DEPARTMENT OF CHEMICAL ENGINEERING
SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502

R-16 Effective from the Academic Year 2018-2019

DEPARTMENT OF CHEMICAL ENGINEERING :: S V U C E :: TIRUPATI
SCHEME OF INSTRUCTION –- CHOICE BASED CREDIT SYSTEM
R-16 B.Tech (Chemical Engineering) , Effective 2017-2018

I Semester

Course Code	COURSE TITLE	INSTRUCTION hr/week L	Tut	P/D	Credits	EVALUATION Test I Dur.	Marks	Test II Dur.	Marks	End Exam Dur.	Marks	TOTAL
MAT01	Engg Mathematics – I	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CST01	Computer Programming	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
PHT01	Engg. Physics	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CYT01	Engg Chemistry	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CET01	Environmental Studies	2	2	--	3	2 hr	40	2 hr	40	3 hr	60	100
MET01	Engg Graphics	2	--	3	4	Continuous Evaluation 40				3 hr	60	100
CSP01	Programming Laboratory	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
MEP01	Workshop Practice	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
	TOTAL	**16**	**6**	**9**	**25**							**800**

II Semester

Course Code	COURSE TITLE	INSTRUCTION hr/week L	Tut	P/D	Credits	EVALUATION Test I Dur.	Marks	Test II Dur.	Marks	End Exam Dur.	Marks	TOTAL
MAT02	Engg Mathematics-II	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CST02	Data Structures	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
EET43	Basics of Elec.& Electr.Engg	2	2	--	3	2 hr	40	2 hr	40	3 hr	60	100
CYT02	Physical Chemistry	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
MET41	Mechanical Technology	4	--	--	4	2 hr	40	2 hr	40	3 hr	60	100
ENT01	English	3		--	3	2 hr	40	2 hr	40	3 hr	60	100
CSP02	Data Structures Laboratory	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
ENP01	English Communication Lab	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
	TOTAL	**18**	**6**	**6**	**25**							**800**

DEPARTMENT OF CHEMICAL ENGINEERING :: S V U C E :: TIRUPATI
SCHEME OF INSTRUCTION –- CHOICE BASED CREDIT SYSTEM
R-16 B.Tech (Chemical Engineering) , Effective 2017-2018

III Semester

Course Code	COURSE TITLE	INSTRUCTION hr/week L	Tut	P/D	Credits	EVALUATION Test I Dur.	Marks	Test II Dur.	Marks	End Exam Dur.	Marks	TOTAL
MAT03	Engg Mathematics-III	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CET44	Mechanics of Solids	2	2	--	3	2 hr	40	2 hr	40	3 hr	60	100
CYT03	Organic Chemistry	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHT01	Momentum Transfer	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CHT02	Chemical Process Calculations	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CHT03	Inorganic Chemical Technology	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHP01	Momentum Transfer Lab	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
CHP02	Chemical Analysis lab	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
		17	**8**	**6**	**25**							**800**

IV Semester

Course Code	COURSE TITLE	INSTRUCTION hr/week L	Tut	P/D	Credits	EVALUATION Test I Dur.	Marks	Test II Dur.	Marks	End Exam Dur.	Marks	TOTAL
MAT04	Probability & Statistics	2	2	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHT04	Chem Engg Thermodynamics-I	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CHT05	Mechanical Unit Operations	2	2	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHT06	Industrial Effluent Treatment	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHT07	Material Technology	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHT08	Organic Chemical Technology	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHP03	Mechanical Unit Operations lab	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
CHP04	Instrumental Analysis Lab	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
CHS01	Seminar-I			2	1	Continuous Evaluation 40				3 hr	60	100
	TOTAL	**17**	**6**	**6**	**24**							**900**

DEPARTMENT OF CHEMICAL ENGINEERING :: S V U C E :: TIRUPATI
SCHEME OF INSTRUCTION –- CHOICE BASED CREDIT SYSTEM
R-16 B.Tech (Chemical Engineering) , Effective 2017-2018

V Semester

Course Code	COURSE TITLE	INSTRUCTION hr/week L	Tut	P/D	Credits	EVALUATION Test I Dur.	Marks	Test II Dur.	Marks	End Exam Dur.	Marks	TOTAL
MAT05	Numerical Methods for Chemical Engineering	2	2	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHT09	Chem Engg Thermodynamics-II	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CHT10	Heat Transfer	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CHT11	Mass Transfer Operations-I	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CHT12	Process Instrumentation	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHE01	Elective - I	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHP05	Heat Transfer Lab	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
CHP06	Computational Techniques lab	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
		17	**8**	**6**	**25**							**800**

Elective – I from CHE01A Petroleum Refining Process
CHE01B Safety and Loss Prevention in Process Industries
CHE01C Polymer Science and Engineering
CHE01D Pharmaceutical Technology
CHE01E Food Processing and Preservation Technology

VI Semester

Course Code	COURSE TITLE	INSTRUCTION hr/week L	Tut	P/D	Credits	EVALUATION Test I Dur.	Marks	Test II Dur.	Marks	End Exam Dur.	Marks	TOTAL
CHT13	Mass Transfer Operations-II	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CHT14	Chemical Reaction Engg-I	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CHT15	Process Dynamics & Control	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CHT16	Bioprocess Engineering	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
	Open Elective -	2	--	--	2	2 hr	40	2 hr	40	3 hr	60	100
MET42	Industrial Management	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHP07	Mass Transfer Operations Lab-I	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
CHP08	Process Dynamics & Control Lab	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
CHS02	Seminar - II	--	--	2	1	Continuous Evaluation						100
	TOTAL	**16**	**6**	**8**	**25**							**900**

Open Elective: Open Elective can be chosen any one of the elective course

VII Semester

Course Code	COURSE TITLE	INSTRUCTION hr/week L	Tut	P/D	Credits	EVALUATION Test I Dur.	Marks	Test II Dur.	Marks	End Exam Dur.	Marks	TOTAL
CHT17	Chem. Reaction Engineering-II	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CHT18	Transport Phenomena	3	2	--	4	2 hr	40	2 hr	40	3 hr	60	100
CHT19	Plant Design & Proc. Economics	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHT20	Process Modeling & Simulation	3	-	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHT21	Engineering Ethics	2	--	--	2	2 hr	40	2 hr	40	3 hr	60	100
CHE02	Elective-II	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHP09	Mass Transfer Operations Lab-II	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
CHP10	Chem Reaction Engg Lab	--	--	3	2	Continuous Evaluation 40				3 hr	60	100
	TOTAL	**17**	**4**	**6**	**23**							**800**

Elective II from CHE 02A : Fundamentals of Neural Networks and Fuzzy Logic
CHE 02B : Fundamentals of Microelectronic Material Processing
CHE 02C : Computer Applications in Chemical Engineering
CHE 02 D: Computational Fluid Dynamics
CHE 02 E : Fuel Cell Systems CHE 02 F Energy Engineering

VIII Semesters

Course Code	COURSE TITLE	INSTRUCTION hr/week L	Tut	P/D	Credits	EVALUATION Test I Dur.	Marks	Test II Dur.	Marks	End Exam Dur.	Marks	TOTAL
CHT22	Optimization Techniques	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHE 03	Elective-III	3	--	--	3	2 hr	40	2 hr	40	3 hr	60	100
CHT24	Computer Aided Process Equipment Design & Drawing	1	--	3	4	Continuous Evaluation 40				4 hr	60	100
CHP11	Project Work	--	--	4	6	Continuous Evaluation 40				3 hr	60	100
CHP12	Internship/Mini Project	--	--		2	Continuous Evaluation 100						100
	MOOCs	--	--	--	2	Continuous Evaluation 100						100
		7	**--**	**7**	**20**							**600**

Elective III from CHE 03A : Fundamentals of Nanotechnology
CHE 03 B : Fluidization Engineering CHE 03 C: Membrane Separations
CHE 03 D : Microprocessors and their Applications
CH E 03 E : Process Synthesis & Analysis

Sem	I	II	III	IV	V	VI	VII	VIII	TOTAL
Credits	**25**	**25**	**25**	**24**	**25**	**25**	**23**	**20**	**192**

DEPARTMENT OF CHEMICAL ENGINEERING : : S V U C E

THE VISION

To be a world class department of chemical engineering in effective teaching and knowledge creation which is seamlessly integrated with bordering sciences and is committed to ignite and propel young minds with passion for originality, innovation and excellence.

THE MISSION

- To train technically competent and socially aware chemical engineers through innovative and rigorous educational programs to meet technological needs of the society
- To encourage self learning, problem solving, inquisitiveness and team work among students.
- To enable students to develop capabilities needed to perform in multidisciplinary environment.
- To promote industry- institute interaction to nurture collaborative and applied research programs
- To help students develop a well rounded personality with qualities of innovative thinking, leadership, entrepreneurship and ethical mind.
- To create amiable ambience of academics for intellectual pursuit and innovative research

THE GOALS

- To promote self-learning among students
- To help the students to develop a strong personality, so that in turn they help the Institute to realize its objectives
- To strive for academic excellence
- To sensitize students towards the needs and aspirations of the society
- To identify the core strengths of the Department and develop expertise through advanced research
- To promote Industry-Institute Interaction for mutual benefit

DEPARTMENT OF CHEMICAL ENGINEERING : : S V U C E

PROGRAM EDUCATIONAL OBJECTIVES

The Department of Chemical Engineering offers B.Tech (Chemical Engineering) program with the following objectives of enabling its graduates.

1. To seek career as Chemical engineers in traditional Chemical industries and also in areas of manufacture of newer materials, pharmaceuticals and biological, environmental remediation and development of renewable energy sources.

2. To pursue higher qualification in Chemical Engineering or a related discipline, with a view to become a researcher or an academician.

3. To be able to synthesize a chemical process from simple and even complex chemistry and to translate any chemical process from conceptual to commercial stage.

4. To possess good breadth in scientific and engineering knowledge so as to understand, analyze and to offer novel solutions to problems arising in today's rapidly changing increasingly technological global society.

5. To be socially conscious chemical engineers through their sensitivity towards impact on environment, energy, security and sustainability.

PROGRAM OUTCOMES

A graduate of this Department

after successful completion of B.Tech, will be able

a. To integrate and apply concepts of mathematics, physics, chemistry and biology to real life situations.

b. To apply principles of conservation, thermodynamics, transport processes, reaction engineering and process control to analyze and design process equipment.

c. To develop mathematical models of chemical engineering systems.

d. To demonstrate computational abilities and use of software tools in design & simulation of process and equipment.

e. To apply techniques of optimization to improve the performance of chemical processes.

f. To analyze equipment and processes for retrofitting and debottlenccking.

g. To conduct energy audit and suggest strategies for its conservation.

h. To incorporate effective measures for environmental protection and sustainability into chemical process design.

i. To participate in laboratory scale process development and scale up or scale down of processes.

j. To communicate effectively in both verbal and written forms.

k. To adapt to changing scenario and circumstances, with self confidence.

l. To succeed in competitive examinations like GATE, UPSC

MAT01 ENGINEERINGMATHEMATICS–I

Instruction Hours /Week:5 **Credits:4**

Common to all branches and with effect from 2017-18

Course Objective:

- To gain the knowledge of mathematics & Engineering problems
- To model a wide range of engineering and practical problems as ordinary differential equations
- To train the students thoroughly in Mathematical concepts of ordinary differential equations, multiple integrals, Laplace Transforms and their applications.
- To prepare students for lifelong learning and successful careers using mathematical concepts of ordinary differential equations, multiple integrals, Laplace Transforms and their applications.
- To develop the skill pertinent to the practice of the mathematical concepts including the student abilities to formulate and modeling the problems, to think creatively and to synthesize information.

Unit –I

DifferentialEquations:Lineardifferentialequationsofsecondandhigherorderwithconstantcoefficients-particular integrals-homogeneous differential equations with variable coefficients-method ofparameters-simulationequations.

Unit –2

LaplaceTransformsI:Laplacetransformsofstandardfunctions-inversetransforms-transformsofderivativesand integrals-derivatives oftransforms-integrals of transforms.

Unit –3

Laplace Transforms II: Transforms of periodic functions-convolution theorem-applications to solution ofordinarydifferentialequations.

Unit –4

Calculus: Roll's and Mean value theorems - Taylor's and Maclaurins's series-maxima and minima forfunctions of two variables - Infinite series - Convergence Tests series of positive terms - comparison,Ratiotests-Alternatingseries-Leibnitz'srule -Absolute and

conditionalconvergence.

Unit –5

Multiple Integrals: Curve tracing (both Cartesian and polar coordinate) - Evaluations of double and Tripleintegrals-change of order of integrations-change of variables of integrations-simple applications to areasandvolumes.

TextBooks:

1. BSGrewal,HigherEngineeringMathematics,40th Edition,KhannaPublications,2007.
2. MKVenkataraman,EngineeringMathematics,NationalPublishingCompany,Chennai.
3. BVRamana,HigherEngineeringMathematics,6thReprint,TataMcGraw-Hill,2008.
4. Baliand Iyengar, EngineeringMathematics,6th Edition,LaxmiPublications,2006.

COURSE OUTCOME:

1. Analyze differential equations and solve them. Apply differential equations to engineering problems.
2. Use shift theorems to compute the Laplace transform, inverse Laplace transform and the solutions of second order, linear equations with constant coefficients.
3. Solve an initial value problem for an n^{th} order ordinary differential equation using the Laplace transform.
4. Expand functions as power series using Maclaurin's and Talor's series
5. Draw an approximate shape by the study of some of its important characteristics such as symmetry, tangents, regions etc using curve tracing method to find length, area, volume. Use multiple integral in evaluating area and volume of any region bounded by the given curves.

Mapping of Course Outcomes with Program Outcomes:

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

CST01COMPUTERPROGRAMMING

InstructionHours /Week:5 **Credits:4**

Common to all branches and with effect from 2017-18

Course Objective:

- To understand the core aspects of computer problem solving techniques
- To understand the various concepts of C language such as branching, loops, functions, input/output, expression evaluation, arrays, pointers and files.
- To apply the syntax of control and looping statements
- To understand the programming language constructs
- To understand the programming paradigms

UNIT–I

IntroductiontoProgramming–ProblemSolvingSteps,SDLC,Algorithms,andflowcharts.

Common features of C and C++ Programming Languages –Identifiers, Variables, Constants,datatypes, Operators and Expressions, Input / Output operations.Statements- Decision Making, Branching andLooping,continue,gotoandbreak.PrecedenceandAssociatively,ExpressionEvaluation,Typeconversions.Cand C++ SimpleProgrammingexamples

UNIT–II

Arrays and Strings – Concepts, arrays, one and two and multidimensional arrays.Strings Handling:String Input / Output functions, arrays of strings, string manipulation functions, data conversion, C andC++SimpleProgrammingexamples

Designing Structured Programs- Functions- basics, functions,Scope, Storage classes- auto, register,static,extern, scoperules,type qualifiers,recursion, Preprocessor directives.

Derived types – Structures – Declaration, definition and initialization ofStructures, accessing structures,nested structures, arrays of structures, structures and functions, pointers to structures, self referentialstructures,unions,typedef,bitfields, enumeratedtypes.C andC++ Simple Programmingexamples

UNIT–III

Pointers – Introduction, Pointers for inter function communication, pointers to pointers, compatibility,memory allocation functions, array of pointers, pointers to void, pointers to functions, command –linearguments.C and C++ SimpleProgrammingexamples

DataFileHandling: InputandOutput–Conceptofa file,streams,standardinput/output

Functions, formatted input / output functions, text files and binary files, file input / output operations, filestatusfunctions(Eq.error handling),C and C++ SimpleProgrammingexamples.

Dynamic Memory Allocation: Allocating a Block and Multiple Blocks, releasing the used space andalteringmemorysize. C and C++ SimpleProgrammingexamples

UNIT–IV

BasicsofObjectOrientedProgramming(OOP)and**C++:**BenefitsofOOP,datatypes,declarations,expression sandoperatorprecedence,scopeofvariables

IntroductiontoOOPandConcepts: Abstraction**,**Datahiding,EncapsulationClassesandobjects,Con structors&Destructors,Operatoroverloading&typeconversions.

Polymorphism: Pointers, virtualfunctions andpolymorphism- pointers to objects,thispointer, pointers toderivedclasses,virtualandpurevirtualfunctions,C++Simple Programmingexamples

UNIT–V

Inheritance: Derived classes, syntax of derived classes, making privatemembers inheritable, single,multilevel,multiple,hierarchical,hybridinheritance.

Templates, Exception handling,consoleI/Oand FileI/O:classtemplates,Function templates, memberfunctiontemplates,exceptionhandling,managingconsoleI/Ooperations,workingwithfil es.Programmingguidelinesand Simple C++Programmingexamples

Course Outcome:

CO1	Graduates will possess knowledge on mathematics, science and fundamental engineering concepts.
CO2	The ability to design and develop applications, as well as to analyze and interpret data.

CO3	The ability to function on multi-disciplinary areas and will be able to demonstrate with excellent programming, analytical, logical and problem solving skills.
CO4	Graduates will demonstrate with an ability to develop, test and debug the software.
CO5	Graduates will demonstrate with an ability to deploy, analyze, troubleshoot, maintain, manage and secure the computer network.

TEXTBOOKS:

1. ScheldtH,C:TheCompleteReference,4thEdition,TataMcGraw-Hill,2002.
2. Balagurusamy E, Programming in ANSI C, 4th Edition, Tata McGraw-Hill,2008
3. RobertLefore,ObjectOrientedProgramminginC++,4th edition,PEARSONEducation
4. ScheldtH,C++:TheCompleteReference,TataMcGraw-Hill

REFERENCES:

1. CProgrammingwithproblemsolving,J.A.Jones&K.Harrow,dreamtechPress
2. ProgramminginC–StephenG.Kochan,IIIEdition,PearsonEductaion.
3. CforEngineersandScientists,H.Cheng,Mc.Graw-HillInternationalEdition
4. DataStructuresusingC–A.M.Tanenbaum,Y.Langsam,andM.J.Augenstein,PearsonEducation /PHI
5. CProgramming& DataStructures,P.Dey,MGhoshRThereja,OxfordUniversityPress
6. C&Data structures– EVPrasadand N BVenkateswarlu, S.Chand& Co
7. KernighanandRitchie,TheCprogramminglanguage(2nd edition).PrenticeHallofIndia,1988.
8. CoohoonandDavidson,C++ProgramDesign:AnintroductiontoProgrammingandObject-OrientedDesign.TataMcGraw Hill3rd edition.2003.
9. G.Dromey,HowtoSolveitbyComputer,Prentice-HallInc.,UpperSaddleRiver,NJ,1982.YashwantKanetkar,Let's C, Allied Publishers,1998.
10. ProgramminginC,PradipDey,ManasGhosh,SecondEdition,OXFORD

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

PHT01ENGINEERINGPHYSICS

InstructionHours /Week:3 **Credits:3**

Common to all branches and with effect from 2017-18

Course Objective:

- To learn and understand the basic concepts of quantum mechanics and the merits and demerits of classical and quantum free electron theory.
- To develop interest on various phenomenon of light waves like interference, diffraction, amplification of light through stimulated emission, propagation of light with engineering applications.
- To understand the arrangement of atoms, direction, planes in crystals, structure of crystals and application of ultrasonic.
- To recognize the mechanism of superconductors and magnetic materials, their properties and applications
- To acquire knowledge in understanding semiconductors, basic concepts and significance of nonmaterial's, their synthesis and applications & understanding semiconductor based electronic devices, basic concepts and applications of semiconductors & magnetic materials have been introduced which find potential in the emerging micro device applications.

UNIT-I

Crystallography : Unit Cell – Bravais Lattice – Crystal systems – Crystal packing – Close PackedStructures – NaCl, ZnS and Diamond – Miller Indices – Bragg`s Law –Bragg`s Spectrometer andCrystalStructure determination –Defectsincrystal Structure– PointDefectsandLineDefects.

UNIT–II

Quantum Mechanics : Wave – Particle duality – de Broglie Concept of Matter Waves – Properties ofMatterWaves–DavisonandGermerExperiment–G.P.ThomsonExperiment– Heisenberg'sUncertaintyPrinciple–
Schrödinger'sTimeIndependentandTimeDependentWaveequation–Significance of Wave Function – Electron in an Infinite Square Potential Well – Probability Densities

andEnergyLevels.

UNIT–III

Band Theory of Solids : Classical Free Electron Theory of Metals – Success and Failures – QuantumFreeElectron Theory – FermiFactor– Electron in PeriodicPotential – Bloch Theorem – Kronig –Penney Model – Distinction between Metals , Insulators and Semiconductors – Intrinsic and ExtrinsicSemiconductors–Hall Effect.

UNIT–IV

Lasers:Introduction–SpontaneousandStimulatedemissions–PopulationInversion–TypesofLasers –RubyLaser –He-NeLaser – SemiconductorLaser –Applicationsof Lasers.

Ultrasonics:Introduction–ProductionofUltrasonicWavesbyMagnetostrictionandPiezoelectricmethods– Detectionand Applications of Ultrasonic Waves.

UNIT–V

NanoPhysics and Nanotechnology : Introduction to Nanomaterials –Properties: Optical Properties –Quantum Confinement – Electrical properties. Synthesis of Nanomaterials: Ball milling, Arc depositionmethod – Chemical Vapour Deposition-Pulsed laser deposition. Characteristics of C^{60} (Zero dimensional),CarbonNanotubes(OneDimensional)andGraphene(TwoDimensional).Applicationso fNanomaterials.

Course Outcome:

CO1	Students demonstrate appropriate competence and working knowledge of laws of modern physics in understanding advanced technical engineering courses.
CO2	Ability to understand the crystal geometries and estimation of crystal structure by X-ray diffraction techniques.
CO3	Students demonstrate the ability to identify and apply appropriate analytical and mathematical tools of physics in solving engineering problems.
CO4	Student's ability to understand the principles in the production and applications of lasers and their effective utilization in optical communication and detection.
CO5	Students poses the ability to understand size depended properties of nano dimensional materials and their effective utilization in making nano and micro devices for further microminiaturization of electronic devices.

TextBooks:

1. R.K.GaurandS.L.Gupta``EngineeringPhysics"SultanandChandPub.,NewDelhi
2. S.P.BasavaRaju `` A Detailed Text Book of Engineering Physics" Sole Distributers, SubhashStoresBookCorner, Bangalore
3. HitendraK.Malik and A.K.Singh ``Engineering Physics"Tata MCGraw Hill Education PVt.Ltd.,NewDelhi
4. G.SenthilKumar,``EngineeringPhysics''VRHPublishersPvt.Ltd,Hyderabad
5. M.S.RamachandraRaoandShubraSingh,``NanoscienceandNanotechnology``WileyIndiaPvt.Ltd, New Delhi.

Refrence Books

6. JohnAllison,``ElectronicEngineeringMaterialsandDevices"TataMcGrawHill Publications.
7. B.LTheraja,"Modernphysics", S.Chand&Company.
8. V.Raghavan "MaterialScience",TataMcGraw Hill Publications

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	1			1						
CO 2	1	1	2									1
CO 3		2				2	2	1				
CO 4				1	2		2					1
CO 5			1		2	3	3					1

CYT01ENGINEERINGCHEMISTRY

InstructionHours /Week:3 **Credits:3**

Common to all branches and with effect from 2017-18

Course Objective:

- The Engineering Chemistry course for undergraduate students is framed to strengthen the fundamentals of chemistry and then build an interface of theoretical concepts with their industrial/engineering applications
- To study the effect of hard water and its treatment for various purposes, corrosion and control of metallic materials,
- To study the engineering materials such as high polymers namely plastics, rubbers and their preparation, properties and applications along with lubricants, refractories with its applications.
- To study the calorific value of fuels, combustion of fuels, working of batteries, recharging of batteries, application of different fuel cells
- The lucid explanation of the topics will help students understand the fundamental concepts and apply them to design engineering materials and solve problems related to them. An attempt has been made to logically correlate the topic with its application.

UNIT-I:

WATER TREATMENT: Introduction – Effect of water on rocks and minerals – hardness of water –disadvantagesofhardwater–boilerfeedwater–scaleandsludgeformationinboilers–causticembrittlement – boiler corrosion – priming and foaming – softening methods-lime soda, zeolite and ionexchangeprocess-SpecificationofpotablewaterandpurificationofDrinkingwater–chemicalanalysisofwater-Hardness, acidity,alkalinity, chloride anddissolvedoxygen.

