### SEMESTER II

(Common to all B. E. / B. Tech. Degree Programmes except B. E. – Marine Engineering)

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1. B.E. Electrical and Electronics Engineering
2. B.E. Electronics and Instrumentation Engineering
3. B.E. Instrumentation and Control Engineering

II Faculty of Information and Communication Engineering
1. B.E. Computer Science and Engineering
2. B.E. Electronics and Communication Engineering
3. B.E. Bio Medical Engineering
4. B.Tech. Information Technology

B. NON – CIRCUIT BRANCHES

I Faculty of Civil Engineering
1. B.E. Civil Engineering

II Faculty of Mechanical Engineering
1. B.E. Aeronautical Engineering
2. B.E. Automobile Engineering
3. B.E. Marine Engineering
4. B.E. Mechanical Engineering
5. B.E. Production Engineering

III Faculty of Technology
1. B.Tech. Chemical Engineering
2. B.Tech. Biotechnology
3. B.Tech. Polymer Technology
4. B.Tech. Textile Technology
5. B.Tech. Textile Technology (Fashion Technology)
7. B.Tech. Plastics Technology
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AIM
To encourage students to actively involve in participative learning of English and to help them acquire Communication Skills.

OBJECTIVES
- To help students develop listening skills for academic and professional purposes.
- To help students acquire the ability to speak effectively in English in real-life situations.
- To inculcate reading habit and to develop effective reading skills.
- To help students improve their active and passive vocabulary.
- To familiarize students with different rhetorical functions of scientific English.
- To enable students write letters and reports effectively in formal and business situations.

UNIT I
Technical Vocabulary - meanings in context, sequencing words, Articles- Prepositions, intensive reading& predicting content, Reading and interpretation, extended definitions, Process description

Suggested activities:
1. Exercises on word formation using the prefix ‘self’ - Gap filling with preposition.
2. Exercises - Using sequence words.
3. Reading comprehension exercise with questions based on inference – Reading headings
4. and predicting the content – Reading advertisements and interpretation.
5. Writing extended definitions – Writing descriptions of processes – Writing paragraphs based on discussions – Writing paragraphs describing the future.

UNIT II

Suggested activities:
1. Reading comprehension exercises with questions on overall content – Discussions analyzing stylistic features (creative and factual description) - Reading comprehension exercises with texts including graphic communication - Exercises in interpreting non-verbal communication.
2. Listening comprehension exercises to categorise data in tables.
3. Writing formal letters, quotations, clarification, complaint – Letter seeking permission for Industrial visits– Writing analytical paragraphs on different debatable issues.

UNIT III
Cause and effect expressions – Different grammatical forms of the same word – Speaking – stress and intonation, Group Discussions - Reading – Critical reading - Listening, - Writing – using connectives, report writing – types, structure, data collection, content, form, recommendations.

Suggested activities:
1. Exercises combining sentences using cause and effect expressions – Gap filling exercises using the appropriate tense forms – Making sentences using different grammatical forms of the same word. ( Eg: object –verb / object – noun )
2. Speaking exercises involving the use of stress and intonation – Group discussions– analysis of problems and offering solutions.
3. Reading comprehension exercises with critical questions, Multiple choice question.

UNIT IV
12
Numerical adjectives – Oral instructions – Descriptive writing – Argumentative paragraphs – Letter of application - content, format (CV / Bio-data) - Instructions, imperative forms - Checklists, Yes/No question form – E-mail communication.

Suggested Activities:
1. Rewriting exercises using numerical adjectives.
2. Reading comprehension exercises with analytical questions on content – Evaluation of content.
3. Listening comprehension – entering information in tabular form, intensive listening exercise and completing the steps of a process.
4. Speaking - Role play – group discussions – Activities giving oral instructions.

UNIT V
9
Speaking - Discussion of Problems and solutions - Creative and critical thinking – Writing an essay, Writing a proposal.

Suggested Activities:
1. Case Studies on problems and solutions
2. Brain storming and discussion
3. Writing Critical essays
4. Writing short proposals of 2 pages for starting a project, solving problems, etc.
5. Writing advertisements.

TOTAL: 60 PERIODS

TEXT BOOK

REFERENCES

Extensive Reading:

Note:
The book listed under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.
UNIT I
ORDINARY DIFFERENTIAL EQUATIONS
Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy’s and Legendre’s linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT II
VECTOR CALCULUS

UNIT III
ANALYTIC FUNCTIONS
Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping : w= z+c, cz, 1/z, and bilinear transformation.

UNIT IV
COMPLEX INTEGRATION

UNIT V
LAPLACE TRANSFORM

Definition of Inverse Laplace transform as contour integral – Convolution theorem (excluding proof) – Initial and Final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

TOTAL : 60 PERIODS

TEXT BOOKS

REFERENCES
UNIT I  CONDUCTING MATERIALS  9

UNIT II  SEMICONDUCTING MATERIALS  9

UNIT III  MAGNETIC AND SUPERCONDUCTING MATERIALS  9
Superconductivity : properties - Types of super conductors – BCS theory of superconductivity(Qualitative) - High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV  DIELECTRIC MATERIALS  9

UNIT V  MODERN ENGINEERING MATERIALS  9
Metallic glasses: preparation, properties and applications.
Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA

TOTAL : 45 PERIODS

TEXT BOOKS
2. Charles P. Poole and Frank J.Ownen, ’Introduction to Nanotechnology’, Wiley India(2007) (for Unit V)

REFERENCES
AIM
To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

OBJECTIVES
- The student should be conversant with the principles electrochemistry, electrochemical cells, emf and applications of emf measurements.
- Principles of corrosion control
- Chemistry of Fuels and combustion
- Industrial importance of Phase rule and alloys
- Analytical techniques and their importance.

