Bharati Vidyapeeth (Deemed to be University)

College of Engineering, Pune

Faculty of Engineering and Technology

Department of Chemical Engineering

B. Tech. (Chemical) Curriculum Structure (2023 Course)

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

B. Tech. (Chemical): Semester –I (2023 COURSE)

Sr. No.	Category	Course Code	Course	Teaching Scheme			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1	BSC		Engineering Mathematics- I	3	-	1	60	40	-	-	-	100	3	-	1	4
2	BSC		Engineering Chemistry	3	2	-	60	40	50	-	-	150	3	1	-	4
3	ESC		Computer Aided Engineering Graphics	4	2	-	60	40	50	-	-	150	4	1	-	5
4	PCC		Analytical Techniques	4	2	-	60	40	50	-	-	150	4	1	-	5
5	PCC		Chemical Engineering (Scope and Significance)	4	-	-	60	40	-	-	-	100	4	-	-	4
6	HSMC		Communication Skills	-	2	-	-	-	50	-	-	50	-	1	-	1
7	SBC		Skill Based Course-I: Computer Programming- I	-	4	-	-	-	25	-	25	50	-	2	-	2
Total				**18**	**12**	**1**	**300**	**200**	**225**	**-**	**25**	**750**	**18**	**6**	**1**	**25**

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

B. Tech. (Chemical): Semester –II (2023 COURSE)

Sr. No.	Category	Course Code	Course	Teaching Scheme			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1	BSC		Engineering Mathematics- II	3	-	1	60	40	-	-	-	100	3	-	1	4
2	BSC		Engineering Physics	3	2	-	60	40	50	-	-	150	3	1	-	4
3	PCC		Biological Sciences	4	2	-	60	40	50	-	-	150	4	1	-	5
4	PCC		Mechanical Operation	4	2	-	60	40	50	-	-	150	4	1	-	5
5	PCC		Material and Energy Balance Calculations	4	-	-	60	40	-	-	-	100	4	-	-	4
6	HSMC		Universal Human Values	-	2	-	-	-	50	-	-	50	-	1	-	1
7	SBC		Skill Based Course – II: Computer Programming- II	-	4	-	-	-	25	-	25	50	-	2	-	2
Total				**18**	**12**	**1**	**300**	**200**	**225**	**-**	**25**	**750**	**18**	**6**	**1**	**25**

Bharati Vidyapeeth (Deemed to be University)

College of Engineering, Pune

Faculty of Engineering and Technology

Department of Chemical Engineering

B. Tech. (Chemical) Curriculum: Syllabi of First Year Courses

Programme: B. Tech Chemical (2023 Course)

Semester- I (Chemical)

ENGINEERING MATHEMATICS -I					
Designation: Basic Science					
Pre-requisite Courses: Algebra of matrices and its Determinants, Maxima and Minima of single variable functions					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lecture	: 03 Hours/Week	End Semester Examination	: 60 Marks	Lecture	: 03
Tutorial	: 01 Hours/Week	Internal Assessment	: 40 Marks	Tutorial	: 01
Total	: 04 Hours/Week	Total	: 100 Marks	Total	: 04

Course Outcomes	
1	Understand rank of matrix and apply it to solve system of line arc equations
2	Understand the DeMoiver's theorem, hyperbolic functions and apply it in engineering problems.
3	Understand the Leibnitz's rule and apply it to find nth derivative of a function.
4	Understand fundamental concepts of convergence, divergence of infinite series and its tests.
5	Understandtheconceptofpartialdifferentiationandapplyittofindtotalderivative.
6	Evaluate the maxima and minima of any two variables functions..

Topics Covered		
UNIT-I	**Matrices** Rank, Normal form, System of Linear Equations, Linear Dependence and Independence, Linear and Orthogonal Transformations, Eigen values, Eigen Vectors, Cayley – Hamilton Theorem.	**(06 Hours)**
UNIT-II	**Complex Numbers and Applications** Definition, Cartesian, Polar and Exponential Forms, Argand's Diagram, 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	**(06 Hours)**
UNIT-III	**Differential Calculus** Successive Differentiation, nth Derivatives of Standard Functions, Leibnitz's Theorem Expansion of Functions: Taylor's Series and Maclaurin's Series	**(06 Hours)**
UNIT-IV	**Differential Calculus** Indeterminate Forms, L' Hospital's Rule, Evaluation of Limits. Infinite Series: Infinite Sequences, Infinite Series, Alternating Series,Tests for	**(06 Hours)**

	Convergence, Absolute and Conditional Convergence, Power series, Range of Convergence	
UNIT-V	**Partial Differentiation and Applications** Partial Derivatives, Euler's Theoremon Homogeneous Functions, Implicit functions, Total Derivatives, Change of Independent Variables, Errors and Approximations.	**(06 Hours)**
UNIT-VI	**Jacobian** Jacobians and their applications, Chain Rule, Functional Dependence. Maxima and Minima: Maxima and Minima of Functions of two variables, Lagrange's method of undetermined multipliers.	**(06 Hours)**

Project Based Learning	
1	Echelon form
2	Normal form
3	Linear and orthogonal transformation
4	Eigen values and eigen vectors
5	Argand diagram
6	De Movre’st heorem
7	Hyperbolic and logarithmic functions
8	Leibnitz theorem
9	Taylor’s theorem
10	L’Hospital rule
11	Tests for convergence
12	Euler theorem for homogeneous functions
13	Total derivative
14	Maxima and minima for two variable function
15	Langrage undetermined multipliers

