uses of such heterocyclic compounds like pyrole, pyridine, thiophene and furan.
6	Illustrate the principles of organometallic chemistry and importance of synthesis reactions and their applications

Topics covered

UNIT-I	**Nucleophilic Substitution at saturated carbon** Introduction, Nucelophiles and leaving groups, Mechanism of nucleophilic substitution:-SN1 reaction: Kinetics and Mechanism. SN1 reaction: stereochemistry (Racemisation) The SN2 reaction: Kinetics and Mechanism. SN2 reaction: stereochemistry (Inversion) Comparison of SN1 and SN2 reaction.	**(08 Hours)**
UNIT-II	**Elimination Reactions and Aromatic substitution reactions** Introduction, Mechanism of 1, 2-elimination reactions, The E2 mechanism, Evidence for E2 mechanism, Orientation and reactivity in E2:- Saytzeff rule, Hoffmann elimination. E1 mechanism, Evidence for E1 mechanism, Orientation in E1 General mechanism of Electrophilic substitutions, Friedel-Crafts alkylation and acylation reactions, nitration, halogenations, sulphonation, chloro-sulphonation.	**(08 Hours)**
UNIT-III	**Haloalkanes and haloarenes** Alkyl halides: Methods of preparation, nucleophilic substitution reactions – SN1 and SN2 mechanisms and effect of solvent etc. Aryl halides: Methods of preparation-diazonium salts. nucleophilic aromatic substitution. Relative reactivity of alkyl,	**(08 Hours)**

	allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions. Nitro and amino arenes: General reactions, Basicity of aminoarenes	
UNIT-IV	**Ionic Liquids and Natural products** Ionic Liquids: Introduction to Ionic liquids, structure and formation of ionic liquids, Physical properties of ionic liquids. Natural Products: Terpenoids :- Introduction, Isolation and Purification Classification of Terpenoids, General methods for structure determination of Terpenoids, Isoprene rule. Alkaloids :- Introduction, Extraction and Purification General properties of Alkaloids, General methods for structure determination of Alkaloids.	**(08 Hours)**
UNIT-V	**Heterocyclic Compounds** Definition, classification and nomenclature of heterocyclic compounds. Five membered heterocyclic compounds - Furan, Thiophene and Pyrrole Structure and Method of synthesis, Properties and reactions, Electrophilic orientation. Six membered heterocyclic compounds – Pyridine, Structure and Method of synthesis, Properties and chemical reactions.	**(08 Hours)**
UNIT-VI	**Metal Organics** Introduction to Organometallic Chemistry: Metal- carbon bond formation, factors affecting M-C bond formation; Transition metal-π alkene complexes: synthesis, reactions, bonding and stability, Metal Organometallics: Organo-Lithium Compounds and Organo-Magnesium Compounds Applications of organometallic compounds: in catalytic processes such as hydroformylation and hydrogenation.	**(08 Hours)**

Assignments

Six assignments to be given by the subject teacher (Theory)-one from each unit/one mini project with report-students can work in group of 4 Maximum.

Project Based Learning

Following is the list topic for project based learning (Not Limited to) based on the syllabus contents:

1	Prepare and give the composition and role of chelating compounds in engineering applications.
2	Prepare a safe way to make surface disinfectant at home.
3	Write a review paper based on the role of alkaloids and derivatives in the cosmetic, food, and pharmaceutical industries and get it published in reputed journal (eg. Google Scholar).
4	With the help of extraction from rose petals/discharge essential oil. How to present and introduce rose petals essential oil products?
5	Prepare a model based on structure and formation of ionic liquids.
6	Write a review paper based on diazonium salts with nucleophilic aromatic substitution
7	In practice and get it published in reputed journal (eg. Google Scholar).

*Students in a group of 3 to 4 shall complete any one project from the above list.