UNIT–II:

ELECTRO CHEMISTRY AND CORROSION: Electrode potential – reference electrodes – hydrogen,calomel and glass electrode – PH and its determination –batteries – fuel cells – aluminum air battery –solar battery – lead acid storage cell.-Corrosion: Types of corrosion – factors influencing corrosion –theories of corrosion – prevention of corrosion – cathodic protection – metallic coatings – hot dipping,spraying,cementation, claddingand electroplating.

UNIT–III:

FUELSANDCOMBUSTION:Introduction–classificationoffuels–
calorificvalueanditsdetermination – bomb calorimeter – Boy's gas calorimeter – theoretical calculation of calorific value offuel – coal – analysis of coal – metallurgical coke – petroleum – refining of petroleum- synthetic petrol –octane and cetane number– combustion – mass analysis from volume analysis and vice versa – analysisof flue gas byOrsat's apparatus.

UNIT–IV:

HIGH POLYMERS:Nomenclature of polymers – typesof polymerization-Plastics – classification ofplastics – moulding constituents of plastics– preparation, properties and applications ofpolythene, nylon,Teflon,and bakelite – Rubbers – vulcanization of rubber –compounding of rubber- synthetic rubbers-buna-N, thiocol and silicon rubbers- Lubricants-classification-mechanism-properties of lubricating oils-selection oflubricantsfor engineeringapplications.

UNIT–V:

BUILDING MATERIALS:Manufacture-dry and wet processes-setting and hardening of cement-analysisof cement. Refractories-classification-properties and engineering applications. Ceramics-classification-propertiesandengineeringapplications

Course Outcome:

CO1	Students acquire the knowledge of with the preparation of various colloidal systems.
CO2	Students will understand different principles involved in electrochemical processes and their importance in industry like electro deposition and electroplating etc.,
CO3	Students will be able to understand different types of corrosion methods and their impact in metallic industry, boilers and furnaces.
CO4	Students will be able to learn different types of hardness and its disadvantages in daily life and in industry.
CO5	It provides the classification and some polymerization methods

BooksRecommended:

1. EngineeringChemistry :PCJain&MJain-Dhanpatraipublishingcompany,NewDelhi

2. EngineeringChemistry : BK Sharma

3. EngineeringChemistry :SSDhara

4. PhysicalChemistry :Puri&Sharma-VishalPulishingCompany(VPC),Jalandhar

5. PhysicalChemistry : Bahl&Tuli-

6PolymerScience-

:Gowarika

r-7Physical Chemistryby:

Glasstone-

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1				2	2					1
CO 2		1		2		1	1					
CO 3		2			1		2					2
CO 4				1	1		2					
CO 5	1			1	2		1					

CET01ENVIRONMENTAL STUDIES

InstructionHours /Week:4 **Credits:3**

Common to all branches and with effect from 2017-18

Course Objective:

- To understand the impacts of developmental activities and mitigation measures along with the environmental policies and regulations.
- To recognize major concepts in environmental studies and demonstrate in-depth understanding the environment.
- To implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management
- To know about global environmental problems like Acid Rains, Global Warming, Green House Effects, Ozone layer depletion.

Unit I EnvironmentalStudiesandNaturalResources

Definition,Scopeandimportanceof Environment,Environmentalstudies,Needforpublic awareness

Components of Environment- Atmosphere, Hydrosphere, Lithosphere.**Renewable**and**NonRenewableResourcesandassociat edproblems**

- Waterresources:Useandoverutilizationofsurfaceandgroundwater,floods,drought,conflictsoverwater, dams benefits and problems.
- Forestresources:Useandoverexploitation,deforestation,casestudies.Timberextraction,mining,dams and their effects on forestsandtribal people.
- Landresources:Landasaresource,landdegradation,Maninducedlandslides,soilerosion anddesertification.
- Mineralresources:Useandoverexploitation,Environmentaleffectsofextractingandusi

ngmineralresources, casestudies.

- Foodresources:Worldfoodproblems,changescausedagricultureandovergrazing,effectsofmodernagriculture,fertilizer–pesticide problems,waterlogging,salinity,Casestudies.
- Energy resources:Growingenergy needs,renewableandnonrenewableenergy sources,useof alternateenergysources.Case studies.
- Role of anindividualinconservation of naturalresources.

Unit II Ecosystem and Biodiversity

:Ecosystem-

Conceptofanecosystem.

1. Structureandfunctionsofanecosystem.
2. Producers,consumersanddecomposers.
3. Energyflowintheecosystem.
4. Ecologicalsuccession.
5. Foodchains,foodwebsandecologicalpyramids.
6. Introduction,types,characteristicfeatures,structureandfunctionofthefollowingecosystem.
   (a) Forestecosystem.(b)Grasslandecosystem
   (c)Desert ecosystem. (d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans,estuaries)

Biodiversityand itsconservation:

- Definition,geneticspeciesandecosystemdiversity.
- BiogeographicallyclassificationofIndia.
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and optionvalues.
- Biodiversityat global,Nationalandlocallevels.
- India asa mega-diversitynation.
- Hot-spotsofbiodiversity.
- Threatstobiodiversity:habitatloss,poachingofwildlife,man–wildlifeconflicts.
- Conservationofbiodiversity:in-situandex-situconservationofbiodiversity.

UnitIII EnvironmentalpollutionandGlobal Effects.

- Definition,Causes,Effects,andcontrolmeasuresof(a)Airpollution(b)Waterpollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclearhazards
- SolidwasteManagement:Causes,effectsandcontrolmeasuresofurbanandindustrialwastes.
- Roleof anindividualin prevention of pollution.
- Pollutioncasestudies.
- Disastermanagement:Floods,earthquakes,cyclone,landslides,Tsunami.
- Climatechange-Globalwarming,Acidrain,Ozonedepletion,.

Unit IV EnvironmentIssues andManagement

- Environment and Human health – Epidemic diseases, HIV/AIDS, Aviation Flue, WaterBorneDiseases.

- Environmental Impact Assessment, Sustainable Development, Clean Production and CleanDevelopment Mechanisms
- Environment Legislation: Environmental Protection Act, Water Act, Air Act, Wild LifeProtection Act, Forest Conservation Act, Public Liability & Insurance Act, Issues involvedinEnforcementof Environmentallegislation.

UnitV SocialIssuesandtheEnvironment

- Populationgrowth,PopulationExplosion,PopulationControl,WomenandChildwelfare.
- Urbanization, Industrialization, Development projects, Resettlement and Rehabilitation ofpeople– Problems concerned, Casestudies.
- Consumerism and Waste Products Conservation, Public Awareness, Water Conservation,Rain water harvesting, watershed management, Wasteland reclamation, Human Rights,Valueeducation, Environmental ethics-Issuesandpossiblesolution.
- RoleofinformationTechnologyin Environment andHuman Health.

Course Outcome:

CO1	Able to understand the importance of the environment
CO2	Able to identify conservation concepts of natural resources
CO3	Able to identify problems due to human interactions in the environment
CO4	Able to understand the enforcement of environment acts in our constitution
CO5	Capable of managing social issues related to environment

Textbooks:

1. AnubhaKaushik&CP Kaushik, Environmentalstudies,NewageInternational Publishers,2008
2. BennyJoseph,Environmentalstudies,TataMcGraw-HillPublishers,2005
3. MChandraSekhar,EnvironmentalScience,Hi-TechPublishers,2004
4. KeerthinarayanaandDanielYesudian, PrinciplesofEnvironmentalSciencesandEngineering, Hi-Tech Publishers, 2005
5. AmalK.Datta,IntroductiontoEnvironmentalScienceandEngineering, Oxford&IBHPublishingCo.Pvt.Ltd, 2000
6. SanthoshkumarGarg,RajeshawriGargandRajniGarg,EcologicalandEnvironmental studies,Khannapublishers,2006

Referencebooks:

1. GilbertM,IntroductiontoEnvironmentalEngineeringandScience,
MastersPublicationbyPrentice–Hallof IndiaPrivateLtd., 1991

2.WilliamPCunninghamandMaryAnnCunningham,PrinciplesofEnvironmentalScience,TataMcGraw Hill PublishingCo.Ltd,2002

Mapping of Course Outcomes with Program Outcomes:

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

MET01ENGINEERINGGRAPHICS

Lecture/Hoursperweek:02 hrs | Credits:04
Drawing/week:03hrs | Sessionals:20+20
EndSemesterExam:60

Course Objective:

- This course will introduce students to Engineering Drawing and build their ability to read drawings and interpret the position and form of simple geometry, culminating into understanding of simple technical assemblies.
- To gain and understanding of the basics of geometrical constructions of various planes and solids, understanding system of graphical representation of various objects and various views to draft and read the products to be designed and eventually for manufacturing applications
- To familiarize the students in basic concept of conic sections, projections and developments of Objects.
- To impart knowledge about standard principles of orthographic projection of objects.
- To draw sectional views and pictorial views of solids.

UNIT-I

Scales,planescale,diagonalscalePractices
Conics- construction of Ellipse, parabola and Hyperbola by eccentricity methodEllipse-Concentric circlesandOblong methods,
Rectangularhyperbola

UNIT-II

Constructionof cycloidalcurves-epi cycloidandhypocycloid, Involutes-Circle,Polygon

UNIT-III

Projection of points-Principles of Projections, First and Third angle projections, projections of

pointsProjectionofLines-
ProjectionofstraightLines,linesinclinedtooneplaneandparalleltotheother,Linesinclinedto bothplanes,True length andtrueinclinations, Location oftraces

UNIT-IV

Projection of Plane surfaces and solids-Projection of Polygonal surfaces and circular lamina inclined toboth planes. Projection of right regular solids- Projection of simple solids such as Prisms, Pyramids,Cylinders and Cones with their axes perpendicular to anyone of the Principal planes and inclined to theother.

UNIT-V

Section of Solids- Sections of above solids in simple vertical position resting on their base, by cuttingplanesinclined toonereference planeandperpendicular to the other-Trueshape ofthe sections.
OrthographicProjections-Conversionof Pictorialviewsintoorthographicviewsofsimple objects.

Course Outcome:

CO1	Able to Select, Construct and Interpret appropriate drawing scale as per the situation.
CO2	Able to draw simple curves like ellipse, cycloid and spiral.
CO3	Able to draw projections of points and lines in any direction of plane.
CO4	Able to draw projections of planes and solids in any direction of a plane.
CO5	Draw orthographic projection of solids like cylinders, cones, prisms and pyramids including sections.

Text Books:

1. **BhattN.D.andV.M.Panchal,**EngineeringDrawingRevisedEdition,CharotarPublications,2001.
2. **DhananjayaAJolhe,**EngineeringDrawingwithanintroductiontoAutoCAD,TataMeGrawhill-2009
3. **K.L.NarayanaandP.Kannaih,**Atext BookofEngineeringDrawing,ScitechPublications–1999.
4. **Venugopal,K.,**EngineeringDrawingandGraphics,NewAgeInternationalPublishers

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1	1			1	1					
CO 2	2	1				1	1					
CO 3		2		2		2						1
CO 4			1	2			1					
CO 5		1		2		3						

CSP01COMPUTERPROGRAMMINGLAB

InstructionHours /Week:3 **Credits:2**

Common to all branches and with effect from 2017-18

Course Objective:

- To make the student solve problems, implement algorithms using C language.
- To make the student solve problems, implement those using C & C++ programming languages.
- To strengthen the ability to identify and apply the suitable data structure for the given real world problem
- To organize the user's data for decision making and iterative processes.
- To apply structured programming approach to solve real time applications.

Syllabus

1. **C and C++ Programming Languages shall be used for Implementation of thefollowingPrograms.**

2. **ThefollowingListisnotexhaustive,Theinstructorchangestheproblemsandnumber ofprogramsforcontinuousevaluationTeachingLearningProcess**

Week-1 1)WriteaC program to make thefollowing exchange between thevariablesa->b-> c->d-> a

2) Write a C program to carry out the arithmetic operations addition,subtraction,multiplication,anddivisionbetweentwovaria bles
3) WriteaC programforprintingprimenumbersbetween 1and n.

Week-2 1)Writea Cprogramtoconstructamultiplication tablefor a given number.
2) Writeaprogramtoreversethe digitofa given integer.
3) Writea C programto findthesumof individualdigitsof apositiveinteger.
4) Writea Cprogramtocalculate the factorialofagiven number

Week-3 1) Fibonacci sequence is defined as follows: the first and second terms in the sequenceare 0 and 1. Subsequent terms are found by adding the preceding two terms in thesequence.Write a C programto generatethefirst n terms

ofthesequence.

2) Writeaprogramtocalculate tax, given thefollowingconditions:

a) Ifincome is less than 1,50,000 then notax.
b) If taxableincome isintherange1,50,001 –300,000 thencharge 10%tax
c) If taxableincome isintherange3,00,001 –500,000 thencharge 20%tax
d) If taxableincomeis above5,00,001thencharge 30%tax

Week-4 Writea programto printthe calendarfora month given thefirst Week-dayofthemonth.

Input the first day of the month
(Sun=0,Mon=1,Tue=2,Wed=3,.....) ::3Totalnumberofdays inthe month :31
Expectedoutput

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
-	-	-	*1*	*2*	*3*	*4*
5	*6*	*7*	*8*	*9*	*10*	*11*
12	*13*	*14*	*15*	*16*	*17*	*18*
19	*20*	*21*	*22*	*23*	*24*	*25*
25	*26*	*27*	*28*	*29*	*30*	*31*

2) Writea C programtofind therootsof a quadraticequation

Week-5

1) Writea programto printthePascaltrianglefor agiven number
2) WriteaC programtofindtheGCD(greatest commondivisor)of twogiven integers
3) WriteaC programtoconstructapyramid ofnumbers.
4) WriteCcodeto define afunction cash_dispense, which takes anamount asits input, andreturns the numberof1000,500,100, 50, 20, 10, 5,2, 1rupee denominationthatmakeupthe givenamount

Week-6

1) Write Ccodetoreverse thecontents ofthearray.For example, [1,2,3,4,5]should become[5,4,3,2,1]
2) Writea C programthat uses functionsto performthefollowing:
   i) AdditionofTwoMatrices

   ii)MultiplicationofTwoMatrices

3) Writeaprogramthatwillsearch andfindout theposition wherethe given key element existina userchosenarrayandprintitas output.

Week-7

1) Write Ccodeto compute the frequencytableofsurvey responsesgiven by20 users.Thesurveyresponsesrange from1 to 5 andare stored inan array. For example, 10responses are stored inthe array[1,1,5,2,3,3,5,5,2,2].Thefrequency tablewillbeasshownbelow:
   a. 1 = 2
   b. 2 = 3
   c. 3 = 2
   d. 4 = 0
   e. 5 = 3
2) Writea programto defineafunction tosort anarrayofintegersin ascendingorder byusingexchangesort.

Week-8

1) Write a C program to check whether a given string is a palindrome or not, withoutusinganybuilt-in functions.
2) Writea Cprogramto determine ifthe givenstringis apalindrome ornotbyusing stringfunctions.
3) Writea functionthat accepts a stringand deletethefirst character.
4) Writea functionthat accepts astringand deleteallthe leadingspaces.

Week-9 Write a program to accept a string from user and display number of vowels,consonants, digits and special characters present in each of the words of the givenstring.

Week-10 1)Write a C program to define a union and structure both having exactly the samenumbers using the sizeof operators print the sizeof structure variables as well asunion variable

2)Declare astructure*time*that hasthreefields*hr,min,secs.*Createtwo variables,*start_time*and*end_time.*Input there values from the user. Then while*start_time*isnot equal to*end_time*displayGOODDAY onscreen.

Week-11 1)Write a program to read in an array of names and to sort them inalphabetical order.Use sort function that receives pointers to the functionsstrcmp,andswap,sortinturnshouldcallthesefunctionsviathepointers.

2) Writeaprogram toreadanddisplayvaluesof aninteger array.Allocatespacedynamicallyforthe arrayusingthe*malloc()*.
3) Write a program to calculate area of a triangle using function that has theinputparametersas pointersas sidesof thetriangle.

Week-12 1)Two text files are given with the names text1 and text2. These files have severallines of text. Write a program to merge (first line of text1 followed by first line oftext2 and so on until both the files reach the end of the file) the lines of text1 andtext2 and writethemerged text toa newfiletext3.

2)Write a program to split a given text file into n parts. Name each part as the nameof the original file followed by .part<**n**>where n is the sequence number of thepartfile.

Course Outcome:

CO1	The ability to design and develop applications, as well as to analyze and interpret data.
CO2	Graduates will be able to demonstrate with excellent programming, analytical, logical and problem solving skills.
CO3	Graduates will demonstrate with an ability to develop, test and debug the software.
CO4	Graduates will demonstrate with an ability to deploy, analyze, troubleshoot, maintain, manage and secure the computer network.
CO5	Graduates will be able to communicate effectively in both verbal and written forms.

ReferenceBooks:

1. Computer Science, A Structured Programming Approach Using C byBehrouz A. Forouzan& Richard F. Gilberg, Third Edition, CengageLearning
2. CProgrammingAProblem-SolvingApproach,BehrouzA.Forouzan& E.V.Prasad,F.Gilberg, ThirdEdition,CengageLearning
3. ProgrammingwithCRemaTheraja,Oxford
4. "CTestYourSkills",Kamthane,PearsonEducation
5. ProgramminginC:APracticalApproach,AjayMittal,Pearson
6. ProblemsolvingwithC,M.T.Somasekhara,PHI
7. CProgrammingwithproblemsolving,J.A.Jones&K.Harro w,DreamtechPress

Programmingwithc,ByronSGottfried,JitenderKumarChhabra,TMH,2011

Mapping of Couse Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	1									
CO 2	1			2	2							
CO 3			2	3		1						
CO 4		1		2								
CO 5			2	2	1							

MEP01 WORKSHOPPRACTICE

Practicalsperweek:03hrs Credits:02
Sessionals: 20+20EndSemesterExam:60

Course Objective:

- To understand the basic tools and operations in carpentry
- To understand the basic tools and operations in fitting & various types of joints.
- To understand the basic tools and operations in sheet metal trades.
- To understand the basic tools of house wiring & house wiring connections etc.
- To understand the basic tools and manufacturing processes in a foundry trade

Carpentry

Woodsizingexercise inplanning,marking, sawing,chiselingandgroovingto prepare

1. Half–lapjoint
2. Dove–tailjoint
3. MitredMortiseandTenonjoint

Fitting

Markings,cuttingandfilingtoprepare

1. Straightfitting
2. V–fitting
3. Squarefitting

Tin smithy

Markings,bendingandcuttingtoprepare

1. Roundtin
2. Squaretin
3. TruncatedPrism

Foundry

Rammingand placingofriserand runnerto preparethe mouldsforthefollowing

1. Two–stepped pulley
2. Three–steppedpulley
3. Dumbell

ElectricalWiring

1. Onelightcontrolledbyoneswitchin parallel
2. Twolightscontrolledbyone wayswitchinseries

Course Outcome:

CO1	Design and develop different types of wood joints based on the requirement
CO2	Design and develop different types of fittings as per requirement
CO3	Able to develop prototype models by using tin smithy too1ls.
CO4	Design and develop different moulds as per practical requirements.
CO5	Able to connect bulbs either series or parallel

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1		1		1	1						1
CO 2	1		2		2	2						
CO 3		1		3	3	2						
CO 4			1	2	2							1
CO 5			1		2	2						1

MAT02ENGINEERINGMATHEMATICS–II

Instruction Hours /Week:5 **Credits:4**

Common to all branches and with effect from 2017-18

Course Objective:

- This course will illuminate the students in the concepts of liner algebra.
- To introduce the vector methods and vector calculus in evaluating multiple integrals in two and three dimensional spaces.
- To equip the students with standard concepts of Fourier series and harmonic analysis and their applications.
- To familiarize the students with the techniques of evaluating improper integrals.
- To provide knowledge on Legendre's polynomials and properties of Bessel's functions.

Unit– 1

Matrices: rank of a matrix-solution of system of linear equations-eigenvalues,vectors-cayley-hamiltontheorem-quadraticforms-diagonalization.

Unit– 2

Vector Calculus: Gradient, Divergence, Curl of a vector and related properties-line, surface, volumeintegrals-Green's, Stokes'sand Gauss Divergencetheoremsand itsapplications.

Unit– 3

Fourier Series: Fourier series-even and odd functions, periodic functions-half range sine and cosineseries-harmonic analysis.

Unit– 4

Special Functions I: Gamma and Beta functions-series solutions of differential equations-

ordinary points.**Unit– 5**

SpecialFunctionsII:Besselfunction-recurrenceformulae-generatingfunctionfor$J_n(X)$-Lengenderpolynomials-recurrence formulae-generating function for $P_n(X)$ - Rodrigue's formula - orthogonality ofLengender polynomials.

Course Outcome:

CO1	Use ranks of matrices to decide whether the system of linear equations is consistent or not and hence solve.
CO2	Acquire knowledge about the physical interpretation of the gradient, divergence and curl.
CO3	Able to know the basic results about the properties of Fourier transform and Fourier series and its convergence.
CO4	Acquire the knowledge of properties of special functions and to use this to solve differential equations.
CO5	Able to generate the functions of Lengender polynomials.

TextBooks:

1. BSGrewal,HigherEngineeringMathematics,40th Edition,KhannaPublications,2007.
2. MKVenkataraman,EngineeringMathematics,NationalPublishingCompany,Chennai.
3. BVRamana,HigherEngineeringMathematics,6thReprint,TataMcGraw-Hill,2008.
4. Baliand Iyengar, EngineeringMathematics,6th Edition,LaxmiPublications,2006.

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	2	2		2	1						
CO 2	1	1		2	2							
CO 3		1		2	2							
CO 4		2		2	2							
CO 5		1	2	2								

CST02DATASTRUCTURES

InstructionHours /Week:5 **Credits:4**

Commontoallbranchesandwitheffectfrom2016-17

Course Objective:

- To provide the knowledge of basic data structures and their implementations.
- To choose the appropriate data structure and algorithm design method for a specified application.
- To efficiently implement the different data structures and solutions for specific problems.
- To solve problems using data structures such as linear lists, stacks, queues, binary trees, binary search trees, and graphs and writing programs for these solutions.
- To develop skills to apply appropriate data structures in problem solving and allow to assess how the choice of data structures and algorithm design methods impacts the performance of programs.

UNITI

DefinitionsofDatastructures,StorageStructuresandFileStructures.PrimitiveandNon-primitiveDataStructures, LinearandNonlinear DataStructures. PerformanceAnalysis,AsymptoticNotationandPerformanceMeasurement.LinearLists-ADT,ArrayRepresentation,LinkedRepresentation andapplications.

UNITII

Stacks:Definition,TheAbstractDataType,ArrayRepresentation,LinkedRepresentation.Queues:Definition, The Abstract Data Type,Array Representation, LinkedRepresentation, Circular Queues,Applications. Linked Lists: Single Linked Lists – Insertion and Deletion, Double Linked Lists – Insertionand Deletion.

SkipListandHashing: Dictionaries,theADTofSkipList,LinearListRepresentation,HashTableRepresentation.

UNITIII

BinaryTrees-DefinitionandProperties,ADT,ArrayRepresentation,LinkedRepresentation,andApplications.Heap -Definition and Applications.

BinarySearchTrees-Definition,ADT,ImplementationandApplications.

Introduction to Balanced Search Trees - AVL Trees, Red-Black Trees, and

Splay Trees.**UNITIV**

Graphs - Definition and Properties, Modeling Problems as Graphs, ADT, Representations, BreadthFirst Search and Depth First Search.Priority Queues: Definition and Applications, Single and DoubleEnded Priority Queues, Linear Lists, Heaps, Leftist Trees, Binomial Heaps, Fibonacci Heaps, PairingHeaps

Introduction to Algorithms for Solving Problems: Minimum Spanning Tree, Single Source ShortestPaths,All-PairsShortest Paths, and MaximumFlow.