Text Books/References	
1	Applied Mathematics (Volumes I and II) by P. N. Wartikar & J. N. Wartikar (Pune Vidyarthi Griha Prakashan, Pune),7thEdition,1988,Reprint 2010
2	Higher Engineering Mathematics by B.S. Grewal (Khanna Publication, Delhi),42th Edition,2012
3	Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill),Edition,2008
4	Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.), 8th Edition,1999,Reprint2010
5	Advanced EngineeringMathematics,7e,byPeterV.O'Neil(ThomsonLearning),Edition 2007
6	Advanced Engineering Mathematics, 2e,byM.D.Greenberg(Pearson Education),2nd,Edition, 2002

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

ENGINEERING CHEMISTRY					
Designation: Basic Science					
Pre-requisite Courses: Basic chemistry, Basic electrochemistry and chemistry of materials					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lecture	: 03 Hours/Week	End Semester Examination	: 60 Marks	Lecture	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours/Week	Term Work	: 50 Marks	Total	: 04
		Total	: 150 Marks		

Course Outcomes	
1	Understand the different methods of analysis of water, different environmental pollutants and importance of green chemistry
2	Understand the importance of fuels and apply it for various engineering applications.
3	Explain the drawbacks of corrosion and different methods of elimination of corrosion
4	Apply the concept of polymer to study advanced materials.
5	Apply the basic concept of chemistry to explain the chemical properties and processes of materials of nanoscale
6	Understand the instrumental analysis helpful for various engineering applications

Topics Covered		
UNIT-I	**Water Technology & Green Chemistry** Introduction, sources and impurities in water, Hardness of water, types, and determination of hardness using EDTA titration, softening of hard water by ion- exchange process. Numerical problems on hardness of water. Major environmental pollutants, Basic principles of green chemistry. Atom economy, Synthesis ofadipic acid, Industrial applications of green chemistry, Numerical problems on Atom economy	**(06 Hours)**
UNIT-II	**Electrochemical energy and solar energy** Fuels: Introduction, Definition, importance of fuels, calorific value, types, fluidized bed catalytic cracking, knocking(Petrol engine), mechanism and its ill effects, biodiesel, power alcohol, octane and cetane number.Solar Energy: Introduction, construction, working and applications of photovoltaic cell.	**(06 Hours)**
UNIT-III	**Corrosion technology and it's control** Introduction, Electrochemical theory of corrosion, Types of corrosion, Differential metal and differential aeration (pitting and water line) caustic	**(06 Hours)**

	embrittlement. Factors affecting the rate of corrosion, Corrosion control: Cathodic protection, sacrificial anode and impressed current methods, Metal coatings, Galvanization and tinning, Anodizing, Anodizing of aluminium, Organic coatings: Paint and varnishes. Metal finishing: Introduction, Technological importance. Principles of electroplating. Electroplating of chromium. Electro less plating: Introduction, electro less plating of nickel & copper on PCB with applications	
UNIT-IV	**Engineering Materials and Technology** Polymers: Introduction, classification, Synthesis and applications of Polyurethane, polycarbonates, Conducting Polymers: Synthesis & Mechanism of conduction in poly aniline. Composites: Introduction, constitution, classification. Types: fiber glass, hybrid and reinforced Composites with applications.	**(06 Hours)**
UNIT-V	**Nano materials** Introduction, size dependent properties (Surface area, Electrical, Optical, Catalytic and Thermal properties). Synthesis of nano materials: Top down and bottom up approaches, Synthesis by Sol-gel, precipitation and chemical vapour deposition, Nano scale materials: Fullerenes, Carbon nano tubes and graphenes – properties and applications.	**(06 Hours)**
UNIT-VI	**Instrumental methods of analysis** Introduction, Theory, Instrumentation and applications of colorimetry, pH metry, conductometry Introduction to spectroscopy, principles and applications of UV/Vis.Spectroscopy	**(06 Hours)**

Project Based Learning	
1.	Comparison of Hardness, Alkalinity, Dissolved oxygen, Chlorides and COD of water from two different sources
2.	Removal of industrial pollutants from wastewater by adsorption on activated charcoal
3.	Preparation of biofuels from two natural sources
4.	Two synthetic approaches for the production of H_2 as a clean fuel
5.	Prevention of corrosion by metal coupling
6.	Construction of bio sensor in engineering applications
7.	Design and simulation of automatic solar - photo voltaicpanels as renewable energysource.
8.	Synthesis of Conjugated Polymers and Molecules Using Sugar Reagents and Solventless Reactions. OR Composite materials and it properties, applications and types
9.	To study mechanism of lubrication
10.	Electroplating- study on how different metals can be used and the practical applications
11	Prepare Ag- nanoparticles by using sol-gel method
12	Preparation of Ag nanoparticle from two natural sources

13	With the help of green chemistry principles, prepare any organic dye by using Traditional and Green pathway.
14	Prepare epoxy resins by using suitable metho
15	Measurement and effect of waste disposal from laboratories in the college
Practicals **(Any Eight of the Following)**	
1.	Determination of Hardness of water sample by EDTA method
2.	To determine strength of acid by pH – metric Titration
3.	To measure the strength of acid by conductometric titration
4.	Measurement of Surface tension of a given liquid by Stalgmometer.
5.	To determine alkalinity water sample.
6.	Estimation of the given amount of copper in the given solution by colorimetry
7.	Synthesis of conducting polyaniline from aniline by oxidative polymerization
8.	Determination of iron content in the given solution by Mohr's method
9.	To determine the strength of given acid solution by titrating it against base solution using indicator
10.	Determination of reaction rate, order and molecularity of hydrolysis of ethyl acetate
11	Verification of Beer-Lambert's Law.
12	Determination of Viscosity of Liquids by Ostwald's Viscometer
13	Determination Of Chloride Content Of Water By Argentometry
14	Estimation of copper from brass by iodometry
15	To study set up of Daniel cell.
Text Books/References	
1	Engineering Chemistry, Jain P.C & Jain Monica,Dhanpat Rai & Sons, Delhi (1992)
2	Engineering Chemistry, O. G. Palanna, Tata McGraw-Hill Publication, New Delhi
3	A textbook of Engineering Chemistry, S. S. Dara, McGraw-Hill Publication, New Delhi
4	Engineering Chemistry- Fundamentals and applications, Shikha Agarwal,Cambridge Publishers (2015)
5	Polymer Science and technology (2nd Edition), P. Ghosh, Tata McGRAW Hill, (2008)
6	Principles of Instrumental Analysis, Douglas A. Skoog, F. James Holler,Stanley R. Crouch,Cengage learning (2017)
7	Polymers: Chemistry & Physics of Modern Materials (2nd edition) J.M.G.Cowie, Blackie, Academic & Professional(1994)
8	Integrated design and operation of water treatment facilities, Kawamura, Susumu. John Wiley & Sons(2000)
Syllabus for Unit Tests	