Term Work

1	Determination of Rf values and identification of organic compounds.
	1) To prepare tribromobenzene from aniline.
	2) To prepare p-nitro aniline from acetanilide.
	3) To separate green leaf pigments by thin layer chromatography and determine their Rfvalues
2	Determine the type and performs functional group test for the given organic compounds-
	1) Aldehydes
	2) Ketones
	3) Phenols
	4) Carboxylic acids

	5) Esters
	6) Ethers
Text Books/ References:	
1	R. T. Morrison, R. N. Boyd and S K Bhattacharjee , Organic Chemistry, 7th Ed., Pearson Prentice Hall, Chennai, 2011
2	J. J. Li, C. Limberakis, D. A. Pflum, Modern Organic Synthesis, Oxford University Press, New York, 2007.
3	J. Clayden, N. Greeves, S. Warren, and P. Wothers, Organic Chemistry, Oxford University Press, 2009
4	P. Wasserscheid, T. Welton, Ionic Liquids in Synthesis, 2nd edition , Wiley-VCH, 2007
5	McMurry, J.E. Fundamentals of Organic Chemistry, 7thEd. Cengage Learning India Edition, 2013.
Syllabus for Unit Test:	
Unit Test : I	Units : I, II, and III
Unit Test : II	UNIT : IV, V, and VI

INORGANIC CHEMISTRY

Designation: Basic Science

Pre-requisite Courses: Basic knowledge of Chemistry, Types of bonding, Periodic Table.

Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lectures	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 04
Practical	: 02 Hours/Week	Continuous Assessment	: 40 Marks	Tutorial	: -
Total	: 05 Hours/Week	Term-work (TW)	: 25 Marks	Practical	: 01
		Practical/Oral	: 25 Marks	Total Credits	: 04
		Total	: 150 Marks		

Course Outcomes

1	Appraise the importance, formation and rearrangement of chemical bonding.
2	Infer the chemical bonding as per the molecular structure.
3	Justify the chemical bonding based on the properties of s, p, d, f elemental orbitals and chemistry of group IA, IIB, IIIB and VIIB.
4	Justify the importance of transition metal complexes and design their chemical interactions.
5	Appraise the importance, formation and rearrangement of chemical bonding based upon acid base chemistry.
6	Design a pathway for chemical transformation through chemical kinetics

Topics Covered

UNIT-I	**Chemical Bonding** Quantum mechanical methods in chemical bonding: molecular orbital theory, symmetry of molecular orbitals, MOs for homonuclear diatomic molecules, application of MO theory to heteronucleardiatomics, valence bond theory, hybridization, hybridization involving d orbitals, conjugated molecules, Huckel molecular orbital theory of conjugated systems, metallic bonding, band theory.	**(06 Hours)**
UNIT-II	**Chemical Bonding and Molecular structure** Orbital concept and its implications for periodicity and chemical reactivity, Lewis bonding and the derivation of Lewis structures, Octet rule and extensions to the octet rule, VSEPR theory, Valence Bond theory and hybrid orbitals, Molecular Orbital theory and delocalised orbitals.	**(06 Hours)**
UNIT-III	**s, p, d, f elements and chemistry of group IA, IIB, IIIB and VIIB** Periodic Table, s, p, d and f elements and their general properties, correlations among various properties. Main group Chemistry: Hydrogen, Chemistry of Group IA, II B and Group IIIB to VIIB elements and noble gases	**(06 Hours)**
UNIT-IV	**Transition Metal** Bonding in transition metal complexes: coordination compounds, crystal field theory, octahedral, tetrahedral and square planar complexes, crystal field stabilization energies, Jahn-Teller theorem, spectral and magnetic properties.	**(06 Hours)**

UNIT-V	**Acid-base and solution** Brønsted and Lewis acids, pH concept and pK values, Hydrolysis equilibria of weak acids and bases, Hydrolysis equilibria of polyprotic acids/bases, Speciation Diagrams, Hydrolysis equilibria in salt solutions, Buffers, Solubility and solubility product, Simple coordination (complex formation) equilibria, Simultaneous equilibria	**(06 Hours)**
UNIT-VI	**Chemical kinetics** Rate of reaction and rate laws, Elementary and non-elementary reactions, Empirical kinetics, First and second order reactions, Integral and differential evaluation, Isolation method, Initial rate method, Complex mechanisms, Parallel reactions, Reactions with equilibrium, Sequential reactions, Radical chain reactions, Derivation of a mechanistic rate law, Steady-state approximation, Quasi-equilibirium approximation, Reaction intermediates and transition states, Temperature dependence of rates (Arrhenius law).	**(06 Hours)**