UNIT I  ELECTROCHEMISTRY  9
Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – Single electrode potential – Nernst equation (problem) – reference electrodes – Standard Hydrogen electrode - Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – electrochemical series – significance – potentiometer titrations (redox \( \text{Fe}^{2+} \) vs dichromate and precipitation – \( \text{Ag}^+ \) vs \( \text{Cl}^- \) titrations) and conduct metric titrations (acid-base – \( \text{HCl} \) vs, \( \text{NaOH} \) titrations,

UNIT II  CORROSION AND CORROSION CONTROL  9

UNIT III  FUELS AND COMBUSTION  9

UNIT IV  PHASE RULE AND ALLOYS  9

UNIT V  ANALYTICAL TECHNIQUES  9

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

ME2151 ENGINEERING MECHANICS

OBJECTIVE
At the end of this course the student should be able to understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions. Further, he should understand the principle of work and energy. He should be able to comprehend the effect of friction on equilibrium. He should be able to understand the laws of motion, the kinematics of motion and the interrelationship. He should also be able to write the dynamic equilibrium equation. All these should be achieved both conceptually and through solved examples.

UNIT I BASICS & STATICS OF PARTICLES

UNIT II EQUILIBRIUM OF RIGID BODIES

UNIT III PROPERTIES OF SURFACES AND SOLIDS

UNIT IV DYNAMICS OF PARTICLES
UNIT V  FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS  12
Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

TEXT BOOK

REFERENCES

EE2151  CIRCUIT THEORY  L T P C
(Common to EEE, EIE and ICE Branches)  3 1 0 4

UNIT I  BASIC CIRCUITS ANALYSIS  12

UNIT II  NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS  12
Network reduction: voltage and current division, source transformation – star delta conversion.
Thevenins and Novton & Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.

UNIT III  RESONANCE AND COUPLED CIRCUITS  12

UNIT IV  TRANSIENT RESPONSE FOR DC CIRCUITS  12
Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input.

UNIT V  ANALYSING THREE PHASE CIRCUITS  12
Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

TOTAL : 60 PERIODS
TEXT BOOKS

REFERENCES

EC2151 ELECTRIC CIRCUITS AND ELECTRON DEVICES L T P C
(For ECE, CSE, IT and Biomedical Engg. Branches) 3 1 0 4

UNIT I CIRCUIT ANALYSIS TECHNIQUES 12

UNIT II TRANSIENT RESONANCE IN RLC CIRCUITS 12

UNIT III SEMICONDUCTOR DIODES 12

UNIT IV TRANSISTORS 12
Principle of operation of PNP and NPN transistors – study of CE, CB and CC configurations and comparison of their characteristics – Breakdown in transistors – operation and comparison of N-Channel and P-Channel JFET – drain current equation – MOSFET – Enhancement and depletion types – structure and operation – comparison of BJT with MOSFET – thermal effect on MOSFET.

UNIT V SPECIAL SEMICONDUCTOR DEVICES (Qualitative Treatment only) 12

TOTAL : 60 PERIODS
TEXT BOOKS

REFERENCES

GE2151 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
(Common to branches under Civil, Mechanical and Technology faculty) 4 0 0 4

UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS 12
Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II ELECTRICAL MECHANICS 12

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 12

UNIT IV DIGITAL ELECTRONICS 12
Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts)

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 12
Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TOTAL : 60 PERIODS
TEXT BOOKS

REFERENCES

GE2152 BASIC CIVIL & MECHANICAL ENGINEERING
L T P C
(4 0 0 4)

A – CIVIL ENGINEERING

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 15


UNIT II BUILDING COMPONENTS AND STRUCTURES 15
Foundations: Types, Bearing capacity – Requirement of good foundations.


TOTAL: 30 PERIODS

B – MECHANICAL ENGINEERING

UNIT III POWER PLANT ENGINEERING 10

UNIT IV I C ENGINES 10
Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 10

TOTAL: 30 PERIODS
REFERENCES

GE2155 COMPUTER PRACTICE LABORATORY – II

LIST OF EXPERIMENTS

1. UNIX COMMANDS
   Study of Unix OS - Basic Shell Commands - Unix Editor

2. SHELL PROGRAMMING
   Simple Shell program - Conditional Statements - Testing and Loops

3. C PROGRAMMING ON UNIX
   Dynamic Storage Allocation-Pointers-Functions-File Handling

TOTAL : 45 PERIODS

HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Hardware
   • 1 UNIX Clone Server
   • 33 Nodes (thin client or PCs)
   • Printer – 3 Nos.

Software
   • OS – UNIX Clone (33 user license or License free Linux)
   • Compiler - C
**GS2165 PHYSICS LABORATORY – II**  
**L T P C**  
0 0 3 2

**LIST OF EXPERIMENTS**
1. Determination of Young’s modulus of the material – non uniform bending.
2. Determination of band gap of a semiconductor material.
3. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.
5. Spectrometer dispersive power of a prism.
6. Determination of Young’s modulus of the material – uniform bending.

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.
- The lab examinations will be held only in the second semester.

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**GS2165 CHEMISTRY LABORATORY – II**  
**L T P C**  
0 0 3 2

**LIST OF EXPERIMENTS**
1. Conduct metric titration (Simple acid base)
2. Conduct metric titration (Mixture of weak and strong acids)
3. Conduct metric titration using $\text{BaCl}_2$ vs $\text{Na}_2\text{SO}_4$
4. Potentiometric Titration ($\text{Fe}^{2+}$ / $\text{KMnO}_4$ or $\text{K}_2\text{Cr}_2\text{O}_7$)
5. PH titration (acid & base)
6. Determination of water of crystallization of a crystalline salt (Copper sulphate)
7. Estimation of Ferric iron by spectrophotometry.

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.
- The lab examinations will be held only in the second semester.