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

COMPUTER AIDED ENGINEERING GRAPHICS					
Designation: Engineering Science Course					
Pre-requisite Courses: Basics of Mathematics at Secondary School Level					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lecture	: 04 Hours/Week	End Semester Examination	: 60 Marks	Lecture	: 04
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 06 Hours/Week	Term Work	: 50 Marks	Total	: 05
		Total	: 150 Marks		

Course Outcomes	
1	Understand dimensioning methods and drawing of engineering curves
2	Draw orthographic projections using 1st angle method of projection
3	Draw Isometric views from given orthographic projections
4	Draw projection of points, lines and planes.
5	Draw projection of different solids
6	Draw development of lateral surfaces of 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 Directrix Focus Method, Arc of Circle Method and Concentric Circle Method, In volutes of acircle, Cycloid, Archimedean Spiral, Helixon cone and Cylinder. Fundamentals of Computer Aided Drafting(CAD) and its applications, Various software's for Computer Aided Graphics/Drafting. AutoCAD initial setting and AutoCAD commands	**(08 Hours)**
UNIT-II	**Orthographic Projections** Basic principles of orthographic projection (First and Third angle method). Orthographic projection of objects by first angle projection method only. Procedure for preparing scaled drawing, sectional views and types of cutting planes and their representation, hatching of sections.	**(08 Hours)**
UNIT-III	**Sectional Orthographic Projections** Types of Sections, Sectional orthographic Projection.	**(08 Hours)**
UNIT-IV	**Isometric Projections** Isometric view, Isometrics cale to draw Isometric projection, non-isometric	**(08 Hours)**

	lines, and construction of isometric view from given orthographic views and to construct isometric view.	
UNIT-V	**Projections of Points, Lines, Planes and Solids** Projections of points, projections of lines, lines inclined to one reference plane, lines inclined to both reference planes. (Lines in First Quadrant Only). Projection of prism, pyramid, cone and cylinder by rotation method	**(08 Hours)**
UNIT-VI	**Development of Lateral Surfaces** Development of the lateral surfaces of solids like prisms, pyramids, cylinders and cones.	**(08 Hours)**

Project Based Learning	
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.

Assignments: Minimum five problems on each unit in A3 size Drawing Book

Term Work

Term Work shall consist of **seven** A_2 size (594mm×420 mm) sheets by hand and 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 Lines and planes
6	Projection of Solids
7	Development of Lateral surfaces

Text Books/References	
1	“Elementary Engineering Drawing”, N.D. Bhatt, Charotar Publishing house, An and India.
2	“Text Book on Engineering Drawing”, K. L. Narayana &P .Kannaiah, Scitech Publications, Chennai.
3	“Fundamentals of Engineering Drawing”, Warren J. Luzzader, Prentice Hall of India, NewDelhi
4	“Engineering Drawing and Graphics”, Venugopal K., New Age International publishers
5	M.B.Shahand B.C.Rana, "Engineering Drawing",1st Ed,PearsonEducation,2005
6	P.S.Gill, "Engineering Drawing (Geometrical Drawing)",10 Edition,S.K.KatariaandSons,2005
Syllabus for Unit Tests	
Unit Test I	Units I, II, and III
Unit Test II	Units IV, V, and VI

ANALYTICAL TECHNIQUES					
Designation: Professional Core					
Course Pre-requisites: Chemistry, Physics					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lecture	: 04 Hours/Week	End Semester Examination	: 60 Marks	Lecture	: 04
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 06 Hours/Week	Term Work	: 50 Marks	Total	: 05
		Total	: 150 Marks		

Course Outcomes	
After completion of the course students will be able to	
1.	Determine the need for analysis and select the method of analysis
2.	Analyse the samples using chromatographic methods and define its content and concentration
3.	Analyse the samples using spectroscopic methods and define its content and concentration
4.	Analyse the samples for carbon, fluoride ion content and define its flow properties
5.	Analyse water and fuel samples for properties and composition
6.	Analyse the samples for surface properties and particle size

Topics Covered		
Unit I	**Introduction and basics of analysis** Need of analysis, Determination and Measurement, Analysis principle; Classifying Analytical Techniques, Criteria of selection; Qualitative and quantitative results, Accuracy, Precision, Sensitivity, Selectivity, Robustness and Ruggedness, Scale of Operation, Equipment, Time, and Cost, Making the Final Choice	**(08 Hours)**
Unit II	**Chromatographic Analysis** ***a) Gas Chromatography*** Analysis principle; Criteria of selection; Preparation of samples; Selection of eluent and detector; Temperature programming; Elution conditions; Standardization and calibration; Sample analysis: Qualitative and quantitative results ***b) High Precision Liquid Chromatography*** Analysis principle; Criteria of selection; Preparation of samples; Selection of eluent and detector; Selection of elution conditions; Standardization and calibration; Sample analysis: Qualitative and quantitative results ***c) Gel Permeation Chromatography***	**(08 Hours)**