Project based learning

- Prepare a hardware model based on Huckel molecular orbital theory of conjugated systems.
- With the help of Hydrolysis equilibria, select for study various salt solutions.
- Write a review paper based on applications of Bonding in transition metal complexes and get it published in reputed journal (eg. Google Scholar).
- With the help of, d and f elements and their general properties, prepare a model based on correlations among various properties,
- Prepare a hardware model based on VSEPR theory.
- Write a review paper based on applications of MO theory to heteronucleardiatomics and get it published in reputed journal (eg. Google Scholar).

*Students in a group of 3 to 4 shall complete any one project from the above list.

Term work

Term work will consist of the experiments listed below, which are to be performed in laboratory by the students

1	To determine the equivalent weight of the given metal (Zn or Mg) Eudiometrically.
2	To determine distribution coefficient of iodine between water and CCl_4.
3	To standardize Na_2SO_4 solution by preparing $K_2Cr_2O_3$& to estimate % of copper from given solution.
4	Heat of neutralization.
5	Thermodynamic parameters.
6	To determine loss in weight & percentage composition of $NaHCO_3$ by gravimetric method.
7	To determine water of crystallization of $MgSO_4.xH_2O$ by gravimetric method.
8	To determine water of crystallization of $BaCl_2$. xH_2O by gravimetric method.
9	Determine λ-max for $KMnO_4$ and find concentration of unknown solution by using colorimetric measurements.
10	Determine surface tension of a given liquid by stalagmometer.
11	Experiments based on chemical reaction equlibria
12	Experiments based on chemical reaction kinetics

13	Experiments based on electrolyte systems, acid- base and solution chemistry
14	Experiments based on surface andinterfacial phenomena
Text Books/References:	
1	C.E. Housecroft ,E.C. Constable, Chemistry, 4th Ed., Pearson - Prentice Hall, London, 2010.
2	J. D. Lee, Concise Inorganic Chemistry, Chapman & Hall, London, 1996.
3	J. A. C. Broekaert, Analytical Atomic Spectrometry withFlames and Plasmas, Wiley-VCH Verlag GmbH & Co. KGaA, New York, 2002
4	W. L. Jolly, Modern Inorganic Chemistry, McGraw-Hill International, 2nd Ed., New York, 1991.
5	J. E. Huheey, E.A. Keiter, R.L. Keiter, Inorganic Chemistry, Principles of Structure and Reactivity, Harper Collins, New York 1997.

Syllabus for Unit Tests	
Unit Test I	Units I, II, and III
Unit Test II	Units IV, V, and VI

BIOLOGICAL SCIENCES					
Designation: Professional Core					
Pre-requisite Courses: Biology, Chemistry					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lectures	: 3 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 4 Hours/ Week	Internal Assessment	: 40 Marks	TW/OR/PR	: 02
Total	: 7 Hours / Week	Term-work (TW)	: 25 Marks	Total Credits	: 05
		Practical/Oral	: 25 Marks		
		Total	: 150Marks		

Course Outcomes:

After completion of the course students would be able to:

1	Identify the microorganism and its structure.
2	Learn the basics of biochemistry.
3	Analyze the enzyme technology with different aspects.
4	Identify the biomaterials and their applications.
5	Learn the concept of Biodiversity and applications of biological science.
6	Analyze the Bio safety framework in India.

