Rashtreeya Sikshana Samithi Trust

R.V.COLLEGE OF ENGINEERING

(Autonomous Institution Affiliated to VTU, Belgaum)

R.V. Vidyaniketan Post, Mysore Road

Bengaluru – 560 059

Scheme & Syllabus

III & IV Semester B.E.
CHEMICAL ENGINEERING

w.e.f. 2015

Department of Chemical Engineering

Vision

Imparting quality education in Chemical Engineering to promote leadership in research, innovation and sustainable technologies through teamwork.

Mission

1. Impart quality education in basic and applied areas of Chemical Engineering
2. Enable students and faculty to achieve proficiency in Chemical Engineering through innovative teaching and state-of-the-art laboratories
3. Encourage faculty and students to make career in research through development of novel processes and products
4. Develop inclusive technologies with a focus on sustainability
5. Collaborate with industries and research institutes to cater societal needs
6. Inculcate leadership qualities, entrepreneurial skills, societal and ethical values in students and faculty

Program Educational Objectives:

PEO 1: Exhibit knowledge of basic sciences, concepts and principles of Chemical Engineering

PEO 2: Comprehend, analyze, design and implement engineering systems with a focus on research, innovation and sustainability

PEO 3: Work in multidisciplinary team and cater to the needs of process industries with appropriate safety, health and environmental regulations

PEO 4: Demonstrate effective communication skills, leadership qualities and develop into successful entrepreneurs.

Program Outcomes:

The graduates will be able to

PO1. Apply knowledge of mathematics, basic sciences and engineering fundamentals to identify, formulate and solve chemical engineering problems

PO2. Design a system, component, or process to meet desired needs with appropriate societal and environmental regulations

PO3. Work in multi-disciplinary teams and develop leadership qualities with effective communication

PO4. Engage in life-long learning and follow ethical principles

PO5. Identify and use appropriate computational tools in chemical engineering practice

PO6. Undertake research leading to innovations, sustainable technologies and entrepreneurship with a focus on project management

Department of Chemical Engineering
R.V. College of Engineering, Bengaluru – 59
(Autonomous Institution Affiliated to VTU, Belagavi)
SCHEME OF TEACHING & EXAMINATION

Semester: III

Sl. No.	Course Code	Course	BoS	Credit Allocation				Total Credits
				Lecture	Tutorial	Practical	Self Study	
1	12MA31	Applied Mathematics-III	Sc	3	1	0	0	4
2	12EM32	Engineering Materials	ME	3	0	0	0	3
3	12CH33	Momentum Transfer	CH	3	0	1	1	5
4	12CH34	Particulate Technology	CH	3	0	1	1	5
5	12CH35	Thermodynamics	CH	3	1	0	1	5
6	12CH36	Technical Chemistry	Sc	3	0	1	1	5
	12DMA37	Bridge Course Mathematics-I	Sc					
		Total Credits		18	02	03	04	27
		No. of Hrs.		18	04	06	16	44

Semester IV

Sl. No.	Course Code	Course	BoS	Credit Allocation				Total Credits
				Lecture	Tutorial	Practical	Self Study	
1	12MA41	Applied Mathematics-IV	Sc	3	1	0	0	4
2	12EB42	Environmental Science and Biology for Engineers	Sc	3	0	0	1	4
3	12CH43	Process Heat Transfer	CH	3	0	1	0	4
4	12CH44	Mass Transfer-I	CH	3	1	0	1	5
5	12CH45	Reaction Engineering	CH	3	0	1	1	5
6	12CH46	Process Principles and calculations	CH	3	1	0	1	5
7	12HSS47	Innovation and social Skills	HSS	0	0	1	0	1
	12DMA47	Bridge Course Mathematics-II	Sc					
		Total Credits		18	03	03	04	28
		No. of Hrs.		18	06	06	16	46

Semester III

Applied Mathematics III

Course Code: 12MA31 **CIE Marks: 100**
Hrs/Week: L:T:P:S 3:2:0:0 **SEE Marks: 100**
Credits: 04 **SEE : 3 Hrs**

Course Learning Objectives:
Student will be able to:

- The student should be able to analyze periodic phenomena using concept of Fourier series.
- Understand the basics of matrix theory and its applications for finding solution of system of linear equations.
- Finding the approximate solutions using numerical methods, for problems which do not have analytical solutions.
- Approximating functional values with different curves.
- Optimizing real functional with various applications.

UNIT – I **08 Hrs**

Fourier series and Fourier Transforms
Introduction, periodic functions, Even and odd functions, properties. Special waveforms - Square wave, half wave rectifier, saw-tooth wave and triangular wave. Euler's formula for Fourier series, Fourier series for functions of period 2L (particular cases), Dirichlet's conditions - problems. Half Range Fourier series-Construction of Half range cosine and sine series, Complex form of Fourier series. Complex Fourier Transforms –Properties & simple problems.

UNIT – II **07 Hrs**

Matrices and Linear Equations: Elementary transformation, rank of matrix by using Echelon form, consistency of system of linear equations and solutions, solution of system of linear equations using Gauss elimination method, Gauss Jordan method, Gauss Seidel method, Eigenvalues and Eigenvectors, finding largest eigenvalue by using Power method.

UNIT – III **07 Hrs**

Curve Fitting and Interpolation: Method of Least squares - fitting of the curves of the form $y = ax + b$, $y = ae^{bx}$, $y = ax^b$ and $y = ax^2 + bx + c$, Correlation and Regression analysis. Finite differences-forward and backward differences, Interpolation-Newton's forward and backward interpolation formulae, Lagrange's interpolation formula.

UNIT – IV **07 Hrs**

Numerical methods: Numerical integration – Simpson's rules, Weddle's rule and Gaussian quadrature (two point & three point formula). Numerical methods for first order ODE – Single step & Multistep methods-Taylor's series method, Runge-Kutta fourth order method, Adam-Bash forth's method, BVP for ODE – Shooting methods for second order ODE (All methods without proof).

UNIT – V **07 Hrs**

Calculus of Variation: Introduction, Variation of functions and functional, extremal of a functional, variational problem, Euler's equation and special cases. Examples - Geodesics, Hanging cable, and Brachistochrome problem.

Course outcomes:
After completion of the course the student will be able to:

1. Understand the concepts of applied mathematics in relevant branches of engineering.
2. Apply the existing approximate methods for solving engineering problems analytically and numerically.
3. Analyze and interpret physical phenomena which find importance in engineering applications.

4. Ability to model Engineering problems & choose the proper methods to evaluate solution based on proper judgment
5. Ability to combine the varied mathematical concepts, predict suitable model and create appropriate mathematical methods

Reference Books:

1. B.S. Grewal - Higher Engineering Mathematics, Khanna publishers, 40th Edition, 2007, ISBN: 81-7409-195-5, Chapters 2, 10, 24, 28, 29, 31, 34.
2. N.P Bali & Manish Goyal - A Text Book of Engineering Mathematics, Lakshmi publications, 7th edition, 2010, ISBN: 978-81-7008-992-6, Chapters: 3(3.34-3.40,3.46, 3.47), 10 (10.1-10.7-10.10), 2 (2.24 -2.26).
3. Erwin Kreyszig - Advanced Engineering Mathematics, John Wiley & Sons, 9th Edition, 2007, ISBN: 978-81-265-3135-6, Chapters: 6, 7.1, 7.2,10(10.1-10.5,10.9-10.11),17, 18,19.
4. Murray R Spiegel - Theory & problems of Fourier Analysis with applications to Boundary Value problems, Schaum's Outline Series.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

Engineering Materials
Common to all Branches

Course Code: 12EM32 **Marks: 100**
Hrs/Week: L:P:T:S : 3:0:0:0 **SEE Marks: 100**
Credits: 03 **SEE : 03 Hrs**

Course Learning Objectives:

Student will be able to:
1. Compare materials based on their properties
2. Identify appropriate materials for specific engineering applications
3. Identify the phases and structure – property relations in alloys based on the phase diagrams
4. Apply Define and differentiate thermodynamic work and heat.
5. Select materials and process parameters for Flexible Electronics Technology
6. Identify appropriate nanomaterials for engineering applications and their characterization
7. Identify materials and property requirements for advanced engineering applications

UNIT – I **06 Hrs**

Introduction:
Classification of Materials - Metals, Ceramics, Polymers, composites, Advanced Materials- semiconductors, biomaterials, smart materials, nanostructured materials and their applications
Material properties – Mechanical properties, thermal properties – Heat capacity, CTE, thermal conductivity, Electrical and Electronic conductivity, Magnetic properties – dia, para, ferro, ferri, antiferro, domains and hysteresis. Optical properties -Luminescence and photoconductivity.

UNIT – II **08 Hrs**

Ferrous Materials and Alloys: Binary phase diagrams, Phase Rule, Lever Rule, Solidification, Nucleation and Grain Growth.
Cast Iron, Chromium steels, Nickel steels, Silicon Steels, Tungsten and Molybdenum Steels & Stainless Steels; Tool Steels, structural steels, Corrosion and Heat Treatment.
Non-ferrous Materials and alloy: Aluminum, Copper and Titanium, their alloys, properties and applications.

UNIT – III **08 Hrs**

Overview of Flexible Electronics Technology
History of Flexible Electronics, Materials for Flexible Electronics , Fabrication Technology for Flexible Electronics Fabrication on Sheets by Batch Processing, Fabrication on Web by Roll-to-Roll Processing , Additive Printing, Low-temperature Amorphous and Nanocrystalline Silicon Materials, Low-temperature Dielectrics, Low-temperature Thin-film Transistor Devices
Ceramic Materials - Definition, Classification of Ceramic Materials, Processing Methods, Properties and Industrial, Medical and Commercial Applications
Polymers– Definition, Classification of Polymers, Properties and their applications, intrinsically conductive material

UNIT – IV **08 Hrs**

Composites: Types of Matrix Materials and Reinforcements, Selection of Composites, Properties, Applications, Rule of Mixture for density, elastic modulus and tensile strength.
Nanomaterials: Definition, classification and synthesis – physical and chemical processes, Characterization of nanomaterials – Electron microscope, X-Ray Diffraction, particle size analyzer

UNIT – V **06 Hrs**

Advanced materials for - Construction Applications, Biomedical applications, High temperature Applications, Sensors and Actuators - Shape Memory Alloys and Composites, Thin films and coatings.

Course Outcome:

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

1. List the various properties of materials for industrial applications
2. Develop characterizations technique for nanomaterials, thin films, sensors and actuators
3. Evaluate use of materials based on composition and properties
4. Construct engineering materials such as flexible electronics, sensors and actuators for industrial applications

Reference Books

1. William D. Callister; "Materials Science & Engineering- An Introduction"; Wiley India Pvt. Ltd.; 6th Edition; 2006; New Delhi; ISBN:9814-12-669-1; 1,4,6,7,8,9
2. Fred W. Billmeyer, Jr; "Text Book Of Polymer Science"; Wiley-Interscience Publication; 2nd Edition; 1984; ISBN:0-471-82834-3; 8
3. Donald R. Askland, Pradeep P. Phule, "Essentials of Materials Science and Engineering", Thomas Canada Learning India Edition, ISBN:81-315-0233-3
4. William Smith, "Foundation of Materials Science and Engineering", 3rd Edition, McGraw Hill, 1997. ISBN:9780073529240
5. Flexible Electronics: Materials and Applications, William S. Wong and Alberto Salleo, eds. ISBN 978-0-387-74362-2, 2009

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

Momentum Transfer

Course Code : 12CH33 **CIE Marks : 100+50**
Hrs/Week : L:P:T:S 3:2:0:4 **SEE Marks : 100+50**
Credits : 05 **SEE Duration: 3+3Hrs**

Course Learning Objectives (CLO):
Student will be able to:
1. Measure pressure and its variations in static fluids
2. Identify the various types of fluid and explain its flow behavior
3. Analyze the fluid flow in different conduits, open channels and estimate energy requirements
4. Predict time of emptying tanks
5. Measure flow rates using appropriate measuring instruments.
6. Identify suitable fittings, valves, and pumps in transportation of fluid
7. Evaluate factors influencing fluid flow pattern
8. Obtain functional relationships using dimensional analysis

UNIT – I **08 Hrs**

Fluid Statics and its Applications: Concept of Momentum Transfer, Nature of fluids, Pressure concept, Variation of pressure with height – hydrostatic equilibrium, Barometric equation, Measurement of fluid pressure – manometers. Decanter: Continuous gravity and Centrifugal decanters.
Fluid Flow Phenomena: Types of fluids – shear stress and velocity gradient relationship Newtonian and non – Newtonian fluids, Viscosity of gases and liquids. Types of flow – laminar and turbulent flow, Reynolds stress, Eddy viscosity. Flow in boundary layers, Reynolds number, Boundary layer separation and wake formation.

UNIT – II **07 Hrs**

Basic Equations of Fluid Flow: Average velocity, Mass velocity, Continuity equation, Euler and Bernoulli equations, Modified equations for real fluids with correction factors. Pump work in Bernoulli equation.

UNIT – III **07 Hrs**

Flow of Incompressible Fluids in Conduits and Thin Layer: Laminar flow through circular and non-circular conduits, Hagen Poiseuille equation, Laminar flow of non-Newtonian liquids. Turbulent flow in pipes, Friction factor charts, friction due to change in velocity or direction. Friction losses in Bernoulli equation. Flow of fluids over flat plate.

Introduction to Unsteady State Flow: Time to empty the liquid from a tank, Rectangular, Cylindrical (Horizontal and Vertical) and Hemi spherical.

UNIT – IV **07 Hrs**

Transportation and Metering of Fluids: Pipes, Fitting and valves, Measurement of liquid and gas flow rates by Pitot tube, Orifice meter, Venturi meter and Rota meter. Flow through open channels–weirs and notches. Performance characteristics of pumps–positive displacement and centrifugal pumps. Fans, Compressor and Blowers.

UNIT – V **07 Hrs**

Dimensional Analysis: Dimensional homogeneity, Rayleigh's and Buckingham π – methods. Significance of different dimensionless numbers. Elementary treatment of similitude between model and prototype.
Flow of Compressible Fluids: Continuity equation, Concept of Mach number, Total energy balance, Velocity of sound, Ideal gas equations. Flow through variable-area conduits. Adiabatic frictional flow. Isothermal frictional flow (elementary treatment only)

Course Outcomes:
After completion of the course, students will be able to
1. Recall the concepts of fluid statics and dynamics
2. Explain the fundamental equations of fluid flow
3. Apply fluid flow principles in flow measurement, transportation and energy losses
4. Analyse the flow behavior in various geometries and situations
5. Estimate the power requirements for transportation of fluids
6. Select appropriate pipe fittings, flow measuring instruments and fluid moving machinery

Self Study:
Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus.

Reference Books:

1. McCabe and Smith W.L., "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, New York, 2007.
2. Coulson J.M. and Richardson J.F., "Chemical Engineering" Vol.2, 5th Edition, Asian Books (P) Ltd., New Delhi, 2003.
3. Badger W.I. and Banchero J.T., "Introduction to Chemical Engineering", 7th Edition, Tata McGraw Hill, New York, 2007.
4. Kumar K.I. "Engineering Fluid Mechanics", 3rd Edition, Eurasia Publishing House (P) Ltd., New Delhi, 2009.

Scheme of Continuous Internal Evaluation for Theory:
CIE consists of Three Tests, each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition twenty marks to be earned through self learning component in emerging topics.

Laboratory Component

List of experiments:
1. Flow through circular pipes
2. Flow through helical coils
3. Flow measurement using Venturi meter
4. Flow measurement using Orifice meter
5. Local velocity measurement using Pitot tube
6. Flow over notches
7. Determination of Hydraulic coefficients
8. Flow through Packed bed
9. Flow through Fluidized bed
10. Performance study of centrifugal pump
11. Flow through pipe fittings
12. Flow measurement of compressible fluids
13. Performance study of Air lift pump
14. Performance study of Positive displacement pump
15. Flow through non circular pipes

Scheme of Continuous Internal Evaluation for Practical's:
- Students will be conducting experiments which will carry 40 marks. Viva voce will be for 10 marks. Total marks obtained will be reduced to 30 marks.
- Test evaluation is for 20 marks.

Cumulative continuous evaluation (30 marks for regular practical work and 20 marks for test = 50 marks).

Scheme of Semester End Examination for Theory:
The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

Scheme of Semester End Examination for Practicals:
A student is expected to conduct an experiment in the practical exam. The procedure and write up is evaluated for 10 marks, Experimental conductions are evaluated for 30 marks and viva voce is for 10 Marks.

Total marks will be, 10 + 30 + 10 = 50 marks

Particulate Technology

Course Code: 12CH34 **CIE Marks: 100+50**
Hrs/Week: L:P:T:S 3:2:0:4 **SIE Marks: 100+50**
Credits: 05 **SEE Duration: 3+3Hrs**

Course Learning Objectives (CLO):
Student will be able to:

1. Analyze particle size of coarse, medium and fine sized particles
2. Choose appropriate equipments for size reduction and estimate power requirements
3. Determine the settling velocity of particles in fluids and design thickeners
4. Analyze packed and fluidized beds,select suitable filtration equipment
5. Estimate power requirements for agitation and mixing equipments and analyze conveying equipments

UNIT – I **06 Hrs**

Particle Technology: Particle shape and size, shape factor and sphericity. Standard screens, differential and cumulative sieve analysis, Number of particles and specific surface of mixture of particles. Screens – ideal and actual screens, Effectiveness of screen, industrial screening equipment, Motion of screen, Grizzly, Gyratory screen, Vibrating screen, Trommels, Sub sieve analysis – Air permeability method, Sedimentation and elutriation methods.

UNIT – II **08 Hrs**

Size Reduction: Forces and criteria for communition, characteristics of comminuted products. Laws of size reduction, Work Index.. Methods of operating crushers – Free crushing, Choke feeding, Open circuit grinding, Closed circuit grinding, Wet and dry grinding, Equipments for size reduction – Blake jaw crusher, Gyratory crusher, Smooth roll crusher, Toothed roll crusher, Impactor, Attrition mill, Ball mill- Critical speed of ball mill, Ultra fine grinders, Fluid energy mill, Colloid mill, Cutters – Knife cutter.

Sampling and Storage and Conveying of Solids: Sampling and storage of solids, Open and closed storage, Bulk and bin storage, Conveyors – Belt conveyors, Chain conveyors, Apron conveyor, Bucket conveyor, Bucket elevators, Screw conveyor.

UNIT – III **08 Hrs**

Motion of Particles through Fluids: Mechanics of particle motion, equation for one dimensional motion of particles through a fluid in gravitational and centrifugal field. Terminal velocity, Drag coefficient, Motion of spherical particles in Stoke's region, Newton's region and Intermediate region, Criterion for settling regime, Hindered settling, Modification of equation for hindered settling, Centrifugal separators, Cyclones and Hydro cyclones. Sedimentation: Batch settling test, Application of batch settling test to design of a continuous thickener, Coe and Clevenger theory, Kynch theory Thickener design Application to Environmental Engineering.

UNIT – IV **08 Hrs**

Flow of Fluids Past Immersed Bodies: Pressure drop studies in packed bed –Ergun, Kozeny-Carman and Blake-Plummer Equations, Fluidization, Conditions for fluidization, Minimum fluidization velocity, Types of fluidization, Applications of fluidization, Slurry transport, Pneumatic conveying

Filtration: Classification of filtration, Batch and continuous filtration, pressure and vacuum filtration Constant rate, constant pressure filtration characteristics of filter media, industrial filters, sand filter, Filter press, leaf filter, Rotary drum filter, Horizontal belt filter, Bag filter, Centrifugal filtration–Suspended batch centrifuge, Filter aids, Principles of cake filtration, Modification of Kozeny – Carman Equation for filtration. Estimation of cake resistance and medium resistance.

UNIT – V **08 Hrs**

Agitation and mixing: Application of agitation, Agitation equipment, Types of impellers – Propellers, Paddles and Turbines, Flow patterns in agitated vessels, Prevention of swirling, Standard turbine design, Power correlation and power calculation, Mixing of solids, Types of mixers – Change can mixers, Muller mixers, Mixing index, Ribbon lender, Internal screw mixer, Tumbling mixer.

Miscellaneous Separation: Magnetic separation, electrostatic separation, Jigging, Heavy media separation, Froth floatation process, Additives used during flotation, Floatation cells, Typical floatation circuits, Size enlargement (only principle and equipment) – Flocculation, Briquetting, Pelletization, Granulation.

Course Outcomes:

After completion of the course, students will be able to

1. Know the various standard screens and undertake the size estimation of particulate solids.
2. Identify the appropriate size reduction equipment, conveying mechanism and calculate the settling velocity of the particles.
3. Calculate the area of thickener, pressure drop in fluidizing and filtration units, velocity of particles in motion.
4. Conduct batch sedimentation test, analyze the results.
5. Compare the various size reduction, conveyors, filtration, mixers and agitation Equipments.
6. Design thickener, packed and fluidized bed, compare and select appropriate filtration, agitation and mixing unit

Self Study:

Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus.

Reference Books:

1. McCabe and Smith W.L., "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, International, New York, 2007.
2. Badger W.L., and Banchero J.T., "Introduction to Chemical Engineering" 7th Edition., McGraw Hill, International Edition, Singapore, 2005.
3. Coulson J.M. and Richardson J.F., "Coulson and Richardson's Chemical Engineering Vol. 2, 5th Edition, Asian Books Pvt. Ltd. New Delhi, 2002.
4. Brown G.G., "Unit Operations" 1st Edition., CBS Publishers, New Delhi, 2009.
5. Perry R. and Green W.D., "Perry's Chemical Engineer's Hand book", 8th Edition, McGraw Hill, International Edition, New York, 2000.

Scheme of Continuous Internal Evaluation for Theory:

CIE consists of Three Tests, each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition twenty marks to be earned through self learning component in emerging topics.

Laboratory Component

List of experiments

1. Sieve analysis and Screen effectiveness studies
2. Particle Size Analysis using Air Elutriator
3. Particle Size Analysis using ICI sedimentation
4. Particle Size Analysis using Beaker decantation
5. Determination of Specific surface area using Air permeability set up
6. Verification of Laws of size reduction using Ball mill
7. Verification of Laws of size reduction using Jaw crusher
8. Verification of Laws of size reduction using Drop weight crusher
9. Design of Thickener
10. Separation of solids using Cyclone
11. Heavy media Separation using Froth floatation cell
12. Determination of specific cake and medium resistance using Leaf filter
13. Determination of specific cake and medium resistance using Plate and frame filter press
14. Determination of Grindability Index
15. gyrator

Scheme of Continuous Internal Evaluation for Practicals:

- Students will be conducting experiments which will carry 40 marks. Viva vice will be for 10 marks. Total marks obtained will be reduced to 30 marks.
- Test evaluation is for 20 marks.

Cumulative continuous evaluation (30 marks for regular practical work and 20 marks for test = 50 marks).

Scheme of Semester End Examination for Theory:
The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

Scheme of Semester End Examination for Practicals:
A student is expected to conduct an experiment in the practical exam. The procedure and write up is evaluated for 10 marks, Experimental conductions are evaluated for 30 marks and viva voce is for 10 Marks.

Total marks will be, 10 + 30 + 10 = 50 marks

Thermodynamics

Course Code: 12CH35 **CIE Marks: 100**
Hrs/week: L:P:T:S 3:0:2:4 **SEE Marks: 100**
Credits: 05 **SEE duration: 03 Hrs**

Course Learning Objectives (CLO):
Student will be able to:

1. State first and second law of thermodynamics and solve problems using these laws in various systems
2. Perform feasibility studies on chemical engineering processes
3. Examine the behavior of ideal and non ideal gases and solutions
4. Review the thermodynamic principles in bio-reactors

UNIT – I **07 Hrs**

Introduction: The Scope of Thermodynamics, Dimensions and units, Measures of amount size, force, temperature, pressure, work, energy, Heat.

The First Law and other basic concepts: Joules experiments, Internal energy, The first law of thermodynamics, energy balance for closed systems, Thermodynamic state and state functions, Equilibrium, the phase rule, the reversible process, constant –V and constant-P Processes, Enthalpy, Heat capacity, mass and energy balance for open systems.

UNIT – II **07 Hrs**

The Second Law of Thermodynamics: Statement, heat engines, heat pumps, Thermodynamic temperature scales, Entropy, entropy changes for ideal gas, mathematical statement for second law: Clausius and Kelvin's inequality, Entropy balances for open systems, Calculation of ideal work, lost work, The third law of thermodynamics.

Thermodynamic Properties of Fluids: Property relations, residual properties, residual properties by equations of state, two phase systems, thermodynamic diagrams.

UNIT – III **08 Hrs**

Vapor/Liquid Equilibrium: Introduction: The nature of equilibrium, The phase rule, Duhem's theorem, Simple models for vapor liquid equilibrium, VLE by modified Raoult's Law.

Solution Thermodynamics: Fundamental property relation, The chemical potential and phase equilibria, partial properties, fugacity and fugacity coefficient: Pure species, species in solution, generalized correlation for the fugacity coefficient, Ideal solution model, excess properties.

UNIT – IV **07 Hrs**

Heat Effects: Sensible Heat effects, latent heat of pure substances, standard heat of reaction, formation, combustion, temperature dependence of ΔH.

Solution thermodynamics: Applications, Liquid phase properties from VLE data, Models for excess Gibbs energy, consistency test for VLE data, Property changes of mixing, Heat effects of mixing.

UNIT – V **10 Hrs**

Chemical Reaction Equilibria: 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 system, multi reaction equilibria.

Biochemical Thermodynamics: Acidity of solutions, Ionization of bio-chemicals, solubility's of weak acids and weak bases. Protein concentration in an ultra centrifuge, Gibbs Donnan equilibrium and membrane potentials, ATP-ADP energy storage mechanism, Thermodynamic analysis of fermentors.

Course outcomes:

After completion of the course, students will be able to

1. Recall the Laws of thermodynamics
2. Explain heat, work, entropy, internal energy and determine changes of all these in cyclic and non-cyclic processes
3. Calculate the thermodynamic properties of pure substances, solutions (two phase) and mixtures involving reactions
4. Evaluate heat, work involved in processes and estimate heat –work inter-conversions
5. Formulate thermodynamic properties for equipment design
6. **Self Study:**
   Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus

Reference Books:

1. Smith J.M. and Vanness H.C., "Introduction to Chemical Engineering Thermodynamics", 6th Edition, McGraw Hill, New York, 1998.
2. Rao Y.V.C., "Chemical Engineering Thermodynamics", 2nd Edition, 4th Reprint, New Age International Publication, Nagpur, 2009.
3. Narayanan K.V., "Textbook of Chemical Engineering Thermodynamics", 3rd Edition, 8th Reprint, Prentice Hall of India Private Limited, New Delhi, 2006.
4. Nag P.K., "Engineering Thermodynamics", 3rd Edition, Tata McGraw Hill Book Co., New Delhi, 2007.
5. Sundaram S., "Chemical Engineering Thermodynamics", 2nd Edition, Ahuja Book Company Pvt. Ltd, New Delhi, 2007.
6. Stanley I Sandler, Chemical, Biochemical and Engineering Thermodynamics, 4th Edition, Wiley India, New Delhi, Reprint 2006.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests, each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition twenty marks to be earned through self learning component in emerging topics.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily

Technical Chemistry

Sub Code	**: 12CH36**	**CIE Marks**	**: 100+50**
Hrs / Week	**: L:P:T:S:3:2:0:4**	**SEE Marks :**	**100+50**
Credits	**: 05**	**Exam hours:**	**3+3**

Course Learning Objectives (CLO):

student will be able:

1. To apply the basic concepts of Chemistry to develop futuristic materials for high-tech applications in the area of Chemical Engineering.
2. To organize the knowledge of chemistry to study and exploit the available energy resources towards the National growth.
3. To develop synthetic and analytical techniques involved in ascertaining the chemical structures and its reactive tendencies.
4. To develop better technology for manufacturing soaps and detergents and insecticides.
5. To create and develop new electrochemical devices for the application of Engineering and Technology.
6. To evaluate various corrosion situations and implement suitable corrosion control measures.
7. To be aware of synthesis and estimation of industrially important chemicals.

UNIT – I **08 Hrs**

Reaction Mechanism: Electron displacements in organic molecules – inductive, electromeric, mesomeric and hyper conjugative effects – Reaction intermediates- Carbocation, Carbanion & Free radicals- Formation, stability reactivity and examples. Types of reactions- substitution, addition and rearrangements. Mechanism, Kinetics and stereochemistry of S_N1, S_N2, E_1 and E_2 reactions. Aromatic electrophillic substitution reactions - Friedel Crafts alkylation, Friedel Crafts acylation, Nitration, Sulphonation. Orientation effect of substituents in aromatic electrophillic substitution of toluene, nitrobenzene, phenol and benzenesulphonic acid.

UNIT – II **07 Hrs**

Active Methylene Compounds: Preparation, reactivity and applications of Ethyl acetoacetate and Diethyl Malonate.

Heterocyclic Compounds: Synthesis, properties and applications of Thiophene, Pyridine, Indole, Quinoline and Quinine.

Insecticides: Manufacture of DDT, BHC, Malathion and Baygon.

UNIT – III **08 Hrs**

Dyes: Colour and its relation with electromagnetic radiation. Chromophore, Chromogen and Auxochrome. Modern theory of colour. Classification of dyes- based on structure & methods of application. Preparation of azo dyes- Congored, and Methyl orange. Tertiaryamine dyes – Malachitegreen and Phenolphthalein. Anthraquinone dyes- Alizarin and Indigo.

Bio-inorganic Chemistry Definition, functional role of biological inorganic elements, Fe, Cu, Zn, Co, Mn and Mo in living systems. Redox mechanism in biological system.

UNIT – IV **06 Hrs**

Theory of Dilute Solutions: Introduction: colligative properties-meaning, types, Raoult's law, vapour pressure and boiling point. measurement of lowering of vapour pressure by Oswaltd-walker's method. Elevation in boiling point-relation between boiling point elevation-Landsberger Walker's method, numerical problems. Functioning of semi permeable membranes, preparation of cupric ferrocyanide membrane, measurement of osmatic pressure by Berkely-Hartley's method, Isotonic solution, depression in freezing point-relation with lowering of vapour pressure and molar mass, measurement of freezing point depression by Beckmann's method. Abnormal colligative properties in solutions.

UNIT – V **09 Hrs**

Coordination Chemistry: Introduction to Coordination chemistry Terminologies, Isomerism in coordination compounds-structural and stereo isomerism. Theories for bonding coordination compounds-Valence bond theory, Crystal field theory-salient features, applications, Crystal filed splitting of d-orbitals in octahedral, tetra hedral and square planar complexes. Factors influencing the formation & stability of coordination complexes. John Tellar effect. Ligand filed theory-salient features

Laboratory

1. Preparation of acetanilide from aniline.
2. Preparation of benzoic acid from benzaldehyde.
3. Preparation of m-Dinitro benzene from Nitrobenzene
4. Estimation of phenol by bromination method.
5. Estimation of the percentage amine and number of amine groups by acetyltion method.
6. Estimation of HCl and CH_3COOH in a given acid mixture conductometrically.
7. Determination of partition coefficient of iodine between water and CCl_4.
8. Study of the kinetics of the reaction between $K_2S_2O_8$ and KI.
9. Determination of Nickel as Nickel dimethyl glyoximate gravimetrically (after separating iron) in the given stainless steel solution.
10. Determination of molecular weight of a non volatile solute by elevation in boiling point (using Mc Coy's apparatus).

Course Outcomes:

After completion of the course student will be able to:

1. Understand the fundamentals of bonding and relate them the structure, reactivity, properties and stability
2. Explain the properties of organic and inorganic compounds based on general chemical principles and with examples
3. Apply the concepts to produce new compounds for various applications
4. Examine the validity of the chemistry concepts through experimentation and problems solving.
5. Justify the chemical processes and predict the behavior of any new substance of Engineering importance
1. **Self Study:**
   Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus

Reference Books:

1. Organic Chemistry, Morrison B.R. and Boyd L.L., 6th Edition, ELBS, New Delhi, 2007, ISBN – 81-7381-141-4
2. Physical Chemistry, Puri L.R. and Sharma B.R., 14th Edition, Chand S. and Co., New Delhi 1998 ISBN-13, 9788188646005
3. Inorganic Chemistry, J E Huheey, E A Keiter and R L Keiter, 4th Edition, Harper and Row Publishers 1997 ISBN-13: 978-0471199571
4. Bioinorganic Chemistry by Harry B. Gray & Steephen J. Lippard ISBN-10: 0935702725

Scheme of continuous Internal Evaluation:

CIE consists of three Test each for 40 marks (15marks for Quiz+25marks for descriptive) out of which best of two will be considered. In addition twenty marks to be earned through self learning component in emerging topics.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

In the laboratory the student is required to answer/ perform one question.

Bridge Course Mathematics – I

Course Code: 12MA37 **CIE Marks: 100**
Hrs/Week: L:T:P : 2:0:0 SEE Marks:100
Audit course SEE : 3Hrs

Course Learning Objectives:
Student will be able to:

- Apply the knowledge of ordinary and partial differentiation in engineering and real life problems;
- Learn how to formulate and interpret a Taylor series approximation of a function.
- Make the student to learn the concepts of vector analysis.
- Recognize and model differential equations, apply analytic techniques to compute solution for engineering problems.

UNIT – I

Differential Calculus:
Successive differentiation, n^{th} derivatives of standard functions, Leibnitz's theorem. Taylor's series and Maclaurin's series for function of single variable (all results without proof).

UNIT – II

Partial Differentiation:
Introduction-partial derivatives, total derivative, differentiation of composite and implicit functions. Jacobians and problems.

UNIT – III

Ordinary Differential Equations:
Solution of first order and first degree differential equations - variable separable methods homogeneous, linear, Bernoulli, exact equations (without integrating factor).

