R. V. R. & J. C. COLLEGE OF ENGINEERING

(Autonomous)
ACCREDITED BY NBA AND NAAC WITH 'A' GRADE
Chowdavaram,GUNTUR – 522 019

Regulations (R-16)

Scheme of Instruction, Examinations and Syllabi
[Four Year Bachelor of Technology (B.Tech.)Programme, w.e.f. 2016-17]

CHEMICAL ENGINEERING

THE DEPARTMENT OF CHEMICAL ENGINEERING

VISION & MISSION

Vision

The vision of the department is to be a globally recognized undergraduate chemical engineering program coupled with research strengths in Process Heat Transfer, Advanced Separation Technologies, Environmental Engineering and Biochemical Engineering to meet the current and future challenges of chemical and allied industries.

Mission

To develop a center of academic excellence in the field of Chemical Engineering, capable of training Chemical Engineering professionals to cater the needs of the society

Department Profile

The Department of Chemical Engineering was established in the year 1996 and presently offers 4-year B.Tech. Programme in Chemical Engineering with an intake of 60 students. The programme is approved by AICTE and Accredited Thrice by National Board of Accreditation (NBA), AICTE, New Delhi (Five years in 2012). The Department is planning to start M.Tech. in Chemical Engineering in the near future.

The Chemical Engineering programme is run as per the curriculum and syllabus prescribed by RVR & JC College of Engineering (Autonomous). The curriculum and syllabi is designed by the Board of Studies in Chemical Engineering and is approved by the Academic Council of the College. The board of studies consists of senior faculty from the Chemical Engineering Department as well as from the other Universities and senior executives from the industries.

Presently the Head of the Department of Chemical Engineering, Dr. M.Venkateswara Rao is the Chairman for the Board of studies in Chemical Engineering and Dean, Examinations, RVR & JC College of Engineering (Autonomous). The Department of Chemical Engineering with its laboratories, lecture halls and faculty rooms etc., are housed in an exclusive building. The Department has the state of the art equipment necessary for

curricular needs and latest software in Chemical Engineering like Aspen plus University Package and TSPL.

The following are the laboratories:

Momentum Transfer
Mechanical Operations
Computational Programming
Process Heat Transfer
Chemical Technology
Mass Transfer Operations
Instrumentation & Process Control
Chemical Reaction Engineering
Pollution Control
Computer Applications in Chemical Engineering
Computer Aided Process Equipment Design
Research Laboratory

Further, the Department shares the equipment in Fluid Mechanics laboratory of Civil Engineering Department and Heat Transfer laboratory of Mechanical Engineering Department, besides the common workshop facility. The laboratories are so equipped that all experiments prescribed in the curriculum can be conducted.

The Department is complimented with qualified and experienced staff members. Three of them possess Doctoral Degrees while the others have M.Tech. degrees. Two faculty members have submitted their thesis and Four faculty members are actively pursuing their Ph.D. programmes in reputed universities.

The curriculum is implemented through well planned and organized lectures to make the learning most effective. The teaching and training is more student cantered so that the pass outs will be able to prove themselves in a competitive environment. Periodic tests are used to gauge the performance of the students and counselling is offered appropriately to bring up the under performers.

The Department lays special emphasis on project work. The projects are so conceived that they call for application of knowledge gained in various subject areas in Chemical Engineering.

The Department exposes the students to live situations in Chemical Engineering by organizing Guest Lectures, inviting eminent personnel from Industry and Institutions. Further industrial visits are regularly arranged to process industries besides arranging practical training during the summer vacation after 3rd year.

The teachers closely watch the student's performance and behaviour and corrective suggestions are given whenever necessary for an all-round personality development. While the teachers bestow their utmost efforts they expect the students to be disciplined and utilize the guidance and counselling available to become Engineers with a competitive edge.

As a fillip to the aim of continuing education, the students are specially trained for GATE, GRE and TOEFL. All the attempts are made by the Department and placement cell to arrange recruitment for the pass outs to the extent possible. Central Placement Cell provides guidance, counselling & training for development of integrated personality of each and every student. The Department not only enhance the employability skills of the students but also develop innovative entrepreneurs & dynamic leaders for the nation. Most of the students have been recruited in campus placements every year.

The Alumni of the Department are faring well in their occupations. A good number of students are admitted into IIT's, NIT's for higher studies and a number of students are pursuing their higher studies abroad. Our students have made their mark in companies like ONGC, IOCL, GAIL, Shell, Reliance, ISRO, RCF, Hetero, Granules, TCS, IBM& many more… Many of our alumni occupy high-level positions in industry and government organizations not only in India but in other countries as well.

Traditionally the Department organizes State/National level programs every year, thus providing a forum for exchange of ideas and transfer of know how between students and staff of Chemical Engineering Departments in various institutions across the state/country. The Department organized 6th Annual Session of Student Chemical Engineering Congress (SCHEMCON-2010) during 24-25 September, 2010 on the theme “Process Industries and Sustainable Development”. The Department (IIChE RVR&JCCE Student Chapter)

organized IIChE 2nd council meeting on 07-02-2015. The Department is also actively involved in establishing IIChE- Guntur Regional Centre and its activities.

.

Programme Educational Objectives:

The student

I. Acquires working knowledge of applied Mathematics, Physics, Chemistry and basic Engineering Sciences that lay the solid foundation for understanding the core Chemical Engineering and specializations.

II. Develops an understanding of engineering principles related to the major aspects of Chemical Engineering and ability to obtain data & information necessary to formulate and to solve problems related to Chemical Engineering Equipment/ unit operations / unit processes with or without the support of software.

III. Integrates knowledge of core and allied courses to comprehend the multi-disciplinary nature of technological and organizational problems and be alive to the needs of industry and society.

IV. Develops inter-personal skills, managerial skills, professional ethics & values, life long learning and entrepreneurship needed for professional success and growth of the organization and individual.

Programme Outcomes:

Upon graduation, students of the program will:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including predication and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological changes.

Programme Specific Outcomes:

The Chemical Engineering Graduate will be able to

1. Synthesize a conceptual integrated chemical process selecting equipment, operations and conditions with proper control systems to produce products with specifications.

2. Analyze the economics of conceptual process design & modify the process with the aid of process simulation and also analyze the potential environmental impacts & safety concerns.

Scheme of Instruction and Examinations

I Year I Semester

S. No.	Code No. & Subject	Scheme of Instruction periods per week		Scheme of Examination				Category Code
		Theory + Tutorial	Practicals	Duration of Semester End Exam. (hrs)	Sessional Marks	Semester End Exam. Marks	Credits	
1	CH 101 Engineering Mathematics – I	3+1	-	3	40	60	3	BS
2	CH 102 Engineering Physics (common to all branches)	4	-	3	40	60	3	BS
3	CH 103 Inorganic Chemistry	4	-	3	40	60	3	BS
4	CH 104 Environmental Studies	4	-	3	40	60	3	ES
5	CH 105 Applied Mechanics& Mechanical Engineering	4	-	3	40	60	3	ES
6	CH 106 Basic Electrical and Electronics Engineering	4	-	3	40	60	3	BS
7	CH 151 Physics Laboratory	-	3	3	40	60	2	BS
8	CH 152 Workshop Practice	-	3	3	40	60	2	HS
9	CH 153 Communication Skills Lab.	-	3	3	40	60	2	ES
Total		23+1	9	-	360	540	24	

I Year II Semester

S.No.	Code No. & Subject	Scheme of Instruction periods per week		Scheme of Examination				Category Code
		Theory + Tutorial	Practicals	Duration of Semester EndExam. (hrs)	Sessional Marks	Semester End Exam. Marks	Credits	
1	CH 107 Engineering Mathematics – II	3+1	-	3	40	60	3	BS
2	CH 108 Material Science	4	-	3	40	60	3	BS
3	CH 109 Physical Chemistry	4	-	3	40	60	3	ES
4	CH 110 English for Communication (common to all branches)	4	-	3	40	60	3	HS
5	CH 111 Problem Solving with C (common to all branches)	4	-	3	40	60	3	ES
6	CH 112 Introduction to Chemical Engineering	3+1	-	3	40	60	3	PC
7	CH 154 Chemistry Laboratory	-	3	3	40	60	2	BS
8	CH 155 C-Programming Lab.	-	3	3	40	60	2	ES
9	CH 156 Engineering Graphics Lab.	2	4	3	40	60	2	ES
Total		24+2	10	-	360	540	24	

II Year I Semester

S.No.	Code No. & Subject	Scheme of Instruction periods per week		Scheme of Examination				Category Code
		Theory + Tutorial	Practicals	Duration of Semester End Exam. (hrs)	Sessional Marks	Semester End Exam. Marks	Credits	
1	CH 201 Probability &Transforms	3+1	-	3	40	60	3	HS
2	CH 202 Organic Chemistry	4	-	3	40	60	3	BS
3	CH 203 ChemicalProcess Calculations	4	-	3	40	60	3	PC
4	CH 204 Momentum Transfer	3+1	-	3	40	60	3	PC
5	CH 205 MechanicalOperations	4	-	3	40	60	3	PC
6	CH 206 Material Technology	4	-	3	40	60	3	PC
7	CH 251 Momentum Transfer Lab.	-	3	3	40	60	2	PC
8	CH 252 Basic Electrical and Electronics Engineering Lab.	-	3	3	40	60	2	ES
9	CH 253 Professional Communication Skills Lab	-	3	3	40	60	2	HS
Total		22+2	9	-	360	540	24	

Enrolmentof NCC / NSO / NSS programme will be initiated from the date of commencement of class work for II Year I Semester.

Subjects, which are offered in both I and II Semesters:

CH206:Material Technology
CH212: Professional Ethics & Human Values

II Year II Semester

S.No.	Code No. & Subject	Scheme of Instruction periods per week		Scheme of Examination				Category Code
		Theory + Tutorial	Practicals	Duration of Semester EndExam. (hrs)	Sessional Marks	Semester End Exam. Marks	Credits	
1	CH 207 Partial Differential Equations and Numerical Methods	3+1	-	3	40	60	3	HS
2	CH 208 ProcessHeatTransfer	3+1	-	3	40	60	3	PC
3	CH 209 ChemicalEngineering Thermodynamics-I	4	-	3	40	60	3	PC
4	CH 210 Inorganic Chemical Technology	4	-	3	40	60	3	PC
5	CH 211 Process Instrumentation and Instrumental Methods of Analysis	4	-	3	40	60	3	PC
6	CH 212 Professional Ethics & Human Values	4	-	3	40	60	3	HS
7	CH 254 Organic Chemistry Lab	-	3	3	40	60	2	BS
8	CH 255 Mechanical Operations Lab.	-	3	3	40	60	2	PC
9	CH 256 Computational Programming Lab.	-	3	3	40	60	2	PC
Total		22+2	9	-	360	540	24	

Enrollment of Internship / Industrial Training / Certification Coursewill be initiated from theend of II Year II Semester.

Subjects, which are offered in both I and II Semesters:

CH206: Material Technology
CH212: Professional Ethics & Human Values

III YearI Semester

S.No.	Code No. & Subject	Scheme of Instruction periods per week		Scheme of Examination				Category Code
		Theory + Tutorial	Practicals	Duration of Semester EndExam. (hrs)	Sessional Marks	Semester End Exam. Marks	Credits	
1	CH 301 MassTransferOperations-I	3+1	-	3	40	60	3	PC
2	CH 302 Chemical Reaction Engineering-I	4	-	3	40	60	3	PC
3	CH 303 Chemical Engineering Thermodynamics-II	4	-	3	40	60	3	PC
4	CH 304 Organic Chemical Technology	4	-	3	40	60	3	PC
5	CH 305 IndustrialPollutionControl	4	-	3	40	60	3	PC
6	CH 306 Elective - 1	4	-	3	40	60	3	PE
7	CH 351 Process Heat Transfer Lab.	-	3	3	40	60	2	PC
8	CH 352 Mass Transfer Operations Lab.-I	-	3	3	40	60	2	PC
9	CH 353 Chemical Technology Lab.	-	3	3	40	60	2	PC
Total		23+1	9	-	360	540	24	

Enrolment of MOOCS course will be initiated from the date of commencement of class work for III Year I Semester.

Subjects, which are offered in both I and II Semesters:

CH305 : Industrial Pollution Control

Elective-I
CH 306(A) Computer Simulators
CH 306(B) General Pharmacy
CH 306(C) Petroleum Exploration
CH 306(D) Electrochemical Engineering
CH311 : Industrial Hazards and Safety Analysis

Elective-II
CH 312(A) Computational Fluid Dynamics
CH 312(B) Pre-formulation Studies including Stability Studies
CH 312(C) Petroleum well Logging and Technology
CH 312(D) Fluidization Engineering

III Year II Semester

S.No.	Code No. & Subject	Scheme of Instruction periods per week		Scheme of Examination				Category Code
		Theory + Tutorial	Practicals	Duration of Semester EndExam. (hrs)	Sessional Marks	Semester End Exam. Marks	Credits	
1	CH 307 MassTransfer Operations-II	3+1	-	3	40	60	3	PC
2	CH 308 ChemicalReaction Engineering-II	4	-	3	40	60	3	PC
3	CH 309 ProcessDynamics& Control	3+1	-	3	40	60	3	PC
4	CH 310 Process Economics and Plant Design	4	-	3	40	60	3	PC
5	CH 311 Industrial Hazards and Safety Analysis	4	-	3	40	60	3	PC
6	CH 312 Elective-II	4	-	3	40	60	3	PE
7	CH 354 PollutionControl Lab.	-	3	3	40	60	2	PC
8	CH 355 ChemicalReaction Engineering Lab.	-	3	3	40	60	2	PC
9	CH 356 Mass Transfer Operations Lab.-II	-	3	3	40	60	2	PC
Total		22+2	9	-	360	540	24	

NCC / NSO / NSS certificate must be submitted on or before the last instruction day of III Year II Semester, otherwise his / her Semester End Examination results will not be declared.

Subjects, which are offered in both I and II Semesters:

CH305 : Industrial Pollution Control

Elective-I
CH 306(A) Computer Simulators
CH 306(B) General Pharmacy
CH 306(C) Petroleum Exploration
CH 306(D) Electrochemical Engineering

CH311 : Industrial Hazards and Safety Analysis

Elective-II
CH 312(A) Computational Fluid Dynamics
CH 312(B) Pre-formulation Studies including Stability Studies
CH 312(C) Petroleum well Logging and Technology
CH 312(D) Fluidization Engineering

IV Year I Semester

S.No.	Code No. & Subject	Scheme of Instruction periods per week		Scheme of Examination				Category Code
		Theory + Tutorial	Practicals	Duration of Semester End Exam. (hrs)	Sessional Marks	Semester End Exam. Marks	Credits	
1	CH 401 TransportPhenomena	3+1	-	3	40	60	3	PC
2	CH 402 ChemicalProcess EquipmentDesign	3+1	-	3	40	60	3	PC
3	CH 403MOOCS*	--	--	--	--	--	--	PC
4	CH 404* Elective-III(Open Elective)	4	-	3	40	60	3	OE
5	CH 405 Process Modelling and Simulation	4	-	3	40	60	3	PC
6	CH 406Elective-IV	4	-	--	40	60	3	PE
7	CH 451 Mini project//Term paper	-	3	3	100	--	2	PC
8	CH 452 Computer Applications in Chemical Engineering Lab.	--	3	3	40	60	2	PC
9	CH 453 Instrumentation & ProcessControl Lab.	-	3	3	40	60	2	PC
Total		18+2	9	--	380	420	21	

* MOOCS Certificate must be submitted on or before the last instruction day of IV Year I semester,otherwise his / her Semester End Examination results will not be declared.

Internship/Industrial Training/Certification Course completion certificate must besubmitted on or before the last instruction day of IV Year I Semester, otherwise his / herSemester End Examination results will not be declared.

Subjects, which are offered in both I and II Semesters:

CH 405: Process Modelling and Simulation

Elective-IV

CH 406(A) Computer Aided Process Engineering

CH 406(B) Industrial Pharmacy

CH 406(C) Natural Gas Production and its applications

CH 406(D) Nanotechnology

Elective-V

CH 409(A) Computer Aided Design

CH 409(B) Quality Control of Pharmaceutical Dosage Forms

CH 409(C) Petroleum Refining

CH 409(D) Advanced Separation Techniques

Elective VI

CH 410(A) Micro Process & Electronic Programming

CH 410(B) Validation and Documentation of Pharmaceuticals

CH 410(C) Petrochemical Technology

CH410(D) Biochemical Engineering

IV Year II Semester

S.No.	Code No. & Subject	Scheme of Instruction periods per week		Scheme of Examination				Category Code
		Theory + Tutorial	Practicals	Duration of Semester EndExam. (hrs)	Sessional Marks	Semester End Exam. Marks	Credits	
1	CH 407 Industrial Management	4	-	3	40	60	3	ES
2	CH 408 Optimization of Chemical Process	3+1	-	3	40	60	3	PC
3	CH 409 Elective-V	4	-	3	40	60	3	PE
4	CH 410 Elective-VI	4	-	3	40	60	3	PE
5	CH 454 Computer Aided Process Equipment Design Lab.	-	3	3	40	60	2	PC
6	CH 455 Project Work	-	9	3	40	60	10	PC
Total		15+1	12	-	240	360	24	

Subjects, which are offered in both I and II Semesters:

CH 405: Process Modelling and Simulation

Elective-IV

CH 406(A) Computer Aided Process Engineering

CH 406(B) Industrial Pharmacy

CH 406(C) Natural Gas Production and its applications

CH 406(D) Nanotechnology

Elective-V

CH 409(A) Computer Aided Design

CH 409(B) Quality Control of Pharmaceutical Dosage Forms

CH 409(C) Petroleum Refining

CH 409(D) Advanced Separation Techniques

Elective VI

CH 410(A) Micro Process & Electronic Programming

CH 410(B) Validation and Documentation of Pharmaceuticals

CH 410(C) Petrochemical Technology

CH410(D) Biochemical Engineering

*Open Electives (elective III) offered by other departments

1. CE 404(A) Basic Surveying
   CE 404(B)Building Materials & Estimation
   CS 404(A)Jaya Programming
   CS 404(B)Data Base Management Systems
   EC 404(A)Applied Electronics
   EC 404(B)Basic Communication
   EE 404(A)Non-Conventional Energy Sources
   EE 404(B)Utilization of Electrical Energy
   IT 404(A)Web Technologies
10. IT 404(B) Software Engineering
11. ME 404(A) Robotics
12. ME 404(B) Operations Research

IYear I Semester

CH 101 ENGINEERING MATHEMATICS – I

Lectures : 4 periods / week *Sessional Marks : 40*
Tutorials : 1 period / week *Semester End Exam Marks : 60*
Semester End Exam: 3 hrs *Credits :3*

Course Objectives:

To provide knowledge on solving ordinary differential equations.
To provide knowledge on applications of first order ordinary differential equations.
To provide knowledge on solving higher order ordinary differential equations.
To provide knowledge on curve fitting, correlation and regression lines.
To give basic knowledge on evaluation of double, triple integrals, area and volume.
Understand the basic linear algebraic concepts.

Course Out comes:

Understand methods of solving first order differential equations.
Understand some physical applications of first order differential equations.
Solve higher order differential equations.
Understand the basic linear algebraic concepts.
Evaluate double, triple integrals and the area, volume by double &triple integrals respectively.

UNIT - I

Ordinary Differential Equations: Introduction, Linear equation, Bernoulli's equation, exact differential equations.

Equations reducible to exact equations, Orthogonal trajectories, Newton's law of cooling.

UNIT - II

Linear differential equations with constant coefficients: Definition, Theorem, Operator D, Rules for finding the complementary function.

Inverse operator, Rules for finding the particular integral, working procedure to solve the equation.

UNIT - III

Method of variation of parameters, Equations reducible to linear equations with constant coefficients: Cauchy's homogeneous linear equation, Legendre's linear equation, Simultaneous linear equations.

Statistics: Method of least squares, Correlation, Co-efficient of correlation (direct method), Lines of regression.

UNIT - IV

Multiple Integrals: Double integrals, Change of order of integration, Double integrals in polar coordinates, Area enclosed by plane curves, Triple integrals, Volume by triple integral,

Change of variables in a double integral. Beta Gamma functions, Error function.

UNIT - V

Matrices: Rank of a matrix, vectors, Consistency of linear system of equations, Linear transformations, Characteristic equation, Properties of Eigen values (without proofs), Cayley-Hamilton theorem (without proof)

Reduction to diagonal form. Reduction of quadratic form to canonical form, Nature of a quadratic form, Complex matrices.

LEARNING RESOURCES

TEXT BOOK:

Higher Engineering Mathematics by B.S. Grewal, Khanna publishers, 41st edition, New Delhi (2010)

REFERENCE BOOK:

Advanced Engineering Mathematics by Erwin Kreyszig, 9th edition, Wiley India Pvt. Ltd. (2011)

CH 102 ENGINEERING PHYSICS

(Common to all branches)

Lectures : 3 periods / week *Sessional Marks : 40*
Tutorials : 1 period / week *Semester End Exam Marks : 60*
Semester End Exam: 3 hrs. *Credits :3*

Course Objectives:

To impart knowledge and understanding of basic principles of Ultrasound and its applications in imaging and industry.
Basic phenomena of light waves
Knowledge to be imparted on fundamentals of Laser, its types and applications. 3-D photography, principle and applications of optical fiber.
Essential formulation of physics in the micro world.
Imparting the knowledge on the development of Electromagnetic wave equations

Course Outcomes:

After completion of the course the student will be able to:
Introducing the Concepts of Ultrasonic waves, production and applications in NDT.
Interference in thin films and its application, Concept of diffraction and grating, birefringence and production and detection of different polarized lights.
Acquire Knowledge on basics of lasers, holography, fibers and their applications.
Introducing the student to the domain of quantum world by Schrodinger wave equation and its applications in 1-D. To describe the nature of electromagnetic radiation and matter in terms of the particles.

UNIT –I

Ultrasonics: properties, production of ultrasonics by magnetostriction, piezo electric oscillator methods, detection by acoustic grating method, General applications of ultrasonics in industry and medicine.

NDT: Pulse echo testing methods (reflection & transmission modes), Ultrasonic imaging (A Scan & B scan).

UNIT -II

Physical Optics: Interference: Introduction, Stoke's principle (change of phase on reflection), interference in thin films due to reflected light (Cosine law), theory of air wedge (fringes produced by a wedge shaped thin film), theory of Newton's rings (reflected system).

Diffraction: Introduction, Fraunhofer diffraction due to a single slit (quantitative), theory of plane transmission diffraction grating.
Polarization: Introduction, double refraction, construction and working of a nicol prism, quarter wave plate, production and detection of circular and elliptical polarizations (qualitative).

UNIT - III

Lasers: characteristics, spontaneous and stimulated emissions, Einstein coefficients and Relation between them, population inversion, pumping, active system, gas (He-Ne) laser, Nd: YAG laser and semiconductor (GaAs) laser, applications of lasers.

Holography: basic principle, recording, reproduction and applications.

Fiber optics: Principle & structure of an optical fiber, numerical aperture, acceptance angle and acceptance cone, fractional index change, types of optical fibers, fiber optics in communication system and its advantages. Applications of optical fibers.

UNIT - IV

Principles of Quantum Mechanics: de Broglie's concept of matter waves, Davisson and Germer experiment, Heisenberg's uncertainty principle-experimental verification (electron diffraction - single slit),

Schrodinger equation and application: Time independent Schrodinger's wave equation, physical significance of the wave function, particle in a box (one dimensional), tunneling effect, expression for transition probability (Qualitative treatment).

UNIT - V

Electromagnetism: induced electric fields, displacement current and conduction current, Maxwell's equation – qualitative (differential & integral forms)-significance, velocity of electromagnetic wave equation in free space, Poynting Theorem, LC oscillations (quantitative)

LEARNING RESOURCES

TEXT BOOKS

Engineering Physics, M.N. Avadhanulu& P.G. Kshirasagar, S.Chand&Co.Ltd.
Engineering Physics, V. Rajendran.

REFERENCE BOOKS

Fundamentals of Physics, Resnick&Halliday, John Wiley sons.
Engineering Physics, SL Kakani&Shubhrakakani (3rd Edition), CBS Publications Pvt. Ltd. Delhi.
Engineering Physics, B. K. Pandey& S. Chaturvedi, Cengage Learning India Pvt. Ltd., Delhi.
Engineering Physics, Hitendra K. Malik &A.K.Singh, Tata MacGraw Hill, New Delhi.
Engineering Physics, P.K.Palanisamy, Scitech Publications.

CH 103 INORGANIC CHEMISTRY

Lectures : 3 periods / week *Sessional Marks : 40*
Tutorials : 1 period / week *Semester End Exam Marks : 60*
Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

The student should acquire skill in solving problems by adopting a planned procedure.
Student should understand the characteristics and bonding nature of various elements.
Student should know the chemistry of important compounds useful in industry and day-to-day life.
To understand how metals are extracted from their ores profitably.
To acquire knowledge on water treatment methods for effective utilisation in industries and for domestic purposes.

Course Outcomes:

Student can establish relationship between various parameters involved in Stoichiometry. (useful in - chemical technology)
Student can relate various theories, using which he can have insight at structure and reactivity of compounds.
iii. The student would be able to arrive at various properties of compounds based on their bonding by acquiring knowledge on the chemistry of various elements.
Shall be able to know the chemistry of inorganic polymers and various metallurgical operations.
Would understand how water is treated using different methods and use it wisely for further development.

UNIT - I

Mole Concept: Introduction, Stoichiometry (Mass-Mass, Mass-Volume, Volume-Volume), oxidation number, redox reactions and balancing equations.

Chemical Bonding: Valence bond approach for diatomic molecules (Homo and Hetro), Hybridisation, types (SP, SP^2 and SP^3) and shapes of molecules, Molecular Orbital theory with respect to O_2, O_2^-, N_2 and CO molecules.

UNIT - II:

d-block elements: Electronic configuration, General characteristics, Oxidation states.

Transition metal Chemistry: Nomenclature and E.A.N concept, Werner's co-ordination theory, bonding in transition metal complexes - VBT, Crystal field theory - Octahedral, Tetrahedral and square planar complexes.

UNIT - III

f-block elements: Introduction of lanthanides and actinides, Oxidation states, Lanthanide contraction

Oxidising and Reducing agents: Preparation and properties of potassium permanganate, potassium dichromate, sodium Boro hydride, lithium aluminium hydride.

UNIT - IV

Inorganic polymers: - Introduction, preparation, properties and applications of Polysiloxanes, polysilanes and polyphosphazenes.

Principles of metallurgy: Introduction, General treatment methods in metallurgy-Ore dressing, Extraction and purification

UNIT - V

Water technology: Various impurities of Water, Hardness units, Types and determination by EDTA method (simple problems), Softening methods-Lime soda process (simple problems), softening by ion exchange process and Zeolite process.

Water treatment for drinking purpose- WHO guidelines, sedimentation, coagulation, filtration (slow sand filter), various methods of chlorination, breakpoint chlorination.

LEARNING RESOURCES

TEXT BOOKS:

Principles of Inorganic Chemistry, Puri, Sarma and Kalia, 31st edition, 2013, Milestone Publishers & Distributors.

Engineering Chemistry, P.C. Jain and Monika Jain, 15th Edition, 2008, DhanpatRai Publishing Company, New Delhi.

REFERENCE BOOKS:

New concise Inorganic chemistry, J.D.Lee, 5th edition, 2001, Nostrand Reinhold Co. Ltd., London.

Selected Topics in Inorganic Chemistry, W. U. Malik, G. D. Tuli& R. D. Madan, 17th edition, 2010, S.Chand& company Ltd.

CH 104: ENVIRONMENTAL STUDIES

Lectures : 4 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60

Semester End Exam : 3 hrs *Credits :3*

Course Objectives

To give a comprehensive insight into natural resources.
To create awareness on eco system and bio diversity.
To educate the causes for various environmental pollutions and the abatement methods
To demonstrate how to sustain the environment.
To impart some fundamental knowledge on human welfare measures and environmental acts.

Course Outcomes

The students are able

Acquire knowledge regarding proper utilization of natural resources
To understand the concept of ecosystems and biodiversity
To understand the causes, effects and controlling measures of different types of environmental pollutions.
To define and explain the basic issues concerning the ability of the human community to interact in a sustainable way with the environment.
To create awareness among worldwide environmental legislation.

UNIT-I

Multidisciplinary nature of environmental studies: Definition, Scope and Importance – Need for Public Awareness, components of Environment and their interactions.

Natural resources: *Forest Resources*: Benefits, Deforestation: Causes, effects, effects on Environment, control measures, Case Study: Chipko Movement. *Mining*: social damages of mining, mineral resources of India. *Dams*: purposes of Dam, Benefits of Dams, problems with dams, Impacts of Dams, Displacement due to Dams, Case study: Narmada River Dams, Three Gorges Dam. *Water Resources*- conflicts over water- Narmada Bachao Andolan.

UNIT-II

Energy resources- sources, types , advantages and disadvantages, energy and environment, renewable energy- solar power, wind, geothermal, hydro-electric power, marine , biomass, hydrogen energy, Fuel cell , energy saving tips. *Land resources*- land degradation, soil erosion, desertification, landslides. Role of an individual in conservation of natural resources.

Ecosystems: Concept of a Biome and Ecosystem. Structure and function of an ecosystem, Energy flow in the ecosystem, Food Chains and Webs, Ecological Pyramids, biological magnification , Biogeochemical Cycles – water cycle, carbon cycle, oxygen cycle, nitrogen cycle, phosphorous cycle, sulphur cycle, Forest ecosystem, Grassland ecosystem, Aquatic Ecosystem, Desert Ecosystem

UNIT-III

Biodiversity And Its Conservation: Introduction, Genetic, Species and Ecosystem diversity. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Bio-geographical classification of India, India as a mega diversity nation ,

Endemic species of India, Threats to biodiversity, Hot spots of Biodiversity, Endangered Species of India, Conservation of biodiversity: In-Situ and Ex-Situ conservation of biodiversity. Case study: Silent Valley Project.

Environmental Pollution: Air Pollution: Sources, pollutants, effects, air pollution control technologies- Cyclone separator, bag filter, Electro static precipitator (ESP), wet scrubber. Case Studies: Bhopal Gas Tragedy. Water pollution- types of water pollutants, sources, management of Municipal Sewage, treatment of sewage- Primary treatment, Secondary treatment- Activated Sludge Process, trickling filter, septic tank, oxidation pond and Tertiary treatment-.Microfiltration, Ultrafiltration, Reverse Osmosis. Case study: fluorosis.

UNIT-IV

Soil pollution- sources, effects, control of soil pollution. *Marine* pollution- types, oil spills and offshore sources, marine pollution Abatement. *Noise* Pollution- sources, effects, control measures, *Thermal pollution* – sources, effects and control measures.

Solid Waste Management: types of solid waste, 3R Concept, Causes, effects and control measures – Composting, Vermicomposting, Landfills, Incineration, Disposal methods, Hazardous Waste Management, Role of individual in pollution prevention.

UNIT-V

Social Issues and the Environment: From Unsustainable to Sustainable development - Urban problems related to energy -Water conservation, rain water harvesting- Ralegaon siddhi, and watershed management -Resettlement and rehabilitation of people its problems and concerns: case study- Tehri Dam; Environmental Ethics: Issues and possible solutions. - Climate change, global warming, acid rain- Tajmahal- Madhura refinery, Ozone layer depletion, nuclear accidents- Chernobyl Nuclear disaster,

Environmental acts: Prevention and Control of Water pollution & Air Pollution act, Environmental protection act, Wild life protection act, Forest Conservation act. International Conventions: Stockholm Conference 1972, Earth Summit 1992. Copenhagen Summit 2009, COP21 Paris Climate Conference.

Field Work: Visit to a local area to document environmental assets River /forest grassland/hill/mountain -Visit to a local polluted site-Urban/ Rural/industrial/ Agricultural Study of common plants, insects, birds - Study of simple ecosystems-pond, river, hill slopes, etc. Visits to industries – water treatment plants, effluent treatment plants.

LEARNING RESOURCES

TEXT BOOK:

Environmental Studies by T Benny Joseph, 2nd edition Tata McGraw-Hill Publishing Company Limited, New Delhi., (2008).

REFERENCE BOOKS:

Bharucha. E., Textbook of Environmental Studies for Undergraduate Courses, University Press, 2005.

Environmental studies by Anubha Kaushik and C.P.Kaushik., New Age International Publishers, New Delhi.,3rd Edition (2012)

VenugopalaRaoP.,Principles of Environmental Science and Engineering, Prentice-Hall of India Private Limited, New Delhi, 2006.

Rajagopalan. R., Environmental Studies, Oxford University Press, 2005.

CH105 APPLIED MECHANICS & MECHANICAL ENGINEERING

Lectures : 4 periods / week *Sessional Marks : 40*

Semester End Exam Marks : 60

Semester End Exam : 3 hrs. *Credits :3*

Course Objectives:

To understand the various coplanar forces applied to a body and method of resolving the forces and determination of resultant force, and conditions required for equilibrium, and also to know what is centre of gravity and moment of inertia and their importance and determining them for simple objects

To know the different stresses developed/induced when the body is subjected to external forces or temperature changes and to know the hoop and longitudinal stresses developed in the thick and thin cylinders when subjected to internal pressure and also determine the change in the dimensions of the cylinder due to these stresses and strains.

To understand the formation of steam and different properties associated with it and working principles of different boilers and different mountings and accessories used for the safety operation of boilers

To understand the working principles of 2 stroke and 4 stroke petrol and diesel engines and knowing the procedures of estimating the performance characteristics of I.C. Engine.

To impart the knowledge about different drive systems like belts and gear drives and to know about the working principles and importance of different bearing and couplings.

Course Outcomes:

The student must be in a position to understand different coplanar forces and determine the resultant forces. He is also able to estimate centre of gravity and moment of inertia for simple objects.

The student must be able to estimate the tensile, compressive, shear and thermal stresses in a body when subjected for different forces, change in temperature etc., He can also understand the difference between thick and thin cylinders and able to estimate hoop and longitudinal stresses, changes in dimensions of the cylinder due to these stresses and strains.

The student can understand the formation of steam, working principles of Babcock and Wilcox boilers, different mountings and accessories used in the boilers.

He must be in a position to know what is I.C.Engine, its important components, working principles of CI and SI engines, 2 stroke and 4 stroke engines and their differences. He is in a position to estimate the different performance characteristics.

The student must be in a position to know how the power is transmitted through belt and gear drives, estimate the tensions, power transmitted, length of the belt required etc., He is also in position to understand the importance of bearing and couplings in power transmission and different types of bearing and couplings.

UNIT - I

Forces:Concurrent Forces, Composition and Resolution of coplanar Forces, Equilibrium of Coplanar forces.

Section Properties: Centre of gravity and Moment of Inertia of simple and composite elements (Problems related to simple objects only).