UNITV

EfficientBinarySearchTrees:OptimalBinarySearchTrees,AVLTrees,Red–BlackTrees,SplayTrees. MultiwaySearchTrees:m– waySearchTrees,B– Trees,B+ -Trees

ExternalSearching-ConceptsofSimpleIndexing,MultilevelIndexing,B-Trees,B+Trees,StaticHashing,CollisionResolutionTechniques,PackingDensity,BucketSizeandExtendibleHashing.

Course Outcome:

CO1	Understand various algorithms for searching and sorting
CO2	Design and implement data structures like arrays, stacks & queues
CO3	Learning to use singly/doubly linked lists for efficient implementation of data structures
CO4	Understanding the tree data structure, with focus on binary trees, binary search trees and height-balanced trees

CO5	Understand data structures such as minimum spanning trees and graphs and also their applications in real world scenarios

TextBooks:

1. SahniS,DataStructures,AlgorithmsandApplicationsinC++,2ndEdition,UniversitiesPress,2005.
2. MalikDS,Data StructuresusingC++, CengageLearning,2003.
3. Fundamentals of Data Structures in C++ by Ellis Horowitz, SartajSahni, Dinesh Mehta,UniversitiesPress, SecondEdition.

REFERENCES:

1. DataStructuresandAlgorithmsUsingC++byAnandaRaoAkepoguandRadhikaRajuPalagiri
2. ClassicDataStructurebyD. Samanta,Eastern EconomyEdition.
3. Data Structures and Algorithms Made Easy by NarasimhaKarumanchi, Second Edition, Writtenin C/C++, CareerMonkPublications,Hyderabad
4. ADTs,Data StructuresandProblemSolvingwithC++,LarryNyhoff,Pearson
5. DataStructuresusingC++,D.S.Malik, 2nd Edition,Cengage Learning
6. DataStructuresthroughC++,YashavantP.Kanetkar,BPBPublication
7. Data Structures using C and C++, YedidyahLangsam.MosheJ.Augenstein Aaron M.Tenenbaum,2nd Edition,PHI
8. DataStructuresusingC &C++,RajeshK.Shukla,Wiley-India
9. Tremblay J P and Sorenson P G, Introduction to Data Structures with Applications, 2nd Edition,McGraw-Hill,1984.
10. Cormen T H, Leiserson C E, Stein C, and Rivest R L, Introduction to Algorithms, 2nd Edition,PrenticeHall of India, 2007.
11. Folk M J, Riccardi G, and Zoellick B, File Structures-An Object-Oriented Approach with C++,Pearson
12. T.H.Cormen, C.E.Leiserson, R.L.Rivest, C. Stein, Introduction to Algorithms, 2nd edition,Prentice-Hall India, 2001
13. J.Kleinbergand E.Tardos,AlgorithmDesign,PearsonInternational Edition,2005.
14. Data StructuresUsing C andC++ YddishLangsam,Moshe J. Augenstein and Aaron M.Tanenbaum,Prentice HallOfIndia(2nd Edition)(Chapters1to 8)

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	2		1	2							
CO 2	1	2	1		1							
CO 3		1	2	2								
CO 4		1	2	1	2							
CO 5			2	2	1							

EET43 BASICELECTRICALENGINEERING

InstructionHours /Week:3 **Credits:3**

Common to Civil, Mechanical, Chemical branches and with effect from 2017-2018

Course Objective:

- To introduce the concepts of electrical circuits and its components
- To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
- To study and understand the different types of DC/AC machines and Transformers.
- To import the knowledge of various electrical installations.
- To introduce the concept of power, power factor and its improvement.

UNIT-I

Basic Circuit Concepts: Basic circuit elements R, L and C—Classification of circuit elements,voltageand current sources—Kirchoff's laws—Star-delta andDelta to Star transformations, Network reductiontechniques,Simpleproblems

UNIT-II

DC Circuits: DC Circuit analysis by mesh current method and Nodal voltage method, Superpositiontheorem,Thevenin'stheoremandmaximumpower transfertheorem–ApplicationtosimpleDCcircuits

UNIT-III

AC Circuits: Averagevalue—RMSvalue—form factor,crestfactor---j-notation,Phasordiagrams,reactance, impedance and admittance, active power, reactive power, apparent power , power triangle.—Expressionfor realpower in accircuit—Analysisof simple---seriesand parallelcircuits

UNIT-IV

DC Machines: Principle of operation of dc generator, emf equation, types of generators, principle ofoperation of dc motor, Back EMF, torque equation of dc motor, Illustrative examples, applications dcmotors

UNIT-V

Transformers: Single phase transformer –principle of operation—types of transformers—emf equation,transformer on load

InductionMotors:principleofoperationof3-phaseinductionmotor,typesof3-phaseinductionmotorsPrincipleofsinglephaseinductionmotor,types,applicationsof3-phaseandsinglephaseinduction motors

Illuminations: Introduction,LawsofIllumination,Lightingcalculations,Designof lightingschemes

Course Outcome:

CO1	Demonstrate and able to explain electrical components, electrical circuits and Kirchoff's laws.
CO2	Acquire knowledge of DC circuit analysis, DC network theorems and their applications
CO3	Formulate and solve complex AC, DC circuits.
CO4	Understand the principles of operation of DC machines, single phase transformers and three phase induction motors
CO5	Identify the starting methods of starting synchronous and induction motors and speed control methods for DC motors

TextBooks:

1. NetworkanalysisbyASudhakar,ShyamMohan(TataMcGrawHill)
2. Basic Electrical Engineering by DP Kothari, IH Nagrath (Tata McGrawHill)

References:

1. ElectricalTechnology–E.Hughes(UniversityPress)
2. ElectricalCircuits–JosephEdminister(TMHSeries)

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1		2								
CO 2	2	1	2									
CO 3		1		2	2							
CO 4			2	2	1	1						
CO 5			1	1	2							

CYT 02 PHYSICAL CHEMISTRY

Instruction: 3 hr / week **Credits:3**

Unit -I: SOLUTIONS: Definition – types – solutions of liquids in liquids – solids in liquids-gases in liquids – Raoult's law ideal and non- ideal solutions-Dilute solutions-Colligate properties, lowering of vapor pressure-elevation of boiling point-depression of freezing point and Osmotic pressure.

PHYSICAL PROPERTIES AND CHEMICAL CONSTITUTION: Surface tension-viscosity – dipole moment – refractive index – optical activity – magnetic properties.

Unit – II: ELECTRO CHEMISTRY: Conductance of solutions-Arrhenius theory of electrolytic dissociation – Las of independent migration of ions-transport number and its determination – Debye – Hukel theory – Conductometric titrations – Polarization – over voltage.

POLAROGRAPHY: Concentration of polarization-Polarographic cell assembly-llkovic equation – Half wave potential – applications of polarography – Amperometric titrations.

Unit – III: PHOTO CHEMISTRY: Laws of photochemistry – Consequences of light absorption – quantum efficiency and its determination – photochemical reactions-kinetics of (H_2 – Cl_2), H_2 – Br_2 and decomposition of Hl – photosensitization – photosynthesis – fluorescence – phosphorescence – Chemiluminiscence – photoelectric cells.

SURFACE CHEMISTRY: Types of adsorption – adsorption of gasses by solids – factors affecting adsorption – Freundlich adsorption isotherm – Langmur adsorption isotherm – applications of adsorption.

Unit – IV: SPECTROSCOPY: Introduction – properties of electromagnetic radiations – atomic and molecular spectra – principle, instrumentation and applications of UV, IR , AAS, flame photometry, Colorimetry, Polarimetry, Fluorometry and Turbidometry.

Unit – V: CHROMATOGRAPHY: Separation – definition – classification – principles and instrumentation of paper, thin layer, gas, high performance liquid chromatography, electrophoresis and ion exchange methods.

THERMOMETRIC METHODS: Introduction – thermo-gravimetric analysis – differential thermal analysis – thermo-balances – applications of thermometric titrations.

BOOKS:

1. Elements of physical chemistry – Samuel Glasstone and D.Lewis

2. Physical Chemistry – Puri and Sharma

3. Instrumental methods of analysis – Willard, Merit, Dean and Settle

4. Instrumental methods of analysis – BK Sharma

MET 41 MECHANICAL TECHNOLOGY

Instruction: 4 hr / week **Credits: 4**

Unit I : TRANSMISSION OF MOTION: GEARS - Introduction, type of gears, Terminology of gears, Fundamental law of gears, Relative velocity between gear teeth, Gear tooth forms, Comparison between Involutes and cycloidal tooth profiles, Introduction to gear trains

BELTS AND ROPES: Introduction, Types of belts, velocity ratio, Effect of slip, Law of belting, Length of open and cross belt, Angle or arc of contact, Ratio of belt tensions, Power transmitted, Initial belt tension, Effect of initial tension on power transmission, belt materials.

Unit II : BOILERS Classification of boilers, Comparison between fire tube and water tube boilers – selection of boiler, Essentials of a good steam boiler – boiler terms – fire tube boilers – simple vertical and locomotive boiler, water tube boilers – Babcock and Wilcox boiler – boiler mountings and accessories (functions only)

Unit III : STEAM ENGINES: Steam Engines parts and description, working of single cylinder steam engine and compound steam engine.

STEAM TURBINES: Classification, advantage of steam turbine, uses of steam turbine, description, common type of turbines.

CONDENSERS: Classification, organs of a steam condensing plant, principles of working of condensers such as jet condenser and surface condenser

Unit IV : I C ENGINES – Classification, application of I C Engines, different part of I C Engines, two stroke and four stroke cycle engines, comparison of four stroke and two stroke cycle engines, comparison of spark ignition (SI) and combustion ignition (CI) engines – fuel system, cooling system and lubrication system.

TESTING OF I C ENGINES – Indicated power (IP), Brake power (BP), Friction Power (FP), Mechanical and brake thermal efficiencies (simple problems)

Unit V : GAS TURBINES – Classification, Merits of Gas Turbines, Constant pressure, Combustion Turbines: Open Cycle gas turbine, closed cycle gas turbine, constant volume combustion turbine – uses of gas Turbine, Gas Turbine fuels

JET PROPULSION - Turbojet, Ramjet and Turbo – propulsion.

BOOKS:

1. Theory of Machines by Sadhu Singh

2. Thermal Engineering by R.K. Rajput.

3. Elements of Mechanical Engineering by Roy and Chowdary

ENT01 ENGLISH

InstructionHours /Week:3 **Credits:3**

Common to all branches and with effect from 2017-18

Course Objective:

- Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
- Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
- Develop study skills and communication skills in formal and informal situations.
- To develop communication skills among the students.
- To construct proficiency in academic and social purpose to improve their grammatical accuracy.

Unit-I EffectiveCommunication: Role andImportanceof Communication, Features ofHumanCommunication, Process of Communication, Interpersonal Communication, Barriers, Types-Verbal,Non-Verbal.

Unit-II Grammar:Articles,prepositions,tenses,reportedspeech,idiomsandphrases

Unit-III ListeningSkills:ProcessofListening,TipsforEffectiveListening,

Speaking Skills: Basics of Spoken English, English Sounds, Rhythm and

IntonationTelephonicSkills, Group Communication

ReadingSkills: DevelopingReadingSkills,ReadingStrategies,ReadingComprehension,

WritingSkills:ParagraphWriting,EssayWriting,E-writing,Jobapplications,,Reports.Resume andLetter Writing.

Unit-IV

SoftSkills:TemWorkSkills,InterviewSkills,Problem-SolvingSkillsAdoptabilitySkills,PresentationSkills and Group Discussions.

Unit-V StoriesfromDelightandWisdom(AnAnthologyofShortStories)

1. TheGiftof MagiByO. Henry
2. TheDiamondNecklacebyGuyDeMaupassant
3. MyBrother, MyBrother byNorahBurke
4. TheOpen WindowbySaki
5. TheChildbyPremchand

TextBooks:

1. OxfordguidetoEffectivewritingandSpeakingbyJohnSeely,OxfordUniversityPress,2013,ISBN-978-0-19-871393-7
2. DelightandWisdompublishedbyOrientBlackswan,2009,ISBN:978-81-250-3716-3

ReferenceBooks:

1. DavidGreen,StructureandCompositioninEnglish,MacmillanPublishersIndia Limted.
2. CommunicativeEnglishbyE.SureshKumar,P.Sreehari,OrientBalckSwan,2009. ISBN:13:9788125032502

3. EnglishandSoftSkillsbySP DhanavelpublishedbyOrientBlackswan,2013. ISBN9788125039808
4. Personality Development and Soft Skills by Barun K. Mitrapublished byOxford UniversityPress.2012.ISBN: 13:97280198066217

5. Course Outcome:

6.

CO1	Able to understand the use of English in everyday situations and contexts.
CO2	Student will be in a position to face computer based competition exams like TOEFL.
CO3	Able to communicate effectively and write accurately using English language.
CO4	By the end of the course students will be able to graduate with good English competence
CO5	Phonetics makes the students to pronounce accurately

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	2									
CO 2	2		2	2								
CO 3		1		2	2							
CO 4			2	2	3							
CO 5		1	1	2								

CSP02DATASTRUCTURESLAB

InstructionHours /Week:3 **Credits:2**

Common to all branches and with effect from 2017-18

Course Objective:

- The course is designed to develop skills to design and analyze simple linear and non-linear data structures.
- To make the student learn an object oriented way of solving problems.
- It strengthen the ability to the students to identify and apply the suitable data structure for the given real world problem.
- It enables them to gain knowledge in practical applications of data structures.
- It is used to choose the appropriate data structure and algorithm design method for a specified application and determine which algorithm or data structure to use in different scenarios.

1. WriteaC++Programtocreateasequentialfilewithatleast5records,eachrecordhavingthestructureshown below:

USN	**Name**	**Marks1**	**Marks2**	**Marks3**
Non-zeroposi tive integer	25 Characters	Positiv eIntege r	Positiv eIntege r	Positiv eIntege r

Writenecessaryfunctions

a. Todisplayallthe recordsin the file.

b. TosearchforaspecificrecordbasedontheUSN.Incasetherecordisnotfound,suitablemessa

geshould be displayed. Boththeoptionsinthis case mustbedemonstrated.

2. Writeand demonstratethefollowingC++ functions:
   a. **newStrCpy**thatdoesthesamejobas**strcpy**

   b. **newStrCat** thatdoesthesame job as**strcat**withoutusinganylibraryfunctions.

3. Write a C++ Program, which accepts the Internet Protocol (IP) address in decimal dot format(ex.153.18.8.105) and converts it into 32-bit long integer (ex. 2568095849) using **strtok** libraryfunctionandunions.
4. Write a C++ Program to construct a **stack of integers** and to perform the following operations onit:
   a. Push

   b. Pop

   c. Display

Theprogramshouldprintappropriatemessagesforstackoverflow,stackunderflow,andstack empty.

1. Write a C++ Program to convert and print a given valid parenthesized **infix** arithmetic expressionto**postfix**expression.Theexpressionconsistsofsinglecharacteroperandsandthe binaryoperators+(plus),-(minus), * (multiply)and / (divide).
2. Write a C++ Program to evaluate a valid **suffix/postfix** expression using stack. Assume thatthesuffix/postfixexpressionisreadasasinglelineconsistingofnon-negativesingledigitoperandsand binary arithmetic operators. The arithmetic operators are + (add), - (subtract), *(multiply)and/ (divide).
3. Write a C++ Program to simulate the working of a **queue of integers** using an array. Provide thefollowingoperations:

   d. Insert

   e. Delete

   f. Display

4. Write a C++ Program to simulate the working of a **circular queue of integers** using an array.Providethefollowingoperations:
   g. Insert

   h. Delete

i. Display

5. Write a C++ Program using dynamic variables and pointers, to construct a **singly linked list**consisting of the following information in each node: student id (integer), student name (characterstring)andsemester (integer).The operations to besupported are:

j. Theinsertionoperation
   i. Atthe frontof a list
   ii. At the backofthelist
   iii. At anyposition inthe list
k. Deleting a node based on student id. If the specified node is not present in the list an errorMessageshould bedisplayed. Boththe options shouldbedemonstrated.
l. Searching a node based on student id and updates the information content. If the specifiedNode is not present in the list an error message should be displayed. Both situationsshouldbedisplayed.
m. Displayingallthenodesinthelist.
(Note:Onlyonesetofoperationsamonga,bandcwithdmaybeaskedintheexamination)

6. Write a C++ Program using dynamic variables and pointers to construct a **stack of integers**using**singlylinked list** andto performthefollowingoperations:
   n. Push
   o. Pop
   p. Display

   Theprogramshouldprintappropriate messagesforstackoverflowandstackempty.

7. WriteaC++Programusingdynamicvariablesandpointerstoconstructa**queueofintegers**usin g**singlylinked list** andto performthefollowingoperations:
   q. Insert
   r. Delete
   s. Display

   Theprogramshould printappropriatemessagesforqueuefull andqueueempty.

8. WriteaC++Programtosupportthefollowingoperationsona**doublylinkedlist**whereeachnod econsists ofintegers:
   t. Create a doublylinked listbyaddingeach nodeat thefront.
   u. Insertanewnodeto theleftofthe node whosekey valueisread asaninput
   v. Deletethenodeofagiven data,ifitisfound, otherwisedisplayappropriate message.
   w. Displaythecontentsofthelist.
   (Note: Onlyeither (a, bandd)or (a,c andd) maybe asked in the examination)
9. Writea C++ Program
   x. Toconstructa**binarysearchtree**ofintegers.
   y. Totraversethetree usingallthe methodsi.e.,**inorder,preorder andpostorder**.
   z. Todisplaytheelements inthe tree.
10. WriterecursiveC++Programs for

Searchinganelementona givenlist ofintegersusingthe

aa. Binary Searchmethod.

bb. Solvingthe **TowersofHanoiproblem**.

7. **Course Outcome:**

8.

CO1	Acquire knowledge of various Methods and Notations for comparing the performance of various Data Structures.
CO2	Acquire knowledge of development of linear data structures like stacks, Queues and their operations, Implementation using Arrays and Linked Lists.
CO3	Acquire knowledge of properties of Binary Search Trees, balanced binary search trees, Splay Trees, Red Black Trees, AVL Trees and their implementation
CO4	Acquire knowledge of efficient external searching techniques using Indexing, Hashing.
CO5	Acquire knowledge of indexing implementation in B-Trees and B+ Trees

Text Books:

1. Data structures and Algorithms using C++, AnandaRaoAkepogu andRadhikaRajuPalagiri,PearsonEducation.
2. C++ Solutionsfor MathematicalProblems,Ghosh,Arun,NewAgeInternationalPublishers.
3. Data Structures A Pseudocode Approach with C++, IndiaEdition,R.F.GilbergandB.A.Forouzan,Cengage Learning.
4. Programming Principles and Practice using C++,B.Stroustrup,Addison-Wesley(Pearsoneducation).
5. DataStructuresandSTL,W.J.Collins,McGrawHill,Internationaledition.
6. DatastructuresandAlgorithmswithOODesignpatternsinC++,B.R.Priess,JohnWiley&sons.
7. TheArt,Philosophy,andScienceofOOPwithC++,RickMiller,SPD.
8. C++forProgrammers,P.J.DeitelandH.M.Deitel,PHI/Pearson

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	2		1	2	1						
CO 2	1	2	1		1	1						
CO 3		1	2	2								
CO 4		1	2	1	2							
CO 5			2	2	1							

ENP01ENGLISHCOMMUNICATIONLAB

InstructionHours /Week:3 **Credits:2**

Common to all branches and with effect from 2017-18

Course Objective:

- To improve the students' fluency in English, through a well-developed vocabulary
- To enable them listening spoken English at normal conversational speed by educated English speakers
- To respond appropriately in different socio-cultural and professional contexts.
- To communicate effectively and appropriately in real life situation and develop drafting skills among the students.
- To develop and integrate use of the four language skills and enhance employability skills

Syllabus

Atleasttwentyexercisescoveringthetopics:Stress,Introduction,Accent,Intonation,EnglishvsHinglishandImportantSkillsusingComputer-Aided Packages.

Course Outcome:

CO1	Better pronunciation and accent
CO2	Ability to use functional English
CO3	Competency in analytical skills and problem solving skills
CO4	Increase possibilities of job prospects
CO5	Communicate confidently in formal and informal contexts

TextBook:

1.BarryTomalinandSuhashiniThomas,InternationalEnglishforCallCentres,McMillanPublishers,IndiaLimited, 2009

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	2									
CO 2	2		2	2								
CO 3		1		2	2							
CO 4			2	2	3							
CO 5		1	1	2								

III SEMESTER

MAT 03 ENGINEERING MATHEMATICS - III

Instruction: 3+2 hr / week **Credits: 4**

Course Educational Objectives:

- To gain the knowledge of mathematics & Engineering problems
- To model a wide range of engineering and practical problems as ordinary differential equations
- To train the students thoroughly in Mathematical concepts of ordinary differential equations, multiple integrals, Laplace Transforms and their applications.
- To prepare students for lifelong learning and successful careers using mathematical concepts of ordinary differential equations, multiple integrals, Laplace Transforms and their applications.
- To develop the skill pertinent to the practice of the mathematical concepts including the student abilities to formulate and modeling the problems, to think creatively and to synthesize information.

UNIT - I

Complex analysis - I: Analytical functions - Cauchy-Reimann equations – Construction of Analytic functions- Complex integration - Cauchy's theorem - Integral formula - Evaluation of integrals.

UNIT - II

Complex analysis - II**:** Taylor's and Laurents' series- Transformations- Conformal mapping - Bilinear transformations - Transformation of 1/z, z^2, sin z and cos z.

UNIT - III

Complex anaylasis –III: Singularities - Poles - Residues - Residue theorem – Contour integration- Evaluation of real integrals

UNIT - IV

Partial differential equations - I : Formation of differential equations - Classification - First order linear partial differential equations – Lagranges' linear equation - Method of multipliers - first order non-linear partial differential equations - Charpits method.

UNIT- V

Partial differential equations - II: Method of separation of variables - One dimensional wave equation - Heat equation – Laplace's equation.

Text Books:

1. Grewal B S, Higher Engineering Mathematics, 40th Edition, Khanna Publications, 2007.
2. Venkataraman M K, Engineering Mathematics, Vol. I & II, National Publishing Company, 1993.
3. Venkataraman M K, Engineering Mathematics, National Publishing Company, 1995.
4. Grewal B S, Engineering Mathematics, 13th Edition, Khanna Publications.
5. Kreyszig E, Advanced Engineering Mathematics, 8th edition, Wiley, 1998.

COURSE OUTCOME:

1	Applying various statistical models and methods for drawing conclusions and making decisions under uncertainty in engineering contexts
2	Apply statistical and numerical methods in various computer science related projects, seminars and research
3	Apply the knowledge of iterative methods to solve algebraic and transcendental equations, simultaneous linear equations, ODE (ordinary differential equations)
4	Acquire knowledge of finite differences, interpolation, numerical differentiation and numerical integration
5	Demonstrate a basic knowledge of the techniques for accurate and efficient solution of models based on linear and nonlinear systems of equations, ordinary differential equations and partial differential equations.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

CET 44 MECHANICS OF SOLIDS

Instruction : 2+2 hr/week **Credits : 3**

Objectives:

1. The course is designed to give fundamental knowledge of mechanics of deformable solids including stress, strain, stress – strain relations.
2. Theories of failure and energy methods.

UNIT – I: SIMPLE STRESSES AND STRAINS

Concept of stress and strain – Elasticity and plasticity, Hooke's Law – Stress – Strain Diagram – Factor of safety – Poisson's ratio – volumetric strain – Relation between elastic constants – Saint Venant's Principle – Principle of super position – Temperature stresses for simple bars only

UNIT – II: BEAMS & BENDING

Types of supports – loads – Shear force and bending moment for cantilever and simply supported beams without overhanging for all types of loads – Shear force and Bending Moment diagrams.

UNIT – III: FLEXURAL & SHEAR STRESSES

Theory of simple bending, simple bending formula. Distribution of Flexural and Shear stress in Beam section – Shear stress formula – Shear stress distribution for some standard sections.

UNIT – IV:

(A) COMBINED FLEXURE AND AXIAL LOADS - Circular, rectangular and triangular sections (Solid & Hollow) – Stress distribution due to combined flexure and axial load – Chimneys.