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**ME2155 COMPUTER AIDED DRAFTING AND MODELING LABORATORY**  
**L T P C**  
0 1 2 2

**List of Exercises using software capable of Drafting and Modeling**

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using B spline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

TOTAL: 45 PERIODS

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

List of Equipments for a batch of 30 students:
1. Pentium IV computer or better hardware, with suitable graphics facility -30 No.
2. Licensed software for Drafting and Modeling. – 30 Licenses
3. Laser Printer or Plotter to print / plot drawings – 2 No.

EE2155 ELECTRICAL CIRCUIT LABORATORY (Common to EEE, EIE and ICE) L T P C 0 0 3 2

LIST OF EXPERIMENTS
1. Verification of ohm’s laws and kirchoff’s laws.
2. Verification of Thevemin’s and Norton’s Theorem
3. Verification of superposition Theorem
4. Verification of maximum power transfer theorem.
5. Verification of reciprocity theorem
6. Measurement of self inductance of a coil
7. Verification of mesh and nodal analysis.
8. Transient response of RL and RC circuits for DC input.
10. Frequency response of single tuned coupled circuits.

TOTAL: 45 PERIODS
EC2155  CIRCUITS AND DEVICES LABORATORY  

0 0 3 2

1. Verification of KVL and KCL
2. Verification of Thevenin and Norton Theorems.
3. Verification of superposition Theorem.
4. Verification of Maximum power transfer and reciprocity theorems.
5. Frequency response of series and parallel resonance circuits.
6. Characteristics of PN and Zener diode
7. Characteristics of CE configuration
8. Characteristics of CB configuration
9. Characteristics of UJT and SCR
10. Characteristics of JFET and MOSFET

TOTAL: 45 PERIODS

ENGLISH LANGUAGE LABORATORY (Optional)  

0 0 2 -

1. Listening:  
   Listening & answering questions – gap filling – Listening and Note taking– Listening to telephone conversations

2. Speaking:  
   Pronouncing words & sentences correctly – word stress – Conversation practice.

Classroom Session  
1. Speaking: Introducing oneself, Introducing others, Role play, Debate-
   Presentations: Body language, gestures, postures.
   Group Discussions etc
2. Goal setting – interviews – stress time management – situational reasons

Evaluation
(1) Lab Session – 40 marks
   Listening – 10 marks  
   Speaking – 10 marks  
   Reading – 10 marks  
   Writing – 10 marks

(2) Classroom Session – 60 marks
   Role play activities giving real life context – 30 marks  
   Presentation – 30 marks

Note on Evaluation
1. Examples for role play situations:
   a. Marketing engineer convincing a customer to buy his product.
   b. Telephone conversation – Fixing an official appointment / Enquiry on
      availability of flight or train tickets / placing an order. etc.

2. Presentations could be just a Minute (JAM activity) or an Extempore on simple
   topics or visuals could be provided and students could be asked to talk about it.

REFERENCES
2. Doff, Adrian and Christopher Jones, Language in Use – (Intermediate level),
3. Gammidge, Mick, Speaking Extra – A resource book of multi-level skills activities,
4. Craven, Miles, Listening Extra - A resource book of multi-level skills activities,
5. Naterop, Jean & Rod Revell, Telephoning in English, Cambridge University Press,

LAB REQUIREMENTS
1. Teacher – Console and systems for students
2. English Language Lab Software
3. Tape Recorders.

MA2211 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATION  L  T  P  C
(Common to all branches)  3 1 0 4

OBJECTIVES
The course objective is to develop the skills of the students in the areas of Transforms and
Partial Differential Equations. This will be necessary for their effective studies in a large
number of engineering subjects like heat conduction, communication systems, electro-optics
and electromagnetic theory. The course will also serve as a prerequisite for post graduate
and specialized studies and research.

UNIT I  FOURIER SERIES  9 + 3
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine
series – Half range cosine series – Complex form of Fourier Series – Parseval’s identify –
Harmonic Analysis.

UNIT II  FOURIER TRANSFORMS  9 + 3
Fourier integral theorem (without proof) – Fourier transform pair – Sine and
Cosine transforms – Properties – Transforms of simple functions – Convolution theorem –
Parseval’s identity.
UNIT III  PARTIAL DIFFERENTIAL EQUATIONS  \(9 + 3\)
Formation of partial differential equations – Lagrange’s linear equation – Solutions of standard types of first order partial differential equations - Linear partial differential equations of second and higher order with constant coefficients.

UNIT IV  APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS  \(9 + 3\)
Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in cartesian coordinates.

UNIT V  Z -TRANSFORMS AND DIFFERENCE EQUATIONS  \(9 + 3\)

LECTURES: 45  TUTORIALS : 15  TOTAL : 60 PERIODS

TEXT BOOKS

REFERENCES

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CH3202  PHYSICAL CHEMISTRY  

UNIT I  MOLECULAR QUANTUM MECHANICS  \(9\)
Term symbols for a diatomic molecule; symmetry of molecular orbitals, Molecular orbitals for homonuclear diatomic molecules, (Eg.H\(_2\)) MO energy level diagrams for heteronuclear diatomic molecules (Eg. CO)

UNIT II  GROUP THEORY  \(9\)
Symmetry elements & symmetry operations, group postulates, types of groups, point groups, representations of molecular point groups, character tables for point groups, point groups & geometry of some common molecules (Eg. H\(_2\), CO\(_2\), CH\(_4\), NH\(_3\) and H\(_2\)) Applications of group theory, crystal systems, molecular symmetry and crystallographic symmetry, quasi crystals.
UNIT III PHOTOCHEMISTRY & ELECTRIC AND MAGNETIC PROPERTIES 9

UNIT IV STATISTICAL THERMODYNAMICS 9
Classical statistical mechanics and quantum statistical mechanics, combination and permutation, Probability, Error, Microstates and macro states, Maxwell’s law of distribution of velocities, Maxwell’s velocity distribution function and speed distribution function, Maxwell Boltzmann distribution, Quantum statistics, Bose Einstein and Fermi Dirac statistics, Applications, Partition functions, Types, Relationship between partition functions and thermodynamic quantities.