UNIT - II

Stress and Strain: Simple stress and strain, Hooke's Law, Stress strain diagram for brittle and ductile materials- Factor of safety, Thermal stresses, Lateral strain, Modulus of rigidity, Bulk modulus-Relation between G,K and C, (Problems on simple stresses, elongations only)

Thin and Thick Cylinders:Thin and thick circular cylinders subjected to internal and external pressure. Thin and thick cylinders with spherical ends. Lame's theorem and application to thick cylinders.

UNIT - III

Steam: Generation of steam, Properties of steam, Use of steam tables and Mollier chart-(Problems related to enthalpy, entropy, specific volume calculations for different conditions of steam only- No problems on non flow processes).

Steam Generators: Classification – Working of Cochran and Babcock-Wilcox boilers only-Accessories and mountings (Listing and functions only).

UNIT - IV

I.C. Engines: Classification-Main components of IC engines, working of 2-stroke and 4-stroke Petrol and Diesel engines-Differences between SI & CI engines, 2 Stroke & 4 stroke engines, Applications. Fuel supply systems –Functions/Requirements– Working of Simple Carburetor and Fuel Injection pump only.

Testing and Performance of I.C. Engines:Performance parameters of IC engines, Definitions, Formulae and Simple problems only (No heat balance calculations).

UNIT - V

Drives:Belts Classification, Expression for the ratio of tensions on the slack and tight side, Power transmitted, V-belts, Chain drives-Simple problems only.
Gears: Classification –Spur, Bevel, Helical gears and applications.

Bearings:Purpose of bearings, Slipper bearing, Thrust bearing, Ball and Roller bearings.

Couplings:Flange, Flexible couplings, Hook's joint, Universal coupling.

LEARNING RESOURCES

TEXT BOOKS:

Strength of Materials, S. Ramamrutham, 17th Edition, DhanpathRai Publishers, Delhi (Unit – I, II)(2011)
Elements of Mechanical Engineering, Mathur, and Mehta Jain Brothers, Delhi (Unit – III, IV), (2005)
Treatise on Heat Engineering, V. P.Vasandhani&Kuma . Metropolitan Publishers.
I.C. Engines - V. Ganesan, TMH.

REFERENCE BOOKS:

Applied Mechanics & Strength of Materials, R. S. Khurmi, 13th Edition, S. Chand & Co.(1977).
Basic Mechanical Engineering, T.J.Prabhu& Others, 1st Edition, SciTech Publishers(2010).
Machine Design, R.S. Khurmi.

CH 106BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Lectures : 4 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam : 3 hrs. *Credits :3*

Course Objectives:

To study the behavior of electrical elements and circuits for DC as well as AC excitation.
To understand basic concepts of electrical machines with operation, control, testing and application.
To understand the principle of operation and characteristics of basic electronic devices and power supplies.
To understand the operation of different analog and digital meters.
To study the basic transducers with their applications.

Course Outcomes:

To understand the concept of DC/AC circuits and analyze.
Able to analyze performance of D.C. machines in terms of efficiency and their utilizations in different applications.
Able to analyze performance of Transformers and induction motors.
To know various electronic devices operation and their applications.
To know the principles of operation of Electrical and electronic measuring devices.

UNIT - I

Basic concept components and Electrical Circuits: The unit of charge, voltage, current, power and energy. Circuit elements, circuit concept, Kirchhoff's voltage law and Kirchhoff's current law applied to simple series and parallel circuits. Alternating currents: Definition of Peak value, RMS value, Average value, Peak factor and Form factor of Alternate current, Behaviour of Resistance, Inductance and Capacitance to Sinusoidal voltage.

Vector and J-notation as applied to the resolution of AC circuit, Vector diagrams, Single-phase series, and Parallel and Series-parallel circuits to sinusoidal excitation. Calculation of Active, Reactive and Complex power and Power factor. Polyphase circuits: 3-phase supply, star-delta connections, Voltage, Current and Power relationships.

UNIT - II

DC generators and Motors: Constructional features of Dc machines and functions of component parts, Calculation of induced E.M.F, Methods of excitation, Characteristics of shunt, series and compound generators

D.C motors: operation and applications, Torque developed in a motor, Dc 3 point Starter, losses and efficiency calculations, Testing of Dc machines: O.C.C. on Dc shunt generator, Swinburne’s test and Brake test on Dc motor.

UNIT - III

Transformers: Construction, Principle of Operation, EMF equation, efficiency, O.C. and S.C. test of single phase transformers.

Three-phase induction motors: Construction, Principle of Operation, Production of rotating magnetic field, Theory of slip-ring and squirrel cage induction motors, Torque-slip characteristics.

UNIT - IV

Electronic devices: Characteristics of Semiconductor junction Diode Zener diode transistor, JFET, UJT, SCR and their applications. Zener Voltage Regulator and their applications.

Power supplies: Half-wave, full-wave rectifiers and Bridge rectifier, with (L and LC) and without filters. Oscillators: Classification, RC phase shift, wien-bridge, Hartley and Colpitts oscillators.

UNIT - V

Electrical and Electronic Measurements: Classification of instruments, construction and Principle of operation of permanent magnetic moving coil, moving iron dynamo meter type wattmeter.

Principle of operation of DVMs and CROs. Transducers: Introduction to transducers principle of operation of LVDT, Thermister Thermo Couple and their applications.

LEARNING RESOURCES

TEXT BOOKS:

Electrical Technology, B.L.Theraja&A.K.Theraja, Volume - I &II (Unit - I, II, IV).
Electronic Devices and Circuits, S Salivahanan, N Suresh Kumar and AVallavaraj (Unit-III, V), 4th Edition (2012).
Principles Electrical Engineering, V.K.Mehta&Rohit Mehta, 2ndEdition, S.Chand& Co., New Delhi (2010). (Unit - II, III.)

REFERENCE BOOKS:

Basic Electronics, N.N.Bhargava&Kulasresta, Tata McGraw Hills, New Delhi.
Basic Electrical Engineering, DP Kothari and I. J. Nagrath, 2nd edition, Tata McGraw Hills, New Delhi.

WEB RESOURCES:

http://www.tcyonline.com/video-tutorials-kirchoff-s-law/10209
http://www.nptelvideos.com/electrical_engineering/
http://nptel.iitm.ac.in/
http://nptel.ac.in/video.php?subjectId=11710306
http://nptel.ac.in/courses/108105053/
http://www.nptelvideos.in/2012/11/industrial-instrumentation.html
http://www.slideshare.net/saaz1425/measuring-instruments-23906475?from_action=save

CH 151 PHYSICS LABORATORY

Practicals : 3 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam : 3 hrs *Credits : 2*

Course Objectives:

1. To understand the general, scientific concepts required for technology.

CourseOutcomes:

Use CRO, signal generator, spectrometer for making measurements.
Test the optical components using principles of interference & diffraction.
Determination of the selectivity parameter in electrical circuits.

List of Experiments:

Interference fringes – measurement of thickness of a foil using wedge method.
Newton's rings - measurement of radius of curvature of Plano- convex lens.
Lissajous' figures – calibration of an audio oscillator.
Photo cell – characteristic curves and determination of stopping potential.
Diffraction grating - measurement of wavelengths.
Torsional pendulum – determination of Rigidity modulus of a wire.
Photo-Voltaic cell – determination of fill factor.
Series LCR resonance circuit –determination of Q factor.
Sonometer – determination of A.C. frequency.
Laser- determination of wave length using diffraction grating.
Variation of magnetic field along the axis of a circular current carrying coil.
Optical Fiber – Determination of Numerical Aperture and Acceptance Angle.

REFERENCE BOOK:

Lab Manual

CH 152 WORKSHOPPRACTICE

Practicals : 3 periods / week *Sessional Marks : 40*

Semester End Exam Marks : 60

Semester End Exam : 3 hrs *Credits :2*

Course Objectives:

To provide the students hands on experience to make different joints in carpentry with hand tools like jack plane, various chisels & handsaws

To provide the students hands on experience to make different joints in welding with tools & equipment like electric arc welding machine,

TIG Welding Machine, MIG Welding Machine, hack saws, chipping tools etc.

To provide the students hands on experience to make different joints in Sheet metal work with hand tools like snips, stacks, nylon mallets, etc.

To provide the students hands on experience to make different connections in house wiring with hand *tools like cutting pliers ,tester, lamps& lamp holders etc.* .

Course Outcomes:

To familiarize with -The Basics of tools and equipment used in Carpentry, Tin Smithy, Welding and House Wiring.

The production of simple models in the above four trades

LIST OF EXPERIMENTS:

Minimum three experiments should be conducted from each trade

1. CARPENTRY

To make the following jobs with hand tools

Lap joint
Lap Tee joint
Dove tail joint
Mortise &Tenon joint
Cross-Lap joint

WELDING USING ELECTRIC ARC WELDING PROCESS / GAS WELDING.

The following joints to be welded.

Lap joint
Tee joint
Edge joint
Butt joint
Corner joint

SHEET METAL OPERATIONS WITH HAND TOOLS.

Rectangular Tray
Triangular Tray
Pipe Joint
Funnel
Rectangular Scoop

HOUSE WIRING

To connect one lamp with one switch
To connect two lamps with one switch
To connect a fluorescent tube
Stair case wiring
Go down wiring

LEARNING RESOURCES

TEXT BOOKS:

Kannaiah P. &Narayana K. C., "Manual on Work Shop Practice", Scitech Publications, Chennai,1999.
Workshop Lab Manual, R.V.R. & J.C. College of Engineering, Guntur.

CH 153 COMMUNICATION SKILLS LABORATORY

Practicals : 3 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam : 3 hrs *Credits : 2*

Course Objectives:

To acquaint the students with the standard English pronunciation, i.e., Received Pronunciation (RP), with the knowledge of stress and intonation.
To develop the art of effective reading and answer comprehension passages.
To enable the students use phrasal verbs and idiomatic expressions in an apt manner.
To equip with appropriate and spontaneous speech dynamics.
To develop production and process of language useful for social and professional life.

Course Outcomes:

At the end of the course the students will be able to:

Know the IPA phonetics symbols, and their relation to pronunciation; recognize the difference among the native, regional and neutral accent of English.
Employ different skills, inferring lexical and contextual meaning and attempt comprehension passages.
Use confidently phrases and idioms for effective communication.
Develop appropriate speech dynamics in professional situations.
Focus on communication skills and social graces necessary for effective communication.

Phonetics:

Sounds, Symbols, Stress and Intonation.
Pronunciation – Mother tongue influence – Indianisms etc.

II. Reading Comprehension

Strategies, Reading skills – Skimming and Scanning,
Intensive and Extensive reading.

III. Idioms & Phrases

Idioms of variety.

IV. Interactive classroom activities.

Jam– (Guided & Free) – Extempore –Elocution – Telephonic Skills.
Articulation and flow of oral presentation – voice modulation – content generation – Key Word Approach(KWA).

V. Communication Skills

Greeting and Introducing; Making Requests; Agreeing and disagreeing; Asking for and giving permissions; Offering help; Art of small talk; making a short formal speech; Describing people, places, events & things.

LEARNING RESOURCES:

A Course in Listening & Speaking II, Foundation books by G. Raja Gopal,2012. (UNIT – I) & (UNIT - IV)
Books on GRE, IELTS & TOEFEL (Unit –II)

English Idioms by Jennifer Seidl W. McMordie, OUP, V Edition , 2009
Interactive classroom activities. (10 titles -CUP) (UNIT - IV)
A course in English Communication – by KiranmaiDutt, Rajeevan, C.L.N Prakash, 2013. (UNIT -V).
Better English Pronunciation - J.D.O' Connor, Second Edition, 2009, Cambridge Semester Press. (UNIT - I).

SOFTWARE:

Pronunciation power I & II
Author plus - Clarity.
Call Centre Communication - Clarity.

I Year II Semester

CH 107 ENGINEERING MATHEMATICS – II

Lectures : 4 periods / week *Sessional Marks : 40*
Tutorials : 1 period / week *Semester End Exam Marks : 60*
Semester End Exam 3 hrs *Credits :3*

Course Objectives:

To write series expansion of functions and finding extreme values or stationary values of functions of two (or) three variables.
To provide sufficient theoretical and analytical background of differentiation and integration of vector functions.
To provide knowledge on complex analysis because technology we rely on requires scientists and engineers to understand this topic. Complex analysis is widely used in the fields of science and technology.
To provide knowledge on complex integration.
To provide knowledge on singularities, poles and residues.

Course Outcomes:

Assess the importance of derivative in series expansions and extreme values.
Able to solve problems related to gradient, divergence and curl of vector differentiation.
Apply Cauchy-Riemann equations and harmonic functions to problems of fluid mechanics, thermodynamics and electro-magnetic fields.
Evaluate complex line integrals.
Find singularities of complex functions and determine the values of integrals using residues.

UNIT - I

Differential Calculus: Rolle's Theorem (without proof), Lagrange's Mean value Theorem (without proof), Taylor's and Maclaurin's Series for single variable (without proof).

Maxima and minima of two variables, Lagrange's method of undetermined multipliers

UNIT - II

Vector Calculus: Scalar and vector point functions, Del applied to scalar point functions, Gradient, Del applied to vector point functions, Physical interpretation of divergence and curl, Del applied twice to point functions, Del applied to products of point functions.

Integration of vectors, Line integral, Surface integral, Green's theorem in the plane (without proof), Stoke's theorem (without proof), Volume integral, Gauss divergence theorem (without proof).

UNIT - III

Complex Analysis: Introduction, Continuity, Cauchy's Riemann equations (without proof), Analytic Functions, Harmonic functions, Orthogonal system.

Complex Integration: Cauchy's Integral Theorem, Cauchy's Integral Formula.

UNIT - IV

Series: Taylor's Series (without proof), Laurent's Series (without proof).

Calculation of residues: Zeroes and Singularities, Calculation of residues,

UNIT V

Evaluation of real definite integrals (by applying the residue theorem).

Conformal Mapping: Conformal mapping, Linear fractional transformations, Special linear fractional transformations, Mapping by other functions.

LEARNING RESOURCES

TEXT BOOK:

Higher Engineering Mathematics by B.S. Grewal, Khanna publishers, 41st edition, New Delhi (2010).

REFERENCE BOOK:

Advanced Engineering Mathematics by Erwin Kreyszig, 9th edition, Wiley India Pvt. Ltd. (2011).

CH 108 PHYSICAL CHEMISTRY

Lectures : 4 periods / week *Sessional Marks : 40*
Tutorials : 1period/ week *Semester End Exam Marks : 60*
Semester End Exam : 3 hrs *Credits :3*

Course Objectives:

- To develop scientific concepts, principles, problem solving skills, attitudes, appreciations and interests.
- Defines terms associated with thermodynamics, phase rule and chemical equilibrium.
- Understanding the mechanisms of catalysis.
- Calculation related to conductance, reduction potentials, cell e.m.f., concentrations and rate constants.

Course Outcomes:

Able to apply the gaseous laws in solving industrial problems.
Able to calculate molar heat capacities and internal energy & work.
Able to know the number of phases, components and degree of freedom.
Able to calculate the distribution of solute in liquid-liquid systems.
Able to calculate rate of reaction and do selection of catalyst.

UNIT - I

Gas Laws-definition, mathematical representation, graphical representation and simple problems on Boyle's Law, Charles law, Gaylussac-Charles law, ideal gas equation, Avogadro's law, Dalton's law of partial pressures,

Amagat's law of partial volumes, Vander Waal's gas equation, Henry's law, and Raoult's Law, concept of osmotic pressure.

UNIT - II:

Thermodynamics: Thermodynamic terms and basic concepts, Thermodynamic processes, reversible and irreversible processes, pressure volume work, Internal energy, First law, enthalpy, molar heat capacities, adiabatic and isothermal expansion of ideal gas.(simple problems on work done)

Spontaneous process, entropy, second law, entropy change for an ideal gas, entropy change accompanying phase change (problems), Physical significance of entropy.Trouton's rule

UNIT - III:

Free energy, work function, free energy change for ideal gas, Gibbs-Helmholtz equation, Clausius-Clapeyronequation, Equilibrium constant –Van't Hoff isotherm, third law of thermodynamics.

Phase rule: Definition, explanation of the terms –phase, component, degrees of freedom, Phase diagram of water system, two component system Pb-Ag, Application of eutectics.

UNIT - IV:

Chemical equilibria:Reversible reactions, Law of mass action, Equilibrium constants-K_p, K_c, K_x for homogenous reactions. Effect of temperature on Equlibria-Van'tHoff equation, Le-Chateliar principle and applications.

Distribution law: Nernst distribution law, explanation and limitations, modification when solute undergoes association and dissociation, Determination of equilibrium constant from distribution law, extraction of a solute from solution with an immiscible solvent, applications distribution law.

UNIT - V:

Chemical Kinetics: Order, Molecularity, activation energy, Specific reaction rate, first order and second order reactions. Half-life period, Effect of temperature on reaction rate(simple problems on 1^{st},2^{nd} order reactions and half-life periods).

Catalysis: Homogeneous and Heterogeneous catalysis, Characteristics of Catalyst, promoter, negative catalyst, catalytic poison, adsorption theory of catalysis, enzyme catalysis. Michelis and Menton enzyme kinetics. Industrial applications of catalysis.

LEARNING RESOURCES

TEXT BOOK:

Essentials of Physical Chemistry, Bahl.B.S and Tuli, 18^{th} edition, 2010, S.Chand& Co., Delhi.

REFERENCE BOOKS:

Engineering chemistry by Jain and Jain, 15^{th} edition, 2008, Dhanpat Rai Publishing company, Delhi.

Principles of Physical Chemistry, B.R Puri, L.R Sharma, Madan.S.Pathania, 46^{th} edition,2013, Vishal publications,Jalandhar.

WEB REFERENCES:

http://www.chem.arizona.edu/~salzmanr/103a004/nts004/nts004.html
http://www.cdeep.iitb.ac.in/nptel/Core%20Science/
http://www.wiziq.com/tutorial/
http://www.powerstream.com/BatteryFAQ.html#lec

CH 109 MATERIAL SCIENCE

Lectures : 4 periods / week *Sessional Marks : 40*
Tutorials : 1period/ week *Semester End Exam Marks : 60*
Semester End Exam : 3 hrs *Credits :3*

Course Objectives:

Selection of materials for various applications based on crystal structures and their properties.
Study of defects and basic mechanical properties.
Interactionof optical energy with matter and study of optical properties, understanding the basics of Composites.
Basics of Dielectrics and magnetism, Classification of materials on Polarization and Magnetization and applications.
Properties and applications of super conducting and nano materials.

CourseOutcomes:

Characterizing the crystals and amorphous materials and appropriate selection of materials for desired property.
Acquire Knowledge on imperfections in solids and mechanical properties of solids
Significance of optical properties of matter when interacted with optical energy and the knowledge of Composites.
Importance of polarization and magnetization phenomena and their applications.
Relevance of superconductivity and Nano materials

UNIT - I

Engineering Materials: Structure – Property relationship (Mechanical, Thermal, Electrical, Magnetic and Optical Properties), Material Selection for Engineering applications, Classification of Engineering Materials.

Crystal Structure: Crystalline and amorphous solids, lattice, basis, unit cell, Crystallographic axes, Miller indices in cubic systems, its determination and uses, Interplanar distance, Crystal Parameters (atomic radius, coordination no., Packing factor) for SC, BCC, FCC and HCP Crystal structures, Diffraction of X-rays, Bragg's derivation Law, Crystal structure determination: Powder defractometer (Debye-Scherrer method).

UNIT - II

Crystal Imperfections: Point (Vacancy, substitutional, interstitial, Frenkel and Schottky) defects; Line (Edge and Screw dislocations) defects, Burger's Vector; Surface (Grain & Twin boundaries) defects, stacking faults.

Mechanical Properties Of Solids: Stress and strain, Hook's law, elastic behavior of a material, factors affecting elasticity, three moduli of elasticity, shafts, torsional pendulum, bending of beams, bending moment, depression of a cantilever, young's modulus by cantilever (statistical & dynamic methods), oscillations of a cantilever, work done in bending a cantilever, uniform and non-uniform bending.

UNIT – III

Classification of Optical Materials: Transparent, translucent and opaque; optical properties of Metals and non-metals; reflection, refraction; Absorption in metals. Insulators and semiconductors and transmission

Composite Materials: Classification, Large particle reinforced and dispersion strengthened composites; Fibre orientation and Concentration Influences, discontinuous and alignment randomly oriented; processing techniques for composite materials and fibre reinforced composites, applications.

UNIT - IV

Dielectric Properties: Fundamental definitions; dipole moment, polarization, polarisability, dielectric constant and susceptibility, Electronic and Ionic polarizations – Clausius-Mosotti equation; Frequency dependence of Polarisation, Ferroelectrics and few applications.

Magnetic Materials: Introduction, origin of Magnetic moment and Bohr magneton, classification of dia, para and ferro magnetic materials on the basis of magnetic moment (Qualitative), soft and hard magnetic materials, Ferrites and their applications.

UNIT - V

Superconducting Materials: Introduction, critical parameters (T_C, H_C, I_C), Meissner effect, types of superconductors, entropy, specific heat, energy gap, BCS Theory (in brief), applications of superconductors.

Nano Materials: Basic concepts of Science & Technology, Nano Scale, Introduction to Nano materials, surface to volume ratio, General properties of nano materials in brief, fabrication of nano materials (sol-gel and chemical vapour deposition methods), applications of nano materials.

LEARNING RESOURCES

TEXT BOOKS:

Material Science: V.Rajendran-MGH.
Engineering Physics: M.Arumugam,Anuradha Publications, Chennai.

REFERENCE BOOKS:

Materials Science, M.Vijaya and G.Rangarajan, TMH, New Delhi.
Engineering Physics: V.Rajendran,MGH.

CH 110ENGLISH FOR COMMUNICATION
(Common to all branches)

Lectures: 3 period / week *Internal Marks: 40*
Tutorials: 1 period/week *Semester End Exam Marks: 60*
Sem End Exam Duration: 3 hours *Credits: 3*

Course Objectives:

To enable students improve their lexical and communicative competence.
To equip students with oral and written communication skills.
To help students understand and learn the correct usage and application of Grammar principles.
To get them acquainted with the features of successful professional communication.
To enable students acquire various specific features of effective written communication.

Course Outcomes:

At the end of the course, the student will be able to :

Use vocabulary contextually;
Compose effectively the various forms of professional communication.
Apply grammar rules efficiently in spoken and written forms.
Understand and overcome the barriers in communication. Develop professional writing.

Unit – I

Lexis: [12]
i.Synonyms & Antonyms
Words often confused
b. i. One Word Substitutes
Analogies

Unit – II

Written Communication: [12]
Note-taking & Note-making
Writing a Proposal
Memo Writing
Paragraph writing

Unit – III

Principles of Grammar: [12]

Exposure to basics of grammar with emphasis on
Articles & Prepositions
Tenses
Voice
Speech

Unit – IV

Communication: [12]

Forms of communication– Barriers to communication – Non-verbal Communication - Kinesics, Proxemics, Occulesics, Haptics

Unit – V

Composition: [12]

E-mail
Letter-writing: order, complaint, job application, invitation.
Precis writing
Biographical writing:
APJ Abdul Kalam
Ratan Tata
Sudha Murthy
Mother Teresa

Text Books Prescribed :

Technical English - by Dr. M. Sambaiah, Wiley India Pvt. Ltd, New Delhi 2015.

Communication Skills – OUP, by Sanjay Kumar & Pushpa Latha (This text is prescribed for the topics; (1) One Word Substitutes (2) Note-taking and (3) Haptics.)

Reference:

Dictionary of Synonyms and Antonyms, Oxford & IBH, III Ed

Objective English III Edition, Mc-Graw Hill Companies- by Hari Mohan Prasad, Uma Rani Sharma.

Technical Communication – Principles & Practice. II Ed, by Meenakshi Raman & Sangeetha Sharma

Oxford Michael Swan- Practical English Usage – III Ed . New international Students ' Ed,OUP.

Business Communication II Ed. Meenakshi Raman & Prakash Singh, OUP.

Handouts.

A course in English Communication – by Kiranmai Dutt, Rajeevan, C.L.N Prakash.

The Most Common Mistakes in English Usage – Thomas Elliott Berry.

*****

CH 111 PROBLEM SOLVING WITHC
(Common to all branches)

Lectures : 4 periods / week *Sessional Marks : 40*
Tutorials : 1 period / week *Semester End Exam Marks : 60*
Semester End Exam 3 hrs *Credits : 3*

Course Objectives:

The basic problem solving process using algorithm, Flow Charts and pseudo-code development.
The basic concepts of control structures in C.
The concepts of arrays, functions and pointers in C and can effectively use pointers for Dynamic memory allocation.
The concepts of structures, unions, files and command line arguments in C.

Course Outcomes:

At the end of the course, the student will be able to

Develop algorithms and flow charts for simple problems.
Use suitable control structures for developing code in C.
Design modular programs using the concepts of functions and arrays.
Design well-structured programs using the concepts of structures and pointers.
Develop code for complex applications using file handling features.

UNIT - I

Introduction: Computer & it's Components, Hardware , Software, programming languages, Algorithm, Characteristics of algorithm, Flowchart, Symbols used in flowchart, history of C, structure of C program, C language features.
C Tokens: Character set, Identifiers, Keywords, constants, Data types, type qualifiers, Declaration and Initialization of variables.

Operators & Expressions: C operators and expressions, Type-conversion methods, Operators Precedence and Associativity, Input/ Output functions and other library functions.
Programming Exercises: C-Expressions for algebraic expressions, Evaluation of arithmetic and boolean expressions. Values of variables at the end of execution of a program fragment, Computation of values using scientific and engineering formulae.

UNIT - II

Control Statements: If-Else statement, Else-lf statement, Switch statement and goto statement.

Looping- While, Do-While and for statements, Break and continue statements.

Programming Exercises: Finding the largest of three given numbers, Computation of discount on different types of products with different ranges of discount, finding the type of triangle formed by the given sides, Computation of income-tax, Computation of Electricity bill, finding roots of a quadratic equation. Finding the factorial of a given number, test whether a given number is-prime, perfect, palindrome or not, Generation of prime and Fibonacci numbers.

UNIT - III

Arrays: One - dimensional, Two-dimensional numeric and character arrays.

Functions: Function Definition, Function prototype, types of User Defined Functions, Function calling mechanisms, Built-in string handling and character handling functions, recursion, Storage Classes, mult-file compilation, Function with Arrays.

Programming Exercises: Computation of statistical parameters of a list of numbers, sorting and searching a given list of numbers, Operations on Matrices such as addition, multiplication, Transpose of a matrix. Finding whether a given string is palindrome or not, sorting of names, operations on strings with and without using library functions, recursive functions to find the factorial value, Fibonacci series, GCD, swapping of two variables, calling the function by passing arrays.

UNIT - IV

Pointers: Pointer, Accessing a variable through pointer, pointer Arithmetic, pointer and Arrays, Dynamic memory allocation, pointer to pointer, Array of pointers.

Structures: Structures, Nested structures, Array of structures, Pointer to structures, passing structures to functions, self referential structure, Unions.

Programming Exercises: Sort and search the given list using functions and pointers, operations on arrays using functions and pointers. Operations on complex numbers, maintaining the books details by passing array of structures to functions, sorting the list of records.

UNIT - V

Files: defining and opening a file, closing a file, input/output operations on files using file handling functions, random access to files.

Command line arguments, C-preprocessor directives.

Programming Exercises: create and display the contents of text file, copy the contents of one file into another, merging the contents of two files, writing, reading and updation of student records in a file, programs to display the contents of a file and copy the contents of one file into another using command line arguments.

LEARNING RESOURCES

TEXT BOOK:

Programming with C (Schaum's Outlines) by Byron Gottfried, Third Edition, Tata McGraw-Hill.

REFERENCE BOOKS:

□□Ā□□`□Ā□ *Programming in C by Stephen G. Kochan, Fourth Edition, Pearson*
□□Ā□□`□Ā□ *C Complete Reference, Herbert Sheildt, TMH., 2000.*
□□Ā□□`□Ā□ *Programming with C by K R Venugopal&Sudeep R Prasad, TMH., 1997*
□□Ā□□`□Ā□ *The C programming Language by Brian W. Kernighan & Dennis M. Ritchie, Second Edition, Prentice Hall*

WEB REFERENCES:

http://cprogramminglanguage.net/
http://lectures-c.blogspot.com/
http://www.coronadoenterprises.com/tutorials/c/c_intro.htm
http://vfu.bg/en/e-Learning/Computer-Basics--computer_basics2.pdf

CH 112 INTRODUCTION TO CHEMICAL ENGINEERING

Lectures : 4 periods / week *Sessional Marks : 40*

Semester End Exam Marks : 60

Semester End Exam : 3 hrs *Credits : 4*

Course Objectives:

To introduce history, importance and components of chemical engineering

To provide concepts of unit operations and unit processes, and current scenario of chemical and allied process industries.

To provide Basic principles and calculations of chemical engineering; material balances and their applications.

To provide basic principles of momentum, heat and mass transfer and equipment.

Provide the foundation for Chemical reaction engineering and all subsequent Chemical Engineering courses

Course Outcomes:

Awareness of career options, potential job functions, contemporary and professional issues.

Understand what Chemical Engineering is and what careers are possible with a degree in Chemical Engineering.

Acquire basic principles of momentum and heat transfer & heat transfer equipment.

Acquire basic principles of mass transfer and equipment.

Understand the reaction kinetics and various types of industrial reactors.

UNIT – I

Introduction: Definition of Chemical Engineering, Role of Chemical Engineer in everyday life, History of Chemical Engineering and Chemical Technology; Scope of Chemical Engineering, nature of industries and applications, Scaling up or down, Chemical Engineering applications of portable devices, Flow diagram, Flow sheet, with simple examples.

Batch Processing, continuous processing, transition from batch to continuous processing. Role of basic sciences in Chemical Engineering. Units & dimensions, unit processes & unit operations and basic laws.

UNIT – II

Principles of stoichiometry: Stoichiometric relations, Basis of calculations, methods of expressing compositions of mixtures and solutions, density and specific gravity.

Momentum Transfer: Nature of a Fluid, viscosity, velocity profile, flow field, types of fluid motion, laminar and turbulent flow, conservation mass. Conservation of Energy, Total energy balance for steady flow, mechanical energy balance for study flow: Bernoullis theorem, Friction loses in laminar flow through a circular tube: Hagen-Poiseuille equation, Friction losses in turbulent flow: Fanning equation.

UNIT – III

Heat Transfer: Conduction: Fourier’s law, mean area of heat transfer, conduction through a composite plain wall. Convection: Newton’s law of cooling, individual heat transfer

coefficients, correlations for calculation of heat transfer coefficients, overall heat transfer coefficients and logarithmic mean temperature difference.

Radiation: Stefan-Boltzmann law(Black body Radiation), radiation from the sun. Heat transfer equipment: Double pipe, shell & tube heat exchangers (description with diagrams).

UNIT – IV

Mass Transfer: Diffusion: Diffusion in different phases, diffusivity, role of concentration difference in diffusion, resistance to diffusion, diffusion in liquids, Relative volatility, Boiling point diagram.

Distillation: Flash distillation, differential distillation, steam distillation, Fractional distillation McCabe-Thiele method. Mass Transfer Equipment: Equipment for Gas-Liquid operations plate and packed columns: description with diagrams.

UNIT – V

Introduction to mechanical operations: Size reduction, filtration, basic differences between agitation and mixing.

Chemical kinetics: Rate and order of the reaction, types of reactions, thermodynamic review, and determination of the rate equation. Effect of temperature on reaction rate, catalysis, reactors (description with diagrams).

LEARNING RESOURCES

TEXT BOOKS:

Introduction to Chemical Engineering, S.Pushpavanam, PHI Learning Private Limited,. New Delhi (2012). (Unit –I)

Introduction to Chemical Engineering, S. K. Ghosal, S. K. Sanyal& S. Datta, Tata-McGraw-Hill, New Delhi (2006). (Unit – II, III, IV,V)

REFERENCE BOOKS:

Unit Operations of Chemical Engineering, Warren L. McCabe, Julian C.Smith, Peter Harriot, 7th edition, McGraw Hill, New Delhi.

Chemical process Principles Part–1, Material and Energy Balances by O.A.Hougen,K.M. Watson, and R.A.Ragatz, 2nd Edition, John Wiley & Sons(2004).

CH 154 CHEMISTRY LABORATORY

Practicals : 3 periods / week *Sessional Marks : 40*

Semester End Exam Marks : 60

SemesterendExam: 3 hrs *Credits :2*

Course Objectives :

To learn concepts of equivalent weight, molecular weight, normality, molarity, weight and volume percent and to prepare molar solutions of different compounds.

To know the methods of determining alkalinity, hardness and chloride ion content of water sample.

To know the methods to determine purity of washing soda, percentage of available chlorine in bleaching powder.

To know principles and methods involved in using instruments like conductivity bridge, spectrophotometer, pH meter and potentiometer.

Course Outcomes:

Students acquire knowledge on equivalent weight, molecular weight, normality, molarity, oxidants and reductants.

Students can prepare solutions of different concentrations.

Students can analyze water for its hardness, alkalinity, chloride ion and iron content.

Student understands the principles behind the development of the instruments suitable for chemical analysis. Later he can use the knowledge in modifying the instruments.

(Any 10 out of the following experiments)

Determination of total alkalinity of water sample

a. Standardization of HCl solution b. Determination of alkalinity of water

Determination of purity of washing soda

a. Standardization of HCl solution b. Determination of percentage purity of washing soda

Estimation of Chlorides in water sample

a. Standardization of $AgNO_3$ solution b. Estimation of Chlorides in water

Determination of Total Hardness of water sample

a. Standardization of EDTA solution b. Determination of Total Hardness of water

Estimation of Mohr's salt-Permanganometry

a. Standardization of $KMnO_4$ solution b. Estimation of Mohr's salt

Estimation of Mohr's salt –Dichrometry

a. Standardization of $K_2Cr_2O_7$ solution b. Estimation of Mohr's salt

Determination of available chlorine in bleaching powder-Iodometry

a. Standardization of Hypo b.Determination of available chlorine in bleaching powder

Estimation of Magnesium

a. Standardization of EDTA solution b. Estimation of Magnesium

Conductometric titration of an acid vs base

Potentiometric titrations: Ferrous vs Dichromate

Demonstration Experiments:

pH metric titrations of an acid vs base

Spectrophotometry: Estimation of Mn/Fe

CH 155 C – PROGRAMMING LABORATORY

Practicals : 3 periods / week *Sessional Marks : 40*

Semester End Exam Marks : 60

Semester End Exam : 3 hrs *Credits :2*

Course Objectives:

1. The fundamentals of C and working with ANSI C/Turbo C compilers.
   The basic concepts of control structures in C.
   The concepts of arrays, functions and pointersin C and can effectively use pointers for Dynamic memory allocation.
   The concepts of structures, unions, files and command line arguments in C.