UNIT – IV

Linear Ordinary Differential Equations of Second and Higher Order:
Linear differential equations of higher order with constant coefficients. Solution by inverse differential operator method. Solution by method of variation of parameters.

UNIT – V

Vector Analysis:
Vector Algebra - Vector addition, Multiplication (dot, cross & triple products), Vector differentiation – velocity, acceleration of a vector point function.

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

- Use the concept of functions of several variables and their partial derivatives for computing the areas, volumes using multiple integrals.
- Ability to apply concept of differential equations to handle physical problems.

Reference Books:

1. B. S. GREWAL, "Higher Engineering Mathematics", Khanna Publications, 40^{th} Edition 2007.
2. N. P. BALI, MANISH GOYAL "A Text Book of Engineering Mathematics", Laxmi Publications, 7^{th} Edition, 2007.
3. B. V. RAMANA "Higher Engineering Mathematics", Tata Mc Graw Hill Publications, 2007.
4. E- KREYSZIG "Advanced Engineering Mathematics", John Wiley & Sons Publications, 8^{th} Edition, 2007.

Scheme of Continuous Internal Evaluation:
CIE consists of Two Tests each for 50 marks (20 marks for Quiz + 30 marks for descriptive).

Scheme of Semester End Examination:
The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

Semester - IV
Applied Mathematics IV

Course Code: 12MA41 **CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:2:0:0 **SEE Marks: 100**
Credits: 04 **SEE : 3 Hrs**

Course Learning Objectives:
Student will be able to:

- Provide basic definitions and theorems of the calculus of complex functions which are involved in any field problems of Engineering.
- Use of Bessel functions and Legendre polynomials and their properties in Heat, wave and Laplace equations with cylindrical and spherical symmetry.
- The theory of probability in study of random phenomena, analyzing and interpreting data that involves uncertainities.
- Apply linear programming techniques for optimization problems subject to linear constraints in the various areas of Engineering & Science.
- A student will be able to find the solution of partial differential equations which arise in physical situations.

UNIT – I **07 Hrs**

Complex Analysis: Complex variables - Function of a complex variable, analytic functions-Cauchy-Riemann equations in cartesian and polar forms (without proof), properties of analytic functions, construction of analytic functions by Milne-Thomson method.
Complex integration - Complex line integrals-Cauchy's theorem and corollaries (without proof), Taylor's and Laurent's series (statements only), singularities, poles, residues, residue theorem (without proof) - problems.

UNIT – II **07 Hrs**

Special Functions: Introduction of Bessel's and Legendre's differential equation using the solution of Laplace equation in cylindrical and spherical system. Series solution of Bessel's differential equation leading to Bessel function of first kind, recurrence relations, generating functions, Bessel's integral formula, orthogonality of Bessel function. Legendre's differential equation, Legendre polynomials, Rodrigue's formula.

Unit – III **07 Hrs**

Linear Programming Problem: Mathematical formulation of Linear Programming Problem, Graphical method, Simplex method and Big M method.

UNIT – IV **07 Hrs**

Probability and Distributions: Basics of Probability: Sample Space, events, probability of an event, addition theorem. Conditional probability, Multiplication theorem, Baye's rule. Random Variables: Discrete and continuous, Probability mass function, Probability density function, Cumulative density function, Mean, Variance, standard deviation Binomial, Poisson, Exponential and Normal Distributions.

UNIT – V **07 Hrs**

Partial Differential Equations: Classification of second order Partial differential equations - Elliptic, Parabolic and Hyperbolic. Solution of two dimensional Laplace equation in polar coordinates by the method of separation of variables. Solution of two dimensional heat flow in transient state and steady state. Solution of two dimensional wave equation by the method of separation of variables. Vibrating membrane, solution in the case of rectangular and circular membrane - Simple problems.

Course outcomes:

After completion of the course student will be able to:

1. Understand the constantly evolving nature of engineering problems and identify the need for awareness of latest developments in engineering fields.
2. Apply the new techniques for solving complex engineering problems analytically and numerically.
3. Analyze and interpret the random phenomena and physical phenomena which find importance in engineering applications.
4. Evaluate analytical and quantitative skills and improve their problem solving and logical reasoning capabilities
5. Ability to combine the varies mathematical concepts, predict suitable model and create appropriate mathematical methods.

Reference Books:

1. B.S. Grewal - Higher Engineering Mathematics, Khanna Publishers, 40th Edition, 2007, ISBN: 81-7409-195-5, Chapters: 16, 17, 19, 20, 26 and 33.
2. N.P Bali & Manish Goyal - A Text Book of Engineering Mathematics, Lakshmi Publications, 7th Edition, 2010, ISBN: 978-81-7008-992-6,Chapters: 15, 16, 21.
3. Erwin Kreyszig - Advanced Engineering Mathematics, John Wiley & Sons, 9th Edition, 2007, ISBN: 978-81-265-3135-6, Chapters: 4, 11, 12, 20 and 22.
4. Seymour Lipschutz & Marc Lars Lipson- Theory and Problems of Probability, Schaum's Outline Series, 2nd Edition, ISBN: 0-07—118356-6, Chapters: 1, 2, 3, 4, 5and 6.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

Environmental Science and Biology for Engineers

Sub Code: 12EB42 **CIE Marks: 100**
Hrs/week: L:P:T:S 3:0:0:4 **SEE Marks: 100**
Credits:04 **SEE duration: 03 Hrs**

Course Learning Objectives:
Student will be able to:

1. To inculcate awareness on environmental, societal, ethical, health and safety issues and their relevance in engineering.
2. To encourage for optimal resource utilization and sustainable life styles.
3. To promote environmental design and simulation concept.
4. To understand different biomolecules, components of cells and various physiological systems.
5. To trigger innovative thinking at the interface of biological phenomena

UNIT – I **06 Hrs**

Ecosystems and Environment: Principles of ecosystem, impact of human being on environment: pollution, resource depletion and global environmental issues, ecosystem health and environmental changes and human health. Procedure to assess ecosystem's health. Standards- ISO14000 and Environmental Impact Assessment – definition, objectives, and types. Rapid and Comprehensive Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS) and Finding Of No Significant Impact (FONSI). Some EIA examples –Thermal Power Plant, Construction Projects, Water and Wastewater Treatment Plants.

UNIT – II **10 Hrs**

Strategies and Technology- based Solutions for Improvement of Environment Quality: Environment quality objectives and 'Waste challenge' in modern society - types of waste: municipal, agricultural, medical, E-waste, industrial, nuclear. Engineering ethics, 3 R's – Reduce, Reuse & Recycle, and Sustainable waste management: Compacting, drying, ,composting, bioremediation, biodegradation (chemicals and oil spillage). Waste to energy – energy recovery by incineration, bio-gasification, gasification and pyrolysis, bioconversion to clean energy (biofuels). Some examples: Upflow anaerobic sludge blanket (UASB) digestion for waste water treatment and biogas production. **Technology for cleaner environment :** SO_2/CO_2 reduction by smoke-scrubber in coal thermal plants, chlorofluorocarbon (CFC) and incandescent bulb replacement, Renewable energy sources – wind, solar, tidal waves and biomass. Overview of emerging technologies.

UNIT – III **06 Hrs**

Design and Modeling for Development of Environment:

Environmental Design: Principles, benefits and motivation. Environmental design for manufactured products, building and for developmental planning. Systems Engineering – Analysis - Design – synthesis - applications to environmental Engineering Systems.

Environmental Modeling: Introduction, forecast modeling and growth modeling, sensitivity analysis. Application of remote-sensing and geographic information systems (GIS) in environmental modeling.

UNIT – IV **06 Hrs**

Introduction to cell and organ systems: Cell Types: Structure of plant, animal and microbial cell and Specialized cells like stem cells and nerve cells. Biological macromolecules: Carbohydrates, proteins and nucleic acids and Special biomolecules – hormones, enzymes, vitamins and antibiotics. Introduction to organ systems for example digestive, respiratory, excretory nervous and circulatory. Nervous Control and coordination, sensory organs: Auditory, vision, olfactory, touch and taste.

UNIT – V **08 Hrs**

Bio-Inspired engineering (BIE) or Bionics: Biological phenomena and innovative engineering. Introduction to Bioelectronics, Biocomputing, biophotonics and biomechatronics. Locomotion and Bio-inspired Robotics, Prosthesis and biomedical implants, Aerodynamics and flight muscle functioning (birds & Drosophila). **Signaling**: Enzymes and recognition receptors in biosensors; Neurotransmission and neural networks (artificial intelligence, signal processing and imaging); Bioelectric signals and cardiac generator. **Sound**: Ultrasonics in biology (echolocation in bats, sonar in whales & dolphins) and instrumentation (medical ultrasonography - ultrasound imaging).**Light**: Photosynthesis and photovoltaic cells

Course outcomes:
After completion of the course student will be able to:

1. Comprehend the principles of biology and environment.
2. Analyze the environmental, societal, ethical, health and safety issues of anthropogenic activities.
3. Appraise the elements of environmental designs and models and examine their significance in sustainable development.
4. Evaluate the technical solution at the interface of engineering and biology.

References:

1. Vijay Kulkarni and T. V. Ramachandra 2009. Environment Management. TERI Press; ISBN: 8179931846, 9788179931844
2. Gerald Kiely 1997. Environmental Engineering. McGraw-Hill; ISBN: 9780077091279
3. Sven Erik Jørgensen 2002. Integration of Ecosystem Theories: A Pattern Ecology & Environment; Edition 3, Springer; ISBN: 1402007558, 9781402007552
4. Linvil Gene Rich 2003. Environmental Systems Engineering, McGraw-Hill; ISBN: 9780070522503
5. Ni-Bin Chang: Systems Analysis for Sustainable Engineering: Theory and Applications (Green Manufacturing & Systems Engineering). McGraw-Hill Professional, 2011, ISBN: 0071630058, 9780071630054
6. Larry Canter 1995. "Environmental Impact Assessment", McGraw-Hill. ISBN: 0070097674

Self Study **12 Hrs**

Case study, design and emerging technologies to be discussed pertaining to the course. 1 credit: 4 Hrs/week

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition twenty marks to be earned through self learning component on Emerging Topics.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

Process Heat Transfer

Course Code: 12CH43 **CIE Marks: 100+50**
Hrs/Week: L:P:T:S 3:2:0:0 **SEE Marks: 100+50**
Credits: 04 **SEE Duration : 3 +3 Hrs**

Course Learning Objectives (CLO):

Student will be able to:

1. Recognize modes of heat transfer
2. Explain heat flux, thermal resistances and temperature profiles for various geometries
3. Predict and estimate the properties, heat transfer co-efficient and dimensions of components of heat exchange equipment
4. Select appropriate materials, geometry and flow pattern in various heat transfer applications
5. Design heat transfer equipments and components for various applications

UNIT – I **07 Hrs**

Introduction: Various modes of heat Transfer. Conduction, Convection and Radiation

Conduction: Fourier's law, Steady state unidirectional heat flow through single and multiple layer slabs, cylinders & spheres for constant and variable thermal conductivity compound walls, Numerical Problems.

Insulation: Properties of insulation materials. Types of insulation, Critical and optimum thickness of insulation.

UNIT – II **08 Hrs**

Unsteady State Conduction: Elementary treatment of 1-Dimensional and 2-Dimensional.

Extended Surfaces: Fins- Types of fins-Derivation of fin efficiency for longitudinal fins. Fin effectiveness.

Convection: Individual and Overall heat transfer coefficients- LMTD, LMTD correction factor, Dimensional numbers-Dimensional analysis Empirical correlations for forced and natural convection. Analogy between momentum and heat transfer-Reynold's, Coulburn and prandtl analogies.

UNIT– III **07 Hrs**

Heat Transfer with Phase Change: Boiling phenomenon, nucleate boiling and film boiling, Condensation-Film and drop wise condensation. Nusselts equation.

Heat Transfer Equipment: Double pipe heat exchanger. Shell and tube heat exchangers. Types of shell and tube heat exchangers, Construction details, Condensers, type of condensers.

Design of Heat Transfer Equipment: Elementary design of double pipe heat exchanger. Shell and tube heat exchanger and condensers.

UNIT – IV **07Hrs**

Evaporators: Types of evaporators, Performance of tubular evaporator- evaporator capacity, evaporator economy, Multiple effect evaporators- Methods of feeding-Effect of Liquid head and boiling point elevation on capacity. Process Design of evaporators, Vapor compression evaporation.

UNIT – V **07 Hrs**

Radiation: Properties and definitions-Absorptivity-Reflectivity-Emissivity-Emissive power and intensity of radiation-Black body radiation-Gray body radiation- Stefan-Boltzmann law, Weins displacement law, Kirchoff's law, View factors, Radiation between surfaces, Radiation involving gases and vapors, Radiation shields.

Course outcomes:

After completion of course students will be able to:

1. Recall the fundamentals of various modes of heat transfer
2. Explain heat flux, thermal resistances and temperature profiles
3. Apply laws of heat transfer to various processes
4. Analyze thermal, flow and material properties of heat transfer systems
5. Determine heat flux, thermal resistance and temperature distribution in heat transfer systems
6. Design various components and heat transfer equipments

Reference Books:

1. McCabe and Smith W.L., "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, New York, 2007.
2. Coulson J.M and Richardson J.F., "Unit Operations of Chemical Engineering" Vol.1, 6th Edition, Indian Reprint Elsevier New Delhi, 2006.
3. Kern D.Q., "Process Heat Transfer", Mc Graw Hill, New York, 7th Edition. 2004.
4. Rao Y.V.C., "Heat Transfer", 1st Edition, Universities Press (India) Ltd., New Delhi, 2001.

Scheme of Continuous Internal Evaluation for Theory:

CIE consists of Three Tests, each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition twenty marks to be earned through self learning component in emerging topics.

Scheme of Semester End Examination for Theory:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily

Laboratory Component

List of experiments

1. Natural Convection in Bare Tube
2. Natural Convection in Tubes with Fins
3. Vertical Condenser
4. Horizontal Condenser.
5. Shell and Tube Condenser
6. Emissivity Determination
7. Packed Bed Heat Transfer
8. Double Pipe Heat Exchanger.
9. Heat Transfer in Jacketed Vessel
10. Transient Heat Conduction
11. Insulation Thickness
12. Heat Transfer in Fluidized Bed
13. Evaporator
14. Solar heater
15. Heat Transfer. in jacketed vessel

CIE for Practicals:

The Record is evaluated for 40 Marks and final test is conducted for 10 Marks.

SEE for Practical's:

A student is expected to conduct an experiment in the practical exam. The procedure & write up is evaluated for 10 marks, Experiment conduction is evaluated for 30 marks and viva voce is for 10 Marks.

Mass Transfer – I

Course Code : 12CH44 **CIE Marks: 100**
Hrs/Week : L:P:T:S 3:0:2:4 **SEE Marks: 100**
Credits : 05 **SEE Duration: 03 Hrs**

Course Learning Objectives (CLO):
Student will be able to:

1. Understand the fundamentals of inter- phase mass transfer
2. Provide an introduction to diffusion and separation processes for fluid mixtures.
3. Explain the principles of mass transfer and their application to separation and purification processes
4. Demonstrate an ability to design and analyze a mass transfer systems
5. Know the principle and operations of mass transfer equipment's.

UNIT – I **08 Hrs**

Molecular and Eddy Diffusion in Fluids: Fick's Law of diffusion, N and J type fluxes, measurement and calculation of diffusivities in stationary fluid, equi-molar counter diffusion, mass transfer coefficients and their correlations, analogies in transfer processes, theories of mass transfer, NTU and HTU concepts, diffusion in turbulent flow.
Diffusion of Solids: Fick's Law of diffusion in solids, Types of solid diffusion.

UNIT – II **08 Hrs**

Inter Phase Mass Transfer: Equilibrium diffusion between phases, Material balance analysis of single and multistage operations.

Crystallization: Solubility and Equilibrium curve, Material and energy balances, Factors governing nucleation and crystal growth rates, controlled growth of crystals, Design of Crystallizers.

UNIT – III **08 Hrs**

Humidification: Basic definitions, adiabatic saturation temperature. Humidification and dehumidification. Cooling towers-classification and design.

UNIT – IV **09 Hrs**

Drying: Equilibria, drying rate curves, batch and continuous drying equipments, mechanism of drying, and calculation of drying period for batch and continuous operations.

UNIT – V **08 Hrs**

Adsorption: Theories of adsorption, recovery of solvent vapours, industrial adsorbents, adsorption calculations and equipment.

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

1. Recall the basic concepts of the mass transfer
2. Understand the principles of mass transfer operations
3. Estimate diffusive fluxes and diffusivity co-efficient
4. Determine equilibrium stages in mass transfer operations
5. Design of cooling towers, humidification systems, adsorption equipment
6. Evaluate the performance of mass transfer equipment's

Self Study:
Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus.
Reference Books:

1. Robert E. Treybal., "Mass Transfer Operation", 5th Edition, Mc Graw Hill, New York, 2007.
2. McCabe and Smith W.L., "Unit Operations in Chemical Engineering", 7th Edition, Mc Graw Hill, New York, 2007.
3. Coulson and Richardson, "Chemical Engineering – Vol. 1 and 2", 6th Edition, Pergomen Press, 2003, Elsevier New Delhi, Indian reprint 2006.
4. Geankoplis. C.J., "Transport Processes and Unit Operations", Prentice Hall (I), 4th Edition, New Delhi, 2000.

Scheme of Continuous Internal Evaluation:
CIE consists of Three Tests, each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition twenty marks to be earned through self learning component in emerging topics.

Scheme of Semester End Examination:
The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

Reaction Engineering

Subject Code: 12CH45 **CIE Marks: 100**
Hrs/week: L:P:T:S 3:2:0:4 **SEE Marks: 100**
Credits: 05 **SEE duration:03 Hrs**

Course Learning Objectives (CLO):
Student will be able to:

1. Explain the kinetics of reactions and Interpret the kinetic data
2. Analyze batch, plug flow and mixed flow reactors for single and multiple reactions
3. Discuss non-ideality in reactors
4. Analyze non-isothermal reactors for single reactions

UNIT – I **08 Hrs**

Introduction: Classification, molecularity, order of reactions, rate equation, elementary and non-elementary reactions, kinetic models, Arrhenius law, collision and transition state theories.

Kinetics of Homogeneous Reactions: Differential, integral methods of analysis for constant volume and variable volume reactions, zero, first, second order irreversible reactions, first order reversible reactions, autocatalytic reactions, half life, total pressure method, shifting order.

UNIT – II **07 Hrs**

Reactor Design: Reactor Types: batch, semi batch, flow reactors, Design equations for ideal batch, ideal plug flow and mixed flow reactors for constant volume and variable volume reactions.

UNIT – III **08 Hrs**

Reactor Performance Evaluation: Comparison of reactors, evaluation of performance of reactors in series and parallel combination, size optimization of flow reactors.

Reactors for Multiple Reactions: Product distribution in parallel reactions, over-all and fractional yield, design of batch, plug and mixed flow reactors for series, parallel and series-parallel reactions.

UNIT – IV **08 Hrs**

Non-Ideality in Reactors: Basics of non-ideal flow, conversion in non-ideal flow reactors, dispersion model, tanks in series model, convection model.

UNIT – VI **06 Hrs**

Non-Isothermal Reactor Design: Design and simulation of adiabatic, batch, plug flow and mixed flow reactors, Introduction to reactors with heat exchange.

Part B: Laboratory

List of experiments

1. Batch Reactor
2. Plug Flow Reactor
3. Mixed Flow Reactor
4. RTD in Mixed Flow Reactor
5. RTD in Plug Flow Reactor
6. Semi batch Reactor
7. Temperature effect on kinetics
8. Multiple Reactors – PFR followed by MFR
9. Multiple Reactors – MFR followed by PFR
10. Biochemical Reactor
11. RTD in Packed Bed Reactor
12. Adiabatic Reactor
13. Sonochemical Reactor

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

1. Define and classify reactions and reactors
2. Interpret kinetic data obtained from reactors and fit rate equations
3. Prepares Material balance and energy balance for the reactors
4. Design ideal (isothermal and adiabatic) reactors for single and multiple reactions
5. Evaluate best reactor / combination of reactors for a given reaction
6. Model non-ideality in reactors and evaluate the performance

Reference Books:

1. O.Levenspiel, "Chemical Reaction Engineering", 3rd Edition, John Wiley and Sons, 2004
2. H. Scott Fogler, "Elements of Chemical Reaction Engineering", 2nd Edition, Prentice Hall, 2006
3. J. M. Smith, "Chemical Engineering Kinetics", 3rd Edition, Mc Graw Hill,1984

Scheme of CIE:
Theory:
The CIE consists of Three Tests each for 45 Marks (15 Marks for Quiz + 30 Marks for descriptive) out of which best of two will be considered. In addition, there will be seminar on recent trends/ model presentation/ Assignment etc. for 10 marks.

Practicals:
The Record is evaluated for 40 Marks and final test is conducted for 10 Marks.

Scheme of
SEE: Theory:
The question paper consists of Parts A and B. Part A will be for 20 Marks covering complete syllabus and is compulsory. Part B will be for 80 Marks and shall consist of 5 questions carrying 16 Marks each. All five questions from part B will have internal choice and one of the two have to be answered compulsorily.

Practicals:
A student is expected to conduct an experiment in the practical exam. The Procedure & Write up is evaluated for 10 Marks, Experiment Conduction is evaluated for 30 Marks and Viva Voce is for 10 Marks.

Process Principles and Calculations

Subject Code: 12CH46 **CIE Marks: 100**
Hrs/week: L:T:P:S 3:2:0:4 **SEE Marks: 100**
Credits: 05 **SEE duration: 03 Hrs**

Course Learning Objectives (CLO):
Student will be able to:
1. Convert one system of units to the other
2. Identify unit operations and their role in process industries
3. Calculate material and energy requirements for unit operations and process industries
4. Calculate energy released in reactions

UNIT – I **07 Hrs**

Units and Dimensions: Fundamental and derived units, inter conversion of units from one system to another
(FPS, CGS, MKS, SI). Conversion of equations.
Basic Chemical Calculations: Concept of mole and molecule, composition of mixtures of solids, liquids and gases. Composition of mixtures and solutions- percentage by weight, mole and volume. Normality, molarity, molality and ppm.

UNIT – II **07 Hrs**

Material Balance: Introduction to material and energy balances, equations for material and energy balances.
General material balance, techniques for material balance without reaction, problems on mixed acid, distillation, extraction and crystallization.

UNIT – III **07 Hrs**

Material Balance without Chemical Reactions contd: Material balance for evaporation, drying, absorption,
leaching.
Definitions of vapor pressure, partial pressure, relative saturation, percentage saturation, humidity, molal humidity, percentage humidity, psychrometry, simple problem solving using psychrometric charts. Material balance involving by pass, recycle and purge.

UNIT – IV **08 Hrs**

Material Balance Involving Chemical Reactions: Principle of stoichiometry, definitions of limiting and excess reactants, fractional and percentage conversion, yield, selectivity. Problems based on various unit processes. Fuels and combustion: ultimate and proximate analysis of fuels; Combustion calculations involving excess air and air-fuel ratio.

UNIT – V **07 Hrs**

Energy Balance: General energy balance equation for steady state. Thermo physics and thermo chemistry, heat capacity, estimation of heat capacity for solids, liquids, gases and their mixtures. Standard heat of formation, standard heat of reaction, Standard heat of combustion and calorific value of fuels. Calculation of ΔH_R at elevated temperature. Adiabatic reaction temperature and adiabatic flame temperature and their calculations.

Course Outcome:
After completion of the course the student's will be able to
1. Recall the fundamentals of process and process calculations.
2. Apply conservation principles to solve problems.
3. Explain the basic principles of unit operations.
4. Analyze the material and energy balance problems to draw the flow sheet.
5. Evaluate raw material requirements and energy requirements for the process.

Self Study:
Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus.

Reference Books:

1. Bhatt B. I. and Vora S. M., Stoichiometry, McGraw Hill, New Delhi, 4th Edition, 2004.
2. Himmelblau D.M., Basic Principles and Calculations in Chemical Engineering, Prentice Hall, New Delhi, 6th Edition, 2002.
3. Hougen O. A., Waston K. M. and Ragatz R. A., Chemical Process Principles Part–I, Material and Energy Balances, CBS Publishers and Distributors, New Delhi, 2nd Edition, 1995.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests, each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition twenty marks to be earned through self learning component in emerging topics.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

Bridge Course Mathematics – II

Course Code: 12MA48 **CIE Marks: 100**
Hrs/Week: L:T:P : 2:0:0 **SEE Marks:100**
Audit course **SEE: 3 Hrs**

Course Learning Objectives:
Student will be able to:

- Recognize partial differential equations and apply analytic techniques to compute solution for engineering problems.
- Apply the significance of vector differentiation and their theoretical importance in engineering problems.
- Apply the significance of Laplace transforms and inverse Laplace transforms and their theoretical importance in engineering problems.
- Identify and solve initial value problems, physically interpret the solutions using the Laplace transforms.

UNIT – I **06 Hrs**

Laplace Transforms:
Definition, transforms of elementary functions, properties, derivatives and integrals, unit step function.

UNIT – II **06 Hrs**

Inverse Laplace Transforms:
Inverse Laplace transforms- properties, convolution theorem (statement only) - problems. Solution of linear differential equations with constant coefficients.

UNIT – III **06 Hrs**

Integral Calculus:
Multiple integrals - Double and Triple integrals. Area enclosed by plane curves, Volume of solids. Definition of beta and gamma functions and problems.

UNIT – IV **06 Hrs**

Partial Differential Equations (PDE):
Formation of Partial differential equations by elimination of arbitrary constants/functions. Solution of Lagrange's linear PDE. Solution of PDE by the Method of separation of variables (first and second order equations).

UNIT – V **06 Hrs**

Vector Analysis:
Vector Differentiation - Scalar and vector point functions, gradient, directional derivative, divergence and curl. Solenoidal and Irrotational fields, Vector identities.

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

- The student will be able to solve problems arising in signal processing and various systems using Laplace transforms techniques for problems arising in signals and systems.
- The student will be able to apply vector integration to different Engineering applications.

Reference Books:

1. B. S. GREWAL, "Higher Engineering Mathematics", Khanna Publications, 40th Edition 2007.
2. N. P. BALI, MANISH GOYAL, "A Text Book of Engineering Mathematics", Laxmi Publications, 7th Edition, 2007.
3. B. V. RAMANA, "Higher Engineering Mathematics", Tata Mc Graw Hill Publications, 2007.
4. E- KREYSZIG, "Advanced Engineering Mathematics", John Wiley & Sons Publications, 8th Edition, 2007.

Scheme of Continuous Internal Evaluation:
CIE consists of Two Tests each for 50 marks (20 marks for Quiz + 30 marks for descriptive).

Scheme of Semester End Examination:
The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

Rashtreeya Sikshana Samithi Trust

R. V. COLLEGE OF ENGINEERING

(Autonomous Institution Affiliated to VTU, Belgavi)

R.V Vidyaniketan Post, Mysore Road

Bengaluru-560 059

Scheme & Syllabus

V & VI Semester B.E

CHEMICAL ENGINEERING

(2012 Scheme)

Department of Chemical Engineering

Vision

Imparting quality education in Chemical Engineering to promote leadership in research, innovation and sustainable technologies through teamwork.

Mission

1. Impart quality education in basic and applied areas of Chemical Engineering
2. Enable students and faculty to achieve proficiency in Chemical Engineering through state-of-the-art laboratories
3. Encourage faculty and students to make career in research through development of novel processes and products
4. Develop inclusive technologies with a focus on sustainability
5. Collaborate with industries and research institutes to cater societal needs
6. Inculcate leadership qualities, entrepreneurial skills, societal and ethical values in students and faculty

Program Educational Objectives:

PEO1 Exhibit knowledge of basic sciences, concepts and principles of Chemical Engineering

PEO2 Comprehend, analyze, design and implement engineering systems with a focus on research, innovation and sustainability

PEO3 Work in multidisciplinary team and cater to the needs of process industries with appropriate safety, health and environmental regulations

PEO4 Demonstrate effective communication skills, leadership qualities and develop into successful entrepreneurs

Program outcomes

Graduates will be able to

PO1 Apply knowledge of mathematics, basic sciences and engineering fundamentals to Identify, formulate and solve chemical engineering problems

PO2 Design a system, component, or process to meet desired needs with appropriate societal and environmental regulations

PO3 Work in multi-disciplinary teams and develop leadership qualities with effective Communication

PO4 Engage in life-long learning and follow ethical principles

PO5 Identify and use appropriate computational tools in chemical engineering practice

PO6 Undertake research leading to innovations, sustainable technologies and entrepreneurship with a focus on project management

Department of Chemical Engineering
R.V. College of Engineering, Bangalore – 59
(Autonomous Institution Affiliated to VTU, Belgavi)

SCHEME OF TEACHING & EXAMINATION

FIFTH SEMESTER

Sl. No.	Course Code	Course	BoS	Credit Allocation				Total Credits
				Lecture	Tutorial	Practical	Self Study	
1	12HS151	IPR & Entrepreneurship	HSS	3	0	0	0	3
2	12CH52	Chemical Equipment Design & Drawing	CH	3	0	1	1	5
3	12CH53	Mass Transfer II	CH	3	0	1	1	5
4	12CH54	Bio Chemical Engineering	CH	3	1	0	1	5
5	12CH5AX	Elective A	CH	3	0	0	1	4
6	12CH5BX	Elective B	CH	3	1	0	0	4
		Total Credits						26
		No. Of Hrs.		18	04	04	16	42

The self study topic should be related to the elective offered in sl.no.5

SIXTH SEMESTER

Sl. No.	Course Code	Course	BoS	Credit Allocation				Total Credits
				Lecture	Tutorial	Practical	Self Study	
1	12HSM61	Management & Organizational Behaviour	HSS	3	0	0	0	3
2	12CH62	Transport Phenomena	CH	3	1	1	0	5
3	12CH63	Process Dynamics & Control	CH	3	0	1	1	5
4	12CH64	Chemical Process Integration	CH	3	0	0	1	4
5	12CHE65	Emerging Technologies	CH	2	0	0	0	2
6	12CH6CX	Elective C	CH	3	0	0	1	4
7	12CH6DX	Elective D	CH	3	0	0	0	3
		Total Credits						26
		No. Of Hrs.		20	02	04	12	38

The self study topic should be related to the elective offered in sl.no.6

Elective List

Group A	Group B	Group C	Group D
12 CH 5A1 Petroleum Processing	12 CH 5B1 Industrial waste water Treatment	12 CH 6C1 Petrochemical Processing	12 CH 6D1 Composite Materials
12 CH 5A2 Instrumental Methods of Analysis	12 CH 5B2 Fuel cell Technology	12 CH 6C2 Applied Mathematics in Chemical Engineering	12 CH 6D2 Novel Separation Techniques
12 CH 5A3 Polymer Science and Technology	12 CH 5B3 Green Technology	12 CH 6C3 Heterogeneous Reaction System	12 CH 6D3 Industrial Safety and Risk management
12 CH 5A4 Nano Technology	12 CH 5B4 Food Technology	12 CH 6C4 Chemical Process Engineering Economics	12 CH 6D4 Piping Engineering and Design

Semester: V

INTELLECTUAL PROPERTY RIGHTS AND ENTREPRENEURSHIP

Course Code: 12HSI51 CIE Marks : 50
Hrs/Week L:T:P:S:3:0:0:0 SEE Marks: 100
Credits:03 Exam Hrs:02 Hrs

Course Learning Objectives

Student will be able to

- Identify and analyse the legal regulation of the way in which ideas, innovation and artistic endeavour are protected and commercially exploited.
- Understand the law relating to patents, trademarks, passing off, copyright, registered designs, plant varieties, trade secrets and confidential information.
- Appraise and evaluate the social and economic justifications for such rights.
- To explores the challenges to IP law in the digital age and examines specific electronic commerce practices that raise complex Trademark, Patent And Copyright policy questions.
- To provide practical, useful and easy to understand information on IP law as it relates to commercial activities on the Internet
- To find sophisticated problem related solutions of different forms of IPR.
- To act as an interface between industry / government and multilateral institution in various aspects relating to Intellectual Property

Unit – I

Introduction: Types of Intellectual Property, International Scenario in IPR: WIPO, WTO, TRIPS.

Patents: Introduction, Object of patent; Scope and salient features of patent; patentable inventions, inventions are not patentable, Patent Procedure- Overview, Rights and obligations of patentee; Transfer of Patent Rights; Government use of inventions; Biotechnology patents, protection of traditional knowledge, Infringement of patents and remedy, Case study **08Hrs**

Trade Secrets: Definition, Significance, Tools to protect Trade secrets in India.

Unit – II

Trade Marks: Introduction and overview of trade mark; Evolution of trade mark law; Object of trade mark; Features of good trade mark; Different forms of trade mark; Trade mark registry and register of trademarks; Registrable and non- registrable marks; Basic principles of registration of trade mark; Deceptive similarity; Assignment and transmission; Trade mark and ECO Label, Infringement of trade mark; Passing off; Offences and penalties, Case study **5Hrs**

Unit – III

Industrial Design: Introduction, Need for Protection of Industrial Designs, Subject Matter of Protection and Requirements, Procedure for obtaining Design Protection, Revocation, Infringement and Remedies , Case study

Copy Right: Introduction, Nature and scope, Subject matter, the works in which copy right subsists, Rights conferred by copy right, Copy right protection in India, transfer of copy rights, right of broad casting organisations and of performer and Case Studies. **8Hrs**

Intellectual property and cyberspace; Emergence of cyber-crime ; Grant in software patent and Copyright in software; Software piracy; Trademarks issues related to Internet (Domain name); Data protection in cyberspace;; Salient features of Information Technology Act; IPR provisions in IT Act; Internet policy of Government

Unit – IV

Entrepreneur and Entrepreneurship: Evolution of the concept of Entrepreneur, Characteristics of an Entrepreneur, Distinction between an entrepreneur and a manager, Functions of an entrepreneur, types of entrepreneur, Intrapreneur, Concept of Entrepreneurship ,Growth of entrepreneurship in India, Role of Entrepreneurship in economic development, overview on entrepreneurial development models, Case discussions on a couple of successful entrepreneurs. **7Hrs**

Unit – V

Micro Small & Medium Enterprises (MSME): Definition, Characteristics, Need and rationale, Objectives, Scope, role of MSME in Economic Development, Advantages of MSME, Steps to start an MSME – Government policy towards MSME, Impact of Liberalization, Privatisation & Globalization on MSME, Effect of WTO / GATT. Sustainability and MSME. **7Hrs**

Institutional Support to entrepreneurs: Over view on National and State Agencies. Identification of Business Opportunities: Market Feasibility studies; Technical Feasibility Studies; Financial Feasibility Studies and Social Feasibility studies.