(B) PURE TORSION - Torsion formula – Power transmitted by a solid shaft - Hollow cylindrical shafts – Member subjected to combined torsion and axial load – Equivalent Bending moment and equivalent torque.

UNIT – V:

(A) THIN SHELLS - Thin cylindrical shells – Riveted cylinders (Boiler shells) thin spherical shells – wire wound thin cylinders.

(B)THICK SHELLS: Lame's equation – Compound cylinders – Shrink – fit allowance

.

TEXT BOOKS :

(1) Engineering Mechanics, Strength of Materials and Elements of Structural Analysis – C.Venkataramaiah & A.V.Narasimha Rao

REFERENCES :

(1) Strength of Materials – I.B.Prasad.
(2) Strength of Materials – S.S.Bhavikatti.
(3) Mechanics of Structures Vol. I --- S.B. Junnarkar
(4) Strength of Materials part - I ----Stephen Timoshenko.

Course Outcomes (COs):

At the end of this course students will be able to

1. Learn about the elastic and plastic behavior of material and evaluate stress invariants,
2. Shear force and bending moment diagrams.
3. Distribution of Flexural and Shear stress in Beam section
4. Stress distribution due to combined flexure and axial load
5. Thin shells and Thick shells..

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1		2								
CO 2	2	1	2									
CO 3		1		2	2							
CO 4			2	2	1	1						
CO 5			1	1	2							

CYT 03 ORGANIC CHEMISTRY

Instruction: 3 hr/week **Credits: 3**

UNIT - I: MECHANISMS OF ORGANIC REACTIONS

Aldol condensation - Birch reduction - Perkins reaction - Wolf Kishner reduction - Benzoin Condensation - Hydro boration - Cannizeros - Riemer tieman reaction - Wittig reaction - Grignard reactions.

UNIT II: STEREO ISOMERISM

Optical isomerism - Symmetry and Chirality - Optical isomerism of Lactic and tartaric acids - Sequence rule - Enantiomers - Diastereo isomers - Geometrical isomerism - E, Z system of Nomenclature - Confirmation of Cyclo hexane.

UNIT - III:CARBOHYDRATES

Classification - D and L designations - elucidation of structure of Glucose and Fructose. – Physical and Chemical properties – mutarotation

UNIT - IV

AMINO ACIDS: Dipolar nature of amino acids - Methods of preparation - Properties of amino acids

PROTEINS : Structure of proteins - peptides - classification and properties.

UNIT - V: HETEROCYCLIC COMPOUNDS

Nomenclature - preparation and chemical properties of Pyrrole, Furan, Thiophene, Pyridine, Quinoline, and Indole - their important derivatives.

TEXT BOOKS :

1. Text Book of Organic Chemistry, Robert Morrison and Robert Boyd, 3rd

REFERENCE BOOKS:

1. Organic Chemistry Vol.I and II, I.L.Finar
2. Synthetic Organic Chemistry O.P.Agarwal
3. Advanced Organic Chemistry - B.S. Bahl and Arun Bahl.

CHT 01 MOMENTUM TRANSFER

Instruction : 3+2 hr/ week **Credits: 4**

Course Educational Objectives:

1. To learn dimensional analysis, fluid statics and its applications.
2. To understand the important phenomena observed in flowing fluids, basic quantitative laws and equations of fluid flow.
3. To form a firm idea of the flow of impressible and impressible fluid flow through pipes and in thin layers.
4. To understand the flow past solid surfaces, through packed bed and in fluidized beds and able to learn the settling characteristics of particles through fluids.
5. To learn the working and performance of pumps and impressors, valves and able to understood the instruction and operation of flow measuring devices.

UNIT - I:

Introduction: Units, Dimensions and Dimensional analysis, Fluid statics and its applications.

UNIT - II:

Fluid flow phenomena, kinematics, of flow, velocity field - streamlines - irrotational flow - Newton's law of viscosity - Non-Newtonian fluids - Laminar and turbulent flows,

Basic equations of fluid flow - continuity equation - Bernoulli's equation and its applications.

UNIT - III:

Flow of incompressible fluids in conduits and thin layers - Laminar and turbulent flows in pipes and closed channels - Universal velocity distribution - friction factor, effect of fittings and valves. Flow of compressible fluids - continuity equation, mechanical energy balances, ideal gas equations.

UNIT - IV:

Flow pas immersed bodies, drag force and drag coefficient, friction in flow through bed of solids - motion of particles through fluids - free and hindered settling - Mechanism and pressure drop of fluidization and its applications - fundamental concepts of two – phase, gas liquid flow.

UNIT - V:

Transportation and metering of fluids, fluid moving machinery - classification and performance of pumps and compressors - selection and specifications - measurement of flowing fluids, storage and handling.

TEXT BOOKS:

1. Unit operations of Chemical Engineering (5th ed) Warren L.McCabe, Juliane Smith and Peter Harriott, McGraw Hill.

REFERENCES:

1. Chemical Engineering Vol.I by Coulson and Richardson, Pergamon Press.

Course Outcomes:

1. To be able to perform dimensional analysis of fluid flow problems and develop pressure drop equations for fluid static equipments in which fluid is at rest.
2. To have the knowledge on different types of flow regions in fluid flow, rheological properties of fluids, turbulence and boundary layers.
3. To be able to carry out macroscopic mass, momentum and energy balance to solve engineering problems related to fluid flow and to analyze flow past solid surface, through packed bed and in fluidized beds.
4. Determine the minimum fluidization velocity andterminal velocity of the fluid in Stokes and Newton's law regions.
5. The analysis of fluid flow measuring devices like Orifice meter, Venturimeter, Rotameter and Pitot tube, the construction and working of Centrifugal and reciprocating pumps. And also give the knowledge on different types of valve, selection of pipe and fittings.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

CHT 02 CHEMICAL PROCESS CALCULATIONS

Instruction : 3+2 hr/ week **Credits: 4**

Course Educational Objectives:

1. To understand different representations of mixture compositions and reaction stoichiometry.
2. To understand the ideal gas law and its applications.
3. To learn the concepts of vapor pressure and different representations of vapor presence in gas mixtures.
4. To understand and to apply the law of conservation of mass.
5. To understand and to apply the law of conservation of energy and to analyze combustion operations, from material and energy perspective.

UNIT – I:
BASIC CONCEPTS – Units & Dimensions - Graphical integration and differentiation - use of log-log, semi-log and triangular graphs, conversion of units.

STOICHIOMETRIC AND COMPOSITION RELATIONS - Stoichiometric relation, basis of calculation, method of expressing composition of mixture and solutions, density and specific gravity.

BEHAVIOR OF IDEAL GASES: Ideal gas law and applications, gaseous mixtures, gases in chemical reactions.

UNIT - II:
MASS BALANCE WITHOUT CHEMICAL REACTION – Formulation – Mass balance calculations for unit operations like distillation, absorption, extraction, crystallization (single solute systems), drying, evaporation

UNIT - III:
MASS BALANCE WITH CHEMICAL REACTION – Mass balance calculations for processes involving reactions – Mass balance calculations for systems involving recycle, purge and bypass

UNIT - IV :
VAPOR PRESSURE - Concept of vapor pressure, liquifaction and liquid state, vaporization, boiling point, effect of temperature on vapor pressure, vapor pressure plots, vapor pressure of immiscible liquids and solutions, Raoult's law and its limitations.

HUMIDITY AND SATURATION: Relative and percent saturation, dew point, wet and dry bulb temperatures, Humidity charts

UNIT - V:
ENERGY BALANCE

THERMOPHYSICS - Concepts of energy, energy balance equation, heat capacity of gases, liquids and mixtures in energy balance problems, Kopp's rule, latent heat - heats of fusion and vaporization, Trouton's ratio, Kistyakowski equation.

THERMOCHEMISTRY - Heats of formation, combustion and reaction, Hess law, Calculation of heat of reaction from heat of formation / combustion data, Effect of temperature and pressure on heat of reaction, Adiabatic reaction temperature

FUELS & COMBUSTION - Heating value, Theoretical and actual flame temperatures

TEXT BOOK:

1. Chemical Process Principles part - I, Material and Energy Balances by Hougen, O.A., Watson, K.M. and Ragatz, R.A. John Wiley and sons, 2nd ed.
2. Stoichiometry (3 rd edition) - Bhatt and Vora , tata-McGraw-Hill Publication

REFERENCES:

1. Chemical Process Calculations - David Himmelblau.
2. Elementary Principles of Chemical Process , 3 rd edition – Richard M.Felder & Ronald W.Rousseau, Wiley - Eastern
3. Process Calculations by K.V.Narayanan and Lakshmi Kutty.

Course Outcomes:

1. To understand the dimension-unit systems and their inter relationships, to be able to represent mixture compositions in different forms and to be able to make calculations using reaction stoichiometry.
2. To be able to make mass balance calculations for different operations, without reaction, its mathematical form and its application to different operations and reactions.
3. To be able to make mass balance calculations for different operations, with reaction , its mathematical form and its application to different operations and reactions.
4. To have learnt the significance of vapor pressure and its dependence and to have learnt different representations of partial saturation and to apply ideal gas law in conjunction with variation in levels of saturation.
5. To be able to estimate parameters like oxygen requirement, flue gas analysis, energy released and flame temperatures.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

CHT 03 INROGANIC CHEMICAL TECHNOLOGY

Instruction: 3 hr/week **Credits: 3**

Course Educational Objectives:

1. To know the difference between unit operations and unit processes.
2. To learn principles of different unit operations like screening, filtration, size reduction, mixing.
3. To learn how to draw flow sheet for a process.
4. To know the industrial production of cements, industrial gases, nitrogen, sulphur phosphorous, glass and ceramic industries.
5. To learn the thermodynamic nsiderations, engineering problems and enomic factors in the production.

UNIT - I:

WATER TECHNOLOGY: Sources of water - methods of treating fresh water - conditioning - fresh water from saline water sewage and waste water treatment.

Fuel andIndustrial gases: Natural gas, LPG, Carbon dioxide, hydrogen, nitrogen and synthesis gas.

UNIT - II:

CEMENT - Types and manufacture.

CHLOR-ALKALI INDUSTRY: Common salt manufacture uses-manufacture of soda ash sodium bicarbonate-caustic soda, chlorine and bleaching powder.

UNIT - III:

NITROGEN INDUSTRIES - Synthetic ammonia, Urea, Nitric acid and other Nitrogenous compounds. Explosives - types and characteristics, industrial and military explosives, propellants for rockets.

UNIT - IV:

PHOSPHOROUS INDUSTRIES: Phosphate rock and super phosphate, triple super phosphate, phosphoric acid. Sulfur and sulfuric acid, Hydrochloric acid.

UNIT - V:

GLASS - Types and manufacture

CERAMIC INDUSTRIES: basic raw materials, whit waxes, heavy clay products, refractories, enamels and enameled metals.

TEXT BOOK:

1. Chemical Process Industries by R.N.Shreve and J.A.Brink Jr. McGraw Hill 5th ed.

REFERENCE:

1. Dryden's Outlines of Chemical Technology by Gopal Rao and Marshall sitting. - - Boca Raton

COURSE OUTCOMES :

1. Able to differentiate between unit operations and unit processes in industrial processes. Can understand the sources of water and different water treatment methods.
2. Know types of cements and raw materials, production of different types of cements, Chloro alkali industries.
3. Able to know the raw materials used, reactions involved and different methods for the production nitrogenous compounds and explosive materials phosphorous, Sulphur.
4. Able to know the raw materials used, reactions involved and different methods for the production phosphoric and sulfur compounds.
5. Knows different types of glasses, raw materials and production process. Understand about basic raw materials, production process of different ceramic products and about refractories.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

CHP 021 MOMENTUM TRANSFER LAB

Instruction : 3 hr/ week **Credits : 2**

EXPERIMENTS:

1. Flow Through Straight Pipe
2. Losses Due To Fittings
3. Venturimeter
4 .Orficemeter
5.Flow Through Helical Coil
6.Characteristics Of Centrifugal Pump
7.Flow Through Annulus
8.Frictional Loss Due To Sudden Expansion
9.Bernoulli's Experiment
10.Flow Through Packed Bed
11.Fluidization

CHP 02 CHEMICAL ANALYSIS LAB

Instruction : 3 hr/ week **Credits: 2**

EXPERIMENTS:

1.Analysis Of Water(Hardness)
2.Estimation Of Chromium
3.Bleaching Powder
4.Estimation Of Phenol
5.Estimation Of Sugars
6.Analysis Of Vegetable Oils
7.Analysis Of Water(Total Chloride)
8.Analysis Of Soda Ash
9.Analysis Of Pyrolusite
10. Analysis of Urea

IV SEMESTER

MAT 04 Probability and Statistics

Instruction : 2+2 hr/week **Credits : 3**

Course Objectives:

1. To To familiarize the students with the concept of probability distributions and statistics as indispensable tools for data analysis and decision making in engineering fields.
2. To introduce basic concepts of statistics, various distribution functions.
3. To explain the concept of estimation and t-test, F-test and Chi-square test.
4. To explain the objective of Correlation and Regression analysis.
5. To acquaint the students with different types Quality Control charts.

Unit – 1

Probability: Introduction, axiomatic approach, conditional probability, Baye's theorem, stochastic process, Random variables, Discrete and Continuous distributions, expectation, variance, moments, moments generating functions.

Unit – 2

Distributions: Binomial, Poisson, Normal, Uniform, Exponential and Gamma Properties and applications.

Unit – 3

Estimator: Estimation of parameters by method of moments and maximum likelihood - Testing of hypothesis - small sample tests-t-test, f-test and chi-square test.

Unit – 4

Correlation: curve fitting by method of least squares - Linear, Quadratic and Exponential fitting – Correlation – Rank, Correlation - Regression analysis - Multiple correlation.

Unit – 5

Quality Control: Concept of quality of a manufactured product - Causes of variation - Principles of Shewart control charts - X-chart, R-chart, p-chart, np-chart and C-chart.

Text Books:

1. S P Gupta, Statistical Methods, 38th Edition, Sultan Chand & Sons Educational Publishers, 2009.
2. Y K V Iyengar et al, Probability and Statistics 2nd Edition, S. Chand & Company Ltd, 2010.

3. S C Gupta and V K Kapur, Fundamentals of Applied Statistics, 3rd Edition, Sultan Chand & Sons Educational Publishers.

Course Outcomes: At the end of the course, students will be able to

1. To make use of the concepts of probability and their applications. Apply Probability theory to find the chances of happening of events.
2. To discuss Distributions and Properties and applications.
3. To measure the quantity of estimations.
4. Design the components of a classical hypothesis test. Infer the statistical inferential methods based on small and large sampling tests. Interpret the association of characteristics and through correlation and regression tools.
5. To acquire knowledge of Quality control charts.

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

CHT 04 CHEMICAL ENGINEERING THERMODYNAMICS - I

Instruction: 3+2 hr/week **Credits: 4**

Course Educational Objectives:

1. To understand the concepts of energy, forms of energy, equilibrium and reversibility
2. To learn and apply the first law of thermodynamics
3. To understand the P-V-T behavior of pure fluids
4. To learn the concept of entropy and to apply second law of thermodynamics
5. To study the feasibility of processes and able to learn thermodynamic analysis of refrigeration and different flow processes

UNIT - I:

INTRODUCTION – Scope, Dimensions and Units – Mass, mole, volume, force, temperature, pressure, work, energy, heat, internal energy.

THE FIRST LAW OF THERMODYNAMICS, Energy balance for closed systems, Thermodynamic state and state functions, equilibrium, The phase rule, The reversible process, enthalpy, heat capacity, Mass and energy balances for open systems, Energy balances for steady state flow processes

UNIT - II:

VOLUMETRIC PROPERTIES OF PURE SUBSTANCES: P-V-T behaviour, Virial expressions, The ideal gas, Applications of Virial equations , Cubic equations of state - vander walls and Redlich - Kwongg equations, Theorem of corresponding states, generalized correlation – Pitzer correlation.

UNIT - III:

HEAT EFFECTS – Sensible and latent heat effects, Heats of formation , combustion and reaction, Temperature dependence, heat effects of industrial reactions .

UNIT - IV:

SECOND LAW – Statement, Heat engine, Thermodynamic Temperature scale, concept of entropy, mathematical statement of second law, Entropy changes of an ideal gas, Calculation of ideal work and lost work The Third Law of Thermodynamics

UNIT - V:

REFRIGERATION: The Carnot refrigerator, The vapor compression cycle, choice of refrigerant, cascade systems, absorption refrigeration, Heat pump, Liquefaction process.

THERMODYNAMICS OF FLOW PROCESSES - Duct flow of Compressible fluids – turbines – compression process

PRODUCTION OF POWER FROM HEAT – The steam power plant, Internal combustion engines, Jet engines

TEXT BOOK:

1. J.M.Smith , H C Van Ness and M.M.Abbott - Introduction to Chemical Engineering Thermodynamics 6 th ed. Tata McGraw-Hill Publishing Company .

REFERENCES:

1. Chemical Engineering Thermodynamics by Thomas E.Daubert

2. Chemical Engineering Thermodynamics, YVC Rao, University publications.

Course Outcomes:

1. To have learnt the fundamental ideas about energy, equilibrium and reversibility. To be able to apply first law to estimate heat and work effects in closed, open and flow systems.

2. To understand PV and PT phase diagrams, ideal gas law and its applications. To be able to estimate heat and work effects for different processes – isothermal, isobaric, isometric, and adiabatic processes.

3. To be to apply second law of thermodynamics to estimate efficiency of a cycle. To have understood the concept of entropy and its estimation.

4. To have learnt different refrigeration cycles and also to be able to calculate their COP.

5. To have learnt the thermodynamic analysis of flow processes.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1							1			1
CO2		2		1		1			1			1
CO3		1					1		1			
CO4	1	1							1			1
CO5		1				1	1		1			1

CHT 05 MECHANICAL UNIT OPERATIONS

Instruction: 2+2 hr/week **Credits: 3**

Course Educational Objectives:

1. To develop understanding of solids, their characterization, solid handling and mixing.
2. To develop understanding of the principles of comminution, milling and size reduction operations.
3. To understand separation of solid mixtures.
4. To understand the different techniques of separation of solid-liquid mixtures.
5. To understand on methods and effect of agitation and mixing of liquids.

UNIT - I: **CHARACTERIZATION OF PARTICULATE MASSES**

Properties, handling and mixing of particulate solids: characterization of solid particles, properties of particulate masses, storage, transportation and mixing of solids, types of mixers, mixers for cohesive solids, mixers for free flowing solids.

UNIT - II: **SIZE REDUCTION**

Principles of comminution, computer simulation of milling, Operations size reduction equipment -crushers, grinders, ultra fine grinders, cutting machines, equipment and operation.

UNIT - III:

MECHANICAL SEPARATIONS -I:

Screening, screening equipment, Separations based on motion of particles through fluids, gravity settling processes and centrifugal settling processes, Gas cleaning. Flotation

UNIT – IV: **MECHANICS SEPARATIONS-II**

Filtration – Cake filters - Centrifugal filters, principles of cake filtration and clarifying filters, liquid clarification, principles of clarification, cross flow filtration,

UNIT - V:

AGITATION AND MIXING OF LIQUIDS: agitation of liquids, circulation velocities, power consumption in agitated vessel, blending and mixing - suspension of solid particles, dispersion operation.

TEXT BOOK:

1. Unit operations of Chemical Engineering (5th ed) Warren L.McCabe, Juliane Smith and Peter Harriott, McGraw Hill.

REFERENCE:

1. Chemical Engineering Vol.I & II, Coulson and Richardson , Pergamon Press.

2. Mechanical Operations for Chemical Engineers by Narayanan & Bhattacharya, Khanna Publishers

Publishers.

Course Outcomes :

1. To be able to determine the Volume surface mean diameter, mass mean diameter, number of particles and types of mixers.
2. To have the knowledge of different types of Crushers, grinders, ultrafine grinders, cutters, to be able to find the power requirement using three crushing laws.
3. To be able to calculate the screening effectiveness .To have understood settling processes and flotation technique.
4. To develop the rate equations for constant pressure and constant volume filtration techniques and also to solve the problems related to these techniques.To have acquired the construction and operation of different filtration, settling and clarifying equipment.
5. To understand the functioning of agitated vessels and to calculate the power consumption.To have the knowledge on different types of turbines, blending and mixing.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1									1			1
CO2						1	1		1			1
CO3						1	1	1	1			1
CO4						1	1	1	1			1
CO5		1			1				1			1

CHT 06 INDUSTRIAL EFFLUENT TREATMENT

Instruction: 3 hr/week **Credits : 3**

Course Educational Objectives:

1. Develop and apply high performance structural materials ,systems and Improve the reliability, performance, and disaster-resistance of water supplies, treatment processes, and distribution systems
2. Create new engineering materials to improve the performance of infrastructure and Characterize and mitigate natural and man-made hazards
3. Improve fundamental knowledge of the inter-relationships between the built environment and natural systems
4. Develop the technological innovations needed to safeguard, improve, and economize infrastructure and society
5. Pursue lifelong learning through continuing education and/or advanced degrees in environmental engineering or other related fields.

UNIT - I:

INTRODUCTION TO ENVIRONMENT - Environmental pollution - causes and effects - Legislation for environmental pollution control - water act 1974 and clean air act 1981.Waste water sources - domestic, municipal and industrial - characterization - treatment requirements, Analysis of pollutants.

UNIT - II:

WASTE WATER TREATMENT - Removal of BOD- biological treatment- activated sludge process, aerobic and anaerobic processes, Neutralization and clarification, etc., special separations such as adsorption, ion exchange, reverse osmosis, electro dialysis.

UNIT - III:

POLLUTION CONTROL FOR SPECIFIC POLLUTANTS – Removal of Chromium, phenolic effluents, particulate matter, sulfur dioxide, oxides of nitrogen, Pollution control aspects of fertilizer industries, petroleum refinery and petrochemical units and miscellaneous industries.

UNIT -IV:

AIR POLLUTION - Types of pollutants and their effect on vegetation and materials - meteorological factors - air quality - control methodologies for air pollution, Solid waste management - Characteristics of municipal solid waste and hazardous materials - collection and transportation - treatment methods - land filling, incineration - recovery and disposal.

UNIT - V :

HAZARD WASTE TREATMENT: Types - Sources, properties of hazardous waste. Primary, secondary & tertiary treatment for liquid wastes, treatment of gaseous wastes. Conventional/modern unit operations for separations, bio-remediation. Physico chemical and biological treatment. Case studies; CN, HCN, phenolics.

REFERENCES:

1. S.P. Mahajan ,Pollution Control in process Industries Tata McGraw Hill
2. E.B.Beseheivre, M.Schwartz, Treatment of Industrial Wastes McGraw Hill.
3. Pollution control in Process Industries, Mahajan by C.S.Rao Wiley Eastern Ltd., (1992).
4. Environmental pollution control Engg by C.S.Rao Wiley Eastern.
5. Industrial Effluent Treatment Vol.1 J.K.Walters and A.Wint.
6. Industrial Effluent Treatment Vol.2 J.K.Walters & A.Wint Applied Science publishing Ltd. London.
6. Treatment of Hazardous wastes Noyes Data corp. NJ (1983).

COURSE OUTCOMES :

1. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability.
2. An ability to recognition of the water treatment processes and control methodologies for air pollution. An ability to use different techniques for hazard waste treatment. Able to understand about removal of BOD, Chromium and Particulate matter.
3. An ability to know about the main sources of different types of pollutions and control methods, Student can reach to reduce the pollution control aspects of fertilizer industries, petroleum refineries.
4. An ability to know types of air pollution and their effect on vegetation, control methodologies for air pollution. Characteristics of municipal solid waste, its treatment methods.
5. An ability to apply knowledge of biological treatment methods and case studies for hazard waste treatments like CN, HCN and heavy metals. An ability to design the equipment for removal of particulate matter from effluent gases.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1						1	1	1			
CO2	1				1			1	1			
CO3	1				1			1	1			
CO4	1				1			1	1			
CO5	1				1			1	1			

CHT 07 MATERIAL TECHNOLOGY

Instruction : 3 hr/ week **Credits: 3**

Course Educational Objectives:

1) To have fundamental knowledge on Engineering materials.
2) To study Phase diagrams and its applications.
3) To learn different Heat treatment processes.
4) To have knowledge on Ceramic and composite materials.
5) To study Corrosion, its nature and its prevention
6) To learn a basic view of Nano materials.