UNIT V IONICS 9
Ion solvent interaction - Introduction, Expression for ΔH and ΔS of ion-solvent interaction., Experimental verification of Born Model, Ion-dipole model of ion-solvent interaction and expression for heat of salvation. Ion transport in solution - Einstein-Smoluchowski equation, transport numbers, molar and equivalent conductance. Ion-Ion Interaction -true and potential electrolytes, activity coefficient and ion-ion interaction

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

CH3203 ORGANIC CHEMISTRY L T P C
3 0 0 3

UNIT I ORGANIC REACTION MECHANISM 9
Electrophillic reactions-Friedel crafts reaction, Riemer Tiemenn reaction, Beckmann rearrangements; nucleophilic reactions- aldol condensation, perkin reaction, benzoin condensation; free radical reaction-halogenation of alkane, addition of HBr on alkene in presence of peroxide; allylic halogenation - using N-Bromo Succinamide (NBS), thermal halogenation of alkene CH₃–CH = CH₂
**UNIT II  CARBOHYDRATES**

Introduction – mono and disaccharides – important reactions – polysaccarides – starch and cellulose – derivatives of cellulose – carboxy methyl cellulose and gun cotton – structural aspects of cellulose

**UNIT III  POLYNUCLEAR AROMATICS AND HETEROCYCLES**

Classification of polynuclear aromatics. naphthalene preparation, properties and uses. Classification of heterocyclic compounds. Furan, thiophene, pyridine preparation, properties and uses

**UNIT IV  AMINO ACIDS AND PROPERTIES**


**UNIT V  DRUGS, PESTICIDES & DYES**

Classification and properties of drugs. sulpha drugs, mode of action, synthesis of sulphanilamide, chloroquine and chloramphenicol, pesticides - classes. Synthesis of DDT and methoxychlor. 


**TOTAL : 45 PERIODS**

**TEXT BOOKS**


**REFERENCES**

UNIT I  STRUCTURE OF MATERIALS  
Introduction-classification of materials, selection of materials, properties of materials, x-ray crystallography, Bragg's law, x-ray diffraction for determining crystal structures, structure of NaCl and diamond, crystal defects, point, line, surface and volume defects, Alloy formation, solid solution types, solidification of castings, Macro and Micro structural examination, specimen preparation, Microscopes, macro etching and observation.

UNIT II  METALLURGICAL PROPERTIES OF MATERIALS  

UNIT III  TYPES OF MATERIALS  
Classification of steel, structure of steel, Fe-C phase diagram, heat treatment, TTT curves, ausforming, marforming, annealing types, normalizing, hardening, tempering, case hardening methods, effect of alloying elements, tool steels, stainless steel, cast iron, malleable and ductile types and their formation and properties, copper and its alloys brass, bronze, copper, nickel precipitation hardened types aluminium and its alloys, cast and wrought types precipitation, hardening treatment Al cladding and welding electric and magnetic materials, nano particles and nano structures, nickel and its alloys, titanium and its alloys, cerments.

UNIT IV  PHYSICAL CHARACTERISTICS OF MATERIALS  

UNIT V  NON-METALLIC MATERIALS  
Ceramic materials, oxides, silicates, refractories, acid, basic and neutral types, glasses, enamels; abrasives, cement and concrete materials. Classification of polymers, reaction types, mechanisms, addition, condensation, copolymerization, shapes, cross linking branching, deformation, of polymers, mechanical, thermal, electrical and chemical, behaviour, rubber, silicones, fluoro carbons, composites, FRP, particulates, and laminates.

TOTAL : 45 PERIODS

TEXT BOOKS
REFERENCES

CH3205 CHEMICAL PROCESS CALCULATIONS L T P C
3 0 0 3

UNIT I BASIC CONCEPTS – MATERIAL BALANCE IN UNIT OPERATIONS 9
Methods of expressing composition of mixtures and solutions. Use of molal units, partial pressure and pure component volume in calculations. Material balance for processes not involving chemical reactions - unit operations like distillation, evaporation, drying etc.

UNIT II MATERIAL BALANCE IN REACTION SYSTEM- UNSTEADY STATE PROCESSES 9

UNIT III HUMIDITY AND SATURATION 9

UNIT IV THERMO CHEMISTRY AND THERMO PHYSICS 9

UNIT V FUELS AND COMBUSTION 9

TOTAL : 45 PERIODS

TEXT BOOKS
REFERENCES

CE3201 FLUID MECHANICS L T P C
3 0 0 3

OBJECTIVES
To understand the basic properties of the fluid, fluid kinematics, fluid dynamics and to analyse and appreciate the complexities involved in solving the fluid flow problems.

UNIT I FLUID PROPERTIES AND FLUID STATICS 9
Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillarity and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

UNIT II FLUID KINEMATICS 9
Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net.

UNIT III FLUID DYNAMICS 9
Fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube – flow through weirs and notches.

UNIT IV FLOW THROUGH PIPES 9
Viscous flow - Navier-Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseulle's) - Hydraulic and energy gradient - flow through pipes - Darcy -weisbach's equation - pipe roughness -friction factor- Moody's diagram.