Course Outcomes:

Write simple programs using C fundamentals and control statements.
Develop various menu driven programs using concepts of control statements, arrays, functions and pointers.
Use dynamic memory allocation for efficient memory management.
Design well-structured programs using the concepts of structures, unions and file handling features.
Design applications using C.

List of programs (to be recorded)

1. A program for electricity bill taking different categories of users, different slabs in each category. (Using nested if else statement or Switch statement).

Domestic level consumption as follows	
Consumption units	Rate of charges(Rs.)
0-200	0.50 per unit
201-400	100 plus 0.65 per unit
401-600	230 plus 0.80 per unit
601 and above	390 plus 1.00 per unit
Street level consumption as follows	
Consumption units	Rate of charges(Rs.)
0-100	0.50 per unit
101-200	50 plus 0.60 per unit
201-300	100 plus 0.70 per unit
301 and above	200 plus 1.00 per unit

Write a C program to evaluate the following (using loops):

$x-x^3/3!+x^5/5!-x^7/7!+$----------up to n terms

$1+x+x^2/2!+x^3/3!+$----------up to n terms

$1-x^2/2!+x^4/4!-x^6/6!+$----------up to n terms

A menu driven program to test whether a given number is (using Loops):

Prime or not
Perfect or not
Armstrong or not
Strong or not
Palindrome or not

A menu driven program to display statistical parameters (using one - dimensional array)

Mean
Median
Mode
Standard deviation

A menu driven program to perform the following operations in a list (using one - Dimensional array)

Insertion of an element
Deletion of an element
Remove duplicates form the list
Print the list

A menu driven program with options (using two dimensional array)

To compute A+B
To compute A x B
To find transpose of matrix A.
Where A and B are matrices.

Write C programs to perform the following using Strings

To test the given string is palindrome or not
To sort strings in alphabetical order

Write C programs using recursive functions

To find the Factorial value
To generate Fibonacci series
To find the GCD of two given numbers

A menu driven program with options (using dynamic memory allocation)

Linear search
Binary search

A menu driven program with options (using Character array of pointers)

To insert a student name
To delete a name
To sort names in alphabetical order
To print list of names

Write a program to perform the following operations on Complex numbers (using Structures & pointers):

Read a Complex number
Addition, subtraction and multiplication of two complex numbers
Display a Complex number

Write C programs to perform the following operations on files

merging the contents of two files
writing, reading and updation of student records in a file
Copy the contents of one file into another using command line argument.

CH 156 ENGINEERING GRAPHICS LABORATORY

Lectures : 2 periods / week *Sessional Marks : 40*
Drawing : 4 periods /week *Semester End Exam Marks : 60*
Semester End Exam : 3 hrs *Credits :2*

Course Objectives:

Comprehend general projection theory with emphasis on orthographic projection to represent three dimensional objects in two dimensional views.
Construct letters & Numerals in a legible freehand form_ To be able to plan and prepare neat orthographic drawings of points, Straight lines, Regular planes and solids
Draw and identify various types of section and Auxiliary views_ To enable the students the aspects of development of surfaces in-sheet metal working
Introduce Auto CAD software for the creation of basic entities and usage of different tool bars.

Course Outcomes:

Acquire basic skills in Technical graphic communication.
The students will be able to visualize and communicate with 2D as well as three dimensional shapes.
Understands the application of Industry standards and best practices applied in Engineering Graphics.
The student is able to apply the knowledge of development of surfaces in real life situations.
Student is introduced to modern CAD system using Auto CAD.
The students will be able to draw simple 2D Engineering Drawings using Auto

CAD. (To be taught & examined in First angle projection)

General: Use of Drawing instruments, Lettering.-Single stroke letters, Dimensioning-Representation of various type lines. GeometricalConstructions.Representative fraction.

Curves: Curves used in Engineering practice - conic sections – general construction and special methods for ellipse, parabola and hyperbola.
cycloidal curves - cycloid, epicycloid and hypocycloid; involute of circleandArchemedian spiral.

Method of Projections: Principles of projection - First angle and third angle projection of points. Projection of straight lines. Traces of lines.

Projections of Planes: Projections of planes, projections on auxiliary planes.

Projections of Solids: Projections of Cubes, Prisms, Pyramids, Cylinders and Cones with varying positions.

Sections Of Solids: Sections of Cubes, Prisms, Pyramids, cylinders and Cones. true shapes of sections. (Limited to the Section Planes perpendicular to one of the Principal Planes).

Development of Surfaces: Lateral development of cut sections of Cubes, Prisms, Pyramids, Cylinders and Cones.

Isometric Projections: Isometric Projection and conversion of Orthographic Projections into isometric views. (Treatment is limited to simple objects only).

Orthographic Projections: Conversion of pictorial views into Orthographic views. (Treatment is limited to simple castings).

Computer Aided Drafting (Using any standard package) (Demonstration only):
Setting upa drawing: starting, main menu(New, Open, Save, Save As etc.), Opening screen, error correction onscreen, units, co-ordinate system, limits, grid, snap, ortho.

Tool bars: Draw tool bar, object snap tool bar, modify tool bar, dimensiontool Bar

Practice Of 2D Drawings: Exercises of Orthographic views for simple solids using all commands in various tool bars.

LEARNING RESOURCES

TEXT BOOK:

Engineering Drawing by N.D. Bhatt & V.M. Paschal. (CharotarPublishingHouse, Anand), Charotar publishing house, 50th Edition, 2010.

REFERENCE BOOKS:

Engineering Drawing by K.L.Narayana& R.K.Kannaiah, Scitech Publications, 2010.
Engineering Graphics with AutoCAD 2002 by James D. Bethune, PHI,2011.

WEB REFERENCES:

www.wikipedia.com
NPTEL Lectures

II Year I Semester

CH 201 PROBABILITY AND TRANSFORMS

Lectures : 4 periods / week *Sessional Marks : 40*

Semester End Exam Marks : 60

Semester End Exam : 3 hrs *Credits : 3*

Course Objectives:

To provide knowledge on Fourier series.
To provide knowledge on Fourier transforms
To make the student to learn Laplace and inverse transforms of a function.
To impart the basic principles of various probability distributions.
To provide basic knowledge of statistical inference and applying it to practical problems

Course Outcomes:

Find Fourier series.
Find Fourier transforms.
Find solution of differential equations using Laplace transforms.
Apply knowledge of distribution theory to various data.
Test hypotheses and draw inference for engineering problems

UNIT - I

Fourier series: Introduction, Euler's formula, Conditions for a Fourier expansion, Functions having points of discontinuity,

Change of interval, Even and Odd functions, half range series. Parseval's formula, Practical harmonic analysis

UNIT - II

Integral Transforms: Introduction, Definition, Fourier Integral Theorem (without proof), Fourier sine and cosine integrals, Complex form of the Fourier Integral,

Fourier Transforms, Fourier sine and cosine transforms.

UNIT - III

Laplace Transforms: Introduction, Transforms of elementary functions, properties of Laplace Transforms, Existence conditions, Transforms of derivatives, Transforms of integrals, multiplication by t^n, division by t. Evaluation of integrals by Laplace Transforms, Periodic function,

Inverse Transforms, Convolution theorem (without proof), Application to Differential equations with constant coefficients.

UNIT - IV

Probability and Distributions: Probability and problems related to probability – addition theorem, multiplication theorem,Baye's theorem.

Binomial distribution, Poisson distribution, Normal distribution.

UNIT - V

Sampling and Inference: Sampling, Testing a Hypothesis, Sampling of Variables – large and small samples (Tests Concerning Means),

Chi-Square test: Definition, Goodness of fit.

LEARNING RESOURCES

TEXT BOOK:

Higher Engineering Mathematics, B.S. Grewal, 40th edition, Khanna publishers, New Delhi, 2007.

REFERENCE BOOK:

Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition, John wiley& Sons, 2007.

CH 202 ORGANIC CHEMISTRY

Lectures : 4 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam : 3 hrs *Credits : 3*

Course Objectives:

To study the various factors involved in reactivity of organic compounds and an ability to study the reaction mechanisms and basics of isomerism phenomenon.
An ability to explain the stabilities of organic compounds by aromatic character and some substitutions of groups in aromatic compounds.
To provide an experience in the study of various organic compounds containing different functional groups and the study of products obtained by the reactants and reagents.
To study the acidic and basic nature of various organic compounds and effect of derivatization.
To know the chemical composition, structure of Biomolecules, drugs, dyes and their importance in human life.

Course Outcomes:

The graduate acquires the knowledge of stability of organic compounds based on their chemical reactivity according to rules.
The student would be able to predict stereochemistry of simple organic compounds and influence of substituents on aromatic compounds.
The graduate can understand the mechanism of different named reactions and able to predict products formed.
The graduate acquires knowledge about the acidic and basis strength of different organic compounds.
Student would know the importance of Drugs and other Biomolecules in their day to day life.

UNIT- I

Electron displacements in a molecule: Inductive, mesomeric and electromericeffects,hyperconjugation. Reaction mechanisms of SN^1, SN^2, E_1 and E_2 reactions.

Reactive intermediates: structure and stability of carbocation, carbanion, and free radicals.
Stereo chemistry: Basics of optical and geometrical isomerisms – Enantiomers, Diastereomers, Meso compounds, Sequence rules- R and S,E and Z configuration, Keto-enoltautomerism.

UNIT - II

Conformational Analysis: Conformations of ethane and n- butane.
Stability of cycloalkanes, Bayer's Strain theory, Conformation analysis of cyclohexane and di-substituted cyclohexanes.
Alkenes: Preparation by dehydration of alcohols, dehydrohalogenation of alkyl halides (Saytzeff's rule), Addition reactions –Markownikoff's rule and anti-Markownikoff's rule, 1,2-and 1,4-additions in dienes(Diels-Alder reaction).

Benzene: Resonance, aromaticity, Huckel's rule, Molecular Orbital description of aromaticity, Electrophilic aromatic substitution, Mechanism of nitration, Friedal–Crafts

alkylation , Orientation in disubstituted benzenes, activating and de-activating groups, anti-aromaticity.

UNIT - III

Heterocyclic Compounds: Synthesis and properties of Furan, Thiophene, Pyrrole, Pyridine and Indole.

Hydroxy Compounds: Preparation methods of alcohols-phenols–acidity comparison with alcohols–differences between phenols and alcohols. Reactions of phenols–Reimer-Tiemann reaction, Kolbe's reaction and Fries rearrangement.

Carbonyl compounds: Aldehydes and Ketones–Preparation–Grignard reagents. Nucleophilic addition reactions of carbonyl compounds-Cannizaro reaction, Aldol condensation, Perkin reaction, Claisen condensation, Wolf-Kishner reduction, Pinacol-Pinacolone rearrangement, Deckmann condensation and Benzoin condensation.

UNIT - IV

Carboxylic acids: Acidity, Influence of substituents on acidity, Functional derivatives of carboxylic acids-acid halides, amides, anhydrides and esters.

Aliphatic and Aromatic amines: 1^0, 2^0, 3^0 amines-Distinguishing tests, Preparation by Hofmann's degradation of amides, basicity of amines, Diazonium salts-preparation and synthetic importance-Sand Mayer reaction.

UNIT - V

Biomolecules: Nomenclature, Classification of Carbohydrates, Structure and general reactions of Glucose and Fructose and their inter conversions, mutarotation.Amino acids and their classification

Drugs and dyes

Synthesis of anti-bacterial drugs: Sulphanilamide, Sulphapyridine
Synthesis of anti-malarial drugs: Isopentaquine, Chloroquine.
Synthesis and uses of Bismarkbrown,Congo red and Malachite green.

LEARNING RESOURCES

TEXT BOOKS:

Text Book of Organic Chemistry, B.S.Bahl and ArunBahl, 20th Edition (Unit - I,-V)(2011)S.Chand & Co., Delhi.

Text Book of Organic Chemistry, Vol.2, I.L. Finar, 5th Edition, Pearson education(Unit–IV and V) (2007).

REFERENCE BOOKS:

Text Book of Organic Chemistry, R.T.Morrison and R.N.Boyd, 6th edition, PHI, Delhi.(2008)

Principles of Organic Chemistry, M.K. Jain, 9th edition. S. Nagin& Co.

Fundamentals of Biochemistry, J.L. Jain.

CH 203CHEMICAL PROCESS CALCULATIONS

Lectures : 4 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam : 3 hrs *Credits : 3*

Course Objectives:

To Understands the stoichiometric approach to chemical reactions.
To comprehend important principles such as Ideal gas Law, Raoult's Law and Humidity charts
To understand the tie substance, conversion and yield.
Comprehends and solves the material balances in a simple flow sheet involving chemical reactions.
Solves the energy balance in simple mixing and with reactions.

Course Outcomes:

Ability to troubleshoot problems in material flow rate handling in chemical production.
Apply Ideal gas law for gaseous mixtures and gases in chemical reactions.
Ability to design air flow rates in drying and humidification processes.
Ability to calculate the yield in chemical production processes.
Ability to calculate energy requirement.

UNIT - I

Stoichiometric and composition relationships: Units and dimensions, Conservation of mass, Stoichiometric relations, Basis of calculations, methods of expressing the composition of mixtures and solutions, density and specific gravity.

Behavior of ideal gases: Introduction, Applications of the Ideal-gas law, gaseous mixtures, volume changes with changes in composition, Gases in Chemical reactions.

UNIT - II

VaporPressures:Introduction, Effect of temperature on vapor pressure, vapor pressure plots, vapor pressure of immiscible liquids, solutions

Humidity and Saturation: Introduction, vaporization process, condensation, wet-bulb and dry-bulb thermometry, psychometric chart.

UNIT - III

Material Balances: Introduction, Material balances without chemical reaction.

Material balances with chemical reaction. Calculations involving condensation, evaporation drying, dissolution and crystallization

UNIT - IV

Basic concepts of inert, tie component, Limiting reactant, excess reactant, selectivity, and yield. Basic concepts of recycle bypass and purge streams.

Material balances for non-reactive systems with recycle stream. Material balances for reactive systems with recycle stream.

UNIT - V

Thermo Physics: Introduction, Energy, energy balances, heat capacity of gases, heat capacities of solids, heat capacity of liquid and solutions, latent heats, heat of vaporization, evolution of enthalpy, enthalpy of humid air.

Thermo Chemistry: Introduction, Thermo chemistry of solution, Effect of pressure on heat of reaction, Heat of reaction at constant pressure and at constant volume, Effect of temperature on heat of reaction, Temperature of reaction, Theoretical flame temperature, Actual flame temperature.

LEARNING RESOURCES

TEXT BOOKS:

Chemical process Principles Part–1, Material and Energy Balances by O.A.Hougen,K.M. Watson, and R.A.Ragatz, 2nd Edition, John Wiley & Sons(2004).

Basic Principles and Calculations in Chemical Engineering by David M.Himmelblau and James B.Riqqs,7th edition, Prentice Hall India(2003).

REFERENCE BOOKS:

Stoichiometry by B. Bhatt and S.Vora, 4th edition, Tata McGraw Hill(2004).

Stoichiometry and Process Calculations by K. V. Narayanan and B. Lakshmikutty, Prentice-Hall of India Private Limited, New Delhi.

CH 204MOMENTUM TRANSFER

Lectures : 4 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

To introduce basis and models for fluids.
To provide basis for formulating conservative principles.
To provide an understanding about compressible fluids and flow past immersed bodies.
To study methods for transporting and measuring of flow in various conduits.
To study Quantitative laws and equation of fluid flow.

Course Outcomes:

To apply the concept of hydrostatic equilibrium and to have a knowledge on fluid flow Phenomena.
To determine engineering design quantities for laminar and turbulent flows.
To work with compressible fluids, packed bed and fluidized bed columns.
To work with variety of pumps and to estimate pressure losses due to various flow measuring Apparatus.
To handle important engineering tasks of moving fluids through process equipment and measuring and controlling in flow.

UNIT – I

Introduction: Unit operations, unit systems, dimensional analysis, basic concepts. Fluid statics and its applications-hydrostatic equilibrium, applications of fluid statics.

Fluid Flow Phenomena: Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, Boundary layers.

UNIT – II

Basic Equations of Fluid Flow: Mass balance in a flowing fluid; Continuity, differential momentum balance; equations of motion, macroscopic momentum balances, Mechanical energy equations.

Incompressible Flow in Pipes and Channels: shear stress and skin friction in pipes, laminar flow in pipes and channels, turbulent flow in pipes and channels, friction from changes in velocity or direction.

UNIT – III

Flow of compressible fluids: definitions and basic equations, processes of compressible flow, isentropic flow through nozzles, adiabatic frictional flow and isothermal frictional flow.

Flow past immersed bodies: drag and drag coefficient, flow through bed of solids, motion of particles through fluids, fluidization. Two phase flow: Applications of Gas-Liquid, Gas-Solid, Solid-Liquid flows in Chemical engineering.

UNIT - IV

Transportation of fluids: Introduction to: pipe and tubing, joint and fittings, gate valves and globe valves, plug cocks and ball valves, check valves.

Pumps: Types, Selection, Applications, Performance characteristics of centrifugal and reciprocating pumps. Comparison of devices for moving fluids, constructional features and working principle of jet ejectors, compressors.

UNIT - V

Metering of fluids: Constructional features and working principles of: venturi meter, orifice meter, rota meters, Pitot tube, target meters, vortex-shedding meter, turbine meter, magnetic meters.

Application of Bernoulli equation: Venturi meter and Orifice meter, flow rate calculations from the readings of venture meter, orifice meter and Pitot tube. Flow rate calculations from the readings of venture meter, orifice meter and Pitot tube.

LEARNING RESOURCES

TEXT BOOK:

Unit Operations of Chemical Engineering, Warren L.McCabe, Julian C.Smith, Peter Harriot, 7th Edition, McGraw Hill.

REFERENCE BOOKS:

Perry's Chemical Engineers Hand Book, Robert H. Perry, 8th edition, McGraw Hill (2007).

Coulson & Richardson's Chemical Engineering, Volume-1, J.F. Richardson, J. H. Harker and J.R. Backhurst.

CH 205: MECHANICAL OPERATIONS

Lectures : 4 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

To learn the equipment involved in mechanical separation, mixing and size reduction.
To learn mathematical problems related to different unit operations by using different laws
To learn about the basic concepts of screening procedure.
To learn the unit operations involved in the contacting and physical separation of phases, such as filtration, sedimentation and centrifugation, floatation is also studied.
To learn the concepts of clarifiers, cyclone separators, and other separation equipment's.

Course Outcomes:

To understand the characterization of solid particles and Properties of particulate.
To solve mathematical problems related to comminution operations by using different laws.
To choose appropriate screening equipment and calculate thescreening effectiveness.
To understand the concepts of filtration, equipment and design of filtration equipment.
To understand the concepts of clarifiers, cyclone separators and other separation equipment's. Selection of appropriate mixing process for the fluids and solids.

UNIT - I

Characterization of solid particles, particle shape, particle size, mixed particle sizes and size analysis, specific surface of mixture, average particle size, screen analysis: standard screen series. Size measurements with fine particles.

Properties of masses of particulate, storage of solids, mixing and conveying of solids.

UNIT –II

Principle of comminution, Characteristics of comminuted products, energy and power requirements in comminution, crushing laws, empirical relationships: Rittinger's and Kick's laws. Bond's law and work index and work index.

Equipment for size reduction; crushers, grinders, ultra-fine grinders and cutting machines. Equipment operation; Open circuit and closed circuit operation, energy consumption, size enlargement.

UNIT - III

Screening, comparison of ideal and actual screens, material balances over screen, screen effectiveness, capacity and effectiveness of screens.

Screening equipment: stationary screens and grizzlies, gyrating screens, vibrating screens, Magnetic separators, Electro- static separators and froth flotation.

UNIT - IV

Filtration, cake filters, principle and working of filter press, rotary drum filters, suspended batch centrifuges, centrifugal filters, Clarifying filters; liquid clarification, gas cleaning, principle of clarification.

Filter media, filter aids, Principles of cake filtration, pressure drop through filter cake, compressible and incompressible filter cakes, filter-medium resistance, constant pressure filtration, continuous filtration, constant rate filtration.

UNIT –V

Gravity classifiers, sorting classifier; sink and float methods, differential settling methods, clarifiers and thickeners. Centrifugal sedimentation processes; cyclones, hydroclones, centrifugal decanters, jigging and tabling.

Purpose of agitation, agitation vessels, flow patterns: prevention of swirling, draft tubes. Standard turbine design, power consumption in agitated vessels. Blending and mixing.

LEARNING RESOURCES

TEXT BOOK

Warren. L. McCabe, Julian. C. Smith and Peter Harriott, "Unit Operations of Chemical Engineering, 7th Edn., McGraw Hill International Edition, New York.

REFERENCE BOOKS

Chemical Engineering, vol.-II, J.H.Coulson and Richardson,5th edition,Elsevier India (2006).

Mechanical Operations for Chemical Engineers, C. M. Narayana and B.C.Bhattacharyya, Khanna Publishers (1992).

Perry's Chemical Engineers Hand Book, Perry Rober H, 8th edition, McGraw Hill(2007)

CH 206 MATERIAL TECHNOLOGY

Lectures : 4 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

To provide the background knowledge about the structure and properties of various metallic and non-metallic materials of construction starting from fundamentals.
To develop the understanding of present-day materials demand a thorough knowledge of basic engineering and scientific principles, including heat treatment techniques, elastic and plastic behavior.
To provide the mechanical behaviour and failure mechanisms of various metals, alloys.
To understand the fabrication of powder metallurgy and application of semiconductors
To provide basic knowledge on Selection of materials of construction for chemical engineering processes and operations to minimize corrosion rates

Course Outcomes:

An ability to apply knowledge of mathematics, physics, chemistry, materials and statistics to identify, formulate and solve the problems encountered in the production or application of a material.
Apply and integrate knowledge from the major elements of the field (structure, properties, processing, and performance) to solve materials selection and design problems.
Use the techniques, skills and modern engineering tools necessary engineering practice.
To graduate the students who contribute to their profession in process industry through engineering practice.
Identify various types of corrosion, illustrate methods to mitigate corrosion and select suitable material for various chemical processes.

UNIT – I

Phase diagrams: The phase rule, single component systems, binary phase diagrams, micro structural changes during cooling, the lever rule, summary of phase diagram rules.

Forming Processes: General aspects, Rolling, Forging, Extrusion processes, wire drawing, Cold pressing and Deep drawing, tube drawing, tube making

UNIT – II

Strengthening of metals and alloys: Introduction, Strengthening Grain refinement, strain hardening, solid solution strengthening, precipitation or age hardening, dispersion hardening, Particulate Strengthening, Phase transformation Harding, Strain ageing.

Heat treatment process: Annealing, normalizing, hardening, tempering, temper brittleness, quench cracks, age hardening, surface hardening.

UNIT – III

Deformation of Metals: Deformation, Slip, Critical resolved shear stress, twinning, difference between slip and twinning

Creep: Definition, Mechanism of creep, methods to reduce Creep in materials. Fracture: Ductile fracture, Brittle fracture, methods of protection against fracture, Fatigue-Mechanism and preventive methods

UNIT – IV

Powder metallurgy: Manufacture of metal powders, procedure of fabrication of powder metallurgy product, industrial applications of powder metallurgy, advantages and limitations of powder metallurgy

Semiconductors: Characteristic of semiconductors, Examples of semiconducting materials, Atomic structure, intrinsic and extrinsic semiconductors, doping, p-type and n-type semiconductors, Applications of semiconductor materials, difference between semiconductor, conductor and insulator.

UNIT – V

Corrosion: General aspects, Factors influenced in corrosion, General types of corrosion, Various types of corrosion, Corrosion in marine concrete, Control and prevention of corrosion, Corrosion monitoring and measurement, oxidation resistant materials.

Ferrous Metals and alloys: Introduction, iron wore, pig iron, cast iron, wrought iron. Nonferrous metals and alloys:Aluminium, copper, lead, tin, zinc, magnesium, Nickel and their alloys. Criteria of selection of materials in process industry.

LEARNING RESOURCES

TEXT BOOKS:

Material Science and Engineering by R.K.Rajput,3rd edition S.K.Kataria& Sons, Delhi(2005).

Material Science and Engineering by V.Raghavan, 5th edition, Prentice Hall of India Pvt.Ltd.,New Delhi (2009).

REFERENCE BOOKS:

Material Science and Metallurgy - V.D.Kodgire, Everest Publishers, 2008.

Material Science for Engineering,D.CallistersJr,Weily& Sons, New Delhi (2006)

Elements of Material Science and Engineering by Van Vlock, L.H,6th edition., PHI, New Delhi(1989).

CH 251 MOMENTUM TRANSFER LABORATORY

Practicals : 3 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam: 3 hrs. *Credits : 2*

Course Objectives:

Experimentation, observation and analysis of physical phenomena in Fluid Mechanics.
Training students in measurement of the physical properties of fluids
Provide experience in collection, analysis, interpretation and presentation of experimental data. Precision analysis and equipment limitations.
To measure the frictional losses in laminar and turbulent pipe flows

Course Outcomes:

Students should be able to collect quality raw data from an operation
Students should be able to compare observed with predicted performance
Students should be able to communicate the results of their analysis effectively in written and oral reports
Students should be able to function effectively in a lab team

Flow measurement using orifice meter.
Flow measurement using Venturimeter. Determination of Venturi Coefficient
Open Orifice
Flow measurement using V-notch
Flow measurement using Rectangular Notch
Performance characteristics study in single stage Centrifugal pump.
Performance characteristics of Reciprocating Pump
Identification of laminar and turbulent flows (Reynolds apparatus)
Verification of Bernoulli's Principle
Pressure drop study in packed bed
Pressure drop study in fluidized bed
Measurement of point velocities (Pitot tube)
13. . Calibration of Rotameter
Drag study
Determination of Friction factor
Determination of Momentum losses in pipes, fittings and valves (minor loses).
Determination of viscosity using Cannon Fenske Viscometer

CH 252 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

Practicals : 3 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam: 3 hrs. *Credits : 2*

Course Objectives:

To know different types of power supplies, protecting devices, different types of meters used for AC and DC supplies.
To connect the elements in series and parallel or to connect a network and give supply.
To connect the different meters to measure the different electrical quantities.
To conduct different test on the electrical and electronics equipment.

Course Outcomes:

Acquires knowledge basic electrical circuits and parameters.
Acquires knowledge on operation of transformer.
Acquires knowledge on operation of DC and AC Machines
Acquires knowledge on electronic devices operation and their applications

Verification of KVL and KCL.
Parameters of choke coil.
OC and SC Tests on transformer.
O.C.C Test on D.C. Shunt Generator
Load test on D C Shunt Generator
Brake test on D.C. Shunt motor.
Swinburnes test on D. C. Shunt machine
Load test on Three Phase squirrel - cage induction motor
VI Characteristics of Junction diode.
VI Characteristics of Zener diode.
Zener Diode as Voltage Regulator.
Half wave Rectifier and Full wave rectifier.
Common Emitter configuration of a Transistor.
Characteristics of FET.
Characteristics of UJT.

Note: Minimum of ten experiments have to be performed and recorded by the candidate to attain eligibility for Semester End Examinations

CH 253 PROFESSIONAL COMMUNICATION SKILLS LABORATORY

Practicals : 3 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam Exam: 3 hrs *Credits: 2*

Course objectives:

Improve the dynamics of professional presentations.
Develop the ability to compeer professional occasions.
Enable to read newspaper for their communicative competence.
Equip with effective business correspondence.
Develop in them communication and social graces necessary for functioning. for employable ready skills
win in the job interviews
Build confidence to handle professional tasks.

CourseOutcomes:

Develop effective communication and presentation skills.
Learn corporate etiquette - organizing and managing professional events.
Understands how reading enhances their communicative competency.
Conduct effective correspondence and prepare reports which produce results.
Develop all-round personalities with a mature outlook to function effectively in different circumstances.
Know his/her skills and abilities for better career plans.

Presentation skills:

Key presentation skills inspired by Steve Jobs – You Tube.
Personality & finishing skills training videos.

How to make Effective Presentations, Methodology, Structure, using Technology and Conclusion.

Speech writing:

Welcoming guests on to the stage.
Proposing vote of thanks.

Invite and thank people with professional etiquette

Reading skills:

Newspaper reading
Reading and interpretation

News paper reading – loud reading within the groups.
Reporting the news with one another without the help of the news paper.
(Besides this, motivate students to read News Paper every day without fail.)

IV. Writing Skills:

Report writing
Feasibility report
Project report

(Writing an Abstract - Parts of a report - Title page – Declaration - Acknowledgements – Table of contents – Introduction – Conclusion – Citations – References – Appendices.)

V. Career skills:

a. Resume & Cover letter.

Interview – The purpose & preparation for an interview.

Discover oneself – Self Introduction – Social background (family, home and town) – interests, Hobbies, likes & dislikes (persons, places, food, music, etc.) – Strengths, Weaknesses, Skills, Qualities, Achievements – Opinions (love, life, marriage, politics, India, etc.) what is life according to me? A creative narration with factual information is expected.

Effective Resume writing: structure and presentation – planning and defining the career objective – strengths and skills set – format - cover letter

Facing Interviews: Interview Process – Understanding employer expectations – Pre- interview planning – Opening strategies – Answering strategies, Frequently Asked Questions (FAQs).

LEARNING RESOURCES

TEXT BOOKS:

Business Communication, II Ed, OUP, by Meenakshi Raman &PrakashSingh, 2012.
Technical Communication – English Skills For Engineers, II Ed, OUP, Meenakshi Rama &Sangeetha Sharma-(Unit –IV). , 2011.
Technical Communication- Principles and Practice, II Ed, OUP, Meenakshi Raman &Sangeetha Sharma-(Unit –V), 2015.

SUGGESTED SOFTWARE:

TOEFL Mastery, Rosetta Stone, TED Talks, Globarena, Clarity.

WEB RESOURCES:

www.esl-lab.com, www.eslgold .com

IIYear II Semester

CH 207 PARTIAL DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS

Lectures : 4 periods / week *Sessional Marks : 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

Focused in partial differential equations.
To gain knowledge on applications of partial differential equations.
Provide basic knowledge of numerical methods including solving systems of linear equations.
To provide knowledge on numerical differentiation and integration.
To provide knowledge on numerical solution of ordinary and partial differential equations.

Course Outcomes:

To solve partial differential equations.
To apply partial differential equations in solving the chemical engineering processes.
To solve system of equations numerically.
Find numerical solution of ordinary differential equations.
Find numerical solution of partial differential equations.

UNIT - I

Partial Differential Equations: Introduction, Formation of Partial Differential Equations, Solutions of a Partial Differential Equations, Equations solvable by direct integration, Linear equations of the first order, Non-Linear equations of the first order using Charpit's Method,

Homogeneous Linear Equations with Constant Coefficients, Rules for finding the Complementary Function, Rules for finding the Particular Integral, Non-Homogeneous Linear Equations.

UNIT - II

Applications of Partial Differential Equations: Introduction, Method of separation of variables, One dimensional wave equation, One dimensional heat equation- steady and unsteady states.

Two dimensional heat flow equation: Steady state heat flow –Laplace's equation in Cartesian coordinates.

UNIT - III

Numerical Methods: Solution of Algebraic and Transcendental Equations: Introduction, Newton-Raphson Method, Solution of Linear Simultaneous Equations: Gauss Seidel Iterative Method.

Finite Differences & Interpolation: Introduction, Finite difference operators, Symbolic relations, Differences of a polynomial, Newton's forward and backward interpolation formulae,

UNIT - IV

Interpolation with Unequal intervals: Lagrange's Interpolation, inverse interpolation.
Numerical Differentiation: Finding First and Second order Differentials using Newton's formulae.

Numerical Integration: Trapezoidal rule, Simpson's one-third rule.

UNIT - V

Numerical Solutions of Ordinary Differential Equations (first order): Picard's Method, Euler's Method, Runge-Kutta Method of fourth order, Simultaneous equations (R K method).

Numerical Solutions of Partial Differential Equations: Classification of Partial Differential Equation of second order, Solutions of Laplace's and Poisson's Equations by iteration methods.

LEARNING RESOURCES

TEXT BOOK:

Higher Engineering Mathematics, B.S.Grewal, 40th edition, Khanna publishers, New Delhi, 2007.

REFERENCE BOOKS:

Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition, John wiley& Sons, 2007.

A text book of Engineering Mathematics by N.P. Bali, 6th edition, Lakshmi Publications, 2003.

CH 208 PROCESS HEAT TRANSFER

Lectures : 3 periods / week *Sessional Marks : 40*
Tutorials : 1 period / week *Semester End Exam Marks : 60*
Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

Solve analytically using basic laws and semi-empirical correlations one dimensional steady heat transfer problems for a variety of geometries.
Solve transient heat transfer problems using the lumped capacitance method.
Solve problems involving heat transfer by convection and acquire a basic understanding of heat transfer operations.
Develop the students ability to design or predict the performance of heat exchangers.
Understand radiation, Heat exchangers & evaporators.

Course Outcomes:

Describe the three modes of heat transfer mathematically and physically.
Estimate the thermal conductivity, convective heat transfer coefficient and emissivity for any application.
Calculate convective heat transfer coefficients for forced, free, phase change problems.
Design or predict the performance of different types of heat exchangers.
Design different types of evaporators.

UNIT – I

Introduction: Modes of heat transfer, basic laws of heat transfer. Thermal conductivity. Steady state one dimensional heat conduction through plan

Conduction: Steady state one dimensional heat conduction through cylindrical wall, spherical wall, Critical insulation thickness, composite resistance in series.

UNIT – II

Unsteady stateheat conduction: through infinite slab, infinite long solid cylinder, and sphere. Heat flow with variable surface temperature. Heat flow in semi-infinite solids.

Convection: Heat exchange equipment, energy balances, heat flux and heat transfer coefficients, LMTD, relation between individual and overall heat transfer coefficients, thermal boundary layer, dimensionless numbers in heat transfer and their significance.

UNIT – III

Forced Convection: Heat transfer by forced convection inside tubes and ducts in laminar, transition & turbulent flow. Analogy between heat and momentum transfer, Reynold's, Prandtl and Colburn analogies.

Heat transfer to liquid metals, forced convection over exterior surfaces. Heat transfer for tubes in cross flow. Natural convection:Grashoff number, natural convection from vertical and horizontal surfaces.

UNIT – IV

Heat transfer to fluids with phase change: Heat transfer from condensing vapours; film wise and drop wise condensation, derivation and practical use of Nusselt equation, condensation of super heatedvapours, Effect of non-condensable gases on rate of condensation. Heat transfer to boiling liquids; Boiling of saturated liquid, maximum flux and critical temperature drop, minimum flux and film boiling, sub-cooled boiling.

Radiation: Thermal radiation, emission of radiation, absorption of radiation by opaque solids, radiation between surfaces, radiation to semitransparent materials, combined heat transfer by conduction, convection and radiation.