UNIT - I: **ENGINEERING MATERIALS**

Classification - levels of structure - properties Mechanical, thermal, electrical, and magnetic properties) - structure - property relationship. Structure of solids - crystalline and non crystalline state - Inorganic solids - Crystal Imperfections (point defects, line defects and surface imperfections, Grain boundaries).

UNIT - II: **METALS AND ALLOYS**

Elastic and Plastic deformations - Re-crystallization - cold and hot working - creep, fatigue and Fracture.

Phase diagrams and their applications - phase rule - completely soluble, partially soluble, Insoluble in solid phase, peritectic phase diagrams. Iron - Iron carbide phase diagram.

Heat treatment processes - Annealing - quenching and tempering - Age hardening.

UNIT – III :

CERAMIC PHASES AND THEIR PROPERTIES - Structure of ceramics - Mechanical and electrical properties. Abrasives - silicon carbide various silicates - structure of quartz - uses. Piezo and Ferroelectric material - $BaTiO_3$.

COMPOSITE MATERIALS - Fiber, particle and Plastic reinforced composites. Whiskers. Porosity - Bulk characteristics. Agglomerated materials - concrete - Asphalt and Asphalt mixtures.

UNIT - IV: **CORROSION**

Definition - Electrochemical principles - Environmental effects - oxidizers, Temperature, Agitation(velocity) and polarization. Passivity. Eight forms of corrosion(brief) - Galvanic, Crevice corrosion, Selective leaching, Erosion and Hydrogen damage. Corrosion of metals and Alloys due to sulfuric, hydrochloric nitric, phosphoric and acetic acids. Corrosion prevention and control - Selection of materials - Design principles - Inhibitors - Alteration of environment - Anodic protection. Inorganic and Metallic coatings. Organic coatings.

UNIT - V : **NANOMATERIALS**

Evolution of nanotechnology - Electron Microscopy – Priniciples of SEM, TEM, SPM and STM - Manipulation of atoms (manipulator – tweezer – nanodots – self assembly – nanolithography) - Nano materials - Plasma arcing - Chemical Vapor Deposition - Sol gel - Electrodeposition - Ball milling - Applications of Nanomaterials

TEXT BOOKS:

1. Elements of material science by Van Vlack L.R. Addison Wesley Publishing Co.

2. Corrosion Engineering by Mars G.Fontana
3. Nanotechnology : Basic Science and Emerging Trends – Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Reguse, Overseas Press

REFERENCES :

1. Material science and Engineering by V.Raghavan.
2. Material Science by William Smith

Course Outcomes:

1. Able to understand classification, properties and the structures of Engineering materials. Able to have knowledge on Crystal imperfections.
2. To learn various deformations regarding Creep, Fracture, Cold and Hot working.Able to understand Phase diagram and its applications. To learn various heat treatment process regarding Annealing, Quenching and Tempering.
3. Able to understand the Mechanical and Electrical properties of Ceramic materials. Able to understand various forms of Composites.
4. Able to learn various forms of Corrosion. Able to have knowledge on Corrosion prevention and control.
5. Able to have knowledge on Evolution of Nanotechnology, Electron Microscope and its applications.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1								1				1
CO2		`1						1	1			
CO3		1						1	1			
CO4						1		1	1			1
CO5	1	1						1	1			1

CHT 08 ORGANIC CHEMICAL TECHNOLOGY

Instruction: 3 hr/week **Credits: 3**

Course Educational Objectives:

1. To know the difference between unit operations and unit processes
2. To learn principles of different unit operations
3. To learn to understand flow sheet representation of a manufacturing process
4. To know the industrial production of different organic compounds sugars, alcohol, paper, oils, soaps, paints, plastics, and rubbers
5. To learn the thermodynamic considerations, engineering problems and economic factors in the production of various products

UNIT - I

Sugar and Starch industry: manufacture of cane sugar, production of starch from maize

Fermentation industries: Yeast, bacteria and molds-media for their growth - patterns and chemical activities - industrial alcohol, acetone and butanol, acetic acid, vinegar, penicillin.

UNIT - II:

Pulp and paper industry: methods of pulping, production of sulphate and sulphite pulp, production of paper - wet process.

Petroleum Processing : constituents of petroleum, refining and products of refining,

UNIT - III:

Oils, fats and waxes: Edible oil - extraction of vegetable oils- hydrogenation of oils - methods of production of essential oils .

Soaps and detergents- manufacture of soaps, detergents and glycerin.

UNIT - IV:

Paints: Paints - pigments (white lead, ZnS, TiO_2, carbon black, chromium oxides and hydrates), varnishes, lacquers -printing inks and linoleum

Synthetic fibers: Manufacture of Rayon, Nylon and polyester fibers.

UNIT - V:

Plastics: Classification-types of synthetic resins and plastics and their manufacture - thermosetting resins-thermoplastic resins, oil soluble and modified resins-laminated Plastics.

Rubbers: Classification, natural rubber, monomers for synthetic rubber, manufacture of SBR.

TEXT BOOK:

1. Chemical Process Industries by R.N.Shreve and J.A.Brink Jr. McGraw Hill 5th ed.

REFERENCE:

1. Dryden's Outlines of Chemical Technology by Gopal Rao and Marshall sitting.

Course Outcomes:

1. Able to differentiate unit operations and unit processes. To Know the basic principles of different unit operations. Able to know constituents of petroleum, and the extraction of petroleum compounds petrol, diesel
2. Can understand the raw materials and production of Ammonia, Urea, Phosphorus industries.
3. Can understand the raw materials, pulp and paper industry, reactions involved and the production of sugar, starch.
4. Get knowledge about alcohol, soaps, edible oils, hydrogenation of oils and extraction of vegetable oils.
5. Can understand the difference between paints and varnishes and about the production. Know the classification of plastics, industrial production of plastics and rubbers.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

CHP 03 MECHANICAL UNIT OPERATIONS LAB

Instruction : 3 hr/ week **Credits : 2** **Assessment 40 + 60**

EXPERIMENTS:

1.Sieve Analysis
2.Roll Crusher
3.Ball Mill
4.Rod Mill
5.Pulverizer
6.Cyclone Separator
7.Crystallizer
8.Plate And Frame Filter Press
9.Leaf Filter
10.Hydro Classifier
11.Motion Of Particles Through A Fluid
12.Disk Grinder

CHP 04 INSTRUMENTAL ANALYSIS LAB

Instruction : 3 hr/ week **Credits: 2** **Assessment: 40 + 60**

EXPERIMENTS:

1.Flurometer
2.Refractometer
3.Polarimeter
4.Conductometric Titration
5.Viscosity And Flash Point Determination
6.Measurement Of P^h Using P^h Meter
7.Colourimeter
8.Potentiometric Titration
9.Fuel Characterization-Calorific Value, Flash And Cloud Points
10.Tablet Characterization

V SEMESTER

MAT 05 NUMERICAL METHODS FOR CHEMICAL ENGINEERING

Instruction: 2+2 hr/week **Credits: 3**

COURSE OBJECTIVES:

- This course aims at providing the student with the knowledge on various numerical methods.
- Evaluation of finite differences and difference equations.
- To acquaint the student with different types of numerical methods to solve.
- To provide suitable and effective methods called numerical methods for differential equations.
- Evaluation of iterative methods and finite difference approximation to derivatives, solutions of Laplace, poisson equations by iterative methods.

Unit I : Finite Differences And Difference Equations

Finite Difference, the Difference Operator - properties of Difference Operators - Difference Tables - other Difference Operators

Difference Equation - formation, linear Difference Equations, Complementary Function and particular integral, Difference Equations reducible to linear forms, simultaneous Difference Equations with constant coefficients

Unit-II :Numerical Interpolation, Integration & Differentiation - Newton's forward & backward interpolation formula - Lagrange's interpolation formula - Numerical differentiation by Richardson's extrapolation - Numerical integration by Romberg method

UNIT - III: **Solutions of Algebriac & Transcendental Equations**: Determination of roots of non - linear equations by iterative methods - Falsi position method - Newton Raphson method - Multiple roots by Newton Raphson method - Complex roots by Mueller's method.

UNIT - IV: **Solution of linear and non-linear algebraic equations -** iterative methods - Gauss elimination with pivotal condensation - Triangular factorization methods – ill condition systems - Gauss Seidal & Newton Raphson iterative methods - Comparison of convergence properties of GS & NR iterative techniques.

UNIT - V: **Solution of ordinary & partial differential equations** - Euler's method - Euler's modified method - Runge Kutta second & fourth order methods - Runge Kutta Gill method - Milne's predictor and corrector methods for first order equations.

Finite Difference approximation to derivatives, solutions of Laplace, Poisson equations by iterative methods.

TEXT BOOK:

1.Higher Engineering Mathematics – B.S.Grewal

2. Numerical methods by E. Balagurusamy, Tata McGraw-Hill Publishing Co.

3. Numerical Methods for Scientific and Engineering Computation 3 rd edition by Jain, New Age International

COURSE OUTCOMES:

CO1	Applying various statistical models and methods for drawing conclusions and making decisions under uncertainty in engineering contexts
CO2	Apply statistical and numerical methods in various computer science related projects, seminars and research
CO3	Apply the knowledge of iterative methods to solve algebraic and transcendental equations, simultaneous linear equations, ODE (ordinary differential equations)
CO4	Acquire knowledge of finite differences, interpolation, numerical differentiation and numerical integration
CO5	Demonstrate a basic knowledge of the techniques for accurate and efficient solution of models based on linear and nonlinear systems of equations, ordinary differential equations and partial differential equations

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1		3			2							
CO2		3			2							
CO3		3			2							
CO4		3			2							
CO5		3			2							

CHT 09 CHEMICAL ENGINEERING THERMODYNAMICS - II

Instruction : 3+2hr/week **Credits : 4**

Course Educational Objectives:

To develop frame work to estimate thermodynamic properties of fluids

2. To systematize the synthesis of mixture properties from pure component properties

3. To develop equilibrium criterion and examine its various forms

4. To study phase equilibria

5. To study chemical reaction equilibria

Unit I :

THERMODYNAMIC PROPERTIES OF FLUIDS

Property relations for homogeneous phases - Residual properties - Two phase systems - Thermodynamic diagrams - Tables - Properties from virial equations - Properties from equations of state - Properties from Pitzer-type correlations

UNIT – II :

SOLUTION THERMODYNAMICS

Fundamental property relations - Chemical potential as a criterion for phase equilibrium - Partial properties -Ideal gas mixtures - Fugacity and fugacity coefficient for pure species and component in solutions - Ideal solutions - Excess properties, Liquid phase properties from VLE data, models for excess Gibb's energy, property changes of mixing.

UNIT – III

VLE AT LOW TO MODERATE PRESSURES

Nature of equilibrium - Phase rule, Duhem's theorem, qualitative behaviour, the gamma/phi formulation of VLE, Dewpoint and bubble point calculations, flash calculations.

UNIT – IV

Topics in Phase Equilibria:

VLE from cubic equations of state, VLE from k-value correlations - Equilibrium and stability - liquid-liquid equilibrium (LLE), vapor-liquid-liquid equilibrium (VLLE)

UNIT - V:

CHEMICAL REACTION EQUILIBRIA

Reaction coordinate - application of equilibrium criterion to chemical reactions - standard Gibb's energy change and the equilibrium constant - effect of temperature on equilibrium constant - Evaluation of equilibrium constant - relation to composition - equilibrium conversion for single reactions - phase rule and Duhem's theorem for reacting systems.

TEXT BOOK:

1. J.M.Smith and H C Van Ness, Introduction to Chemical Engineering Thermodynamics 5th ed. McGraw Hill 1996.

REFERENCES:

1. Chemical Engineering Thermodynamics by Thomas E.Daubert

2. Chemical Engineering Thermodynamics, YVC Rao, University publication

Course Outcomes :

1. To be able to develop and use expressions for property estimation. To be able to calculate property values from equations of state.
2. To have learnt the concepts of residual, excess, partial molar properties and property changes of mixing**.** To have understood concepts of ideal solutions, fugacity and activity coefficient.
3. To be able to use modified forms of Raoult's law for non-ideal systems, Dewpoint and bubble point calculations.
4. To be able to make phase equilibrium calculations using Raoult's law. To have learnt the concepts of LLE and VLLE.
5. To have learnt the concept of equilibrium constant and its calculation. To be able to estimate equilibrium conversion of single and simple multiple reactions.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

CHT 10 HEAT TRANSFER

Instruction : 3+2 hr/week **Credits : 4**

Course Educational Objectives:

1. To understand different modes of heat transfer and their characterization
2. To understand the transfer mechanism of heat in fluids with and without phase change
3. To learn the principles of radiation heat transfer
4.. To design heat exchange equipment
5. To understand the principles of evaporation and the working of equipment and to learn the principles of crystallization

Unit I :

HEAT TRANSFER BY CONDUCTION

Fourier's law - one dimensional steady state conduction- compound resistances in series - plain wall, cylinder, sphere - critical thickness of insulation - Unsteady state heat conduction - one dimensional, semi infinite solid, infinite slab – lumped hat capacity systems

Unit II :

HEAT TRANSFER TO FLUIDS WITH OUT PHASE CHANGE -

Concept of hydrodynamic and thermal boundary layers – Dimensional Analysis

Forced Convection in laminar flow over plates and in tubes – correlations for heat transfer in turbulent flow

Analogy between heat and momentum transfer – Reynold's, Prandtl and Colburn analogies

Natural Convection – Heat transfer over vertical plates and tubes, horizontal plates and tubes

Combined heat transfer by conduction and convection

Extended surfaces - Fins

Unit III :

HEAT TRANSFER TO FLUIDS WITH PHASE CHANGE

Heat transfer from condensing vapors - drop wise and film wise condensation - Nusselt assumptions and derivation of Nusselt equation – Condensation of superheated vapors - effect of non-condensable gases on rate of condensation - heat transfer to boiling liquids

Fundamentals of Radiation heat transfer – laws of black body radiation – radiation between surfaces – view factors – radiant heat exchange between black and non-black surfaces – combined heat transfer by conduction, convection and radiation – radiation shields

UNIT – IV :

HEAT EXCHANGE EQUIPMENT

Principles of heat flow in fluids – heat exchange equipment – parallel and countercurrent flow – energy balances – calculation of over all heat transfer coefficient – log

mean temperature difference – single and multiple heat exchangers – correction for LMTD – NTU and effectiveness methods – plate type heat exchangers

Condensers - boiler and calandria - heat transfer in agitated vessels, heat transfer in packed beds - scraped surface exchangers

UNIT V :

Evaporation : types of evaporators – capacity and economy of evaporators - material and energy balances in single effect evaporators - multiple effect evaporators – methods of feeding

Crystallization : Crystal geometry, principles of crystallization – calculation of yield of crystals – super saturation - nucleation and growth of crystals – crystallization equipment

Text book

1. Unit Operations of Chemical Engineering by Warren L.McCabe and Julian C.Smith

Reference Book

1. Heat Transfer by J.P.Holman, McGraw-Hill Publications

Course Outcomes :

1. To be able to calculate the heat transfer flux in one-dimensional heat conduction .To have learnt the concepts of turbulence, boundary layer and analogies.

2. To have understood the construction and flow patterns in heat exchange equipment.

3. To be able to calculate heat flux in natural convection. To be able to estimate heat flux in forced convection.

4. To have understood the concepts of black body, view factors and to be able to calculate radiation heat flux. To be able to handle conduction-convection conduction-convection-radiation heat transfer.

5. To be able to design heat exchangers and condensers. To have understood the functioning of evaporators.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**1**	**1**	**1**	**1**	**1**						**1**
CO2		**1**	**1**	**2**		**1**	**2**					
CO3					**1**	**1**						
CO4				**1**				**1**	**1**			
CO5										**1**		

CHT 11 MASS TRANSFER OPERATIONS - I

Instruction : 3+2 hr/week **Credits : 4**

Course Educational Objectives:

1. To understand the mechanisms of mass transfer – diffusive and convective transport
2. To synthesize the overall resistance for transfer from individual phase resistances
3. To develop the frame work for the design of equipment for staged and continuous contacting devices
4. To learn the construction, operation and inoperable conditions in gas-liquid contacting devices
5. To understand the equilibrium considerations in the operations – absorption / drying / humidification

UNIT - I:

Introduction: Scope of Mass Transfer Operations - Classification of Mass Transfer Operations - Choice of Separation method - Methods of conducting Mass Transfer Operations - design principles.

Diffusion In Fluids : Molecular diffusion - The equation of continuity - Steady state molecular diffusion of Fluids at rest and in laminar flow - Diffusivity of gases and liquids - Applications of molecular diffusion.

Eddy Diffusion - Mass transfer coefficients - Mass transfer coefficients in laminar flow and turbulent flow - mass transfer theories - Mass, Heat and Momentum Transfer Analogies - Mass Transfer data for simple situations.

UNIT - II:

Inter Phase Mass Transfer: Equilibrium – Overall mass transfer coefficients – gas phase & liquid phase controlled situations

Equipment for gas-liquid contact – Description of continuous and stage wise contact equipment – packing for packed columns liquid distribution – mass transfer coefficients in packed columns - inoperable conditions – stage , ideal stage, Point, plate and column efficiency – comparison of plate and packed columns

UNIT - III

Gas Absorption: Equilibrium solubility of gases in liquids - choice of solvent for absorption- Co-current and Counter current flow (one component transferred) – material balance, Minimum liquid - gas ratio for absorbers, Dilute gas mixtures, Absorption factor – Kremser-Brown equations - Determination of number of transfer units and height of transfer unit

UNIT - IV:

Humidification Operations: Vapor - liquid Equilibrium and Enthalpy for a pure substance - vapor gas mixtures, Air-water system - Adiabatic saturation curves, wet bulb temperature – Psychrometric charts – humidification and dehumidification – Operating lines and design of packed humidifiers, dehumidifiers - cooling towers - spray chamber - Evaporative cooling.

UNIT - V:

Drying : Equilibrium - Insoluble solids - Soluble solids - Drying Operations - Batch Drying - Mechanisms of Batch Drying-Thorough Circulation Drying - Continuous Drying - Equipment - Rate of drying

TEXT BOOK:

1. Mass Transfer Operations - Robert E.Treybal (3rd Ed.) McGraw Hill, Kogakusha.

REFERENCE :

1. Principles of Mass transfer and Separation Processes – B. K.Datta - PHI

Course Outcomes :

1. To be able to calculate the flux in cases involving diffusive transfer. To appreciate the contribution of turbulence to transfer and to calculate coefficients and from them, the flux.
2. To be able to differentiate different representations of resistances and to properly integrate them to obtain the overall resistance. To be able to estimate the process parameters like solvent requirement, number of theoretical stages, height and diameter of columns.
3. To understand equilibrium relevant to absorption and to calculate the number of stages, number and height of transfer units.
4. To understand the equilibrium concerned to humidification, various methods of conducting the operation and to design a cooling tower.
5. To understand the mechanism of drying operation and to calculate the time of drying.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**1**	**1**	**1**	**1**	**1**						**1**
CO2		**1**	**1**	**2**		**1**	**2**					
CO3					**1**	**1**						
CO4				**1**				**1**	**1**			
CO5										**1**		

CHT 12 PROCESS INSTRUMENTATION

Instruction : 3 hr/week **Credits : 3**

Course Educational Objectives:

1. To learn basic structure and characteristics of measuring elements
2. To learn the construction, working and features of instruments suitable for temperature measurement
3. To learn construction and operation of pressure measuring instruments.
4. To learn construction and working of liquid-level measuring instruments.
5. To understand the utilization of different instruments like Refractometers, spectrometers and to give knowledge about recording, indicating, signaling type instrument.

UNIT - I:

Elements of instruments, static and dynamic characteristics, basic concepts of response of first order type instruments,

Temperature Measurement : mercury in glass thermometer, bimetallic thermometer, pressure spring thermometers, static accuracy and response of thermometers, thermoelectric temperature measurement, resistance thermometer bulbs and circuits, radiation receiving elements, radiation, photoelectric and optical pyrometers.

UNIT - II:

Composition Analysis, spectroscopic analysis by absorption, emission, mass and color measurement spectrometers, gas analysis by thermal conductivity, analysis of moisture, gas chromatography, refractometer.

UNIT - III:

Pressure Measurement - liquid column manometers, measuring elements for gauge pressure and vacuum, indicating elements for pressure gauge, measurement of absolute pressure, measurement of pressure in corrosive liquids, static accuracy and response of pressure gauges.

UNIT - IV:

Measurement of Head & Level: Head, density and specific gravity - direct measurement of liquid level, pressure measurement in open vessels, level measurements in pressure vessels, measurement of interface level, density measurement, level of dry materials.

UNIT - V:

Flow Measurement : Measurement of Head flow meters, area flow meters, open channel meters, viscosity meters.

Recording instruments, indicating and signaling instruments, transmission of instrument reading, control center, instrumentation diagram, process analysis.

TEXT BOOK:

1. Industrial Instrumentation by Donald P. Eckman, Wiley Eastern, 1950.

REFERENCE:

1.Principles of Industrial instrumentation by Patranabis, TMH.

Course Outcomes :

1. Can understand the basic for measuring device of temperature
2. Can able to measure the composition of the mixture with driffent analytical instruments
3. Can understand driffent instrument for pressure measurement of driffent liquid and elements of pressure measuring device
4. Can understand the level measurement device in the industries
5. Can understand the flow measuring device and various system of control unit in various plant

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						1			1			
CO2						1			1			
CO3						1			1			
CO4						1			1			
CO5						1			1			1

CHE 01 A PETROLEUM REFINING PROCESSES

Instruction : 3 hr/week **Credits : 3**

Course Educational Objectives:

1) To have a fundamental knowledge on origin, composition and formation of petroleum.
2) To learn different Refinery products and testing methods.
3) To study types of Distillation.
4) To have knowledge on treatment of petroleum products.
5) To study different Cracking processes in petroleum industry and to have knowledge on Polymerization and Isomerization.

UNIT I :

Origin, Formation and Composition of Petroleum: Origin and Formation of Petroleum, Reserves and Deposits of World, Petro Glimpses and Petroleum Industry in India, Composition of Petroleum

Petroleum Processing Data: Evaluation of Petroleum, Thermal Properties of Petroleum Fractions.

UNIT II :

Important Products – Properties and Test Methods

UNIT III :

Fractionation of Petroleum: Dehydration and Desalting of Crudes, Heating of Crude-Pipe Still Heaters, Distillation of Petroleum, Blending of Gasolines.

UNIT IV :

Treatment Techniques: Fractions-Impurities, Gasoline Treatment, Treatment of Kerosene, Treatment of Lubes, Wax and Purification.