Topics covered

UNIT-I	**Molecular Cell Biology** Introduction to cell; Eukaryotes and prokaryotes; Classification of microorganisms and important cell types; Structures of the bacterial cell; Classification and Identification of microorganisms; Cultivation of bacteria; Reproduction and growth.	**(06 Hours)**
UNIT-II	**Biochemistry** Biological oxidations; Photosynthesis; Carbohydrates, lipids and their metabolism; Structure of biomolecules; Intra and intermolecular forces; Introduction to kinetics of biological systems.	**(06 Hours)**
UNIT-III	**Enzymes for Life Sciences** Classification of enzymes; Specificity of enzyme action; Factors modifying enzyme activity; Biotechnological applications of enzymes in various industries; Enzyme Immobilization.	**(06 Hours)**
UNIT-IV	**Bio-materials** Classification of biomaterials; Comparison of properties of some common biomaterials; Effects of physiological fluid on the properties of biomaterials; Biodegradable materials; Introduction to bio-materials in medicine.	**(06 Hours)**
UNIT-V	**Biodiversity and Applications of Biological science** Components of Biodiversity; Biodiversity crisis and biodiversity loss, Importance of biodiversity in daily life; Biodiversity and climate change; Biofuel; Bio fertilizers; Biocides; Application in food industry.	**(06 Hours)**
UNIT-VI	**Biosafety-regulatory Framework in India** Food Adulteration Act (1955), Standard safety methods for handling microorganisms; National Environment Policy (2006); Storage of hazardous microorganisms/genetically engineered organisms or cells; Case studies for	**(06 Hours)**

	handling of various microorganisms.	
***Project Based Learning**		
1	Identification of microorganisms according to structure of bacterial cell	
2	Learn to cultivate bacteria	
3	Analyze enzyme applications in medical field	
4	Analyze enzyme applications in chemical engineering	
5	Analyze enzyme applications in food industry	
6	Illustration of Biomaterial applications in medical field	
7	Learn the concept of Biodiversity and climate change	
8	Analyze application of biofuel	
9	Analyze application of biocides in agricultural industry	
10	Learn handling of microorganisms at various conditions	
*Students in a group of 3 to 4 shall complete any one project from the above list.		
Term Work		
Term work will consist of the experiments listed below, which are to be performed in laboratory by the students.		
1	Enzyme catalysis	
2	Enzyme activity assay	
3	Yeast fermentation	
4	Enzyme concentration	
5	Substrate concentration effect on enzyme activity	
6	Temperature effect on enzyme activity	
7	Effect of pH on enzyme activity	
8	Effect of inhibitors on the enzymatic activity	
9	Effect of inhibitors on the enzyme activity	
Text Books/References:		
1	Bruce A. Alexander J. Julian L., Martin R. Keith R. and Peter W.: "Molecular Biology of the Cell", 5th Edition, CRC Press, India.	
2	Paul D.: "Physics in Biology and Medicine", 3rd Edition, Academic Press, USA.	
3	Colin R. Bjorn K. : "Basic Biotechnology", 3rd Edition, Cambridge University Press, UK	
Syllabus for Unit Test:		
Unit Test : I	Units : I, II, and III	
Unit Test : II	UNIT : IV, V, and VI	

MATERIAL AND ENERGY BALANCE CALCULATIONS

Designation: Professional Core

Course Pre-requisites: Basic knowledge of chemistry

Teaching Scheme	**Examination Scheme**	**Credits Allotted**
Lectures : 04 Hours/Week	End Semester Examination : 60 Marks	Theory : 04
Total : 04 Hours/Week	Internal Assessment : 40 Marks	Total Credits : 04
	Total : 100 Marks	

Course Outcomes:

1	Solve problems based on basic chemical calculations with considering the concepts of units and dimensions.
2	Estimate material balance calculations without chemical reaction for the systems involved in various unit operations.
3	Estimate material balance calculations involving chemical reaction for the unit processes carried out in chemical industry.
4	Elaborate the concept of recycle, bypass, purge operations and solve problems based on humidification, recycle, bypass and purge operations.
5	Interpret the concept of energy balance and solve the problems based on energy balance calculations.
6	Evaluate gross and net calorific values of fuel and solve the problems based on them.