Reference Books:

1. Dr G.B Reddy, "Intellectual Property Rights and the Law' Gogia Law Agency, 7th Edn.,2008
2. Prabuddha Ganguly, "Intellectual Property Rights: Unleashing Knowledge Economy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1st Edition, 2001. ISBN: 0074638602.
3. Rodney Ryder – Intellectual Property and the Internet. ISBN: 8180380025; LexisNexis Butterworth ,New Delhi , 2002;
4. Rahul Matthan – The law relating to Computers and the Internet. ISBN 10: 8187162139 / ISBN 13: 9788187162131 Oscar Publications (Delhi, DEL, India)
5. S.R Myneni, "Law of Intellectual Property", Asia Law House, Hyderabad, 2001, SKU – 664773841.
6. SS Khanka ,Entrepreneurial Development , S Chand & Co, 2008,ISBN:81-219-1801-4
7. Entrepreneurship Development & Small Business Enterprises – Poornima M Charantimath , Pearson Education ,2007 ,ISBN: 81-7758-260-7

Course Outcomes

After completion of the course student will be able to:

1. Identify and recognize the applicable source, scope and limitations of the core Intellectual property disciplines and entrepreneurship
2. Explain the Knowledge and Competence related to the various legal issues pertaining to Intellectual Property Rights and entrepreneurship
3. Apply the concepts of IPRE to identify problems arising out of online transactions and provoke them to find solutions
4. Demonstrate the Intellectual Property issues in the cyber space and the growth and development of the law in this regard

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Continuous internal evaluation Scheme

CIE consists of two Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of one will be considered. The test component will have a weightage of 45 marks in CIE. In addition there will be one seminar on new topics / model presentation etc. for 05 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

CHEMICAL EQUIPMENT DESIGN & DRAWING

Course Code:12CH52 **CIE Marks:100**
Hrs/Week L:T:P:S 3:0:4:2 **SEE Marks:100**
Credits:05 **Exam Hrs:4Hrs**

Course Learning Objectives:

Student will be able to:

- Design process equipments like reactors, mass transfer heat transfer equipment, pipelines, storage tanks
- Study relevant codes for design of chemical plant equipment as per the standard procedures specified by design code books
- Learn the fabrication techniques and testing methods
- Learn design and engineering skills directly applied in design, installation and commissioning of equipments

Unit – I **08 Hrs**

Detailed chemical engineering process design and drawing (The detailed dimensional drawings shall include sectional front view, Full Top/side view) of double pipe heat exchanger and shell & tube heat exchanger

Unit – II **07 Hrs**

Detailed chemical engineering process design and drawing (The detailed dimensional drawings shall include sectional front view, Full Top/side view) of horizontal and vertical condensers

Unit – III **07 Hrs**

Detailed chemical engineering process design and drawing (The detailed dimensional drawings shall include sectional front view, Full Top/side view) of single effect **e**vaporator

Unit – IV **07 Hrs**

Detailed chemical engineering process design and drawing (The detailed dimensional drawings shall include sectional front view, Full Top/side view) of bubble cap distillation Column

Unit – V **07 Hrs**

Detailed chemical engineering process design and drawing (The detailed dimensional drawings shall include sectional front view, Full Top/side view) of Packed Bed Absorption Column

Course outcomes:

After completion of the course student will be able to:

1. Recall the general design procedures and standard codes
2. Explain the chemical engineering principles in design of process equipments
3. Apply principles of unit operations to design various process equipments
4. Analyze various design options at all design stages
5. Estimate physical dimensions of various parts of chemical process equipments and accessories
6. Generate sectional views (drawings) of designed equipments and accessories

Reference Books:

1. R.H.Perry and D.W.Green; Chemical Engineers Handbook; McGraw Hill; 7th Edition; 1998;ISBN 0-07-115982-7
2. J.M.Coulson and J.F.Richardson; Chemical Engineering; Pregman Press; Vol.6, 3rd Edition; 1993; ISBN:10-0750641428
3. Brownell and Young: Process Equipment Design - Vessel Design; John Willey; Published 1951; ISBN:0471113190
4. M.V.Joshi;Process Equipment Design;3rd Edition, Macmillan and Co. India; Delhi; reprint 1998;

ISBN 023-063-810-4

Self Study:

Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus.

Scheme of Continuous Internal Evaluation:
CIE consists of Three Tests each for 40 marks (40 marks for descriptive) out of which best two will be considered. In addition there will be two presentations and submission of report for the self study evaluation and will be evaluated for 20 marks.

Scheme of Semester End Examination:
The question paper consists of two questions carrying 100 marks each for the design and drawing of any two equipments. Student is required to answer any one. There shall not be split of equipments among the questions.

MASS TRANSFER-II (Theory & Practice**)**

Course Code: 12CH53 **CIE Marks:100+50**

Hrs/Week: L:T:P:S 3:0:2:4 **SEE Marks:100+50**

Credits: 05 **Exam Hrs:3+3 Hrs**

Course Learning Objectives:

Student will be able to

- Identify suitable equipment for gas-liquid, liquid- liquid and liquid-solid contacts
- Understand the concepts of stage operations
- Understand the working principles and constructional details of mass transfer equipments
- Design equipments for mass transfer operations

Unit – I **07 Hrs**

Gas Liquid Contacting Systems: Types, construction and working of plate and packed columns, types and properties of industrial pickings, plate efficiencies, HETP and HTU concepts.

Packed Tower Absorption: Liquid phase hold up and pressure drop in absorption towers. Design of packed towers (process design-height and diameter)

Unit – II **07 Hrs**

Distillation: Introduction, vapour liquid equilibria, relative volatility, prediction of VLE from vapour pressure data using Raoult's law, VLE for multi-component systems, Non-ideal systems, Azeotropes, Immiscible systems, Steam distillation**,** Flash and simple distillation .

Unit – III **06 Hrs**

Distillation: Multi-stage rectification column. Design using McCabe Thiele method for binary mixtures

Distillation: Ponchon-Savarit method. Introduction to Multicomponent distillation, Vacuum, molecular, extractive and azeotropic distillations

Unit – IV **08 Hrs**

Liquid-Liquid Extraction: Ternary equilibrium, solvent selection, single stage, multi-stage cross-current, counter-current extraction. Equipment for liquid-liquid extraction. Numerical problems on miscible and immiscible systems.

Unit – V **08 Hrs**

Leaching Operation: Equipment for leaching, preparation of solids for leaching, equilibrium diagrams. Calculations for single stage and multistage leaching operations. Numerical Problems.

Laboratory Work:

1. Diffusion of Organic vapors in Air
2. Simple (Differential) Distillation
3. Packed Column/Plate Column distillation
4. Steam Distillation
5. Solid Liquid Leaching
6. Surface Evaporation
7. Tray Dryer
8. Adsorption Studies

9. Liquid Liquid/Vapor Liquid Equilibrium
10. Liquid Extraction (Cross Current: Single and 2 or 3 Stage)
11. Holdup Studies in Packed Columns
12. Rotary/Vacuum Dryers
13. Wetted Wall Column/Mass Transfer Coefficient Estimation
14. Cooling Tower
15. Solid Dissolution

Course Outcomes:

After completion of the course student will be able to:

1. Recall the concepts of equilibrium and stage operations
2. Explain the material balance equations of mass transfer operations
3. Apply the principles and mechanisms of mass transfer operations in chemical processing
4. Analyze separation in various mass transfer equipments
5. Design various mass transfer equipments
6. Evaluate the performance of mass transfer equipments

Self Study:

Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus

Reference Books:

1 Mass Transfer Operations, Robert E Treybal, 3rd Edition, McGraw Hill 1981.

2 Unit Operations in Chemical Engineering, McCabe & Smith, 6th Edition, McGraw Hall, 2001.

3 Coulson and Richardson, "Chemical Engineering Volume 1 and Volume 2", 4th Edition, Pergemen Press, 1998

4 Badger and Banchero, "Introduction to Chemical Engineering", Edition 1997, Tata McGraw Hill.

5 Alan S. Foust, Leonard A. Wenzel, Curtis W. Clump and L. Brice Anderson "Principles of Unit Operations", 2nd Edition, John Wiley, Reprint 1994

6 Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall (I), 2000.

Scheme of Continuous Internal Evaluation for Theory:

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be two presentations and submission of report for the self study evaluation and will be evaluated for 20 marks.

Scheme of Continuous Internal Evaluation for Practical:

The record is evaluated for 40 Marks and final test is conducted for 10 Marks

Scheme of Semester End Examination for Theory:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

Scheme of Semester End Examination for Practical:

A student is expected to conduct an experiment in the practical exam. The Procedure & write up is evaluated for 10 marks, experiment conduction is evaluated for 30 Marks and Viva voce is for 10 marks.

BIOCHEMICAL ENGINEERING

Course Code: 12CH54 **CIE Marks: 100**

Hrs/Week: L:T:P:S 3:2:0:4 **SEE Marks: 100**

Credits: 05 **Exam Hrs:3 Hrs**

Course Learning Objectives:

Student will be able to:

1. Describe the basic structure and functions of cells.
2. Examine the application of Biological and Engineering principles in problems involving microbial and biological system
3. Evaluate the various product recovery operations
4. Design bioreactors
5. Select appropriate sterilization Technique

Unit – I **08 Hrs**

Microbiology: Scope, Classification of microorganisms, Whitaker's 5–Kingdom concept. Prokaryotic cells: structure, Classification and reproduction in bacteria. Eukaryotic cells: structure, Classification and reproduction in Fungi, Yeasts, molds. Biochemistry**:** Cell construction, Amino acids and proteins, Carbohydrates: Mono and polysaccharides, Nucleic acids, RNA and DNA, Lipids, fats, steroids, Cell nutrients.

Unit – II **07 Hrs**

Enzyme Catalyzed Reactions: Introduction, Enzyme kinetics, MM, BH approach, evaluation of kinetic parameters.

Enzyme Inhibitors: Types of inhibitors, Effects of temperature and pH, Enzyme immobilization, methods of immobilization.

Unit – III **06 Hrs**

Stoichiometry of Cell Growth and Product Formation: Elemental balances, available electron balances, degrees of reduction; yield coefficients of biomass and product formation, maintenance coefficients.

Growth media: Medium formulation, Oxygen consumption and heat evolution in aerobic cultures.

Unit – IV **08 Hrs**

Kinetics of Microbial Growth and Product Formation: Phases of cell growth and kinetics in batch cultures, Monod and Leudeking-Piret equations, unstructured nonsegrated models to predict specific growth rate, substrate limited growth, models with growth inhibitors. Introduction to structured models, Ideal Bioreactors, Batch reactor, Ideal Chemostat. Sterilization techniques

Unit – V **08 Hrs**

Recovery and purification of products: Removal of microbial cells and other solid matter, foam separation, precipitation, filtration, centrifugation, cell disruption, chemical methods, liquid-liquid extraction, chromatography, membrane separation, drying.

Course outcomes:

After completion of the course student will be able to:

1. Recall the basics of microbiology and enzymes.
2. Explain the various product recovery operations
3. Analyze the enzyme kinetics and the factors affecting enzyme kinetics
4. Predict appropriate sterilization Techniques.
5. Design Bioreactors

Self Study: Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus.

Reference Books:

1. Bailey and Ollis, "Biochemical Engineering Fundamentals", 2nd Edition, McGraw Hill, 1986
2. Shuler M. L. and F. Kargi, "Bioprocess Engineering – Basic Concepts", 2nd Edition, Prentice Hall 2003
3. Pelczar and Chan, "Microbiology Concepts and Applications", 5th Edition, McGraw Hill, Reprint, 2001
4. Shuichi Aiba, "Biochemical Engineering", 2nd Edition, Academic press, 1973

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best two will be considered. In addition there will be two presentations and submission of report for the self study evaluation and will be evaluated for 20 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

PETROLEUM PROCESSING

Course Code: 12CH 5A1 **CIE MARKS: 100**
Hrs/Week: L:T:P:S: 3:0:0:4 **SEE MARKS: 100**
Credits: 04 **Exam Hrs : 3 Hrs**

Course learning objectives :

Student will be able to:

1. Study about the petroleum industries in the country and abroad and the operations that is carried out in them.
2. Learn about the classification and compositions of crudes.
3. Study the important products (gasoline, diesel, kerosene and lube oil), properties and test methods for crudes.
4. Study the various crude processing methods such as reforming, cracking etc.
5. Learn the crude pretreatment methods and operations involved in it.
6. Study about the various impurities present in the crude and method of their treatment to produce useful products like LPG, LNG, gasoline, lube etc.

Unit – I **08 hrs**

Introduction: Prospects and future, composition of crude and classification of crude oil, evaluation of petroleum: UOP-K factor, TBP analysis, EFV analysis, average boiling point, ASTM curves, thermal properties of petroleum fractions.

Properties and test methods: Reid vapour pressure analysis, octane number, oxidation stability, characterization for flash point or fire point, smoke point, volatility, burning qualities etc., octane testing and viscosity index.

Unit – II **06 hrs**

Crude pretreatment: Pumping of crude oils, dehydration of crude by chemical, gravity, centrifugal and electrical de - salter. Heating of crude: heater (furnaces), pipe still heaters. Crude distillation: arrangement of towers for various types of reflux.

Unit – III **08 hrs**

Treatment techniques: Types of impurities, treatment of LPG and LNG, sweetening operations for gases - merox, ethanolamine, copper chloride, stretford. Catalytic de-sulphonisation. Treatment of kerosene- de-aromatisation and merox. Treatment of diesel - desulphurisation by hydrogen and catalysis. Treatment of lubes- sulphuric acid, clay treatment, solvent treatment. Phenol, furfural.

Unit – IV **08 hrs**

Thermal processes: Thermal cracking reactions, factors influencing the properties of cracked materials, Vis-breaking.

Catalytic cracking: Cracking catalysts, various catalytic cracking processes, fixed bed crackers, moving bed crackers, fluid catalytic cracking. Comparison of thermal and catalytic cracking.

Coking: Theory of coking

Unit- V **06 Hrs**

Hydro cracking: Theory of hydro cracking, catalysts for hydro cracking

Catalytic reforming: Theory of reforming, factors influencing reforming, reforming catalysts, feedstock requirements, platforming

Course outcomes:
After completion of the course student will be able to:

1. Classify the crude and understand its composition.
2. Explain process and operations of oil exploration, off shore and onshore oil exploration methods.
3. Draw the flow sheets for various manufacturing process
4. Compare alternative process

Self study:
Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus.

Reference books:

1. W.l.Nelson; Petroleum Refinery Engineering; Mcgraw hill; 4th edition; 14th reprint 1982; ISBN:10070462682

2. Bhaskara Rao; Modem Petroleum Refining Processes; Oxford and IBH publication; 3rd edition; reprint 1999; ISBN:9788120417151

3. Nagpal J.M.; Challenges in Crude Oil Evaluation; Tata Mcgraw hill; published 1998; ISBN:9780074632864

4. Kuriacose and rajaram; chemistry in engineering and technology; tata mcgraw hill volume 2; 3rd reprint; 2004; ISBN:9780074517369

Scheme of continuous internal evaluation:

CIE consists of three tests each for 40 marks (15 marks for quiz + 25 marks for descriptive) out of which best of two will be considered. In addition twenty marks to be earned through self learning component in emerging topics.

Scheme of semester end examination:

The question paper consists of part A and part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from part b will have internal choice and one of the two have to be answered compulsorily.

INSTRUMENTAL METHODS OF ANALYSIS

Course Code: 12CH5A2 **CIE Marks: 100**
Hrs/Week: L: T:P:S: 3:0:0:4 **SEE Marks: 100**
Credits: 04 **Exam Hrs: 3 Hrs**

Course learning objectives:
Student will be able to:

- Study the basic principles, construction and working of various analytical instruments
- Application of various analytical instruments
- Analysis of functional groups of materials
- Characterization and evaluation of properties

Unit – I 06 Hrs

Spectroscopy: Nature and interaction of electromagnetic radiations, selection rules, spectral width, factors influencing positions and intensity of spectral lines. Quantitative aspects of absorption measurements – Beer's law and its limitations, terminologies associated with electronic spectroscopy, types of absorption bands and theoretical interpretation, effect of solvent and structure on maximum wavelength.

Unit – II 06 Hrs

Infrared spectroscopy: Theory of IR, types of vibrations, fundamental modes of vibrations and group frequencies, factors affecting the group frequencies and band shapes. FTIR, NIR Instrument and its advantages, applications of IR to identify organic molecular structures. Raman Spectra.

Unit – III 08 Hrs

Instruments for powder characterization:

X-Ray Diffractometer, Thermogravimetric analyzer, Differential scanning calorimeter, Scanning Electron Microscope.

Mass Spectroscopy: Mass spectrometer GCMS, methods of generation of positively charged ions. Mass analysers.

Unit – IV 08 Hrs

Instruments for detection of trace Ions and compounds: Working principles of Nephelometry, Turbidometry, Polarography, Fluorimetry, Flame emission spectroscopy (FES) and Atomic absorption spectroscopy (AAS), NMR.

Unit – V 08 Hrs

Chromatography: General description, definitions, terms and parameters used in chromatography, classification of chromatographic methods, working principle, Instrumentation and applications of high pressure liquid chromatography (HPLC), Gas chromatography (GC), Thin layer chromatography (TLC), Elution chromatography.

Course Outcomes:

After completion of the course student will be able to:

1. Describe the basic principles of spectroscopy and chromatography.
2. Explain the construction and working principle of various analytical instruments.
3. Explain the use of spectroscopic, chromatographic and other instruments for identification of ions and compounds.
4. Analyze the functional groups present in compounds.
5. Characterize synthesized materials.

Self Study:

Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus

Reference Books

1. Jaffery, Gill, Basset. J; Vogel's Text Book of Quantitative Inorganic Analysis; ELBS; 5th Edition; 1998; ISBN:81-7808-256-X.

2. Ewing G.W; Instrumental methods of Chemical Analysis; Mc Graw Hill International; 1985; ISBN: 07-085210-3.

3. ChatwalAnand; Instrumental Methods of Chemical Analysis; Himalaya Publishing House; 5th Edition; 1980; ISBN: 81-8318-083-3.

4. Skoog, D.A.; Principles of Instrumental Analysis Saunders College; 3rd Edition; 1985; ISBN: 0-03-001229-5.

5. Sharma K.; Instrumental Methods of Chemical Analysis; Goel Publishing House, Meerut; 2000.

Scheme of Continuous Internal Evaluation :

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 20 marks.

Scheme of Semester End Examination :

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

POLYMER SCIENCE AND TECHNOLOGY

Course Code: 12CH 5A3 **CIE Marks: 100**

Hrs/Week: L:T:P:S 3:0:0:4 **SEE Marks: 100**

Credits: 04 **Exam Hrs: 3 Hrs**

Course Learning Objectives:

Student will be able to:

- Learn various polymerization processes
- Tailor made products for specific applications.
- Explore the methods for degradation of polymers

Unit – I 06Hrs

Introduction to Polymers With Emphasis On Important Concepts Such As : Monomers, Polymer, Oligomer, Repeating units, End groups, Polymerization, addition and condensation polymerization, Functionality, Latent functionality, Amorphous and Crystalline polymers. Classification of polymers on the basis of source, Polymerization mechanism, chemical structure. Plastics, Elastomers and fibres. Copolymers-Random, Alternating, Graft, and Block. Thermoplastics and Thermosets.

Basic Principles of Molecular Weight, Importance of Molecular Weight Control: Number Average molecular weight (Mn), Weight average molecular weight (Mw), Viscosity Average Molecular weight (Mv),Practical Significance of polymer molecular weight, problems.

Unit – II 08 Hrs

Methods of Polymerization: Bulk polymerization, Solution polymerization, Pearl or Suspension polymerization, Emulsion polymerization, Advantages and disadvantages of each technique.

Mechanism of Polymerisation: Free radical, Cationic and Anionic mechanisms

Polymer Additives, Blends and composites: Additives-Plasticizers, Fillers and Reinforcements, Stabilizers, Flame retardants, Compatibilizers, Colorants, Blowing agents, Antistatic agents, Impact modifiers.

Types of Composites- Reinforced, Thermoplastic, Thermoset, Elastomers

Resins (Isopolyesters, Epoxy, Phenol formaldehyde, Polyimide, PEEK, PP,PBT, PC etc).

Reinforcements (particulate, fibrous)

Unit – III 10 Hrs

Glass Transition Temperature: Definition, Importance of Glass transition temperature, Factors Influencing glass transition temperature, Glass transition temperature of Copolymers, Determination of Glass transition temperature using DSC, Glass transition temperature and Molecular weight, Glass transition temperature and melting point., Heat distortion temperature.

Crystallinity in Polymers, Degree of Crystallinity, Crystallites, Structural regularity and crystallisability, Effect of crystallinity on the properties of Polymers.

Polymer Reactions: Hydrolysis, Acidolysis, Hydrogenation and Addition & Substitution reactions.

Unit – IV **08 Hrs**

Polymer Nano Materials: Introduction to nanotechnology, Polymer nanocomposites, significance, classification, Nanoparticles, Nanotubes, Nanofibres, Fullerenes, Nanowires, Carbon nanotubes (CNTs) - chemistry, types, structure, properties and applications. Properties of Polymer Nanostructured Materials, Application of nanomaterial in medicine, fuel cell, catalysis (only general idea)

Unit – V **07 Hrs**

Degradation Stability and Environment: Polymer degradation, types of polymer degradation, thermal degradation, Factors affecting thermal stability, Mechanical degradation, Photo degradation, Oxidative degradation, hydrolytic degradation. Recycling of polymers, incineration, Biodegradable polymes

Course outcomes:

After completion of the course student will be able to:

1. Recall the fundamental concepts of polymer materials.
2. Apply the knowledge of molecular mass to understand the properties of polymers.
3. Determine the thermo mechanical properties of polymer materials.
4. Utilize the nanopolymers and additives for specific applications.
5. Select the appropriate methods of polymerization and degradability of polymers

Reference Books

1. Fred W. Billmeyer, JR. ; Text Book of Polymer Science; Wiley Inter Science;3rd Edition ; 2005 ;ISBN:O471-82834-3
2. V. R. Gowarikar, N V Viswanathan, Jaydev Sreedhar; Polymer Science; New Age International Pvt. Ltd; 2012; ISBN: 0-85226-307-4
3. Alfred Rudin; The Elements of Polymer science and Engineering, Second Edition,2006, ISBN-13:978-81-312-0309-5
4. Joel Fried; Polymer Science; Prentice Hall PTR;1995;ISBN :81-203-1458-1

Self study: Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 20 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

NANO TECHNOLOGY

Course Code: 12CH5A4 **CIE Marks: 100**
Hrs/Week: L: T:P:S : 3:0:0:4 **SEE Marks: 100**
Credits: 04 **Exam Hrs : 3 Hrs**

Unit – I **06 Hrs**

Introduction: Nanotechnology, importance and scope of nanotechnology, basics of quantum mechanics, harmonic oscillator, band structure in solids, bonding in solids, anisotropy, de Broglie's hypothesis, Heisenberg uncertainty principle, Pauli exclusion principle, Schrödinger's equation, Properties of the wave function**.**

Unit – II **08 Hrs**

Synthesis of Nanomaterials: Synthesis of Nanomaterials- top down and bottom up approach, vapor phase Sputtering, Thermal Evaporation, Laser method, mechanical attrition, sol-gel method, electro deposition, attrition milling, microwave synthesis route, gas, micro emulsion method, hydrothermal synthesis, ultrasonic method**.**

Unit – III **07 Hrs**

Characterization of Nanomaterials: Sample preparation techniques, Mossbauer spectroscopy, X-ray diffraction technique, Electron microscopy-scanning and transmission, atomic force microscopy.

Unit – IV **08 Hrs**

Nanoscale Manufacturing: Nanomanipulation, Nanolithography, Epitaxy: molecular beam, vapor phase, solid phase. Nanoscopic electrodes and nanowires fabrication, quantum Dots.

Unit – V **07 Hrs**

Application of Nanotechnology: Fluorescent nanoparticles for biolabelling, Fullerenes, catalysis, biocatalysis. Application of following materials: silicon, Titanium, carbon nanotubes.

Course outcomes:

After completion of the course student will be able to:

1. Describe the basic principles of nonmaterial synthesis and characterization.
2. Predict and interpret the behavior of nonomaterials.
3. Demonstrate nanomaterial synthesis and characterization techniques for modern applications.
4. Select appropriate process and characterization techniques for nanomanufacturing and applications.
5. Justify the synthesis and characterization technique for engineering application

Self Study: Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus

Reference Books

1 Carl C. Koch; Nanostructured Materials: Processing, Properties and Applications; Jaico Publishing House; 2009; ISBN: 978-81-8495-040.

2 M Wilson, K Kannangara, G Smith, M Simmons; Nanotechnology: Basic Science and Emerging Technologies; Chapman and Hall; 2002; ISBN: 8188689803.

3 A.K. Bandyopadhyay; Nano Materials; New Age International Publishers; First edition; 2007; ISBN:0-13-101400-5.

4 B, Viswanathan; Nanomaterials; Narosa Publishing House; First edition; 2010; ISBN: 978-81-7319-936-3.

5 M A. Ratner, D Ratner, M Ratner; Nanotechnology; A Gentle Introduction to the Next Big Idea; Prentice Hall PTR; 2002.

Scheme of Continuous Internal Evaluation:
CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition twenty marks to be earned through self learning component in emerging topics.

Scheme of Semester End Examination:
The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

INDUSTRIAL WASTEWATER TREATMENT

Course Code: 12CH 5B1 **CIE Marks: 100**
Hrs/Week: L:T:P :S 3:2:0:0 **SEE Marks: 100**
Credits: 04 **Exam Hrs : 03Hrs**

Course Learning Objectives:

- Understand importance of industrial wastewater treatment.
- Discernment of knowledge development and research directions towards industrial wastewater treatment
- Application of systematic engineering practices and design of ETP

Unit – I **08 Hrs**

Characteristics of Wastewater:
Organic, Inorganic and refractory organic impurities, Solids, Color, Odor, Temperature, BOD, COD, Total Nitrogen, Total Phosphorous, Heavy Metals. Interpretation of data- Bio degradability- Nutrients.

Unit – II **07 Hrs**

Physico – Chemical Treatment:
Screens, Flow Equalizers, Neutralizers, Oil Skimmers, Flotation Reactors, Settling Tanks, Clarifiers, Tube Settlers.
Filters: Sand, Activated Carbon, Multi-media filter

Unit – III **06 Hrs**

Bio – Chemical Treatment:
Activated Sludge Process, Extended Aeration, Contact Stabilization, Pure Oxygen Systems, Rotating Biological Contactors, UASB Reactors, Combination of aerobic and anaerobic processes, Membrane Bioreactors.

Unit – IV **08 Hrs**

Advanced Treatment:
Membrane Technologies; Microfiltration, Ultra filtration, Nan filtration and Reverse Osmosis, Solar Evaporation Pans, Mechanical Evaporators, Common effluent treatment plants/ Zero liquid discharge plants, Operation & Maintenance of ETPs.

Unit – V **08 Hrs**

Statutory Requirements and Treatment for Industrial Wastewater:
MOEF and CPCB guidelines and standards for effluent treatment and disposal, Typical effluent treatment schematics for Sugar, Dairy, Distillery, Textile, Tannery, Electroplating and Pharmaceutical industries.

Course outcomes:
After completion of the course student will be able to:

1. Recall the principles of environmental science.
2. Summarize the quality parameters to characterize wastewater.
3. Apply the Physical, chemical and biological methods for wastewater treatment.
4. Organize treatment methods for a typical industrial waste water treatment plant.
5. Evaluate the working of effluent treatment plants for various industries.

Reference Books:

1. Theories and practice of Industrial Waste Treatment , Nemerraw, N.L., Addision - Wesley. Pub, Co., 1963.
2. Principles of Industrial Waste Treatment , Gurnam, C.F., John Wiley & Sons, Inc., New York, 1965.
3. The Treatment of Industrial Wastes, Berselievre, E.B., New York, 1969.

4. Wesley Eckenfelder, W., “Industrial water pollution control” Tata McGraw-Hill Publishing Company Ltd., New Delhi.
5. Manual on Water Supply and Treatment, Third Edition, Ministry of Urban Development, New Delhi, 1999

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be assignment for 10 marks.

Scheme of Semester End Examination: The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

FUEL CELL TECHNOLOGY

Course Code : 12CH5B2 **CIE Marks: 100**
Hrs/Week: L:T:P:S 3:2:0:0 **SEE Marks: 100**
Credits: 04 **Exam Hrs : 3 Hrs**

Course Learning Objectives:
Student will be able to:

- Classification of fuel cells
- Determination of efficiency of fuel cells
- Characterization of fuel cells
- Applications of fuel cells

Unit I **07 Hrs**

Introduction: Fuel cell definition, historical developments, working principle of fuel cell, components of fuel cell, EMF of the cell, Fuel Cell Reactions, fuels for cells and their properties.

Unit II **07 Hrs**

Fuel Cell Types: Classification of fuel cells, alkaline fuel cell, polymer electrolyte fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, advantages and disadvantages of each.

Unit III **08 Hrs**

Fuel Cell Reaction Kinetics: activation kinetics and electrode kinetics, open circuit voltage**,** intrinsic maximum efficiency, voltage efficiency, Faradaic efficiency, over all efficiency, over-voltages and Tafel equation.

Unit IV **07 Hrs**

Fuel Cell Characterization: current – voltage curve, in-situ characterization, current – voltage measurement, current interrupt measurement, cyclic voltammetry, electrochemical impedance, spectroscopy and ex-situ characterization techniques.

Unit V **07 Hrs**

Applications of Fuel Cells: applications of fuel cells in various sectors,hydrogen production, storage, handling and safety issues.

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

1. Recall the concepts of fuel cells including components, working principle, types, kinetics and
2. Explain fuel cell types, electrode kinetics, efficiencies and characterization techniques.
3. Apply fuel cell technology in various sectors.
4. Compare various fuel cells based on efficiencies and i-v curve characteristics.

Reference Books:

1 Viswanathan and M AuliceScibioh; Fuel Cells – Principles and Applications; Universities Press; First Edition, reprinted in 2009

2 James Larminie and Andrew Dicks; Fuel Cell Systems Explained; John Wiley & Sons; Second Edition; 2003

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best two will be considered. In addition there will be an assignment for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

GREEN TECHNOLOGY

Course Code: 12CH 5B3 **CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:2:0:0 **SEE Marks: 100**
Credits: 04 **Exam Hrs : 3 Hrs**

Unit – I 07 Hrs

Current practices and future sustainability: Need for green technology, The mechanics, advantages and disadvantages of renewable energy sources, energy conservation and audits, zero waste technology, 7R rules, Life cycle assessment, extended product responsibility, cradle to cradle design, carbon credits

Cleaner production: Promoting cleaner production, benefits and obstacles of cleaner production, cleaner production technologies.

Unit -II 08 Hrs

Solar energy: Brief introduction for harnessing solar energy, solar cells: Place of photovoltaic cells in world energy scenario. Fundamentals of semiconductors, design of solar cell, thin film solar cell technology: Evaporation, sputtering, PECVD

Geothermal energy: Resource identification and development, geothermal power generation systems, geothermal power plants case studies and environmental impact assessment.

Unit -III 07 Hrs

Bio energy (Thermal conversion): Methods for obtaining energy from Biomass, Thermal Gasification of Biomass, Classification of Biomass Gasifiers, Chemistry of the Gasification process, Applications of the Gasifiers in power plants.

Bio fuels: Different types of biofuels. Environmental and economical benefits of biofuels, Biodiesel-Introduction, sources of biodiesel, production methods, Application of Biodiesel, prospects of biodiesel in India, E-Diesel (Ethanol Blending)

Unit – IV 07 Hrs

Ocean thermal energy: OTEC-Introduction, Ocean Thermal Electric conversion (OTEC), Methods o f Ocean Thermal electric power generation, open cycle OTEC system, the closed or Anderson, OTEC cycle, Hybrid cycle
Energy from tides: Basic principles of Tidal power, components of Tidal power plants, operation methods of utilization of Tidal energy, Advantages and limitations of tidal power generation.

Unit – V 07 Hrs

Application of green technology: Electronic waste management, Bioprocesses, Green Composite materials, Green Construction technology, green ICT, green transportation.
Sustainability of industrial waste management: case studies on cement industry, iron and steel industry, petroleum sectors, marble and granite industry, sugar industry.

Course Outcomes

After completion of the course student will be able to:

1. Recall the fundamentals of various forms of energy.
2. Explain the principles of various forms of renewable energy.
3. Apply the concept of zero waste, atom economy for waste management.
4. Analyze various forms of energy and evaluate the applicability and advantage of one form over other.
5. Create a waste management plan incorporating tools of green technology in various industries.