UNIT V:

Thermal and Catalytical Processes : Cracking ,Catalytic Cracking, Catalytic Reforming-Introduction and Theory, Naptha Cracking ,Coking, Hydrogen Processes, Alkylation, Isomerization Processes, Polymer Gasolines

Asphalt Technology : Source of Asphalt , Air Blowing of Bitumen, Upgradation of Heavy Crudes

Text Book

Modern Petroleum Refining Processes by B.K.Bhaskara Rao

Reference Books:

1. Petroleum Refining and Petrochemicals by N.K Sinha
2. Petroleum Refinery Engineering by Nelson, McGraw Hill.

Course outcomes

1. Able to to study about and manufacturing of the petrol, origin and formation
2. Able to understand the test methods and the properties of the petroleum

3. Understanding to deal with the by product of the petroleum and learning about the hydration , distillation of the petroleum
4. Understating in dealing with the treatment of the other petroleum group elements
5. Able to understand about cracking, reforming of the petroleum production

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1					1		1	1	1			1
CO2					1							1
CO3					1		1		1			1
CO4					1		1		1			1
CO5					1				1			1

CHP 05 HEAT TRANSFER LAB

Instruction : 3 hr/ week **Credits: 2** **Assessment: 40 + 60**

1. Double Pipe Heat Exchanger
2. Heat Transfer through Composite Wall
3. Thermal Conductivity of Insulating Powder
4. Heat Transfer from Pin Fin Apparatus
5. Heat Transfer through Natural Convection
6. Heat Transfer through Forced Convection
7. Critical Heat Flux Apparatus
8. Heat Transfer in Agitated Equipment
9. Condensation of Steam on Vertical Copper Tube
10. Heat Transfer through Radiation

CHP 06 COMPUTATIONAL TECHNIQUES LAB

Instruction : 3 hr/ week **Credits: 2** **Assessment: 40 + 60**

1. Euler's Method
2. Runge-Kutta Fourth Order Method
3. Regular Falsi Method
4. Newton Raphson Method
5. Newton Raphson Multiple Roots Method
6. Newton Forward Interpolation Method
7. Newton Backward Interpolation Method
8. Lagranges Interpolation Method
9. Jacobi Iteration Method
10. Gauss-Siedel Iteration Method

VI SEMESTER

CHT 13 MASS TRANSFER OPERATIONS – II

Instruction : 3+2 hr/week **Credits : 4**

Course Educational Objectives:

1. To understand VLE and to learn the design of plate and packed columns suitable for distillation
2. To understand LLE and to learn the design of staged columns for liquid-liquid and solid-liquid extraction. Also to learn the construction and operation of different equipment for the said operations
3. To understand the mechanism of adsorption and to estimate the process parameters
4. To get a fundamental understanding of membrane separations
5. To understand the mechanism of ion exchange and leaching processes

UNIT – I : DISTILLATION – I

Vapor- Liquid Equilibria - P-x-y and t-x-y diagrams – x-y and H-x-y diagrams - ideal solutions - Raoult's Law, positive and negative deviations from ideality, Minimum and Maximum boiling azeotropes Steam distillation - Flash vaporization - Differential Distillation – batch distillation with reflux

UNIT – II : DISTILLATION – II

Continuous Fractionation - Binary systems, Multistage towers - The method of Ponchan and Savarit - The method of McCabe-Thiele - Feed tray location, total reflux, minimum reflux ratio, optimum reflux ratio, use of open steam, multiple feeds, partial and total condensers - Packed bed distillation. – Principles of azeotropic and Extractive Distillation

UNIT - III:LIQUID - LIQUID EXTRACTION

Liquid Extraction - Fields of usefulness - Liquid Equilibria - Equilateral Triangular coordinates - Rectangular coordinates - Rectangular coordinates on solvent free basis - Systems of three liquids - One pair partially soluble, two pairs partially soluble - Effect of temperature, choice of solvent. Single stage Extraction - Multistage cross current extraction and continuous counter current multistage extraction with out and with reflux - Insoluble liquids – Equipment for solvent extraction - agitated vessels, Emulsions and Dispersions, Mixer - settler cascades, sieve tray towers. Continuous contact (Differential)contactors - Spray towers - packed towers

- Mechanically agitated counter current extractors, Rotating Disc contactors, centrifugal Extractors.

UNIT IV: LEACHING

Preparation of the solid - Temperature of Leaching - unsteady - state operation - in-place Leaching, Heap leaching, percolation tanks - Counter current multiple contact (the shanks system), percolation in closed vessels, Filter - press leaching Agitated vessels. –Batch settling - Steady - stage (continuous) operation - Leaching during grinding, Agitated vessel, Thickeners, continuous counter current Decantation, Hydro cyclones, continuous leaching of course solids, classifiers, leaching of vegetable seeds.

Basics of Membrane Separations – classification – capillary and solution diffusion models – retention coefficient – concentration polarization – fouling – membranes (operational requirement – structure and preparation) – components of a typical membrane separation plant – micro filtration – ultrafiltration – reverse osmosis – dialysis – electro dialysis - pervaporation

UNIT – V :ADSORPTION

Types of adsorption - Nature of Adsorbents - Adsorption equilibrium - single gases and vapors, vapor and gas mixtures, liquids. Adsorption operations - Stage wise operation - Multistage cross current and counter current operation, application of the Freundlich equation, Equipment - Agitated vessels, Fluidized beds, Steady state fixed bed absorbers, adsorption wave, Ion Exchange - Principles of ion exchange, Techniques and applications, Equilibrium Rate of ion exchange.

Text Book:

1. Mass Transfer Operations - Robert E Treybal (3rd ed.) McGraw Hill, Kogakusha.

Reference Books :

1. Bioseparations – Principles and Techniques – B.Sivasankar
2. Principles of Mass transfer and Separation Processes – B. K.Datta - PHI

Course Outcomes :

1. To be able to analyze different phase diagrams – pxy, txy, hxy, bimodal solubility curve and Nxy representations. To be able to calculate flash calculations. To be able to apply Rayleigh's equation (differential distillation).
2. To be able to calculate the number of ideal stages using Ponchon-Savarit and McCabe-Theile procedures. To acquire a fundamental understanding of azeotropic and extractive distillation.
3. To be able to calculate the solvent requirement and number of stages for different contacting patterns like single stage, cross current and countercurrent modes.
4. To be familiar with different constructions of equipment suitable for extraction and leaching.
5. To be able to explain the equilibrium of adsorption and to calculate the material requirement and number of stages for different contacting schemes. To have visualized fixed and moving bed adsorption and regeneration.

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

CHT 14 CHEMICAL REACTION ENGINEERING - I

Instruction : 3+2 hr/week **Credits : 4**

Course Educational Objectives:

To provide knowledge on different types of reactions, reaction rate and mechanism
2. To provide knowledge on collection and analysis of batch reactor data for homogeneous reactions
3. To provide knowledge of different types of ideal reactors and to derive their design equations
4. To teach about different reactor configurations, their selection and performance analysis
5. To provide a foundation on deriving rate expressions for multiple reactions and able to understood the heat effects during the reaction and finding the rate of reaction

UNIT - I:

Introduction: Performance equation, Classification of Reactions, Variables affecting the rate of reaction, Definition of Reaction rate.

Kinetics of Homogeneous Reaction: Concentration - dependent term of a rate equation - Temperature dependent term of Rate equation, Searching for a mechanism.

UNIT - II:

Interpretation of Batch Reactor Data: Constant - Volume Batch Reactor - Integral method and differential method of Analysis of Data. Variable - Volume Batch

Reactor - differential and integral methods of analysis of Data. Temperature and Reaction Rate, the search for a rate equation.

Single Ideal Reactor Design - Ideal Batch Reactor - Steady state mixed flow Reactor - Steady state plug flow Reactor - Space time, Space velocity, holding time in flow systems.

UNIT - III:

Design for Single Reactions: Size comparison of Single Reactions - Batch Reactors - Mixed Vs.Plug flow Reactors - First and Second order Reactions - Variations of Reactant ratio for second order reactions - General graphical procedure. Multiple Reactor systems - plug flow Reactors in series and/ or in parallel, Equal size mixed Reactors in series and/or in parallel, mixed reactors of different sizes in series - reactors of different types in series, Recycle reactor (omit auto catalytic reactions).

UNIT - IV:

Design for Multiple Reactions: Reactions in Parallel - in series - successive first order reactions - first order followed by zero order reaction - zero order followed by first order reaction successive irreversible reactions of different orders. Reversible reactions; series/parallel reactions and applications.

UNIT - V:

Temperature and Pressure Effects: Single Reactions - Heats of Reactions from Thermodynamics, Equilibrium constant from Thermodynamics, General Graphical Design Procedure, Optimum temperature progression. Heat effects, Adiabatic and Non-adiabatic operations, comments and Extensions. Exothermic Reactions in Mixed Reactors - A special problem.

TEXT BOOK:

1. Chemical Reaction Engineering (3rd Ed) Octave Levenspiel.

REFERENCES:

1. Chemical Engineering Kinetics (3rd ed) J M Smith.
2. Elements of Chemical Reaction Engineering (2nd) - H.Scott Foggler

Course Outcomes :

1. To be able to write rate expressions for elementary reactions and to study the temperature dependence of reactions.
2. b. To be able to apply analytical procedures (integral, differential, fractional life, initial velocity methods) to convert batch reactor data in to kinetic expression.
3. d. To be able to make performance analysis of multiple reactor systems – PFR in series and parallel, CSTRs in series and in parallel, mixed reactors in series.
4. e. To be able to analyse multiple reactions – series, parallel and series-parallel. To be able to suggest reaction controls for desired product distribution.

5. g. To be able to estimate heat effects of industrial reactions. To be able to suggest optimum temperature progression.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1			2			1			3
CO2	1	1	1	1	1	2		1	1			2
CO3	1	1	1	1	1	2		1	1			1
CO4	1	1	1	1	1	2		1	1			2
CO5	1	1	1	1	1	2		1	1			3

CHT 15 PROCESS DYNAMICS AND CONTROL

Instruction: 3+2 hr/week **Credits : 4**

Course Educational Objectives:

1. To introduce the fundamental principles of system dynamics and response, with emphasis on process systems
2. To introduce the basic features of different controllers and control elements
3. To develop and analyze feedback control loops for stability
4. To introduce the features of advanced control strategies
5. To train the students in the basic approach of modeling a physical process

UNIT I:

Response of first order systems: Physical examples of first order systems, Response of first order systems in series.

UNIT II:

Higher Order Systems: Characteristics, response and transportation lag,

Control systems: controllers and final control elements, Block diagrammatic representation.

UNIT III:

Closed loop transfer functions, Transient response of simple control systems Stability, Routh Criterion.

UNIT - IV:

Root Locus : Transient response from locus, Application of root locus to control systems

Introduction To Frequency Response: control systems design by frequency response.

UNIT - V:

Advanced Control Strategies : Cascade control, feed forward control, ratio control, Smith predictor, internal model control, Controller tuning and process identification, control valves.

TEXT BOOK:

1. Process systems Analysis and process Control by D R Coughanowr, 2nd ed. McGraw Hill.

REFERENCES:

1. Chemical Process Control by G.Stephanopolous, Prentice Hall 1998.

2. Computer Control of Industrial Processes, Emenule, S.Savas, McGraw-Hill, London.

Course Outcomes :

1. To be able to model physical systems/processes like thermometer / level systems / manometer. To have acquired the ability to study the response behavior of systems.
2. To be able to suggest an appropriate controller for an application.To develop feed back control loops and reduce it to single block representation for further analysis.
3. To be able to construct and analyze Routh array.
4. To be able to obtain the locus of roots of a characteristic equation. To be able to make stability analysis-based frequency response (Bode plots) approach.
5. To have learnt the basics of advanced control strategies. To have learnt controller tuning rules.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		1	1	1	2				1			1
CO2		1	1	1	2				2			1
CO3		1	1	1	2				2			1
CO4		1	1	1	1				2			1
CO5		1	1	1	1				2			1

CHT 16 BIOPROCESS ENIGNEERING

Instruction : 3 hr/week **Credits : 3**

Course Educational Objectives:

1. To study the mechanism of catalytic action
2. To study production of enzymes
3. To have a view on cell growth
4. To study the operation and cultivation method of cells in bio reactors
5. To have a view on selection and control of bio-reactors
6. To have a knowledge on recovery and purification of products

Unit I : Enzymes :

Introduction – Mechanism of catalytic action – Enzyme kinetics – Immobilized Enzyme systems – Methods and kinetics – large scale production of enzymes – medicinal and industrial utilization of enzymes

Unit II :

Cells : Microbial diversity- naming of cells – cell nutrients – metabolic regulation – transport of small molecules across cellular membrane

Cell Growth – batch growth – Quantifying cell growth – cell growth in continuous culture

Unit III :

Bioreactors – I : Operating considerations : choosing the cultivation method – batch and continuous reactors – immobilized cell systems – Solid State Fermentations

Unit IV :

Bioreactors – II : Selection, Scale-up and Control: Scale up – bioreactor instrumentation and its control – sterilization of Process fluids

Unit V :

Recovery and Purification of Products : Product recovery strategy – separation of insoluble products – cell disruption – separation of soluble products – finishing steps – integration of reactor and separation

Text Book :

1. Bioprocess Engineering – Basic Concepts by Michael L. Shuler and Fikret Kargi, Prentice Hall of India Pvt. Ltd.,

References :

1. Biochemical Engineering Fundamentals by J.E.Bailey and D.O.Ollis (McGraw-Hill)
2. Biochemical Engineering by S.Aiba, Humphrey and Millis.

Course Outcomes:

a) Able to analyze kinetics of enzymes and immobilized enzyme systems
b) Able to have knowledge on medicinal and industrial utilization of enzymesCan learn microbial diversityHave knowledge on cell growth in batch and continuous reactors
c) Able to choose different cultivation methods
d) Have knowledge on bio reactor instrumentation and its control
e) Can understand the strategies of product recovery and separation of soluble and insoluble products

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						1			1			
CO2						1			1			
CO3						1			1		1	
CO4						1			1			
CO5						1			1			

CHE 02 F ENERGY ENGINEERING

Instruction : 3 hr/week **Credits : 3**

Course Educational Objectives:

1. To understand the present situation of energy supply and consumption rate in the world and India.
2. To understand the preparation of fossil fuels for use.
3. Make the students to have knowledge on alternative energy sources like solar energy,nuclear energy resources, and hydrogen energy and non conventional energies like gobar gas plants, wind energy, ocean energy and geothermal energy.
4. Students will learn principles of conservation and audit,to get knowledge on economic concept of energy.

UNIT - I:
Scenario – Energy Consumption as a measure of prosperity – World energy future – Energy consumption (world & India) Energy Sources and its availability
FOSSIL FUELS - Coal and coke - Occurrence, preparation, classification
PETROLEUM AND NATURAL GAS - Constitution, occurrence, sources and production.
PROCESSED FUELS - Water gas, Producer gas, Refinery gas, LPG.

UNIT - II:
SOLAR ENERGY – Solar radiation at earth's surface – Solar energy collectors – Flat plate collectors, Concentrating collectors, non concentrating collectors Storage systems – Solar pond, extraction of thermal energy, applications . Applications of Solar Energy and conversion methods.

UNIT - III:
CHEMICAL ENERGY SOURCES – Fuel Cells – Classification – Types – Applications
NUCLEAR ENERGY – Uranium as Energy source, types of reactors – sources in India, Nuclear Fuel
Complex
HYDROGEN ENERGY – Introduction – Storage – Transportation – Utilization of Hydrogen gas – Hydrogen as an alternative fuel
UNIT - IV:
OTHER NON-CONVENTIONAL ENERGY SOURCES –
GOBAR GAS PLANTS - Principle, construction and working – KVIC Plant - Impact on rural development -
WIND ENERGY - Introduction – Wind energy conversion system – classification - advantages & disadvantages – applications – storage
OCEAN ENERGY – Ocean Thermal electric conversion – open cycle, closed cycle – Utilization

GEOTHERMAL ENERGY – Introduction – Geothermal sources – hydrothermal sources – advantages& disadvantages – applications

UNIT – V :

ENERGY CONSERVATION - Economic concept of energy – Principles of conservation and audit – cogeneration – heat reccuperators – regenerators – heat pipe – heat pump

REFERENCE:

1. Conventional Energy Technology – Fuels an Chemical Energy by S.B.Pandya, TMH
2. Energy Resources, Demand and Conservation (with special reference to India) by Chaman Kashkari, TMH (1975).
3. Solar Energy Utilization, G.D.Rai, Khanna Pub. (1984).
4. Non-conventional Energy Sources G.D.Rai, Khanna publications.
5. Energy Conservation and Utilization by Jerrold H.Krentz, Allyn and Bacur Inc1976.
6. Elements of Energy Conservation by Rused C.K, McGraw-Hill

Course outcomes

1. Students will be able to understand present situation of energy resources
2. Students will be able to get knowledge on solar energy collectors ,Students will come to know applications of solar energy and conversion methods .
3. Able to understand utilization of Hydrogen energy, Have the knowledge on fuel cells
4. Able to implement principles and working knowledge of Gobar plants, Will have the knowledge on wind energy and its applications, Acquired knowledge on ocean thermal electric conversion.
5. Acquired basic knowledge on economic concept of energy and principles of conservation and audit.

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					1		1	1	1			1
CO2					1							1
CO3					1		1		1			1
CO4					1		1		1			1
CO5					1				1			1

MET 42 INDUSTRIAL MANAGEMENT

Instruction : 3hr/week **Credits : 3**

Course Objectives:

1. To understand the concept of management, administration, organization, objectives, nature, scope, role, responsibilities & approaches of a management.
2. Enable the students to be educated with planning/production and plant layouts, studying about strategies of material handling and equipment's, selection of site locations andStudy PPC through PERT/CPM.
3. Able to familiarize the basic cost concepts, allocation and control of various costs and methods of costing, purchasing, inventory control systems, EOQ models, etc.
4. Understand the concept of control charts, TQM concepts towards improvement of quality through quality improvement techniques.
5. Gain personal and professional insight intoplant Maintenance in an Industry, personnel management, exposure to the industrial relations and related aspects prevailing in industries and various Labor Legislations applicable to businesses.

UNIT:I

Administration, Management and Organisation, Scientific management, functions of management, principles of management, types of organization/Principles for organization, enterpreneurship - Concept, need development of enterpreneual talents, pitfalls and steps for successful enterpreneurship.

UNIT - II:

Plant location, location factors, plant layout, objectives, types of lay outs, material handling, objectives, equipment and factors influencing their selection.

Production planning and control - objectives and functions, types of production systems - project scheduling: Introduction to PERT/CPM Techniques,

Marketing management – introduction and functions.

UNIT - III:

Elements of cost - methods of allocation of overhead charges - outlines of financial cost and cost accounting - methods of costing and control - sources of finance.

Purchasing - objectives, source selection and vendor rating - stores management - inventory management, basic EOQ model and inventory control systems – ABC Analysis

UNIT - IV:

Quality – Control charts – Control charts for Variables (X and R charts) – Control charts for attributes (p and C charts only) - acceptance sampling plans(single sampling only) - OC curve and its characteristics – Reliability - Total Quality

Management - Quality costs – Quality Circles – Six-sigma concept – Quality improvement techniques – Introduction to ISO-9000

UNIT - V:

Plant Maintenance – need and Objectives – types of maintenance – safety in industries – principles of accident prevention in chemical industries

Personnel Management - functions - role of personnel manager -concepts of job evaluation and merit rating- Factories act - Industrial disputes - Collective bargaining - labor participation in management .

Text Books:

1. Management for business and industry - Claude S George Jr.
2. Industrial Engineering and Management - O.P.Khanna

Reference Books:

1. Production Control - Moore
2. Production -operation Management - Adam & Eberts.
3. Operations management - Joseph G. Marks.

Course Outcomes:

1. Understand the evolutionary development of management thought, general principles of management and conceptof entrepreneurship.
2. Able to identify and design plant location, plant layout, material handling systems and apply forecasting and PPC techniques to production systems.
3. To realize the importance of significance of quality, manage quality improvement teams and identify requirements of quality improvement programs for various industries.
4. Able to construct an operating characteristic curve for various sampling plans, construct and interpret various charts and apply quality improvement techniques in real world situations.
5. Understand the philosophy and basic concepts of quality improvement, design, use, and interpret control charts for variables, attributes, and quality improvement techniques.

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

CHP 07 MASS TRANSFER OPERATIONS LAB-I

Instruction : 3 hr/ week **Credits: 2** **Assessment: 40 + 60**

1. Diffusion In Still Air
2. .Diffusion Through Porous Wall
3. Surface Evaporation
4. Solid Dissolution
5. Vapour- Liquid Equilibrium
6. Liquid-Liquid Equilibrium
7. Wetted Wall Coloumn
8. Humidification/Dehumidification In Packed Column
9. Continuous Drying
10. Single Drop Extraction Column

CHP 08 PROCESS DYNAMICS AND CONTROL LAB

Instruction : 3 hr/ week **Credits: 2** **Assessment: 40 + 60**

1. Characteristics of Control Valves
2. Dynamics of Liquid Filled Manometer
3. Dynamics of Mixing Process
4. Study of Two Interacting Liquid Level Systems
5. Characterization of Liquid Level System
6. Dynamics of Stirred Tank with Heat Transfer
7. Study of Temperature Control Loop
8. Characteristics of I/P Converter
9. Response of Pressure Vessels
10. Dynamics of Thermometer

VII SEMESTER

CHT 17 CHEMICAL REACTION ENGINEERING II

Instruction: 3+2 hr/week **Credits: 4**

Course Educational Objectives:

1. To develop a general methodology of combining reaction chemistry and chemical engineering concepts,

2. To optimize variety of systems where modeling or engineering of reactions is needed.

3. To understand the suitability and performance characteristics of different types of reactors like packed bed reactors, mixed reactors

4. To teach various types of flows like Ideal flow, Non-Ideal flow and mixing of fluids

5. To understand the mechanism of solid Catalyzed reactions and fluid –fluid reactions.

UNIT - I: Non Ideal Flow

Residence time Distribution of fluid in Vessels - E curve, the age distribution of fluid leaving in Vessel, Experimental methods, the F curve the C curve Relations among F, C and E curves, mean time for closed vessels, useful mathematical tools, ways of using Age distribution information. Conversion directly from Tracer information - linear process. Models for Non ideal flow - Segregation model, Dispersion Model, Tanks in series Model, Diagnosing ills of operating Equipment. Chemical reaction and dispersion

Mixing of fluids - self mixing of a single fluid, Mixing of two miscible fluids.

UNIT - II: HETEROGENEOUS PROCESSES, CATALYSIS AND ADSORPTION:

Heterogeneous Processes - Global Rates of Reaction, types of heterogeneous reactions. Catalysis - The nature of catalytic reactions, the mechanism of catalytic reactions.

Adsorption - Physical adsorption and Chemical Adsorption. Adsorption Isotherms, Rates of Adsorption. Solid catalysis - Determination of physical properties - Surface Area, Void volume, solid density, pore volume distribution. Classification of catalysts - Catalyst preparation - promoters and inhibitors, catalyst deactivation.

UNIT - III : Solid - Catalyzed Reactions:

The Rate Equation Rate of Adsorption, Desorption, Surface Reaction, Rate of equations in terms of Fluid - phase concentrations at the catalyst surface - film resistance controls, surface phenomenon controls, Qualitative analysis of rate equation, qualitative predictions from Active - site theory, Quantitative interpretation of kinetic data, pore diffusion resistance important, diffusion in single cylindrical pores, diffusion porous catalysts, heat effects during reaction,

combination of resistances for isothermal particles. Experimental methods for finding rates - Comparison of Experimental Reactors, Determination of controlling resistances and the rate equation.

UNTI - IV : Fluid- Fluid Reactions:

The rate equation, kinetic regimes for Mass Transfer and Reaction, Rate equations for instantaneous fast, slow, intermediate and infinitely slow reactions. Hatta number and enhancement factor for first order reactions, tower reactor design.

UNIT - V : Fluid particle non-catalytic reactions;

selection of a model - unreacted core model for spherical particles of unchanging size - diffusion through gas film controls - diffusion through ash layer controls - chemical reaction controls - rate of reaction for shrinking spherical particles - chemical reaction controls - gas film diffusion controls - determination of the rate - controlling step - application to design.

Text Books:

1. Levenspiel O Chemical Reaction Engineering 3rd ed. John Willey
2. 2. Smith J.M. Chemical Engineering Kinetics 3rd ed. McGraw Hill Newyork

Reference Books:

1. Elements of Chemical Reaction Engineering by H Scott Fogler, 2nd ed. PHI 1992

Course Outcomes:

1. Residence time Distribution of fluid in Vessels, the F curve the C curve Relations. Formulate a residence time distribution from tracer experiment results and use it to predict conversion in a non-ideal reactor.
2. Write reaction rate equations for common types of homogeneous and heterogeneous reactions. Physical adsorption and Chemical Adsorption.
3. Identify the mechanisms involved in a heterogeneous reaction and formulate an effective rate equation.
4. Calculate the impact of changing solid (or fluid) properties on the conversion of a heterogeneous reaction.
5. Fluid particle non-catalytic reactions. unreacted core model for spherical particles, chemical reaction controls.