UNIT – V

Heat-Exchange Equipment: Shell & tube heat exchangers, plate – type exchangers, extended surface equipment, scraped - surface exchangers, condensers and vaporizers, heat transfer in agitated vessels and packed beds.

Evaporation: Types of evaporators. Performance of evaporators; capacity and economy of evaporators, boiling point elevation and Duhring's rule, material and energy balances in single effect evaporator. Multi effect evaporators; methods of feeding, capacity and economy.

LEARNING RESOURCES

TEXT BOOK:

Unit Operations of Chemical Engineering, Warren L.McCabe, Julian C.Smith, Peter Harriot, 7th edition, McGraw Hill, New Delhi.

REFERENCE BOOKS:

Heat Transmission by H. William and Mc Adams, McGraw Hill(1954)

Process Heat Transfer by Donald, Q.Kern, McGraw Hill(2001)

Process Heat Transfer–Principles and Applications by Robert W Serth, 7th edition, Elsevier Science & Technology Books(2007)

CH 209 CHEMICAL ENGINEERING THERMODYNAMICS-I

Lectures : 4 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

To provide the students with the terminology of thermodynamics like system, properties, Processes, reversibility, equilibrium, phases, components; the relationship between heat and work by understanding the significance of the first law of thermodynamics;
To learn how to estimate the thermal and volumetric properties of real fluids.
To understand the limitations imposed by the second law of thermodynamics on the conversion of heat to work.
To understand the applications of first and second law of thermodynamics to specific process.
To understand the concept of adiabatic and theoretical flame temperatures and to explain the effect of temperature on the enthalpy change of a chemical reaction.

Course Outcomes:

Students will be able to understand the scope and relevance of Chemical Engineering Thermodynamics.
Students will be able to estimate the volumetric properties of pure fluids.
Students will be able to state the second law of thermodynamics and to estimate the efficiency of heat engines.
Students will be able to apply the concepts of first and second law of thermodynamics to analyze the specific process.
Students will be able to perceive the principles of heat effects of industrial reactions and temperature dependency of heat of reaction.

UNIT – I

The First Law and other Basic Concepts: Relevance and scope of chemical engineering thermodynamics, internal energy, first law of thermodynamics, energy balance for closed systems, Thermodynamic state and state functions.

Equilibrium, the phase rule, the reversible process, constant volume and constant pressure processes, enthalpy, heat capacity, mass and energy balances for open systems.

UNIT – II

PVT behavior of pure substances: PT and PV diagram, the ideal gas, equations for process calculations (for an ideal gas in any mechanically reversible closed- system process): isothermal process, isobaric process, isochoric process, adiabatic process, and polytrophic process. Ideal gas equation.

Virial equations of state, Application of the virial equations, introduction to cubic equations of state: Vander Waals equation, Redlich/Kwong equation, theorem of corresponding states; acentric factor. Generalized correlations for gases and liquids.

UNIT –III

The Second Law of Thermodynamics Statements of the second law, heat engines, thermodynamic temperatures scales, thermodynamic temperature and the ideal gas scale.

Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics, and entropy from the microscopic view point, calculation of ideal work and lost work.

UNIT – IV

Applications of Thermodynamics to Flow Processes: Principles of conservation of mass, entropy and energy for flow systems, analysis of expansion processes; turbines, throttling; compression processes –compressors and pumps.

Refrigeration, Carnot refrigeration, vapor – compression cycle, choice of refrigerant, absorption refrigeration, Heat pump, liquefaction processes: Linde liquefaction process, Claude liquefaction process.

UNIT – V

Heat effects: Sensible heat effects, temperature dependence of heat capacity, heat effects accompanying the phase changes.

The standard heat of reaction, formation and combustion, temperature dependence of heat of reaction, heat effects of industrial reactions.

LEARNING RESOURCES

TEXT BOOK:

Introduction to Chemical Engineering Thermodynamics by J.M.Smith, H.C.Vannessand M.M. Abbott7th Edition (In SI units), Tata McGraw Hill

REFERENCE BOOKS:

Chemical Engineering Thermodynamics by T.E. Daubert, McGraw Hill.
Chemical Engineering Thermodynamics by Y.V.C.Rao, University Press.
A textbook of Chemical Engineering Thermodynamics by K.V. Narayana, PHI.

CH 210 INORGANIC CHEMICAL TECHNOLOGY

Lectures : 4 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

Know inorganic chemical manufacturing processes of alkali industries and water treatment.
Know the important unit operations of some major inorganic chemical industries like ceramics, glasses and cements.
Understand manufacturing processes of N, P, K compounds.
Know the important manufacturing processes of S, H_2SO_4.
5. Understand the important processes of industrial gases, nuclear industries.

Course Outcomes:

Student should be able to

i. Acquire the basic knowledge of Alkali industries, Water treatment.

ii. Gain the complete knowledge of unit operations of major inorganic chemical industries like ceramics, glasses and cements.
Acquire the complete knowledge of N, P, K fertilizers.
Acquire the knowledge of S, H_2SO_4 industries.
Gain the basic knowledge of industrial gases and nuclear industries.

UNIT – I

Introduction: Objectives, unit processes and unit operations. General Fundamentals
Water: Water conditioning and waste water treatment.

Alkali Industries: Soda ash- Solvay process, dual process, Natural soda ash from deposits, Electrolytic process- Caustic soda, chlorine

UNIT – II

Ceramic industries: Raw materials, Chemical conversions, white wares, Structural – clay products, refractories.
Glass: Raw materials, manufacture, special glasses-high silica, fused silica, coloured and coated, safety, fiberglass.

Cement: Types, compounds in cement, manufacture, special cements-pozzolans, high alumina, silicates, sulphur, polymer concrete, magnesium oxy chloride cements.

UNIT – III

Nitrogen industries: Synthetic ammonia, urea, other nitrogenous fertilizers, nitric acid.

Phosphate Industries: Phosphoric Acid, calcium phosphate and super phosphate
Potassium Industries: Potassium chloride and potassium sulphate.

UNIT – IV

Sulfur and sulfuric acid: Manufacture of sulfur by Frasch process & from fuel gases and sulfuric acid.

Hydrochloric acid: Manufacture of Hydrochloric acid
Aluminium Industries: Aluminium sulphate and alum

UNIT V
Industrial gases: Nitrogen, Carbon dioxide, hydrogen and oxygen.

Nuclear industries: Uranium and thorium fission, nuclear fuels.

LEARNING RESOURCES

TEXT BOOK:

Dryden's Outlines of Chemical Technology for 21st Century by M.GopalRao and M.Sittig, 3rd edition, East West Press (2010).

REFERENCE BOOKS:

Shreve's Chemical Process Industries byG.T. Austin, McGraw Hill, 5th edition (1984)
A Text Book of Chemical Technology (Volume II), by G.N.Panday, Vikas Publishers.
Chemical Process Technology by Jacob A.Moulijin, MIchielMakkee and Annelies Van Diepen,John Wiley &Sons (2001)

CH 211: PROCESS INSTRUMENTATION &INSTRUMENTAL METHODS OF ANALYSIS

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam : 3 hours *credits : 3*

Course Objectives:

To provide the basic principles of primary sensing elements, transducers, transmitters, indicators and recorders in process industries.

To provide knowledge on types of instruments used for measurement of temperature

To provide knowledge on the choice of measuring instruments and statistical background of the methods and limitations of measurement techniques for pressure and vacuum.

To provide an understanding on instrumental methods for composition analysis

To provide knowledge on principles and types of chromatography used for measurement of chemical composition

Course Outcomes:

Understand the basic measurement principles of the physical quantities of interest and elements of control system.

Understand principles expansion and resistance thermometers.

Learn various sensors used for measurement of process parameters such as flow, pressure, level etc. covering principle of operation, specifications etc.

Familiar with principles and various spectrometric instrumental methods used for measurement of chemical composition.

Familiar with principles and various chromatrographic methods used for measurement of chemical composition.

UNIT – I

Qualities of measurement: Elements of instruments, static characteristics, dynamic characteristics, dynamic response of first order instruments.

Recording instruments, indicating and signaling instruments, the control center, instrumentation diagram, process analysis.

UNIT – II

Expansion thermometers: mercury in glass thermometer, bimetallic, pressure spring, accuracy and response of thermometers. Thermo-electric temperature measurement: thermo electricity, industrial thermocouples, thermocouple lead wires, thermal wells, response of thermocouples, mill voltmeter, null potentiometer.

Resistance thermometers: Thermal coefficient of resistance, industrial resistance – thermometer bulbs, resistance thermometer circuits - wheat stone bridge, calendar Griffiths bridge, Radiation temperature measurement: laws of radiation, radiation receiving elements, radiation pyrometers, photoelectric pyrometer and optical pyrometers

UNIT – III

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

Measurement of head and 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.
Flow metering: head flow meters, area meters, open channel meters, velocity meters, flow of dry materials and viscosity measurement.

UNIT – IV

Instrumental Methods
Beer-Lambert's Law Flame photometry – Principle and Instrumentation (Block diagram – only) disadvantages.Estimation of Sodium by Flame Photometry.Principle of Fluorometry – Applications – Disadvantages.Introduction of Infra-Red Spectroscopy – Modes of Vibrations of atoms in polyatomic molecular – Vibration Coupling – Instrumentation – Disadvantages – Applications.

Introduction of Atomic absorption Spectrophotometer: Principles – Instrumentation – Block diagram – Disadvantages – Applications – Estimation of Nickel by Atomic Absorption Spectroscopy.

UNIT - V

Chromatographic Methods:
Ion Exchange Chromatography – Recycling chromatography – Ion Pair Chromatography – Classification of Ion pair liquid Chromatography – Application of Ion Pair liquid chromatography – Retention – Solubility – Thin Layer Chromatography – Paper Chromatography.

Chromatographic Development – High Pressure Liquid chromatography(HPLC) – Solvent Delivery System – Pumps – Reciprocating pumps – Syringe type pumps – Constant Pressure Pumps – Sample Injection System – Column Packing – Characterization of Detectors – Performance – Advantages of HPLC – Effect of temperature in HPLC – Applications of HPLC.Thermo Gravimetric Analysis and Differential Thermal Analysis – Principle – Instrumentation – Applications

LEARNING RESOURCES

TEXT BOOK:

1. *Industrial Instrumentation by Donald P. Eckman, 1st edition, Wiley Eastern Ltd. (2004).*

REFERENCE BOOKS:

Principles of Industrial Instruments by Patrenabis, 3rd edition,Tata McGraw Hill(2010)
Instrumental Methods of Chemical Analysis by R. Gurudeep, ChatwalandSham K. Anand, Himalaya Publishing house (2007).
Introduction to Chemical Analysis by Robert D. Braun, 2nd edition, McGraw Hill (2012).

CH 212PROFESSIONAL ETHICS & HUMAN VALUES

Lectures : 4 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

To provide training on the basic concepts of human values.
To provide knowledge on various issues of engineering ethics, Professionalism and theories about right action.
To provide training to understand the concept of engineering as social experimentation and safety & risk analysis.
To provide the knowledge on work place rights and responsibilities.
To provide the knowledge on global issues and moral leadership.

Course Outcomes:

To understand the importance of human values.
To understand the issues of engineering ethics and to perform right actions.
To understand the basic duties of engineering professional and perform safety & risk analysis.
To understand the work place rights and responsibilities and to bring goodness to the society.
To understand the global issues and code of ethics of professional societies.

UNIT - I

Human Values: Morals, Values and Ethics, Integrity, Work Ethics, Service Learning, Civic Virtue, Respect for Others, Living Peacefully, caring, Sharing,.

Honesty, Courage, Valuing Time, Co-operation, Commitment, Empathy, Self-Confidence, Character, Spirituality.

UNIT - II

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.

Professional and Professionalism, Professional Ideals and Virtues, Theories about right action, Self-interest, Customs and Religion and Uses of Ethical Theories.

UNIT - III

Engineering as Social Experimentation: Engineering as Experimentation, Engineers as responsible Experimenters, Codes of Ethics, A Balanced Outlook on Law.

Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and reducing risk.

UNIT - IV

Workplace responsibilities: Collegiality, Respect for Authority, Collective Bargaining, Confidentiality, Conflicts of Interest, Occupational Crime.

Rights: Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Discrimination.

UNIT - V

Global Issues: Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors.

Moral Leadership, Sample Code of Ethics like Indian Institute of Chemical Engineers(IIChE), ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers, India, etc.

LEARNING RESOURCES

TEXT BOOK:

Professional Ethics & Human Values, K.R. Govindan&S.Senthil Kumar, Anuradha Publications.

REFERENCE BOOKS:

Ethics in Engineering Practice & Research by Caroline Whitbeck, 2nd edition Elsevier (2011).

Ethics in Engineering by Mike Martin and Roland Schinzinger, 3rd edition, McGraw Hill. New York (2012). 3. Professional Ethics& Human Values by R.S. Naagarazan, 1st edition, New Age International Publishers (2006).

CH 254 ORGANIC CHEMISTRY LABORATORY

Practicals : 3 periods / week *Sessional Marks : 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 2*

Course Objectives:

To know how various types of reactions can be applied in organic compound preparations.
To acquire knowledge about the qualitative analysis of organic compounds.
To learn how the yield of an organic compound can be determined.
To describe the preparation of suitable derivatives of organic compounds selected for analysis.
To apply the basic knowledge about functional groups in identifying the given organic compound.

Course Outcomes:

Students would be able to identify the nature and type of the given organic compound.
Students can prepare the required organic compound or derivative and confirm its identity by suitable methods.
Students can prepare solutions of different concentrations.
Student understands the principles behind the development of the instruments suitable for chemical analysis. Later he can use the knowledge in modifying the instruments.

Preparation of Aspirin
Preparation of Benzanilide
Preparation of m-dinitrobenzene
Preparation of Benzoic acid
Preparation of Dibromo aniline
Preparation of Methyl Orange
Preparation of Parabenzoquinone
Preparation of Nerolin
Detection of Extra elements
Analysis of compound-1
Analysis of compound – 2
Analysis of compound – 3
Analysis of compound – 4
Analysis of compound – 5
Analysis of compound – 6.

Note: Analysis of organic compound with single functional groups containing phenol, aldehyde, ketone, carboxylic acid, amides, amines, monosaccharides with two derivatives

CH 255 MECHANICAL OPERATIONS LABORATORY

Practicals : 3 periods / week *Sessional Marks : 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 2*

Course Objectives:

Have sound knowledge on objects, their behaviors, relationships and modelled these objects into a functional application that the student will compile, modify, enhance and run.

Be able to implement one or more patterns involving realization of an abstract interface and utilization of polymorphism in the solution of problems which can take advantage of dynamic dispatching.

Learn other features of the C++ language including templates, exceptions, forms of casting, conversions, covering all features of the language.

Exploit their awareness to understand interrelated subjects and be able to effectively utilize current platforms and tools.

Course Outcomes:

Understand the properties of solids and different types of size reduction principles

Able to Use the best screening and settling methods in chemical industries.

Able to decide the best separation operation needed in chemical process industries

Able to design a liquid solid separation equipments.

Sampling by Riffle, Cone & Quartering and Bulk method
Grindability index (G.I.) of coal.
Ball Mill
Sink and float.
Optimum time of sieving.
Verify the laws of crushing.
Effectiveness of a given screen by hand sieving
Effectiveness of a given screen using vibrating/Rotap sieving
Magnetic separator
Terminal settling velocity in viscous medium.
Plate & Frame filter press
Centrifugal separator.
Mixing Index
Cyclone separator.

CH 256: COMPUTATIONAL PROGRAMMING LABORATORY

Practicals : 4 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam: 3 hrs. *Credits : 2*

Course Objectives:

To Learn basics in EXCEL/MATLAB skills
To solve linear/polynomial regression problems
To solve problems involving iterative solutions
To successfully employ programming both In EXCEL and MATLAB

CourseOutcomes:

Students shall be able to:

Successfully employ EXCEL/MATLAB skills
Solve linear/polynomial regression problems
Solve problems involving iterative solutions
Successfully employ programming both In EXCEL and MATLAB

Excel And Matlab Basics: Introduction, Plotting Graphs, Using Built in Functions to Solve Regression and Iterative Solutions, Using Macros, Programming in Excel and MATLAB.

Numerical Methods: Roots of algebraic equation; Solution of simultaneous equations; Regression analysis; Interpolation, Extrapolation and Numerical Differentiation; Numerical Integration; Solution of ordinary differential equations.

Application of Numerical Methods to Solve Chemical Engineering Problems: Material and Energy Balances-Fluid flow operations-Heat transfer and Evaporation-Mass transfer operations-Thermodynamics-Mechanical Operations-Prediction of Properties.

Introduction to Aspen Plus simulation tool.

IIIYear I Semester

CH 301 MASS TRANSFER OPERATIONS – I

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

To impart knowledge on how certain substances undergo the change in composition, change in phases and exhibit the properties according to the changed environment.

To learn given a physical description of a system, be able to compute or determine the applicable diffusion and mass transfer coefficients from mathematical models, engineering data, or correlations.

To explain the students with the basic principles of mass transfer operations and other separation processes with examples.

To discuss the principles of Absorption and stripping and equipment used.

To describe and illustrate to the students the equipment used in operations involving mass transfer and other separation processes with their advantages and disadvantages.

Course Outcomes:

An ability to define the basic principles of mass transfer operations and other separation processes.

An ability to calculate the mass transfer coefficients.

An ability to identify the major parts of various mass transfer equipment and calculate the number of stages and solvent required for absorption.

An ability to design humidification and dehumidification processes.

An ability to calculate the drying rate, design the drier, crystilization rate and equipment.

UNIT - I

Molecular Diffusion: Steady state diffusion into fluids at rest and in laminar flow, Fick's law, diffusion coefficient, continuity equation, diffusion in binary gas mixtures–one component stagnant, equimolar counter diffusion.

Diffusivity of liquids, estimation of diffusivities in liquids and gases. Diffusion in solids: Types of solid diffusion-diffusion through polymers, crystalline solids, porous solids.

UNIT - II

Mass transfer coefficients: notation for mass transfer coefficients for liquids and gases, mass transfer from gas into a flat falling liquid film, Sherwood number, Peclet number, Schmidt number, Reynolds number, mass transfer coefficient correlations for laminar and turbulent flow in circular pipes. Mass transfer theories: film theory, penetration theory, surface renewal theory; analogy between mass, heat and momentum transfer.

Inter-phase Mass Transfer: Equilibrium, Diffusion on both sides of an interface, relationship of overall mass transfer coefficient with either side mass transfer coefficient

UNIT - III

Equipment for Gas-Liquid Operations: Gas dispersed: Sparged vessels – diameter of gas bubbles, gas hold up, specific interfacial area, mass transfer coefficient, Mechanically agitated vessels, Tray towers – sieve trays, bubble cap trays, Tray Efficiency.Liquid

dispersed: Ventura scrubbers, wetted wall tower, spray tower, packed tower, types of packing, mass transfer coefficient in packed tower, Tray towers vs. packed towers.

Gas Absorption: Solubility of gases in liquids, ideal liquid solutions, non-ideal liquid solutions, choice of solvent for absorption. Single component absorption material balance - counter current multi stage operations in plate tower, absorption of one component in packed tower, HETP concept.

UNIT - IV

Humidification:

Vapor-gas mixtures, absolute humidity, dry bulb temperature, relative saturation, percentage saturation, dew point, enthalpy, Humid Volume and heat, psychrometric charts, air-water system, wet bulb temperature, Lewis relation, Adiabatic operation – design of water cooling with air.

Humidification Equipment: water-cooling towers, spray chambers and ponds, Dehumidification, Non-adiabatic operation – evaporative cooling.

UNIT - IV

Drying: Batch drying, rate of batch drying, time of drying, mechanism of batch drying, equipment for batch and continuous drying operations.

Crystallization: Crystal geometry, nucleation, crystal growth, equipment – vacuum crystallizer & draft tube crystallizer.

LEARNING RESOURCES

TEXT BOOK:

Mass Transfer Operations, Robert E. Treybal, 3rd edition, International Edition, McGraw Hill.

Principles of Mass Transfer and Separation Processes, Binay K. Dutta, PHI, New Delhi.

REFERENCE BOOKS:

Transport process and separation process principles, Christie John Geankoplis, 4th edition, PHI.

Separation Process Principles, J D Seader and E J Henly, 2nd edition, John Wiley &Sons.

Unit Operations of Chemical Engineering, Warren, L., McCabe, Julian C. Smith, Peter Harriot, 7th Edition, McGraw Hill, New Delhi. (UNIT - 2, Crystallization).

CH 302 CHEMICAL REACTION ENGINEERING –I

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

To provide knowledge on different types of reactions, reaction rate, collection and analysis of reaction rate data to derive rate expressions.

To provide knowledge on different kinetic models to analyze the batch reactor data

To provide knowledge of different types of reactors (Batch, semi batch, CSTR, PFR) and to derive the design equations of ideal reactors from mole balance.

To provide a foundation on deriving rate expressions for series, parallel, reversible reactions and the knowledge about product distribution in multiple reactions, recycle reactors and auto catalytic reactions.

To provide the knowledge on thermal characteristics of various reactions

Course Outcomes:

Analyze kinetic data and determine the rate expressions (reaction order and specific reaction rate) for a reaction.

Derive and solve design equations for batch, semi batch and steady state flow reactors.

Solve appropriate rate expressions for series, parallel and reversible reactions. Understand the performance characteristics and the advantages and disadvantages of major reactor types

Analyze multiple reactions to determine selectivity and yield.

Able to explain the thermal characteristics and design of adiabatic reactors for single and multiple reactions.

UNIT – I

Introduction to Chemical Reaction Engineering; Elementary and Non-elementary Reactions, Homogeneous and Heterogeneous Reactions, the definition of rate of reaction, variables affecting the rate of reaction.

Kinetics of homogeneous reactions: Concentration dependent term of rate equation, temperature dependent term for rate equation, searching for a mechanism, predictability of reaction rate from theory.

UNIT – II

Constant volume batch reactor- Analysis of Rate Data:, integral and differential Methods Method of Half-Lives, Method of Initial Rates, Method of Fractional life. Analysis of total pressure data.

Variable volume batch reactor, fractional volume change, temperature and reaction rate, and search for a rate equation. Reactions of shifting order, design of batch reactor.

UNIT – III

Design of Isothermal Flow reactors-general discussion, symbols and relationship between C_A and X_A,space time and space velocity, steady state mixed flow reactor, steady state plug flow reactor, holding time and space time for flow systems.

Size comparison of single reactors, multiple reactor systems Autocatalytic reactions and Recycle Reactors.

UNIT – IV

Design for parallel reactions- introduction to multiple reactions, qualitative discussion about product distribution, quantitative treatment of product distribution and of reactor size.

Irreversible first order reactions in series, qualitative discussion about product distribution, quantitative treatment of batch or plug flow reactor, quantitative treatment of mixed flow reactor.

UNIT – V

Temperature and pressure effects: Single reaction-heats of reactions from thermodynamics, heat of reaction and temperature, equilibrium constants from thermodynamics, equilibrium conversion from thermodynamics, general graphical design procedure, optimum temperature progression.

Design of non-isothermal reactors: heat effects, adiabatic and non-adiabatic operations. Exothermic reactions in mixed flow reactors, multiple reactions.

LEARNING RESOURCES

TEXT BOOK:

1. *Chemical Reaction Engineering, Octave Levenspiel, 3rd edition, John Wiley & Sons*

REFERENCE BOOKS:

Elements of chemical reaction engineering, H.S.Fogler, 4th edition, PHI
Chemical Engineering Kinetics, J.M.Smith, 3rd edition, McGraw Hill.

CH 303 CHEMICAL ENGINEERINGTHERMODYNAMICS-II

Lectures: 4 Periods / week | Sessional Marks: 40
Semester End Exam Marks : 60
Semester End Exam: 3 hrs. | *Credits* : 3

Course Objectives:

To learn the estimation of thermodynamic properties of fluids and to provide the knowledge on power cycles.
To learn the concepts of solution thermodynamics and estimation of the fugacity coefficients.
To develop the theoretical foundation for applications of thermodynamics to gas mixtures and liquid solutions and to familiarize on vapour liquid equilibrium.
To perform the phase equilibrium calculations using simple models for VLE, and to provide knowledge on phase equilibria.
To determine the effect of temperature, pressure and initial composition on the equilibrium conversion of chemical reactions.

Course Outcomes:

Student will be able to estimate the thermodynamic properties of pure fluids and to apply the power cycles for the production of heat.
Students will be able to estimate partial properties and fugacity coefficients.
Student will be able to apply the concepts of solution thermodynamics to estimate the properties of gas mixtures and liquid solutions.
Students will be able to perform the bubble point and dew point calculations.
Students will be able to estimate the equilibrium compositions of mixtures under chemical-reaction equilibria.

UNIT – I

Thermodynamic Properties of Fluids: Property relations for homogeneous phases, Maxwell’s equations, residual properties, two phase systems, thermodynamic diagrams, generalized property correlations for gases.

Production of power from heat: steam power plant, Rankine cycle. Otto engine, Diesel engine, Jet engines (Qualitative Discussion only).

UNIT – II

Solution thermodynamics: Fundamental property relation, chemical potential, criterion for phase equilibria, partial properties, ideal gas mixtures.

Fugacity and fugacity coefficients, generalized correlations for fugacity coefficients, the ideal solution, excess properties.

UNIT – III

Solution Thermodynamics Applications: Liquid phase properties from VLE data, activity coefficient, excess Gibb's energy, Gibb's Duhem equation, data reduction, thermodynamic consistency, models for excess Gibb's energy, property changes of mixing, heat effects of mixing processes.

Vapor-Liquid Equilibrium: Nature of equilibrium, Phase rule, Duhem's Theorem, VLE: Qualitative behavior, simple models for VLE, Dew point and bubble point calculations.

UNIT - IV

VLE from modified Raoult's Law: Dew point and bubble point calculations. VLE from k – values correlations and flash calculations.

Topics in phase Equilibria: VLE from cubic equations of state, Equilibrium and stability, liquid-liquid equilibrium (LLE), vapor- liquid–liquid equilibrium (VLLE), solid-liquid equilibrium (SLE), solid vapor equilibrium (SVE).

UNIT – V

Chemical Reaction Equilibrium: The reaction coordinate, application of equilibrium criteria to chemical reactions, the standard Gibbs Energy change and the equilibrium constant, Effect of temperature on the equilibrium constant, evaluation of equilibrium constants.

Relation of equilibrium constants to composition, equilibrium conversions for single reactions, phase rule and Duhem's theorem for reacting systems, multireactionequilibria.

LEARNING RESOURCES

TEXT BOOK:

Introduction to Chemical Engineering Thermodynamics by J.M.Smith, H.C.Vannessand M.M. Abbott7th Edition (In SI units), Tata McGraw Hill.

REFERENCE BOOKS:

Chemical Engineering Thermodynamics by T.E. Daubert, McGraw Hill.
Chemical Engineering Thermodynamics by Y.V.C.Rao, University Press.
A textbook of Chemical Engineering Thermodynamics by K.V. Narayana, PHI.

CH 304 ORGANIC CHEMICAL TECHNOLOGY

Lectures: 4 Periods / week *Sessional Marks: 40*
Semester End Exam Marks : 60
Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

Know organic chemical manufacturing processes of sugars, pulp and paper industries.
Know various details about petroleum crude.
Know the important unit operations and processes in petroleum industries.
Know about natural products like rubbers, fibres, oils and soaps.
Know the manufacturing processes of plastics, paints and varnishes.

Course outcomes:

Student should be able to

Acquire the knowledge of manufacturing processes of sugars, pulp and paper industries.
Gain the complete knowledge of petroleum crude.
Gain the complete knowledge of petroleum refining processes.
Acquire the knowledge of organic chemical products like rubbers, fibres, oils and soaps.
Acquire the knowledge of organic chemical products like plastics, paints and varnishes.

UNIT –I

Sugar and starch industry: Manufacture of cane sugar, production of starch from maize.
Fermentation industry: Manufacture of alcohol from molasses, manufacture of penicillin.

Pulp and paper industry: Methods of pulping, production of sulphate and sulphite pulp, production of paper–wet process.

UNIT-II

Petroleum: Origin, occurrence and reserves, composition, classification, characteristics, exploration and production.

Constituents of petroleum, petroleum products, testing and analysis of petroleum products, desalting, atmospheric and vacuum distillation.

UNIT- III

Petroleum Refining:
Thermal & Catalytic cracking processes: Visbreaking- Delayed Coking –Fluid Catalyticcracking and Hydrocracking-Feed stocks– Catalysts - Process variables –Product Recoveries

Catalytic reforming and isomerization: Catalytic reforming processes (for petroleum and petrochemical feed stocks) – Isomerization Processes -Feed stocks-Feed preparation – Yields.
Hydro treating& Hydro processing: Naphtha, Kerosene, Diesel,VGO& Resid, Hydrotreating / Hydroprocessing – Feed stocks – Process description and Process variables

UNIT – IV

Rubbers: Classification, natural rubber, monomers of synthetic rubber, manufacture of SBR.
Synthetic Fibers: Classification, manufacture of nylon 6, 6, polyester fibre, viscose rayon fibre.

Oils, soaps and detergents: Definitions, constitution of oils, extraction and expression of vegetable oils, refining and hydrogenation of oils, continuous process for the production of fatty acids and soap, production of detergents

UNIT – V

Plastic industry: Classification of plastics outlines and manufacture of phenols, formaldehyde, vinyl chloride and vinyl acetate, manufacture of phenol-formaldehyde resin and polyvinyl resins.

Paints and Varnishes: Constituents of paints and varnishes and their manufacturing procedures.

LEARNING RESOURCES

TEXT BOOK:

Dryden's Outlines of Chemical Technology for 21st Century by M.GopalRao and M.Sittig, 3rd edition, East West Press (2010).

REFERENCE BOOKS:

Shreve's Chemical Process Industries by G.T. Austin, McGraw Hill, 5th edition (1984)
Text Book of Chemical Technology (Volume II), G.N.Panday, Vikas Publishers(2000)

CH 305 INDUSTRIAL POLLUTION CONTROL

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

To provide the student knowledge on environmental impacts of human activities and understanding of the factors which determine how emission legislation is approached and of relevant legislation.

To provide knowledge of the unit operations and unit processes which can be used for water pollution abatement.

To provide knowledge on the sources, affects and control measures of air pollution.

To provide knowledge on the sources, affects and control measures of solid waste.

To provide knowledge of the concepts of waste minimization, clean technology and green chemistry in chemical process industries.

Course Outcomes:

The student will be able to

Describe and quantify health risks due to toxic chemicals.

Perform basic mass balances, formulate flow sheets and carry out preliminary sizing for biological unit operations for pollutant removal including activated sludge and trickling filters.

Describe mobile and stationary sources of air pollutants and their removal processes from the environment

Describe the sources of solid waste and their removal processes from the environment.

Define hierarchies for pollution prevention and to discuss concepts of waste minimization.

UNIT – I

Introduction:

Man & Environment, Types of Pollution (Air, Water, Land and Noise), water and air Pollution control aspects.

Industrial Pollution emissions & Indian Standards:

Industrial emissions-Liquids, Gases, Environmental Legislation, Water quality management in India, Air (Prevention and control of Pollution) Act -1981.

UNIT – II

Water Pollution:

Removal of BOD, Biological oxidation, Biological oxidation units-Activated sludge process, trickle filter, stabilization ponds, aerated lagoons, oxidation ditches and fluidized bed contactors. Anaerobictreatment. Removal of Chromium- Reduction-Precipitation, ion exchange, reverse osmosis, lime coagulation and adsorption.

Removal of Mercury: Removal of mercury from gaseous and liquid streams. Removal of Ammonia, Urea- Physico-chemical processes, biological methods, Algae-bacterial flocculation system. Treatment of Phenolic effluents-Steam gas stripping, Adsorption/ion exchange, Solvent extraction and oxidation methods.

UNIT – III

Air Pollution:

Removal of Particulate matter: Introduction, separation of particulate matter from effluent gases, preliminary methods of separations, cyclone separators, fabric filters, electrostatic precipitators. Wet scrubbers: spray towers, centrifugal scrubbers, packed beds and plate columns venturi scrubbers.

Removal of Sulfur dioxide: Harmful effects of SO_2, control methods, process changes, desulfurization of fuels, reduction of SO_2 concentration, wet processes & dry processes.

UNIT - IV

Removal of Oxides of Nitrogen: Control measures. Removal of Organic vapors from Effluent-Absorption of vapors in suitable liquids and media, incineration of organic vapors.

Solid waste management: sources, classification, public health aspects, disposal methods, potential methods of disposal.

UNIT –V

Pollution control in selected process Industries: General considerations, pollution control aspects of Fertilizer industries

Pollution control in Petroleum Refineries and Petrochemical units. Pollution control in pulp and paper industries.

LEARNING RESOURCES

TEXT BOOKS:

Pollution control in Process Industries by S.P .Mahajan, Tata McGraw Hill Publishing, Company Ltd, New Delhi (1985).

Environmental Pollution Control Engineering by C.S.Rao, 2nd edition, New AgeInternational Ltd (2006) for (UNIT - IV-solid waste management).

REFERENCE BOOKS:

Air pollution by M.N.Rao and H.V.N.Rao, Tata McGraw Hill (1989).

Industrial Water Pollution control by W.Wesley Eckenfelder Jr.,3rd edition,TataMcGraw-Hill (1999).

ELECTIVE-I

CH 306(A): COMPUTER SIMULATORS

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

The course will enable the students to:

Formulate a chemical engineering problem as a mathematical model, and select an appropriate solution method.
Understand the Simulating environment using CFD
Use the MATLAB to perform the numerical solution to a chemical engineering problem.
Understand the simulating environment using SIMULINK
Understand the simulating environment using ASPEN PLUS

Course Outcomes:

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

Understand the stages involved in the development of a process model.
Simulate by Using FLUENT.
Simulate the Chemical Engineering Problem by using MATLAB
Solve a Chemical Engineering by using SIMULINK.
Understand the Simulation and Design concepts by using ASPEN PLUS.

UNIT-I

Chemical Process Simulation: Introduction, Process simulation Techniques- sequential, simultaneous and equation oriented approaches, Partitioning and Tearing, The Flow sheet Simulator.

Numerical Methods in Chemical Engineering: application of numerical techniques to simulate chemical engineering problems.

UNIT-II

Introduction to Computational Fluid Dynamics: What is CFD, How does a CFD Code works, problem solving with CFD, Conservation Laws of Fluid Motion and boundary conditions

Governing equations of fluid flow and heat transfer, Navier Stokes equation. Introduction to CFD using ANSYS FLUENT software: Basic Concepts and Simulation stepwise procedure.

UNIT-III

Introduction to MATLAB, MATLAB Scripts, MATLAB Arrays, Linear models, graphing data in MATLAB, MATLAB Array Math.