Reference Books

1. Salah El-Haggar; Sustainable industrial design and Waste management; Elsevier Academic Press; 2007; ISBN – 13-978-0-12-373623-9
2. G.D.Rai , "Non-Conventional Energy Sources", Khanna Publications, 4th Edition, Twentieth Reprint, 2007: ISBN: 81-7409-073-8.
3. DiPippo Ronald; Geothermal power plants- Principle, application, case study and environmental impact; Butterworth Heinemann (an imprint of Elsevier), 3rd edition, 2012; ISBN: 978-0-08-098206-9
4. Boyle, Godfrey; Renewable Energy; Oxford University Press; 2nd Edition; Indian Reprint 2010; ISBN:978-0-19-958651-6

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be an assignment for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

FOOD TECHNOLOGY

Course Code: 12CH5B4 **CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:2:0:0 **SEE Marks: 100**
Credits: 04 **Exam Hrs : 3 Hrs**

Course Learning Objectives:

Student will be able to:

- Discuss chemistry of food
- Apply unit operations for food processing
- Study quality attributes of food
- Know various methods of food preservation

Unit – I **08 Hrs**

Formation and chemistry of food: Nutritive aspects of food constituents.

Unit – II **07 Hrs**

Quality attributes of food: Size and shape, color and gloss, texture, visual and objectively measurable attributes, flavor factors. Quality standards, Food laws and standards. Introduction to sensory evaluation of foods and beverages.

Unit – III **08 Hrs**

Food processing: Unit operations.
Various methods of food preservation: Low temperature, high temperature preservation. Chemical preservatives. Food irradiation.

Unit – IV **07 Hrs**

Food additives: Types of additives: Chemical, technological and toxicological aspects.
Food contamination and adulteration: Types of adulterants and contaminants, Intentional adulterants, incidental adulterants and its effects.

Unit – V **06 Hrs**

Modern trends in food science: Biofortification, genetically modified foods, organic foods. Packaging of foods and nutrition labeling.

Course outcomes:

After completion of the course student will be able to:

1. Explain the chemistry of food.
2. Define and evaluate quality of food.
3. Apply techniques to identify the food adulterants
4. Employ chemical process principles in food technology
5. Design and develop food preservation techniques.

Reference Books

1 Norman N. Potter and Joseph H., "Food Science", HotchkinAvi Publishing Co., 5th Ed., 1995, ISBN: 0-8342-1265-X

2 N. ShakuntalaManay and M. Sadaksharamurthy, "Foods, Facts and Principles", New Age Publishers, 2nd Ed., 2005, ISBN: 81-224-1325-0

3 B. Srilakshmi, "Food Science", New Age International, 4th Ed., 2010, ISBN: 978-81-224-2724-0

4 Romeo T. Toledo; Fundamentals of Food Process Engineering; Springer; 2nd Ed; 2007;ISBN:978-0-387-29019-5

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be an assignment for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five descriptive questions, carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

Semester VI

MANAGEMENT & ORGANIZATIONAL BEHAVIOUR

Course Code: 12HSM61 **CIE Marks:100**
Hrs/Week: L:T:P:S 3:0:0:0 **SEE Marks:100**
Credits:03 **Exam Hours:3 Hrs**

UNIT – I

Introduction to Management: Management Functions, Roles & Skills, Management History – Classical Approach: Scientific Management & Administrative Theory, Quantitative Approach: Operations Research, Behavioral Approach: Hawthorne Studies, Contemporary Approach: Systems Theory, Overview of Social Responsibility & Managerial Ethics, Case Study. 6 Hrs

UNIT – II

Foundations of Planning: Types of Goals &Plans, Approaches to Setting Goals & Plans, Strategic Management Process, Corporate & Competitive Strategies, Decision Making Process, Types of Decisions& Decision Making Conditions, Case Study. 4Hrs

Organizational Structure & Design: Designing Organizational Structure: Work Specialization, Departmentalization, Chain of Command, Span of Control, Centralization & Decentralization, Mechanistic &Organic Structures, Organizational Design: Traditional & Contemporary, Case Study. 4Hrs

UNIT – III

Understanding Organizational Behavior: Attitudes, Job Satisfaction& Organizational Commitment, Cognitive Dissonance Theory, Personality: MBTI & Big Five Model, Emotional Intelligence, Perception & Factors Influencing Perception, Attribution Theory, Learning: Classical & Operant Conditioning, Social Learning & Shaping Behavior, Case Study. 6 Hrs

UNIT - IV

Managing Teams: Groups & Stages of Group Development, Group Structure, Processes & Tasks, Work Team & Types of Work Teams, Case Study. 2 Hrs

Motivating Employees: Early Theories of Motivation: Maslow's Hierarchy of Needs Theory, McGregor's Theory X& Theory Y, Herzberg's Two Factor Theory& McClelland's Three Needs Theory, Contemporary Theories of Motivation: Adam's Equity Theory & Vroom's Expectancy Theory, Case Study. 4 Hrs

UNIT - V

Managers as Leaders: Early Leadership Theories: Traitt theories, Behavioral Theories: Ohio State Studies, University of Michigan Studies, Blake & Mouton's Managerial Grid, Contingency Theories of Leadership: The Fiedler Model, Hersey & Blanchard's Situational Leadership, Contemporary Views of Leadership: Transactional & Transformational Leadership, Case Study. 4 Hrs

Introduction to Controlling: The Control Process, Controlling for Organizational Performance & Tools for Measuring Organizational Performance, Case Study. 2 Hrs

Course Outcomes:

After completion of the course student will be able to:

1. Understand the principles of management theory &Recognize the characteristics of an organization.
2. Demonstrate the importance of key performance areas in strategic management & decision-making process.
3. Design appropriate organizational structures and possess an ability to conceive organizational dynamics.

4. Evaluate leadership practices in organizations & Implement the right one that would enable systems orientation.

Reference Books:

1. Stephen Robbins, Mary Coulter & Neharika Vohra, Management, Pearson Education Publications, 10th Edition, ISBN: 978-81-317-2720-1.
2. James Stoner, Edward Freeman & Daniel Gilbert Jr, Management, PHI, 6th Edition, ISBN: 81-203-0981-2.
3. Stephen Robbins, Timothy Judge & Seema Sanghi, Organizational Behavior, Pearson Education Publications, 13th Edition, ISBN: 978-81-317-2121-6.

Scheme of Continuous Internal Evaluation (CIE):

CIE consists of three tests, each for 45 Marks (15 Marks for Quiz + 30 marks for Descriptive –inclusive of case studies) out of which the best two will be considered. In addition, there will be one seminar on emerging topics in Management and Organizational Behaviour for 10 Marks

Scheme of Semester End Examination (SEE):

The question paper consists of Part A and Part B. Part A will be for 20 Marks covering the complete syllabus and is compulsory. Part \B will be for 80 marks and will consist of five questions, inclusive of case studies, carrying 16 Marks each, All five questions from Part B will have an internal choice and one of the two have to be answered compulsorily

TRANSPORT PHENOMENA (Theory & Practice**)**

Course Code: 12CH62 **CIE Marks: 100+50**
Hrs/Week: L:T:P:S 3:2:2:0 **SEE Marks: 100+50**
Credits: 05 **Exam Hrs: 3+3 Hrs**

Course Learning Objectives:

Student will be able to:

- Explain basic laws of transport operations and solving problems
- Derive model equations for heat, mass and momentum transfer systems with assumptions
- Explain various boundary conditions
- Analytical Solution of simple models
- Derive Equation of continuity, equation of motion
- Simple problems using equation of continuity and equation of motion

Unit – I **08 Hrs**

Review: Newton's law of viscosity (NLV), Numerical problems, Effect of temperature and pressure on viscosity of fluids.

Velocity profile, Average Velocity, Shear Stress Distribution and Forces in Laminar Flow: Development of models to describe laminar flow over flat inclined plate, flow through a circular tube, flow through annulus, flow between parallel plate and through a slit, flow as wetted wall column, annular flow with inner cylinder moving.

07 Hrs

Unit – II

Velocity Distributions in Turbulent Flow: Comparison of laminar and turbulent flows, time-smoothed equations of change, Reynolds rules of averaging, Reynolds stresses, turbulence models

Thermal Conductivity and Mechanism of Energy Transport: Fourier law of heat conduction. Effect of Temperature and pressure on thermal conductivity, heat transfer through composite plane wall, composite cylindrical wall, composite spherical wall, Over-all heat transfer co-efficient.

Unit – III **08 Hrs**

Temperature Distribution in Solids and Laminar Flow: Heat conduction problems of Chemical Engineering for heat conduction with internal generation by electrical, nuclear, viscous sources, heat transfer in annular flow, conduction through walls of varying thermal conductivity as function of temperature.

Diffusivity and Mechanism of Mass Transport: Fick's law of diffusion, Effect of temperature and pressure on diffusivity of liquids and gases.

08 Hrs

Unit – IV

Concentration Distributions in Solids and in Laminar Flow: Steady state shell mass balance, Diffusion through stagnant gas and liquid film, Equi-molar counter diffusion, Diffusion with homogeneous and heterogeneous reaction, diffusion and reaction inside a porous catalyst.

Unit – V **08 Hrs**

Equations of Change for Isothermal Systems: Equation of continuity, equation of motion, Navier-Stokes equation in Cartesian coordinates, Modifications of all these equations to spherical and cylindrical coordinates, Application of these equations to solve simple flow problems, Couette flow and rotating cylinder.

Laboratory Work:

1. Cyclone separator
2. Velocity profile in a straight pipe
3. Heat transfer to a moving fluid in the pipe and temperature profile
4. Natural convection in a vessel
5. Flow in a tank with two inlets and one outlet
6. Flow through sudden expansion contraction
7. Velocity profile in annulus
8. Plug flow reactor analysis
9. Gaseous fuel combustion
10. Mixing of two fluids

Course Outcomes:

After completion of the course student will be able to:

1. Recall fundamentals of heat, mass and momentum transfer.
2. Explain geometry, domain and flux distribution for transfer operations.
3. Apply laws of conservation to carry out shell balance for transfer operations.
4. Justify boundary conditions for models under laminar flow regime.
5. Determine fundamental properties using analytical solutions for the models.
6. Develop steady state models involving momentum, heat and mass transfer

Reference Books:

1 Bird R.B., W.E. Stewart and E.N. Lightfoot, Transport Phenomena, John Wiley and Sons, Second Ed., 2002

2 Welty, J.R., C.E. Wicks and R.E. Wilson, Fundamental of Momentum, Heat and Mass Transfer, John Wiley and Sons, 1976

3 Sissom L.E. and D.R.Pitts, Elements of Transport Phenomena, McGraw Hill, NewYork, 1972

4 Brodkey R.S. and H.C.Hershey, Transport Phenomena, A United Approach McGraw Hill

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be an assignment for 10 Marks

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

PROCESS DYNAMICS AND CONTROL (Theory & Practice)

Course Code: 12CH63 **CIE Marks: 100+50**
Hrs/Week: L:T:P:S 3:0:2:4 **SEE Marks: 100+50**
Credits: 05 **Exam Hrs: 03+3Hrs**

Course Learning Objectives:

Student will be able to:

1. Formulation of dynamic models based on fundamental laws and analytically solve linear dynamic models of first and second order system
2. Understand the different modes of control system and components of control system
3. Analyze the response of controllers for various types of inputs
4. Determine the stability of a closed-loop feed-back control system

Unit – I **07 Hrs**

First order Systems: Transfer functions, transient response, mercury in glass thermometer, liquid level system, mixing process in tanks and stirred tank reactors. Linearization of non-linear first order systems. Response of first order system in series: interacting and non-interacting systems.

Unit – II **07 Hrs**

Second order Systems: Terms of second order under damped process, Under and over damping, transient response, examples of second order systems: U-tube manometer, Damped vibrator. Transportation lag.

Unit – III **07 Hrs**

Controllers: Controllers, components of a control system, closed loop and open loop systems, Transfer functions for two position, proportional, Proportional +Reset (P+I), Proportional + Rate (P+D), Proportional + Reset +Rate controller (P+I+D)

Final Control element: actuators, valve body, valve characteristics.

Unit – IV **08 Hrs**

Closed Loop Systems: Control System, servo and regulator problem, Overall transfer function for single-loop systems and multiloop control system, overall transfer function for set-point change and load change. Lumped and distributed parameter system.

Introduction to Industrial Process Control System

Unit – V **07 Hrs**

Stability: Concept of Stability, Stability criteria, Routh Herwitz test for stability, Root Locus method.

Frequency Response: Bode diagrams for first, second order systems and controllers, Bode stability criteria, Ziegler-Nichols tuning method.

Laboratory Work:

1. Time constant determination and response to step change of thermometer: First order
2. Single tank system: First order
3. Non interacting First order elements in series
4. Interacting First order elements in series
5. II order under damped U-tube manometer

6. Level controller ONOFF action
7. Level controller (P, I, D, PID controllers)
8. Flow controller (P, I, D, PID controllers)
9. Pressure controller (P, I, D, PID controllers)
10. Control valve characteristics
11. Temperature controller (P, I, D, PID controllers)
12. U tube manometer: second order system

Course Outcomes:

After completion of the course student will be able to:

1. Recall the concepts of Laplace transforms, first & second order transfer functions, control system and stability
2. Explain the dynamics of process engineering systems.
3. Compute transfer functions for first, second order and control systems
4. Analyze the response of first & second order systems and controllers for various inputs
5. Determine the overall transfer function and evaluate the stability of control systems

Self Study:

Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus

Reference Books

1. Coughanour and Koppel; Process System Analysis and Control; McGraw Hill, New Delhi; 2nd Edition; 1991; ISBN: 0070132127.
2. Luyben; Process Modeling, Simulation and Control for Chemical Engineers; McGraw Hill, 2nd Edition; 1990; ISBN"007039159-9.
3. Coulson and Richardson; Chemical Engineering; Pergamon Press; 3rd Edition; 1999; ISBN 81-8147-144X.
4. George Stephanopoules; Chemical Process Control, An Introduction to Theory and Practical; Prentice Hall, New Delhi; 1st Edition; 1998; ISBN: 9788120306653.
5. R.P.Vyas; Process Control and Instrumentation; Central Techno Publications; 1st Edition; 2001; ISBN 81-87316-56-X.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best two will be considered. In addition there will be one seminar on new topics/model presentation etc. for 20 marks.

Scheme of Continuous Internal Evaluation for Practical:

Students will be conducting experiments which will carry 40 marks. Viva voce will be for 10 marks. Total marks obtained will be reduced to 30 marks. Test evaluation is for 20 marks. Cumulative internal evaluation is for 50 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

Scheme of Semester End Examination for Practical:

A student is expected to conduct an experiment in the practical exam. The procedure and write up is evaluated for 10 marks, experimental conductions are evaluated for 30 marks and viva voce is for 10 marks.

CHEMICAL PROCESS INTEGRATION

Course Code: 12CH64 **CIE Marks: 100**
Hrs/Week: L: T:P:S 3:0:0:4 **SEE Marks: 100**
Credits: 04 **Exam Hrs: 3 Hrs**

Course learning Objectives:
Student will be able to:

1. Integrate and optimize processes with several unit operations.
2. Evaluate flow sheet of any process.
3. Apply graphical techniques for direct recycle and synthesis of mass exchange networks.
4. Use algebraic approach for direct recycle and Heat integration technologies.
5. Carry out Heat and Power integration

Unit - I **07 Hrs**

Introduction to Process Integration: Process Synthesis, Process Analysis, Targeting minimum waste, minimum purchase, strategies for targets.

Unit – II **08 Hrs**

Graphical Techniques: Sources, sinks, recycle routes, Direct-Recycle, pinch diagram, design rules, multi component mapping diagram, graphical visualization technique

Unit – III **07 Hrs**

Synthesis of Mass Exchange Networks: design of Individual mass exchangers, mass exchange networks, pinch diagram, for development of mass integrated system. Algebraic approach to targeting direct recycles.

Unit – IV **08 Hrs**

Algebraic Approach: targeting mass exchange, load interval diagram, composition-interval diagram, cascade diagrams, Network, Recycle strategies using property integration.
Heat Integration: Thermal Pinch Diagram, minimum utility targeting, cascade diagrams for heat integration.

Unit – V **06 Hrs**

Combined Heat and Power Integration: Heat engines, heat pumps, vapor compression, vapor absorption, placement of heat engines, heat, cogeneration targeting, case study

Course Outcomes

After completion of the course student will be able to:

1. Recall the fundamentals and strategies of process integration
2. Explain graphical, algebraic and mathematical techniques for process integration
3. Apply process strategies on chemical engineering systems
4. Analyze chemical engineering processes to identify limits on process integration
5. Evaluate energy/purchase/waste minimization in chemical engineering processes
6. Synthesize possible heat and mass exchange networks using process integration strategies

Self Study:

Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus

Reference Books:

1. Mahmoud M El-Halwagi, “Process Integration”, Elsevier Academic Press.
2. Robin Smith, “Chemical Process Design and Integration”, McGraw-Hill. . Shenoy U. V.; Heat Exchanger Network Synthesis", Gulf Publishing company.
3. Smith R.; "Chemical Process Design", McGraw-Hill.
4. Linnhoff B., Townsend D. W., Boland D, Hewitt G. F., Thomas B. E. A., Guy A. R., and
5. Marsland R. H.; "A User Guide on Process Integration for the Efficient Uses of Energy", Inst. Of Chemical Engineers

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition twenty marks to be earned through self learning component in emerging topics

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

SURFACE ENGINEERING AND NANO FABRICATION
(Emerging Technologies)

Course Code: 12CHE65 **CIE Marks: 50**
L:T:P:S 2:0:0:0
Credits: 02

Course Learning Objectives:
Student will be able to:

- Understanding of the basic concepts of surface engineering.
- Identification of the difference between surface and bulk dominated regimes.
- Applications of surface engineering in processes and materials.

Unit – I **12 Hrs**

SURFACE ENGINEERING

Surface Tension, capillarity: Effects of confinement and finite size. Concepts of surface and interfacial energies and tensions.
Generalized equation for pressure jump across a curved surface. Young-Laplace equation of capillarity, vapor pressure of a drop, temperature effect (Kelvin equation).

Three phase systems: Neumann triangle/Contact angle. Young's equation.
Adhesion: Apolar (van der Waals) and polar (acid-base) components of interfacial tensions. Determination of apolar (van der Waals) and acid-base components of surface/interfacial tension. Reversible work/Free energy of adhesion.

Unit – II 12 Hrs

NANO FABRICATION

Fabrication Process
Preparation of semiconductor solutions: Chemical and Physical properties of solvents. Solution based deposition techniques: spin coating, drop casting, dip coating, Langmuir-Blodgett technique. Large area printing methods, screen printing, stamping, gravure, flexography, ink-jet printing

Photolithography
Optical lithography, Electron beam lithography, X-ray lithography and LIGA (Lithography, Electroplating, and Molding)

Solution based lithographic techniques:
Solution based techniques, electroplating, electro polymerisation, selective de-wetting, laser assisted dry printing. Nano imprinting, dip pen lithography, thin film deposition, dry etching technologies

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

1. Recall the concepts of surface and interfacial energies.
2. Understand the thermodynamic and mechanical approaches to interfacial tension.
3. Apply interfacial science concepts to material design and synthesis of processes at micrometer scale.
4. Analyse appropriate lithographic techniques for fabrication of films.
5. Evaluate the apolar and polar components of interfacial tension.
6. Design and develop solution based lithographic techniques.

Suggested References:

1. Hiemenz P. C., Rajagopalan R.; Principles of Colloid and Surface Chemistry; Marcel Dekker, New York; 3rd ed.; 1997; ISBN: 978-082479397-5
2. Adamson A. W. and Gast A. P.; Physical Chemistry of Surfaces; Wiley; 6th ed.; 1997; ISBN: 978-812653417-3
3. Cui Z.; Nanofabrication: Principles, Capabilities and Limits; Springer; 2008; ISBN: 978-038775576-2

4. Tseng AA; Nanofabrication: Fundamentals and Applications; World Scientific; 2008; ISBN: 978-981270542-6

Scheme of Continuous Internal Evaluation (CIE)

CIE consists of 2 phases

Phase 1: Test+ Assignment=20+5=25

Phase 2: Test + Assignment=20+5=25

Total=25+25=50 Marks

Semester: VI

PETROCHEMICAL PROCESSING

Course Code:12CH 6C1 **CIE Marks: 100**
Hrs/Week: L:T:P:S 3:0:0:4 **SEE Marks: 100**
Credits: 04 **Exam Hrs : 3 Hrs**

Course Learning Objectives:
Student will be able to:

- Explain the manufacturing details of C1 To C4 compounds
- Explain the flow sheets of manufacturing
- Application of C1 to C4 compounds

Unit – I **08 Hrs**

Definition of Petrochemicals Petrochemical, industries in India, Principal raw materials Introduction to chemicals from C1 ,C2, C3 and C4 compounds **Chemicals from C1 Compounds:** Manufacture of methanol and chloromethanes, Manufacture of perchloro ethylene.

Unit – II **07 Hrs**

Chemicals From C2 Compounds: Ethylene and acetylene, ethanol, polyethylene, ethylene dichloride, acetaldehyde, vinyl chloride, ethylene oxide, ethanol amines, vinyl acetate, acetic acid.

Unit – III **07 Hrs**

Chemical From C3 Compounds: Isopropanol, acetone, lumen (isopropyl benzene), acrylonitrile, isoprene, polypropylene, epichlorohydrin, propylene oxide.

Unit – IV **08 Hrs**

Chemical From C4 Compounds: Butadiene dehydrogenation of butane (Houdry). Dehydrogenation of butylenes. Dehydrogenation-dehydration of ethanol. Steam cracking of hydrocarbons **Chemicals From Aromatics:** Primary raw material, Hydro alkylation.

Unit – V **06 Hrs**

Manufacture of Phenol: various methods of manufacture, Pthalic anhydride, nitrobenzene, aniline.

Manufacture of industrial dyes based on petroleum feed stock

Course outcomes:

After completion of the course student will be able to:

1. List various components from C1 to C4 compounds
2. Discuss the process of manufacturing of petrochemicals
3. Draw the flow sheets for various manufacturing process
4. Compare alternative processes

Self Study:
Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus

Reference Books:

1. I.D.Mall; Petrochemical Process Technology; Macmillan India; New Delhi; 2008; ISBN:13:9781403931979
2. Austin T.George; Shreve's Chemical Process Industries; McGrew Hill; 5th Edition; 1984; ISBN:0070661677
3. G.N.Pandey;Chemical Technology;3rd Edition;1997; ISBN:9780706986884
4. B.K.R.Rao;Petrochemicals; Khanna Publishers 1990; ISBN:9788174090447

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be two presentations and submission of report for the self study evaluation and will be evaluated for 20 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

APPLIED MATHEMATICS IN CHEMICAL ENGINEERING

Course Code: 12CH 6C2 **CIE Marks: 100**
Hrs/Week: L:T:P:S 3:0:0:4 **SEE Marks: 100**
Credits: 04 **Exam Hrs : 3 Hrs**

Course Learning Objectives:
Student will be able to:
Develop mathematical models for unit operations
Apply analytical techniques to solve chemical engineering problems.
Formulate and optimize one or more objective functions for a chemical process.
Know the computational methods developed from mathematical analogues.

Unit – I **08 Hrs**

Linear ordinary differential equations: Overview of total differential equations for lumped parameter chemical engineering systems. Solution methods: characteristic equation for linear equations. Homogeneous and particular solutions, method of undetermined coefficients.

Unit – II **04 Hrs**

Nonlinear ordinary differential equations: Frobenius method for nonlinear second order O. D. E. and applications in Chemical Engineering.

Unit – III **09 Hrs**

Partial differential Equations: Types of second order P.D.E.s – elliptic, parabolic – used to model steady and unsteady transport. First order hyperbolic P.D.E. for inviscid flow.

Solution by separation of variables, method of moments (parabolic P.D.E.), d'Alembert's principle (hyperbolic P.D.E.). Applications in Chemical Engineering.

Unit – IV **08 Hrs**

z-transforms: Definition, relation with Laplace transform, properties of z-transform, inverse. Computer solution of partial fraction expansion, solution of difference equations using z-transforms.

Unit – V **07 Hrs**

Optimization: Objective function for process. Unconstrained optimization by steepest descent method. Constrained optimization. Applications in Chemical Engineering.

Course outcomes:

After completion of the course student will be able to:

1. Define the system boundaries for simple unit operations
2. Write model equations for chemical engineering systems
3. Apply suitable mathematical tools to solve these equations
4. Compare with fitted parameter model results with experimental data
5. Devise an algorithm for developing chemical engineering systems

Self Study:

Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus.

Reference Books

1. Richard G. Rice, Duang D. Do; Applied Mathematics and Modeling for Chemical Engineers"; John Wiley; 2nd edition; 2012; ISBN: 978-1-118-02472-0
2. Hyun-Ku Rhee , Rutherford Aris, Neal R. Amundson; First Order Partial Differential Equations – volumes 1 & 2; Dover; 1st edition; 1986; ISBN: 978-0-486-4199(3-0, 4-0)
3. Thomas F. Edgar, David M. Himmelblau, Leon S. Lasdon; Optimization of Chemical Processes; McGraw-Hill; 2nd edition; 2001; ISBN: 978-0-070-39359-2
4. Benjamin C. Kuo; Automatic Control Systems; PHI Learning Pvt. Ltd., 7th edition; 1995; ISBN: 978-81-203-0968-5

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 20 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

HETEROGENEOUS REACTION SYSTEMS

Course Code: 12CH6C3 **CIE Marks: 100**
Hrs/Week: L:T:P:S 3:0:0:4 **SEE Marks: 100**
Credits: 04 **Exam Hrs: 3 Hrs**

Course Learning Objectives:
Student will be able to:

- Define rates for heterogeneous reactions
- Describe various heterogeneous reactors
- Analyze catalyst properties
- Interpret experimental data and determine rate equations
- Design the reactors for fluid-solid and fluid-fluid reactions

Unit – I **08 Hrs**

Introduction to Heterogeneous Reaction Systems: Examples for heterogeneous catalytic reactions and heterogeneous non-catalytic reactions, Rate equations for heterogeneous reactions, Overall rates for linear and nonlinear process.

Non Catalytic Systems: Fluid particle reactions and their kinetics.

Unit – II **08 Hrs**

Catalysis: Introduction, Properties, characterization and preparation of catalyst, mechanisms of catalysis, Adsorption Isotherms, Rate controlling steps, rates of adsorption, surface reaction and desorption. Wheelers model, Types of diffusion in porous catalysts, effectiveness of catalyst.

Unit – III **08 Hrs**

Fluid-Fluid Reactions: Kinetic regimes for mass transfer and reaction, rate equation for Instantaneous reaction, Fast reaction, Intermediate rate, Rate equation for slow reaction, Film conversion parameter, clues for kinetic regimes, slurry reaction kinetics.

Unit – IV **06 Hrs**

Catalyst Deactivation: Mechanism of deactivation, rate equations for deactivation reactions.
Eley-Rideal, Mars-Krevelen mechanisms, Langmuir Hinshelwood kinetics.

Unit – V **08 Hrs**

Experimental Methods For Finding Rates: Differential and Integral Reactor. Differential and integral analysis.

Design of Reactors: Fluid-particle, fluid- fluid reactor design, Slurry Reactor, Packed bed catalytic reactor, Trickle bed reactor, Three phase fluidized beds.

Course Outcomes:

After completion of the course student will be able to:

1. Describe the rates and rate controlling steps for heterogeneous reactions
2. Determination of Catalyst properties
3. Interpretation of experimental data and determination of rate equations
4. Design of reactors for heterogeneous reactions

Self Study:

Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus

Reference Books:

1 Levenspiel, "Octave, Chemical Reaction Engineering", 3rd Edition, John Wiley and Sons, 2005
2 J. M. Smith, "Chemical Engg Kinetics", 3rd Edition ,Mc Graw Hill, 2004
3 H. Scott Foggler, "Elements of Chemical Reaction Engineering", 3rd Edition, Prentice Hall 2002
4 James J. Carberry, "Chemical and Catalytic Reaction Engineering", 1st Edition, McGraw Hill, 1976

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be two presentations and submission of report for the self study evaluation and will be evaluated for 20 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

CHEMICAL PROCESS ENGINEERING ECONOMICS

Course Code:12CH6C4 **CIE Marks: 100**
Hrs/Week: L:T:P:S 3:0:0:4 **SEE Marks: 100**
Credits: 04 **Exam Hrs: 3 Hrs**

Course Learning Objectives:

Student will be able to:

- Estimate cost of capital and working capital
- Analyze tax implications on process industry
- Determine profitability and breakeven point
- Make a choice among various investment ideas

Unit – I **8 Hrs**

Process Design Development: Overall planning of chemical process plant – Types of designs, Feasibility survey, Process development, Material & Energy Balance, Equipment design & selection, Process flow sheet, Plant location and layout, Factors affecting plant design.

Unit – II **07 Hrs**

Cost Analysis: Factors involved in project cost estimation, Methods employed for the estimation of the capital investment. Estimation of working capital, Time value of money and equivalence.

Unit – III **06 Hrs**

Depreciation and Taxes: – Depreciation calculation methods, Equivalence after taxes, cost compassions after taxes.

Unit – IV **08 Hrs**

Profitability: – Methods for the evaluation of profitability, financial statements, Cash flow diagrams, Concept of break-even analysis

Unit – V **07 Hrs**

Replacement and Alternative Investments, Design Report: Types of reports, organization of report

Course Outcomes:

After completion of course students will be able to:

1. Calculate Depreciation and Depletion.
2. Draw cash flow diagrams and do break-even analysis.
3. Selection of alternatives.
4. Evaluation of profitability in process industries

Self Study:

Case study, Design and Emerging Technologies to be discussed pertaining to the course and beyond syllabus

Reference Books

1. M.S. Peters and K.D. Timmerhaus "Plant Design and Economics for Chemical Engineers" – 4th edn, McGraw Hill,2008.
2. T.R.Banga and S.C. Sharma – "Industrial Organization and Engineering Economics" - 22nd Edn., Khanna Publishers. 2007
3. J. Haffel and D.J. Jordan, Chemical Process Economics, Marcal Dekker Inc. 2005

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 20 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

COMPOSITE MATERIALS

Course Code : 12CH6D1 **CIE Marks: 100**
Hrs/Week :L:T:P::S 3:0:0:0 **SEE Marks: 100**
Credits: 03 **SEE: 03**

Course Learning Objectives:

Student will be able to:

- Relate structure and composition of composite material
- Analyze and compare the behavior of various components of composite materials
- Explain various manufacturing process of composites
- Identify composite materials for particular applications

Unit I **07 Hrs**

Introduction: General introduction, basic constituents, specific modulus and specific strength of a composite, advantages and disadvantages of composites over metals, factors contributing to the mechanical performance of a composite and classification of composites.

Unit II **07 Hrs**

Polymer Matrix Composites: Polymer composites, polymer degradation – thermal and oxidative degradation, stabilization of polymers – antioxidants, fire retardant polymers, stress-strain behavior of polymers, thermal expansion of polymers and draw backs of polymer matrix composites.

Unit III **08 Hrs**

Composite Manufacturing: Fundamental of composites manufacturing, Injection Molding, Compression Molding, Filament Winding, Pultrusion, Resin Transfer Molding, Autoclave Curing, Vacuum Bagging (release fabric/peel ply, bleeder/breather materials, bagging films, sealant and mold release), advantages and disadvantages of each manufacturing process.

Unit IV **07 Hrs**

Composite Tooling: Tooling, selection of tool material, coefficient of thermal expansion, soft tooling, hard tooling, non-destructive testing of composites and mechanical testing of composites.

Unit V **07 Hrs**

Applications of composite materials: Applications of FRP composites related to aerospace, automobile, bridges and other Civil Engineering Structures (adhesively bonded FRP composites in strengthening of civil engineering structural components such as beams, Columns etc)

Course outcomes:

After completion of the course student will be able to:

1. Identify the basic constituents of a composite material and list the choice of materials available
2. Understand the applications of composite materials in aerospace, automobiles and civil engineering structures
3. Learn the manufacturing processes with the help of a diagram.
4. Estimate the properties of composite materials for an engineering application.

Reference Books:

1 Krishan K Chawla, "Composite Materials Science and Engineering", Springer International Edition.

2 Autar K. Kaw "Mechanics of Composite Materials", Taylor and Francis Group

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

NOVEL SEPARATION TECHNIQUES

Course Code: 12CH6D2 **CIE Marks: 100**
Hrs/Week: L:T:P:S 3:0:0:0 **SEE Marks: 100**
Credits: 03 **Exam Hrs : 3 Hrs**
Course Learning Objectives:

Student will be able to:

- Explain various separation techniques based on their applications
- Apply chemical engineering principles to novel separation techniques
- Apply novel separation techniques in conventional chemical processes.

Unit – I **09 Hrs**

Adsorptive Separations: Review of fundamentals. Models of adsorptive column, pressure and thermal swing adsorption, ion-exchange, affinity chromatography, gradient chromatography.

Unit – II **08 Hrs**

Membrane Separation Processes: Classification, structure and characteristics of membrane, membrane modules. Thermodynamic and mass transfer considerations, Reverse Osmosis, Ultra Filtration, pervaporation.

Unit – III **07 Hrs**

Surfactant Based Separations: Fundamentals of surfactants at surfaces and in solutions, liquid membrane permeation, foam separations, micellar separations.

Unit – IV **06 Hrs**

Super Critical Fluid Extraction: Physico-chemical principles, thermodynamics, process synthesis and energy analysis.

Unit – V **06 Hrs**

Other Separations: Separation by thermal diffusion, electrophoresis, adductive crystallization.