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

CHT 18 TRANSPORT PHENOMENA

Instruction : 3+2 hr/week **Credits : 4**

Course Educational Objectives:

1. Study the fluid dynamics, heat transfer and mass transfer together at the introductory level.
2. Carry out macroscopic mass, momentum and energy balance to solve engineering problems related to fluid and heat flow laminar flow.
3. Give an idea about simple flow problems involving Non-Newtonian models and turbulent flows.
4. Perform dimensional analysis of equation of motion and energy, time smoothed operations.
5. Analyze flow past solid surface, through packed bed and in fluidized beds and they can able to Focus on diffusivity and mechanism of mass transport, diffusion through a stagnant gas film and falling film

UNIT - I: Introduction to momentum transport - viscosity and the non-Newtonian fluids - pressure and temperature dependence of viscosity of liquids and gases. Viscosity distribution in laminar flow, shell momentum balances and boundary conditions, flow of a falling film - flow through circular tube and annulus - adjacent flow of two immiscible liquids.

UNIT - II: Equations of continuity and motion - Application of Navier Stokes equation and Euler equation for laminar - steady flow problems, tangential annular flow of a newtonian fluid - shape of the surface of a rotating liquid - dimensional analysis of the equation of change - Velocity distribution in turbulent flow, fluctuations and time

smoothed quantities - time smoothing of equations of change for an incompressible fluid ,logarithmic distribution law for tube flow (far from wall).

UNIT - III: Inter-phase transport in isothermal systems, friction factors for flow in tube - pressure drop calculations, friction factors for flow around spheres - packed columns. Macroscopic mass, momentum and mechanical energy balances, Estimation of friction loss - pressure rise and friction loss in a sudden expansion, performance of a liquid - liquid ejector - power requirements for a pipe line flow.

UNIT - IV : Energy transport by steady state conduction - Thermal conductivity mechanism of energy transport - Fourier's law - effect of temperature and pressure on thermal Conductivity.
Temperature distribution in solids and in laminar flow, shell energy balances - boundary conditions, heat conduction with an electrical heat source - viscous heat source - heat conduction through composite wall, addition of resistances - forced convection and free convection. Heat transfer coefficients - forced convection in tubes and around submerged objects - heat loss by free convection from a horizontal pipe - condensation of pure vapors on a solid surface.
UNIT - V : Diffusivity and mechanism of mass transport, definition of concentration, velocities and mass fluxes-Fick's law of diffusion -temperature and pressure dependence of mass diffusivity, shell mass balances, boundary conditions and applications diffusion through a stagnant gas film - diffusion with heterogeneous and homogeneous chemical reactions. Diffusion into falling- liquid film.

Text Books:

1. Transport Phenomena by R.B.Bird, Warren E stewart and Edwin N Light foot, Wiley International Editors, Chemical Engineering Series.

Course Out comes :

1. Have the knowledge of derivations of the momentum, heat, mass flux distributions and also velocity, temperature, concentration distributions for various systems.
2. Able to Solve continuity, Navier-Stokes and energy equations to analyze engineering problems related to Newtonian fluid flow laminar flow,Perform dimensionless forms of three transport phenomena.
3. Educate about the formation and calculation of fluid friction in pipes, conduits and around sphere.
4. Know the different types of heat transfer coefficients and performance of liquid – liquid ejector.Have the knowledge of temperature, pressure dependence of viscosity, thermal conductivity and mass diffusivity.
5. Understand the diffusion with homogeneous and heterogeneous chemical reaction.

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

CHT 19 PLANT DESIGN AND PROCESS ECONOMICS

Instruction : 3 hr/week **Credits : 3**

Course Educational Objectives:

1. To understand the general overall design considerations and practical design considerations
2. To understand the plant location ,plant layout, plant operation and control and patent considerations
3. To understand the process design development
4. Gives an idea on time value of money and cash flow patterns
5. It gives an idea on analysis of cost estimation
6. To determine profitability, alternative investments and replacements

UNIT - I :
Introduction – Chemical Engineering Plant Design-General Overall Design Considerations – Practical Considerations in Design - Engineering Ethics
General Design Considerations – Health and Safety hazards – Loss Prevention – Environmental Protection Plant Location – Plant Layout – Plant Operation and Control – Patent Considerations

UNIT - II :

Process Design Development – Development of Design database – Process Creation – Process Design – Process Flow Diagrams – Piping and Instrumentation Diagrams – Vessel and Piping layout – Equipment Design and Specifications

UNIT - III :
Interest, Time Value of Money, Taxes , and Fixed Charges – Interest – Cost of Capital – Time Value of Money – Cash Flow Patterns – Compounding and Discounting factors – Income taxes – Fixed Charges

UNIT - IV:
Analysis of Cost Estimation – Cash flow for industrial Operations – Factors affecting investment and production costs – capital investment – Estimation of capital investment – Cost Indexes – Cost components in Capital Investment – Methods for estimating capital investment – estimation of revenue – Gross Profit, Net profit and cash flow - contingencies.

UNIT - V:
Profitability, Alternative investments and Replacements – Profitability Standards – Methods for calculating Profitability – Alternative Investments – Replacements – Practical factors in alternative investment and replacement analysis

Text Books:
Plant Design and Economics for Chemical Engineers , 5 th Ed. – Max S.Peters and Klaus D. Timmerhaus and Ronald E.West – McGraw Hill

References :
1. Chemical Engineering Plant Design by Vilbrandt and Dryden, McGraw Hill Intl.
2. Process Engineering Economics by H.E. Schweyer McGraw Hill Co.

Course Outcomes :

1. Students will have knowledge to understand design considerations and engineering ethics. Students able to understand plant location, plant lay out, plant operation and control in a profitable way.
2. Students able to design process flow diagrams, piping and instrumentation diagrams and vessel and piping layout.
3. Students will have the knowledge on interest, time value of money and cash flow patterns useful for cost estimation.
4. Students will have an idea on analysis of cost estimation involves capital investments, estimation of revenue, and cost indexes, students will come to know factors affecting investment and production costs.

5. They will able to find out the alternate investments and replacements, it will also helps the students to understand profitability standards and methods for calculating profitability.

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

CHT 20 PROCESS MODELING AND SIMULATION

Instruction : 3 hr/week **Credits : 3**

Course Educational Objectives:

1. To understand the concepts of model, development of model, algebraic equations and linearization.
2. To educate about the development of model in the field of chemical engineering.
3. To have the knowledge on classification of models with examples.
4. To learn about the numerical methods, computer programming and simulation methods.
5. To acquire abilities to propose, solve and simulate simple chemical process, unit operation and control system models in the chemical industry.

UNIT - I: Mathematical models of Chemical Engineering systems. - Fundamentals - Introduction - Fundamental laws. Principles of formation, review of algebraic, ordinary and partial differential equations, solutions of the above equations.

Linearisation, probabilization models, development of models by experiment and statistic, regression and correlation analysis.

UNIT - II: Examples of mathematical models of chemical engineering systems, constant volume CSTRs, two heated tanks, gas phase pressurized CSTR, non-isothermal CSTR.

UNIT - III: Introduction to Matrix models, lumped parameter model, distributed parameter model. Examples of single component vaporizer, batch reactor, reactor with mass transfer, ideal binary distillation column, batch distillation with holdup.

UNIT - IV: Computer simulation, numerical methods, computer programming, iterative convergence methods, numerical integration of ODEs. Discrete even and continuous simulation.

UNIT - V: Computer simulation, examples gravity flow tank, three CSTRs, in series, binary distillation column, batch reactor, VLE, dewpoint &bubble point calculations, counter current heat exchanger. simulation in process control.

Text Book:

1. Process Modeling, Simulation and Control for Chemical Engineering by W.L.Luyben, 2nd ed. McGraw Hill (1990).
2. Ramirez, W: Computational Methods in Process Simulation, Butter worths publishers, New York, 1989
3. Lorentze T.Biegler, Ignacio Grossmann and Arthur W.Westerberg – Systematic Methods of Chemical Process Design – Prentice Hall International, 1997

Reference Book:

1. Edgar, T.F; Himmelblau, D.M; Optimisation of Chemical Processes, McGraw-Hill Book Co; New York.
2. Gaikwad R.W. and Dhirendra – Process Modeling and Simulation – Central Techno Publications, Nagpur, 2004
3. Morton M.Denn – Process Modeling – Longman Scientific & Technical , 1987
4. A.W.Westerberg, H.P.Hutchinson, R.L.Motard and P.Winter – Process Flowsheeting – Cambridge University Press, 1985

Course Outcomes:

a) Able to analyze kinetics of enzymes and immobilized enzyme systems. Able to have knowledge on medicinal and industrial utilization of enzymes.
b) Can learn microbial diversity. Have knowledge on cell growth in batch and continuous reactors.
c) Able to choose different cultivation methods.
d) Have knowledge on bio reactor instrumentation and its control.

Can understand the strategies of product recovery and separation of soluble and insoluble products

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1				1			1	1			
CO2		2			1			2	1			
CO3		1	1		1			2	1			
CO4		1			1			1	2			
CO5		1			1			1	1			

CHT 21 ENGINEERING ETHICS

Instruction : 2 hr/wk **Credits – 2**

COURSE OBJECTIVES:

1. Instill the moral values that ought to guide their profession.
2. Resolve the moral issues in the profession.
3. Infer moral judgment concerning the profession.
4. Correlate the concepts in addressing the ethical dilemmas.
5. Judge a global issue by presenting an optimum solution.

UNIT-I

HUMAN VALUES - Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – Self-Confidence – Character

ENGINEERING ETHICS - Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories. Valuing Time – Co-operation – Commitment

UNIT-II

ENGINEERING AS SOCIAL EXPERIMENTATION Engineering as experimentation - engineers as responsible experimenters – Research Ethics - codes of ethics – Industrial Standards - A balanced outlook on law - the challenger case study

UNIT-III

SAFETY, RESPONSIBILITIES AND RIGHTS - Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk – Government regulator's approach to risk - the three mile island, Chernobyl and Bhopal case studies.

UNIT IV

RESPONSIBILITIES AND RIGHTS - Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination

UNIT V

GLOBAL ISSUES -Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York , 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004

COURSE OUTCOMES:

1. Distinguish between ethical and non ethical situations. Practice moral judgment in conditions of dilemma.
2. Relate the code of ethics to social experimentation.
3. Risk benefit analysis and reducing risk
4. Resolve moral responsibilities in complications.
5. Defend one's views in supporting the moral concerns. Apply risk and safety measures in various engineering fields.

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

CHE 02 B FUNDAMENTALS OF MICROELECTRONIC MATERIAL PROCESSING

Instruction : 3 hr/week **Credits : 3**

Cource Educational Objectives :

1) To have a fundamental knowledge about Integrated Circuits and its fabrication.
2) To learn the basic units of Integrated Circuits and Microelectronics processing.
3) To study in detail regarding Incorporation and Transport of Dopants.
4) To learn the Chemical rate processes and Kinetics of Microprocessing.
5) To study in detail regarding to Chemical Vapor deposition reactors and its design.
6) To study in detail regarding to physical and physicochemical rate process and its reactors.

UNIT - I: Integrated circuits and fabrication : Integrated circuits - Semiconductors and charge carriers - Basic relationships and conductivity - Basic units of Integrated circuits - Microelectronics processing.

Silicon Refining and other Raw Materials: Metallurgical Grade Silicon and source Gases - Electronic Grade silicon - Metal organic compounds.

UNIT - II: Bulk Crystal Growth: Introduction - Crystal structures and defects - Crystal Growth and Impurity distribution (Czochralski Technique) - Oxygen precipitation.

Incorporation and Transport of Dopants - introduction - - nature of diffusion in solids - dopant incorporation - radiation damage and annealing - dopant redistribution and autodoping - lithography.

UNIT - III: Chemical Rate Processes and Kinetics: Introduction - Growth processes of films of crystalline structure - homogenous reactions - heterogeneous reactions and deposition kinetics - gas - solid reactions - photochemical reactions - selective deposition

UNIT - IV: Chemical Vapor Deposition Reactors : CVD reactors - regimes of fluid flow - free convection and flow stability - intrinsic kinetics and transport effects - reactor design (isothermal, non isothermal, molecular flow reactors) and further considerations.

UNIT - V: Physical and Physicochemical Rate Processes and Apparatus : Introduction - Evaporation and physical vapor deposition - plasma - Physical sputtering - plasma deposition and gas - solid reactors - plasma etching - PVD apparatuses - plasma reactors.

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Text Book:

1. Fundamentals of Microelectronics Processing – Hong H.Lee, McGraw-Hill

Course Outcomes :

1. To be able to design an Integrated Circuit.Able to have knowledge on Integrated Circuit processing.
2. Able to learn the nature of Diffusion in solids ,Incorporation of dopants and dopant redistribution,to learn the concept of Lithography.
3. Able to have knowledge on Homogenous and Heterogenous reactions involvimg in process.
4. Able to design a Chemical Vapor deposition reactor.
5. Able to design a Physical Vapor deposition apparatus and plasma reactors

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1						1	1	1			
CO2	1				1			1	1			
CO3	1				1			1	1			
CO4	1				1			1	1			
CO5	1				1			1	1			

CHP 09 MASS TRANSFER OPERATIONS – II LAB

Instruction : 3 hr/ week **Credits: 2** **Assessment: 40 + 60**

1. Differential Distillation
2. Steam Distillation
3. HETP Determination in Packed Column
4. Absorption in Bubble Column
5. Spray Extraction Column
6. Stage Wise Liquid Extraction Column
7. Ion-Exchange Column
8. Absorption In Packed Tower
9. Mass Transfer With Chemical Reaction (liquid-liquid)
10. Mass Transfer With Chemical Reaction (Solid-liquid)

CHP 10 CHEMICAL REACTION ENGINEERING LAB

Instruction : 3 hr/ week **Credits: 2** **Assessment: 40 + 60**

1. Study of Temperature Dependence of Reaction
2. Kinetics Study under Pseudo Behaviour Conditions
3. Kinetics Study in a Mixed Flow Reactor
4. Kinetics Study in Adiabatic Batch Reactor
5. Modeling of a Mixed Flow Reactor
6. Flow Characterization of a Plug Flow Reactor
7. Modeling of a Packed Bed Reactor
8. Residence Time Distribution in Tanks in Series Assembly
9. Kinetics of Saponification in a Batch Reactor
10. Effect of Mass Transfer on Reaction

VIII SEMESTER

CHT 22 OPTIMIZATION TECHNIQUES

Instruction: 3hr/week **Credits : 3**

Course Educational Objectives:

1. To Teach finding the best design with the available resources is the goal of design optimization. Many of the design problems in aerospace systems (and also other areas) can be cast as optimization problems.

2. To Teach These problems can then be solved using the optimization techniques.

3. One can model the problems well only with a good understanding of the theory behind optimization.

4. In this course we will deal with continuous optimization methods with emphasis upon nonlinear programming

Unit I : Introduction :

Formulation of objective function, fitting models to data, classification of functions, necessary and sufficient conditions for optimum, unimodel & multi model functions, analytical methods, Lagrange multiplier method

Unit II : Numerical methods :

Unimodel functions, Newton, quasi-Newton, secant methods, region elimination methods, polynomial approximation, quadratic and cubic interpolation technique for optimum, multimodel functions, direct methods, random, grid, hooke's nelder and mead methods, powell's technique, indirect methods, gradient and conjugate gradient methods, secant method

Unit III : Linear and Non-Linear Programming :

Review of basic concepts of LP Formulations, simplex method, integer, quadratic, geometric and dynamic programming

Unit IV : Applications- I :

Heat transfer and energy conservation, separation processes, fluid flow systems, reactor design and operation, large scale operations

Unit V : Applications – II

Optimal pipe diameter, optimal residence time for maximum yield in an ideal batch reactor, chemostat, optimization of a thermal cracker using linear programming

Text Book :

1. Optimization of Chemical Process by T F Edgar and D M Himmelblau, McGraw Hill 1998

References :

1. Reklaitis,G.V., Ravindran A., Ragsdell K.M. Engineering Optimization, John Wiley, NY 1980
2. Bile,W.E., Swain J.J., Optimization and Industrial Experimentation, Inter Science,NY 1980
3. Seinfeld J.H., Lapidus L., Process Modeling, Estimation and Identification, Prentice Hall,Engelwood Cliffs, New Jersey,1974
4. Beveridge,C.S., Schechter,R.S., Optimization Theory and Practice McGraw Hill, NY 1970
5. Plant Design & Economics for Chemical Engineers, 5 th Ed – Max S.Peters, Klaus D.Timmerhaus and Ronald E.West, McGraw Hill.

Outcomes:

1. An ability to apply knowledge of mathematics, science, and engineering, An ability to design and conduct experiments, as well as to analyze and interpret data.

2. Become familiar with optimization methods Mathematical modeling of optimization problems

3. Implementation of the algorithms discussed and solve realistic design problems,The student should master most of the issues in numerical optimization

4. Develops ability to obtain data and information necessary to formulate and to solve problems related to Chemical Engineering with or without the support of software8.

5. This course introduces you to the optimization theory and tells you how it can be applied to solve design problems.

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1	1	1				1	1			
CO2		2	1	1				2	1			
CO3		1	1	1		2	1	1	1			
CO4		2	1	1				2	1			
CO5		2	2	1				1	1			

CHE 03 B FLUIDIZATION ENGINEERING

Instruction: 3 hr/week **Credits: 3**

Course Educational Objectives:

1. This course focuses on different types of fluidization, their advantages and disadvantages.
2. Analyze the various types of distributors used for fluidized beds and its design.
3. Study the classification of particles, carry over particles in fluidization and pneumatic transport of solids.

4. Give the knowledge of Transport Disengaging Height (TDH) and its significance in entrainment.
5. This course will help to understand elutriation from fluidized beds and Elutriation constants.
6. This subject focus on solid circulation systems for fast fluidized operations and flow patterns of gas-solid mixtures flowing in horizontal and vertical pipes.
7. Educate the industrial applications of fluidized beds and spouted beds with examples.

UNIT- I

INTRODUCTION**:** The Phenomenon of fluidization, Liquid like Behavior of a fluidized Bed, Comparison with other Contacting Methods, Advantages and Disadvantages of Fluidized beds for Industrial Operations, Fluidization Quality, Selection of a Contacting Mode for a given Application, Overall Plan.

FLUIDIZATION AND MAPPING OF REGIMES.: Fixed beds of particles: Characterization of particles, fixed beds- One size of particles, fixed beds- Solid with a Distribution of sizes, Determination of the effective Spericity from Experiment. Fluidization without Carryover of particles Minimum Fluidizing Velocity,μ_{mf} ,Pressure Drop-verses-Velocity Diagram, Effect of Pressure and Temperature on Fluidized Behavior, Sintering and Agglomeration of Particles at High Temperature.

UNIT-II

Types of Gas Fluidization without carryover – The Geldart classification of particles; Fluidization with carryover particles – Terminal velocity of particles, u_t — Turbulent and Churning Fluidization – Pneumatic Transport of solids – Fast Fluidization – Voidage Diagrams for All Solid Carryover Regimes; The Mapping of Fluidization Regimes.

THE DENSE BED: DISTRIBUTORS, GAS JETS, AND PUMPING POWER: Distributor Types – Ideal Distributors – Perforated and Multiorifice Plates – Tuyeres and Caps – Pipe Grids and Spargers; Gas Entry Region of a Bed; Gas Jets in Fluidized Beds; Pressure Drop Requirements across distributors; Design of Gas Distributors Power Consumption.

UNIT – III

ENTRAINMENT AND ELUTRIATION FROM FLUIDIZED BEDS**:** Freeboard Behavior – Origin of Solids Ejected in to the Freeboard – experimental Findings; Location of the Gas Outlet of a Vessel – Estimation Of the TDH; Entrainment from Tall Vessels: H_f >TDH – Procedure of Zenz et al. [21,8] – The Elutriation Constant Approach

– Relationship between **k** and G_s – Experimental Methods for finding **k** and $\mathbf{k}^*$ - Experimental Findings for $\mathbf{k}^*$ - Entrainment from Short Vessels: H_f <TDH – Freeboard – Entrainment Model.

UNIT – IV

HIGH – VELOCITY FLUIDIZATION**:** Turbulent Fluidized Beds – Experimental Findings; Fast Fluidization - Experimental Findings; The Freeboard – Entrainment Model Applied to Fast Fluidization – Design Considerations; Pressure Drop in Turbulent and Fast Fluidization.

CIRCULATION SYSTEMS**:** Circuits for the Circulation of Solids – Classification of Circulation Loops – Pressure Balance in a Circulation loop; Finding Require Circulation Rates - Circulation Rate for Deactivating Catalysts – Circulation Rate for a Require Heat Removal Rate.

UNIT – V

INDUSTRIAL APPLICATIONS OF FLUIDIZED BEDS: Historical Highlights – Coal Gasification – Gasoline from other Petroleum Fractions – Gasoline from natural and Synthesis Gases - Synthesis Reactions – Metallurgical and Other Processes; Physical Operations – Heat exchange – Solidification of a Melt to make Granules – Coating metal objects with plastic – Drying of Solids - Coating of Objects and Growth of Particles – Adsorption; Synthesis Reactions – Phallic Anhydride – Fischer – Tropsch Synthesis – acrylonotrile by the Sohio Process- Maleic anhydride - Other Catalytic Reactions – Comments – Polymerization of Olefins; Cracking of Hydrocarbons – Fluid catalytic Cracking (FCC) – Fluid Cooking and Flexi – Coking – Thermal cracking; Combustion and Incineration – Fluidized Combustion of coal – Incineration of Solid Waste; carbonization and gasification – Gasification of Coal and coke – Activation of Carbon – Gasification of Solid waste; Cacination; Reactions Involving Solids – roasting Sulfide Ores – Silicon for Semiconductor and Solar cell industries - Chlorination and Fluorination of Metal Oxides – Reduction of Iron oxide; Biofluidization

Text Book :

1. Fluidization Engineering by Diazo Knuizz & D.Leveaspiel John Wiley.

References :

1. Fluidization by Davidson JF & Harison B, Academic Press.
2. Fluidization and Fluid Particle systems Zenz PA & Othmer D F, Reinhold Pub. Co

Course Out comes

1. Know the advantages, disadvantages, and different types of fluidization. Understand the comparison and selection of contacting methods.Determine the minimum fluidization velocity and terminal velocity
2. Able to design gas distributors and calculate power consumption for fluidized beds.
3. Experimental findings of entrainment, Estimation of TDH, and determination of elutriation constants.
4. Understand the fast fluidization, application of entrainment models to fast fluidization and solid circulation systems for fluidized beds.
5. Have the knowledge of FCC, Combustion and Incineration of coal and Chlorination and Fluorination of Metal Oxides.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			1	1	1			1	1			2
CO2			1	1	2			1	2			1
CO3			2	1	1			1	1			1
CO4			1	2	2			1	1			1
CO5			1	1	1			1	1			1

CHE 03A FUNDAMENTALS OF NANOTECHNOLOGY

Instruction: 3 hr/week **Credits: 3**

Unit – I

Introduction: Importance of Nanotechnology emergence of nanotechnology, size range of nano particles - Thermodynamics and properties of nano scale materials, classification of nano structured materials - Bottom-up and top-down approaches-challenges in nanotechnology. Future of nanotechnology in chemical and Biochemical engineering.

Unit – II

Synthesis of nano particles and processing: Methods for creating nano structures – processes for producing ultra fine powders – Mechanical grinding – wet chemical synthesis of nano materials – sol-gel emulsion processes-liquid-solid reactions- Gas phase synthesis of nano materials – Furnace, flame assisted ultra sonic spray pyrolysis – Gas condensation (CVC) – cold plasma methods- particle precipitation aided CVD.

Unit – III:

Characterization of nano systems: Sample preparation and characterization techniques of nano structured materials – scanning electron microscopy (SEM) – Transition election microscopy and X-Ray photo electron and Auger electron spectroscopy (XPS, AES) – Scanning tunneling microscopy (STM), atomic force microscopy (AFM) – powder X-ray difractometry (XRD).

Unit – IV:

special nano materials: Carbon fullerences and nanotubes – onions – carbon fullerrence- formation, properties and uses – Porous silicon preparation methods-Nano particles of SiC, alumina and zirconia and their sintering techniques – Wafer preparation, wafer cleaning techniques – lithography – etching – Mechanical attrition and nano composites.

Unit – V:

Nano – Engineering applications: Micro electromechanical systems (MEMS) and nano electromechanical systems (NEMS), sensors, microfluidic devices – nano pump – molecular motors – Nano bots – nano medicine – drug delivery systems – catalyis by gold nano particles – wear resistance coatings – weapons – battery and fuel cell electrodes – thermal management – automotive and aerospace components. Environmental impact of nano-particles – ethical, legal and social issues.