UNIT V BOUNDARY LAYER 9

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES:

**CH3208**

PHYSICAL CHEMISTRY LABORATORY

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1. Partition coefficient of iodine between two immiscible solvents,
2. Equilibrium constant of $K_{I + I_2 \rightleftharpoons KI_3}$
3. Phase diagram of binary system
4. Solubility curve for a ternary system
5. Verification of Ostwald dilution law
6. Galvanostatic polarisation
7. Potentiostatic polarisation
8. Ion selective electrode
9. Impedence measurements
10. Adsorption isotherm
11. Heat of solution
12. Determination of acid value in the given oils

**TOTAL : 60 PERIODS**

**CH3209**

ORGANIC CHEMISTRY LABORATORY

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I. QUALITATIVE ANALYSIS

1. Test for saturation / unsaturation
2. Tests for aliphatic / aromatic nature
3. Tests for elements (N, S, Halogens)
4. Tests for functional groups, acids, phenols, esters, aldehydes and ketones, carbohydrates, alcohols, amines, amides nitrogroup, hydrocarbon.
II. ORGANIC PREPARATION

Preparation of organic compounds involving the following reactions.
1. Hydrolysis – benzoic acid from benzamide
2. Acetylation – acetyl salicylic acid from salicylic acid
3. Bromination – tribromo aniline from aniline
4. Nitration – meta dinitrobenzene from nitrobenzene
5. Benzoylation – phenyl benzoate from phenol
6. Oxidation – benzoic acid from benzaldehyde
7. Esterification – carboxylic acid & alcohol

III. ESTIMATION OF POLYMERS

IV. HPLC-GPC - DEMONSTRATION

TOTAL : 60 PERIODS

CH3210 BASIC ELECTRICAL ELECTRONICS ENGINEERING LABORATORY L T P C
0 0 4 2

I : ELECTRICAL: (Any six)

1. RLC circuits.
2. D.C. shunt generator O.C.C.
3. D.C. shunt motor load characteristics
4. Speed control of D.C. shunt motor.
5. O.C. & S.C. test on single phase transformer
6. Alternator regulation (e.m.f. method)
7. Induction motor load tests.
8. Calibration of MI & MC instruments
10. Calibration of energy meter.
11. Study of Star / Delta (Y/Δ) starters.

II : ELECTRONIC: (Any six)

1. Diode characteristics
2. Transistor characteristics
3. FET characteristics
4. UJT characteristics
5. SCR characteristics
6. Multivibrators using IC 555
7. Frequency response of RC coupled amplifier
8. RC phase shift oscillator
9. Wien bridge oscillator
10. Basic operational amplifier using IC 741
11. Adder, Multiplier, Integrator, Differentiator using IC741
12. Study of logic gates and counters.

TOTAL : 60 PERIODS
UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS (10 +3)

UNIT II INTERPOLATION AND APPROXIMATION (8 + 3)
Interpolation with unequal intervals - Lagrange interpolation – Newton’s divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton’s forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION (9 + 3)

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS (9 + 3)

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS (9 + 3)
Finite difference methods for solving two-point linear boundary value problems. Finite difference techniques for the solution of two dimensional Laplace’s and Poisson’s equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank Nicholson) methods - One dimensional wave equation by explicit method.

L: 45 T: 15 TOTAL : 60 PERIODS

TEXT BOOKS

REFERENCES
UNIT I  FIRST LAW AND P-V-T RELATIONS OF FLUIDS  9
The first law and zeroth law, internal energy and enthalpy, state and point functions, reversible process, constant volume and constant pressure process, heat capacity, energy balance for closed and open systems. PVT behaviour of pure substances, virial equations and its applications, ideal gases, cubic equations of state, generalized correlations for gases.

UNIT II  SECOND LAW AND PROPERTIES OF FLUIDS  9
Statements of second law by Classius and Kelvin, Planck, the heat engine, thermodynamic temperature scale, carnot cycle, ideal-gas temperature scale, entropy, entropy changes of an ideal gas, the third law of thermodynamics, entropy from microscopic point of view. Property relationship for homogeneous phase of constant composition, Maxwell equations, residual properties from the virial equations of the state, two phase systems, thermodynamic diagrams, generalized property correlations for gases.

UNIT III  FLOW PROCESSES, POWER FROM HEAT AND REFRIGERATION  9
Flow process: flow through duct, pipe, nozzle, throttling, compression and expansion process, carnot engines, carnots principle, production of power by steam power plant, otto engine, diesel engine and gas-turbine engine. Refrigeration by carnot refrigerator, vapour – compression refrigerator and absorption refrigerator, liquefaction process

UNIT IV  VAPOUR/LIQUID EQUILIBRIA AND SOLUTION THERMODYNAMICS THEORY  9
Vapour – liquid equilibrium: The phase rule, Duhem theorem, retrograde condensation, azeotrope, dew point and bubble point calculations with Raoults law and modified Raoults law solution thermodynamics: The chemical potential and phase equilibria, partial properties, ideal gas mixtures, fugacity and fugacity coefficient, ideal solution, excess properties

UNIT V  CHEMICAL REACTIONS  9
The reaction coordinate, equilibrium criteria to chemical reactions. Gibbs-energy change and equilibrium constant, temperature effect on equilibrium constant, equilibrium constant relations to gas-phase and liquid – phase reactions, equilibrium conversions for homogeneous gas phase reactions. Adiabatic reaction temperature

L : 45 T : 15 TOTAL : 60 PERIODS

TEXT BOOKS

REFERENCES
1. Y.V.C Rao, “Chemical Engineering Thermodynamics”, Universities Press (India), 1997
UNIT I  KINETICS OF HOMOGENEOUS REACTION AND INTERPRETATION OF
BATCH REACTOR RATE
Classification of reactions. Types of rate expressions, Elementary and non elementary
reactions. Temperature dependency of the rate constant based on Arrhenius
theory. Differential and integral methods of analysis of rate data. Interpretation of rate data in
constant and variable volume systems. Kinetics of irreversible, parallel and series reactions
in constant volume batch reactor.

UNIT II  DESIGN OF SINGLE IDEAL REACTORS
Introduction to reactor design – ideal batch reactor – space time and space velocity – steady
state mixed flow reactor – steady state plug flow reactor – holding time and space time for
flow reactors.

UNIT III  DESIGN FOR SINGLE REACTION
Size comparison of single reactor – multiple reactor system – plug flow reactor in
series/parallel – equal size mixed reactors in series – reactors of different types in series –
recycle reactor.