Topics covered

UNIT-I	**Basic Chemical Calculations** Units and dimensions;Mole, atomic mass, and molar mass concept; Gas mixtures; Gas –liquid mixtures; Joule Thomson effect; Basic composition calculations for homogeneous two phase and three phase systems.	**(08 Hours)**
UNIT-II	**Material Balances without Chemical Reactions** Generalized law of conservation of mass; Mass conservation without chemical reaction; Mass balances for unit operations encountered in chemical process industry : Distillation, extraction, evaporation, crystallization, blending etc.	**(08 Hours)**
UNIT-III	**Material Balances involving Chemical Reactions** Generalization of law of conservation of mass involving chemical reaction and its simplification; Chemical equations and stoichiometry; Basic concepts: conversion, yield, selectivity; Material balance for unit processes encountered in chemical process industry: nitration, esterification, acylation, sulfonation etc.	**(08 Hours)**
UNIT-IV	**Recycle, Bypass and Purge Operations** Necessity of recycle, bypass and purge streams; Basic calculations of recycle, bypass and purge streams for unit operations and unit processes; Industrial examples of recycling, bypassing and purging with complete mass balance viz. biofuel synthesis, food processing etc.; Humidification operation**.**	**(08 Hours)**
UNIT-V	**Energy Balance** Basic concepts; Heat capacity; Sensible heat and latent heat: Clausius-Clapeyron equation; Standard heat of formation, combustion and reaction; Hess's law; General equation of energy balance; Energy balance approach and calculations for exothermic and endothermic reactions with industrial examples; Steam table and its utility; Utility energy balance calculations; Simultaneous heat and energy balance; Humidification operation**.**	**(08 Hours)**

UNIT-VI	**Fuels and Combustion** Types of fuels: solid, liquid and gas; Calculations of energy content of fuel; Analysis of fuel; Oxygen requirement and excessity; Adiabatic flame temperature calculations; Endothermic and exothermic reaction; Energy analysis and calculations.	**(08 Hours)**

Project Based Learning:	
1.	Investigate and prepare a report on mass and energy balance for any one of following unit operations for given system.
	a) Distillation
	b) Evaporation
	c) Extraction
	d) Crystallization
	e) Drying. etc
2.	Investigate and prepare a report onmass and energy balance for any one of following unit processes for given system. It may include overall energy and/or mass balance over a given chemical process equipment.
	a) Nitration
	b) Esterification
	d) Fermentation
	e) Sulfonation etc.
3.	Visit chemical industry and prepare a detailed report on various unit operations and unit processes used in industry along with their mass and energy balance.
4.	Measure the calorific values of any two types of fuel and prepare an assessment on the factors affecting calorific value.
5.	Prepare an report and present the mass and energy balance for unit operations and unit processes with chemical reaction carried out in chemical industry.
6.	Solve last five years GATE question papers with reference to material and energy balance calculations.
7.	Students have to study any five NPTEL videos related to material and energy balance calculations and prepare/present power point presentation.
8.	Technical interview based on knowledge of material and energy balance calculations.
9.	Prepare models for recycle, bypass and purge operations carried out in chemical industry.
10.	With the help of this subject knowledge, write a report on how you would apply your concepts in industry.
11.	Prepare a report on unit operations which are newly introduced in the current year.
12.	Write a report on your visit to research and development laboratory of national/international repute.
Students in a group of 3 to 4 shall complete any one project from the above list. In addition to these above stated topics concern faculty member may design his/her won topics.	

Text Books/References:	
1.	B. I. Bhatt and S. M. Vora, Stoichiometry (SI Units), 5thEd., Tata McGraw Hill Publishers, New Delhi, 2010.
2.	D. M. Himmelblau, Basic Principles and Calculations in Chemical Engineering, 8th Ed. Prentice Hall Publications, 2015.
3.	O. A. Hougen, K. M Watson and R. A. Ragatz, Chemical Processes Principles, Part-I, Material and Energy Balances, Asia Publishing House, Bombay, 2004.

4.	R.M. Felder and R.W. Rousseau, Elementary Principles of Chemical Processes, 3rd edition, John Wiley & Sons Publications, 2005.
5.	D. F. Rudd, G. J. Powers and J. F. Sirola, Process Synthesis, Prentice Hall Publications.
6.	S.D. Shukla and G. N. Pandey, Chemical Engineering Calculations, Lion Press, Kanpur.
7.	W.E. Ranz, Describing Chemical Engineering Systems, McGraw Hill Publications, 1970.