Applications of MATLAB: Polynomials, Curve fitting, Linear Algebra, Solution of Ordinary Differential Equations, Numerical Integration.

UNIT-IV

Simulation Examples of: Heat exchanger, Distillation column, Plug flow reactor, CSTR.

Simulation using Simulink: introduction to Simulink, process modeling and simulation using Simulink tool, examples of application of Simulink for modeling chemical processes.

UNIT-V

Aspen simulation: Introduction to ASPEN Properties, thermodynamic property methods, property estimation of pure component, binary and ternary mixtures, bubble point and dew point estimation

Introduction to ASPEN Plus: Process flow sheet, Simple Simulation Examples by using Aspen Plus: Flash column, mixers and splitters, reactors, pipes, pumps and compressors, distillation columns.

LEARNING RESOURCES

TEXTBOOKS:

Chemical Process Computations by Raghu Raman, Elsevier Applied Science Publishers, the University of Michigan (1985) (UNIT-I).

Getting Started With MATLAB: A Quick Introduction For Scientists And Engineers, RudraPratap, Oxford University Press, 2010 (UNIT-III and UNIT-IV)

Process Simulation and Control Using Aspen, Amiya. K. Jana, PHI, 2009 (UNIT-V)

Versteeg. H. K and Malalasekera. W. "An introduction to computational fluid dynamics – The finite volume method", Longman Group Ltd 1995(UNIT-II)

REFERENCE BOOKS:

Introduction to Chemical Engineering Computing by Bruce.A.Finlayson, Wiley-Interscience, 2006

Chemical Process Modeling and Computer Simulation, Amiya K. Jana, 2nd edition, PHI(2011)

Computational methods for process simulation by W. F. Ramirez,2nd edition, Betterworthus series in Chemical Engineering(1998)

CH 306 (B) GENERAL PHARMACY

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

This chapter is designed to impart fundamental knowledge on various calculations used in the preparation of dosage forms, packaging containers used and labeling requirements.

This chapter is designed to impart a fundamental knowledge on the art and science of formulations available, formulation requirements for formulating different types of dosage forms.

The main objective of the chapter deals with imparting fundamental knowledge on the different types of monophasic liquid preparations available, formulation aspects of monophasic liquid preparations.

The main objective of the chapter deals with imparting fundamental knowledge on the different types of biphasic liquid preparations available, formulation aspects of biphasic liquid preparations.

The main objective of the chapter deals with the study of different extraction processes used for the preparation of galenicals, preparation of galenicals, preparation of Suppositories and Pessaries.

Course Outcomes:

Upon completion of the topic the student shall be able to perform the calculations required for development of formulations, packaging materials used and labeling requirements.

Upon completion of the unit the student shall be able to acquire the knowledge on different formulations available, formulation requirements for formulating different types of dosage forms.

Upon completion of the unit the student shall be able to acquire the knowledge on of monophasic liquid preparations available, formulate different types of monophasic liquid

Upon completion of the unit the student shall be able to acquire the knowledge on of biphasic liquid preparations available, formulate different types of biphasic liquid preparations.

Upon completion of the unit the student shall be able to prepare galenicals, suppositories and peccaries.

UNIT - I

Metrology : Systems of Weights and Measures - Metric and Imperial systems – Percentage calculations and adjustment of products - Interconversions - Use of alligation method in calculations - Isotonic solutions and proof spirits - Weighing -Selection and care of Weights and balances

.

Packaging and Labelling of Pharmaceuticals: Desirable features of a container - Types of containers - Study of glass and plastics as materials for containers and rubber as a material for closures - their merits and demerits - Labelling requirements

UNIT - II

Introduction to Dosage Forms: Classification - Types with examples, Definitions and essential characteristics of different dosage forms - Formulation and its purpose.

Formulation Additives: Solvents, Vehicles for Liquids, Antioxidants, Preservatives, Colouring agents, Sweetening and flavouring agents in Liquid dosage forms.

UNIT - III

Mono Phasic Liquids: Liquid oral dosage forms : Definitions, General formulation, methods of preparation, uses of official and other products in common usage of the following: Solutions, Aromatic Waters, Spirits, Syrups, Elixirs, Dry Syrups, Mixtures.

Monophasic Liquids for external and other uses: Definitions, general formulation, methods of preparation, uses of official and other products in common usage of the following:Lotions, Liniments, throat paints, gargles, mouthwashes, glycerins, collodions, Ear drops, Nasal drops and Sprays, Douches, preparations.

UNIT - IV

Biphasic liquid dosage Forms:Suspensions - Definitions, Types, Ideal requirements, Formulation additives, Typical examples for oral and external use, Methods of preparation.

Emulsions - Definitions, Types, Ideal requirements, Formulation additives, Typical examples for oral and external use, Methods of preparation.

UNIT - V

Galenicals: Study of extraction processes – Maceration Percolation and their modifications, continuous hot extraction - Their applications. Principles and methods of preparations of dry, soft and liquid extracts and tinctures of I.P and B.P.

Suppositories and Pessaries: Ideal requirements, different bases, Preparation methods – Typical examples, calculations involving displacement value - Packaging and supply.

LEARNING RESOURCES

TEXT BOOKS:

Introduction to Pharmaceutiacl Dosage forms by H.C. Ansel.9th Edition
Dispensing for pharmaceutical students by Cooper & Gunn's 12th Edition

REFERENCES:

Pharmaceutical Sciences, Remington's, 21st Edition
Text book of professional pharmacy, N. K.Jain & S.N Sharma, 5th Edition

CH306 (C) PETROLEUM EXPLORATION

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

To have a knowledge of exploration methods in India.
To understandPetroleum exploration methods with special emphasis on gravity/magnetic methods.
To understand about the Seismic methods for Oil exploration.
To understand Sedimentology and biostratigraphy.
To understand the sedimentary sequences holding hydrocarbons.

CourseOutcomes:

Able to know Sedimentlogical and biostratigraphic approaches in hydrocarbon exploration.
Able to know about acquisition methods, processing and interpretation.
Acquires knowledge on the Seismic methods for Oil exploration.
Able to do seismic refraction survey.
Able to perform various flooding processes.

UNIT - I

Introduction: Overview of petroleum exploration in India, Introduction to Geophysical/Geological methods used in Petroleum Exploration.

Sedimentlogical and biostratigraphic approaches in hydrocarbon exploration.

UNIT - II

Basic concepts of Gravity/magnetic methods: Newton’s gravitational law- Units of gravity- Gravity measuring instruments- Gravity survey- Gravity anomalies- Gravity data reduction- Drift- latitude- Elevation and free air correction- Free air &bouguer anomalies- Gravity response of simple shapes- Interpretation of gravity anomalies- Application of gravity methods.

The geomagnetic field- Magnetic anomalies- Magnetic survey-instruments- Field method of magnetic surveys- Reduction of magnetic data-Diurnal correction and geomagnetic correction-Interpretation of magnetic anomaly- Response of magnetic method for different type of bodies and geological structure- Application of magnetic surveys both overland and from air.

UNIT - III

Basic Concepts of seismic methods: Seismic refraction surveys- Geometry of refracted path, planar interface- Two layer case with horizontal interface- Methodology of refraction profiling-Recording instruments & energy sources.

Corrections applied to refraction data Interpretation of refraction data- Application of seismic refraction method.

UNIT - IV

Geometry of reflected ray path: Single horizontal reflector- The reflection seismograph and seismogram (Seismic traces)- Importance of seismic reflection survey over seismic refraction survey technique- Common depth point (CDP) profiling & stacking- 2D, 3D, & 4D seismic surveys.

Field procedures & principles- Time corrections applied to seismic data- Data processing- Interpretation of reflection data- Introduction to 3D data acquisition & interpretation.

UNIT - V

Well seismic shooting for velocity determination and Vertical Seismic Profiling (VSP). Chemical Flooding: Polymer flooding and mobility control processes, Micellar/ polymer flooding, phase behavior of micro-emulsions, phase behavior and IFT, wettability alterations, Alkali flooding.

Miscible Displacement Processes: Mechanism of miscible displacement, phase behavior related to miscibility, high pressure gas injection, enriched gas injection, LPG flooding, Carbon dioxide flooding, alcohol flooding. Thermal Recovery Processes: mechanism of thermal flooding, hot water flooding, cyclic steam injection, estimation of oil recovery from steam drive, in-situ combustion, air requirement for in-situ combustion.

LEARNING RESOURCES

TEXT BOOKS:

Introduction to Geophysical Prospecting, Milton B. Dobrin, and Carl H. Savit, 4th Edition, McGraw Hill, 1988.

REFERENCE BOOK:

Outlines of Geophysical Prospecting: A Manual for Geologists, M.B. RamachandraRao, EBD Educational Pvt. Ltd., 1993.

Field Geophysics, John Milsom and AsgerEriksen, 4th Edition, John Wiley, 2011.

Elements of Geology: Oil and Gas Exploration Techniques, J. Guillemot, Technip 1991.

CH 306 (D) ELECTRO CHEMICAL ENGINEERING

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

To apply Chemical Engineering principles to develop mathematical models for Electro Chemical Processes

To provide knowledge on Paired redox reactions; diffusion and migration processes to overall transport rates in electro chemical systems and Electrodes used in different electro chemical industries.

The course objective is to explain the principles and describe the design and operation of Electrochemical reactors and processes, fuel cells and batteries;

Concept of electrode potentials and their use in predicting spontaneous and anti-spontaneous

To provide the knowledge on corrosion resistance and rate

Course Outcomes:

Students will be able to understand balanced electrochemical reactions; analyze the open-circuit potentials of electrochemical cells, including liquid-junction potentials and understand the structure of the electric double layer, based partly on surface-tension data.

Students will be able to understand the reaction mechanisms and kinetics to obtain electrode over potentials and mass-transfer phenomena, including the estimation of limiting currents.

Students will be able to explain the principles and working conditions of the different types of primary and secondary batteries.

Students will be able to understand the uses of electrodes in used in various electro chemical and Students will be able to understand the industries like metal finishing, electroplating and electro polishing, etc.

To provide basic knowledge on operations to minimize corrosion rates

UNIT – I

Review of basics of Electro - Chemistry: Mechanism of Electrolysis, Degree of dissociation,Laws of Electrolysis, ionic mobility's, Transference Numbers,Nernst equation, galvanic cells, cell design.

The electrical double layer: Its role in Electro-chemical process, Electro-capillary curve, Helmota layer, Gucy, Steven's layer, fields at the interface.

UNIT – II

Mass transfer in Electro-Chemical systems:

Measurements and Systems Analysis: Conductivity measurements - Conduct metric analysis - Titrations, Measurements of pH, potential - potentiometric titrations.

Mass transfer in Electro-Chemical systems:

Polarization, Diffusion controlled Electro-chemical reaction, the importance of convection and the concept of limiting current, mass transfer over potential or concentration polarization.

UNIT – III

Primary and Secondary Batteries:
Lechlanche dry cell, Alkaline manganese cell, mercury cell

The lead acid accumulator, The Davityan Water –gas cell, The Redox-Fuel cell and Hydrogen/Oxygen Cells, Ni-Cd, Ni-Fe, sodium-sulphur, Li ion cell

UNIT – IV

Electrodes used in different Electrochemical Industries: Metals, graphite, lead dioxide, iron oxide, semi conducting type etc.

Metal finishing: Electro deposition, Electro refining, Electro forming, Electro polishing, Anodizing.

UNIT – V

Corrosion theory: Manifestation of corrosion, bases of electrochemical corrosion, amount and intensity of corrosion, Eight forms of corrosion: Uniform attack, Galvanic corrosion, crevice corrosion,Pittingcorrosion, inter granular corrosion, Selective leaching and stress corrosion cracking.

Methods of corrosion prevention and control: Design, coatings and inhibition, cathodic protection, stray current corrosion, passivity phenomena and development of corrosion resistance alloy, anodic control.

LEARNING RESOURCES

TEXT BOOKS:

An Introduction to Electrochemistry by Samuel Glasstone, Maurice Press(2007)
Electro Chemical Engineering by David J.Picket, Prentice Hall Inc., Publications (1979)

REFERENCE BOOKS:

Electrochemical Power sources Primary and Secondary Batteries by M.Barak and L.K.Steverge, Publisher : The Institution Of Engineering And Technology(1980)
Electro Chemical Engineering Science and Technology in Chemical and other industries by H.Wendt and G.Kreysa, Springer links publications (1999)

CH 351 PROCESS HEAT TRANSFER LABORATORY

Practicals : 3 periods / week *Sessional Marks : 40*

Semester End Exam Marks : 60

Semester End Exam : 3 hrs. *Credits : 2*

Course Objectives

To apply the concepts of heat transfer, fluid dynamics and thermodynamics to the design and operation of heat transfer experiments.
To develop practical understanding of common heat transfer equipments.
To develop skills in experimental design and troubleshooting.
To develop skills in data collection, analysis and interpretation.

Course Outcomes:

Students should be able to

Collect quality raw data from an operation
Compare observed with predicted performance
Communicate the results of their analysis effectively in written and oral reports
Function effectively in a lab team

Thermal conductivity of a metal rod
Heat transfer coefficient in forced convection.
Overall heat transfer coefficient for a fluid in parallel and counter flow in double pipe heat exchanger.
Stefan- Boltzmann constant.
Emissivity of a metal rod.
Heat transfer coefficient for a fluid through a lagged pipe.
Temperature distribution through composite walls.
Boiling heat transfer
Overall heat transfer coefficient for a fluid flow in a shell and tube heat exchanger.
Unsteady state heat transfer in a rod.
Overall Heat transfer coefficient for a fluid flow in agitated vessels.
Overall Heat transfer coefficient for a fluid flow in a jacketed kettle.
Heat flux for a fluid flow through heat pipe.
Heat transfer coefficient for a fluid through fluidized bed
Heat transfer coefficient in drop wise & film type condensation (Demonstration).

CH 352 MASS TRANSFER OPERATIONS LABORATORY-I

Practicals : 3 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam : 3 hrs. *Credits : 2*

Course Objectives:

Determines experimentally the diffusion coefficient in binary systems of liquids and gases.
Understands surface evaporation in stationary and moving surfaces.
Studies dynamics of single drop hydrodynamics and perforated plate tower.
Determines the kinetic and equilibrium parameters of drying of wet solids.

Course Outcomes:

Ability to design experiments to obtain mass transfer coefficients like diffusion coefficient in liquids and gases.
Ability to troubleshoot problems in liquid – liquid extraction perforated towers or spray towers.
Ability to calculate drying rates of wet solids and volatile chemical spills.
Ability to design gas – liquid absorption columns.

Diffusivity coefficient for liquid-liquid system.
Diffusivity coefficient for given vapor-Gas system
Mass transfer coefficient for Surface evaporation of a liquid
Hydrodynamics of single drop extraction.
Hydrodynamics of perforated plate tower
Hydrodynamics in a spray column
Mass transfer coefficient in a perforated plate tower
Mass transfer coefficient in a wetted wall tower
Mass transfer coefficient in a Packed bed absorption
Batch drying.
Humidification
Dehumidification
Solid dissolution
Venturi scrubbers.
Batch Crystallization
Mutual solubility curve and critical solution temperature.

CH 353 CHEMICAL TECHNOLOGY LABORATORY

Practicals : 3 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam : 3 hrs. *Credits : 2*

Course Objectives:

To instil students with an appreciation of the fundamental principles and concepts of Inorganic Chemical Technology.
To provide students with the fundamental aspects of chemical process technology and professional knowledge in selected areas of Inorganic chemical technology.
To provide knowledge in soap manufacturing, analysis and estimation
To provide knowledge in oil (testing), analysis and estimation of glucose and sugar.

Course Outcomes:

Ability to demonstrate knowledge and understanding on fundamental principles of chemistry and Inorganic chemical technology and on contemporary applications.
Ability to design and conduct experiments, as well as critically analyze and interpret experiment results.
Ability to demonstrate and understand the principles of organic chemical technology and other applications.
Ability to identify, modify and design a component process or system to meet the required product quality.

Determination of suspended, dissolved, total solids and pH of water
Determination of chloride in tap water
Determination of copper in brass
Determination of Calorific value of solid, liquid and gaseous fuels
Determination of acid insoluble and available lime
Preparation of copper pigment
Preparation of chrome yellow
Preparation table salt
Estimation of metals by spectrophotometric method.
Proximate analysis.
Estimation of nitrogen content in urea
Estimation of sugars.
Treatment of water by ion-exchange process.
Estimation of Sulphate.
Ferrous content in the iron ore
Beer's law
Estimation of λ_{max}
Preparation of soap by semi boiled process
Total fatty matter in soaps
Determination of adulteration in edible oils

IIIYearII Semester

CH 307 MASS TRANSFER OPERATIONS-II

Lectures : 3 periods / week *Sessional Marks : 40*
Tutorials : 1 period / week *Semester End Exam Marks : 60*
Semester End Exam: 3 hrs. *Credits :3*

Course Objectives:

Understand the concept of vapor liquid equilibrium
Given specifications for a feed and desired product streams, select a separation method and design a process utilizing that method to achieve the desired products.
For a proposed separation process, apply the fundamentals of mass transfer and engineering correlations to unit-level design of process equipment.
To choose an appropriate separation technology for a particular application.
To understand the principles of membrane separations and industrial uses.

Course Outcomes:

An ability to understand the basic concepts of different principles of distillation.
An ability to understand the Continuous rectification and design of distillation process.
An ability to apply the principles Liquid-Liquid Extraction and equipment for Liquid-Liquid Extraction.
An ability to design adsoption column and Ion exchange.
An ability to select suitable equipment for leaching and design of solid liquid extraction, membrane techniques for the separation of miscible systems.

UNIT - I

Distillation-1: Principles of Vapor-Liquid Equilibrium for binary system, relative volatility, enthalpy concentration diagrams.

Flash distillation, differential distillation, batch distillation with reflux.

UNIT - II

Continuous rectification, McCabe-Thiele method, Tray efficiency, Ponchon- Savarit method.

Azeotropes, azeotropic distillation, extractive distillation and steam distillation.

UNIT - III

Liquid-Liquid Extraction: Choice of Solvent, Ternary equilibrium, tie line, equipment - mixer-settler, perforated plate tower, rotating disk contactor, pulsed columns.

Calculations for insoluble liquids - single stage, multi stage cross current and counter current operations.

UNIT - IV

Adsorption: Types of adsorption - physical adsorption and chemisorption, nature of adsorbents, types of industrial adsorbents, types of adsorption isotherms for vapors, Freundlich isotherm for dilute solutions, Calculations for single stage and multi stage cross current.

Calculations for multi stage counter current adsorption operation.Ion Exchange: Principles of ion exchange, mechanism for rate of ion exchange

UNIT - V

Leaching: Fields of applications, Preparation of solids, percolation tanks, Shanks system, filter press leaching, agitated vessels, Rotocel, Kennedy extractor, Bollman extractor, Single stage leaching and multi stage cross current calculations.

Description of multi stage counter current operation and calculations.Membrane Separations: Principle, Membrane modules, dialysis, pervaporation.

LEARNING RESOURCES

TEXT BOOK:

Mass Transfer Operations, Robert E. Treybal, 3rd Edition, International Edition, McGraw Hill.

Principles of Mass Transfer and Separation Process, Binay K. Dutta, PHI, New Delhi.

REFERENCE BOOKS:

Transport process and separation process principles, Christie John Geankoplis, 4th edition, PHI.

Separation Process Principles, J D Seader and E J Henly, 2nd Edition, John Wiley & sons.

CH 308 CHEMICAL REACTION ENGINEERING – II

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

To accomplish knowledge on non-ideal reactors

To provide the knowledge on kinetics of fluid particle reacting systems along with describing the different kinetic models for non-catalytic fluid particle reactions.

To provide knowledge on determination of surface area of catalysts.

To provide the knowledge on mechanisms of catalytic heterogeneous reactions.

To provide the knowledge on mechanisms of catalyst deactivation.

Course Outcomes:

Able to apply the non-ideality concepts in the reacting system for better understanding of the deviations from ideality by applying the tanks-in-series model and the dispersion model.

Able to develop the progressive conversion model and shrinking core model for explaining the fluid particle reaction.

Able to understand the properties of catalyst and to estimate the surface area of the catalyst.

Able to understand the principles and mechanism involved in heterogeneous catalysis and analyze the data of heterogeneous catalytic reactions.

Able to estimate the conversion of reactions involving deactivating catalysts.

UNIT - I

Basics of Non -Ideal flow, The residence time distribution (RTD), State of aggregation of the flowing stream, earliness of mixing, Role of RTD, state of aggregation and earliness of mixing in determining reactor behaviour. Exit age distribution of fluid, Experimental methods for finding E –pulse, step experiments, Relationship between F and E curves.

Analysis of Non-ideal reactors - basic idea. Compartment models - hints, suggestions and possible applications. Dispersion number from C and F curves, Conversion using Dispersion and Tanks in series models for the first order irreversible reaction.

UNIT - II

Introduction to design for heterogeneous reacting systems: Rate equations for heterogeneous reactions, contacting patterns for two phase systems. Kinetics of fluid - fluid reactions. The rate equation for straight mass transfer of A (absorption). The general rate equation and the rate equation for reaction with mass transfer.

Kinetics of fluid-particle reactions, selection of a model, PCM, SCM, comparison of models with real situations.Shrinking fore 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.

UNIT –III

Solid catalysts - Adsorption, Adsorption isotherms, Surface area, Void volume and solid density, Pore volume Distribution.

Theories of heterogeneous catalysis, Classification of catalysts, Catalyst preparation, Promoters and inhibitors. (to the extent covered in J.M. Smith only)

UNIT - IV

Heterogeneous Reactions - Introduction. Solid Catalyzed reactions; Development of rate expressions from L - H - H - W models for reaction A + B → R + S under Adsorption, surface reaction and desorption controlling condition.

Pore diffusion resistance combined with surface kinetics (Single cylindrical pore, first order reaction) Porous catalyst particles. Data analysis for heterogeneous catalytic reactors, isothermal packed bed (PFR) reactor design Experimental methods for finding rates.

UNIT - V

Deactivating catalysts, Mechanisms of catalyst deactivation, the rate and performance equations: The rate equation from experiment.

Determining the rate for batch solids in contact with fluid in batch, mixed flow and plug flow modes for independent deactivation. Effect of pore diffusion resistance.

LEARNING RESOURCES

TEXT BOOK:

1. *Chemical Reaction Engineering, Octave Levenspiel, 3rd edition, John Wiley & Sons*

REFERENCE BOOKS:

Elements of chemical reaction engineering, H.S.Fogler, 4th edition, PHI.
Chemical Engineering Kinetics, J.M.Smith, 3rd edition, McGraw Hill.

CH 309 PROCESSDYNAMICS&CONTROL

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

To provide the students the working knowledge of Laplace transforms to express the dynamics of linear control system in terms of transfer functions.

To provide the students with fundamental background of process control theory

To provide the working knowledge of automatic control systems for chemical process.

To provide the students the knowledge of stability analysis, frequency response analysis and control system design approaches.

To provide the students working knowledge in analysis, design and turning of feedback / feed forward controllers in the context of various control strategies used to control chemical processes.

Course Outcomes:

Analyze typical process dynamics with and without feedback control using both time domain and Laplace domain approaches.

Be able to analyze open loop and closed loop system properties.

Be able to develop the closed loop transfer functions for single and multi loop systems and to apply the Routh test, root locus methods for stability analysis.

Be able to apply the frequency response based analysis for control system stability and performance.

Be able to perform model based tuning and testing of PID controllers and other types of controllers.

UNIT – I

Basic Concepts in Process control, Laplace transforms, inversion by partial fractions and properties of transforms. Linear open loop systems: Response of first order systems.

Physical examples of first order systems, response of first order systems in series.

UNIT – II

Second order systems: Transfer function development, response of second order systems, and transportation lag.

Linear closed loop systems: Control system, controllers and final control elements, block diagram of a chemical reactor control system.

UNIT – III

Closed loop transfer functions: Transfer functions for single loop and multiloopsystems, transient response of simple control systems.

Stability: Routh test for stability and Root locus.

UNIT - IV

Frequency response: Introduction, substitution rule, Bode diagrams.

Control system design by frequency response: Temperature control systems, Bode stability criteria, Ziegler–Nichols control settings, transient responses.

UNIT – V

Advanced control strategies: Cascade control, feed forward control, ratio control and internal model control.

Controller tuning and process identification: Tuning, tuning rules, process identification, Control Valves: Valve construction, sizing, characteristics, and positioner.

LEARNING RESOURCES

TEXT BOOK:

Process systems analysis and control, D.R.Coughanour&Steven E. LeBlanc, 3rd edition, McGraw Hill.

REFERENCE BOOKS:

Chemical Process Control: An introduction to Theory and Practice, George Stephanopoulos, PHI.
Process Control, Peter Harriot, Tata-McGraw-Hill, New Delhi.
Process Control Modeling, Design and Simulation, B.W.Bequette, PHI(2003)
Process Control and Instrumentation, R.P.Vyas, 4th Edition, Dennett &Co.

CH 310 PROCESS ECONOMICS AND PLANT DESIGN

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

To give engineering design concept flow sheet making to the equipment specifications with all engineering instrumentation including design reports

To give a basic understanding of various Health and safety hazard studies

To discuss the various Cost Estimation methods and types of interest.

To understand the various methods of Depreciation, Service Life and Profitability analysis

To discuss the methods to select materials and fabrication of equipment and Transport & Storage of Materials:

Course Outcomes:

Synthesize and analyze process flow sheets, draw flow charts, layout and specification of equipment.

Effectively design chemical engineering projects.

Be able to perform process selection, pollution & its abatement and safety &health considerations.

Be able to calculate the depreciation, payback period.

Select the suitable material, design the storage equipment.

UNIT – I

Introduction to Plant design: Chemical Engineering plant design, Process design development, Optimum design, Practical considerations in design, Design approach and Process Design Development: Design-Project procedure.

Process Design Development: Design information from literature, Flow diagrams, Preliminary Design, Comparison of different processes and Equipment design specifications.

UNIT – II

General design considerations: Health and safety hazards: Source of exposure, Exposure evaluation, Exposure –Hazard control, Fire and Explosion Hazards and Personal safety.

Loss prevention-HAZOPS Study, Fault-Tree Analysis, Failure mode and Effect Analysis, Safety Indices, Safety Audits, Plant location, Plant layout, Plant operation and control, Utilities, Structural design, Storage and Material handling.

UNIT – III

Cost Estimation: Factors affecting investment and Production cost, Capital Investment and Estimation of capital investment.

Cost Indices, Cost Factors in Capital Investment and Estimation of total product cost. Types of interest, Nominal& effective interest rates and Continuous interest.

UNIT – IV

Depreciation: Types of Depreciation, Service Life, Salvage Value, Present Value, Methods for determining Depreciation.

Profitability: Profitability analysis, Comparison of alternative investments and replacements: Accounting for inflation and technological advancement.

UNIT – V

Materials and fabrication selection: Materials of construction, Selection of materials, Economics in Selection of Materials, fabrication of equipment.

Transport & Storage of Materials: Solids, Liquids and gases.

LEARNING RESOURCES

TEXT BOOKS:

Plant Design and Economics for Chemical Engineers, Fourth Edition by Max. S. Peters. and Klaus D.Timmerhaus, McGraw Hill.

Coulson & Richardson's Chemical Engineering, Volume:2, J.F. Richardson, J. H. Harker and J. R. Backhurst, 4th edition, Elsevier. (UNIT-IV)

CH 311 INDUSTRIAL HAZARDS AND SAFETY ANALYSIS

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

The Students are able to understanding the predominating hazards associated with objects, facilities, and equipment and work practices in the work environment.

The Students are able to participate actively in preparing a technical team safety project, analysing a safety scenario and developing a program to correct the problem and prevent recurrences

The Students are able to study the effect of toxic and flammable materials and conduct the management of a fire prevention and abatement program.

The Students are able to demonstrate knowledge of appropriate protective equipment, safety and health training procedures.

The Students are able to understanding the appropriate control procedures and devices to be considered - to control the hazards.

Course Outcomes:

To attain the knowledge of human error and human factors principles and how they relate to Process Safety Management.

To improve human performance by reducing human error-likely work situations through design, improved work instructions, training and the recognition of human factors hazards.

To practice performing human factors and procedures analyses in realistic workshops and safety education training programmes.

Able to reduce the process hazards by using protective equipments and fire extinguishers

Able to reduce the process hazards and communicate the safety and hazard analysis reports

UNIT – I

Introduction:

Definition of safety, the basis for safety, Chemical hazards and worker safety-manufacturing, transportation and use.

Safety aspects of site selection, layout and unit plot planning. Hazards of commercial chemical reactions and operations.

UNIT – II

Safety:

Process design: Introduction, the technique of safe process design- reactor, separation, materials handling, and storage, safe control of process variables.

Instrumentation for safe operations- self- acting temperature and pressure regulators, pneumatic controllers, potentiometric controllers, float switches, alarms, annunciators,and interlocks. Safety education and training.

UNIT – III

Risk: Effect of toxic agents on skin, eyes, respiratory and digestive system. Flammable materials-Fires and Explosions: Fire Triangle, Distinction between Fires and Explosions, Flammability Characteristics of Liquids and Vapors, Concepts to Prevent Fires and Explosions: Explosion-Proof Equipment and Instruments, Ventilation, Sprinkler Systems.

Work permit systems: Hazardous operation permits, hazardous work area permits, special hazard permit and equipment operating permits.

UNIT – IV

Protection: Personnel protective equipment for head& ear protection, gloves, aprons and safety footwear.

Fire extinguishing agents and their applications - classification of fires, extinguishing agents and methods of application, mechanism ofextinguishment.Measuring safety effectiveness-criteria for effective measures.

UNIT V

Risk Assessment -Hazard identification techniques with examples such as QRA, FMEA, Fault Tree Analysis, Event Tree Analysis.

Hazard and operability (HAZOP) study: Introduction, basic concepts, conducting a HAZOP study.

LEARNING RESOURCES

TEXT BOOK:

Safety and accident prevention in Chemical operations by Fawcett H.H. and W.S.Wood, 2nd editon John Wiley and Sons Inc. (1982).

REFERENCE BOOK:

Safety Handling of Hazardous Chemicals by Rohatgi, A.K.Enterprises(1986)
Industrial safety practices by Bob skeltor(UNIT V)
Chemical process safety –Learning from case histories by Roy E Sanders, 3rd edition, Elsevier Butterworth Heinemann (2004).

Elective–II

CH 312(A): COMPUTATIONAL FLUID DYNAMICS

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

The course enables the students to:

Understand the widely used techniques in developing governing equations for a given fluid flow system.

Know how to apply finite difference methods to solve diffusion heat conduction problems

Understand the application finite difference methods to solve problems involving convective transfer.

Understand how to write algorithms for the chemical engineering problems.

Understand the application of Tri-diagonal matrix algorithms

Course Outcomes:

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

Understand the basic principles of formulation of governing equations.

Apply the finite difference techniques.

Apply the finite difference techniques to solve convective equations.

Write the algorithms for one, two and three dimensional equations.

Write the TDMA algorithms.

UNIT - I

Conservation Laws of Fluid Motion: Governing equations of fluid flow and heat transfer, Equation of state, Navier Stokes equations for a Newtonian fluid

Governing equations of the flow of compressible Newtonian fluid – Differential and integral forms of the general transport equations

UNIT - II

Finite Volume Method for Diffusion Problems: Introduction, One-dimensional, two dimensional and three dimensional steady state diffusion problems,

The Finite Volume Method for Convective- diffusion problems: Steady one-dimensional convective and diffusion, the Central differencing scheme, properties of discretization schemes

UNIT - III

The Finite Volume Method for Convective- diffusion problems: Assessment of the central differencing scheme for convective diffusion problems, The upwind differencing scheme, The hybrid differencing scheme

Higher order differencing schemes for convective diffusion – Discretization of transient convection-diffusion equation, the power-law scheme

UNIT - IV

Solution Algorithms For Pressure-Velocity Coupling In Steady Flows: Introduction – The staggered grid – The momentum equations – The SIMPLE algorithm

The SIMPLER algorithm – The SIMPLEC algorithm – The PISO algorithm – Transient SIMPLE algorithm

UNIT - V

Solution Of Discretized Equations: Introduction, The tri-diagonal matrix algorithm, Application of TDMA to two- dimensional problems, Application of the TDMA method to three-dimensional problems

The finite Volume method for un-steady flows: introduction, one-dimensional unsteady heat conduction-Explicit scheme, Crank-Nicholson method, implicit method for two and three-dimensional problems

LEARNING RESOURCES

TEXT BOOK:

Versteeg. H. K and Malalasekera. W. An introduction to computational fluid dynamics – The finite volume method, Longman Group Ltd 1995

REFERENCE BOOK:

1. Ferziger. J.H, and Peric. M. Computational Methods for Fluid Dynamics, Springer, 2002.

CH 312 (B) PREFORMULATION STUDIES INCLUDING STABILITY STUDIES

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

The main objective of the chapter deals studies involved in the assessment of rate and extent of drug that reaches into systemic circulation.

The main objective of the chapter deals with the study of biopharmaceutical considerations in the development of dosage form

The main objective of the chapter deals with the study of sources of quality variations, control of quality variations, and good manufacturing practices in the pharmaceutical industry.

The main objective of the chapter deals with the study of assessing the stability of formulations as per ICH guide lines

The main objective of the chapter deals with the pre-formulation studies to be conducted in the new dosage form design.

Course Outcomes:

Upon completion of the unit the student shall be able to understand and carry preformulation studies for the successful development dosage form.

Upon completion of the unit the student shall be able to consider the various factors influencing the absorption for the successful development of dosage form, able evaluate drug release by dissolution studies.

Upon completion of the unit the student shall be able to know the various Study designs involved in the bioavailability studies and methods for assessment of bioavailability.

Upon completion of the unit the student shall be able to know the various factors affecting the stability of drugs and ICH guideline for conducting stability & photostability studies.

Upon completion of the unit the student shall be able to know the specifications of QA & QC for maintaining the quality of product, good manufacturing practices in the pharmaceutical industry.

UNIT - I

Preformulation Studies: Introduction to preformulation studies, Objective of Preformulation studies, Multidisciplanary development of a drug candidate, Multidisciplanary development of a drug candidate Principle areas of preformulation research Essential information helpful in designing the preformulation evaluation of new drug.

Preformulation studies of Solid and Liquid, dosage forms.

UNIT - II

Drug Solubility & Absorption: Solubility, Factors affecting, Methods for enhancement of solubility, Drug absorption. Significance in product, formulation and development. Drug absorption- Drug transport mechanisms, factors and kinetics involved -Physico- chemical and biological factors involved in Drug absorption - Formulations and dosage form considerations in drug absorption.

Drug Dissolution: Mechanisms, Factors and Kinetics of dissolution, Dissolution rate - Significance,Methods for enhancement of dissolution rate, evaluation - Official methods.