Course outcomes:

After completion of the course student will be able to:

1. Recall the various separation techniques used with their principles.
2. Understand the equilibrium conditions and limitations of various separation techniques
3. Analyze the mechanisms of separation.
4. Compare the various separation techniques and select the proper technique

Reference Books

1. Wankat P.C.; Large Scale Adsorption Chromatography; CRC Press; 1986; ISBN: 9780849355974**.**
2. Rousseau R.W; Handbook of Separation Process Technology; John Wiley and Sons; 1987; ISBN: 978047189558
3. Sourirajan S. and Matsura T; Reverse Osmosis and Ultra Filtration Process Principle; NRC press; 1985.
4. Rosen M. J.; John Wiley and Sons; Surfactants and Interfacial Phenomena; 3rd Edition; 2004; ISBN: 0471478180

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one assignment on new topics / model presentation etc. for 10 marks

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

INDUSTRIAL SAFETY AND RISK MANAGEMENT

Course Code: 12CH 6D3 **CIE Marks: 100**
Hrs/Week : L:T:P::S 3:0:0:0 **SEE Marks : 100**
Credits : 03 **Exam Hrs: 03Hrs**

Course Learning Objectives:
Student will be able to:

- Select appropriate risk assessment techniques and analyze public and individual perception of risk.
- Relate safety, ergonomics and human factors
- Carry out risk assessment and protection in process industries

Unit 1 **08 Hrs**

General: Hazard identification methodologies, risk assessment methods-PHA, HAZOP, MCA, ETA, FTA, Consequence analysis, Profit analysis. Hazards in work places- Nature and type of Work places, Types of hazards, hazards due to improper house keeping, hazards due to fire in multi floor industries and buildings, guidelines and safe methods in above situations

Unit – II **10 Hrs**

Techniques: General, Risk adjusted discounted rate method, Certainty Equivalent Coefficient method, Quantitative Sensitivity analysis, Probability distribution, Coefficient of variation method, Simulation method, Crude Procedures, Payback period, Expected monetary value method, Refined procedures, Shackle approach, Hiller's model, Hertz model, Goal programming

Unit – III **10 Hrs**

Risk Management: Emergency relief Systems, Diers program, Bench scale experiments, Design of emergency relief systems, Internal emergency planning, Risk management plan, mandatory technology option analysis, Risk management alternatives, risk management tools, risk management plans, Risk index method, Dowfire and explosion method, Mond index Method

Unit – IV **10 Hrs**

Risk Assurance and Assessment: Property Insurance, Transport insurance, Liability insurance, Pecunious insurance, Risk Assessment, Scope Canvey study, Rijimond pilot study, Low Probability high consequence events. Fault tree analysis, Event tree analysis, Zero Infinity dilemma.

Unit – V **10 Hrs**

Risk Analysis in Chemical Industries: Handling and storage of Chemicals, Process plants, and Control systems, Personnel protection equipments. Environmental risk analysis, International environmental management system, Corporate management system.

Course outcomes:
After completion of the course student will be able to:

1. Recall the assessment techniques used in interpret the various risk assessment tools process.
2. Use hazard identification tools for safety
3. Analyze tools and safety procedures for protection in process industries
4. Compare the safety tools and procedures in industries
5. Formulate the procedure to relate safety ergonomics and human factors

Reference Books:

1 Srivastav S., "Industrial Maintenance Management", Sultan Chand & Co., 1998.
2 Sincero A. P. and Sincero, G. A., "Environmental Engineering – A Design Approach", Prentice Hall of India, 1996.
3 Pandya C. G., "Risks in Chemical Units", Oxford and IBH Publishers, 1992.
5 Fawcett H. H., "Safety and Accident Prevention in Chemical Operations" by John Wiley & Sons, 1982.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

PIPING ENGINEERING AND DESIGN

Course Code: 12CH 6D4 **CIE Marks: 100**
Hrs/Week: L:T:P::S :3:0:0:0 **SEE Marks: 100**
Credits: 03 **Exam Hrs: 3 Hrs**

Course learning Objectives:

Student will be able to:

- Understand piping layout and pipe fitting requirements in a process industry
- Estimate pipe sizing and pressure loss in pipes
- Select material of construction of piping systems
- Identify methods of corrosion protection for the piping
- Suggest different methods of compensation for expansion of pipes.

Unit – I **07Hrs**

Fundamentals of Fluid Mechanics: Euler's equation of motion, continuity equation, Bernoulli's equation, gas laws.

Hydraulic Design Considerations: Determination of pipe size, determination of pressure losses, thrusts in pipe lines, design of gas pipe lines, measurement of flow in pipes.

Metallurgy of Piping Materials: Selection of piping materials, physical properties of pipe materials, alloying elements in steel, recommended piping materials.

Unit – II **08Hrs**

Pipes and Pipe Fittings: Standards and specifications, steel pipes, steel pipe fittings, cast iron pipes, cast iron fittings, jointing of cast iron pipes, tubes of other materials, design of flanges and flanged pipes.

Valves and Allied Fittings: Valves, functions of valves, valve materials and methods of construction, pressure drop in valves, valve size, types of valves, valve fittings

Unit – III **06Hrs**

Pipe Supports: Load on structural supports, supporting structures of pipe lines, pipe supports- design considerations, platforms and ladders, foundation, supporting span of overhead pipelines, stiffening ribs, pipe clamping, flexible hanger supports.

Unit – IV **08Hrs**

Piping Fabrication: Codes and standards, piping fabrication, welding joints in pipe lines, welding processes used in piping fabrication, preparation of pipe edges, welding electrodes, heat treatment of weld joints, inspection of weld joints, repair of defective weld joints, acceptance standards.

Corrosion Erosion in Pipelines: Corrosion control in a critical task, corrosion process, corrosion reaction, types of corrosion, anticorrosive protective coatings, cathodic protection of pipelines, abrasion.

Unit – V **07Hrs**

Expansion Effects and Compensating Methods: Pipe expansions, methods of compensation, thermal force calculation, methods of compensation, permissible equivalent stresses caused by' additional external loads expansion devices calculation of anchor force using a bellow below material and life, use of hinged compensators.

Thermal Insulation: Functions of thermal insulators, modes of heat transfer, insulating materials, temperature drop in a pipeline, application of insulation, calculation of condensate, desuperheaters.

Course outcomes:

After completion of the course student will be able to:

1. Recall the fundamentals of fluid flow, heat transfer, insulation and corrosion.
2. Calculate pressure losses in pipes and describe the different methods for determining the pipe size.
3. Apply the concept of fluid flow, heat transfer, insulation and corrosion for design of pipelines.
4. Compare and distinguish amongst various alloying elements, materials of construction, pipe fittings, supports, expansion devices and materials of insulation.
5. Determine the specific need and choose pipes/pipe fittings, supports, expansion devices for various processes.
6. Design pipelines, expansion devices, pipe supports and flanges required for specific application

Reference Books

1. G K. Sahu, "Handbook of Piping Design", 1st Edition, New Age Publishers, 1998.

2. Mohinder L. Nayyar, "Piping Hand Book", 7th Edition, Mc. Graw Hill Publication, 1996.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

Rashtreeya Sikshana Samithi Trust

R. V. COLLEGE OF ENGINEERING

(Autonomous Institution Affiliated to VTU, Belagavi)

R.V Vidyaniketan Post, Mysore Road

Bengaluru-560 059

Scheme & Syllabus
VII & VIII Semester B.E
Chemical Engineering

(2012 Scheme)

Department of Chemical Engineering
R.V. College of Engineering, Bengaluru – 59
(Autonomous Institution affiliated to VTU, Belagavi)

Vision

Imparting quality education in Chemical Engineering; promote leadership in research, innovation and sustainable technologies through teamwork.

Mission

1. Impart quality education in basic and applied areas of Chemical Engineering.
2. Enable students and faculty to achieve proficiency in Chemical Engineering through state-of-the-art laboratories.
3. Encourage faculty and students to make career in research through development of novel processes and products.
4. Develop inclusive technologies with a focus on sustainability.
5. Collaborate with industries and research institutes to cater societal needs
6. Inculcate leadership qualities, entrepreneurial skills, societal and ethical values in students and faculty

Program Educational Objectives (PEOs)

Graduates will be able to

PEO1 Exhibit knowledge of basic sciences, concepts and principles of Chemical Engineering

PEO2 Comprehend, analyze, design and implement engineering systems with a focus on research, innovation and sustainability

PEO3 Work in multidisciplinary team and cater to the needs of process industries with appropriate safety, health and environmental regulations

PEO4 Demonstrate effective communication skills, leadership qualities and develop into successful entrepreneurs

Program outcomes

The graduates in Chemical Engineering are expected to acquire following abilities/ qualities

PO1 Apply knowledge of mathematics, basic sciences and engineering fundamentals to Identify, formulate and solve chemical engineering problems
PO2 Design a system, component, or process to meet desired needs with appropriate societal and environmental regulations
PO3 Work in multi-disciplinary teams and develop leadership qualities with effective Communication
PO4 Engage in life-long learning and follow ethical principles
PO5 Identify and use appropriate computational tools in chemical engineering practice
PO6 Undertake research leading to innovations, sustainable technologies and entrepreneurship with a focus on project management

Department of Chemical Engineering
R.V.College of Engineering, Bengaluru-59
(Autonomous Institution affiliated to VT"U, Belagavi)
SCHEME OF TEACHING & EXAMINATION
Semester: VII

Sl. No	Course Code	Course	BoS	Credit allocation				Total Credits
				Lectures	Tutorials	Practical	Self study	
01	12CH71	Process Simulation and Modeling	Chemical	4	0	1	0	5
02	12CH72	Chemical Technology	Chemical	4	1	0	0	5
03	12HSC73*	Legal studies and professional ethics for engineers	HSS	2	0	0	0	2
04	12CH74	Minor Project	Chemical	0	0	2	0	2
05	12CH7EX	Elective E	Chemical	4	0	0	0	4
06	12GF7XX	Elective F	Respective BoS	4	0	0	0	4
07	12GG7XX	Elective G	Respective BoS	3	0	0	0	3
		Total Credits		21	01	03	0	25
		No. of Hrs		21	02	06	0	29

*Mandatory audit course for lateral entry students

Semester VIII

Sl. No	Course Code	Course	BoS	Credit allocation				Total Credits
				Lectures	Tutorials	Practical	Self Study	
01	12CH81	Major Project	Chemical	0	0	18	0	18
02	12CH82	Technical seminar	Chemical	0	0	01	0	01
03	12HSS83	Innovation and Social skills	HSS	0	0	01	0	01
		Total Credits						20
		No. of Hrs				38		38

Group E (4 credit)	**Group F (4 credit)**	**Group G (3 credit)**
Pilot Plant and Scale up methods 12CH7E1	Green Technology 12GF7XX	Industrial Safety & Risk management 12GG7XX
Process Instrumentation 12CH7E2		
Introduction to Microelectronic Fabrication 12CH7E3		
Introduction to Colloid and Interface engineering 12CH7E4		

R.V.COLLEGE OF ENGINEERING, BENGALURU-59
(Autonomous institution affiliated to VTU, Belgavi)
Global Electives for 7th semester – 2012 Scheme

Sl. No	BoS	Group F			Group G		
		Course Code	Course Title	Credits	Course Code	Course Title	Credits
1	BT	12GF701	Nonmaterial: Process and Applications	4	12GG701	Bioinformatics	3
2	CH	12GF702	Green Technology	4	12GG702	Industrial safety & risk management	3
3	CS	12GF703	Mobile Application Development	4	12GG703	Intelligent Systems	3
4	CV	12GF704	Disaster Management	4	12GG704	Solid Waste Management	3
5	EC	12GF705	Artificial Neural Networks	4	12GG705	Automotive Electronics	3
6	EE	12GF706	Designof Renewable Energy Systems	4	12GG706	Industrial electronics	3
7	IM	12GF707	Optimization Techniques	4	12GG707	Systems Engineering	3
8	IM	12GF708	Project Management	4			
9	IS	12GF709	Java & J2EE	4	12GG708	Cloud Computing	3
10	IT	12GF710	Virtual instrumentation	4	12GG709	MEMS	3
11	ME	12GF711	Automotive Engineering	4	12GG710	Mechatronics	3
12	TE	12GF712	Telecommunication Systems	4	12GG711	Space Technology and Applications	3
13	BS				12GG712	**Linear Algebra**	3
14	BS	12GF713	Thin Films and Surface Engineering	4			

15	BS	12GF714	Engineering Materials for Advanced Technology	4			
16	HSS	12GF715	Applied Psychology for Engineers	4			

PROCESS SIMULATION AND MODELING

Course Code : 12CH71 **CIE Marks: 150**
Hrs/Week L:T:P:S 4:0:2:0 **SEE Marks: 150**
Credits: 05 **SEE: 03 Hrs**

Course Learning Objectives:
The student will be able to

- Apply numerical techniques to solve chemical engineering problems
- Analyze chemical engineering system in term of modeling principle
- Distinguish simulation from design of equipments
- Develop algorithm for modeling & solve the model
- Distinguish ASPEN from computational fluid dynamics commercial package
- Develop simple chemical engineering packages

Unit I **10 Hrs**

Modeling in Chemical Engineering: Introduction, Fundamental laws, scope of coverage, principles of formulation, modeling aspects, classification of models. continuity equation, equations of motion, transport equations, equations of state, equilibrium, and chemical kinetics

Unit II **10 Hrs**

Models of Separation processes: Steady state single and multiple stage solvent extraction, unsteady state single stage solvent extraction, multistage gas absorption, single component vaporizer and ideal binary distillation column

Unit III **10 Hrs**

Models of reactors: Series of Isothermal, constant hold-up CSTRs, CSTRs with variable hold-ups, Non-isothermal CSTR, batch reactor and reactor with mass transfer

Unit IV **10 Hrs**

Numerical analysis for simulation: Introduction to simulation, Role of computers and numerical methods in simulation, iterative convergence methods – interval halving, Newton-Raphson method, false-position, Wegstein and Muller methods, numerical integration of ODEs – Euler and Runge-Kutta, introduction to FEM and basic steps in FEM formulation

Unit V **08 Hrs**

Professional simulation packages: Overview of commercial packages for chemical engineering modeling and simulation, Use of Aspen-Hysys, computational fluid dynamics packages and property methods containing thermodynamic models in Aspen – Hysys.

LABORATORY WORK

1. Simulation of Shell and Tube Heat Exchanger
2. Simulation of Centrifugal Pump
3. Simulation of Separator
4. Simulation of single stream gas heater/cooler
5. Simulation of CSTR
6. Simulation of Ethylene glycol production from ethylene oxide and water
7. Simulation of propylene glycol production from propylene oxide and water
8. Simulation of aromatic stripper with recycling
9. Simulation of Benzene production
10. Simulation of methanol-water separation using RADFRAC

11. Simulation of various reactor types to model a single reaction
12. Simulation of cyclo hexane production

These simulations are to be carried out using Aspen Tech or similar software packages

Course outcomes:

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

CO1	Recall the fundamental laws in modeling chemical engineering systems
CO2	Explain modeling and simulation of simple chemical engineering systems
CO3	Apply mathematical tools to solve model equations
CO4	Analyze chemical engineering systems for model development
CO5	Asses the performance of various models
CO6	Develop models for simple chemical engineering systems

Reference Books:

1	William L. Luyben, "Process Modeling, Simulation and Control for Chemical Engineers", McGraw Hill 2nd Edition,1999
2	B V Babu, "Process Plant Simulation", Oxford University Press,1st Edition, 2004
3	H Scott Fogler, "Elements of Chemical Reaction Engineering", Prentice Hall of India, 3rd Edition, 2004
4	D.Q.Kern, "Process Heat Transfer", Tata McGraw Hill,1st Edition, 2012

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests, each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics/model presentation etc. for 10 marks.

Scheme of Continuous Internal Evaluation for Practical's:

The Record is evaluated for 40 marks and final test is conducted for 10 Marks

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

Scheme of Semester End Examination for practical's:

In the laboratory the student is required to answer/ perform one question. It is evaluated for 50 marks.

CHEMICAL TECHNOLOGY

Course Code : 12CH72 **CIE Marks: 100**
Hrs/Week L:T:P:S 4:1:0:0 **SEE Marks: 100**
Credits: 05 **SEE: 03 Hrs.**

Course Learning Objectives:

The student will be able to

- Apply the knowledge of basic engineering to understand and describe unit operations used in the chemical industry.
- To acquire a basic knowledge of unit process to develop process flow diagrams.
- To make the student aware of challenges of the manufacturing processes, faced by the process industries.
- Distinguish manufacture methods based on purity and yield of products.
- Develop simple process plant lay-outs for chemical industry.

Unit I **10 Hrs**

Introduction-Symbols, Flow sheeting and PI Diagram
Chloro-Alkali Industries: Sodium Chloride, Soda ash, Caustic soda and Chlorine.
Industrial Gases: Carbon dioxide, Hydrogen, Oxygen and Nitrogen.

Unit II **10 Hrs**

Acids: Sulfuric acid, Nitric acid, Hydrochloric acid and Phosphoric acids.
Soaps and detergents: Soaps and detergents, manufacture of soaps and heavy duty detergents, linear alkyl benzenes (LAB).

Unit III **08 Hrs**

Fertilizers: Ammonia, Urea, Ammonium Nitrate, Ammonium Phosphate, Ammonium Sulfate, DAP, Super phosphate and Triple Super Phosphate.

Unit IV **08 Hrs**

Sugar and Starch Industries: Production of cane sugar, chemistry of starch. Manufacturing of industrial starch and its applications.

Unit V **10 Hrs**

Petrochemicals, Polymers and Rubber: Polypropylene, PVC, natural rubber, synthetic rubber and rubber compounding.
Pulp and paper: Raw materials, manufacture of pulp, paper and structural boards.

Course outcomes:
At the end of the course the student will be able to:

CO1 Recall the fundamentals of unit operations and unit processes
CO2 Explain process flow sheet for important industrial chemicals
CO3 Draw process flow diagrams
CO4 Analyze processes for challenges and engineering problems
CO5 Compare alternative processes of manufacturing

Reference Books:

1. M. Gopala Rao Marshall Sittig; Dryden's Outlines of Chemical Technology; East-West Press Publications, New Delhi, 2nd edition,1973, ISBN: 81-85938-79-2
2. Austin T George; Shreve's Chemical Process Industries; Mc. Graw Hill; 5th edition; 1984. ISBN: 0070661677
3. G.N. Pandey; Text book of Chemical Technology, Vol – I & Vol – II; Vikas Publication, 1979
4. Kirk Othmer; Encyclopedia of Chemical Technology, Volumes 20, Edition 5th, 2006. ISBN 04711485039

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests, each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics/model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

LEGAL STUDIES & PROFESSIONAL ETHICS FOR ENGINEERS

Course Code	**:**	**12HSC73**	**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L: T: P: S: 2: 0: 0: 0**	**SEE Marks**	**:**	**50**
Credits	**:**	**02**	**SEE Duration**	**:**	**2 Hrs**

Course Learning Objectives

1. Understanding of ethical and legal aspects of advertising, consumer problems and their redressal mechanism related to product and service standards.
2. Discuss the knowledge of substantive Labor law and to develop skills for legal reasoning and statutory interpretations.
3. Apply the knowledge of the constitutional literacy to become aware of the fundamental rights and duties in their role as Engineers
4. Appraise the knowledge of consumer rights, responsibilities and socio-legal framework of protection of consumer interest
5. Evaluate individual role, responsibilities and emphasize on professional/ engineering ethics in shaping professions

UNIT – I **06Hrs**

Salient features of Indian Constitution: Preamble to the Constitution of India. Scope & Extent of Fundamental Rights under Part III. Constitutional Provisions relating to Right to Education under Article 21-A: Right to Information Act with Case studies

UNIT – II **06Hrs**

Significance of Directive Principles of State Policy under Part – IV. Executive of the Union and State, Parliament & State Legislature. Anti-defection law, Union Judiciary & State Judiciary, Ombudsman-concept and need, Lokpal and Lokayukta.

UNIT-III **04Hrs**

Consumer Protection Law- concept, definition and scope, object of C P Act, 1986, Rights of Consumers .Unfair Trade Practice, Restriction Trade Practice, Defect in goods, Deficiency in service: Medical, Lawyering, Electricity, Housing, Postal services etc. Enforcement of Consumer Rights- Consumer Forum

UNIT-IV **04Hrs**

Introduction to Labour Legislations - Industrial Relation, Labour Problem and Labour Policy in India, Labour Welfare- Factories Act, 1948**,** Hazardous process, Safety and Welfare, Working Hours of Adults, Employment of young persons, Industrial Dispute Act, 1947**,** Reference of Disputes to Boards, Courts or Tribunals

UNIT – V **04Hrs**

Scope and aims of engineering ethics (NSPE Code of Ethics), Responsibility of Engineers, Impediments to responsibility. Honesty, Integrity and reliability, Risks, Safety and Liability in Engineering. Corporate Social Responsibility. Statutory Provision regarding prohibition and prevention of Ragging and Sexual Harassment.

Course Outcome:

CO1. Understanding process of ethical and moral analysis in decision making scenarios and inculcate ethical behavior as a trait for professional development
CO2. Identify the conflict management in legal perspective and judicial systems pertaining to professional environment.
CO3. Apply engineering & ethical knowledge gained during their professional career to protect the interests of society and carry out their duties with integrity.
CO4. Demonstrate the consumer responsibility and capability to take affirmative action as an

aware citizen, to defend their rights.

References:

1. Dr. J. N Pandey, Constitutional Law of India, Central Law Agency, 44th Edition, 2010.
2. S.C. Srivastava: Industrial Relation and Labour,Vikas Publishing House, 6th Edition, 2012, ISBN: 9789325955400
3. Avtar Singh: Law of Consumer Protection: Principles and Practice, 4th Edition, Eastern Book Company, 2005, ISBN 8170128544, 9788170128540
4. Jr. Charles E Harris, Michael. S. Pritchard and Michael J Rabins, Engineering Ethics, Thompson Asia,5th Edition, 2003,ISBN-10:1-133-93468-4

Scheme of Continuous Internal Evaluation:(50 Marks)

CIE consists of five components: two quizzes (30%), two written test (60%) and one Assignment (10%). The written test is aimed at evaluating the interim knowledge gained in the subject by the students. The quizzes are aimed at assisting faculty in checking the progress of the students in the subject. Assignment develops the writing skill and acquired knowledge with scientific background in a well-organized way.

Scheme of Semester End Examination: (50 Marks)

The question paper consists of Part A and Part B. Part A is objective type for 10 marks covering the complete syllabus and is compulsory. Part B is for 40 marks, and shall consist of 5 questions carrying 08 marks each without any sub questions. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

MINOR PROJECT

Course code	**: 12CH74**	**CIE Marks**	**:50**
Hours / Week :L:T:P:S	**: 0:0:4:0**	**SEE Marks**	**:50**
Credits	**: 02**	**SEE Duration**	**:03**

Course Learning Objectives (CLOs):

1. Create interest in innovative developments and preferably interdisciplinary field.
2. Apply the basic knowledge gained in previous semesters for hardware and software integrated design.
3. Inculcate the skills for good presentation and improve the Technical Report writing skills.
4. Demonstrate management principles and apply these to one's own work, as a member and leader in a team.
5. Recognize the need for, planning, preparation, management and financial budgeting.

Mini Project Guidelines:

1. Each project group will consist of minimum two and maximum of four students.
2. Each group has to select a current topic that will use the technical knowledge of their program of study after intensive literature survey.
3. Allocation of the guides is according with the expertise of the faculty.
4. The mini project would be implemented on hardware.
5. The implementation of the project must be preferably carried out using the resources available in the department/college.
6. The CIE evaluation will be done by the committee constituted by the department. The committee shall consist of respective guide & two senior faculty members as examiner.

Course Outcomes

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

1. Define specifications, Conceptualize, Design and implement a project.
2. Communicate the work carried out as a technical report and orally.
3. Work in a team and contribute to team work.
4. Prepare budgetary estimates and project management.
5. Indulge in self-learning and be motivated for lifelong learning.

Scheme of Continuous Internal Examination (CIE):

Evaluation will be carried out under three Phases:

Phase	Activity	Weightage
I	Synopsis submission, Preliminary seminar for the approval of selected topic and Objectives formulation	25%
II	Mid-term seminar to review the progress of the work and documentation	25%
III	Submission of project report , Final seminar and demonstration	50%

During CIE Evaluation following weightage will be given for the various components of the project.

- Selection of the topic & formulation of objectives 10%
- Design and simulation/ algorithm development 30%
- Implementation and testing 30%
- Demonstration & Presentation 20%
- Report 10%

Scheme of Semester End Evaluation (SEE):

- Write up depicting Design, Requirements & Specifications 20%
- Demonstration, Presentation & Results 60%
- Related Questions & Answers 20%

PILOT PLANT AND SCALE UP METHODS

Course Code	**:**	**12CH7E1**	**CIE Marks**	**:**	100
Hrs/Week	**:**	**L: T: P: S: 4: 0: 0: 0**	**SEE Marks**	**:**	100
Credits	**:**	**04**	**SEE Duration**	**:**	**03 Hrs**

Course Learning Objectives

The student will be able to

- Perform process scale up using a systematic approach
- Perform a power analysis and understand flow regime
- Carry out successful process translations from the laboratory to the plant
- Explain different concepts of scale-up in mixing and contacting

UNIT – I **06Hrs**

Pilot Plants: Evolution of process system. Need of pilot plants. Concept of prototypes, models, scale ratios, element

UNIT – II **06Hrs**

Principles of Similarity: Geometric similarity. Distorted similarity. Static, dynamic, kinematics, thermal and chemical similarity with examples

UNIT-III **04Hrs**

Dimensional Analysis: (Review of Rayleigh's, Buckingham Π methods), Differential equation for static systems, flow systems, thermal systems, mass transfer processes, chemical processes homogeneous and heterogeneous

UNIT-IV **04Hrs**

Regime Concept: Static regime. Dynamic regime. Mixed regime concepts. Criteria to decide the regimes. Equations for scale criteria of static, dynamic processes, Extrapolation. Boundary effects.

UNIT – V **04Hrs**

Scale up of mixing process, agitated vessel. Scale up of chemical reactor systems-Homogeneous reaction systems. Reactor for fluid phase processes catalyzed by solids. Fluid-fluid reactors. Stagewise mass transfer processes. Continuous mass transfer processes. Scale up of momentum and heat transfer systems. Environmental challenges of scale up

Course Outcome:

CO1 Describe the prototypes and plant models
CO2 Compare the various similarity models
CO3 Analyze the factors influencing fluid systems
CO4 Justify the selection of different models
CO5 Scale up mixing and reactor systems

References:

1. Attilio Bisio, Robert L. Kabel, Scale up of Chemical Processes, John Wiley & Sons, 1985, ISBN: 0471057479
2. Johnstone and Thring, Pilot Plants Models and scale up method in Chemical Engineering, McGraw Hill, 1957

Scheme of Continuous Internal Evaluation

CIE consists of Three Tests, each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics/model presentation etc. for 10 marks

Scheme of Semester End Examination

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily

PROCESS INSTUMENTATION

Course Code : 12CH7E2 **CIE Marks: 100**
Hrs/Week L:T:P:S 4:0:0:0 **SEE Marks: 100**
Credits: 04

Course Learning Objectives:

The Student will be able to:

- Measure process parameters like temperature, pressure, level and density
- Explain the application of various instruments fin process industry
- Apply advanced skills in using of Temperature, pressure, level and density measurements.
- Analyze and Select suitable measuring device for chemical processes

Unit I **10Hrs**

Introduction-Basics Principle of measurements, static characteristics of measuring instruments, sensing element, transducers and transmission method indicating and Recording means.
Temperature measurement –Introduction-Temperature scale-Technical temperature measurement-methods of temperature measurement-Bimetallic thermometers thermistors sources of errors & precaution to be taken-precaution to be taken on the use of liquid expansion thermometer-thermocouples radiation pyrometer measurement of temperature of gases, liquids, solids, interior of solids radiation methods electrical temperature instruments pyknometers, calibration of thermometer

Unit II **10Hrs**

Pressure measurements-Introduction pressure standards, conventional pressure transducers, pressure gauge-ring balance gauge pressure shell dynamic characteristics of pressure measuring systems-measuring high and low pressure

Unit III **10Hrs**

Flow measurement, Mechanical flow meter stunt flow meter for liquids, variable aperture flow meter, electromagnetic type flow meter mass flow type flow meter vortex flow meter anemometer hot wire anemometer and other advanced instruments

Unit IV **08 Hrs**

Level measurement-Direct and indirect methods electrical conductivity method –capacitive methods ultra sonic method nucleonic method level gauge

Unit V **08 Hrs**

Measurement of densities Hydrometer determination of density to continuous weight measurement Viscosity measurement, float viscometer-Torque method

Miscellaneous recently developed Instruments: Fiber optics Annular Flame scanner-
Bar graph display device semiconductor pressure sensor-Recent trends in flow measurements-smart pressure transducers, Automatic fire detection and alarm system, Flue gas analysis-Fiber optic laser vibrometer

Course Outcomes:

CO1 Recognize suitable instrument for measuring physical properties of fluid
CO2 Explain various instruments for measuring process parameter
CO3 Apply advanced skills in using of Temperature, pressure, level and density measurements.
CO4 Evaluate process parameters to be used for industrial processes
CO5 Predict the sensitivity of flow measuring devices

Reference Books:

1	D P Eckmann ,Industrial Instrumentation, CBS publishers and distributors, 2006, ISBN: 8123908105
2	Austin E Fribance, Industrial Instrumentation Fundamentals, John Wiley and Sons, 1985

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests, each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics/model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

INTRODUCTION TO MICRO ELECTRONIC FABRICATION

Course Code : 12CH7E3 **CIE Marks: 100**
Hrs/Week L:T:P:S 4:0:0:0 **SEE Marks: 100**
Credits: 04 **SEE: 03 Hrs**

Course Learning Objectives:

The student will be able to

- Understand the process of deposition techniques
- Fabricate layers on chips using physical or chemical methods
- Analyze the performance of fabricated microelectronic structures
- Make masks for specific application

Unit I **08 Hrs**

Introduction:
Overview of Chip Manufacturing Process, FEOL and BEOL concepts.
Photo Lithography:
Lithography basics, layout, hierarchy vs flat file, levels and layers in layout file.
Mask making with e-beam, alignment and test structures in masks.
Lithography details:
Projection printing, dark field mask, positive resist and its advantages.
Process details including resist coating, pre-exposure bake, exposure, soft bake, developing and hard bake.Stepper vs scanner. Advanced Lithography; Resolution, numerical aperture, optical proximity correction (OPC), anti reflective coating (ARC), phase shift mask (PSM).

Unit II **08 Hrs**

Chip Production:
Physical Vapor Deposition (PVD) basics, equipment description and operation details, RF/magnetron sputtering, long throw, ionized metal plasma (IMP) sputtering, collimated beam, sputtering yield

Unit III **06 Hrs**

Chip Production:
Introduction to atomic layer deposition (ALD) and molecular beam epitaxy (MBE). Electrochemical deposition, Electro-migration vs grain size, conformal, anti conformal and super fill. Suppressor, accelerator, levelers, effect of seed layer, spin on coating.
Vapour Deposition: Chemical vapor deposition (CVD) basics, Atmospheric pressure chemical vapor deposition (APCVD), Low pressure chemical vapor deposition (LPCVD), Plasma enhanced chemical vapor deposition (PECVD), mass transfer control and reaction kinematics control.
Reactor description and operation, deposition of silicon, poly silicon, oxide, nitride and tungsten,

Unit IV **06 Hrs**

Etching Techniques
Wet etching:
Isotropic etch, selectivity, anisotropic Si etch in KOH, cleaning, micro loading and process proximity correction (ppc).
Chemicals for oxide and nitride removal, effect of dopants, photoresist development.
Dry etching :
Plasma, anisotropic etch, equipment details and operation.
Reactive ion etching (RIE), veil formation and de-veil, electrostatic discharge (ESD), aluminum etch
Chemical Mechanical planarization (CMP) basics, Dishing, Erosion, Issues in Shallow Trench Isolation.
Oxide Polish and Copper Polish, Dummy fill, slotting

Unit V **08 Hrs**

FEOL:
Semiconductor electron band structure, band gap mos capacitor, mos transistor structure for enhancement mode devices

MOS transistor operation: I-V curve, pinch off, hot carrier effect, lightly doped drain (LDD), scaling.

Diffusion :
Junction depth, Concentration profile, interstitial and substitutional diffusion.
Constant source and limited source diffusion, dopant redistribution, Lateral diffusion, Rapid thermal annealing, Gettering

Oxidation:
Native oxide, Wet and dry oxidation, Electro-chemical oxidation, solubility and diffusion of various species in oxide.

Course outcomes

CO1 Recall fundamentals of microelectronic fabrications
CO2 Explain the various deposition techniques
CO3 Distinguish between Physical and chemical vapor deposition techniques
CO4 Analyse the performance of the fabricated structures
CO5 Justify the selection of process of fabrication

Reference Books:

1. Cui Z.; Nanofabrication: Principles, Capabilities and Limits; Springer; 2008; ISBN: 978-038775576-2
2. Tseng A A; Nanofabrication: Fundamentals and Applications; World Scientific; 2008; ISBN: 978-981270542-6
3. Stephen & Campbell; The Science and Engineering of Microelectronic Fabrication, Oxford university press; 2001; ISBN:0195136055

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests, each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics/model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

INTRODUCTION TO COLLOID AND INTERFACE ENGINEERING

Course Code: 12CH7E4 **CIE Marks: 100**
Hrs/Week: L:T:P:S 4:0:0 0 **SEE Marks: 100**
Credits: 04 **SEE Duration: 3 Hrs**

Course Learning Objectives:
The student will be able to:

- Understand basic nomenclature, concepts and tools of colloid and interface science and engineering.
- Explain the differences between the surface and bulk dominated regimes and behavior.
- Appreciation of how these concepts and tools translate into a variety of applications from processes to materials.