Syllabus for Unit Test:	
Unit Test -I	UNIT – I ,II,III
Unit Test -II	UNIT – IV,V,VI

JAVA PROGRAMMING		
Designation: Computing		
Pre-requisite Courses: Basic knowledge of computer fundamentals, C/C++ programming.		
Teaching Scheme	**Examination Scheme**	**Credits Allotted**
Practical : 04 Hours/Week	TW : 50 Marks	TW/OR/PR : 02
	Practical/Oral : 50 Marks	Total Credits : 02
	Total : 100 Marks	

Course Outcomes	
1	Elucidate basic OOPs concepts and requirement of Java
2	Clarify class fundamentals
3	Apply OOPs concept using inheritance
4	Elucidate runtime exceptions
5	Comprehend reading and writing files in java
6	Clarify collection of objects with searching and sorting.

Topics Covered	
UNIT-I	**Introduction to Java** : OOPs concepts; Need of Java; Java Virtual Machine (JVM); Java Development Kit (JDK); byte code; variable; Data types, Handling strings, arrays, operators, and control flow statements: command line arguments, Automatic type promotion. 1. Programs based on if-else, switch-case statements. 2. Programs based on loop statements. 3. Programs based on arrays.
UNIT-II	**Class Fundamentals:** Java classes and objects; Methods and constructors; 'this' keyword; Method accepting and returning objects; Method overloading and constructor overloading; static and final keywords; Nested classes. 4. Programs based on method accepting and returning objects. 5. Programs based on method overloading and constructor overloading. 6. Programs based on object arrays.
UNIT-III	**Inheritance:** Simple inheritance; Member access in inheritance; super class variable can refer subclass object; super keyword; Multilevel hierarchy of inheritance; Method Overriding; Dynamic method dispatch (Run time polymorphism); Abstract classes; Interfaces; DMD using abstract classes and interfaces; Interfaces can be extended; final keyword to restrict inheritance; Creating packages. 7. Programs based on multilevel hierarchy of inheritance. 8. Programs based on super keywords. 9. Programs based on dynamic method dispatch (DMD).
UNIT-IV	**Exception handling:** Exception introduction; Uncaught exception; try-catch blocks; Describing an exception; 'throw' keyword; 'throws' keyword; finally keyword; Manual exception. 10. Programs based on dynamic method dispatch using abstract classes and interfaces 11. Programs based on manual exception.

	12. Programs based on Buffered Reader class.
UNIT-V	**IO Mechanism:** Byte stream; Character stream; Reading data from console: BufferedReader, DataInputStream class; Reading and writing files: FileInputStream and FileOutputStream class. 13. Programs based on DataInputStream class. 14. Programs based on FileInputStream class. 15. Programs based on File Output Stream class.
UNIT-VI	**Collection Framework:** Equals ( ) and hashCode ( ) methods, instanceof operator; Lists; Sets; Maps; Sorting and searching. 16. Programs based on Sorting. 17. Programs based on searching.

In addition to these above stated programs / practicals concern faculty member may design his/her own programs / practicals.

Term Work

Term work will consist of the programs/practicals listed above, out of which any ten programs/practicals are to be performed in laboratory by the students.

Text Books/References

1	H. Schildt, Java 2 Complete Reference, 5th Edition, Tata Mc-Gra Hill.
2	SCJP 1.6 – Khalid Mughal.
3	SCJP 1.6 – Kathy Sierra.
4	JAVA 7 Programming, Black Book ,Kogent Learning Solutions Inc.
5	K. Arnold, J. Gosling, D. Holmes, The Java Programming Language, 3rd Edition, Sun Microsystems.
6	A Primer, E. Balaguruswamy, Programming with Java, Tata Mc-Graw Hill Companies.
7	P. Naughton, H. Schildt, The complete reference Java 2 Third Edition, TMH publication.