UNIT IV  TEMPERATURE AND PRESSURE EFFECTS AND BASIC CONCEPTS OF
NON IDEAL FLOW
Temperature and pressure effects – heat of reaction and temperature - equilibrium constant
– equilibrium conversion - equilibrium conversion with temperature – non ideal flow
residence time distribution of fluid - E the age distribution of fluid – F curve – C curve
relation among F, C and E curves, chemical reaction and dispersion – estimation of
dispersion number from RTD studies.

UNIT V  SOLID CATALYSED REACTION AND KINETICS OF FLUID PARTICLE
REACTION
Solid catalysed reactions – the spectrum of kinetic regimes – pore diffusion resistance
combined with surface kinetics – single cylindrical pore, first order reaction – porous catalyst
particles – non catalytic system – fluid particle reactions – selection of model – unreacted
core model for spherical particles of unchanging size – diffusion through gas film controls –
diffusion through ash layer controls – chemical reaction controls.

TOTAL : 45 PERIODS

TEXT BOOKS
1. Levenspiel, O, “Chemical Reaction Engineering”, Wiley Eastern, New Delhi, 3rd

REFERENCES
   John Wiley & sons, 1977
UNIT I  PROPERTIES OF PARTICULATE SOLID – STORAGE AND CONVEYING SOLIDS  9

UNIT II  SIZE REDUCTION – PRINCIPLES AND EQUIPMENTS  9

UNIT III  FILTRATION  9

UNIT IV  SETTLING AND SEDIMENTATION  9

UNIT V  AGITATION AND MIXING  9

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT I  
DIFFUSION  

UNIT II  
THEORIES OF MASS TRANSFER  
Theories of mass transfer, individual and over all mass transfer coefficients. Differential and stage wise contact operations. Equilibrium and operating lines. Concepts of ideal stages - Concepts of NTU and HTU and their relationships.

UNIT III  
GAS ABSORPTION  

UNIT IV  
ADSORPTION AND ION EXCHANGE  

UNIT V  
LEACHING AND EXTRACTION  
Leaching and extraction. Solid-liquid extraction. Liquid-liquid extraction. Batch and continuous extraction. Extraction equipments. Design of extractors. Calculation of number of stages in extraction and leaching.

TOTAL : 45 PERIODS

TEXT BOOKS  

REFERENCES  
UNIT III  HEAT TRANSFER WITH PHASE CHANGE  9

UNIT IV  HEAT EXCHANGE EQUIPMENT  9

UNIT V  RADIATION AND EVAPORATION  9

TEXT BOOKS

REFERENCES

CE3219  FLUID MECHANICS & MECHANICAL OPERATIONS LABORATORY  L T P C  0 0 4 2
1. Venturimeter
2. V – Notch Weir
3. Efflux time
4. Pipe friction
5. Laminar flow
6. Non – Newtonian flow
7. Settling
8. Drop weight crusher
9. Ball mill
10. Jaw crusher
11. Centrifugal pump
12. Vacuum leaf filter

TOTAL : 60 PERIODS
CH3219  CHEMICAL REACTION ENGINEERING LABORATORY  L T P C  0 0 4 2

1. Batch reactor
2. Semi-batch reactor
3. Mixed flow reactor
4. Plug flow reactor
5. Heterogeneous catalytic reactor
6. Batch recirculation reactor
7. Electrochemical reactor
8. Residence time distribution studies in PFR & CSTR by step response
9. Residence time distribution Studies in PFR & CSTR by pulse response
10. Multiple reactors

TOTAL : 60 PERIODS

EL3220  EQUIPMENT DESIGN AND DRAWING I  L T P C  0 0 3 2

1. STORAGE TANKS


2. PRESSURE VESSELS


2. SEPERATION EQUIPMENT

Design of cyclone separator, Centrifuge, Filtration Equipment, Thickeners and Crystalizers.

TOTAL : 45 PERIODS

TEXT BOOKS
REFERENCES

MA3209 PROBABILITY AND LINEAR PROGRAMMING L T P C 
3 1 0 4

UNIT I PROBABILITY AND RANDOM VARIABLES 9

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 9

UNIT III STANDARD DISTRIBUTIONS 9

UNIT IV LINEAR PROGRAMMING 9

UNIT V FURTHER TOPICS IN LINEAR PROGRAMMING 9
Duality principle – dual simplex method. Transportation model and algorithm, assignment model and Hungarian technique of solution, unbalanced assignment models, maximization case in transportation and assignment method.

TEXT BOOKS

L : 45 T : 15 TOTAL : 60 PERIODS
REFERENCES

CH3302 INSTRUMENTAL METHODS OF ANALYSIS

UNIT I INTRODUCTION TO SPECTRAL METHODS

UNIT II OPTICAL ABSORPTION SPECTROPHOTOMETRY
Ultraviolet and visible spectroscopy – sources – optical components and detectors – chemical applications. Infrared spectroscopy sources and detectors – FT techniques – regions of IR spectrum – chemical applications.

UNIT III CHROMATOGRAPHY

UNIT IV THERMOMETRIC METHODS

UNIT V X-RAY ATOMIC ABSORPTION SPECTROSCOPY AND OTHER SPECTROSCOPY TECHNIQUES

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCE
UNIT I  ELECTRICAL DOUBLE LAYER  
Thermodynamics of ideally polarizable and non-polarizable interfaces- Lipman equation- 
   determination of interfacial tension, charge density, surface excess and double layer 
capacitance by electro capillary & bridge methods- Helmholtz, Gouy-Chapman and stern 
   models of the double layer with discussion of potential and charge distribution inside the 
double layer-contact adsorption and its determination.

UNIT II  ELECTRODE KINETICS  
Concepts of equilibrium potential, Nernst equation, overpotential and its different types, 
equilibrium exchange current density-derivation of Butler-Volmer equation –high field and 
   low field approximations – charge transfer resistance and polarizability of the interface – 
   concepts of rate determining step, Stoichiometric number, reaction order – Determination of 
kinetics parameters \[ i_o, k_s, \beta(\alpha) \] by Tafel and linear polarization methods.