Unit – I **08 Hrs**

Introduction: Concept of Interface. Surface Tension, Equivalence in the concepts of surface energy and surface tension. Application on interfacial science in industries.
Excess Pressure: Generalized equation for excess pressure across a curved surface- the equation of young and Laplace and its application, Kelvin's equation and its application, Capillary condensation super Saturation, Nucleation

Unit – II **07 Hrs**

Measurement of Interfacial tension: Capillary rise method. Drop weight method, Wilhelm plate method, Du Nuoy method, Methods based on shape of static drops or bubbles

Unit – III **06 Hrs**

Wetting fundamentals and contact angles: Work of adhesion, cohesion, Criteria for spreading of liquids Kinetics of spreading, Lens formation-three phase systems. Young's equation. Contact angle hysteresis

Unit – IV **08 Hrs**

Emulsions and Micro emulsions: The conditions required to form emulsions and micro emulsions, charged colloids, emulsions in food science, photographic emulsions.
Electrical aspects of surfaces. The electrical double layer Stern treatment of electrical double layer. Free energy of a diffused double layer. Repulsion between two plane double layers, Colloidal dispersions. Combined attractive and electrical interaction –DLVO theory

Unit – V **08 Hrs**

Surfactants: Introduction to surfactants, common properties of surfactant solution, Thermodynamics of surfactant self assembly, self assembled surfactant structures, surfactants and detergency
Surfactant Based Separations: Fundamentals. Classification of surface active molecules like proteins and enzymes Surfactants at inter phases and in bulk Liquid membrane permeation Foam separations. Micellar separations. Soil remediation

Course outcomes:

CO1Recall the knowledge of basic phenomena manifesting interfacial forces for various engineering applications.
CO2Explain physical causes for interfacial phenomena and convert to mathematical equations.
CO3Apply mathematical tools to analyze interfacial dynamics.
CO4Relate material design and synthesis of processes at micrometer scale.
CO5Comprehend biological system behavior in terms of colloidal interactions.

Reference Books

1. Pallab Ghosh, Colloid and Interface Science, Prentice Hall Publications, 2009; ISBN:978-81-203-3857-9
2. Paul C. Hiemenz, R. Rajgopalan; Principles of Colloid and Surface Chemistry; Marcel Dekker, New York; 3rd edition; 1997; ISBN: 978-082-479397-5

3. Arthur W. Adamson; Physical Chemistry of Surfaces; Wiley; 5th edition; 1990; ISBN: 978-812-653417-3
4. Robert J. Hunter; Foundations of Colloid Science; Clarendon press; Volume 2, 1989; ISBN: 0198551894
5. W. B. Russel, D. A. Saville and W. R. Schowalter; Colloidal Dispersions; Cambridge University Press; 1st Edition. 1991; ISBN: 0521 42600 6

Scheme of Continuous Internal Evaluation:

CIE consists of Three tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

R.V.COLLEGE OF ENGINEERING, BENGALURU-59
(Autonomous institution affiliated to VTU, Belgavi)
Global Electives for 7th semester – 2012 Scheme

Sl. No	BoS	Group F			Group G		
		Course Code	Course Title	Credits	Course Code	Course Title	Credits
1	BT	12GF701	Nonmaterial: Process and Applications	4	12GG701	Bioinformatics	3
2	CH	12GF702	Green Technology	4	12GG702	Industrial safety &risk management	3
3	CS	12GF703	Mobile Application Development	4	12GG703	Intelligent Systems	3
4	CV	12GF704	Disaster Management	4	12GG704	Solid Waste Management	3
5	EC	12GF705	Artificial Neural Networks	4	12GG705	Automotive Electronics	3
6	EE	12GF706	Design of Renewable Energy Systems	4	12GG706	Industrial electronics	3
7	IM	12GF707	Optimization Techniques	4	12GG707	Systems Engineering	3
8	IM	12GF708	Project Management	4			
9	IS	12GF709	Java & J2EE	4	12GG708	Cloud Computing	3
10	IT	12GF710	Virtual instrumentation	4	12GG709	MEMS	3
11	ME	12GF711	Automotive Engineering	4	12GG710	Mechatronics	3
12	TE	12GF712	Telecommunication Systems	4	12GG711	Space Technology and Applications	3
13	BS				12GG712	**Linear Algebra**	3
14	BS	12GF713	Thin Films and Surface Engineering	4			

15	BS	12GF714	Engineering Materials for Advanced Technology	4			
16	HSS	12GF715	Applied Psychology for Engineers	4			

R.V.COLLEGE OF ENGINEERING, BENGALURU-59
(AUTONOMUOUS INSTITUTION AFFILIATED TO VTU, BELAGAVI)
SYLLABUS FOR GLOBAL ELECTIVES GROUP: F

NANOMATERIALS : PROCESS AND APPLICATIONS

(Offered by BoS: Biotechnology)

Course Code : 12GF701 **CIE Marks : 100**
Hrs/Week : L:T:P:S : 4:0:0:0 **SEE Marks : 100**
Credits : 04 **SEE Duration: 3 Hrs**

Prerequisites: Basic knowledge of Physics, Chemistry, Biology, Mechanical engineering and electronics.

Course Learning Objectives:

- Understand fundamentals of nanomaterials and the process.
- Describe methods by which nanoscale manufacturing and characterization can be enabled.
- Learn about Nano sensors and their applications in mechanical, electrical, electronic, Chemical Engineering
- Bring awareness about the nanoscale products and their importance in multidisciplinary fields.

Unit I

Introduction to Nanomaterials: History of Nanotechnology, Introduction & overview of Quantum concepts. Overview of 1st, 2nd and 3rd generation biomaterials, structures and properties of carbon based, metal based, bionanomaterails and hybrids: Bucky Ball, Nanotubes, Diamond like carbon(DLC),Quantum Dots, Magnetic, Nano Shells, Dendrimers, Nanocarriers, Nanocrystals, Nanowires, Nanomembranes, Thin films, hybrid biological/inorganic, protein & DNA based nanostructures. Nanosafety Issues: Toxicologyhealth effects caused by nanoparticles. **10 Hrs**

Unit II

Characterization of Nanostructures: Spectroscopy: UV-Visible spectroscopy, Fourier Transform infrared spectroscopy (FTIR), Raman Spectroscopy, X-ray spectroscopy. **Electron microscopy**: Scanning electron microscopy (SEM), Transmission electron microscopy (TEM).**Scanning probe microscopy**: Atomic Force microscopy (AFM), Scanning tunnel microscopy (STM). **10 Hrs**

Nano Synthesis and Fabrication: Introduction & overview of Nanofabrication: Bottom up and Top down approaches using processes like Ball milling, Sol-gel Process, Chemical Vapour deposition (CVD), Plasma or flame spraying synthesis, Ion-Bean sculpting, electrodeposition and various lithography techniques (Hard & Soft lithography).

Unit III

Nanosensors: Overview of nanosensors, prospects and market. Types of Nanosensors and their applications. Electromagnetic nanosensors: Electronic nose and electronic tongue, Magnetic nanosensors. Mechanical nanosensors: Cantilever Nanosensors, Mechanics of CNTs, Biosensors: Biosensors in modern medicine. **08 Hrs**

UNIT IV

Micro & Nano-Electromechanical systems and Microfluidics: MEMS/NEMS: Magnetic, Chemical and Mechanical Transducers –Sensing and Actuators. Microfludics: Laminar flow, Hagen-Peouiselle equation, basic fluid ideas, Special considerations of flow in small channels, mixing, microvalves & micropumps. **08 Hrs**

UNIT V

Applications of Nanotechnology: Molecular electronics, molecular switches, mechanical cutting tools, machine components, magnets, DLC coated grinding wheels. Electrical, electronic, solar cells, Batteries, fuel cells, Nanofilters. Medical nanotechnology: in Diagnostics, Therapeutics, Drug delivery and Nanosurgery. **08 Hrs**

Course Outcome:

After completion of the course the student will be able to:

CO1. Understand, and apply knowledge of nanomaterials, nanotransducers & NEMs for various engineering applications.

CO2. Classify, analyze and validate Nanosensors, in electronics, mechanical, chemical, and biological systems.

CO3. Evaluate and create nano Design, Devices and Systems in various disciplines.

CO4. Interpret and experiment with implementation and characterization processes..

Reference Books:

1. B.S. Murty., P. Shankar., B.Raj, B..B. Rath, and J. Murday, Textbook of Nanosciences and Nanotechnology, Springer, Co-publication with University Press (India) Pvt. Ltd. VCH, XII. 2013, ISBN- 978-3-642-28030-6.
2. V. K. Khanna, Nanosensors:, Physical, Chemical and Biological, CRC press, 2013, ISBN 9781439827123 .
3. C. C. Kock., Nanostructured materials, Nanostructured materials, William Andrew Publishing, 2007, ISBN 0-8155-1534-0.
4. M .Wilson., K. Kannangara., G.Smith., M.Simmons., B. Raguse., Nanotechnology, , overseas Press (India) Private Ltd., 2005,ISBN 81-88689-20-3.

Scheme of Continuous Internal Evaluation:

CIE will consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition 10 marks are reserved for laboratory work which will be considered for CIE only and there will be no SEE.

Scheme of Semester End Examination:

The question paper will consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

Mobile Applications Development
(Offered by BoS: Computer Science and Engineering)

Sub Code: 12GF703 **CIE Marks: 100**
L:T:P:S : 4:0:0:0 **SEE Marks: 100**
Credits:4 **Duration of SEE:3Hrs**

Prerequisite: Fundamental Java / C++ programming, Clear understanding of all the Native application API, Basics on data communication and working model of various networks.

Course Learning Objectives:

- Understand the working of the android and windows life cycle.
- Write a simple and complex programs for android and windows OS.
- Present different Google Map APIs.
- Perform behavioural analysis of system under test and understand the Network, wi-fi API.
- Introduce the Concept of sharing the data across network.
- Establish adequate research interest in topics Device driver and developing the emulator.

Unit-I

An Overview of Android: Introducing Android, The Open Handset Alliance, Android Platform differences, Android Platform. Configuring Your Development environment, Exploring Android software development Kit, Writing first android application. **9 Hrs**

Understand the Anatomy of an android application: The life Cycle of android application, manifest file, Defining android application using the manifest file, Creating First android application, Type of Android application.

UNIT-II

Managing Application Resources: Resources, Working with resources. Referencing the system resources, Managing multiple Application Configuration, Configurations. **9Hrs**

Exploring User Interface Screen Elements : Introducing Android view ,Widge Layouts, Displaying Text to user, Getting the text from the user, Using Buttons, che and Radio groups, Getting Dates and times user, Indicating the information to the use

Unit-III

Working in the Background : Introducing Services, Creating and Controlling Services, Using background thread, introducingloaders, Manual thread creation and thread synchronization. **9Hrs**

Using Android Data and Storage API: Working with application Prefernces, Working with files and Directories, Storing the Structured data using SQLlite Databases, Implementing query(),insert(),update() and getType (), Updating the Manifest file, Working with Live Folder.maps.

Unit-IV

Windows Mobile Programming: Introducing the Microsoft .NET Framework, Introducing the .NET Compact Framework ,.NET Compact Framework Type System. **9Hrs**

Smartphone Application Development: Developing Your First Smartphone Application, UI Design with Forms and Controls ,Smartphone UI Design, Keyboard Input and Input Mode.

Unit-V

Data Access with SQL Server Mobile : Microsoft SQL Server 2005 Mobile Edition,Writing SQL Server Mobile Applications,Setting Up the SQL Server Mobile Server Environment . **9Hrs**

Networking: Web Access,TCP Servers and Clients,NetworkSockets,Creating E-mail Applications with Managed APIs ,Accessing PIM Data,Using SMS

Course Outcomes:

CO1. Develop mobile applications using third party application tools.

CO2. Modify and test existing applications for mobile use.

CO3. Design, customize and enhance mobile applications.

CO4. Modify existing mobile apps for better performance.

Reference Books:

1. Reto Meier, Professional Android 4 Application Development, Wrox Publication,3rd edition ,2012,ISBN : 978-1-1181-0227-5.
2. Baijian Yang, Pei Zheng, Lionel M. Ni, Professional Microsoft Smartphone Programming, Wrox Publication,7th edition ,2007,ISBN : 978-0-471-76293-5.
3. Shane Conder, Lauren Darcey, Android Wireless Application Development, Addison Wesley, 3rd Edition, 2009,ISBN-13: 978-0-321-61966-2.
4. ZigurdMednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura, Programming Android, O'Reilly Publication, 2nd Edition, 2012, ISBN: 978-1-4493-1664-8.

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

DISASTER MANAGEMENT
(Offered by BoS: Civil Engineering)

Course Code: 12GF704 **CIE Marks: 100**
Hrs/Week:L:T:P:S: 4:0:0:0 **SEE Marks: 100**
Credits: 04 **Exam Hours : 3 Hrs**

Course Learning Objectives:

- Study the environmental impact of natural and manmade calamities
- Learn to analyse and assess risk involved due to disasters.
- Understand the role of public participation.
- Learn the management tools and mitigation techniques.

Unit – I

Natural disasters and Disaster management **10Hrs**

Introduction to natural and Industrial Hazards- floods, landslides, earthquakes, volcanoes, avalanche, cyclones, drought, fire, release of effluents, harmful gases, Blast etc. Prediction and perception.

Environmental risk due to project activities. Preparation of on-site and off-site disaster management plans - Pre disaster, actual disaster, Post disaster plans. Relief camp organization. Role of voluntary organization and armed forces during disasters.

Unit – II

Risk analysis and assessment: **09Hrs**

Basic concept. Purpose of risk analysis. Analytical techniques and tools of risk assessment. Toxicology. Significance of risk. Risk characterization. Risk communication and Management..

Unit – III

Environmental Impact Assessment (EIA): **09Hrs**

Definition, Basic concepts and principles of EIA. Regulatory framework in India. Environmental inventory. Base line studies. Over view of EIA studies.

Unit – IV

Assessment and Methodologies: **10Hrs**

Physical, Biological, Natural resources, Socio economic and cultural environmental assessment. EIA methodologies- Adhoc, Matrix, Checklist approaches. Economic evaluation of impacts- cost benefits of EIA. Public participation in environmental decision making. Procedures for reviewing EIA analysis and statement. Decision methods for evaluation of alternatives

Unit – V

Disaster Mitigation and Management:

Introduction, types, modes of disaster management, tools and techniques, primary and secondary data. Natural disasters its causes and remedies-Earthquake hazards-Causes and remedies, Flood and Drought assessment, causes and remedies, Landslides-causes and remedies. Fire hazards in buildings, Fire hazard management, Traffic management, Cyclones and hurricanes, inter department cooperation. Regional and global disaster mitigation. **10Hrs**

Course outcomes:

After completing this course the student will be able to:

1. Explain the different types of disasters and manage the pre and post disaster situation.
2. Estimate and communicate the risk by conducting the risk assessment and

Environmental Impact Assessment.

3. Identify the methods of disaster mitigation based on the basis of the risk assessment.
4. Analyze and evaluated the impact of measures adopted to mitigate the impacts.

Reference Books

1. John G Rau and David C Wooten ―Environmental Impact Analysis Hand Book, McGraw Hill, Edition:2013, ISBN:978-0070512177.
2. John Glasson, RikiTherivel, Andrew Chadwick. Introduction to environmental Impact assessment, Research Press, Edition: 2012, ISBN:000-0415664705.
3. Girish K Mishrta, G C Mathew (eds) Natural Disaster Reduction. Reliance Publishing House, New Delhi,Edition:2005
4. Thomas M. Lillisand and R.W. Keifer, Remote Sensing and Image Interpretation, John Wiley, 6th edition: , 2002, ISBN:9780470052457.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily

ARTIFICIAL NEURAL NETWORKS

(Offered by BoS: Electronics and Communication)

Course Code: 12GF705 **CIE Marks: 100**

Hrs/Week: L:T:P:S: 4:0:0:0 **SEE Marks: 100**

Credits: 04 **SEE Hrs: 03**

Course Learning Objectives(CLOs):

The student will be able to:

- Define neural network and model of a neuron.
- Analyze learning tasks with and without teacher and implement learning algorithms.
- Analyze and compare various types of perceptrons and develop MLP with 2 hidden layers.
- Develop: Delta learning rule of the output layer and basis function network.

UNIT – I

Introduction to Neural Networks **09 Hrs**

Neural Network, Human Brain, Models of Neuron, Neural networks viewed as directed graphs, Biological Neural Network, Artificial neuron, Artificial Neural Network architecture, ANN learning, analysis and applications, Historical notes.

UNIT – II

Learning Processes **09 Hrs**

Introduction, Error correction learning, Memory-based learning, Hebbian learning, Competitive learning, Boltzmann learning, credit assignment problem, Learning with and without teacher, learning tasks, Memory and Adaptation.

UNIT – III

Single layer Perception **09 Hrs**

Introduction, Pattern Recognition, Linear classifier, Simple perception, Perception learning algorithm, Modified Perception learning algorithm, Adaptive linear combiner, Continuous perception, Learning in continuous perception. Limitation of Perception.

UNIT – IV

Multi-Layer Perceptron Networks **09 Hrs**

Introduction, MLP with 2 hidden layers, Simple layer of a MLP, Delta learning rule of the output layer, Multilayer feed forward neural network with continuous perceptions, Generalized delta learning rule, Back propagation algorithm.

UNIT – V

Radial Basis Function Networks **09 Hrs**

Introduction, Least square estimator, Linear neuron, Recursive least square algorithm, Basis function network, RBF techniques, Gaussian radial basis function, RBF as interpolation networks, RBF as approximation networks, GRBF network training. Application to approximation, MLP vs RBF

Reference Books:

1. Simon Haykins, "Neural Network- A Comprehensive Foundation", Pearson Prentice Hall, 2nd Edition, 1999, ISBN.-13: 978-0-13-147139-9 ISBN-10:0-13-147139-2
2. Zurada and Jacek M, "Introduction to Artificial Neural Systems", West Publishing Company, 1992, ISBN: 053495460X,9780534954604
3. Vojislav Kecman,"Learning & Soft Computing", Pearson Education, 1st Edition, 2004, ISBN.: 0-262-11255-8
4. M T Hagan, H B Demoth, M Beale, "Neural Networks Design", Thomson Learning, Edition: 2002, ISBN-10:0-9717321-1-6 ISBN-13: 978-0-9717321-1-7

Course Outcomes:

After completion of the course the student should be able to demonstrate:

- CO1. Ability to comprehend Neural Network, Neuron and to analyze ANN learning, and its applications.
- CO2. Perform Pattern Recognition, Linear classification.
- CO3. Develop different single layer/multiple layer Perception learning algorithms.
- CO4. Develop detailed mathematical treatment of another class of layered networks: radial basis function networks.

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily

DESIGN OF RENEWABLE ENERGY SYSTEMS

Course Code: 12GF706 **CIE Marks: 100**
Hrs/Week: L:T:P:S 4:0:0:0 **SEE Marks: 100**
Credits: 04 **SEE : 3 Hrs**

Course Learning Objectives:

- To provide opportunity for students to work on multidisciplinary projects.
- To familiarize the students with the basic concepts of nonconventional energy sources and allied technological systems for energy conversion
- To impart skill to formulate, solve and analyze basic Non – conventional energy problems and prepare them for graduate studies.
- To enable the student to design primarily solar and wind power systems.
- To expose the students to various applications of solar, wind and tidal systems.

Unit – I **09Hrs**

An introduction to energy sources: Industry overview, incentives for renewable , utility perspective, Relevant problems discussion, current positions of renewable energy conditions

Unit – II **10 Hrs**

PV Technology: photovoltaic power, PV projects, Building-integrated PV system, PV cell technologies, solar energy maps, Technology trends, **Photovoltaic Power Systems**: PV cell, Module and Array, Equivalent electrical circuit, open-circuit voltage and short-circuit current, i-v and p-v curves , Array design(different methodologies), peak-power operation,system components ,

Unit – III **10 Hrs**

Wind Speed and Energy: speed and power relations, power extracted from the wind, Air density, Global wind patterns, wind speed distribution(parameters calculations) , wind speed prediction, **Wind Power Systems :** system components , turbine rating , power vs. speed and TSR, maximum energy capture , maximum power operation , system-design trade-offs , system control requirements , environmental aspects**,**
(already existed in the methodology)

Unit – IV **09Hrs**

Geothermal and ocean energy: Geothermal power, geo pressured sources ,Geothermal well drilling ,advantages and disadvantages, Comparision of flashed steam and total flow concept ,**Energy from ocean**: OTEC power generation ,OPEN and CLOSED cycle OTEC
Estimate of Energy and power in simple single basin tidal and double basin tidal system

Unit – V **10 Hrs**

Stand alone system: PV stand-alone, Electric vehicle, wind stand-alone , hybrid systems(case study) , system sizing , wind farm sizing ,
Grid-Connected Systems : introduction**,** interface requirements , synchronizing with the grid , operating limit ,
Energy storage and load scheduling**,** Grid stability issues **,** distributed power generation

Course outcomes:

- Demonstrate an understanding of the scientific principles of methodology of Non-conventional energy.
- Acquire working knowledge of different Renewable energy science-related topics.
- Ability to analyze the system related concepts effectively in the wind energy designing.
- Students will be able to decide the appropriate procedures to ensure that the working model has

developed properly.

Reference Books

1. Mukund R Patel "wind and solar power systems Design ,Analysis andoperation"Taylor and Francis publishers ,2nd edition,2006, ISBN 978-0-8493-1570-1
2. G.D.Rai, "Non-Conventional sources of energy", Khanna Publishers, 4th edition, 2007.
3. Sukhatme, "Solar Energy", 2nd edition, TMH, 2006.
4. Renewable energy sources- Twiddle Elbs, 3rd Edition, 2006, ISBN-10: 0419253203.
5. Solar energy hand book – edited by William.C. Dikkinson ASISES, Network, ISBN -13: 978-0865716216.
6. Partain, L. D., "Solar Cells and Their Applications". John Wiley & Sons, 3rd edition, 2003, ISBN:9780470539675.
7. Green, M.A., et al. Solar Cell Efficiency Tables (Version 30). 2007. Prog. Photovolt: Res. Appl. 15:425-430.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

OPTIMIZATION TECHNIQUES
(Offered by BoS: Industrial Engineering and Management)

Course Code :12GF707 **CIE Marks: 100**
Hrs/Week: L: T: P: S:4:0:0:0 **SEE Marks : 100**
Credits :04 **SEE Duration : 3 Hrs**

Course Learning Objectives:

- Understand the concepts behind optimization techniques.
- Explain the modelling frameworks for solving problems using optimization techniques.
- Design and develop optimization models for real life situations.
- Analyze solutions obtained using optimization methods.

Compare models developed using various techniques for optimization.

Unit – I

Introduction: OR Methodology, Definition of OR, Application of OR to Engineering and Managerial problems, Features of OR models, Limitations of OR. **09Hrs**

Linear Programming: Definition, Mathematical Formulation, Standard Form, Solution Space, Types of solution – Feasible, Basic Feasible, Degenerate, Solution through Graphical Method. Problems on Product Mix, Blending, Marketing, Finance, Agriculture and Personnel.

Simplex methods: Variants of Simplex Algorithm – Use of Artificial Variables.

Unit – II

Duality and Sensitivity Analysis: Graphical sensitivity analysis, Algebraic sensitivity analysis - changes in RHS, Changes in objectives, Primal-Dual relationships, Economic interpretation of duality, Post optimal analysis - changes affecting feasibility and optimality, Revised simplex method **09Hrs**

Unit – III

Transportation Problem: Formulation of Transportation Model, Basic Feasible Solution using North-West corner, Least Cost, Vogel's Approximation Method, Optimality Methods, Unbalanced Transportation Problem, Degeneracy in Transportation Problems, Variants in Transportation Problems. **08Hrs**

Assignment Problem: Formulation of the Assignment problem, solution method of assignment problem-Hungarian Method, Variants in assignment problem, Travelling Salesman Problem (TSP).

Unit – IV

Queuing Theory: Queuing system and their characteristics, The M/M/I Queuing system, Steady state performance analyzing of M/M/1 queuing models. Introduction to M/M/C and $M/E_k/1$ queuing models. **09Hrs**

Game Theory: Introduction, Two person Zero Sum game, Pure strategies, Games without saddle point - Arithmetic method, Graphical Method, The rules of dominance

Unit – V

Markov chains: Definition, Absolute and n-step transition probabilities, Classification of the states, Steady state probabilities and mean return times of ergodic chains, First passage times, Absorbing states. Applications in weather prediction and inventory management. **09Hrs**

Over view of OR software's used in practice.

Course Outcomes:

After going through this course the student will be able to:

CO1: Understand the various optimization models and their areas of application.

CO2: Explain the process of formulating and solving problems using optimization methods.

CO3: Develop models for real life problems using optimization techniques.

CO4: Analyze solutions obtained through optimization techniques.

CO5: Create designs for engineering systems using optimization approaches.

Reference Books:

1. Taha H A, Operation Research An Introduction, PHI, 8th Edition, 2009, ISBN: 0130488089.
2. Philips, Ravindran and Solberg - Principles of Operations Research – Theory and Practice, John Wiley & Sons (Asia) Pte Ltd, 2nd Edition, 2000, ISBN 13: 978-81-265-1256-0
3. Hiller, Liberman, Nag, Basu, Introduction to Operation Research, Tata McGraw Hill 9th Edition, 2012, ISBN 13: 978-0-07-133346-7
4. J K Sharma, Operations Research Theory and Application, Pearson Education Pvt Ltd, 4th Edition, 2009, ISBN 13: 978-0-23-063885-3.
5. Prof. J Govardhan, Principles, Methodology and Applications of Operations Research, JEM Consultants, 3rd Edition, 2012

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

PROJECT MANAGEMENT

(Offered by BoS: Industrial Engineering & Management Engineering)

Course Code :12GF708 **CIE Marks: 100**

Hrs/Week: L: T: P: **SEE Marks: 100**

S:4:0:0:0 **SEE Duration: 3 Hrs**

Credits :04

Course Learning Objectives:

- Understand the principles and components of project management.
- Appreciate the integrated approach to managing projects.
- Elaborate the processes of managing project cost and project procurements.

Unit – I

Introduction: What is project, what is project management, relationships among portfolio management, program management, project management, and organizational project management, relationship between project management, operations management and organizational strategy, business value, role of the project manager, project management body of knowledge. **06Hrs**

Unit – II

Organizational influences & Project life cycle: Organizational influences on project management, project state holders & governance, project team, project life cycle. **10Hrs**

Project Integration Management: Develop project charter, develop project management plan, direct & manage project work, monitor & control project work, perform integrated change control, close project or phase.

Unit – III

Project Scope Management: Project scope management, collect requirements define scope, create WBS, validate scope, control scope. **10Hrs**

Project Time Management: Plan schedule management, define activities, sequence activities, estimate activity resources, estimate activity durations, develop schedule, control schedule.

Unit – IV

Project Cost management: Project Cost management, estimate cost, determine budget, control costs. **08Hrs**

Project Quality management: Plan quality management, perform quality assurance, control quality.

Unit – V

Project Risk Management: Plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk resources, control risk. **09Hrs**

Project Procurement Management: Project Procurement Management, conduct procurements, control procurements, close procurement.

Course Outcomes:

After going through this course the student will be able to:

CO1: Understand the concepts, tools and techniques for managing large projects.
CO2: Explain various sub processes in the project management frameworks.
CO3: Analyze and evaluate risks in large and complex project environments.
CO4: Develop project plans for various types of organizations.

Reference Books:

1. Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", 5th Edition, 2013, ISBN: 978-1-935589-67-9
2. Prasanna Chandra, Project Planning Analysis Selection Financing Implementation & Review, Tata McGraw Hill Publication, 7th Edition, 2010, ISBN 0-07-007793-2.

Harold Kerzner, Project Management A System approach to Planning Scheduling & Controlling, CBS Publishers and Distributors, 10th Edition, 2009, ISBN 047027806.

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

JAVA & J2EE
(Offered by BoS: Information Science & Engineering)

Course Code: 12GF709 **CIE Marks: 100**
L:T:P:S: 4:0:0:0 **SEE Marks: 100**
Credits: 04 **SEE Duration: 3 Hrs**

Course Learning Objectives:

- Comprehend the fundamentals of object-oriented programming in Java, including elements of Java programming such as variables, conditional and iterative execution, defining classes, invoking methods, using class libraries, etc.
- Comprehend the essentials of the threads and exceptions, Event driven Graphical User Interface (GUI) programming and Applet Programming.
- Understand and develop applications in java to access databases in java using JDBC driver.
- Analyze the role of J2EE in development of enterprise software in Java language, and to understand how J2EE facilitates integration of java components with non-Java systems including databases using servlets and Java Server Pages(JSP).

Unit - I

Introduction **8Hrs**

An Overview of Java, Introduction to Class - object, A Closer Look at Methods and Classes, Inheritance, Packages and Interfaces. Enumerations, Autoboxing, and Annotations

Unit – II

Advanced features -I **9Hrs**

Exception Handling, Multithreaded Programming, String Handling, Introduction to streams classes.

Unit – III

Advanced features –II **9Hrs**

Applets: Architecture, Applet Lifecycle, repaint ( ), HTML APPLET Tags, passing parameters to Applets; Introduction to Swings

Unit – IV

Overview: J2EE and J2SE. **9Hrs**

Java Database Connectivity:JDBC introduction, JDBC Driver Types, JDBC process, Creating and executing SQL statement - Statement Object, ResultSet Object

Unit – V

Server side programming

Overview:JSP, Servlets and Tomcat, Model View Controller (MVC) **9Hrs**

Servlets: Life Cycle of Servlet, Handling GET and POST requests, The Servlet API, The Javax.servlet Package, Reading Servlet Parameter, The Javax.servlet.http package, Handling HTTP Requests and Responses, Using Cookies, Session Tracking

Course Outcomes

CO1. Understand the basic concepts of Java Standard Edition and Enterprise Edition.

CO2. Use the Java SDK environment to create, debug and run Java standalone and applet programs.

CO3. Design and build robust and maintainable web applications by creating dynamic HTML content with Servlets.

CO4. Promote and be open to creative solutions applying Servlets.

References:

1. Herbert Schildt; "Java The Complete Reference"; McGraw Hill Osborne Media; 8th Edition**,** 2011; ISBN: 9781259002465
2. Y. Daniel Liang; "Introduction to Java Programming"; Prentice Hall; 8th Edition; 2010; ISBN: 0132130807.
3. Jim Keogh; "J2EE - The Complete Reference"; Tata McGraw Hill; 1st Edition; 2002; ISBN: 9780070529120.
4. Bruce Eckel; "Thinking in Java"; Pearson Education; 4th Edition, 2006; ISBN 0131872486

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily

VIRTUAL INSTRUMENTATION
(Offered by BoS: Electronics & Instrumentation Engineering)

Course Code: 12GF710 **CIE Marks: 100**
Hrs/Week: L:T:P:S : 4:0:0:0 **SEE Marks: 100**
Credits: 04 **SEE Duration: 3 Hrs**

Course Learning Objectives:

- Understand the basic components and concepts of LabVIEW programming Language.
- Apply the programming concepts to build virtual application.
- Provide the concepts of interfacing Peripherals.
- Create a virtual system for Real Time applications.

Unit I

Fundamentals of Virtual Instrumentation: Historical perspective, advantages, blocks diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. **09 Hrs**

Software Overview: Lab VIEW , Graphical user interfaces - Controls and Indicators Data types - Data flow programming - Editing - Debugging and Running Virtual instrument - Graphical programming pallets - and their configuration VIs and sub-VIs Typical examples-VIs.

Unit II

Programming Structure: FOR loops, WHILE loop, CASE structure, formula node, Sequence structures **09 Hrs**

Introduction to Arrays and Clusters: Array operations Cluster Functions, Graphs and charts, local and global variables.

Unit III

File Input/Output: Introduction, File Formats, File I/O Functions, Sample VIs to Demonstrate File WRITE and READ Function **09 Hrs**

String Handling: Introduction, String Functions, LabVIEW String Formats, Typical examples.

Unit IV

Basics of Data Acquisition: Introduction to data acquisition Classification of Signals, Analog Interfacing Connecting signal to board , Analog Input/output techniques digital I/O. **09 Hrs**

DAQ Hardware configuration: Introduction, Measurement and Automation Explorer, DAQ Assistants, Analysis Assistants, Instrument Assistant.

Unit V

Interfacing Instruments: GPIB and RS232 : Introduction, RS232 Vs. GPIB, Handshaking, GPIB Interfacing, Standard commands for Programmable Instruments, VISA**.** **09 Hrs**

Use of analysis tools and application of VI: Fourier transforms Power spectrum, Correlation methods, windowing & flittering. Inter-Process Communication, Notifier, Queue, Semaphore, Data Sockets, Programmatically Printing Front Panel.

Course outcomes:

After going through this course the student will be able to

CO1: Understand the fundamentals of Virtual Instrumentation
CO2: Apply the concepts to realize the theoretical design.
CO3: Create a VI system to solve real time problems.
CO4: Analyze and evaluate the performance of Virtual System.

Reference Books:

1. Sanjay Gupta & Joseph John**,** Virtual Instrumentation Using Lab View, Tata Mc Graw Hill Publisher Ltd. New Delhi, 2nd Edition, 2010, ISBN : 978-0070700284
2. Lisa. K. Wills**, "**LabVIEW for Everyone**"** Prentice Hall of India, 2nd Edition, 2008, ISBN : 978-0132681940
3. Garry Johnson, Richard Jennings, LabVIEW Graphical Programming, McGraw Hill Professional, 4thEdition , 2006 ,ISBN: 978-1259005336.
4. Jovitha Jerome, "Virtual instrumentation Using LabVIEW", PHI Learning Pvt.Ltd., 4th Edition, 2010, ISBN: 978-8120340305.