UNIT - III

Bioavailability & Bioequivalence studies: Bioavailabilty: Concept, definition, objectives of bioavailability study, Measurement of Bioavailability as per ICH Guide lines.

Bioequivalence: Concept, definitions,study designs for bioequivalence studies, Study protocol and analysis of data as per ICH Guide lines.

UNIT - IV

Stability Testing: Stability Testing Solid state drug stability, dosage form stability, accelerated stability testing, shelf life calculations, strategies for prolonging shelf life.Effect of packaging materials on dosage form stability. Basic principles of ICH, stability testing of new drug substance and formulations,

Photo Stability Testing: photostability testing and oxidative stability, role of containers in stability testing. ICH stability guidelines

UNIT - V

Specifications of QA &QC: Different test procedures and acceptance criteria for new drug substance and new drug products, sources of quality variations, control of quality variations, statistical quality control.

Good Manufacturing Practices: Layout of buildings, services, equipment and their maintenance. Material Management, Handling and Transportation. Inventory management and control, Production and planning control.Production and planning control, Industrial and personal relationship, Safety and health in Pharmaceutical Industry.

LEARNING RESOURCES

TEXT BOOKS:

Industrial pharmacy by Libermann & Lachman, 4th Edition.
The science and practice of pharmaceutical dosage forms by ME Alton 2nd Edition
BioPharmaceutics and Pharmacokinetics, D.M. Bramankar and Sunil B. Jaiswal.

REFERENCE BOOKS:

BioPharmaceutics and Pharmacokinetics, D.M. Bramankar and Sunil B. Jaiswal, 3rd Edition
Pharmaceutical Sciences by Remington's, 21st Edition
Modern pharmaceutics by Banker & Rhodes, 12th Edition.

CH 312 (C) PETROLEUM WELL LOGGING AND TECHNOLOGY

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

To understand the logging technologies.
To delineate hydrocarbons through direct and indirect means/methods.
Determination of formation lithology through logs like S.P, G.R etc. and also depositional environment with the help of Gamma rays spectroscopy and Dip-meter tools
Determination of physical properties of the subsurface, strata like resistivity, porosity, thickness etc. through tools like latero, induction, density, neutron, etc.
Hydrocarbon saturation estimation with the data acquired by the logging tools

CourseOutcomes:

Able to know various well logging methods.
Able to know resistivity logs method.
Able to know the gamma ray log and density logs methods.
Able to do cased hole logging and production logging methods.
Able to do the hydrocarbon saturation in different reservoir rocks can be calculated at the well site itself.

UNIT - I:

Direct Methods: Mud logging- coring – conventional and sidewall coring - Core analysis.Concepts of well logging: What is well logging? - Logging terminology-Borehole environment-Borehole temperature and pressure-Log header and depth scale-Major components of well logging unit and logging setup- Classification of well logging methods-Log presentation- Log quality control.

Open-hole logging: SP Logging- Origin of SP, uses of SP log-Calculation of salinity affirmation water- Shaliness-Factors influence SP log.

UNIT - II:

Resistivity log: Single point resistance log (SPR) - Conventional resistivity logs- Response of potential and gradient logs over thin and thick conductive and resistive formations-Limitations of conventional resistivity tools. Focused resistivity log- Advantages of focused resistivity tools over conventional resistivity tools.

Micro resistivity log: Conventional and focused micro resistivity logs and their application. Induction log: Principle of induction tool and the advantages. Criteria for selection of induction and lateral logging tool. Determination of true resistivity (Rt) of the formation-Resistivity index-Archie’s equation.

UNIT - III:

Gamma ray log: principle of radioactivity-Uses of gamma ray log- Determination of shaliness of formation-API counts- Calibration of Gamma ray tool-Statistical fluctuation-Time constant. Natural Spectral Gamma ray log: Principle and application. Caliper log: Principle and application of caliper tool.

Density log: Principle of density tool- Environmental corrections-Porosity determination-Tool calibration. Litho density log. Neutron log: Principle and application of neutron tool. Porosity determination. Sonic log: Principle and application of sonic log-Bore hole compensation-Determination of primary and secondary porosity, determination of mechanical properties of rock, elastic constants, fractures etc.

UNIT - IV:

Cased hole logging: Gamma ray spectral log-Neutron decay time log-Determination of fluid saturation behind casing-Cement bond log- Casing collar log-Depth control- Perforation technique- Free point locater and Plug setting-Casing inspection logs.

Production logging: Solving production problems with the help of Fluid Density log-Temperature log and Flow meter logs.

UNIT - V:

Advances in Well logging: Dip meter log-Formation tester-Cased hole resistivity logs – Nuclear magnetic resonance log & Scanner logs (Sonic scanner, MR scanner Rt scanner). Calculating the dip of the formations, collection of fluid samples from wells for confirmation of log interpretation, and also recording resistivity in cased holes.

Interpretation: Quick look interpretation- Cross plots. Neutron- Density, Sonic- Density, Sonic-Neutron cross plots-Hingle plot-Mid plot –Correlation- Hydrocarbon reserve estimate.

LEARNING RESOURCES

TEXT BOOK:

1. *Well logging and formation evaluation, Toby Darling, Elsevier, New York, 2005.*

REFERENCE BOOKS:

Hydrocarbon well logging recommended practice, Society of professional well log analysts.
Well Logging for Earth Scientists, Darwin V. Ellis, Julian M. Singer, Springer, 2007.
Well Logging Handbook, Oberto Serra, Editions Technip, 2008.
Well Logging & Reservoir Evaluation, Oberto Serra, Editions Technip, 2007.

CH 312(D): FLUIDIZATION ENGINEERING

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

The course enables the students to:

To know about various types of fluidized beds.
To understand the relation among pressure versus various parameters in fluidized bed.
To understand the theoretical models that explain the concept of bubble formation.
To know more about entrainment of particles out of fluidized bed\
To understand the circulation of solids between fluidized beds through various media.

Course Outcomes:

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

Differentiate various fluidized beds
Derive expression for the minimum fluidization and terminal velocities
Explain the concept of bubble formation and its rise in a fluidized bed.
Estimate the TDH and Entrainment rate.
To understand how the solid particles circulate through stand pipes.

UNIT – I

Introduction: Phenomena of fluidization, liquid like behavior of fluidized beds, advantages and disadvantages of fluidized beds, Application of fluidization techniques in process industries.

Fixed beds: Derivation of fixed bed pressure drop equations from fundamental characteristics- Kozeny Carman equation and Ergun's equation. Effect of particle size, sphericity, vesicularity, wall effect, surface roughness and voidage on fixed bed pressure drop.

UNIT – II

Minimum fluidization: Derivation for minimum fluidization mass velocity, pressure drop equation for minimum fluidization.

Fluidization: Types of fluidization, batch, continuous and semi fluidizations, pressure drop flow diagrams, slugging, channeling, effect of L/D,

UNIT – III

Fluid distributors, mode of fluidization, power consumption and pumping requirements.

Bubble phenomena: Single rising bubble, two dimensional Davidson model, maximum stable bubble size, criteria for the stability of the bubble, rise velocity of a gas bubble,

UNIT – IV

Bubble phenomena: Bubbling bed model for the bubble phase, Derivation of Terminal Velocity

Entrainment and Elutriation: Transport disengaging height (TDH), entrainment at or above TDH, single size of solids, entrainment below TDH, elutriation rate equation, elutriation of fines, entrainment for an infinite Free Board and small Free Board.

UNIT – V

Flow of High Bulk Density and Low Bulk Density Mixtures: Pressure drop in stick-slip flow, pressure drop in aerated flow, downward discharge from a vertical pipe, flow in a horizontal pipe.

Saltation velocity (horizontal flow), choking velocity (vertical flow), pressure drop in beds, cyclones in fluidized bed reactors, Spouted bed-Pressure drop flow diagram, minimum spouting correlation, spouting requirements

LEARNING RESOURCES

TEXT BOOK:

1. Fluidization Engineering, Kunii, Diazo and Octave Levenspiel, Wiley Eastern

REFERENCE BOOKS:

Fluidization, Max Leva, McGraw Hill

Perry's Chemical Engineers Hand Book, Perry Rober H, 8th edition, McGraw Hill(2007).

CH 354 POLLUTION CONTROL LABORATORY

Practicals : 3 periods / week *Sessional Marks : 40*

Semester End Exam Marks : 60

Semester End Exam : 3 hrs *Credits : 2*

Course Objectives:

To determine the oxygen levels, Biological oxygen demand, chemical oxygen demand in municipal ground sewage and industrial effluent waters.

To determine the dissolved suspended solids fixed and volatile solids in the give sample of water.

To determine the optimum amount of coagulant and alums required for municipal sewage and industrial affluent water.

To determine the chloride and iron contents in the given sample of water, the maximum wave length of colouring agents by using spectrophotometer

Course Outcomes:

Ability to determine the amount of oxygen and the extent of pollution of water due to organic matter

Ability to determine the extent of suspended and dissolved solid pollution in the given sample of water

Ability to predict the optimum dosage of alum and coagulant required for purification of water

Ability to determine the salt dyes and metallic components in a given sample of water.

Suspended solids in air sample using high volume sampler.

CO_2 and CO concentrations in a given sample.

SO_2 concentrations in a given sample.

Hardness

pH value

Dissolved oxygen content.

BOD

COD

Iron content in a given industrial effluent sample.

Determination of Fluoride content in a given sample.

Determination of Chloride content in a given sample.

Nitrates

Determination of optimum dose of coagulant.

Determination of MLSS and MLVSS in a given industrial effluent sample.

Noise Measurement

CH 355 CHEMICAL REACTION ENGINEERING LABORATORY

Practicals : 3 periods / week *Sessional Marks : 40*

Semester End Exam Marks : 60

Semester End Exam : 3 hrs *Credits : 2*

Course Objectives:

To provide a core foundation for the analysis and design of chemical reactors

To provide instruction in the analysis of experimental data to obtain rate equations and kinetic and thermodynamic data

To provide the information of parametric study of the various chemical reactions. To gain knowledge in the design of reactors

To give students experience with a flexible bench scale experiment that can be used to study the processes of liquefaction.

Course Outcomes:

Design ideal continuous reactors operating at isothermal conditions given kinetic data and conversion.

Solve for conversion in a non-ideal reactor given a residence time distribution

To understand how to measure reaction rates using integral and differential methods

Students are aware that materials, construction, operability, safety and ethical issues must be considered in reactor

Determination of the order of a reaction using a Batch reactor and analyzing the data by

Differential method

Integral method.

Determination of activation energy of a reaction using a batch reactor

To determine the specific reaction rate constant of a reaction of known order using a batch reactor

To determine the specific reaction rate constant of a reaction of known order using a CSTR (Continuous Stirred Tank Reactor).

To determine the order of the reaction and the rate constant using tubular reactor.

To determine the order of the reaction and the rate constant using a plug flow reactor

Langmuir adsorption isotherm. To determine the surface area of activated charcoal.

To determine the RTD and the dispersion number in a tubular reactor using a tracer

To determine the RTD and the dispersion number in a CSTR

To determine the RTD and the dispersion number in a CSTR’s in series.

To determine the RTD and the dispersion number in a combined reactor.

Mass transfer with chemical reaction (Liquid–Liquid system) to determine the mass transfer coefficient in the stirred cell

Mass transfer with chemical reaction (Solid-liquid system). To determine the mass transfer coefficient of stirred cell.

Axial mixing in a packed-bed. To determine the RTD and the dispersion number for a packed-bed using a tracer

CH 356 MASS TRANSFER OPERATIONS LABORATORY – II

Practicals : 3 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60
Semester End Exam : 3 hrs *Credits : 2*

Course Objectives:

Determines experimentally the Vapor-Liquid Equilibrium data for binary systems.
Compares theory with experiment for simple distillation and continuous rectification.
Determines the equilibrium data for Liquid-Liquid Equilibrium in ideal and ternary systems.
Compares efficiency of liquid-liquid extraction in single and multi stage operations.

Course Outcomes:

Ability to obtain experimentally the data relevant to different types of distillation.
Ability to determine experimentally the data relevant for liquid-liquid extraction.
Ability to identify solvents for leaching.
Ability to evaluate single versus multi stage operations.

To verify the Steam law and determine of vaporization efficiency for a given system using steam distillation.
To verify Rayleigh's equation for differential distillation
To determine the H.E.T.P of a given packed bed tower for two component distillation.
To determine the Vapor - Liquid Equilibrium data for a given binary system.
To determine the binodal solubility curve in the case of ternary liquid equilibrium.
To determine the liquid – liquid equilibrium data for a given insoluble liquids and a solute.
To perform leaching and determine the oil percentage in the given seeds.
To compare single stage efficiency with multi stage efficiency in liquid – liquid extraction.
Mass transfer coefficient in a single drop extraction
Freundlich's isotherm for a given system.
Multi stage distillation
Raoult's Law verification
Bubble temperature verification
Dew temperature verification
Bubble pressure verification
Dew pressure verification

IV Year I Semester

CH 401 TRANSPORT PHENOMENA

Lectures: 4 Periods / week | Sessional Marks: 40
Semester End Exam Marks : 60
Semester End Exam: 3 hrs | *Credits* : 3

Course Objectives:

To provide knowledge on mechanisms of momentum transport and velocity distributions in laminar flow.
To provide knowledge on equations of change and velocity distributions in turbulent flow.
To provide training on estimation of friction factors and mechanisms of energy transport.
To provide knowledge on temperature distribution in solids and in laminar flow.
To provide training on mechanisms of mass transport and concentration distributions.

Course Outcomes:

To develop the shell momentum balances and solve them to obtain a velocity profiles.
To develop equations of change and apply them to obtain a velocity profile.
To estimate the friction factors and understand the mechanisms of energy transport.
To develop shell energy balances and solve them to obtain a temperature profile.
To develop the shell mass balances and solve them to obtain a concentration profiles.

UNIT – I

Momentum Transport: Introduction to momentum transport, viscosity and the mechanism of momentum transport, Newton's law of viscosity, non-Newtonian fluids. Pressure and temperature dependence of viscosity of liquids and gases.

Velocity distribution in laminar flow, shell momentum balances and boundary conditions, flow of falling film, flow through circular tubes and annulus, flow of two adjacent immiscible fluids.

UNIT – II

Equations of continuity and motion: Application of Navier strokes equation and Euler equation for laminar, steady flow problems: tangential annular flow of a Newtonian fluid, shape of the surface of a rotating liquid.

Turbulent Flow: Velocity distribution in turbulent flow, fluctuations and time smoothed quantities, time smoothing of equations of change for an incompressible fluid, logarithmic distribution law for velocity distribution for tube flow (far from wall and near wall).

UNIT – III

Friction Factors & Macroscopic Balance: Friction factors for flow in tube-pressure drop calculations, friction factors for flow around spheres, packed columns, macroscopic mass, momentum and mechanical energy balances, pressure rise and friction loss in a sudden expansion.

Energy Transport: Steady state conduction, thermal conductivity, mechanism of energy transport, Fourier's law, effect of temperature and pressure on thermal conductivity.

UNIT – IV

Temperature distribution in solids and in laminar flow, shell energy balances, boundary conditions, heat conduction with electrical heat source, nuclear 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 & around submerged objects, free convection on a vertical plate and horizontal pipe.

UNIT - V

Mass Transport: 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, Equation of continuity for binary mixtures.

LEARNING RESOURCES

TEXT BOOK:

Transport Phenomena by R.B.Bird, Warrin.E, Stewat and Edwin N. Light Foot, 2nd edition, John Wiley &Sons(2007).

REFERENCE BOOKS:

Transport process and separation process principles by Christie John Geankoplis, 4th edition, PHI(2003)

Transport Phenomena, A Unified approach by Roberts, Broadkey and Harry C. Hershey, McGraw Hill.

Transport Phenomena, Chemical Processes by Sunil Kumar Thamida, Studium Press(India) Pvt.Ltd (2016)

CH 402 CHEMICAL PROCESS EQUIPMENT DESIGN

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

To select and design most suitable method of transportation of materials (solids and fluids) based economical and operational feasibilities

To Understand principle criteria involved in the design of process heat transfer equipment

To develop working knowledge on Mass transfer, chemical reaction kinetics and design various types of columns/reactors.

Learn the fundamentals of Mechanical design of process equipment

To develop working knowledge on chemical reaction kinetics and design various types of reactors.

Course Outcomes:

Able to calculate the power requirements for transport of fluids

Effectively design chemical engineering projects.

Able to design heat transfer equipment and evaporators

Analyse and design mass equipment including Packed and fluidized bed columns for separation and reactors.

Able to do Mechanical design of process equipment including Pressure, Tall and storage vessels.

UNIT – I

Materials Transfer, Handling and Treatment Equipment Design:
Power Requirements, Friction, Design calculations of Power Requirements, piping standards, Reciprocating pumps, Rotary Positive-Displacement Pumps, Centrifugal Pumps,

Air-Displacement Systems, Gas Compressors, Flow measuring Equipment-Venturi Meter, Orifice Meter and Rotameter, Design of Filters

UNIT – II

Heat transfer equipment design: Determination of heat transfer coefficients, pressure drop in heat exchangers, Selection of heat transfer equipment, Design of heat exchangers

Design of evaporators: Design of single effect and triple effect forward-feed evaporators

UNIT – III

Mass transfer equipment design: Finite-stage contactors- bubble cap tray, sieve tray and valve tray units, maximum allowable vapor velocities, plate and column efficiency, other design factors

Packed Towers: types of packing, liquid distribution, pressure drop, packing efficiencies

UNIT – IV

Reactor equipment design: Reactor principles, Design of Batch Reactors

Design of Tubular Plug Flow Reactors, Design of Back-Mix Reactors

UNIT – V

Mechanical design of process equipment: Pressure vessels – calculation of thickness of cylindrical and spherical shells subjected to internal pressure, heads or covers, Design of Tall Vessels.

Storage vessels – storage of nonvolatile liquids, storage of volatile liquids, storage of gases. Supports for vessels – bracket or lug supports, leg supports, skirt supports, saddle supports

LEARNING RESOURCES

TEXT BOOKS:

Plant Design and Economics for Chemical Engineers, Fourth Edition by Max. S. Peters. and Klaus D.Timmerhaus, McGraw Hill.

Introduction to Chemical Equipment Design, Mechanical aspects, B.C.Battacharyya, CBS Publishers and Distributors, New Delhi, (UNIT - V).

REFERENCE BOOKS:

Process Equipment Design, Joshi, M.V. and Mahajani V.V, Macmilan India Ltd.

Coulson & Richardson's Chemical Engineering, Volume:2, J.F. Richardson, J. H. Harker and J. R. Backhurst, 4th edition, Elsevier.

CH 403 MOOCS*

Elective-III

Open Elective

CE 404(A) BASIC SURVEYING

Lectures: 4 Periods / week | Sessional Marks: 40

Semester End Exam Marks : 60

Semester End Exam: 3 hours | *Credits* : 3

Course Objectives:

To study about the various surveying instruments.
To study the basics of chain survey in linear measurements.
To determine the relative positions of the existing features on the ground.
To obtain basic knowledge on Total Station.
To acquaint with procedures of leveling by dump level & auto level.

Course Outcomes:

By the end of the course surveying-I, the students will be able

To know about the various surveying instruments.
To determine the relative positions of a point on the existing ground by conducting the survey.
To use all basic surveying instruments.
To operate Total Station instrument.
To take the levels of existing ground and to determine the reduced levels.

UNIT - I

Surveying & Measurements: Definitions; Classification; Principles of Surveying; Basic measurements in surveying; Instruments used for different measurements; Units of measurement (linear & Angular); Plan and map; Scales used for Maps and plans; Phases of survey work and Duties of a surveyor. Procedures for distance measurement - Ranging, Chaining/taping a line.

UNIT - II

Chain Surveying: Principle of Chain surveying; Basic definitions; Well-Conditioned & Ill-Conditioned triangles; Selection of stations and survey lines; Procedure of Field Work in Chain Surveying; Off-sets; Booking the survey (Field Book); Conventional Symbols; Problems encountered in chaining; Obstacles in chain Surveying.

UNIT - III

Compass Surveying: Angles and Bearings; Instruments used to measure angles and bearings; Designation of Bearings; Fore and Back Bearings; Calculation of Included Angles from Bearings and Bearings from Included Angles; Prismatic & Surveyor's Compass; Magnetic Dip & Declination; Local Attraction and Corrections.

UNIT - IV

Theodolite Surveying: Types of Theodolites; Vernier Theodolite - Essential Parts; Basic definitions; Temporary adjustments; Field operations - Measurement of horizontal angles(Repetition & Reiteration), vertical angles.

Total Station: Introduction; components of Total Station; Types of Prisms and targets used in total station; various advantages of Total Stations.

UNIT - V

Simple Leveling: Basic definitions; Curvature and Refraction; Different methods of leveling; Levels - Dumpy level, Tilting level, Auto level; Leveling staff; Level field book; Booking and reducing levels; Classification of direct differential leveling methods -Fly leveling, Check leveling, Profile leveling and Cross sectioning, Reciprocal leveling and Precise leveling; Sources of errors & Difficulties in leveling.

LEARNING RESOURCES

TEXT BOOKS:

Surveying Vol. I & II by Dr. K. R. Arora,11th Edition, Standard Book House,2012.
Surveying Vol. I & II by S K Duggal, 4th Edition, McGraw Hill Education (India) Private Limited, 2013.

REFERENCE BOOKS:

Surveying Vol. I&II by B.C. Punmia, Laxmi Publications,2005.
Surveying and Levelling by N.N Basak, McGraw Hill Education (India) Private Limited,2014.
Plane Surveying by AM Chandra, 2nd Edition, New Age International (P) Ltd.,2006.

WEB REFERENCES:

http://nptel.ac.in/courses/105104101/
http://nptel.ac.in/courses/105107121/
http://nptel.ac.in/courses/105107122/

CE 404 (B) BUILDING MATERIALS & ESTIMATION

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hours *Credits : 3*

Course Objectives:

To teach the basics involved in selection of good quality building materials for construction

To give knowledge about various building elements and their specifications

Presents the basics of planning strategies, building bye laws and acoustics of building preparing tender notice and various approvals needed for a project

Valuation of building and rent fixation

Course Outcomes:

At the end of this course,

Students are familiar with various building materials

Students knows about various building elements and their specifications

Students are familiar with types of masonry works and bonds used in construction

Students are capable of understanding building plan and have knowledge about building rules, bye-laws and building elements

Students will have knowledge about Valuation of building and rent fixation

UNIT – I

Clay bricks: Brick clay, Preparation of bricks, Types of bricks, Dimensions of bricks, Weight of bricks, Storing of bricks, Brick substitutes, Classification of bricks, Tests for bricks.Timber: Classification of trees, Structure of wood, seasoning and con-version of timber, Market forms of timber, Defects of timber, Treatment of timber, Classification of timber.

Glass: Manufacture and Classification, Treatment of glass, Uses of glass, testing for quality, Characteristics and Performance of glass, Glass fibre.Plastics: Classification of plastics, Properties of plastics, Fabrication of plastic articles, some plastics in common use, Reinforced plastics.

UNIT-II

Cement: General, Manufacture of Portland cement by dry process, Approximate oxide composition limits of OPC, Bogue’s compounds, Hydration of cement, heat of hydration, structure of hydrated cement.

Types of Cements: Ordinary Portland cement, low alkali cement, Rapid hardening cement, Sulphate resisting cement, Portland blast furnace slag cement, Portland pozzolana cement, air entraining cement, white cement, hydro phobic cement, oil well cement, low heat Portland cement.

UNIT-III

Building Rules and Bye-Laws: Zoning regulations; Regulations regarding layouts or sub-divisions; Building regulations; Rules for special type of buildings; Calculation of plinth, floor and carpet area; Floor space index.

Building Elements: Conventional signs; Guidelines for staircase planning; Guidelines for selecting doors and windows; Terms used in the construction of door and window; Specifications for the drawing of door and window.

UNIT-IV

Analysis of Rates : Task or out – turn work; Labour and materials required for different works; Rates of materials and labour; Preparing analysis of rates for the following items of work: i) Concrete ii) RCC Works iii) Brick work in foundation and super structure iv) Plastering v) CC flooring vi) White washing.

PWD Accounts and Procedure of Works : Organization of Engineering department; Work charged establishment; Contract; Tender; Tender notice; Tender Schedule; Earnest money; Security money; Measurement book; Administrative approval; Technical sanction; Plinth area; Floor Area; Carpet area; Approximate Estimate; Plinth area estimate; Revised Estimate; Supplementary estimate.

UNIT –V

Valuation: Cost; Price & value; Methods of valuation; Out goings; Depreciation; Methods for Estimating cost depreciation; Valuation of building.

Miscellaneous Topics : Gross income; Net income; Scrap value; Salvage value; Obsolescence; Annuity; Capitalized value; Years purchase; Life of structures; Sinking fund; Standard rent; Process of fixing standard rent; Mortgage.

LEARNING RESOURCES:

TEXT BOOKS:

Estimating & Costing in Civil Engineering by B.N. Dutta; UBS Publishers &Distributors, 2010.
Building Materials by P.C. Vergese, 1st Edition,PHI,2009.
Building construction by P.C. Vergese, 1st Edition,PHI, 2009.

REFERENCE BOOKS:

Engineering Materials by Rangawala, Charotar Publications, Fortieth Edition: 2013
Building construction by BC Punmia et al., 10th Edition, Laxmi Publications, 2008.
Building planning, designing and scheduling by Gurucharan Singh, Standard book House, 2006.

WEB REFERENCES:

http://nptel.iitm.ac.in/courses.php
http://freevideolectures.com/Course/86/Building-Materials-and-Construction
http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv053-Page1.htm
http://bookmoving.com/register.php?ref=Building%20materials%20rangwala
http://bookmoving.com/book/building-materials_654.html

CS 404 (A) JAVA PROGRAMMING

Lectures: 4 Periods / week *Sessional Marks: 40*
Semester End Exam Marks : 60
Semester End Exam: 3 hours *Credits : 3*

Course Objectives:

Understand the basic concepts and fundamentals of platform independent object oriented language.
Demonstrate skills in writing programs using exception handling techniques and multithreading.
Understand streams and efficient user interface design techniques.

Course Outcomes:

Use the syntax and semantics of java programming language and basic concepts of OOP.
Develop reusable programs using the concepts of inheritance, polymorphism, interfaces and packages.
Apply the concepts of Multithreading and Exception handling to develop efficient and error free codes.
Demonstrate how the java program communicates with the console and disk files using the concept of streams.
Design event driven GUI and web related applications which mimic the real word scenarios.

UNIT-I

Introduction: The History and Evolution of Java, an Overview of Java.Data Types, Variables, and Arrays: The primitive types, variables, type conversion and casting, Automatic Type Promotion in Expressions, Arrays, Operators, Control statements.

Introducing Classes : Class fundamentals, Declaring the objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this keyword, Garbage Collection, the finalize() Method.A Closer Look at Methods and Classes: Overloading Methods, Using objects as Parameters, Returning Objects, Introducing Access control, Understanding static and final keywords, Nested and Inner Classes.

UNIT-II

Inheritance: Inheritance Basics, Using super, Creating multilevel Hierarchy, When Constructors are executed, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, using final with Inheritance.

Packages and Interfaces: Packages, Access Protection, Importing Packages, Interfaces, Default Interface Methods, Use static Methods in an Interface.

UNIT-III

String Handling: String class, String Buffer class.Exception Handling: Fundamentals, Exception types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java’s Built-in Exceptions , Creating Your Own Exception Subclasses.

Multithreaded Programming : The Java Threaded Model, The Main Thread , Creating a Thread, Creating Multiple Threads, Using is Alive() and join(), Thread Priorities, Synchronization, Inter Thread Communication.

UNIT-IV

I/O Basics: Streams, Byte streams, Character streams, Reading Console Input, Writing Console Output, Reading and Writing Files.

The Applet Class: Applet Basics, Applet Architecture, An Applet Skeleton, Simple Applet Display Methods, Requesting Repainting, The HTML APPLET Tag, Passing Parameters to Applets.

UNIT-V

Event Handling: Two Event Handling Mechanisms, The Delegation Event Model, Event Classes, The KeyEvent Class, Sources of Events, Event Listener Interfaces, Using The Delegation Event Model, Adapter Classes.

Introducing the AWT: Working with Windows, Graphics and Text, Using AWT Controls, Layout Managers and Menus.

LEARNING RESOURCES:

TEXT BOOKS:

Java The Complete Reference 9th Edition, Herbert Schildt, Mc Graw Hill Education(India) Private Limited, New Delhi.

REFERENCE BOOKS:

Java How to Program, Sixth Edition, H.M.Dietel and P.J.Dietel, Pearson Education/PHI.
Introduction to Java programming, By Y.Daniel Liang,Pearson Publication.

CS 404(B) DATABASE MANAGEMENT SYSTEMS

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hours *Credits : 3*

Course Objectives:

To understand the fundamental concepts, historical perspectives, current trends, structures, operations and functions of different components of Databases.

To understand the types of integrity constraints in a relational database system and the concepts of SQL to create and access the database.

To understand basic concepts of ER model and database design using normalization process.

To understand concurrency, Recovery techniques.

Course Outcomes:

An understanding of basic concepts and use of various database systems.

An ability to enforce integrity constraints to maintain validity & accuracy.

An ability to write relational expressions for the queries.

An ability to design and develop a database using normalization theory.

An ability to use different concurrency control and Recovery techniques.

UNIT- I

Databases and Database Users: Introduction - An Example - Characteristics of the Database Approach - Actors on the Scene - Workers behind the Scene - Advantages of Using the DBMS Approach.

Database System Concepts and Architecture: Data Models, Schemas, and Instances - Three-Schema Architecture and Data Independence - Database Languages and Interfaces - The Database System Environment - Centralized and Client/Server Architectures for DBMSs

UNIT- II

Data Modeling Using the Entity-Relationship (ER) Model: Using High- Level Conceptual Data Models for Database Design - An Example Database Application - Entity Types, Entity Sets, Attributes, and Keys - Relationship Types, Relationship Sets, Roles, and Structural Constraints - Weak Entity Types

The Relational Data Model and Relational Database Constraints: Relational Model Concepts - Relational Model Constraints and Relational Database Schemas - Update Operations, Transactions, and Dealing with Constraint Violations.

UNIT-III

SQL-99: Schema Definition, Constraints, Queries, and Views: SQL Data Definition and Data Types - Specifying Constraints in SQL - Schema Change Statements in SQL.

Basic Queries in SQL – More Complex SQL Queries - INSERT, DELETE, and UPDATE Statements in SQL - Views (Virtual Tables) in SQL.

UNIT- IV

Functional Dependencies and Normalization for Relational Databases: Informal Design Guidelines for Relation Schemas - Functional Dependencies - Normal Forms Based on Primary Keys - General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form.

Introduction to Transaction Processing Concepts and Theory: Introduction to Transaction Processing - Transaction and System Concepts - Desirable Properties of Transactions – Characterizing Schedules Based on Recoverability -Characterizing Schedules Based on serializability.

UNIT – V

Concurrency Control Techniques: Two-Phase Locking Techniques for Concurrency Control - Concurrency Control Based on Timestamp Ordering.

Database Recovery Techniques: Recovery Concepts – Recovery Techniques Based on Deferred Update - Recovery Techniques Based on Immediate Update - Shadow Paging.

LEARNING RESOURCES:

TEXT BOOK:

Fundamentals of Database Systems, Ramez Elmasri and ShamKanth B.Navate Pearson Education, 5th edition.

REFERENCE BOOKS:

Introduction to Database Systems, C.J.Date Pearson Education.

Data Base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill, 3rd Edition.

Data base System Concepts, Abraham Silberschatz, Henry.F.Korth, McGraw hill, 5th edition.

EC 404(A) APPLIED ELECTRONICS

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hours *Credits : 3*

COURSE OBJECTIVES:

To understand about various modern electronic systems.
To provide clear explanation of the operation of all the important electronic devices and systems available.
To know about modern audio and video systems.
To know about various Telecommunication Systems.

COURSE OUTCOMES:

Able to understand the working, types and applications of microphones and loudspeakers.
Able to understand the features of commercial, theatre sound recording and colour TV standards
Able to understand the working of various electronic systems, telecommunication and switching systems.
Able to understand the working of various applications like digital clocks, fiber optics, microprocessor and mobile radio systems.
Able to understand consumer electronic equipment and systems like washing machines

UNIT -I

Microphones: Characteristics of microphones, Types: Carbon microphones, moving coil microphones, ribbon microphones, electret microphones and wireless microphones.Headphones: Headphones and Headsets, Types of headphones.

Loud Speakers: Ideal loudspeaker, Types: Crystal loudspeaker, electrostatic loudspeaker, permanent magnet loudspeaker, High frequency loudspeakers: Horn type tweeters,
Equalizers and Mixers.

UNIT -II

Commercial Sound: Recording, manual synthesizer, programmed synthesizer, public address systems, speaker matching systems, PA-system characteristics. Theatre Sound System,

Color TV standards and Systems: Primary and secondary colors, Luminance signal, Chrominance signal, color TV camera tube, color TV picture tube, NTSC system PAL system SECAM system.

UNIT - III

Audio systems, Video Systems, Remote Controls, Modulation Techniques, Carrier Systems, Telecommunication Systems: telephone receivers and handsets, signalling-CCITT NO7, modes of operation, Switching Systems: principle,Read relay and cross bar switching, PBX switching, stored program control.

UNIT - IV

Fiber Optics, Data Services, digital clocks, microprocessor, microcontroller, Mobile radio systems: wireless local loop (WLL), role of WLL, radio paging service, digital cellular block diagram, establishing a call, Fascimile (FAX).

UNIT - V

IN-CAR Computers: Electronic ignition, electronic ignition lock system, ABS, Electronically controlled suspension (ECS), instrument pannel display, air-bag system.

Washing machines: Electronic controller for washing machine, washing machine hardware, washing cycle, software and hardware development, refrigeration systems.

LEARNING RESOURCES:

TEXT BOOK:

S.P.Bali-Consumer Electronics-Pearson Education, ISBN: 9788131717592, first impression-2008.

REFERENCE BOOKS:

Philip Herbert Hoff -Consumer Electronics for Engineers -Cambridge University Press (July 28, 1998),ISBN-10: 0521582075

Ronald K.Jurgen -Digital Consumer Electronics Handbook -(Editor) by McGraw Hill Professional Publishing, 1997. ISBN-10: 0070341435

WEB RESOURCES:

http://www.newagepublishers.com/samplechapter/000969.pdf

http://www.bits-pilani.ac.in:12354/qp1-9-10/EEE_C414_851_C_2009_1.pdf

http://nptel.iitm.ac.in

EC404 (B) BASIC COMMUNICATION

Lectures: 4 Periods / week | Sessional Marks: 40

Semester End Exam Marks : 60

Semester End Exam: 3 hours | *Credits* : 3

COURSE OBJECTIVES:

To understand an overview of communication systems.
To understand the modulation technique, need of modulation, Amplitude modulation.
To understand fundamentals of digital communications
To understand broadband communication systems and Television fundamentals.