	Analysis principle; Criteria of selection; Preparation of samples; Selection of eluent and detector; Selection of elution conditions; Standardization and calibration; Sample analysis: Qualitative and quantitative results	
Unit III	**Spectrographic analysis** Analysis principle and limitations of spectroscopic analysis, calibration and standardization ***UV-visspectrophotometry:***Beart- Lamberts law; Preparation of samples; Dilutions; Standardization and calibration; Sample analysis: Qualitative and quantitative assessment ***Fourier Transfer Infrared Spectroscopy:*** Preparation of samples; KBr palate formation; Film analysis; Powder analysis; Interpretation of data: Sample analysis ***Raman Spectroscopy:*** Principle of analysis, Importance of data, data interpretation ***X-Ray Diffraction:*** Principle of analysis, Importance of data, data interpretation	**(08 Hours)**
Unit IV	**Carbon and Fluoride Ion analysis** Selection of methods for analysis; Preparation of samples; Standardization; Analysis and interpretation **Viscometry analysis** Redwood and plate and cone type viscometers: Measurement principle; Sample Analysis; **Nuclear Magnetic Resonance Ion analysis** Principle, Selection of methods of solvent, Preparation of samples; Standardization; Analysis and interpretation	**(08 Hours)**
Unit V	**Fuel Analysis:** Bomb calorimetry; Flash point analysis; Fire point analysis; Coal analysis: Ultimate and proximate analysis; Moisture content measurement by Karl Fisher titration: Standardization and data analysis. **Water Analysis:**Concept of Biological oxygen demand (BOD), Chemical oxygen demand (COD), Total Organic Carbon (TOC) and heavy metal content analysis; Sample analysis	**(08 Hours)**
Unit VI	**Surface and particle analysis:** ***Particle size analysis:*** Principle; Preparation of solution or dispersion; Sample analysis ***Atomic forced microscopic analysis:*** Principle; AFM analysis. ***Electron microscopic analysis:*** Scanning Electron microscopy, Transmission electron microscopy, Energy-dispersive X-ray spectroscopy, Principle, Sample preparation, data generation and interpretation	**(08 Hours)**
Term Work		

Term work will consist of the experiments listed below, out of which at least eight experiments should be performed in laboratory by the students.	
1	Viscosity analysis of oils and polymer solution
2	UV spectroscopic analysis of inorganic salts
3	Determination of concentration of solution by UV spectroscopic methods
4	GC analysis to determine organic and aqueous contents
5	HPLC analysis for determination pf PEG and salts
6	Proximate and ultimate analysis of coal
7	Calorific value measurement of fuels
8	Acid value measurement of fuels
9	FTIR analysis and determination of compatibility of polymer films
10	Electron microscopic analysis of polymer films to determine compatibility and composition
11	AFM analysis of polymer films and nanoparticle content determination
12	Particle size measurement and determination of particle size variation in given sample
13	Determination of emulsion compatibility and droplet size in given dispersion
Project Based Learning:	
1	Prepare a short report on food industry samples analysis
2	Group discussion on importance of analysis in pharmaceutical industry and their method selection
3	Collection of water samples from various locality and make its complete analysis
4	Collection of fuel samples from various sources and provide its complete analysis
5	Prepare some polymers composites and make a complete formation report with details analytical studies
6	Prepare a short report on paint industry samples analysis
7	Prepare a short report on sugar industry samples analysis
8	Prepare a short report on dairy samples analysis
9	Prepare a short report on fertilizer industry samples analysis
10	Prepare a short report on municipal corporation waste samples analysis
The analytical methods and their applications would be defined along with background information, principal and application determination, limitation and applications	
Text Books/ References:	
1	I. M. Kolthoff, J. D. Winefordner, M. M. Bursey: Treatise on Analytical Chemistry, Part 1 Vol. 11: Theory and Practice, 2nd Ed., Wiley and Sons, New York, 1989
2	J. A. C. Broekaert: Analytical Atomic Spectrometry withFlames and Plasmas, Wiley-VCH Verlag GmbH & Co. KGaA, New York, 2002
3	G. D. Christian, P. K. Dasgupta, K. A. Schug: Analytical Chemistry, John Wiley & Sons, Inc.,

	Danvers, 2014
4	D. Harvey: Modern Analytical Chemistry, McGraw-Hill Higher Education, Kingsport, 2000
5	J. Mendham, A. Vogel: Vogel's Textbook of Quantitative Chemical Analysis, 6th Ed., Addison Wesley Publishing Co., Boston, 2000

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

CHEMICAL ENGINEERING (SCOPE AND SIGNIFICANCE)					
Designation: Professional Core					
Course Pre-requisites: Chemistry and Physics					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lecture	: 04 Hour /Week	End Semester Examination	: 60 Marks	Lecture	: 04
Total	: 04 Hour /Week	Internal Assessment	: 40 Marks	Total	: 04
		Total	: 100 Marks		
Course Outcomes					
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 Othmer Encyclopaedia of Chemical Technology, 4th Ed, Jonh Wiley and Sons, New York, 2000
2	F.Ullmann: Ullmann's Encyclopaedia 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

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

COMMUNICATION SKILLS					
Designation: Humanities/Social and Management					
Pre-requisite Courses: Basic English grammar, Basic information of sound system of English language.					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Practical	: 02 Hours/Week	Term Work	: 50 Marks	Practical	: 01
Total	: 02 Hours/Week	Total	: 50 Marks	Total	: 01

Course Outcomes	
1	Understand and construct the error free sentences of English language and do implementation of it in the spoken and written business communication
2	Understand and apply the sounds of English language for correct pronunciation
3	Understand and develop the ability to enhance sound vocabulary for effective communication
4	Understand communication process and principles to do applications in business communication
5	Understand the techniques of writing skills and apply them in appropriate context and domain
6	Create effective business presentation and do effective implementation of it through activities