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

MODERN AUTOMOTIVE ENGINEERING

(Offered by BoS: Mechanical Engineering)

Course Code : 12GF711 **CIE Marks: 100**
Hrs/Week: L: T: P: S: 4: 0:0: 0 **SEE Marks: 100**
Credits :04 **SEE Duration :3 Hrs**

Course Learning Objectives

- Introduce different sub-systems in a automotive system
- Describe the functions of each of the sub-systems and its effect on the complete system
- Discuss fuel injection, transmission, braking, steering, suspension
- Explain the importance of selection of suitable sub-system for a given performance requirement

UNIT – I

Automotive Engines: Engine types and operation, Subsystems of automotive engines, Supercharger and turbo charges, Radiators and Cooling systems. **08Hrs**

Fuels and Emission: Conventional fuels, alternative fuels:- LPG, CNG, Hydrogen and Biofuels, Solar, Electrical and hybrid drives, Engine emission and its controls,

UNIT – II

Power Transmission: Clutches and its types, Torque converter and fluid coupling, Geared transmission and automatic transmission, Propeller shaft and differential. **08Hrs**

Braking systems: Braking fundamentals, Brake system components, Antilock braking systems, Components and control logic, Electronic stability programs

UNIT-III

Steering systems: **Steering basics, Ackerman Steering Mechanism, conventional mechan**ism, Electronically controlled power steering, **10Hrs**

Suspension Systems: Basics, types: Mcpherson Strut Independent suspension system and front & rear axle suspension system.

UNIT-IV

Vehicle body Engineering: Vehicle body details and classification (Car and Bus), visibility and method of improving visibility and space in car. **08Hrs**

Seating and Safety system: Seating system, material for seating, Traction control system, Air bags and immobilizer system, Vehicle crashworthiness tests.

UNIT – V

Automotive Electricals: Energy systems:- Starter, Generator and start-stop systems, battery. **08Hrs**

Automotive Electronics: Electronic Control Unit, sensors and actuators, Panel display, Infotainment systems.

Course Outcome:

On completion of the course the student will be able to:

CO1. Illustrate the basic knowledge of advanced automobile systems and subsystems

CO2. Apply the engineering technology to design automotive systems

CO3. Analyse the performance of automotive systems to match with present scenario

CO4. Adapt newer technology to develop efficient and nature friendly vehicles

References:

1. Dr N.K Giri, "Automotive Technology", Khanna Publishers, 5th Edition, 2000, BN.No.81-7409-178-5.
2. "Automotive Hand Book", SAE publications, 9th Edition, 2014. ISBN.No. 978-0-7680-8152-7
3. William B. Ribbens, Understanding Automotive Electronics, 6th Edition, 2014 ISBN. No-13: 978-0750675994
4. Barry Hollemback, "Automotive Electricity, Electronics & Computer Controls", 1st Edition, 1998, ISBN No. 13: 978-0827365667

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

TELECOMMUNICATION SYSTEMS
(Offered by BoS: Telecommunication Engineering)

Sub. Code: 12GF712 **CIE Marks:100**
Hrs / Week: L:T:P:S:4:0:0:0 **SEE Marks:100**
Total credits: 04 **SEE Duration :03 Hrs**

Course Learning Objectives (CLO):

- Comprehend various communication system and identify its components
- Understand modulation and multiple access schemes for a communication system.
- Classify different telecommunication services, sub-systems and systems..
- Learn about the features, benefits, applications and operation of wireless and optical technologies.

UNIT I

Introduction to Electronic Communication **(09 Hrs)**

The Significance of Human Communication, Communication Systems, Types of Electronic Communication, Modulation and Multiplexing, The Electromagnetic Spectrum, Bandwidth, A Survey of Communication Applications.

The Fundamentals of Electronics: Gain, Attenuation, and Decibels.

Radio Receivers: Super heterodyne receiver.

UNIT II

Modulation Schemes: Qualitative discussions with practical examples of AM, FM and PM, PCM, Line Codes, ASK, FSK, PSK, and QAM. **(08 Hrs)**

Wideband Modulation: Spread spectrum, FHSS, DSSS – Block Diagram approach.

Telephone and Cable Modems.

UNIT III

Multiplexing and Multiple Access Techniques: Block diagram approach of Frequency division multiplexing, Time division multiplexing, Duplexing; Multiple access: FDMA, TDMA, CDMA,. **(10 Hrs)**

Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Positioning System.

UNIT IV

Optical Communication: Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers, Wavelength- Division Multiplexing, Passive Optical Networks. **(09 Hrs)**

UNIT V

Cell Phone Technologies: Cellular concepts, Frequency allocation, Frequency reuse. **(09 Hrs)**

Introduction to 2 G, 2.5 G, and 3G standards and their features.

Wireless Technologies

Introduction to Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless Networks, Wi-MAX and Wireless Metropolitan-Area Networks.

Course Outcome

After going through this course the student will be able to:

CO1. Understand the processes employed in communication systems.

CO2. Explain the importance of multiplexing, modulation and multiple access for various applications in communication systems.

CO3. Compare the different wired and wireless technologies .

CO4. Apply the concepts of different components and sub-system in advanced communication standards.

Reference Books

1. **Louis E. Frenzel, "Principles of Electronic Communication Systems", Tata McGraw Hill 3rd Edition, 2008,** ISBN: 0070648115**.**
2. Roy Blake, "Electronic Communication Systems", Thomson/Delamar, 2nd edition, 2002, ISBN: 981-240-611-5
3. George Kennedy, "Electronic Communication Systems" **Tata McGraw Hill 3rd Edition 2008, ISBN:0-07-462182-3.**
4. Anu A. Gokhale "Introduction to Telecommunications", **Cengage Learning, 2nd Edition 2008,** ISBN: 10:1-4018-5648-9.

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

Thin films and surface engineering

(Offered by BOS basic sciences

Course code: 12GF 713 CIE marks :100
Hrs/week :L:T:P:S 4:0:0:0 SEE marks: 100
Credits 04 SEE duration :3 hrs

Course Learning Objectives:
Acquire the knowledge of thin film preparation by various techniques.
Analyse the behavior of the thin films by different characterization methods
Apply the knowledge to develop devices.

Unit – I

Vacuum Technology: Basics of Vacuum - Principles of different vacuum pumps (from atmosphere down to 10-11 torr), rotary pump, roots, rotary, diffusion, turbo molecular pump, cryogenic-pump, ion pump, and Ti-sub limitation pump - Measurement of vacuum, Concept of different gauges, bayet- albert gauge, pirani, penning, pressure control - Vacuum Systems & Applications — 08Hrs

Unit – II

Vacuum Technology (08 Hrs.): Basics of Vacuum - Principles of different vacuum pumps (from atmosphere down to 10-11 torr), rotary pump, roots, rotary, diffusion, turbo molecular pump, cryogenic-pump, ion pump, and Ti-sub limitation pump - Measurement of vacuum, Concept of different gauges, bayet- albert gauge, pirani, penning, pressure control – Vacuu Systems & Applications — 08Hrs

Unit – III

Methods of thin film preparation — 10Hrs

Physical Vapor Deposition (PVD) Techniques: Thermal/resistive evaporation, Electron beam evaporation, Laser ablation, Flash evaporation, and Cathode arc deposition. Electrical Discharges used in Thin Film Deposition - Sputtering, Glow discharge sputtering, Magnetron sputtering, Reactive Sputtering, and Ion beam sputtering.

Chemical Vapor Deposition (CVD) Techniques: Different kinds of CVD techniques: Metal organic CVD (MOCVD), thermally activated CVD, Spray pyrolysis, etc., Atomic layer deposition (ALD) and its Importance.

Unit – IV

Characterization of Thin Film Properties — 09 Hrs

Film thickness measurement: Quartz crystal thickness monitor for process monitoring and control - Stylus method – Optical interference methods.

Film Adhesion: Testing and evaluation methods. Annealing and its influence on film properties.

Surface morphology and topography - Composition of thin films – Film structure by X-ray diffraction and Raman studies – Electrical characterization – Optical characterization – Spectrophotometers – Mechanical and tribological studies.

Unit – V

Thin Film Applications: Electrodes, Transparent conducting (electrodes) Oxides (TCO) Thin Film Transistors (TFT), Sensors, Sensors, Solar cells, Solar Thermal Absorbers, Integrated Circuits, MEMS,NEMS etc. - Decorative Coatings, Optical Coatings, Corrosion and Wear resistant coatings, Bio-Medical coatings, Coatings for telecommunication application, Smart Coatings, etc.	09 Hrs

Course outcomes :
After going through the course students will be able to
Acquire adequate knowledge of thin film preparation and characterization
Develop various thin film based devices.

References:
Vacuum Technology by A. Roth, 3 rd Edition, Elsevier Publishers, ISBN-978-0-444-88010
Thin Film Phenomenon by K.L. Chopra, reprint, Mc Graw Hill, ISBN-10: 0070107998,
Materials Science of Thin Films by Milton Ohring, 2nd Edition, Acadmic Press, ISBN-10: 0125249756, ISBN-13: 978-0125249751.
Thin-Film Deposition: Principles and Practice by Donald Smith, Illustrated Edition, Mc Graw Hill Professional, ISBN-10: 0070585024, ISBN-13: 978-0070585027.

Scheme of Continuous Internal Evaluation:
CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.
Scheme of Semester End Examination:
The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

ENGINEERING MATERIALS FOR ADVANCED TECHNOLOGY
(Offered by BoS: Basic Sciences)

Subject Code: 12GF714 **CIE Marks:100**
Hrs / Week: L:T:P : 4:0:0 **SEE Marks:100**
Credits-04 **SEE Duration:03 Hrs**

Course Learning Objectives (CLO):

- Apply the basic concepts of Chemistry to develop futuristic materials for high-tech applications in the area of Engineering.
- Impart sound knowledge in the different fields of material chemistry so as to apply it to the problems in engineering field.
- Develop analytical capabilities of students so that they can characterize, transform and use materials in engineering and apply knowledge gained in solving related engineering problems.

Unit-I

Adhesives: Classification of Adhesives-Natural adhesives, synthetic adhesives-drying adhesives, pressure sensitive adhesives, contact adhesives, hot adhesives. One part adhesives, multi part adhesives. Adhesive Action. Development of Adhesive strength- Physical factors influencing Adhesive Action-surface tension, surface smoothness, thickness of adhesive film, elasticity and tensile strength. Chemical Factors Influencing Adhesive action - presence of polar groups, degree of polymerization, complexity of the adhesive molecules, effect of pH. Adhesive action- specific adhesive action, mechanical adhesive action, fusion adhesion. Development of adhesive strength- adsorption theory and diffusion theory. Preparation, curing and bonding Processes by adhesives-with reference to Epoxy, phenolics, Silicone, Polyurethane, Acrylic adhesives, Poly vinyl alcohol, Polyvinyl acetate . **08Hrs.**

Unit-II

Optoelectronic Materials: Photovoltaic Electricity: The Photon: Energy, Wavelength and Frequency. Classification of solar cells, Structure of an Inorganic Solar Cell, Characteristics of Solar Cells: Short Circuit Current, Open Circuit Voltage, Maximum Power, fill factor. Efficiency of Photovoltaic Solar Cell: Organic Solar Cells. **07 Hrs**

Light Emitting Diodes: Luminance, luminous intensity, luminous flux and luminous efficacy. Inorganic LEDs with device construction, examples and advantages. OLEDs: Introduction, OLED Emission Principle, types of OLEDS-Small molecule OLEDs and Polymer based OLEDs. Classification of OLEDS by Emission Layer Formation Process. OLED materials and their characteristics.

Unit-III

Optical fibre materials : Fiber Optics, Advantages of optical fiber communication over analog communication, Classification based on refractive index of the core-step index and graded index optical fibres, Classification based on core radius-single mode and multimode optical fibres, Fibre fabrication.-Methods to manufacture optical glass fibres. Double crucible method and preform methods. Manufacture of perform- Chemical Vapour Deposition (CVD), Modified vapour **08Hrs**

deposition (MCVD) Plasma activated vapour deposition (PCVD), Outside vapour deposition (OVD)-Vapour-phase axial deposition (VAD). Drawing the fibres from perform, coating and jacketing process.

Ion exchange resins and membranes: Ion exchange resins-Introduction, Types-cation and anion exchange resins, examples, physical properties, chemical properties-capacity, swelling, kinetics, stability, ion exchange equilibrium, regeneration. Applications of ion exchange resins-softening of water, demineralization of water, advantages and disadvantages of ion exchange resins-calcium sulphate fouling, iron fouling, adsorption of organic matter, bacterial contamination. Ion exchange membranes, Types-anion and cation exchange membranes. Classification of ion exchange membranes based on connection way between charged groups and polymeric matrix-homogeneous and heterogeneous ion exchange membranes, examples. Fabrication of ion exchange cottons- anion exchange cotton and cation exchange cotton. Application of ion exchange membranes in purification of water by electro dialysis method.

Unit-IV

Coating and packaging materials: Surface Coating materials: Synthesis and applications of Polymer coating materials: Teflon, Silicone films Polyvinyl chloride & its copolymers, Poly vinyl acetate, Poly ethylene-HDPE, LDPE, Polyurethane. **06Hrs**

Properties required in a pigment and extenders, Inorganic pigments-titanium dioxide, zinc oxide, carbon black, chromate pigments, molybdate orange, chrome green, ultramarine blue, iron blue, cadmium red.

Corrosion inhibiting pigments- zinc phosphate, zinc and barium chromate pigments, ceramic pigments, metal flake pigments, extenders.

Developments in new polymers such as dendrimers, biopoplymers & biodegradable polymers.

Packaging materials: Food products: Cellulosic and Polymeric packaging materials and their properties – including barrier properties, strength properties, optical properties. Glass, aluminium, tin, paper, plastics, composites.

Pharmaceutical products: Injectibles and tablet packaging materials.

Unit-V

Characterisation techniques for materials : Atomic absorption and emission spectroscopy including Raman spectroscopy, UV- visible spectra-photometry, NMR. **15 Hrs**

Raman spectroscopy. Theory of Rayleigh and Raman scattering, classical and quantum models. Rotational Raman effect and an analysis of molecular electric polarization tensor –vibrational Raman effect. Rotational-vibrational transitions from both IR spectroscopy and Raman spectroscopy.

UV- visible spectrophotometry :Introduction-Electronic transitions- factors influencing position and intensity of absorption bands-absorption spectra of dienes, polyene and α,β-unsaturated carbonyl compounds, Working of UV-Vis spectrophotometer, Theoretical calculation of λ_{max} by using Woodward-Fieser rules- for cyclic and α,β-unsaturated carbonyl compounds .

H^1 NMR Spectroscopy : Basic concepts- relaxation process. NMR spectrometer-FT NMR-Solvents used in NMR, internal standards-Chemical equivalence -Integrals and Integrations- chemical shift-Factors affecting chemical shifts- shielding and deshielding effects – chemical and magnetic equivalent –magnetic anisotropy-spin-spin splitting rules- Application of NMR on various compounds such as alkanes, alkenes, alkynes, alkyl halides, alcohols, ethers, amines, aldehydes, ketones,

carboxylic acids, esters, amides & mono substituted aromatic compounds. Problems on prediction of structure of compounds. Application of NMR in magnetic resonance imaging (MRI).

Course outcomes:

After completion of the course student would be able to:

CO1. Identify sustainable engineering materials and understand their properties.

CO2. Apply the basic concepts of chemistry to develop futuristic materials for high-tech applications in different areas of engineering.

CO3. Analyze and evaluate the specific application of materials.

CO4. Design the route for synthesis of material and its characterization.

References

1. Materials Science by G.K.Narula, K.S.Narula & V.K.Gupta. 38th edtion, 2015, ISBN: 9780074517963, Tata McGraw-Hill Publishing Company Limited.
2. Solar Lighting by Ramachandra Pode and Boucar Diouf, Springer e-book, 2011, ISBN: 978-1-4471-2133-6 (Print) 978-1-4471-2134-3 (Online),.
3. Spectroscopy of organic compounds by P.S.Kalsi, New Age Internatioal(P) ltd, 2005, ISBN 13: 9788122415438.
4. Mahadeviah M & Gowramma RV, Food Packaging Materials. Tata McGraw Hill Publishing Company Limited, 1996, ISBN :0074622382 9780074622384

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

Applied Psychology for Engineers
(Offered by BoS: Humanities and Social Sciences)

Course Code	**:**	**12GF715**	**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L: T: P: S: 3:0:1:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**4**	**SEE Duration**	**:**	**3hrs**

Course Learning Objectives:

- Appreciate human behavior and human mind in the context of learner's immediate society and environment.
- Understand the importance of lifelong learning and personal flexibility to sustain personal and professional development as the nature of work evolves.
- Provide students with knowledge and skills for building firm foundation for the suitable engineering professions.
- Prepare students to function as effective Engineering Psychologists in an Industrial, Governmental or consulting organization.
- Enable students to use psychological knowledge, skills, and values in occupational pursuits in a variety of settings that meet personal goals and societal needs.

07Hrs

Unit – I

Introduction to Psychology: Definition and goals of Psychology: Role of a Psychologist in the Society: Today's Perspectives(Branches of psychology)., Psychodynamic, Behaviouristic, Cognitive, Humanistic, Psychological Research and Methods to study Human Behavior: Experimental, Observation, Questionnaire and Clinical Method

Unit – II **07Hrs**

Intelligence and Aptitude: Concept and definition of Intelligence and Aptitude, Nature of Intelligence. Theories of Intelligence – Spearman, Thurston, Guilford Vernon. Characteristics of Intelligence tests, Types of tests. Measurement of Intelligence and Aptitude, Concept of IQ, Measurement of Multiple Intelligence – Fluid and Crystallized Intelligence.

Unit – III **08Hrs**

Personality: Concept and definition of personality, Approaches of personality-psychoanalytical, Socio- Cultural, Interpersonal and developmental, Humanistic, Behaviorist, Trait and type approaches. Assessment of Personality: Self- report measures of Personality, Questionnaires, Rating Scales and Projective techniques, its Characteristics, advantages & limitations, examples. Behavioral Assessment. Psychological Stress: a. Stress- Definition, Symptoms of Stress, Extreme products of stress v s Burnout, Work Place Trauma. Causes of Stress – Job related causes of stress. Sources of Frustration, Stress and Job Performance, Stress Vulnerability-Stress threshold, perceived control.

Unit – IV **07Hrs**

Application of Psychology in Working Environment: The present scenario of information technology, the role of psychologist in the organization, Selection and Training of Psychology Professionals to work in the field of Information Technology. Distance learning, Psychological consequences of recent developments in Information Technology. Type A and Type B Psychological Counseling - Need for Counseling, Types – Directed, Non- Directed, Participative Counseling.

Unit-V **07Hrs**

Learning: Definition, Conditioning – Classical Conditioning, Basics of Classical Conditioning (Pavlov), the process of Extinction, Discrimination and Generalization. Operant Conditioning (Skinner expt). The basics of operant conditioning, Schedules of reinforcement. Cognitive – Social approaches to learning – Latent Learning, Observational Learning, Trial and Error Method, Insightful Learning.

Experimental Psychology Unit – VI (Practicals)

1. Bhatia's Battery of Performance and intelligence test
2. **Multidimensional Assessment of Personality**
3. B.K.Passi test of Creativity
4. Test of Non- Verbal Intelligence test (TONI-4)
5. **David's Battery of Differential Abilities (Aptitude test)**
6. **Bilateral Transfer of Training Mirror drawing apparatus with Electronic Digital Reset Error Counter (Performance)**
7. **Student Stress Scale.**

Course Outcomes:

After going through this course the student will be able to:

CO1. Understand the basic principles and concepts of applied psychology in. mental processes.

CO2. Develop psychological attributes such as intelligence, aptitude, creativity, resulting in their enhancement.

CO3. Apply effective strategies for SWOC, self-management and self-improvement.

CO4. Understand the application of psychology in engineering and technology and develop a route to accomplish goals in their work environment.

Reference Books:

1. Feldman R. S., "Understanding Psychology", McGraw Hill India, 4th edition, 1996

2. Robert A. Baron," Psychology", Prentice Hall India 3rd edition,1995.

3. Stephen P Robbins Organizational Behaviour , Pearson Education Publications, 13th Edition, ISBN – 81-317 – 1132 – 3

4. John W.Newstrem and Keith Davis. Organizational Behavior : Human Behavior at Work Tata McGraw Hill India, 10th edition, ISBN 0-07-046504-5

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. 10 marks are reserved for laboratory, out of which 05 marks for maintaining record and 05 marks for internal test.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

R.V.COLLEGE OF ENGINEERING, BENGALURU-59

Sl.No.	Dept.	Group G		
		Course Code	Course Title	Credits
1	Biotechnology	12GG701	Bioinformatics	3
2	Chemical	12GG702	Industrial safety & risk management	3
3	Comp. Sc. & Engg.	12GG703	Intelligent Systems	3
4	Civil	12GG704	Solid Waste Management	3
5	Elns. & Comm.	12GG705	Automotive Electronics	3
6	Elns. & Elec.	12GG706	Industrial electronics	3
7	Indl. Engg. Mng.	12GG707	Systems Engineering	3
8	Info. Sc. & Engg.	12GG708	Cloud Computing	3
9	Instrumentation	12GG709	MEMS	3
10	Mech. Engg.	12GG710	Mechatronics	3
11	Telecommunication	12GG711	Space Technology and Applications	3
12	Mathematics	12GG712	**Linear Algebra**	3

BIOINFOMATICS
(Offered by BoS: Biotechnology Engg.)

Course Code : 12GG701 **CIE Marks : 100**
Hrs/Week : L:T:P:S : 4:0:0:0 **SEE Marks : 100**
Credits : 04 **SEE Duration: 3 Hrs**

Prerequisites: : Knowledge of Mathematics and Basics of programming

Course Learning Objectives:

- Understand the principles of Bioinformatics and Programming.
- Learn various Biological Databases and Tools that aid in the analysis.
- Use tools such as Web & standalone tools to interface, analyze and interpret biological data
- Use Perl and BioPerl for the analysis of Biological Data.

Unit I

Biomolecules: Introduction to Biomolecules. Structure, Types and Functions of Carbohydrates, Lipids, Nucleic Acids and Proteins. Genetic code, Codon degeneracy, Genes and Genomes. **8 Hrs**

Bioinformatics & Biological Databases: Introduction to Bioinformatics, Goals, Scope, Applications in biological science and medicine. Biological databases – Sequence, structure, Special Databases and applications: Genome, Microarray, Metabolic pathway, motif, and domain databases. Mapping databases – genome wide maps. Chromosome specific human maps.

Unit II

Sequence Alignment: Introduction, Types - Pairwise and Multiple sequence alignment, Alignment algorithms, Scoring matrices, Database Similarity Searching- Basic Local Alignment Search Tool (BLAST), and FASTA. Next Generation Sequencing – Alignment and Assembly. **9 Hrs**

Molecular Phylogenetics: Phylogenetics Basics. Molecular Evolution and Molecular Phylogenetics – Terminology, Forms of Tree Representation. Phylogenetic Tree Construction Methods - Distance-Based Methods, Character-Based Methods. Methods of Phylogenetic Tree evaluation. Phylogenetic analysis programs.

Unit III

Predictive methods using Nucleic acid sequence: Predicting RNA secondary structure, Finding RNA genes, Detection of functional sites in the DNA and Gene Prediction Algorithms –Exon Chaining. Predictive methods using protein sequence – Algorithms used to predict Protein identity and Physical properties. Structure prediction - Prediction of Secondary and Tertiary structure of Protein. **10 Hrs**

Molecular Modeling and Drug Designing: Introduction to Molecular Modeling, methods of Molecular Modeling and Force Fields used in Molecular Modeling. Drug designing process - deriving Pharmacophore, Receptor Mapping, Estimating biological activities, Receptor-Ligand interactions. Molecular Docking. QSAR, Application of QSAR in Drug Design

Unit IV

Perl: Introduction to Perl, writing and executing a Perl program. Operators, Variables and Special variables. Data Types – Scalar, Array and Associative array. Regular Expressions (REGEX), Components of REGEX - Operators, Meta-characters and Modifiers. Subroutines – types of functions, defining and calling functions in Perl, calling function - call by value and call by reference. Perl **9 Hrs**

Package – writing and calling package. Perl Module – writing and calling module

Unit V

BioPerl: Introduction to BioPerl, BioPerl Modules, Applications of BioPerl – Sequence retrieval from Database and submission of sequence to online Database, Indexing and accessing local databases, Transforming formats of database record, Sequence alignments BioPerl and Sequence Analysis - Pair wise and Multiple sequence alignment, Restriction mapping. , Identifying restriction enzyme sites, acid cleavage sites, searching for genes and other structures on genomic DNA, Parsing BLAST and FASTA results. BioPerl and Phylogenetic analysis, BioPerl and Phylogenetic tree manipulation, creating graphics for Sequence display and Annotation. **9 Hrs**

Course Outcomes:

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

CO1. Understand the Architecture and Scheme of online databases including structure of records in these databases.

CO2. Explore the Algorithms, which are used to make prediction in Biology, Chemical Engineering, and Medicine.

CO3. Apply the principles of Bioinformatics and Programming to the problems related to process simulation and process engineering in Biological system.

CO4. Use Bioinformatics tools and Next Generation Technologies to model and simulate biological phenomenon.

Reference Books:

1. T. Christiansen, B. D. Foy, L. Wall, J. Orwant, Programming Perl: Unmatched power for text processing and scripting, O'Reilly Media, Inc., 4th edition, 2012, ISBN-13: 978-0596004927
2. B. Haubold, T. Weihe, Introduction to Computational Biology: An Evolutionary Approach, newagepublishers, Paperback Edition, 2009, ISBN-13: 978-8184890624
3. D. C. Young. Computational Drug Design: A Guide for Computational and Medicinal Chemists,Wiley-Interscience, 1st edition, 2009, ISBN-13: 978-0470126851.
   JinXiong, Essential Bioinformatics. Cambridge University Press, 2nd Edition, 2006, ISBN-13: 978-0521600828.

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

INTELLIGENT SYSTEMS
(Offered by BoS: Computer science and Engineering)

Course Code: 12GG703 **CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:0: 0:0 **SEE Marks: 100**
Credits: 03 **SEE : 3 Hrs**

Prerequisite: Artificial Intelligence

Course Learning Objectives:

- Understand fundamental AI concepts and current issues.
- Understand and apply a range of AI techniques including search, logic-based reasoning, neural networks and reasoning with uncertain information.
- Recognize computational problems suited to an Intelligent system solution.
- Identify and list the basic issues of knowledge representation, blind and heuristic search.
- Analyze the design issues inherent in different Intelligent System approaches.

Unit – I

Introduction To Artificial Intelligence : Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics -Specialized production system- Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction - Related algorithms, Measure of performance and analysis of search algorithms. **07 Hrs**

Unit – II

Representation Of Knowledge: Game playing - Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge. **07 Hrs**

Unit – III

Knowledge Inference: Knowledge representation -Production based system, Frame based system. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory-Bayesian Network-Dempster - Shafer theory. **07 Hrs**

Unit – IV

Expert Systems : Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition –Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells **07 Hrs**

Unit – V

Intelligent Decision Support Systems: Artificial Intelligence and Expert Systems: Knowledge-Based System - Knowledge Acquisition, Representation, and Reasoning - Advanced Intelligent Systems - Intelligent Systems over the Internet. **07 Hrs**

Course outcomes:

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

CO1. Describe and understand the basic concepts and challenges of Artificial Intelligence.
CO2. Analyze and explain basic intelligent system algorithms to solve problems.
CO3. Apply Artificial Intelligence and various logic-based techniques in research applications.
CO4. Assess their applicability by comparing different Intelligent System

techniques.

Reference Books

1. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Tata McGraw-Hill Education Private Limited, 3rd edition, 2009, ISBN: 978-0070678163.
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2nd edition, 2007. ISBN, 0132097680
3. Peter Jackson, "Introduction to Expert Systems", Pearson Education, 3rd edition, 2007. ISBN-13: 978-0201876864
4. Stuart Russel, Peter Norvig , "AI – A Modern Approach", Pearson Education, 2nd edition, ISBN-13: 978-0137903955

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily

SOLID WASTE MANAGEMENT
(Offered by BoS: Civil Engineering)

Course Code: 12GG704 | **CIE Marks: 100**
Hrs/Week: L:T:P:S :: | **SEE Marks: 100**
3:0:0:0 | **SEE Duration : 3 Hrs**
Credits: 03

Course Learning Objectives:

- Impart the knowledge of present methods of solid waste management system and to analyze the drawbacks.
- Understand various waste management statutory rules for the present system.
- Analyze different elements of solid waste management and design and develop recycling options for biodegradable waste by composting.
- Identify hazardous waste, e-waste, plastic waste and bio medical waste and their management systems.

Unit – I

Introduction: Land Pollution. Present solid waste disposal methods. Merits and demerits of open dumping, feeding to hogs, incineration, pyrolysis, composting, sanitary landfill. Scope and importance of solid waste management. Definition and functional elements of solid waste management. **08 Hrs**

Sources: Sources of Solid waste, types of solid waste, composition of municipal solid waste, generation rate, Problems.

Collection and transportation of municipal solid waste: Collection of solid waste- services and systems, Municipal Solid waste (Management and Handling) 2000 rules with amendments. Site visit to collection system.

Unit – II

Composting Aerobic and anaerobic composting - process description, process microbiology, Vermicomposting, Site visit to compost plant, problems. **08 Hrs**

Sanitary land filling: Definition, advantages and disadvantages, site selection, methods, reaction occurring in landfill- Gas and Leachate movement, Control of gas and leachate movement, Site visit to landfill site.

Unit – III

Hazardous waste management: Definitions, Identification of hazardous waste, Classification of hazardous waste, onsite storage, collection, transfer and transport, processing, disposal, hazardous waste (Management and handling) rules 2008 with amendments. Site visit to hazardous landfill site **06 Hrs**

Unit – IV

Bio medical waste management: Classification of bio medical waste, collection, transportation, disposal of bio medical waste, Bio medical waste (Management and Handling) rules 1998 with amendments. Site visit to hospital to see the collection and transportation system and visit to biomedical waste incineration plant. **06 Hrs**

Unit – V

E-waste management: Definition, Components, Materials used in manufacturing electronic **goods,** Recycling and recovery integrated approach. Site visit to e-waste treatment pla **06 Hrs**

Plastic waste management: Manufacturing of plastic with norms. Plastic waste management. Plastic manufacture, sale & usage rules 2009 with amendments.

Course outcomes:

After going through this course the student will be able to:

CO1. Understand the current solid waste management system.

CO2. Analyze drawbacks in the present system and provide recycling and disposal options for each type of waste.

CO3. Distinguish Hazardous waste, Biomedical waste, E waste and to provide scientific management system.

CO4. Evaluate and monitor the Biomedical waste, Hazardous waste, E waste, Plastic and Municipal waste management as per the rules laid by Ministry of Environment & Forest.

Reference Books

1. George.C. Tchobanoglous, "Integrated Solid Waste Management" – McGraw hill publication. International edition 1993, ISBN 978-0070632370
2. R.E. Hester, Roy M Harrison, "Electronic waste management", Cambridge, UK, RSC Publication, 2009, ISBN 9780854041121
3. Municipal Solid waste (Management & Handling Rules) , Ministry of Environment & Forest Notification, New Delhi, 25th Sept 2000 and amendments on 2013.
4. The Plastic Manufacture, Sale and usage Rules2009. Ministry of Environment and Forest Notification, New Delhi, amendment on February 4, 2011
5. Biomedical waste management (Management & Handling Rules) 20th July 1998. Ministry of Environment & Forest Notification, New Delhi, amendment on February 26, 2013.

Scheme of Continuous Internal Evaluation:
CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:
The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily

AUTOMOTIVE ELECTRONICS
(Offered by BoS: Electronics and Communications)

Course Code:12GG705 **CIE Marks: 100**
Hrs/Week: L:T:P:S :3:0:0:0 **SEE Marks: 100**
Credits: 03 **SEE Hrs : 03**

Course Learning Objectives(CLO):

1. Understand fundamentals of Automotive electronics and application.
2. Comprehend principles of sensing technology in automotive field, smart sensors and the type of sensor.
3. Apply control systems in the automotive space resulting in application oriented learning with examples, criticality to real time embedded system like anti wind up function, actuator dithering, etc
4. Understand automotive specific communication protocols and techniques, their significance & benefits.
5. Analyze fault tolerant real time embedded systems, the basics of diagnostics, its method, reporting mechanism and error handling / fault reactions.

UNIT – I **07 Hrs**

Power Train Engineering and Fundamentals of Automotive

Fundamentals of Petrol, diesel and gas engines, electric motors and control systems. Basic Automotive System, System Components, Evolution of Electronics in Automotive. Alternators and charging, battery technology, Ignition systems. Working principles of various electronic components and accessories used in Automotive. Developments in existing engine forms and alternatives. Hybrid designs (solar power, electric/gasoline, LPG, CNG, fuel cells). Basic Transmission systems.

UNIT – II **07 Hrs**

Sensor Technologies in Automotive

In-vehicle sensors: Working principles, Characteristics, limitations and use within the automotive context of the following: Temperature sensing e g. coolant, air intake. Position sensing e.g. crankshaft, throttle plate. Pressure sensing e.g. manifold, exhaust differential, tyre. Distance sensing e.g. anti-Collision, Velocity sensing e.g. speedometer, anti-skid. Torque sensing e.g. automatic transmission. Vibration sensing e.g. Airbags. flow sensing and measurement e.g. fuel injection. Interfacing principles: Operation, topologies and limitations of all sensors covered in the above to in-vehicle processing or communications nodes. Use of Actuators: Types, Working principle, Characteristics, limitations and use within the automotive context of each type.