UNIT III  ELECTROCATALYSIS  
Chemical catalysis and electro catalysis – comparison of electrocatalysts – electro catalysis 
in simple redox reactions involving adsorbed species – electronic and geometric factors in 
electrocatalysts -Discussion on the mechanisms of hydrogen evolution and oxygen 
   reduction reactions.

UNIT IV  ELECTROCHEMICAL TECHNIQUES I  
Ion selective electrodes – Principles of potentiometry and amperometry- determination of 
dissolved oxygen. Linear sweep voltammetry and cyclic voltammetry derivation of Randles- 
   Sevciks equation – effect of sweep rate-analysis of cyclic voltammograms.

UNIT V  ELECTROCHEMICAL TECHNIQUES II  
Potential step method (chronoamperometry) under diffusion control derivation of Cottrell 
equation for a planar and spherical electrode- significance of spherical diffusion – derivation 
of Ilkovic equation.- Chronopotentiometry and analysis of chronopotentiograms-derivation 
of sands equation for constant current input under linear diffusion- concepts of Faradaic 
   impedance –derivation of kinetic parameters from impedance measurements – Nyquist and 
   bode plots for simple redox reactions-principles of scanning probe techniques-STM-AFM 
   and SECM.

L : 45 T : 15 TOTAL : 60 PERIODS

TEXT BOOKS
   unit I: Chapters 8 & 9 for unit II ; chapter 10 for unit III), Volume –II, 1996.

REFERENCES
   John Wiley & sons, Wiley Publication, 1982
UNIT I  SULPHUR, SULPHURIC ACID AND GLASSES  
Mining of sulphur and manufacture of sulphuric acid. Types of cements and its manufacturing process, manufacturing of Glass, special glasses.

UNIT II  INDUSTRIAL GASES AND FERTILIZERS  
Industrial gases; carbon dioxide, nitrogen, Hydrogen, oxygen and acetylene. Fertilizer industries; ammonia, nitric acid, urea, ammonium nitrate, phosphorous and phosphoric acid, super phosphate and triple super phosphate.

UNIT III  NATURAL PRODUCT INDUSTRIES  
Production of sugar starch and starch derivatives – fermentation process for production of ethyl alcohol. Edible oils, soaps and detergents.

UNIT IV  PETROLEUM REFINING AND PETROCHEMICALS  
Petroleum refining to produce naptha, fuel hydrocarbons and lubricants – processes for the production of petrochemical precursors – ethylene, acetylene propylene, butadiene, benzene toluene and xylene.

UNIT V  PLASTICS  

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT I DISTILLATION

UNIT II CONTINUOUS FRACTIONATION

UNIT III CRYSTALLISATION AND DRYING

UNIT IV HUMIDIFICATION

UNIT V NEW SEPARATION PROCESSES
(THEORETICAL PRINCIPLES ONLY – NO PROBLEMS)

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE
UNIT I  CURRENT-VOLTAGE RELATIONSHIPS & ESTIMATION OF MASS TRANSFER CO-EFFICIENT
A general view of electrolytic processes; current-voltage relationships in electrolytic reactors; the limiting current plateau; mass & energy balance, and efficiency in electrochemical reactors. The estimation of mass transport coefficients at commonly occurring electrodes. The estimation of mass transport coefficients under enhanced convection conditions.

UNIT II  PLUG FLOW & CSTER SYSTEMS MODEL
A general view of plug flow model of electrolytic reactors: plug flow model of electrochemical reactors employing parallel plate reactor; Plug flow model under constant mass flux conditions; PFM analysis with electrolyte recycling PFM and real electrochemical reactors. General view of simple CSTER systems; CSTER in cascades; CSTER analysis of batch electrochemical reactors, CSTER analysis of semi-continuous electrochemical reactors; CSTER analysis of electrolyte recycling; Batch reactor combined with electrolyte recycling.

UNIT III  THERMAL BEHAVIOR OF REACTORS
General aspects of thermal behavior in electrochemical reactor. Thermal behavior under CSTER conditions. The estimation of heat losses; the thermal behavior under PFR conditions; Thermal behavior of batch electrochemical reactors.

UNIT IV  CONVECTIVE DIFFUSION EQUATION & CURRENT DISTRIBUTION
Convective diffusion equation and migration effects – derivation of convective diffusion equation theory – scope and limitation – migration effects – Electroneutrality conditions – supporting electrolyte effect – fundamental of Nernst layer model – Estimation of true limiting current

UNIT V  DISPERSION MODELS & OPTIMIZATION OF ELECTROCHEMICAL REACTOR

L : 45   T : 15   TOTAL : 60 PERIODS

TEXT BOOK

REFERENCE
1. Transient state heat conduction
2. Surface evaporation
3. Jacketted kettle
4. Temperature profile of a rod
5. Natural convection
6. Thermal conductivity of composite wall
7. Emissivity measurement
8. Measurement of diffusion coefficient
9. Simple distillation
10. Leaching
11. Adsorption

TOTAL: 60 PERIODS

Heat transfer equipments - design of heat exchangers, condensers, evaporators and reboilers. Mass transfer equipments - design of distillation columns, extraction and absorption equipment, rotary dryers and cooling towers.

TOTAL: 45 PERIODS

TEXT BOOKS
REFERENCES


GE3310  TOTAL QUALITY MANAGEMENT & ENGINEERING ECONOMICS  L T P C 3 0 0 3

UNIT I  QUALITY AND CUSTOMER CONCEPTS  9

UNIT II  QUALITY MANAGEMENT TOOLS AND QUALITY SYSTEMS  9
TQM tools - benchmarking - reasons to benchmark, benchmarking process, quality function deployment - house of quality, QFD process, benefits, Taguchi quality loss function, total productive maintenance - concept, improvement needs, FMEA - stages of FMEA. Quality systems - Need for ISO 9000 and QS 9000 : elements, implementation, documentation, quality auditing, concept, requirements and benefits.