Topics Covered		
UNIT-I	**English grammar** Application of Basic Grammar: Articles, Prepositions, Tenses, Subject-verb agreement, Use of phrases & Clauses in sentences, Common errors	**(04 Hours)**
UNIT-II	**Phonetics/study of sounds in English** Introduction to phonetics, study of speech organs, study of phonetic script, transcriptions of words, articulation of different sound in English, reducing MTI, stress and intonation	**(04 Hours)**
UNIT-III	**Vocabulary Enrichment** Ways of word formation, Foreign phrases, One word substitutions, Synonyms & antonyms, Words often confused, Indian English words, Usage of idioms & phrases. GRAS-PT formula	**(04 Hours)**
UNIT-IV	**Communication Skills** Introduction, forms and function of communication process, non-verbal codes in communication, Importance of listening skills, Listening V/s hearing, Types of listening, Barriers to communication and listening, Importance of LSRW skills in communication	**(04 Hours)**
UNIT-V	**Presentation skills** Designing effective presentation, understanding theme, developing content	**(04 Hours)**

	and layout of presentation, use of tone and language, technological tools for effective presentation	
UNIT-VI	**Technical Writing Skills** The mechanics and principles of written communication, Technical Communication, Need and Importance, technical report writing;, email writing, , notice, agenda, minutes of meeting writing. Use of technology in technical writing	**(04 Hours)**

Text Books/References

1	Business Communication by Meenakshi Raman, Prakash Singh published by Oxford University press, second edition,
2	Spoken English- A manual of Speech and Phonetics by R. K. Bansal, J. B. Harrison published by Orient Blackswan
3	Technical Communication by Meenakshi Raman, Sangeeta Sharma published by Oxford University press
4	Developing Communication Skills by Krishna Mohan, Meera Banerji published by Macmillan India Pvt Ltd

Recommended web-links for enhancing English language and business communication
http://www.bbc.co.uk/worldservice/learningenglish
http://www.englishlearner.com/tests/test.html
http://www.hodu.com/default.html
http://www.communicationskills.co.in/index.html

COMPUTER PROGRAMMING - I					
Designation: Skill Based					
Pre-requisite Courses: Basic knowledge of computers					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Practical	: 04 Hours/Week	Term Work	: 25 Marks	Practical	: 02
Total	: 04 Hours/Week	Oral	: 25 Marks	Total	: 02
		Total	: 50 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 (2023 Course)
Semester- II (Chemical)

ENGINEERING MATHEMATICS -II					
Designation: Basic Science					
Pre-requisite Courses: Differential calculus					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lecture	: 03 Hours/Week	End Semester Examination	: 60 Marks	Lecture	: 03
Tutorial	: 01 Hours/Week	Internal Assessment	: 40 Marks	Tutorial	: 01
Total	: 04 Hours/Week	Total	: 100 Marks	Total	: 04

Course Outcomes	
1	Solve differential equations by different methods
2	Apply different laws to solve Simple Harmonic Motion, One–Dimensional Conduction of Heat.
3	Solve integral calculus and Fourier series.
4	Solve integral calculus with error functions.
5	Determine position in solid geometry.
6	Solve multiple integration problems.

Topics Covered		
UNIT-I	**Differential Equation of First Order and First Degree** Definition, Order and Degree of DE, Formation of DE, Solutions of Variable Separable DE, Exact DE, Linear DE and reducible to these types.	**(06 Hours)**
UNIT-II	**Applications of Differential Equations** Applications of DE to Orthogonal Trajectories, Newton's Law of Cooling, Kirchoff‘s Law of Electrical Circuits, Motion under Gravity, Rectilinear Motion, Simple Harmonic Motion, One–Dimensional Conduction of Heat.	**(06 Hours)**

UNIT-III	**Fourier Series** Definition, Dirichlet's conditions, Fourier Series and Half Range Fourier Series, Harmonic Analysis.	**(06 Hours)**
UNIT-IV	**Integral Calculus** Reduction formulae, Beta and Gamma functions, Differentiation under the Integral Sign, Error functions	**(06 Hours)**
UNIT-V	**Solid Geometry** Cartesian, Spherical Polar and Cylindrical Coordinate Systems, Sphere, Cone and Cylinder.	**(06 Hours)**
UNIT-VI	**Multiple Integrals and their Application** Double and Triple integrations, Applications to Area, Volume, Mean and Root Mean Square Values	**(06 Hours)**

Project Based learning	
1	Formation of differential equation
2	Exact differential Equation
3	Linear differential equation
4	Newton's law of cooling
5	Newton's second law of motion
6	Fourier's law
7	Kirchhoff's voltage law
8	Fourier series
9	Harmonic analysis
10	Gamma and beta function
11	Reduction formulae
12	Locating position in three dimensional space
13	Multiple integrals applications
14	Error function
15	Differentiation under integral sign

Text Books/References	
1	Applied Mathematics (Volumes I and II) by P. N. Wartikar & J. N. Wartikar (Pune Vidyarthi GrihaPrakashan, Pune),7thEdition,1988,Reprint 2010
2	Higher Engineering Mathematics by B.S. Grewal (KhannaPublication,Delhi),42th Edition,2012
3	Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill),Edition,2008
4	Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.), 8th Edition,1999,Reprint2010
5	Advanced EngineeringMathematics,7e,byPeterV.O'Neil(ThomsonLearning),Edition 2007
6	Advanced Engineering Mathematics, 2e,byM.D.Greenberg(Pearson Education),2nd,Edition, 2002

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

ENGINEERING PHYSICS

Designation: Basic Science

Pre-requisite Courses: Basic physics and calculus.

Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lecture	: 03 Hours/Week	End Semester Examination	: 60 Marks	Lecture	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours/Week	Term Work	: 50 Marks	Total	: 04
		Total	: 150 Marks		

Course Outcomes

1	Analyze the properties of charged particles to develop modern instruments such as electron microscopy.
2	Understand the problems associated with architectural acoustics and give their remedies and use ultrasonic as a tool in industry for non destructive testing.
3	Apply quantum physics problems to micro level phenomena and solid state physics.
4	Understand the wave nature of light and apply it to measure stress, pressure and dimension etc.
5	Apply the principles of lasers and fiber optics for applications in the field of engineering.
6	Remember properties of solid matter and connect to applications in the field of engineering.

Topics Covered

UNIT-I	**Modern Physics** Motion of a charged particle in electric and magnetic fields, Electrostatic and Magnetostatic focussing, Electron microscopy, interaction of electron beam with the material, Wavelength and resolution, transmission electron microscope (TEM), scanning electron microscope (SEM), Separation of isotopes by Bainbridge mass spectrograph, cathode ray tube (CRT), CRT in cathode ray oscilloscope (CRO).	**(06 Hours)**

UNIT-II	**Architectural Acoustics** Elementary acoustics, Reverberation and reverberation time, Sabine's formula (without Derivation), Intensity level, Sound intensity level, Loudness, Sound absorption, Sound absorption coefficient, different types of noise and their remedies, basic requirement for acoustically good hall, factors affecting the architectural acoustics and their remedies, introduction to ultrasonics, Production of ultrasonics by magnetostriction and piezoelectric methods, applications (thickness measurement, flaw detection).	**(06 Hours)**
UNIT-III	**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, concept of tunnelling at potential barrier (no derivation-only conceptual discussion).	**(06 Hours)**
UNIT-IV	**Optics – I (Interference and Diffraction)** **Interference**: Interference due to thin film of uniform thickness and nonuniform thickness, engineering applications of interference (optical flatness, non-reflecting coatings). **Diffraction:** Diffraction at a single slit (Geometrical method), Conditions for maximum and minimum, Diffraction at a circular aperture (Result only), Plane diffraction grating, Conditions for principal maxima and minima.	**(06 Hours)**
UNIT-V	**Optics – II (Polarisation and Lasers)** **Polarisation:** Introduction, Double refraction and Huygen's theory, Positive and negative crystals, Nicol prism. **Lasers:** Lasers introduction, Characteristics of Lasers, Working principle and components of He-Ne Laser, Nd -YAG Laser, Semiconductor diode Laser, Applications in the field optical fiber (Principle, Acceptance angle and acceptance cone, Numerical aperture, Types of optical fibers, Fiber optic communication).	**(06 Hours)**

UNIT-VI	**Solid State Physics** Origin of band gap, Energy bands in solids, Fermi-Dirac probability function and position of Fermi level in intrinsic semi-conductors (with derivation) and in extrinsic semi-conductors, Formation and band structure of p-n junction, Hall effect and Hall coefficient. Introductions of nanoparticles, properties of nanoparticles (Optical, electrical, Magnetic, structural, mechanical), synthesis of nanoparticles (Physical and chemical), quantum dots – wide band semiconductors, direct/indirect band gap semiconductors.	**(06 Hours)**

Project Based Learning Topics	
1	Tesla Coil
2	Thin film interference in soap film-formation of colors
3	LiFi- wireless data transfer system using light
4	Need of medium for propagation of sound wave
5	Possible effects of electromagnetic fields (emf) on human health
6	Design and simulation of automatic solar powered time regulated water pumping
7	Solar technology: an alternative source of energy for national development
8	Measurement and effect of environmental noise in the college
9	Electronic eye (Laser Security) as auto-switch/security system
10	Electric power generation by road
11	Design and construction of distance measuring instrument using LASER
12	Design and construction of remote control devices – electronic bell, Fan etc
13	Absorption coefficient of sound absorbing materials
14	Velocity determination of O-ray and E-ray in double refracting materials
15	Velocity determination of O-ray and E-ray in double refracting materials
16	The design and construction of the hearing aid device
17	Study of Quantum confinement effect
18	Wind turbines - a source of electricity

19	Measurement of gravitational constant ‘g’
Practical (Any Eight of the Following)	
1	Determination of radius of planoconvex lens/wavelength of light/Flatness testing by Newton’s rings
2	Determination of wavelength of light using diffraction grating
3	Determination of frequency of ac voltage by CRO.
4	Determination of refractive index for O-ray and E-ray
5	Determination of divergence of a laser beam
6	Particle size by semiconductor laser
7	Determination of wavelength of laser by diffraction grating
8	To study Hall effect and determine the Hall voltage
9	Calculation of conductivity by four probe method
10	Study of solar cell characteristics and calculation of fill factor
11	Determination of band gap of semiconductor
12	Synthesis of metal oxide nanoparticles (ZnO/ZnS/silver/Gold)
13	Measurement of average SPL across spherical wavefront and behaviour with the distance
14	Determination of velocity of sound in liquid by ultrasonic interferometer
15	Study of B-H curve of a sample
16	Determination of Plank’s constant
Text Books	
1	A Textbook of Engineering Physics, M N Avadhanulu, P G Kshirsagar and TVS 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)
References	
1	Fundamentals of Physics, Jearl Walker, David Halliday and Robert Resnick, John Wiley and Sons

	(2013)
2	Optics, Francis Jenkins and Harvey White, Tata Mcgraw Hill (2017)
3	Principles of Physics, John W. Jewett,Cengage publishing (2013)
4	Introduction to Solid State Physics, C. Kittel, Wiley and Sons (2004)
5	Principles of Solid State Physics, H. V. Keer, New Age International (1993)
6	Laser and Non-Linear Optics, B. B. Laud, New Age International Private Limited (2011)
7	Nanotechnology: Principles and Practices, Dr. S. K. Kulkarni, Capital Publishing Company (2014)
8	Science of Engineering Materials- C.M. Srivastava and C. Srinivasan, New Age International Pvt. Ltd. (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 and Chemistry					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lectures	: 04 Hours/Week	End Semester Examination	: 60 Marks	Lecture	: 04
Practical	: 02 Hours/ Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 06 Hours / Week	Term Work	: 50 Marks	Total	: 05
		Total	: 150 Marks		

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;	**(06 Hours)**

	Introduction to kinetics of biological systems.	
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 handling of various microorganisms.	**(06 Hours)**

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

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

Syllabus for Unit Test:

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

MECHANICAL OPERATIONS

Designation: Professional Core

Pre-requisite Courses: None.