Text Books:

1. Introduction to nanotechnology, by Charles P.Poole and Frank Jowens, John wiley (2003)
2. Nanotechnology Research and perspectives, MIT Press (1992)

References:

3. understanding of Nano science and technology, poori Dutta & Sushmita Gupta, Global vision, New Delhi – (2006)
4. Nano materials : Synthesis, properties and Applications A.S.Edestien, R.C.Cammarata, IOP publications, UK (1998)
5. Hand Book of Nanotechnology by Bhushan ,Bharat (Ed) springer (2004)

CHE 03 C MEMBRANE SEPARATIONS

Instruction: 3 hr/week **Credits: 3**

OBJECTIVES

1. To learn classification and principles of membrane separation processes
2. To know the applications of membrane separation processes
3. To get knowledge about ideal separations on capabilities of membrane processes and secondary phenomena occruing in membrane processes.
4. To know about the equipments of membrane processes
5. To understand the design of membrane systems

UNIT- I

Introduction to Membrane Separation Processes : Classification of separation process – separating agents – principles of gas permeation, reverse osmosis, ultra-filtration, pervaporation, dialysis, electro-dialysis.

Unit II :

Applications of membrane separation processes - separation of hydrogen or acid gases, Oxygen – nitrogen separation starting from air,- stability of membrane processes for waste water treatment, applications in pulp and paper, electroplating and electro-coating industries – applications in food industry – denaturing of liquid foods , cheese making and whey production.

Unit III :

Ideal separations on capabilities of membrane processes – separation factor, rejection factor, expressions for ideal separation factors

Secondary phenomena in membrane processes : secondary physical and transport phenomena in membrane processes, concentration polarization

Unit IV :

Equipment for membrane processes : Flat sheet, tubular, spiral wound and hollow fiber, membrane modular designs , single entry and double entry separating elements, separation stage, flow configuration.

Unit V :

Design of membrane systems : Design equations for perfect mixing and cross floe configuration, separation stages for gas permeation, reverse osmosis and ultra-filtration. Design equations foe perfect mixing and parallel flow dialyze, simple design equations for electro-dialytic stacks

Reference Books :

1) Membranes in Separation – S.T.Hwang and K.Mammermeyer, Wiley-Interscience, Newyork (1975)

2) Transport Processes and Unit Operations – Christie J.Geankoplis, Prentice Hall of India Pvt.Ltd (2000)

Course Out comes

1. Able to understand overall view of membrane separation processes.Able to learn different processes in reverse osmosis, ultra filtration, dialysis, electrodialysis.
2. have the knowledge on applications of membrane separation processes
3. to have a knowledge on separation factor, expressions for ideal separation factor.to have a knowledge on transport phenomena in membrane processes
4. able learn knowledge on membrane modular designs, single and double entry separating elements.
5. can understand design equations for mixing and cross flow configurations.Able to design equation for perfect mixing and parallel flow dialyze.to develop the design equation for electro dialytic stacks

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1	1	1				1	1			
CO2		2	1	1				2	1			

CO3		1	1	1		2	1	1	1			
CO4		2	1	1				2	1			
CO5		2	2	1				1	1			

CHE 03 D MICROPROCESSORS AND APPLICATIONS

Instruction: 3 hr/week **Credits: 3**

UNIT – I

Architecture and memory organization:
Architecture of Intel 8086 microprocessor internal architecture: different registers and their specific use, segmentation of memory, physical address, effective address, use of index registers and segment registers in generation physical address
Addressing modes of 80806

UNIT – II

Assembly Language Programming:
Instruction set of 80806: Arithmetic group, logical group, program transfer group, control group, string manipulation group of instruction of 8086, assembler directives writing programs for use with assembler directives, ALP development tools.

UNIT – III

Simple sequence programs, Jumps, Flags and conditional jumps
It-then, If-then-Else and multiple if-then-else programs.
While-do-programs, Repeat-until programs, Instruction timing and delay loops.
Writing and using procedures.

UNIT – IV

Interrupts of 8086: Interrupts and Interrupt responses, Hardware interrupt applications, 8259 priority interrupt controller, software interrupt applications.

UNIT – V

Interfacing of 8086 for real-time applications:
Interfacing of 8086 with 8255
Interfacing of A/D converter and D/A converter, generation of square wave output from 8255, microprocessor based temperature control, An 8086 based process system: simple introductory concepts.

Text Books:

1. Douglas V Hall, “Microprocessors and Interfacing”, Tata McGraw Hill Company Ltd., Second Edition, 2006.
2. John Uffenbeck, “Programming of 8086/8088”, Printice Hall of India

CHE 03 E PROCESS SYNTHESIS & ANALYSIS

Instruction: 3 hr/week **Credits: 3**

UNIT – I :

The Nature Of Process Synthesis And Analysis : Creative Aspects of Process Design - A Hierarchical Approach to Conceptual Design.

ENGINEERING ECONOMICS: Cost Information Required – Estimating Capital and Operating Costs – Total Capital Investment and Total Product Costs-Time Value of Money – Measures of Process Profitability – Simplifying the Economic Analysis for Conceptual Designs.

ECONOMIC DECISION MAKING: DESIGN OF A SOLVENT RECOVERY SYSTEM: Problem Definition and General Considerations – Design of a Gas Absorber: Flow sheet, Material and Energy Balances, and Stream Costs – Equipment Design Considerations – Rules of Thumb.

UNIT – II :

Developing A Conceptual Design And Finding The Best Flow sheet : Input Information And Batch Versus Continuous: Input Information – Level-1 Decision : Batch Versus Continuous.

Input – Output Structure of the Flow sheet : Decisions for the Input – Output Structure – Design Variables, Overall Material Balances, and Stream Costs – Process Alternatives.

Recycle Structure of the Flow sheet: Decisions that Determine the Recycle Structure – Recycle Material Balances – Reactor Heat Effects- Equilibrium Limitations – Compressor Design and Costs – Reactor Design – Recycle Economic Evaluation.

UNIT – III :

SEPARATION SYSTEM : General Structure of the Separation System – Vapor Recovery System – Liquid Separation System – Azeotropic Systems – Rigorous Material Balances.

Heat Exchanger Networks : Minimum Heating and Cooling Requirements – Minimum Number of Exchangers – Area Estimates – Design of Minimum Energy Heat Exchanger Networks –Loops and Paths – Reducing the Number of Exchangers – A More Complete Design Algorithm – Stream Splitting – Heat And Power Integration – Heat and Distillation – HDA Process.

UNIT – IV:

Cost Diagrams and the Quick Screening of Process Alternatives : Cost Diagrams – Cost Diagrams for Complex Processes – Quick Screening of Process Alternatives – HDA Process.

Other Design Tools and Applications: Preliminary Process Optimization: Design Variables and Economic Trade – offs – Cost Models for Process Units – A Cost Model for a Simple Process – Approximate Optimization Analysis.

UNIT – V :

Process Retrofits: A Systematic Procedure for Process Retrofits – HDA Process.

Computer Aided Design Programs (FLOWTRAN) : General Structure of Computer Aided Design Programs – Material Balance Calculations – Complete Plant Simulation

Summary of the Conceptual Design Procedure and Extensions of the Method: A Review of the Hierarchical Decision Procedure for Petrochemical Processes – Design of Solids Processes and Batch Processes – Other Significant Aspects of the Design Problem.

Reference Books:

1) Conceptual Design of Chemical Processes – James M.Douglas, McGraw Hill
2) Chemical Process Synthesis & Engineering Design – Anil Kumar, Tata McGraw Hill.

CHT 24 COMPUTER AIDED PROCESS EQUIPMENT DESIGN & DRAWING

Instruction : 3 hr/ week **Credits: 2** **Assessment: 40 + 60**

LABORATORY MODE EXAMINATION PATTERN

Principles of Jointing, Welding symbols, Flow Chart symbols, PFD & PID

Materials of Construction, Supports, , Heads and Closures, Foundations

Design Calculations and Drawing of Process Equipment - Storage Vessel, Heat Exchanger, Batch Reactor, Perforated Plate Column, Packed Column, Evaporator, Dryer….

CHE01B SAFETY AND LOSS PREVENTION IN PROCESS INDUSTRIES

Instruction: 3 hr/week **Credits: 3**

UNIT – I

Introduction: Safety concepts and programs, Engineering ethics – Accident and loss statistics – Acceptable risk public perceptions – Nature of the accident process and inherent safety.

Toxicology: Methods of entry of toxins in to biological organisms and their effects – Elimination of toxicants from Biological organisms – Toxicological studies – Thresh hold limits – models for dose and response curves.

Unit – II

Industrial Hygiene: Government regulations – process safety and risk management. Plan – Industrial hygiene identification, evaluation and control toxic release and dispersion models; important source models dispersion models of puff with no wind and wind pubb with no wind and with source on ground - pasquill – Gifford model – worst case conditions – effect of release momentum and Buoyancy and release mitigation.

Unit – III

Fires and Explosions : The fire triangle – distinction between fires and explosions – definitions – Flammability characteristics of liquids and vapors – Flam mobility diagram ignition energy – Auto ignition and adiabatic compression – ignition sources – sprays and mists - explosions and their characteristics – damage to people and property – fires explosion - prevention methods and designs.

Unit – IV

Relief concepts – definitions – location of relieves – Relief types, scenarios data for sizing and relief systems relief-sizing for liquid and gas services – rupture disc relieves – two-phase flow during run away reaction relieves – deflagration venting for dust and vapor explosions – venting for fires external to process vessels – venting for thermal expansion of process fluids.

Unit – V

Hazard Identification - Check lists – Surveys HAZOP and HAZAN Studies – safety reviews – Review of probability theory – Event trees – Fault trees – QRA and LOPA analysis – Accident Investigations with typical case histories.

Text Book:-
D.A. Crowl and J.F.Louvar – Chemical process safety (Fundamentals with applications) Printice Hall (2002)

References:-
1. H.H.Faweett and W.S.Wood – Safety and accident prevention in chemical operations, 2nd edn, John wiley and sons, 1982.
2. Coulsion and Richardson – Chemical Engineering – R.K.Sinnot, Vol-6, Butterworth – Heinmann Ltd., 1996.

CHE 01C POLYMER SCIENCE AND ENGINEERING

Instruction: 3 hr/week **Credits: 3**

UNIT - I:

Classification of Polymers, Functionality, Mechanisms of Polymerization, Chair Polymerisation - Free radical, Ionic and cationic Polymerisation - Step polymerization methods. Stereoisomerism in Polymers, Chemicals and Geometrical structures in Polymers. Block and Graft Polymers. Molecular weight of Polymers - weight average, number average and viscosity average molecular weight. Principles and calculations for determination of the molecular weights - Osmometry, Ebulliometry, Light scattering, ultracentrifugation, End group Analysis and viscosity methods.

UNIT II:

Thermodynamics of Solubility of polymers. Transition in polymers. Crystallinity in Polymers. Polymer Degradation method.

Kinetics of Polymerization Reactions– Free radical, Ionic Polymerization and step polymerization reactions. Derivation of rate equations and related numerical problems.

UNIT-III:

Polymerization Methods - Bulk, solution, suspension and emulsion polymerization. Comparison of Polymerization methods. Fabrication methods - Compounding Injection molding, Extrusion blow, blow extrusion, calendaring, Rotational molding, Thermoforming and vacuum forming.

Polymer processing and Rheology: Non-Newtonian flow, Viscosity of Polymer solutions and suspensions, Constitutive, equations; Capillary Rheometer, Couette Rheometer, Cone and Plate Rheometer, Rheometric characterization of polymer solution and melts.

UNIT-IV:

Brief description of individual polymers. Reaction equations, brief process description with a schematic flow sheet, physical properties and uses of the following polymers.

Individual Polymers**:** Thermosets: Phenol Formaldehyde, Urea formaldehyde, Polyester and epoxy resins, Polyrethane. Thermo plastics: Polyethylene, Polypropylene, PVC, Polystyrene, and Co-polymers, PMMA, Polycarbonates.

UNIT-V:

Applications of Polymers: Membrane Separations: Membrane Applications for Polymeric materials, mechanisms of transport and membrane preparation: Biomedical Applications: Artificial organs, Controlled drug delivery, hemodialysis and hemo filtration; Electronics: Electrically conductive polymers, electronic shielding, encapsulation, photonic polymers.

Reference Books:

1. Polymer Science, V.R.Gowariker, M.V.Viswanthan, Jaidev Sridhar, Wiley eastern Ltd, 1988.
2. Plastics engineering – R.J.Crawford, Butterworth Heinemann
3. Rubber and Plastic Technology – R.Chandra and S.Mishra, CBS Publishers
4. Outlines of Polymer Technology: Manufacture of Polymers by R.N.Sinha, Prentice Hall India.
5. J R Fried – Polymer Science and Technology, Prentice Hall of India Pvt., New Delhi, Eastern Economy Edition, 2000.

CHE 01D PHARMACEUTICAL TECHNOLOGY

Instruction: 3 hr/week

Credits: 3

UNIT –I

A brief out line of grades of chemicals used in pharmaceutical industry, sources of impurities in chemicals. Principles and general methods for conducting limit tests for Arsenic, Lead, Iron, Chloride and Sulphide in pharmaceuticals. An introduction to principles of Pharmaceutical processing such as mixing, milling drying, compaction and compression.

UNIT –II

Outlines of preparation, properties, uses and testing of the following pharmaceuticals –Sulphacetamide, Paracetomal ,Riboflavin,Nicotanamide,Flourisine,Procaine hydrochloride,
P-Aminosalicylicacid and Isonicotinic acid hydrazide, ciprofloxacine (ciplax)

UNIT-III

Bulk drug manufacturing and testing-flow sheets, properties, uses and assay of the following pharmaceuticals - Aspirine, Calcium Gluconate, Ferric ammonium citrate, salicyclic acid, sorbitol, phenol(by the toluene oxidation process).

UNIT- IV

Tablet making and coating :- Compressed Tablets – by wet granulation method and dry granulation method, standards of tablets, methods of tablet coating.
Preparation of capsules Extraction of crude drugs :- Introduction, Maceration , percolation, reversed percolation, Digestion and Continuous extraction(Soxhlet method).

Introduction to the preparation of liquid orals, pharmaceutical suspensions, emulsions, semi solids and aerosols.

UNIT- V

Bio pharmaceuticals:- Production and testing of Insulin, Vitamin B_{12}, Dextran, Streptomycin, Pencillin, Streptokinase. Sterilization techniques used in pharmaceutical industry.

TEXT BOOKS:

1. Industrial microbiology, Cacida.
2. Remington's Science and Practice of Pharmacy, Mac. Publishing co., 13th edition, (2000).
3. Dispensing for Pharmaceutical Students, Cooper and Gunn.
4. Text book of Pharmaceutical Chemistry, Bently & Driver., Oxford University press, London, Eighth edition(1960).
5. Bentley's Text Book of Pharmaceutics, H.A.Rawlins, Baillere Tindall and Box, London, Eighth edition, (1977).
6. Pharmaceutical Engineering, C.V.Subramanyam
7. Industrial Chemicals by Faith, Keyes and Clark. John Wiley & Sons, 3rd Edition.

CHE 01 E FOOD PROCESSING & PRESERVATION TECHNOLOGY

Instruction: 3 hr/week **Credits: 3**

Unit – I :
An overview; General aspects of food industry: world food needs and Indian situation – Unit processes and Unit operations of food industry.

Unit – II:
- Food constituents, Quality and derivate factors; Constituents of food; quality and nutritive aspects; food additives; standards; deteriorative factors and their control.

Unit – III:
General Engineering Aspects and processing methods; preliminary processing methods; conversion and preservation operation.

Unit – IV:

Food Preservation Methods; Preservation by heat and cold; dehydration; concentration; drying; irradiation; microwave heating; sterilization and pasteurization; fermentation and picking; packing methods.

Unit – V:

Production and Utilization of food products; Cereal grains; pulses; vegetables; fruits; spices; fats and oils; bakery; confectionery and chocolate products; soft and alcoholic beverages; dairy products; meat; poultry and fish products.

Reference Books :

1 Food Processing & preservation by Sivasankar.

2. Food Processing & preservation by Manoranjan Kalia, Sangita Sood.

3. The Complete Technology book on Processing, Dehydration, Canning, Preservation of

fruits & vegetables by National Institute of Industrial Research

4.Modern Technology on food preservation by National Institute of Industrial Research

5.Food processing principles & applications by Ramaswamy.

6.Introduction to Food science & technology – Stewart

7. Food engineering Operations—3rd edition –J.G.Berman et al

8.Hand book of food preservation ---M.Shaiur Rahman

CHE 02 A FUNDAMENTALS OF NEURAL NETWORKS AND FUZZY LOGIC

Instruction : 3 hr/week **Credits : 3**

UNIT – I

Artificial Neural Networks :

Introduction to Neural Networks, biological neurons, artificial neurons, McCulloch-Pitt's neuron model, neuron modeling for artificial neural systems, feed forward network, perceptron network, supervised and un supervised learning.

Learning Rules : Hebbian learning rule, perceptron learning rule, Delta learning rule, Winner-take-all learning rule, Put-star learning rule.

UNIT – II

Supervised Learning : Perceptrons, exclusive OR problem, single layer perceptron network, multi-layer feed forward networks, linearly non separable patter classification. Delta learning rule for multi perceptron layer, error back propagation algorithm, training errors, ADALINE, Introduction to Radial Basis Function Networks (RBFN).

UNIT – III

Un-Supervised Learning : Hamming net, Max net, Winner-take-all learning, counter propagation network,feature mapping, self-organizing feature maps

Applications of Neural Algorithms : Elementary aspects of applications of character recognition

Neural Network Control Applications : Process Identification, Basic Dynamic learning control architecture.

UNIT – IV

Fundamentals of Fuzzy Logic & Fuzzy Sets : Definition of Fuzzy set, Cardinality, Operations on fuzzy sets : Union, Intersection, Complement, Cartesian Product, Algebriac Sum, definition of fuzzy relation, properties of fuzzy relations, fuzzy composition.

UNIT – V

Design of Fuzzy Systems : Components of fuzzy systems, functions of fuzzification, Rule base patterns, Inference mechanisms, methods of de-fuzzification : COG, COA, MOM, Weighted average height methods

Design of Fuzzy Systems for temperature setting of water heater, fuzzy system for the control of air conditioner

Fuzzy Associate Memories (FAM), Adaptive FAMs

Text Books:

1. Introduction to Artificial Neural Systems – Jacek M.Jurada, Jaico publications
2. Fuzzy Set Theory and Its Applications - Zimmerman, Kluwer Academic Publications
3. Fuzzy Logic with Engineering Applications – Timothy Ross, McGraw Hill

References

1. Neural Networks in Computer Intelligence by Limin Fu, McGraw Hill Co., 1994.
2. Neural Networks & Fuzzy systems by B.Kosko. Prentice Hall (India) Ltd., 1992. Chapters: 7,8,9,10,11
3.Neural Networks – A Comprehensive Foundation by S.Haykin, Maxwell Macmillan

CHE 02 C COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING

Instruction : 3 hr/week **Credits : 3**

UNIT – I

Computers and Software: Computing environments, the software development processes, Algorithm design, Program composition, Quality Control, Documentation, Storage and Maintenance, Software strategy.

Process Models: Uses, Distributed & Lumped parameter models, Linear and Nonlinear models, Steady state and Dynamic models, continuous and Discrete models, Empirical models.

Formulation of Process Models: Momentum, mass and energy balances, constitutive rate equations, transport rate equations, chemical kinetic rate expression, thermodynamic relations. Review on “C” Language Fundamentals.

UNIT – II

Formulation Process Models leading to set of ordinary differential equations and solutions procedures by Euler’s, Modified Euler’s and Runge Kutta methods

UNIT – III

Formulation of Process Models leading to set of linear simultaneous equations and solution procedures by Method of determinants, Gauss Elimination, Gauss Jordan, Jacobi and Gauss Seidal methods

UNIT – IV

Formulation of Process Models leading to transcendental and polynomial equations and solution procedures by Bi – section, Reguli – falsi, Newton Raphson, Richmond, Muller’s and Bairstow methods

UNIT – V

Function Approximations by linear and nonlinear least square analysis, Approximations by orthogonal functions, chebyshev polynomials

Reference Books:

1. Digital Computations for Chemical Engineers by Leon Lapidus, McGraw Hill Book Company, 1962
2. Process Modelling, Simulation and control for Chemical Engineers, by William L Luyben, 2nd edition, McGraw Hill Publishing Company, 1990.

3. Process Modelling Analysis and Simulation by B. Wayne Bequette, Prentice Hall International Series, 1998
4. Numerical methods for Engineers by Steven C.Chapra and Raymond P Canale, 2nd edition, McGraw Hill International edition, 1988

CHE 02 D COMPUTATIONAL FLUID DYNAMICS

Instruction : 3 hr/week **Credits : 3**

Unit I :

Philosophy of CFD – CFD - CFD as a research tool – CFD as a design tool – Examples **Governing Equations of Fluid Dynamics** – Introduction – Models of Flow – The sustainable derivative- Divergence of Velocity – Continuity Equation – Momentum Equation – Energy Equation – Physical boundary conditions – Forms of Governing equations suited to CFD

Unit II :

Mathematical Behaviour of Partial Differential Equations (PDEs) – Classification of quasi linear PDEs – General Method of determining the classification of PDEs – General Behavior of different classes of PDEs

Unit III :

Discretization – Basic aspects – Finite Differences – Difference equations – Explicit and Implicit approaches – Errors and analysis of stability

Unit IV :

Grids with appropriate transformations– General transformation of equations **–** Metrics and Jacobians – Form of governing equations suited to CFD – Stretched grids – boundary fitted coordinate systems – adaptive grids – modern developments in grid generation, finite volume mesh

Unit V :

Simple CFD Techniques - The Lax – Wendroff Technique – MacCormack's technique - Viscous Flows, Conservation form and space marching **–** Relaxation Technique – Aspects of numerical dissipation and dispersion – Alternating – Direction- Implicit technique – Pressure correction technique

Text Book :

1. CFD : The Basics with Applications – John D. Anderson Jr. TMH Publication

Reference

1) Introduction to CFD – Pradip Niyogi, S K Chakrabarthy, M K Laha , Pearson Edu.:

CHE 02 E FUEL CELL SYSTEMS

Instruction : 3 hr/week **Credits : 3**

UNIT-I

Introduction – Fuel Cells- Relevance and Importance – Historical Highlights - Difference from Batteries – Fuel Choice – Classification

Electrochemistry – Thermodynamic Aspects of Electrochemical(EC) Energy Conversion – Theoretical Efficiency of Heat of a Reaction to Mechanical Energy – Efficiency of EC Energy Conversion – Factors Affecting Efficiency of EC Energy Conversion Electrode Kinetics of EC Energy Conversion

UNIT-II

Alkaline Fuel Cells – Description – Working Principle – Components - Modules – Fuel Cell Stacks – General Performance Characteristics – Advancements – System Issues – Ammonia as AFC Fuel

Molten Carbonate Fuel Cells – General Principle – Cell Components – Mechanisms of Electrode Reactions- Status

UNIT-III

Phosphorus Acid Fuel Cells- Technology- Electrode Materials and Manufacturing – Stacks and Systems

Solid Oxide Fuel Cells – History – Advantages and Limitations- Cell Components – Electrode Materials – Interconnects – Fuel – Configuration and Performance – Environmental Impact – Applications

UNIT-IV

Direct Methanol Fuel Cells – Technology Evolution – The Noble Metal Issue- The Catalyst – Electro-oxidation of Methanol – The Electrolyte – Non Catalytic Aspects – Methanol Cross over to DMFC – catalyst Optimization and Scale up – Engineering Aspects

UNIT-V

Proton Exchange Membrane Fuel Cells – Basic Scientific aspects- Challenges – Technology Development – Fuel Processing – Modeling Studies of PEMFC Performance – Applications – Challenges to High Temperature Operations – Technological and Economic Challenges

Text Book :

1. Fuel Cell : Principles and Applications – B.Viswanathan and M. Aulice Scibioh – Universities Press - 2006