COURSE OUTCOMES:

Able to understand transmission of analog signals using amplitude modulation.
Able to understand transmission of digital signals through PCM, PAM, PPM and DELTA Modulation techniques
Able to know about various Broad band communication systems.
Able to know about the monochrome and colour Television fundamentals.
Able to know about Optical communication systems.

UNIT - I

Communications: Communications systems, Information, Transmitter, Channel, noise, Receiver, Modulation, Description, Need for modulation, Bandwidth Requirements. Amplitude Modulation: Amplitude Modulation Theory, Frequency spectrum of the AM wave, Representation of AM, Power relations in the AM wave, Generation of AM, Basic requirements, comparison of levels, Grid modulated class C amplifier, Plat modulated class C amplifier, Modulated transistor amplifiers.

UNIT - II

DIGITAL COMMUNICATIONS

Digital Communications: Digital Technology, Digital fundamentals, sampling theorem, aliasing effect, pulse amplitude modulation (PAM), synchronization in PAM systems, pulse time modulation, spectra of PDM and PPM systems, Elements of pulse code modulation (PCM), sampling and quantization, encoding, regeneration, decoding, DPCM, delta modulation.

UNIT - III

Broadband Communications Systems: Multiplexing, Frequency division multiplex, Time – division multiplex, Short and Medium Haul Systems: Co-axial Cables, Fiber optic links, Microwave links, Long Haul Systems: Satellite Communications, Elements of Long-Distance Telephony, Routing codes and signalling systems, Telephone exchanges (switches) and routing.

UNIT - IV

FUNDAMENTALS OF TELEVISION

Television Fundamentals: TV transmitter and receivers, synchronization, image continuity, interlaced scanning, flicker, picture resolution, horizontal and vertical sync details, number of scanning lines, scanning sequence details.

Essentials of colour television: colour perception, three colour theory, luminance, hue, saturation, colour difference signals.

UNIT - V

OPTICAL COMMUNICATIONS

History and development, nature of light: reflection, refraction, dispersion, diffraction, absorption, scattering, Optical fiber losses, fiber cables, types of fibers.

LEARNING RESOURCES:

TEXT BOOKS:

George Kennedy-Electronic Communication Systems -Tata McGraw-Hill Publishing , 5th Edition,2011 (Unit -1,3, 5)

Simon HykinS, Communication Systems, 2nd Edition-reprint 2010. (Unit -2)

R.R. Gulati -Modern Television Practice – Principles, Technology and Service- New Age International Publication, 2009.(Unit - 4)

REFERENCE BOOKS:

Simon HykinS-Introduction to Analog and Digital Communication. 2007

John M Senior – Optical Fiber Communications – An imprint of Pearson Education- 3rd Edition- 2009.

WEB RESOURCES:

http://web.engr.oregonstate.edu/~magana/ECE461-561/index.htm

http://www.ensc.sfu.ca/~jiel/courses/327/index.html

http://www.ece.utah.edu/~npatwari/ece5520/lectureAll.pdf

http://nptel.iitm.ac.in/syllabus/syllabus.php?subjectId=117105077

EE 404(A)NON-CONVENTIONAL ENERGY SOURCES

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hours *Credits : 3*

Course Objectives:

To know the depletion rate of conventional energy resources and importance of renewable energy resources.

To know the importance of Energy Storage Devices.

To know alternate viable energy sources to meet the energy requirements.

To discuss about solar energy, wind energy, tidal energy and geothermal energy as alternate resources.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

Know the national scene of energy production, utilization, consumption and energy storage systems.

Understand about the basics of solar energy, collectors & generation of electricity from solar energy &photovoltaic's.

Understand the assessment of wind energy potential, wind turbines and wind generators.

Know about ocean energy, temperature differences & principles, extraction of energy from waves.

Understand about geothermal, types & how biogas is produced & digester for power generation.

UNIT - I

Principle of Renewable Energy: Comparison of renewable and conventional energy sources - Ultimate energy sources - natural energy currents on earth - primary supply to end use - Spaghetti & Pie diagrams - energy planning - energy efficiency and management.

Energy Storage Systems: Pumped Hydro- Compressed air storage-Energy storage by fly wheels-Electrical battery storage-Thermal sensible energy storage-Latent heat energy storage.

UNIT – II

Solar Energy: Extra terrestrial solar radiation - terrestrial solar radiation - solar thermal conversion-solar thermal central receiver systems, Solar pond, Distributed systems.

Photovoltaic's: Photovoltaic energy conversion - solar cell- Construction- conversion efficiency & output-VI characteristics.

UNIT – III

Wind energy: Planetary and local winds - vertical axis and horizontal axis wind mills.

Principles of wind power: maximum power – actual power - wind turbine operation - electrical generator.

UNIT – IV

Energy from Oceans: Ocean temperature differences - principles of OTEC plant operations.

Wave energy: devices for energy extraction - tides - simple single pool tidal system, two pool tidal system.

UNIT-V

Geothermal Energy: Origin and types: Hydrothermal, Geo-pressurized & Petro thermal.

Bio fuels: Classification – direct combustion for heat and electricity generator - anaerobic digestion for biogas - biogas digester - power generation.

LEARNING RESOURCES

TEXT BOOKS

JohnTwidell& Toney Weir, Renewable Energy Sources, E&F.N. Spon. (Unit – 1,5)
EL-Wakil, Power Plant Technology, McGraw-Hill Publications. (Unit – 2,3)
G.D.Rai, Non-Conventional Energy Sources, Khanna Publishers.(Unit – 4,5)

REFERENCE BOOKS

Abbasi & Abbasi, Renewable Energy Sources Their impact on global warming and pollution by –PHI.

WEB REFERENCES:

http://www.tn.gov.in/spc/tenthplan/CH_11_2.PD
http://bieap.gov.in/Nonconventionalenergysources
http://www.em-ea.org/Guide%20Books/book4/4.12App%20of%20Non%20conventional

EE 404(B) UTILIZATION OF ELECTRICAL ENERGY

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hours *Credits : 3*

Course Objectives:

To know about the different types of lamps & lighting schemes.
To know about the different types electric heating methods.
To know the design heating elements such as furnaces and ovens.
To know to utilize the electrical energy for production of heat and welding process.
To provide specific knowledge on Principles and characteristics of storage batteries.

Course Outcomes:

Upon successful completion of the course, the student will be able:

To give the overall idea for the different types of lamps & lighting schemes.
To know about the different types electric heating methods.
To know the designing of heat elements such as furnaces and ovens.
To know how to utilize the electrical energy for production of heat and welding process.
To gain knowledge on principles and characteristics of storage batteries.

UNIT – I

Illumination:
Introduction- terms used in illumination-laws of illumination-Square law methods of calculation.

Gas discharge lamps - Fluorescent lamps - Arc lamps - Filament lamps -Comparison between filament and fluorescent lamps.

UNIT – II

Lighting schemes & Introduction to Electric heating:
Factory lighting - flood lighting and street lighting-design of lighting schemes-introduction to Compact Fluorescent Lamps.

Introduction-Modes of heat transfer - Stefan's law-Classification of electric heating methods

UNIT – III

Electric Heating element Design and types of furnaces:
Design of heating element -Construction and working of different types of induction furnaces -resistance furnace - arc furnaces.

Dielectric heating, Dipole formation, generation of dielectric heat and applications.

UNIT – IV

Welding: Introduction- Types of welding - resistance and arc welding -Characteristics of Carbon and metallic arc welding – comparison, welding equipment.

Requirements of good weld, comparisons of A.C and D.C weld(Excluding electronic controls)

UNIT - V Storage

batteries:

Types of cells. Lead acid cell, Nickel Iron cell, Chemical changes during charging and discharging. Applications-rating-classification-dry cell and wet cells.

Methods of charging & common troubles: Charging and discharging of lead acid cells,-methods of charging lead acid batteries-over discharging common troubles with lead acid batteries and remedies-Nickel cadmium batteries.

LEARNING RESOURCES:

TEXT BOOKS:

J.B. Gupta, Utilization Electric Power and Electric Traction, Katson books publishers, Tenth Edition, 2012. (Unit-1,2,3,4)

Utilization, generation & conservation of electrical energy by Sunil S Rao, Khanna publishers, Sixth Edition, 2005. (Unit-5)

REFERENCE BOOKS:

Partab H, Art and Science of Utilization of Electrical Energy, Dhanpat Rai and Sons, New Delhi, Second Edition,2009.

R.K.Rajput, Utilization of Electric Power, Laxmi publications Private Limited, Second Edition, 2013.

G.C.Garg –Utilization of Electric Power and Traction, Kanna publishers, Ninth Edition, 2014.

WEB RESOURCES:

http://nptel.iitm.ac.in/video.php?subjectId=108105060.
http://web.mit.edu/lien hard/www/ahttv201.pdf..
http://www.comp-as.com/pdf/Article03.pdf.
www.srmuniv.ac.in/downloads/welding.doc.
http://www.freesunpower.com/batteries.php.
http://www.trifield.com/content/fixing-common-static-problems/

IT 404(A)SOFTWARE ENGINEERING

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hours *Credits : 3*

Course Objectives

At the end of the course the students will understand

Basic concepts on Software Engineering methods and practices.
Software Process Models and Software Development Life Cycle.
Requirements analysis and design of software development.
Software Development life cycle for Web app.

Course Outcomes

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

Identify, formulate, and solve Software Engineering problems.
Elicit, analyze and specify software requirements for various stakeholders.
Familiar with Design, development, deployment and maintenance of a software project.
Familiar with Architecture design and User Interface design
Apply software engineering paradigms to web apps.

UNIT-I

Introduction to Software Engineering: The Evolving Role of Software, Software, the Changing Nature of Software, Legacy Software, Software Myths.

A Generic View of Process: Software Engineering - A Layered Technology, A Process Framework, The CMMI, Personal and Team Process Models.

UNIT-II

Process Models: The Waterfall Model, Incremental Process Models, Evolutionary, Agile Process Model.

Software Engineering Practice: Software Engineering Practice, Communication Practices, Planning Practices, Modeling Practices, Construction Practice, Deployment.

UNIT -III

Requirements Engineering: A Bridge To Design and Construction, Requirements Engineering Tasks, Initiating the Requirements Engineering Process, Eliciting Requirements, Developing Use-cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

Design Engineering: Design within the Context of Software Engineering, Design Process and Design Quality, Design Concepts, The Design Model.

UNIT -IV

Creating An Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design.

Performing User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT -V

Initiating A Webapp Project: Formulating Web-Based systems, Planning for Web Engineering projects

Analysis For Webapps: Requirements Analysis for WebApps, Analysis Model for WebApps, The Content Model, The Interaction Model.

LEARNING RESOURCES:

TEXTBOOKS:

Roger S.Pressman, Software Engineering- A Practitioner's Approach, 6th Edition, McGraw- Hill International, 2009.

REFERENCE BOOKS:

Ian Sommerville, Software Engineering, 6th Edition, Pearson Education, 2014.
Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd Edition, PHI,2002.
RajibMall, Fundamentals of Software Engineering, 3rd Edition, PHI, 2013.

IT 404(B) WEB TECHNOLOGIES

Lectures: 4 Periods / week | Sessional Marks: 40

Semester End Exam Marks : 60

Semester End Exam: 3 hours | *Credits* : 3

Course Objectives

At the end of the course the students will understand

Basic technologies to develop web documents.
Design web pages with css and apply scripting to web documents.
Design dynamic web pages with javascript.
Concepts of xml.
Concepts of php and database access.

Course Outcomes

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

Apply technologies to develop web documents.
Design web pages with css and apply scripting to web documents.
Create dynamic web pages with javascript.
Create valid and well-formed xml documents.
Write server side scripts with php and database access.

UNIT – I

Fundamentals: A Brief introduction to the Internet, The World Wide Web, Web Browsers, Web Servers, Uniform Resource Locators, Multipurpose Internet Mail Extensions, The HTTP.

Introduction to XHTML: Origins and evolution of HTML, and XHTML,Basic Syntax, Standard XHTML, Document structures, Basic Text markup, images, hypertext links, lists, tables, forms, frames, syntactic differences between HTML & XHTML.

UNIT – II

Cascading Style Sheets (CSS): introduction, levels of style sheets, style specification formats, selector forms, property value forms, font properties, list properties, color, alignment text, The Box model, Background images, the span and div tags.

The Basics of JavaScript: Overview of JavaScript, Object orientation and JavaScript, General Syntactic characteristics, primitives, operations and expressions, Screen output and keyboard input, control statements.

UNIT – III

JavaScript: Object creation and modification, Arrays, Functions, An Example, Constructors, Pattern matching using regular expressions, Errors in scripts.

JavaScript and HTML Documents: The JavaScript Execution Environment, The Document Object Model, Element accessing in JavaScript, Events and Event Handling, Handling Events from Body elements, Handling events from Button elements, Handling Events from Text boxes and password elements, The DOM 2 Event model, The Navigator object.

UNIT – IV

Dynamic Documents with JavaScript: Introduction, Element Passing,Moving Elements, Element Visibility, Changing colors and Fonts, Dynamic Content, Stacking Elements, Locating the mouse cursor, Reacting to mouse click, slow movement of elements, dragging and dropping elements.

Introduction to XML: Introduction, The syntax of XML, XML document structure, Document Type Definition, Namespaces, XML Schemas, Displaying Raw XML documents, displaying XML documents with CSS, XSLT Style sheets.

UNIT-V

Introduction To PHP: Origins and uses of PHP, Overview of PHP, General Syntactic Characteristics, primitives, Operations and Expressions, Output, Control Statements, Arrays, Functions, Pattern Matching, Form Handling.

Database Access through the web: Relational Databases, An Introduction to the Structured Query Language, The MYSQL Database System, Database Access with PHP and MYSQL.

LEARNING RESOURCES:

TEXT BOOK:

1. Robert W. Sebesta, Programming the World Wide Web, 4/e Pearson Education.

REFERENCE BOOKS:

Harvey M. Deitel and Paul J. Deitel, Internet & World Wide Web How to Program, 5/e, Pearson Education.

Jeffrey C. Jackson Web Technologies - A Computer Science Perspective, Pearson Education, 1st Edition.

Jason Cranford Teague, Visual Quick Start Guide CSS, DHTML & AJAX, Pearson Education, 4th Edition.

WEB REFERENCES:

www.wikipedia.com
www.w3schools.com
http://nptel.iitm.ac.in

ME404(A) ROBOTICS

Lectures: 4 Periods / week | Sessional Marks: 40

Semester End Exam Marks : 60

Semester End Exam: 3 hours | *Credits* : 3

Course Objectives:

To provide an introduction to Robotics and Automation including robot classification, design and selection, analysis and applications in industry.

To provide information on various types of end effectors, their design, interfacing and selection.

To provide the details of operations for a variety of sensory devices that are used on robot, the meaning of sensing, classification of sensor, that measure position, velocity & acceleration of robot joint.

The goal of the course is to familiarize the students with the basic concepts of transformations performed by robot.

Familiarize students to perform kinematics and to gain knowledge on programming of robots.

Course Outcomes:

At the end of the course, students will be familiarized in basic components of robotics, classification of robots and their applications.

They will have knowledge on types of robot grippers, their usage and design considerations.

They attain knowledge on various types of sensory devices their working and applications.

Students will apply basic transformations related to the movement of manipulator.

An ability to design a robot mechanism to meet kinematics requirements and to write simple programs.

UNIT - I

Basics of Robot: Introduction to Robotics, major component of a robot, robotic like devices, classification of robots - Classification by coordinate system and by control method, Specifications of robots, fixed versus flexible automation.

Applications of robot: Economic analysis, Robot applications in Material Handling, Processing and assembly.

UNIT - II

Robot End Effectors: Introduction, end effectors, interfacing, types of end effectors, grippers and tools.

Selection: Selection and Design Considerations of End effectors, Remote Centre Compliance device.

UNIT - III

Robotic Sensory Devices:
Position Sensors: Objective, Non-optical position sensors - potentiometers, synchros, inductocyn, optical position sensors – opto interrupters, optical encoders (absolute & incremental).

Proximity Sensors: Contact type, non-contact type – inductive, capacitive proximity sensors, optical proximity sensor, and scanning laser proximity sensor.

UNIT - IV

Touch and Slip Sensors: Proximity rod & photo detector tactile sensor, slip sensors - Forced oscillation slip sensor, interrupted type slip sensors.

Transformations: Objectives, homogenous coordinates, basic transformation operations, fixed angle representation, Euler angle representation.

UNIT - V

Forward Kinematics: Forward solution – Denavit Hartenberg procedure.Simple problems involving 2 and 3 DOF manipulators, SCARA manipulator.

Robot Programming: Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs.

LEARNING RESOURCES

TEXT BOOKS:

Robotic Engineering by Richard D.Klafter, Prentice-Hall of India Pvt Ltd, 2010.
Industrial Robotics by Mikell P. Groover, Tata McGraw-Hill Int. Edition 2, 2012.
Robotics and Control, R.K. Mittal and I.J. Nagarath, TMH, 2005[4 UNIT- 1st chapter].

REFERENCE BOOKS:

Introduction to Robotics: Mechanics And Control, John J.Craig 3rd Edition, Pearson, 2008.
Robotics: Control, Sensing, Vision, and Intelligence, K. S. Fu, R. C. Gonzales, and C. S. G. Lee, Tata McGraw-Hill, NY, 2008.
Introduction to Robotics: Analysis, Systems, Applications, Saeed B. Niku, Prentice Hall, NJ, 2010.

WEB REFERENCES:

http://nptel.iitm.ac.in/courses.php?branch=Mechanical
http://academicearth.org/courses/introduction-to-roboticsVideo references.

ME 404(B) OPERATIONS RESEARCH

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hours *Credits : 3*

Course Objectives:

Grasp the methodology of OR problem solving and formulate linear programming problem.
Develop formulation skills in transportation models and finding solutions
Understand the basics in the field of game theory and assignment problems
Be able to know how project management techniques help in planning and scheduling a project.
Be able to know the basics of dynamic programming and simulation.

Course Outcomes:

Recognize the importance and value of Operations Research and linear programming in solving practical problems in industry
Interpret the transportation models' solutions and infer solutions to the real-world problems.
Recognize and solve game theory and assignment problems.
Gain knowledge of drawing project networks for quantitative analysis of projects
Know when simulation and dynamic programming can be applied in real world problems.

UNIT - I

Linear Programming : Definition and Scope of Operations Research, Mathematical formulation of the problem, graphical method, Simplex method, artificial basis technique, dual Simplex method. Degeneracy, alternative optima, unbounded solution, infeasible solution.

UNIT - II

Transportation Problem: Introduction to the problem, LP formulation of a transportation problem. Basic feasible solution by north-west corner method, Vogel's approximation method, least cost method. Finding optimal solution by MODI method, degeneracy, unbalanced transportation problem and Maximization in transportation model.

UNIT - III

Assignment Problem: One to one assignment problem, optimal solutions, unbalanced assignment matrix, travelling sales man problem, maximization in A.P.

Theory of Games: Introduction, rectangular two person zero sum games, solution of rectangular games in terms of mixed strategies, solution of 2x2 games without saddle point, concept of dominance to reduce the given matrix, Graphical method for 2xn and nx2 games.

UNIT - IV

Project Planning through Networks: Introduction, Basic steps in PERT/CPM techniques, Network diagram representation, Rules of drawing network diagram, Fulkerson's rule, Time estimates and Critical path in network analysis, floats, Project evaluation and review technique, Application areas of PERT/CPM techniques.

UNIT - V

Dynamic Programming: Introduction, Characteristics of D.P. model, the recursive equation approach, Computational Procedure in dynamic Programming, solution of an L.P. by D.P

Simulation: Introduction, Monte-Carlo Simulation, Application to Inventory Control, Application to Queuing Problems

LEARNING RESOURCES

TEXT BOOKS:

Operations Research - S.D. Sharma, Kedarnath Ramnath & Co, 2008.
Operations Research - Theory and Applications,J.K Sharma, Macmillan Publications India Ltd, 2013

REFERENCEBOOKS

Operations Research - H.A. Taha , Pearson , 7th Edition, June 2002.
Introduction to Operations Research - Hiller and Liberman, MGH, 7th Edition, 2002.

WEB REFERENCES:

http://www2.informs.org/Resources
http://www.mit.edu/~orc
http://www.ieor.columbia.edu
http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm
http://www.wolfram.com/solutions/OperationsResearch

CH 405: PROCESS MODELLING AND SIMULATION

Lectures: 4 Periods / week | Sessional Marks: 40
Semester End Exam Marks : 60
Semester End Exam: 3 hrs | *Credits* : 3

Course Objectives:

To understand cause-effect relationships of processes of chemical industry.
To understand the fundamental relationships of mass, heat and momentum transfer interaction in chemical processes.
To provide the knowledge to develop mathematical models for batch reactors, Flash drum, and ideal binary distillation columns.
To provide an overview of numerical methods used for computer simulation.
To provide an overview of computer simulation.

Course Outcomes:

To analyze processes in terms of their fundamental transport rates and thermodynamic equilibria.
To develop mass and energy balance equations for continuous stirred tank reactors, two heated tanks and gas phase pressurised CSTR.
To develop mathematical models for batch reactor, flash drum and ideal binary distillation columns.
To use the appropriate numerical methods to solve the non linear algebraic, ordinary and partial differential equations.
To develop simulation algorithms for various chemical engineering systems.

UNIT – I

Mathematical models for chemical engineering systems: Introduction, Use of mathematical models, Principles of formulation, Fundamental laws, Continuity equation and Energy equation.

Equations of motion, Transport equations, Equations of state, Equilibrium, Chemical kinetics.

UNIT – II

Examples of mathematical models of chemical engineering systems: Introduction, Series of isothermal, constant hold up CSTRs.CSTRs with variable hold-ups.

Two heated tanks, Gas phase pressurized CSTR,Non-isothermal CSTR.

UNIT – III

Modeling of Single component vaporizer, Multicomponent flash drum, pH systems.

Modeling of Batch reactor, Reactor with mass transfer, Ideal binary distillation and Batch distillation with holdup.

UNIT – IV

Methods for solving non-linear equations: Interval Halving method, Newton-Raphson method, False Position method, Wegstein method. Numerical integration of ordinary differential equations: Euler Algorithm and Runge-Kutta (Fourth-Order) methods.

General Concepts of Simulation for Process Design: Introduction, modular approaches to process simulation- sequential modular approach, simultaneous modular approach, equation solving approach, tearing. (Text Book 2)

UNIT – V

Simulation examples: Gravity flow tank, Three CSTRs in series with constant hold-up, Three CSTRs in series with variable hold-up.

Simulation of Non-isothermal CSTR, Batch reactor and Binary distillation column.

LEARNING RESOURCES

TEXT BOOK:

Process Modeling Simulation and Control for Chemical Engineers by W.L.Luyben, 2nd edition, McGraw Hill (1990).

Chemical Process Computations by Raghu Raman, Elsevier Applied Science

REFERENCE BOOKS:

Process Modeling and Simulation by R.W.Gaikwad and Dr. Dhirendra, 2nd edition, Central Techno Publications (2006).

Chemical Process Modeling and Computer Simulation, Amiya K. Jana, 2nd edition,PHI(2011).

Computational methods for process simulation by W. F. Ramirez, 2nd edition, Betterworthus series in Chemical Engineering(1998).

Elective-IV

CH 406(A): COMPUTER AIDED PROCESS ENGINEERING

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

1 The main objective of the Chapter deals with the formulation development, Manufacturing used and evaluation of solid Dosage forms.

The Scope and objective of the chapter deals with the formulation development, manufacturing used and evaluation of monophasic & bi Phasic liquid dosage forms.

The Scope and objective of the chapter deals with the formulation aspects, production facilities required, manufacturing of sterile products.

The Scope and objective of the chapter deals with the formulation aspects, manufacturing and evaluation of semisolid preparations.

The Scope and objective of the chapter deals with the formulation aspects, Types of propellants, manufacturing and evaluation of aerosols

Course outcomes:

Upon completion of the unit the student shall be able to understand the principle involved in formulation of solid dosage forms, Preparation and Evaluation of Tablets and Capsules.

Upon completion of the unit the student shall be able to understand the principle involved in formulation of, preparation and evaluation of solutions, suspensions and emulsions.

Upon completion of the unit the student shall be able to understand the formulation aspects, production facilities required, manufacturing and evaluation of sterile products

Upon completion of the unit the student shall be able to understand the manufacturing and evaluation of semisolid preparations.

Upon completion of the unit the student shall be able to understand the manufacturing and evaluation of semisolid preparations.

UNIT I

Tablets: Definition, Advantages, Disadvantages, Types of tablets, Formulation requirements, Formulation, Manufacturing, Equipments used and quality control tests of tablets.

Capsules: Definition, Advantages, Disadvantages, Formulation, Manufacturing, Equipments used and quality control tests of Hard & Soft gelatin capsules..

UNIT II

Monophasic Liquid Dosage forms: Formulation, Manufacturing equipment used and evaluation of solutions.

Biphasic Liquid Dosage forms: Formulation, Manufacturing equipment used and evaluation of Suspensions and emulsions.

UNIT III

Parenterals: Definition, Formulation aspects, production facilities, layout, manufacturing and quality control of parenterals.

Ophthalmic preparations: Definition, types, ideal requirements, formulations aspects of eye drops & Eye Lotions.

UNIT IV

Ointments, Creams and Pastes: Definition, Types of bases used, formulation, manufacturing process, equipment used and evaluation of Ointments, Creams and Pastes.

Jellies: Definition, formulation requirement manufacturing process and equipment for Jellies.

UNIT V

Pharmaceutical Aerosols: study of the Propellants, principles, formulation, manufacturing process and filling equipments and evaluation for Aerosols.

Pilot plant scale-up techniques used in pharmaceutical manufacturing: Pilot plant: Technology transfer from R&D to pilot plant to pilot scale considerations of steps involved with manufacture (design, facility, equipment selection) of tablets, capsules, suspensions, emulsions & semisolids

LEARNING RESOURCES

TEXT BOOKS:

Industrial pharmacy by Libermann & Lachman, 4th Edition.
The science and practice of pharmaceutical dosage forms by ME Alton 2nd Edition

REFERENCE BOOKS:

Pharmaceutical Sciences by Remington's, 21st Edition.
Modern pharmaceutics by Banker & Rhodes, 12th Edition

CH 406 (B) INDUSTRIAL PHARMACY

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

Able to Understand an industrial pharmacist position with a pharmaceutical company to conduct research and develop drugs by using knowledge of biomedical sciences

Able to understand collaborating with health care professionals.

Develop the student's ability to determine the drug delivery designs for the future and the ability to meet these needs.

Provide a focus on industrial pharmacy and drug dosage design that will provide a competitive edge in the pharmaceutical industry job market

Provides a good manufacturing of the concepts, techniques and applications of production and operation management.

Course Outcomes:

Development of the ability to integrate pharmaceutical skills in pharmaceutical production processes.

Exposure to pharmaceutical pre formulation and product development.

Development of skills in management skills pertaining to industrial pharmacy

Ethical and behavioural skills.

The student shall be able to Use laboratory scale production equipments and Communicate of laboratory results.

UNIT -I

Formulation development of Solid dosage forms: Tablets: Advances in materials, process, equipment and production of tablet and tablet coating technology.

Capsules: Advances in materials, process, equipment and production of Hard and soft gelatin capsules.

UNIT - II

Formulation development of Liquid dosage forms: Monophasic Liquid Dosage forms: Advances in materials, process, equipment and Formulation of Monophasic liquid dosage forms.

Biphasic Liquid Dosage forms: Advances in materials, process, equipment and Formulation of Biphasic liquid dosage forms including Multiple and Micro emulsions.

UNIT - III

Formulation development of sterile dosage forms: Parenterals: Advances in materials and production techniques, filling machines, sterilizers, and layout for production of parenterals.

Ophthalmic preparations: Advances in materials and production techniques, filling machines and sterilizers, for production of eye drops &Eye Lotions.

UNIT - IV

Formulation development of Semisolid dosage forms & Pharmaceutical Aerosols: Semi-solids : study of the principles, formulation, manufacturing process and equipment for semisolid dosage forms.

Pharmaceutical Aerosols: study of the Propellents, principles, formulation, manufacturing process and filling equipments for Aerosols.

UNIT V

Pilot plant scale-up techniques used in pharmaceutical manufacturing: Pilot plant: Technology transfer from R&D to pilot plant to pilot scale considerations of steps involved with manufacture (design, facility, equipment selection) of tablets, capsules, suspensions, emulsions & semisolids.

Scale up: Importance, Scale up process-size reduction, mixing, blending, granulation, compression, coating involved in tablets, capsules & liquid-liquid mixing.

LEARNING RESOURCES

TEXT BOOKS:

Libermann & Lachman, The Theory and Practice of Industrial Pharmacy.
ME Alton, The Science and Practice of Pharmaceutical Dosage forms.

REFERENCES

BioPharmaceutics and Pharmacokinetics, D.M. Bramankarsnd Sunil B. Jaiswal.
Banker, Modern Pharmaceutics.
Remington's Pharmaceutical Sciences

CH 406 (C)NATURAL GAS PRODUCTION AND APPLICATIONS

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

Gain basic knowledge of NG and its prospective.
Different processes, transportation and storage of Natural gas (NG).
Learn different liquification technologies of NG.
Have knowledge on different functional units on receiving terminals
Production and Utilization of NG

Course Outcomes:

Have knowledge on Natural Gas potential, composition and resources.
Able to apply different liquification techniques.
Understand different steps in NG processing.
Have knowledge associated with safety aspects of NG, transportation and storage.
Able to know Unconventional gassources and NG specification, utilization and marketing of natural gas.

UNIT – I:

Introduction: Composition of Natural Gas, Utilization of Natural Gas, Natural Gas Industry, Natural Gas Reserves.

Types of Natural Gas Resources, Future of the Natural Gas Industry.

UNIT – II:

Properties of Natural Gas: Physical properties of natural gas and hydrocarbon liquids associated with natural gas. Reservoir aspects of natural gas. Calorific value of gas and measurement.

Gas Compression: Types of Compressors, Selection, Thermodynamics of Compressors, Compression calculations. Heat and Mass Transfer Principles and Applications in Natural Gas Engineering, Use of Mollier Diagrams.

UNIT – III:

Gas Flow Measurement: Process control and instrumentation in natural gas processing plants.

Natural Gas Processing: Field separation and oil absorption process, Refrigeration and low temperature processing, Liquefaction Process.

Dehydration of Natural Gas, Sweetening of Natural gas and sulphur recovery. Processing for LPG, CNG, system, Conversion of gas to liquid. Custody transfer- principles and measurements.

UNIT – IV:

Gas Gathering, Transport and Storage: Gas Gathering System. Steady Flow in Simple Pipeline System, Steady State and un-Steady State Flow in Pipelines, Solution for Transient Flow.

Transmission of Natural Gas, Specifications. Underground Storage and Conservation of Natural Gas.

UNIT – V:

Unconventional gas: Coal Bed Methane, Natural Gas Hydrate, Basin Centered Gas, Tight Gas Sands, Shale Gas. Current Technology for Shale Gas and Tight Gas Exploration and Production.

LNG: Production and Utilization: Issue and Challenges to Enhance Supply of Natural Gas.

LEARNING RESOURCES

TEXT BOOK:

LNG: Basics of Liquified Natural Gas, I st Edition, Stanley Huang, Hwa Chiu and Doug Elliot, PETEX, 2007

REFERENCE BOOKS:

LNG: A Nontechnical Guide, Michael D'Tusiani, Gordon Shearer PennWell Books, 2007.

Natural Gas Transportation, Storage and Use, Mark Fennell Amazon Digital Services, Inc., 2011.

Liquified Gas Handling Principles on Ships and in Terminals, 3rd Edition, McGuire and White, Witherby Publishers, 2000.

CH 406 (D) NANOTECHNOLOGY

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

To provide the students strong knowledge of the molecular nanotechnology.

To provide the strong knowledge about the concepts of nano powders, nano tubes and Nanomaterial.

To provide the exposure to the students about the synthesis of rotaxanes and catenanes, molecular computers.

To provide the strong knowledge of the nano biometrics.

To provide the knowledge on synthesis of Nanobiology and environmental issues.

Course Outcomes:

An ability to explain about molecular nanotechnology, nanolithography

An ability to explain the concept of preparation of Nanomaterial, sol-gels.

An ability to explain the .synthesis of rotaxanes and catenanes

An ability to explain about lipids, DNA structure.

An ability to understand the synthesis of Nanobiology and apply the Nanomaterial's in environmental pollution control.

UNIT - I

Introduction to nanotechnology and materials, Nanomaterial's, Introduction to Nano sizes and properties comparison with the bulk materials, different shapes and sizes and morphology.

Nanomaterial's characterization: Microscopies SEM, TEM, Atomic Forced Microscopy, Scanning and Tunneling Microscopy, Nano tweezers, atom manipulation, nanodots, nanolithography.

UNIT - II

Nano powders and Nanomaterial's: Concepts of Nanomaterial's, preparation, plasma arcing, chemical vapor deposition, sol-gels, electro deposition, ball milling, applications.

Carbon nanotubes: Structure, Types, formation, assemblies, purification, properties and uses.

UNIT - III

Catenanes and rotaxanes, various molecular switches, synthesis of rotaxanes and catenanes, molecular computers, chemical rotors, prodders, flippers, atom shuttles, actuators, contacts.

Optics, photonics and solar energy: Properties of light and nanotechnology, interaction

UNIT - IV

Nano biometrics: Lipids as Nano-bricks and mortar, self-assembled monolayer's, proteins, 3-D structures arising from amines acids, Nanoscale motors, biological computing ion channels as sensors.

Information in DNA structure, using DNA to build Nano-cubes, hinges, smart glue, wire template

UNIT –V

Nanobiology: biological methods of synthesis. Applications in drug delivery, Nano containers and Responsive Release of active agents, Layer by Layer assembly for Nano spheres.

Safety and health Issues of Nanomaterial, Environmental Impacts, Case Study for Environmental and Societal Impacts.

LEARNING RESOURCES

TEXT BOOK:

Nanotechnology (Basic Science and Emerging Technologies) by Mick Wilson, K.K.Geoff Smith, Michella Simmons and BurkhardRaguge, Overseas Press.

REFERENCE BOOK:

Introduction to Nanotechnology by Charles P. Poole, Jrl and Frank J Owens, 1st edition, Wiley Inter-science.

CH 451 MINI PROJECT /TERM PAPER

Practicals : 3 Periods / week *Sessional Marks: 100*

Credits : 2

Course Objectives

Performs literature search on the topic of their interest.
Develops a process flow sheet for the intended product.
Explains the properties of the product.
Presents the techno-economic demand for the product.