Teaching Scheme	**Examination Scheme**	**Credits Allotted**
Lecture : 04 Hours/Week	End Semester Examination : 60 Marks	Lecture : 04
Practical : 02 Hours /Week	Internal Assessment : 40 Marks	Practical : 01
Total : 06 Hours /Week	Term Work : 50 Marks	Total : 05
	Total : 150 Marks	

Course Outcomes: After completion of the course students will be able to

1	To select suitable type of screening and size reduction equipment for different particle sizes
2	To select suitable type of thickeners and clarifiers for separation of suspended solid particles from liquid for example applications in Wastewater treatment plants.
3	To apply beneficiation techniques in Chemical Industries.
4	To select a suitable type of conveyor for transportation of different types of solids
5	To select a suitable type of agitator for mixing and agitation and to estimate power consumption in mixing and agitation.
6	To select a suitable type of filter for filtration of a slurry or a suspension.

Topics Covered

UNIT-I	**Screening and Size Reduction of Solids** Properties of solids; Performance of screening equipment; Testing sieves; Tyler standard sieve series; Sieve shaker; Types of screen analysis; Necessity of size reduction; Crushing efficiency; Energy requirement calculations by using crushing laws; Classification of size reduction equipment: Crushers, Grinders, Ultrafine grinders, Cutters, Dry versus wet grinding; Open and closed circuit grinding.	**(08 Hours)**

UNIT-II	**Settling and Sedimentation** Motion of particle in fluid; Drag force; Drag coefficient; Gravity settling methods; Terminal falling velocity; Stoke's law and Newton's law of settling; Gravity sedimentation operations; Sedimentation test; Kynch theory; Determination of thickener area and depth of thickener; Thickeners, Clarifiers, Sedimentation centrifuges.	**(08 Hours)**
UNIT-III	**Beneficiation Equipment** Froth flotation; Magnetic separator; Scrubbers; Electrostatic precipitators: Mineral jig: Cyclone separator: Hydro cyclone types and centrifuges.	**(08 Hours)**
UNIT-IV	**Handling and Conveying of Solids** Storage of solids; Characteristics of bulk solids; Conveyors: Principle, Construction and Working, Advantages, Disadvantages and Design calculations of Belt Conveyors, Screw conveyors, Chain & Flight conveyors, Bucket elevators and Pneumatic conveyors.	**(08 Hours)**
UNIT-V	**Mixing and Agitation** Types of Impellers; Flow patterns in un-baffled and baffled tanks; Draft tube; Mechanically agitated vessel; Power requirement in mixing; Performance of mixers; Paste and viscous material mixing; Solid-solid mixing; Batch and continuous mixers; Agitator selection.	**(08 Hours)**
UNIT-VI	**Filtration** Classification of filtration and filters; Theory of filtration-equations; Filter media and filter aids; Batch and continuous filters; Plate and frame filter press; Filling and washing in a filter press; Horizontal pressure leaf filters; Rotary drum vacuum filters; Fabric filter: Centrifugal filters-basket type.	**(08 Hours)**

List of Experiments:

Term work will consist of the experiments listed below, of which at least eight should be performed in laboratory by the students.

1	To determine effectiveness of given set of standard screen.
2	To determine energy consumption and crushing law constants for jaw crusher.

3	To determine Critical speed of Ball mill & Average particle size of the product obtained in ball mill.
4	To determine mixing Index of a mixture in Ribbon Blender. **OR** To determine mixing Index of mixture in Sigma Mixer.
5	To determine filter medium resistance and cake resistance by using Vacuum Leaf filter.
6	To determine filter medium resistance and cake resistance by using Plate & frame Filter Press **OR** by using centrifuge machine.
7	To determine area of batch thickener by conducting batch sedimentation test.
8	To determine separation efficiency by using froth flotation cell.
9	To determine separation efficiency by using magnetic separator.
10	To determine efficiency of Cyclone separator.
Project Base Learning :	
1	What is surface loading rate explain in brief. The flow into clarifier is 3.2 MGD in tank 80 feet long and 40 feet wide. What is surface loading rate?
2	Research on Recent trends in particle size technology.
3	Watch the NPTEL video on this subject of any TWO modules and summarize it
4	Solve numerical problems asked in previous THREE year question papers.
5	Solve questions asked on filtration in previous THREE year question papers.
6	If your particles are not spherical which equivalent particle size would be suitable to calculate for the purpose of filtration
7	What media are used in filters? What factors affect filter efficiency?
8	How does sedimentation fit in to the waste water treatment process?
9	What zones are present in sedimentation basin?
10	How is sedimentation sludge disposed of?
11	Pilot scale solid-liquid fluidization: Expansion characteristics of solids
12	Estimate power consumption for homogeneous system
13	Industry related unit operation (ANY ONE INDUSTRY) detailing of it.
14	How does filtration fit into the water treatment process?
15	How Does Filtration clean water?