UNIT – III **07 Hrs**

Automotive Control Systems

Control system approach in Automotive: Analog and Digital control methods, stability augmentation, control augmentation. Transmission control, System components and functions. Cruise control, traction control, actuator limiting, wind-up, gain scheduling, adaptive control. Special Control Schemes: Vehicle braking fundamentals, Antilock systems. Variable assist steering and steering control. Controls for Lighting. Wipers, Air conditioning /heating. Remote keyless Entry and Anti-theft System, Emission Course-system control. Control techniques used in hybrid system. Electronic Engine control: Motion equations, modeling of linear and non-linear systems, numerical methods, system responses Objective of Electronic Engine control. Spark Ignition and Compression Ignition Engines and their electronic controls. Engine management testing: Engine management system strategies and implementation. Simulation and implementation methods. Methods of improving engine performance and efficiency

UNIT – IV **07 Hrs**

Automotive Communication Systems

Communication interface with ECU's: Interfacing techniques and interfacing with infotainment gadgets. Relevance of internet protocols, such as TCP/IP for automotive applications. Wireless LANs standards, such as Bluetooth, IEEE802.11x. Communication protocols for automotive applications.

Automotive Buses: Use of various buses such as CAN, LIN, Flex Ray. Recent trends in automotive buses (Such as OBDI1. MOST, IE, IELI.I, D2B and DSI).

Application of Telematics in Automotive: Global Positioning Systems (GPS) and General Packet Radio Service (GPRS), for use in an automotive environment.

Higher End Technology: Comparative Study and applications of ARM Cortex.-Aseries/M-series. ARM 9 and ARM11.

UNIT – V **07 Hrs**

Diagnostics and Safety in Automotive

Fundamentals of Diagnostics: Basic wiring system and Multiplex wiring system. Preliminary checks and adjustments, Self-Diagnostic system. Fault finding and corrective measures. Electronic transmission checks and Diagnosis, Diagnostic procedures and sequence. On board and off board diagnostics in Automotive. Safely in Automotive: Safety norms and standards. Passenger comfort and security systems. Future trends in Automotive Electronics.

Reference Books

1. Williams. B. Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier science, Newness publication, , 2003
2. Robert Bosch, "Automotive Electronics Handbook", John Wiley and Sons, 2004
3. Nitaigour Mahalik, "Mechatronics: principles, concepts and Applications", TMH, 2003
4. Uwekiencke and lars Nielsen, "Automotive Control Systems Engine, Driveline and vehicle", 2nd Edition, Springer, 2005

Scheme for Continuous Internal Evaluation (CIE):

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Evaluation for Theory (SEE) (100):

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five

questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

INDUSTRIAL ELECTRONICS

Course Code: 12GG706 **CIE Marks: 100**
Hrs/Week: L:T:P:S 3:0:0:0 **SEE Marks: 100**
Credits: 03 **SEE : 3 Hrs**

Course Learning Objectives:

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

1. Assimilate information and techniques for management of electrical energy.
2. Explain the working of power electronic components used in design of electronic circuits of conversion and control of electrical energy in Industry.
3. Apply the strong knowledge base acquired for analyzing and designing electronic circuits which handle the electrical energy efficiently and economically.
4. Sort-out design problems through the practical and industrial exposure acquired.
5. Use basic concepts of practical design and working of electronic circuits for conversion and control of electrical energy.
6. Make use of the opportunities to work as part of teams on multidisciplinary projects and to discuss industrial problems with regard to application of Power Elecronics.

Unit – I **07 Hrs**

Power semi conductor Devices and static characteristics: Construction, working & characteristics of MOSFET, SCR, IGBT. Comparison of Power BJT, MOSFET, SCR, IGBT. Turn on methods of Power BJT, MOSFET and IGBT. Design of R, R-C, and UJT (pulse train) Gate triggering methods of SCR.

Unit – II **07 Hrs**

Thyristor Dynamic characteristics, Specifications and Protection: Gate characteristics of SCR, Dynamic characteristics of SCR. Design of Snubber circuit for SCR, Line Commutation and Forced Commutation circuits with design, Gate protection & overvoltage protection of SCR.

Unit – III **08 Hrs**

Converters- Single Phase Controlled Convertor- Full wave Half and Fully controlled line commutated bridge converters, Three phase converters –Six pulse converters- with R, RL, RLE load- Active and Reactive power inputs to the convertors with and without Freewheeling diode, Derivation of average load voltage and current, Effect of source inductance, Converter Design.

Unit – IV **07 Hrs**

Converter applications: Industrial Applications of Half and Fully controlled converters to DC drives (Control of DC drives). Dual converters (both single phase and three phase).

Choppers – Step down, Step up Chopper, Step up/Down Chopper, Time ratio control and Current limit control strategies –Derivation of load voltage and currents with R, RL and RLE loads of Step down, Step up Chopper, Step up/Down Chopper – load voltage expression. Design of choppers according to applications.

Unit – V **07 Hrs**

Classification of Choppers and Applications: Type A, Type B, Type C, Type D, Type E choppers and their industrial Applications, Morgan's chopper, Jones chopper and Oscillation chopper (Principle of operation only) , AC Chopper –phase control type.

Inverters – Single phase inverter – Basic series inverter – Basic parallel Capacitor inverter, bridge inverter – Voltage control techniques for inverters Pulse width modulation techniques. – UPS-online, offline (Principle of operation only).

Course outcomes:

1. Understand the comprehensive working of different devices and their applications.
2. Analyze the application of skills in controlling and conversion of electrical energy.
3. Evaluate and distinguish the performance of converters and inverters.
4. Ability to implement their knowledge and skills in design of applications.

Reference Books

1. M. D. Singh & K. B. Kanchandhani, "Power Electronics", Tata Mc Graw – Hill Publishing company, 1998
2. M. H. Rashid, "Power Electronics : Circuits, Devices and Applications", Prentice Hall of India, 2nd edition, 1998
3. P.C.Sen, "Power Electronics", Tata McGraw-Hill Publishing, 1987.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

SYSTEMS ENGINEERING
(Offered by BoS: Industrial Engineering and Management)

Course Code: 12GG707 **CIE Marks:100**
Hrs/Week: L: T: P: S: **SEE Marks :100**
3:0:0:0 **SEE Duration:3 Hrs**
Credits :3

Course Learning Objectives:

- Develop an appreciation and understanding of the role of systems engineering processes and systems management in producing products and services.
- Document systematic measurement approaches for generally cross disciplinary development effort.
- Discuss capability assessment models to evaluate and improve orgnizational systems engineering capabilities.

Unit – I

System Engineering and the World of Modem System: What is System Engineering?, Origins of System Engineering, Examples of Systems Requiring Systems Engineering, System Engineering viewpoint, Systems Engineering as a Profession, The power of Systems Engineering, problems. **07 Hrs**

Structure of Complex Systems: System building blocks and interfaces, Hierarchy of Complex systems, System building blocks, The system environment, Interfaces and Interactions.

The System Development Process: Systems Engineering through the system Life Cycle, Evolutionary Characteristics of the development process, The system engineering method, Testing throughout system development, problems.

Unit – II

Systems Engineering Management: Managing systems development and risks, Work breakdown structure (WBS), System Engineering Management Plan (SEMP), Risk Management, Organization of Systems Engineering, Systems Engineering Capability Maturity Assessment, Systems Engineering standards, Problem. **07 Hrs**

Needs Analysis: Originating a new system, Operations analysis, Functional analysis, Feasibility analysis, Feasibility definition, Needs validation, System operational requirements, problems.

Concept Exploration: Developing the system requirements, Operational requirements analysis, Performance requirements formulation, Implementation concept exploration, Performance requirements validation, problems.

Unit – III

Concept Definition: Selecting the system concept, Performance requirements analysis, Functional analysis and formulation, Concept selection, Concept validation, System Development planning, System Functional Specifications, problems **07 Hrs**

Advanced Development: Reducing program risks, Requirements analysis, Functional Analysis and Design, Prototype development, Development testing, Risk reduction, problems.

Unit – IV

Engineering Design: Implementing the System Building blocks, requirements analysis, Functional analysis and design, Component design, Design validation, Configuration Management, problems. **06 Hrs**

Integration and Evaluation: Integrating, Testing and evaluating the total system, Test planning and preparation, System integration, Developmental system testing, Operational test and evaluation, problems.

Unit – V

Production: Systems Engineering in the factory, Engineering for production, Transition from development to production, Production operations, Acquiring a production knowledge base, problems. **06 Hrs**

Operations and support: Installing, maintenance and upgrading the system, Installation and test, In-service support, Major system upgrades: Modernization, Operational factors in system development, problems.

Course Outcomes:

After completion of course student will be able to:

CO1: Understand the Life Cycle of Systems.

CO2: Explain the role of Stake holders and their needs in organizational systems.

CO3: Develop and Document the knowledge base for effective systems engineering processes.

CO4: Apply available tools, methods and technologies to support complex high technology systems.

CO5: Create the frameworks for quality processes to ensure high reliability of systems.

Reference Books

1. Alexander Kossoakoff, William N Sweet, "Systems Engineering – Principles and Practice" John Wiley & Sons, Inc, edition: 2012, ISBN: 978-81-265-2453-2
2. Andrew P. Sage, William B. Rouse, "Handbook of Systems Engineering And Management" John Wiley & Sons, Inc., edition:1999, ISBN 0-471-15405-9
3. Ludwig von Bertalanffy, "General System Theory: Foundation, Development, Applications", Penguin University Books, 1973, Revised, ISBN: 0140600043, 9780140600049.
4. Blanchard, B., and Fabrycky, W. Systems Engineering and Analysis, Saddle River, NJ, USA: Prentice Hall, 5th edition, 2010.
5. Checkland, P. Systems Thinking, Systems Practice. Hoboken, NJ, USA: Wiley,2nd edition, 1999, ISBN:0471986062, 9780471986065..
6. Rechtin, E. Systems Architecting. Upper Saddle River, NJ,USA: Prentice Hall, 1991, ISBN: 0138803455, 9780138803452.

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily

CLOUD COMPUTING
(Offered by BoS: Information Science & Engineering)

Course Code: 12GG708 **CIE Marks:** 100
L:T:P:S: 3:0:0:0 **SEE Marks:** 100
Credits: 3 **SEE Duration:** 3 Hrs

Course Learning Objectives - CLO:

- Learn advanced and cutting edge state-of-the-art knowledge and implementation in cloud computing.
- read and understand research publications in the technical area of cloud computing, beyond that of the traditional textbook level.
- Get to know about advanced services and applications in stacks of cloud
- Explore the cloud Infrastructure and understand Abstraction & Virtualization in cloud computing

Unit-I

Cloud Computing Fundamental: Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications. **7 Hrs**

Unit – II

Cloud Applications: Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages **7 Hrs**

Unit – III

Virtualized Data Center Architecture : Cloud infrastructures; public, private, hybrid. Service provider interfaces; Saas, Paas, Iaas. VDC environments; concept, planning and design, business continuity and disaster recovery principles. Managing VDC and cloud environments and infrastructures **7 Hrs**

Unit – IV

Information Storage Security &Design : Storage strategy and governance; security and regulations. Designing secure solutions; the considerations and implementations involved. Securing storage in virtualized and cloud environments. Monitoring and management; security auditing and SIEM. **7 Hrs**

Unit-V

Storage Network Design: Architecture of storage, analysis and planning. Storage network design considerations; NAS and FC SANs, hybrid storage networking technologies (iSCSI, FCIP, FCoE), design for storage virtualization in cloud computing, host system design considerations. **7 Hrs**

Working with Twitter API, Flickr API, Google Maps API. Advanced use of JSON and REST.

Management

Planning Business Continuity; Managing availability; Managing Serviceability; Capacity planning; Security considerations

Course Outcomes

On completion of the course the student will be able to:

CO1. Develop the skills to gain a basic understanding of components in cloud computing showing how business agility in an organization can be created

CO2. Explore the functional components of web services from cloud architecture

CO3. Develop and implement a basic consistency of services deployed from a cloud architecture

CO4. Critically analyze case studies to derive the best practice model to apply when developing and deploying cloud based applications

References:

1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, **"Mastering Cloud Computing"**, Indian Edition: Tata McGraw Hill, Feb 2013, ISBN-13: 978-1-25-902995-0,.
2. Venkata Josyula, "**Cloud Computing: Automating the virtualized Data Center" , Pearson** India 2012, ISBN:1-58720-434-7
3. George Reese, **"Cloud application architectures",** Wiley India 2011, ISBN: 978-0596156367
4. GautamShroff," **Enterprise Cloud Computing Technology Architecture Applications"**Tata McGraw Hill, 2011,ISBN: 978-0521137355

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily

MICRO ELECTROMECHANICAL SYSTEMS

(Offered by BoS: Electronics & Instrumentation Engg.)

Course Code: 12GG709 **CIE Marks: 100**

Hrs/Week: L:T:P:S : 3:0:0:0 **SEE Marks: 100**

Credits: 03 **SEE Duration: 3 Hrs**

Course Learning Objectives:

- Learn the fundamentals and working principle of MEMs and Microsystem products like Sensors, Actuators etc.
- Understand the Multidisciplinary nature of Microsystems.
- Understand the Scaling Laws in MEMs and Microsystems.
- Select materials for MEMs for fabrication techniques.

Unit I **07 Hrs**

Over view of MEMS & Microsystems and Working Principles of Microsystems: MEMS and Microsystems, Typical MEMS and Microsystem Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystem, Design and Manufacture, Applications of Microsystems in Automotive, Health Care, Aerospace and other Industries.

Working Principle of Microsystems: Biomedical & Biosensors. Microsensors: Acoustic, Chemical, Optical, Pressure, Thermal.

Unit II **07 Hrs**

Microactuation: Using Thermal forces, Shape Memory alloys, Piezoelectric Crystals and Electrostatic forces. MEMS with Microactuators: Microgrippers, Micromotors, Microvalves and Micropumps. Microaccelerometers, Microfluidics.

Introduction to Thermofluid Engineering, Overview of the Basics of Fluid Mechanics in Macro and Mesoscales: Viscosity of fluids, Streamlines and Stream Tubes, Control Volumes and Control Surfaces, Flow Patterns and Reynolds Number. Basic Equations in Continum Fluid Dynamics: The Continuity Equation, The Momentum Equation and the Equation of motion.

Unit III **07 Hrs**

Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Microconduits, Fluid Flow in Submicrometer and Nanoscale, Heatconduction in Multilayered Thin Films. Introduction to Scaling, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Electromagnetic Forces and Scaling in Fluid Mechanics.

Unit IV **07 Hrs**

Materials for MEMS and Microsystems: Substrates and Wafers, Active Substrate Materials, Silicon as a Substrate Material, Silicon Compounds, Silicon Piezoresistors, Galium Arsenide, Quartz, Piezoelectric Crystals, Polymers and Packaging Materials. The three levels of Microsystem Packaging, Die level packaging, Device level packaging, System level packaging. Interfaces in microsystem Packaging. Essential Packaging Technologies: Die preparation, Surface Bonding, Wire Bonding, Sealing. Three dimensional Packaging.

Unit – V **07 Hrs**

Microsystem Fabrication Processes: Introduction to Microsystem Fabrication Process, Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapor Diposition (CVD), Physical Vapor Deposition-Sputtering, Deposition by Epitaxy, Etching, The LIGA Process: General Description of LIGA Process, Materials for Substrates and Photoresists, Electroplating and SLIGA Process.

Course outcomes:

On completion of the course the student will be able to:

CO1. Understand the basic fundamentals of MEMs and Microsystems.

CO2. Apply the concepts to design the MEMs sensors and actuators.

CO3. Analysis and Evaluate the MEMs sensors and actuators

CO4. Design a system with MEMs sensors and actuators using Various fabrication techniques.

Reference Books

1. Tai-ran tsu "MEMS & Microsystems: Design and manufacture." John Wiley and sons Inc, 2nd edition. 2008,
2. P.Rai-Choudhury "MEMS and MOEMS Technology and Applications "PHI,1st Edition 2009,.
3. K.J.Vinoy, G.K.Ananthasuresh, S.Gopalakrishnan, K.N.Bhat, "Micro and Smart Systems",
4. Stevens S. Saliterman. Fundamentals of Bio MEMS and Medical and Micro devices. Wiley Interscience division. 1st edition, 2006, first edition.

Scheme of Continuous Internal Evaluation:
CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:
The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily.

MECHATRONICS

(Offered by BoS: Mechanical Engg.)

Course Code: **12 GG 710** **CIE Marks: 100**
Hours/Week: L:T:P:S : 3:0:0:0 **SEE Marks: 100**
Credits: 03 **SEE Duration: 3 Hours**

Course Learning Objective

- Understand the evolution and development of Mechatronics as a discipline.
- Substantiate the need for interdisciplinary study in technology education.
- Understand the applications of microprocessors in various systems and to know the functions of each element.
- Identify main parts, hardware forms and internal architecture of PLC.
- Demonstrate the integration philosophy in view of Mechatronics technology.

UNIT-I

Introduction: Definition, Multidisciplinary Scenario, Evolution of Mechatronics, Design of Mechatronics system, Objectives, advantages and disadvantages of Mechatronics. **06 Hrs**

Transducers and sensors: Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, proximity switches and Hall effect sensors.

UNIT-II

Microprocessor & Microcontrollers: Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers. **06 Hrs**

Microprocessor Architecture: Microprocessor architecture and terminology- CPU, memory and address, I/O and Peripheral devices, ALU, Instruction and Program, Assembler, Data, Registers, Program Counter, Flags, Fetch cycle, write cycle, state, bus interrupts. Intel's 8085A Microprocessor**.**

Unit –III

Programmable logic controller: Introduction to PLC's, basic structure, Principle of operation, Programming and concept of ladder diagram, concept of latching & selection of a PLC **06 Hrs**

Integration: Introduction & background, Advanced actuators, Pneumatic actuators, Industrial Robot, different parts of a Robot-Controller, Drive, Arm, End Effectors, Sensor & Functional requirements of robot.

Unit –IV

Mechanical actuation systems: Mechanical systems, types of motion, Cams, Gear trains, Ratchet & Pawl, belt and chain drives, mechanical aspects of motor selection. **06 Hrs**

Electrical actuation systems: Electrical systems, Mechanical switches, Solenoids, Relays, DC/AC Motors, Principle of Stepper Motors & servomotors.

Unit –V

Pneumatic and hydraulic actuation systems: Actuating systems, Pneumatic and hydraulic systems, Classifications of Valves, Pressure relief valves, Pressure regulating/reducing valves, Cylinders and rotary actuators. **08 Hrs**

DCV & FCV- Principle & construction details, types of sliding spool valve, solenoid operated, Symbols of hydraulic elements, components of hydraulic system, functions of various units of hydraulic system. Design of simple hydraulic circuits for various applications

Course Outcomes:

CO1. Define and illustrate various components of Mechatronics systems.

CO2. Identify, categorize and apply transducers & sensors used in automation, control systems, and instruments

CO3. Assess various control systems used in automation.

CO4. Develop mechanical, hydraulic, pneumatic and electrical control systems.

References:

1. Nitaigour Premchand Mahalik , Mechatronics-Principles, Concepts and Applications, Tata McGraw Hill 1st Edition, 2003 ISBN.No. 0071239243, 9780071239240
2. Mechatronics by HMT Ltd. – Tata McGrawHill, 1st Edition, 2000. ISBN:9780074636435
3. W.Bolton-Pearson Education, Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering,1st Edition, 2005 ISBN No. 81-7758-284-4
4. Anthony Esposito, Fluid Power , Pearson Education, 6th Edition, 2011, ISBN No. 9789332518544

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily

SPACE TECHNOLOGY AND APPLICATIONS
(Offered by BoS: Telecommunication Engineering)

Sub Code: 12GG711 **CIE Marks:100**
Hrs / Week: L:T:P:S:3:0:0:0 **SEE Marks:100**
Credits: 3 **SEE :3Hrs**

Course Learning Objectives (CLO):

- **Understand the earth environment and its behaviour, launching vehicles for satellites and its associated concepts.**
- **Differentiate satellites in terms of technology, structure and communications.**
- **Learn the use of satellite in various applications like communication, remote sensing and metrology.**
- **Make the learner appreciate space technology, technology mission and advanced space systems to nation's growth.**

UNIT I

Earths environment: Atmosphere, ionosphere, Magnetosphere, Van Allen Radiation belts, Interplanetary medium, Solar wind, Solar- Earth Weather Relations. **07Hrs**

Launch Vehicles: Rocketry, Propellants, Propulsion, Combustion, Solid, Liquid and Cryogenic engines, Control and Guidance system, Ion propulsion and Nuclear Propulsion.

UNIT II

Satellite Technology: Structural, Mechanical, Thermal, Power control, Telemetry, Tele-command, Quality and Reliability, Payloads, Space simulation. **07Hrs**

Satellite structure: Satellite Communications, Transponders, Satellite Antennas.

UNIT III

Satellite Communications: LEO, MEO and GEO orbits, Altitude and orbit controls, Link design, Multiple Access Techniques. **08Hrs**

Space applications: Telephony, V-SAT, DBS system, Satellite Radio and TV, Tele-Education, Tele-medicine, Satellite navigation, GPS.

UNIT IV

Remote Sensing: Visual bands, Agricultural, Crop vegetation, Forestry, water Resources, Land use, Land mapping, geology, Urban development resource management, image processing techniques. **09Hrs**

Metrology: Weather forecast (Long term and Short term), weather modeling, Cyclone predictions, Disaster and flood warning, rainfall predictions using satellites.

UNIT V

Satellite payloads: Technology missions, deep space planetary missions, Lunar missions, zero gravity experiments, space biology and International space Missions. **09Hrs**

Advanced space systems: Remote sensing cameras, planetary payloads, space shuttle, space station, Inter-space communication systems.

Course outcomes:

At the end of the course student should be able to:

CO1: Define different types of satellites, orbit and associated subsystems.

CO2: Describe the earth environment, basics of satellite technology, launching technologies and space applications.

CO3: Identify appropriate applications of satellites in the area of communication, remote sensing, metrology etc.,

Reference Books:

R G Barry, "Atmosphere, weather and climate", Routledge publications, edition,2009, ISBN.
K N Raja Rao, "Fundamentals of Satellite Communication", PHI, 2nd edition, **2012,** ISBN:.
Timothy pratt, "Satellite Communication" John Wiley, edition, 1986, ISBN:.
B C Panda, "Remote sensing and applications" VIVA books pvt. Ltd., edition, 2009, ISBN:

Scheme of Continuous Internal Evaluation:
CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:
The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily

Linear Algebra
(Offered by BoS; Basic Sciences)

Course Code: 12GG712 **CIE Marks: 100**
Hrs./Week: L:T:P:S : 3:0:0:0 **SEE Marks: 100**
Credits: 03 **SEE : 3 Hrs.**

Course Learning Objectives:

- Use basic terminology of linear algebra in Euclidean spaces, including linear independence, spanning, basis, rank, nullity, subspaces, and linear transformations;
- Apply the abstract notions of vector spaces in analyzing system of equations;
- Find the eigen values and eigenvectors of a matrix of a linear transformation, and using them to diagonalize a matrix;
- Solve an over-determined system of equations via projection concept, analyze and extend the structure of orthogonal vectors required in signal processing.
- Combine different concepts of Linear Algebra in designing new methods for solving complex engineering problems.

Unit – I

Vector Spaces: Vector Spaces and Subspaces, Linear Independence, Basis, Dimension, The Four Fundamental Subspaces: Row space, Null space, Column Space and Left-Null space. Rank Nullity Theorem (without proof) **08Hrs.**

Unit – II

Linear Transformations: Linear Transformations, Geometric Meaning, Matrix Representations, Rank of a Matrix, Change of Basis, Kernel and Image of a Linear Transformation, Rotation, Projection and Reflection Transformations in 2 dimensions. Geometrical interpretations **07Hrs.**

Unit – III

Eigen Values And Eigen Vectors : Eigen values, The Characteristic Equation, Eigenvectors, Algebraic and Geometric Multiplicity of Eigenvalues, Diagonalizabilitly of a Matrix, Geometric meaning of Eigenvalues and Eigenvectors. Applications of Eigenvalues in Stability analysis of differential equations. **07Hrs.**

Unit – IV

Orthogonality: Orthogonal Vectors and Subspaces, Orthogonal Projections, Orthogonal Bases, Orthogonal/Orthonormal Matrices, Gram–Schmidt Orthogonalization, QR Factorizations, Least Squares Problems. **07Hrs.**

Unit – V

Positive Definite Matrices: Minima, Maxima and Saddle Points.. Definite versus Indefinite. Higher Dimensions. Positive Definiteness. Tests for Positive Definiteness. Positive definite matrices and Least-squares. Semi-definite Matrices. Singular Value Decomposition. **07Hrs.**

Course outcomes:

On completion of the course the student will be able to:

CO1: **Relate and interpret** the concepts of Linear Algebra as applied to various branches of engineering using an axiomatic approach

CO2: **Apply** linear transformations in image processing, CAD and other areas of engineering and **extend**ing to higher dimensions

CO3: **Analyze and correlate** the concepts of eigenvectors and eigenvalues required for image processing and many other fields of engineering

CO4: **Assess and evaluate** the basis vectors as required in signal processing and many other areas of engineering

CO5: **Combine and construct** the SVD applied in image processing and principal component analysis

Reference Books

1. Gilbert Strang, "Linear Algebra and Its Applications", Cengage Learning India Edition, 4th edition, 2006, ISBN: 978-0980232714.
2. David C Lay, "Linear Algebra and Its Applications", Pearson Education, 3rd edition, 2003, ISBN: 978-0321780720.
3. Kenneth M Hoffman and Ray Kunze , Linear Algebra, Prentice Hall,2nd edition, 2006, ISBN: 978-0135367971.
4. Howard Anton & Chris Rorres" Elementary Linear Algebra Applications Version",Wiley , 9th edition, 2011, ISBN: 978-0470432051.

Scheme of Continuous Internal Evaluation:

CIE will consist of Three Tests each for 45 marks (15marks for Quiz + 30marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper will consist of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and will be compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five questions from Part B will have internal choice and one of the two have to be answered compulsorily

MAJOR PROJECT

Course Code: 12CH81 **CIE Marks : 100**
Hours/Week : L:T:P:S: 0:0:36:0 **SEE Marks : 100**
Credits : 18 **SEE Duration: 03 Hrs**

Objectives:

1. **Knowledge Application:** Students will acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
2. **Communication:** Students will acquire the skills to communicate effectively and to present ideas clearly and coherently to a specific audience in both the written and oral forms.
3. **Collaboration:** Students will acquire collaborative skills through working in a team to achieve common goals.
4. **Independent Learning:** Students will be able to learn on their own, reflect on their learning and take appropriate action to improve it.
5. **Management and Finance:** Students will prepare schedules and budgets, they along with the guide keep track of the progress and expenditure.

Guidelines

1. Students are required to form a project team/batch before the end of 7th semester.
2. The departments must complete the Internal Guide allotment process before the end of 7th semester .
3. The project topic, title and synopsis has to be finalized and submitted to their respective internal guide(s) before the beginning of the 8th semester.
4. The detailed Synopsis (approved by the department **Project Review Committee**) has to be submitted during the 1st week after the commencement of 8th semester.

Batch Formation:

- Students are free to choose their project partners from within the program or any other program (as interdisciplinary projects are encouraged).
- Each student in the team must contribute towards the successful completion of the project. The project may be carried out In-house / Industry / R & D Institution.
- **The project work is to be carried out by a team of two to four students , in exceptional cases where a student is placed in a company and offered an internship through the competitive process or student is selected for internship at national or international level through competitive process,** the student can work independently.
- **The students are allowed to do either a project for full 5 days in the industry or full 5 days in the college.**
- **In case the project work is carried out outside Bengaluru, such students must be available during Project Evaluation process scheduled by the respective departments and they must also interact with their guide regularly through Email / Webinar / Skype etc.**

Project Topic Selection:

The topics of the project work must be in the **field of respective program areas or in line *with CoE's(Centre of Excellence) identified by the college*** or **List of project areas as given by industry/Faculty. The projects as far as possible should have societal relevance with focus on sustainability.**

Place of Project Work:

- The project work should be carried out in the college.
- The project work can also be carried out in the Industry, in case the project is given by the industry **as internship, provided the department Project Review Committee approves the project** and the facilities for carrying out such project work are not available in the college.
- In case additional facilities are required for testing etc., students are permitted to visit research labs, where such facilities are available. The HoD should be informed in such cases and No objection obtained.

Attendance Requirement:

- Students are required to satisfy minimum attendance criteria as prescribed by the Institution, i.e. (85%)
- Students who are doing project work in the industries are required to go to the industry for full 5 days.
- Students who are doing project work in the college, are required to come to the college for full 5 days (Monday- Friday) and attendance is mandatory.
- Students are requested to adhere to the schedule of various phases of project work.
- The guides shall be responsible to send attendance details every month through HoD, to the Dean(Student affairs)

Project Evaluation:

- Continuous monitoring of project work will be carried out and cumulative evaluation will be done.
- The students are required to meet their internal guides once in a week to report their progress in project work.
- **Weekly Activity Report** (WAR) has to be maintained in the form of a diary by the project batch and the same has to be discussed with the Internal Guide regularly.

- In case of **Industry project**, during the course of project work, the internal guides will be in constant touch with external guides and will visit the industry at least thrice during the project period.
- For CIE assessment the project groups must give a final seminar with the draft copy of the project report.
- The presentation by each group will be for 20-30 minutes and every member of the team needs to defend the work done.
- The project team is required to submit Hard copies of the detailed Project Report in the prescribed format to the department and a Soft copy on a CD, to the Central library.
- For CIE 50% weightage should be given to the project guide and 50% weightage to the project evaluation committee.
- The Project team is required to demonstrate the functioning of the modules and the integrated application along with a presentation on the details of the project carried out during the Semester End Examination (SEE) in the department.
- Before the final evaluations the project group is required to produce a No dues certificate from Industry, Central Library and Department.

Course outcomes:

After the successful completion of the course, the students should be able to

CO1. Perform literature review, identify state of the art in that field and be able define the problem.

CO2. Establish a methodology using advanced tools / techniques for solving the problem including project management and finances.

CO3. Design, Develop Analytical models, Perform Numerical Analysis and Interpret the rresults.

CO4. Prepare quality document of project work for publications, patenting and final thesis.

CIE Assessment:

The following are the weightings given for the various stages of the project.

1. Selection of the topic and formulation of objectives 10%
2. Design and Development of Project methodology 25%
3. Execution of Project 25%
4. Presentation, Demonstration and Results Discussion 30%
5. Report Writing 10%

SEE Assessment:

The following are the weightages given during Viva Examination.

1. Written presentation of synopsis 10%
2. Presentation/Demonstration of the project 30%
3. Methodology and Experimental Results & Discussion 30%
4. Report 10%
5. Viva Voce 20%

Calendar of Events for the project Work:

Week	Event
Beginning of 7th Semester	Formation of Project Committee in the Department. Formation of group and approval by the department committee.
7th Semester	Problem selection and literature survey
Last two weeks of	Finalization of project and guide allotment

7th Semester	
II Week of 8th Semester	Synopsis submission and preliminary seminar
III Week	First visit of the internal guides to industry (In case of project being carried out in industry)
III to VI Week	Design and development of project methodology
VII to IX Week	Implementation of the project
X Week	Second visit by guide to industry (In case of project being carried out in industry) & submission of draft copy of the project report
XI and XII Week	Third visit by guide to industry for demonstration. Final seminar by Department project Committee and guide for internal assessment. Finalization of CIE.

Evaluation Scheme for CIE and SEE

Scheme of Evaluation for CIE		**Scheme of Evaluation for SEE**	
Particulars	**%Marks**	**Particulars**	**%Marks**
Project Evaluation I	10%	Project Synopsis (Initial Write up)	10%
Project Evaluation II	25%	Project Demo / Presentation	30%
Project Evaluation III	25%	Methodology and Results Discussion	30%
Project Evaluation Phase-IV (Submission of Draft Project Report for Verification)	30%	Project Work Report	10%
Project Evaluation Phase-V (Project Final Internal Evaluation)	10%	Viva-voce	20%
Total	100	Total	100

TECHNICAL SEMINAR

Course Code: 12CH82 **CIE Marks : 50**
Hours/Week: L:T:P:S: 0:0:2:0 **SEE Marks : 00**
Credits: 01 **SEE Duration: NA**

Course Learning Objectives:

1. To create awareness to recognize recent developments in Chemical Engineering and in multidisciplinary fields.
2. To summarize the recent technologies and inculcate the skills for literature survey.
3. To demonstrate good presentation skills.
4. To plan and improve the Technical Report writing skills.
5. To support Group discussion and Team work.

General Guidelines for the Seminar

1. The seminar has to be presented by individual student.
2. The topic of the seminar should be from current thrust area. This is to be decided in consent with internal guide.
3. The topic can be based on standard papers (like IEEE/ACM/CSI etc.) in the thrust area for the selected topic.
4. Each student has to prepare a technical paper out of seminar topic.
5. Presenting/publishing this paper in conference/ Journal will be given weightage in CIE.
6. The student needs to submit both hard & soft copy of the seminar report.

Course Outcome:

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

CO1. Understand and interpret latest advancements through different technical papers, reports, Journals, Data sheets, books etc..
CO2. Communicate his/her ideas with his peers as audience, which will enhance both oral and written communication skills.
CO3. Learn to manage resources effectively.
CO4. Create interest to pursue lifelong learning.

Evaluation of CIE Marks:

1. Relevance of the topic :10%
2. Literature Survey :10%
3. Presentation : 40%
4. Report : 20%
5. Paper Publication : 20%

INNOVATION & SOCIAL SKILLS

Course code: 12HSS83
Hours/week: L:T:P:S : 0:0:2:0
Credits: 01

Objectives:

- To provide a platform for the students to exhibit their organizational capabilities, team building, ethical values and extra mural abilities.
- To encourage to carryout innovative ideas and projects.
- Take part in societal and community building activities.
- Make self learning, ethics and lifelong learning a motto.

Guidelines

The HSS will be evaluated individually based on the broad parameters which include the progress made by student during 3rd& 4th year in innovative projects, Seminar, Paper Presentation, Field activity & other Co-curricular activities. Students shall submit a report and documents as a proof his/her achievements.