Course Outcomes

Ability to collect information on own regarding a chemical product or process.
Ability to perform basic and detailed engineering for a given process.
Ability to carry out economic feasibility of a given product production.
Ability to present coherent data and analysis about a given process.

PURPOSE:

The Mini Project helps to supplement the final year Project Work of the B.Tech students. It helps to identify their research area / topic and complete the groundwork and preliminary research required for it comfortably. It trains the students to make use of research tools and material available both in print and digital formats.

PROCEDURE:

The topic of Mini Project is chosen from the B.Tech curriculum. Based on the topic a hypothesis is to be made by the student. The hypothesis may be a null hypothesis also. The students are then required to collect literature and support information for their Mini Project from standard reference books, journals and magazines- Both printed and online. Each student should refer a minimum of 5 reference sources outside the prescribed Text Books. The Mini Project contains:

The Aim and Objective of the study.
The need for Rationale behind the study.
Identify the work already done in the field.
Hypothesis and Discussion
Conclusion
Appendix with support data (Illustrations, Tables, Graphs etc.,)

CH 452: COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING LABORATORY

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 2*

Course Objectives:

To analyze and interpret data, to identify and solve Chemical Engineering problems
To introduces a range of numerical methods for the approximate solution of mathematical equations in Chemical Engineering
To develop a program for the solving the roots of Algebraic and transdental equation
To solve the Chemical Engineering problems by using ASPEN PLUS.

Course Outcomes:

Able to analyze the Chemical Engineering problems with computed knowledge
Able to develop the computer program for the real chemical engineering problems
Able to solve the chemical engineering problems using ASPEN software
Able to solve the numerical methods as well as the roots of various function using C language

Roots of nonlinear equations iterative methods:

- Bisection method
- False position method
- Newton Raphson method
- Secant method

Direct solution for set of linear equations:

- Gauss Elimination Method
- Gauss-Jordan method
- Matrix inversion method
- Triangular Factorization (L.U.Decomposition method)

Iterative solution for set of linear equations:

- Jacobi's method
- Gauss Seidel method

Regression analysis:

- Fitting Linear equation
- Fitting Transdental equations
- Fitting a polynomial function

Numerical integration:

- Trapezoidal rule
- Simpson's 1/3 Rule
- Simpson's 3/8 th rule

Numerical solution of ordinary differential equations:

- Taylor series method
- Euler's method
- Runga-Kutta method

Predictor and corrector methods:

Milne-Simpson method
Adam Bash forth method

Rating of shell and tube heat exchanger using Aspen Plus software.

Rating of Distillation column using Aspen Plus software.

Simulation of Recycle Processes.

Simulation of PFR and CSTR.

CH 453 INSTRUMENTATION AND PROCESS CONTROL LABORATORY

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 2*

Course Objectives:

To provide the fundamental background in understanding the dynamic behavior of physical systems.

To provide knowledge in calibrating the instruments.

To provide knowledge in understanding the role and operation of the main components in a feedback loop.

To evaluate the tuning of a Pneumatic P+I controller through manual tuning

Course Outcomes:

To obtain and analyze the dynamic responses of the physical systems.

To calibrate and use the measuring instruments.

To obtain the transfer function of the unknown processes.

To obtain tuning parameters of Pneumatic P+I controller, to control a particular process.

Response of Hg –Glass bare thermometer

Two tank non interacting system

Two tank interacting system

Control valve characteristics

Response of thermocouples

Response of thermometers

Response of U-Tube manometer

Response of temperature control trainer for step input forcing function

Response of level control trainer for step input forcing function

Response of flow control trainer for step input forcing function

Response of pressure control trainer for step input forcing function

Response of temperature control trainer for sinusoidal input forcing function

Response of level control trainer for sinusoidal input forcing function

Response of flow control trainer for sinusoidal input forcing function

Response of pressure control trainer for sinusoidal input forcing function

Pneumatic P+I controller

IV Year II Semester

CH 407 INDUSTRIAL MANAGEMENT

Lectures : 4 periods / week *Sessional Marks : 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

It provides the students with a foundation of knowledge in management of organizations and give insighton forms of business organization suitable for today's business environment.

It alerts the students to understand the time value of money and gives knowledge about various costs involved for evaluation of several project alternatives and cost controlling techniques.

It is to sensitize the students to the changing environment and its implication for managing the human resources to achieve the corporate excellence in a changing environment.

It provides an idea to the students to get the information about different inventory control techniques, problem formulation and operations research solutions.

It gives knowledge to the students for avoiding any delays in production processes due to non availability of material by effectively managing the function of materials management and produces good quality products but it must satisfy the needs, wants and desires of the consumer.

Course Outcomes:

To gain insight on contemporary issues in General and Industrial Management.

The course helps the students to get knowledge about time value of money and the linkage of various cost concepts to understand how to maintain breakeven scenario for a business.

The course helps to linkage corporate vision, mission, strategies, and policies to human resource management to acquire competitive advantage and to frame strategies to develop talent and to retaining talent.

Recognition of the need and ability to engage in inventory management.

The course helps the students to understand the customer perception, making him to buy the products and retaining the customer in a business.

UNIT – I

General Management:Management Concept, Managerial Roles, Managerial Skills, Brief treatment of managerial functions, Scientific Principles of Management, Administrative Principles of Management.

Forms of Business Organisation:Salient features of sole proprietorship. Partnership, Joint Stock Company, Private limited and Public limited companies.

UNIT – II

Financial Management:Objectives of Financial Management, Concept of interest, compound interest, equivalent cash flow diagram

Economic Evaluation Of Alternatives: Basic methods, the annual equivalent method, present worth method, future worth method.

Depreciation: Purpose, types of depreciation, common methods of depreciation. The straight line method, declining balance method, the sum of the years digits method.

Methods Of Costing:Job Costing, Contract Costing, Process Costing, Unit Costing, Operational Costing, Departmental Costing.

UNIT – III

Human Resource Management:Functions of Human Resource Management – Job Analysis, Human Resources Planning, Brief treatment of Recruitment, Selection, Placement, Induction & Orientation, Training and Development, Performance Appraisal, Job Evaluation, Career Planning and Development, Stress Management, Compensation

Directing: Motivation: Theories of motivation; Leadership: Styles of Leadership.

UNIT – IV

Inventory Management:Reasons for Inventory Control and Inventory Management –EOQ, EPQ, ABC Analysis,FSNAnalysis,VED Analysis.

Operations Research:Problem Formulation, Linear Programming, Simplex and Graphical Solutions.

UNIT – V

Material Management:Functions of Materials Management, Material Requirement Planning, Purchasing, Objectives of Purchasing, Source Selection, Procurement Methods, Vendor Rating.

Marketing Management: Functions of Marketing, Marketing Mix, Product life cycle, Channels of distribution, Marketing Segmentation, Advertising & Sales promotion, Market Research

LEARNING RESOURCES

TEXT BOOKS:

KK Ahuja, Industrial Management & Operations Research, Vol. I & II, DhanpatRai, 1978. (Unit -1)

E.PaulDegarmo, John R Chanda, William G Sullivan, Engineering Economy, Mac Millan Publishing Co, 1979. (Unit -2,3)

Engineering Economics, Paneerselvam, PHI,2009. (Unit -4)

Gary Dessler, Human Resource Management, 11th Edition, Pearson Education, 2008. (Unit -1, 3)

Philip Kotler, Marketing Management, 11th Edition, Pearson Education, 2004. (Unit -1,5)

REFERENCE BOOKS:

P. Gopalakrishnan, Hand Book of Materials Management, PHI, 1999.

Gary Dessler, Human Resource Management,11th Edition,2008.

Heinz Weirich and Harold Koontz, Management, 10th Edition, TMH, 2004.

WEB REFERENCES:

www.managementstudyguide.com: Describes the Concepts of Management &Its Operational Functions.

www.1000ventures.com : Describes about Management Gurus, Business Gurus.

3. *www.citehr.com : Describes the Human Resource Management Topics.*

CH 408: OPTIMIZATION OF CHEMICAL PROCESS

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

The course will enable the students to:

To learn problem formulation of optimization.
To realize the numerical methods of un-constrained optimization.
To learn linear programming and its applications
To understand the use of genetic algorithms in optimization
To know the applications of numerical optimization.

Course Outcomes:

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

Apply the knowledge of optimization to formulate the problems
Apply different methods of optimization and to suggest a technique for specific problem
Apply simplex method for linear optimization problems
Understand advanced optimization techniques like Genetic algorithms
Understand how optimization can be used to solve the industrial problems of relevance to the chemical industry

UNIT - I

Nature and organization of optimization problems: Examples of applications of optimization, the essential features of optimization problems, formulation of objective functions, general procedure for solving optimization problems, obstacles to optimization.

Basic concepts of optimization: Continuity of functions, unimodal versus Multimodel functions. Convex and Concave functions, Convex region, Necessary and sufficient conditions for an extremum of an unconstrained function, interpretation of the objective function in terms of its quadratic approximation

UNIT - II

Optimization of unconstrained functions: one-dimensional search: Numerical methods for optimizing a function of one variable, scanning and bracketing procedures, Newton's, Quasi-Newton's and Secant methods of unidimensional search, polynomial approximation methods, region elimination methods.

Unconstrained multivariable optimization: random search, grid search, uni-variate search, gradient method - Steepest Descent, conjugate gradient method.

UNIT - III

Linear programming and applications: Basic concepts in linear programming, Degenerate LP's – graphical solution, natural occurrence of linear constraints, standard LP form.

Simplex method and applications. Simplex method to solve LP problems, duality principle and converting a LP to dual LP.

UNIT - IV

Genetic Algorithms: (Qualitative treatment) Working principles, differences between GAs and traditional methods, similarities between GAs and traditional methods.

Optimization of Unit operations (Problem Formulation) Optimization of recovery of waste heat, shell and tube heat exchanger.

UNIT - V

Chemical Engineering Examples: optimal pipe diameter, optimal residence time for maximum yield in an ideal isothermal batch reactor, Chemostat.

Evaporator design, liquid-liquid extraction process, optimal design of staged distillation column, optimization of a thermal cracker.

LEARNING RESOURCES

TEXT BOOK:

Optimization of chemical process by T.F.Edgar, D.M.Himmelblau and L.S.Lasdon, 2nd edition, McGraw Hill (2001).

REFERENCE BOOK:

Engineering Optimization: Theory and Practice by S.S.Rao, 3rd edition, New Age International(P) Ltd.,(1996).

Optimization Concepts and Applications in Engineering, Ashok Belegundu, Tirupathi R. Chandrupatla, Cambridge University Press, 2011.

Practical Optimization: Algorithms and Engineering Applications, Andreas Antoniou, Wu- shing Lu, Springer, 2007.

Elective-V

CH 409(A) COMPUTER AIDED DESIGN

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

The course enables the students to:

Know the available computational tools for process flow design development and general design considerations.
Understand the development of system design skills for chemical processes
Experience solving a complex heat transfer design problem
Experience solving a complex mass transfer design problem
Understand the computer aided design of chemical reactors

Course Outcomes:

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

An ability to prepare process flow sheets for design of process equipment
An ability to apply design techniques to solve a chemical process.
An ability to solve heat transfer design problems.
An ability to solve mass transfer design problems.
An ability to design a chemical reactor.

UNIT - I

Introduction: Tracing the Historical Development, Task of the process engineer, what is mathematical modeling and simulation, Scope and structure.

Fugacity of gases and vapors – pure gases, gas mixtures, fugacity of liquids, Estimation of Enthalpy - gas and gas mixtures, pure liquids and liquid mixtures.

UNIT - II

Cad of flow of fluids in pipes: Flow of Newtonian fluids in pipes: Sizing of pipes for Newtonian flow with algorithms and computer programming,

Flow of non-Newtonian fluids in pipes: Sizing of pipes for Newtonian flow with algorithms and computer programming, Pipe network calculations.

UNIT - III

CAD of heat transfer equipment: Introduction: design and rating calculations, Shell and Tube Exchangers without phase change – algorithm with programme.

Condensers: condenser calculations with algorithm and programme, Reboilers: boiling heat transfer coefficient, vertical thermo siphon reboiler, algorithm and programme for vertical reboiler calculations

UNIT - IV

CAD of mass transfer equipment: Introduction, Distillation: algorithm and programme for McCabe Thiele method and Ponchon-Savarit method.

Gas Absorption: absorption and stripping in plate columns, algorithm and programme for plate column absorption calculations, absorption in packed columns.

UNIT – V

Liquid extraction: stage wise calculations – cross current and counter current processes with algorithms and programmes, extraction in packed columns.

CAD of chemical reactors: Introduction, Extent of reaction, analysis of rate data, Temperature effects in homogeneous reactors.

LEARNING RESOURCES

TEXT BOOK:

Chemical Process Computations by Raghu Raman, Elsevier Applied Science Publishers, the University of Michigan (1985).

REFERENCE BOOKS:

Computer Applications in chemical Engineering: Process Design & simulation by Robert G. Squires, G. V. Reklaitis, Books on Demand (1980).

Computer Aided Process Plant Design by M.E.Leesley,Gulf Pub. Co., Book Division (1982).

Chemical Engineering Design by R. K. Sinnott, Gavin Towler, 5th Edition, Elsevier Publications (2010).

CH 409 (B) QUALITY CONTROL OF PHARMACEUTICAL DOSAGE FORMS

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

The main objective of the chapter deals with the analysis of tablets and capsules as per official compendium

The main objective of the chapter deals with the analysis of solutions, suspensions and emulsions as per official compendium

The main objective of the chapter deals with the analysis sterile products as per official compendium

The main objective of the chapter deals with the analysis semisolid preparations as per official compendium

The main objective of the chapter deals with the analysis Suppositories, Pessaries and Oral controlled release dosage forms of as per official compendium

Course Outcomes:

Upon completion of the topic the student shall be able to understand the need, procedure for assessing the quality of tablets and capsules.

Upon completion of the topic the student shall be able to understand the need, procedure for evaluation of solutions, suspensions and emulsions.

Upon completion of the topic the student shall be able to understand the need, procedure for performing the quality control tests for sterile products.

Upon completion of the topic the student shall be able to understand the procedure for assessing the quality of topical preparations and aerosols.

Upon completion of the topic the student shall be able to understand the procedure for evaluating the quality of. Suppositories, Pessaries and Oral controlled release dosage forms

UNIT - I

Tablets: Quality control tests for various types of tablets as per IP

Capsules: Quality control tests for Hard and soft gelatin capsules as per IP.

UNIT- II

Mono phasic liquids: Quality control tests for various types of solutions and elixirs as per IP.

Bi phasic liquids: Quality control tests for Suspensions and Emulsions as per IP.

UNIT - III

Parenterals: Quality control tests for Parenteral preparations as per IP.

Opthalmic Preparations: Quality control tests for Eye, Ear and Nasal drops as per IP.

UNIT - IV

Topical Preparations: Quality control tests for Ointments, Creams, Pastes and Jellies as per IP.

Aerosols: Quality control tests for Aerosols as per IP.

UNIT - V

Suppositories & Pessaries: Quality control tests for Suppositories and Pessaries as per IP.

Oral Controlled Release Dosage forms: Quality control tests for Oral controlled release dosage forms.

LEARNING RESOURCES

TEXT BOOKS

Quality Assurance and Quality Management in Pharmaceutical Industry, by Y. Anjaneyulu and R. Marayya, Pharma book SyndicatePublishers.
Quality Analysis of Drugs in Pharmaceutical Formulations, by P.D. Sethi, Third edition, CBS Publishers and distributors.
Indian pharmacopoeiaby Libermann & Lachman, Vol. 1, 2& 3.

REFERENCE BOOKS:

Pharmaceutical Sciences by Remington's, 21st Edition.
Modern pharmaceutics by Banker & Rhodes, 12th Edition

CH 409 (C) PETROLEUM REFINING

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

To understand the properties and their significance of crude oils and Petroleum fractions.
To understand, design and analyze the various petroleum refinery processes including primary, secondary and supporting processes.
To understand the process technologies for the petrochemical products.
To understand suitable thermal/catalytic conversion (cracking) processes for Vacuum gas oil/residueupgradation and to produce desired fuel blend components and petrochemicalfeed stocks.
To understand suitable processes (such as alkylation, reforming, isomerization) forconverting light ends/ naphtha cuts to meet the desired gasoline blends.

Course Outcomes:

Able to the overall scenario of quality of crude oil.
Able to calculatedifferent Petroleum Products and their specifications.
Able to know the different processes involving for up gradation of petroleum fractions.
Able to do Thermal & Catalytic cracking processes.
Able to do quality estimation, adopt different storage methods and transportation methods.

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, Dehydration and desalting of crudes.

Refinery feed stocks: Crude oil classification-Composition and properties-Composition of petroleum crude suitable for asphalt/coke manufacture – Evaluation of crude oils.

UNIT - II

Petroleum Products and their specifications: LPG- Gasoline- Diesel fuels- Jet and turbine Fuels – Blending of gasoline.

Lube oils-Heating oils – Residual fuel oils - wax and asphalt- Petroleum coke- All Product specifications-Product blending.

UNIT - III

Crude distillation: Atmospheric and Vacuum distillation units, Auxiliary equipment such as pipe still heaters and heat exchanger trains etc.

Catalytic reforming and isomerization: Catalytic reforming processes (for petroleum and petrochemical feed stocks) – Isomerization Processes -Feed stocks-Feed preparation – Yields.

UNIT - IV

Thermal & Catalytic cracking processes: Visbreaking- Delayed Coking –Fluid Catalytic cracking and Hydrocracking - Feed stocks — Catalysts - Process variables –Product Recoveries-Yield estimation.

Hydrotreating&Hydroprocessing: Naphtha, Kerosene, Diesel, VGO &Resid, Hydrotreating / Hydroprocessing – Feed stocks – Process description and Process variables

UNIT V –

Quality, Storage and transportation

Octane number, Cetane number, Diesel index, their determination and importance Storage of petroleum products: tanks, bullets, special types of spheres etc.

Transportation of petroleum products: road, rail, sea and pipeline; Importance of pipeline transportation.

LEARNING RESOURCES

TEXT BOOK:

Petroleum Refining: Technology and Economics, J.H. Gary and G.E.Handwerk, 4th Edition, Marcel Dekkar, Inc., 2001.

REFERENCE BOOKS:

Petrochemical Process Technology, ID Mall, Macmillan India Ltd., 2007.
Handbook of Petrochemicals Production Processes, R.A. Meyers, TRW, Inc., 2005.
Petrochemicals, P.Wiseman, Ellis Horwood, 1986.
Modern Petroleum Refining Processes, B.K. BhaskaraRao, 5th Edition, Oxford & IBH Publishing, 2011.

CH 409(D) – ADVANCED SEPARATION TECHNIQUES

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs. *Credits : 3*

Course Objectives:

To provide the principles of supercritical fluid extraction and short path distillation.
To provide the fundamentals of the different membrane processes.
To provide selection procedure for polymers to prepare membranes and characterisation.
To provide the suitable range of operating conditions for membrane processes and for a separation problem.
To provide knowledge on concentration polarization and fouling.

Course Outcomes:

An ability to extract the solutes with supercritical fluid extraction.
An ability to identify and understand the membrane technology applications for energy efficient and environmental friendly operations.
An ability to select the right material and membrane structure according to the properties of the involved compounds.
An ability to understand the membrane technology to use according to the characteristics of the species to be separated.
An ability to evaluate the flux and concentration modulei for membrane separation techniques.

UNIT – I

Review of conventional processes, Supercritical fluid extraction: Supercritical fluids, phase equilibrium, industrial application, important supercritical processes- decaffeination of coffee, extraction of oil from seeds.

Enhanced Distillation: Short path distillation, Molecular distillation, Reactive Distillation.
Ionic Separations: Controlling factors, Applications, Types of equipment employed for electrophoresis, Di-electrophoresis.

UNIT – II

Introduction to barrier separation processes, definitions and principles membrane separation process, classification of membrane process, modules and modes of operation.

Process configuration, requirements for ideal membrane, comparison with conventional separation processes.

UNIT – III

Synthetic membranes, characteristics of membrane materials, classification, methods of preparation, preparation technique for composite membranes.

Membrane characterization, characterization of porous membranes, characterization of non-porous membranes, structural properties.

UNIT – IV

Pressure driven membrane processes: microfiltration: Introduction, membranes for microfiltration, industrial applications; Ultrafiltration: membranes for ultrafiltration, industrial applications, reverse osmosis and nanofiltration: membranes for reverse osmosis and nanofiltration, industrial applications.

Gas permeation, Dialysis, electro dialysis, Process parameters, membranes for electro dialysis, applications, Membrane electrolysis, Bipolar membranes, Fuel Cells. Liquid membranes, choice of the organic solvent and carrier, applications.

UNIT – V

Pervaporation, Transport in porous and non-porous membranes. Liquid membranes, choice of the organic solvent and carrier, applications.

Concentration polarization, Fouling, factors affecting fouling, methods to reduce fouling and flux enhancement, cleaning of membrane, membrane reactors, membrane distillation, membrane contactors.

LEARNING RESOURCES

TEXT BOOKS:

Basic principles of membrane technology, Marcal Mulder, 2nd Edition, Springer India (1996).
Principles of Mass Transfer and Separation Processes, Binay K. Dutta, PHI, New Delhi. (UNIT-1)

REFERENCE BOOKS:

Ultrafiltration and Microfiltration, MunirCheryan, 2nd Edition, Technomic Publishing Co (1998).
Separation process principles, J.D.Seader and Ernest J. Henley 2nd edition, Wiley-India
Synthetic Polymeric membranes, R. E. Kesting, 2nd Edition, McGraw Hill (1985)
Membrane separation processes, KaushikNath, PHI, New Delhi (2008).

Elective –VI

CH 410 (A) MICROPROCESSORS AND APPLICATIONS

Lectures	*: 3 periods / week*	*Sessional Marks : 40*
Tutorials	*: 1 period / week*	*Semester End Exam Marks : 60*
Semester End Exam	*: 3 hrs*	*Credits :3*

Course Objectives:

The course enables the students to:

Understand the architecture of 8086 family, addressing modes, instruction description and assembler directives of 8086 microprocessors.
Develop the programming skills for applying them on various applications.
Learn Digital Interfacing, Analog interfacing with 8086.
Learn architecture, pin diagram, addressing modes of 8051, instruction setof 8051, counters and timers of 8051, interfacing with 8051.
Learn how the D/A converter operation, interfacing and applications

Course Outcomes:

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

Understand basic concepts on microprocessors and microcomputers and to use 8086 microprocessor addressing modes, registers and instruction sets.
Debug their assembly language programs through different programs.
Understand Digital Interfacing, Analog interfacing with 8086.
Understand the architecture of 8051, addressing modes of 8051.
Understand about A/D and D/A convertors.

UNIT - I

Introduction to microcomputers and microprocessors, introduction and architecture of 8086 microprocessor family: 8086 internal architecture, segment registers, flag register, pointer registers, general purpose registers and other pointer and index registers
Introduction to programming the 8086: programming languages, addressing modes.

UNIT – II

Assembly Language Programming: program developmental steps, standard programming structures: Jumps, Flags and conditional jumps , it-then, If-then-Else and multiple if-then-else programs. While-do-programs, Repeat-until programs

Writing programs for use with an assembler, assembly language program development tools. Flags, Jumps and While – Do implementation

UNIT - III

Writing and using assembler macros, instruction descriptions: AAA instruction, AAD instruction, AAM instruction, AAs instruction, AND instruction.

Assembler directives, 8086 system connections: hardware overview, basic signal flow on 8086 during A read machine cycle and during a write machine cycle.

UNIT - IV

Interrupts and interrupt service procedures: 8086 interrupts and interrupt responses, hardware interrupt applications, 8259 priority interrupt controller.

Programmable parallel ports and handshake input/output: methods of parallel data transfer, single handsome I/O, double handshake data transfer, 8255 internal block diagram and system connections.

UNIT - V

Interface Microprocessor to keyboards: keyboard types, keyboard circuit connections and interfacing, sensors and transducers: temperature sensors, light sensors, force and pressure transducers.

D/A converter operation, interfacing and applications: D/A converter and A/D converter, a microcomputer –based industrial process-control system: an 8086 –based process –control system – simple introductory concepts.

LEARNING RESOURCES

TEXT BOOKS:

Douglas V Hall, "Microprocessors and Interfacing", Tata McGraw Hill Company Ltd., Second Edition, 2006.

REFERENCE BOOKS:

John Uffenbeck, "Programming of 8086/8088", Printice Hall of India, 2000.

Kenneth J. Ayala, The 8051 Microcontroller Architecture Programming and Applications, 2nd Edition, Penram International Publishers (I), 1996.

CH 410 (B) VALIDATION AND DOCUMENTATION OF PHARMACEUTICALS

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

How to validate equipment and different stages of Validation Importance of Water purification, storage and supply systems.

Calibration and Maintenance of Analytical Instruments Preparation of SOP'S

Calibration and Maintenance of Quality Control Equipment used for dosage forms

Knowledge about various Drug Regulatory Authorities Internal Quality Review and Maintenance of Required documents

Selection of Representative sample for conducting Quality Control tests Applications of Statistics and Computers in Establishing GMP and GLP

Course Outcomes:

Role and Responsibility of Validation team Significance of Distilled water and Water for Injection

Timely Calibration and avoiding the occurrence of deviations in Measurements

Timely Calibration and avoiding the occurrence of deviations in Measurements Giving Assurance to a marketed formulation

Acquiring International Trade and Avoiding Duplicate testing Make sure that Internal Systems are ready to face Regulatory Audits

Overcome the inappropriate sampling Establishing the GMP and GLP Principle in most sophisticated way and simplified form

UNIT-I

Concept and Philosophy of Validation: Equipment Validation, Validation of Dry heat Sterilization and Autoclave

Validation methods of Water supply systems, Deionized water, Distilled water and Water for Injection

UNIT-II

Calibration of Analytical Instruments as per ICH guidelines: Calibration of pH meter, Calibration of UV-VIS Spectrophotometer

Calibration of HPLC and Gas-Liquid Chromatography

UNIT -III

Calibration of Equipment as per ICH guidelines: Calibration of Dissolution apparatus and Calibration of Disintegration test apparatus

Calibration of Friability test apparatus and Calibration of Friability test apparatus with abrasion drum

UNIT –IV

Quality Management Systems: Introduction to ISO, Certification of IS and Principles of Total Quality Management

Quality Review and Documentation and International Conference for Harmonization

UNIT –V

Concepts of Statistical Quality Control: SamplingTechniquesandComputer applications in GMP and GLP

Statistical Quality Control and Control Charts

LEARNING RESOURCES

TEXT BOOKS:

Quality Assurance and Quality Management in Pharmaceutical Industry, Y. Anjaneyulu and R. Marayya, Pharma book Syndicate publishers.

Quality Analysis of Drugs in Pharmaceutical Formulations, P.D. Sethi, Third edition, CBS Publishers and distributors.

REFERENCE BOOK:

1. *How to Practice GMP, P.P.Sharma, Vandhana Publications.*

CH 410(C) PETROCHEMICAL TECHNOLOGY

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 3*

Course Objectives:

To make a thorough understanding of the availability of petroleum feed stocks for petrochemicals.

To understand methods to produce various petro Chemicals from ethylene and C_3, C_4 and higher carbon atoms.

To know the various chemical processes, kinetics and safety accepts of petrochemicals.

To methodolically furnishing the conversion of petroleum feedstock's to chemical and intermediates.

To understand the significance of petrochemical in our daily life.

Course Outcome:

Able to know Petrochemical industry-Feedstock, various important Chemicals produced from methane, ethane, ethylene.

Able to produce different petrochemicals from C_3, C_4 and higher carbon atoms, polymerization and production of various polymers.

Able to produce different petroleum aromatics.

Able to produce different intermediate chemicals, synthetic fibers.

Able to classify the synthetic detergents and production of Synthetic detergents.

UNIT - I

Petrochemical industry-Feed stocks: Petrochemical industry in India, feed stocks for petrochemicals. Chemicals from Methane: Methanol, Iso-butylene, Formaldehyde, Acetic acid, Hexamethylenetetramine, PTFE, methyl amine, Hydrogen cyanide.

Production & Chemicals from Ethane-ethylene-Acetylene: Ethylene production, Vinyl chloride monomer, vinylacetate monomer, ethylene oxide, ethylene glycol, acetaldehyde. Acrylic acid, Isoprene.

UNIT - II

Chemicals from C_3, C_4 and higher carbon atoms: Isopropylalcohol, acrylonitrile, acrylic acid, phenol, bisphenol-A, iso and n-butanol, methyltertbutylether, methacrylic acid, malic anhydride.

Polymers of olefins: Polymer structure, methods of polymerization, high density polyethylene (HDPE), low density polyethylene (LDPE), polypropylene, polyvinylchloride, polystyrene.

UNIT - III

Petroleum aromatics:
Higher olefins: Benzene, toluene, xylene, phenol and Styrene

Benzene Derivatives – Aniline, Styrene; Benzoic acid, Products from Toluene- caprolactum, terephthalic acid, phthalic anhydride,

UNIT - IV

Production of intermediate chemicals: Acrylonitrile, ethylene oxide, propylene oxide, ethyl chloride vinyl acetate and vinyl chloride.

Synthetic fibres: Production techniques of synthetic fibres, production of polyethylene Terephthalate, acrylic fibers, polypropylene.

UNIT - V

Synthetic detergents: Classification of detergents, general manufacture of sulphonates, keryl benzene sulphonate.

Non-ionic detergents-preparation of Alkylated phenol detergents, Cationic Detergents. Production of Carbon black.

LEARNING RESOURCES

TEXT BOOK:

1. *A Text on Petrochemicals,B.K.BhaskaraRao, 3rd Edition, Khanna Publishers, New Delhi.*

REFERENCE BOOKS:

Petrochemical processes, Vol.2, 2nd edition, by A.Chanvel and G. Lefebvre, Gulf publishing company.

Shreve's chemical process industries, 5th edition, by George T. Austin, McGraw Hill Publishers.

CH 410 (D) BIO-CHEMICAL ENGINEERING

Lectures : 3 periods / week *Sessional Marks : 40*
Semester End Exam Marks : 60

Semester End Exam : 3 hrs *Credits :3*

Course Objectives:

To provide the fundamental background of the principles of biology and biochemistry in order to understand, design and operation of biochemical processes.

2. To determine the rates of enzyme catalysed reactions and to provide knowledge on the immobilization of enzymes.

To provide knowledge regarding cell growth patterns and design of various bioreactors.

To understand fermentation technology and sterilization techniques

5. To expose the students to the various unit operations and unit processes involved in the downstream processing.

Course Outcomes:

To understand and use the basic principles of biology and biochemistry to successfully design and operate a biochemical process.

To derive the kinetic expression for the rates of enzyme catalysed reactions.

To understand the factors effecting cell growth and to design and operate various bioreactors.

To implement fermentation technology and sterilization techniques

To apply various unit operations and unit processes for carrying out downstream processing

UNIT – I

Introduction: An overview of industrial bio chemical processes, comparing with chemical processes. A little Microbiology: Biophysics and cell doctrine, Structure of cells, types of cells.

Chemicals of life: Lipids, proteins, building blocks and structure of DNA and RNA.

UNIT – II

The kinetics of enzyme–catalysed reactions: The enzyme-substrate complex & enzyme action, simple enzyme kinetics with one and two substrates, substrate activation & inhibition, modulation & regulation of enzyme activity, other influences on enzyme activity.

Applied enzyme catalysis: Applications of enzymes, enzyme immobilization, medical & analytical applications of immobilized enzymes, effect of external mass transfer resistances, analysis of intra particle diffusion & reaction

UNIT – III

The kinetics of cell growth: Ideal reactors for kinetics measurements, Monod growth kinetics, growth cycle phases for batch cultivation.

Biological reactors: Fed batch reactors, enzyme– catalysed reactions in CSTRs, CSTR reactors with recycle and wall growth, the ideal plug flow tubular reactor, packed bed reactors, fluidized bed reactors and trickle-bed reactors .

UNIT - IV

Fermentation Technology:

Medium formulation, aseptic and aerobic fermentation processes, alternate bio-reactor configurations. Sterilization – methods, thermal death kinetics, batch, continuous air and media sterilization.

Transport phenomena in bioprocess system: Transport across cell membrane: passive and facilitated diffusion, active transport, gas liquid mass transfer in cellular systems, determination of oxygen transfer rates

UNIT - V

Product recovery operations: Recovery of particulates - Filtration, centrifugation, sedimentation.

Product Isolation: Extraction, precipitation, Chromatographic techniques, membrane separations, drying and crystallization.

LEARNING RESOURCES

TEXT BOOK:

Biochemical Engineering fundamentals by J.E.Bailey and D.F.Ollis, 2nd edition,McGraw Hill (1986).

REFERENCE BOOKS:

Bio process Engineering Basic Concepts, Michel L. Shuler and FikeetKargi, 2nd edition, PHI(2002)

Biochemical Engineering, James M Lee, PHI (1992).

CH 454 COMPUTER AIDED PROCESS EQUIPMENT DESIGN LABORATORY

Lectures: 4 Periods / week *Sessional Marks: 40*

Semester End Exam Marks : 60

Semester End Exam: 3 hrs *Credits : 2*

- Flow chart symbols
- Engineering drawings

Simulation using Aspen

- Properties estimation
  - Material & Energy balances
  - Sensitivity Analysis
  - Design Specification
  - Mixers & Splitters
  - Pumps
  - Heat Exchangers
  - Columns
- Reactors

CH 455 PROJECT WORK

Practicals: 9 Periods / week *Sessional Marks: 40*

Semester End Examination Marks: 60

Semester Examination: 3 hours *Credits : 10*

Course Objectives

To develop a comprehensive design of a chemical process or chemical plant.

The students are able to do literature survey regarding the current importance of the product and the various processes available for producing that product.

To perform material and energy balances on every unit operation included, if possible by using software such as ASPEN and design of chemical process equipment

To develop a brief plan of plant layout, location, safety, installation costs and profits.

Course Outcomes

Ability to analyze and improve a chemical process or a chemical plant.

Ability to provide alternative methods to reduce energy requirements and raw material requirement.

Ability to design a virtual chemical plant using computer software.

Ability to create a comprehensive technical report and present it.

The project work should be

An Experimental work related to Chemical and allied Industrial products

(OR)

An Industry sponsored Project (theoretical or experimental)

(OR)

A Comprehensive design project of a chemical plant in the form of a report

The project report should contain the following chapters.

Introduction

Physical and chemical properties and uses.

Literature survey for different processes

Selection of the process

Material and energy balances

Specific equipment design / Experimentation

(Process as well as mechanical design with drawing, including computer programs where possible, of heat transfer equipment / separation equipment / reactors)

General equipment specifications.

Plant location and layout

Materials of construction

Health and safety factors

Preliminary cost estimation

Bibliography.