16	What types of filters are used for water treatment? Explain in brief

Text Books/References	
1	McCabe, W. L.; Smith, J. C. and Harriott, P.; Unit Operations of Chemical Engineering, 6th edition, McGraw Hill Publications.
2	Coulson, J.M.; Richardson, J. F.;Backhurst, J. R.; Harker, J. H.; Chemical Engineering Volume 2, 6th edition, Pergamon Press.
3	Badger W. L &Banchero J.T. "Introduction to Chemical Engineering", McGraw Hill
4	Foust A. S "Principles of Unit Operation".
5	George G. Brown, "Unit operations", CBS publishers and distributors.

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

MATERIAL AND ENERGY BALANCE CALCULATIONS					
Designation: Professional Core					
Course Pre-requisites: Basic chemistry					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Lecture	: 04 Hours/Week	End Semester Examination	: 60 Marks	Lecture	: 04
Total	: 04 Hours/Week	Internal Assessment	: 40 Marks	Total	: 04
		Total	: 100 Marks		
Course Outcomes:					
After completion of the course students will be able to					
1	Elaborate the concept of units and dimensions and solve the problems on basic chemical calculations.				
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 numerical 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**			**(08 Hours)**	

	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.	
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.	**(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)**

Assignment:	
1.	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.	Mass and energy balance for any one of following unit processes for given system. These assignment may include overall energy and/or mass balance or energy and/or mass balance over a given chemical process equipment.
	a) Nitration
	b) Esterification
	c) Acylation
	d) Fermentation
	e) Sulfonation etc.
3.	Students have to visit chemical industry and prepare a detailed report on various unit operations and unit processes used in industry.
4.	Measurement of calorific values of any two types of fuel.
5.	Group discussions on mass and energy balance for unit operations and unit processes carried out in chemical industry.
6.	Solve last five years GATE question papers with reference to particular topic.
7.	Students have to study any five NPTEL videos related to Material and Energy Balance Calculations and prepare/present power point presentation.
8.	Numerical based on above six units.
9.	Technical interview based on knowledge of Material and Energy Balance Calculations.
10	Prepare models for recycle, bypass and purge operations carried out in chemical industry.
11.	With the help of this subject knowledge, write a report on how you would apply your concepts in industry.
12.	Prepare a report on unit operations which are newly introduced in the current year.
13.	Write a report on your visit to research and development laboratory of national/international repute.
In addition to these above stated assignments concern faculty member may design his/her won.	
Text Books/References:	

1.	B. I. Bhatt and S. M. Vora, Stoichiometry (SI Units), 3rd Ed., Tata McGraw Hill Publishers, New Delhi.
2.	D. M. Himmelblau, Basic Principles and Calculations in Chemical Engineering, Prentice Hall Publications.
3.	O. A. Hougen, K. M Watson and R. A. Ragatz, Chemical Processes Principles, Part-I, Material and Energy Balances, Asia Publishing House, Bombay
4.	R.M. Felder and R.W. Rousseau, Elementary Principles of Chemical Processes, 3rd edition, John Wiley & Sons Publications.
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.

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

UNIVERSAL HUMAN VALUES					
Designation: Professional Core					
Pre-requisite Courses: During the Induction Program, students would get an initial exposure to human values through Universal Human Values. This exposure is to be augmented by this compulsory full semester foundation course.					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Practical	: 02 Hours/Week	Term work	: 50 Marks	Practical	: 01
Total	: 02 Hours/Week	Total	: 50 Marks	Total	: 01
Course Outcomes					
1	Create more awareness of themselves, and their surroundings (family, society, nature)				
2	Understand the Human being is coexisting with self and body and able to recognize its different needs and fulfilment.				
3	Develop more responsible life with human relationships, while keeping in mind the human nature.				
4	Understand to imbibe sensitive approach towards society and understand the dimensions of harmony in the society.				
5	Understand the recycle structure of the nature and able to recognize the participation				
6	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.				
Topics Covered					
UNIT-I	**Introductions, Aspirations and Concerns** Getting to know each other, Self-exploration, Individual academic, career Expectations of family, peers, society, and nation fixing one's goals Basic human aspirations Need for a holistic perspective, Role of UHV.			**(04 Hours)**	
UNIT-II	**Self-Management, Health** Self-confidence, peer pressure, time management, anger, stress Personality			**(04 Hours)**	

	development, Self-improvement Harmony in the human being. Health issues, healthy diet, healthy lifestyle Hostel life Harmony of the self and Body Mental and physical health.	
UNIT-III	**Relationships** Home sickness, gratitude towards parents, teachers and others Ragging and interaction Competition and cooperation Peer pressure. Harmony in relationship Feelings of trust, respect, gratitude, glory, love.	**(04 Hours)**
UNIT-IV	**Society** Participation in society. Harmony in the society Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals .Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family	**(04 Hours)**
UNIT-V	**Natural Environment** Participation in nature Harmony in nature/existence Understanding the harmony in the Nature Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self regulation in nature	**(04 Hours)**
UNIT-VI	**Self-evaluation Strategy** Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers. At the level of society: as mutually enriching institutions and organizations review role of education Need for a holistic perspective.	**(04 Hours)**

Text Books

1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

References

1	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004. 3. The Story of Stuff (Book).
3	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi 5. Small is Beautiful - E. F Schumacher.
4	Slow is Beautiful - Cecile Andrews
5	Economy of Permanence - J C Kumarappa 8. Bharat Mein Angreji Raj - PanditSunderlal 9. Rediscovering India - by Dharampal
6	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi 11. India Wins Freedom - Maulana Abdul Kalam Azad.
7	Vivekananda - Romain Rolland (English).

COMPUTER PROGRAMMING II		
Designation: Professional Core		
Pre-requisite Courses: Basic knowledge of computer fundamentals, C/C++ programming.		
Teaching Scheme	**Examination Scheme**	**Credits Allotted**
Practical : 04 Hours/Week	Term Work : 25 Marks	Practical : 02
Total : 04 Hours/Week	Oral : 25 Marks	Total : 02
	Total : 50 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 below, 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.