UNIT III  VALUE OF MONEY, AMORTIZATION, CAPITAL REQUIREMENTS, COSTS, EARNINGS, PROFITS  9
Value of money – equivalence - value of money, equations for economic studies, equivalence amortization - capital recovery, depreciation, interest in depreciation calculations, depreciation accounting, capital requirements for process plants - cost indices, the Williams six-tenths factor, capital requirements for complete plants, balance sheet, sources of capital, earnings, profits and returns - variable costs, fixed costs, profits and earnings, economic production charts.

UNIT IV  ECONOMICS OF SELECTING ALTERNATES, RATE OF RETURN & PAYOUT TIME, ECONOMIC BALANCE  9
Economics of selecting alternates - annual cost method, present worth method, equivalent alternates, rate-of return method, payout-time method, replacement of existing facilities, irreducible factors in economic analyses, economic balance - economic balance in evaporation, economic vessel design, economic balance in fluid flow, economic balance with two variables, economic balance in combined operations – economic balance with one variable and two variable.
UNIT V  ECONOMIC BALANCE - CYCLIC OPERATIONS – YIELD AND RECOVERY

Economic balance in cyclic operation, batch operations (fixed cycle time), batch operations (variable cycle time), continuous and semi continuous operations, economic balance in yield and recovery - economic analysis for variable feed and product grades, economic analysis of a complete process - operating plants, proposed plants, evaluation.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT IV      PROCESS INSTRUMENTATION     9
Process control principles and system elements - temperature measurement-monitoring
and control, pressure measurement using bellows and LVDT - pH measurement –
conductivity measurement.

UNIT V      ELECTROCHEMICAL INSTRUMENTATION     9
Basic configuration and applications of constant voltage and anodic stripping voltammetry,
potentiostat, galvanostat and zero resistance ammeter - computer/microprocessor based
instruments, battery life cycle testing – computerized (SCADA) supervisory control systems
for anodic / cathodic protection of steel structure.

TOTAL : 45 PERIODS

TEXT BOOKS
1. A.K.Sawhney, “ A course in Electrical and Electronics measurement and
   instrumentation”, Dhanpat Rai Publication, 1994. (Unit I & II)
2. Ramesh S Goankar, “Microprocessor Architecture, Programming & Applications with
   8085 / 8080A, Wiley Easter Ltd., (Unit III)

REFERENCES
1. Howard A Strobel, Electrochemical Instrumentation, a system approach, Addition werley
   sons, New Delhi, 1990, (Chapter 1,3,4).

EL3312      ENERGY TECHNOLOGY

UNIT I      SOLID FUELS     9
Principal solid fuel, coal – properties, testing, preparation, handling and storage,
carbonisation, Briquetting.

UNIT II      LIQUID FUELS     9
Liquid fuels from crude oil, synthetic and other liquid fuels, storage and handling of liquid
fuels.

UNIT III      GASEOUS FUELS     9
Natural gas, manufacture of gaseous fuels, gas purification, combustion, furnaces, waste
heat recovery.
UNIT IV  NUCLEAR ENERGY SOURCES  

UNIT V  RENEWABLE ENERGY SOURCES  
Solar energy – basic principle, storage, collectors, application such as water heating, photo voltaic cells - production of hydrogen, pumping. Energy from biomasses – biomass conversion and biogas generation, biogas plant, process parameter. Wind energy – basic principle, wind energy conversion, components, design, environmental aspects, safety. Tidal and ocean thermal sources – basic principle, components, operation methods, advantages, limitations

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

EL3313  INDUSTRIAL METAL FINISHING  L T P C
3 0 0 3

UNIT I  ELECTROPLATING OF METALS  
Fundamental principles – Faradays laws, mechanism of deposition, surface preparation for electroplating, electroplating of copper, nickel, chromium, zinc, tin and precious metals (gold and silver)

UNIT II  EVALUATION & TESTING  

UNIT III  ELECTROPLATING OF ALLOYS AND OTHER PLATING METHODS  
Principles of alloy deposition, barrel finishing and plating, electroforming of copper and nickel, electroless deposition of copper and nickel, brush plating, continuous plating, PCB plating.
UNIT IV  ENGINEERING ASPECTS
9
Equipment selection, rectifier, pre-treatment equipment-mechanical - chemical, automation, flooring, materials for tanks and linings, ventilation, bus bar, filtration and purification, agitation, heating and cooling arrangement for electrolytes.

UNIT V  ANODIZING
9
Anodizing of aluminium, principles, pre-treatment, jigging. Sulphuric acid process, operating conditions for decorative and protective anodizing, effect of impurities, analysis for free acid and aluminium content, chromic acid process, operating conditions, effect of impurities, coloring of anodized aluminium with organic dyes. Sealing in hot water and dichromate solution. Testing of anodic film thickness by Eddy current method and stripping method, coating weight – coating ratio.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

EL3314  CORROSION SCIENCE & ENGINEERING
LT PC 3 0 0 3

UNIT I  BASIC ASPECTS
9

UNIT II  FORMS OF CORROSION
9
Definition, factors and control methods of various forms of corrosion: uniform, galvanic, pitting, inter granular, crevice, dezincification, stress corrosion, corrosion fatigue, hydrogen embrittlement.

UNIT III  ATMOSPHERIC CORROSION AND PROTECTIVE COATINGS
9
UNIT IV IMMERSION CORROSION AND ELECTROCHEMICAL PROTECTION 9

UNIT V CORROSION MONITORING 9
Laboratory corrosion tests, accelerated chemical tests for studying different forms of corrosion. Electrochemical methods of corrosion rate measurements by Gravimetric, Tafel polarization, linear polarization, cyclic polarization, impedance spectroscopy, harmonics and NDT techniques- ultrasonics, radiography eddy current.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

EL3315 ELECTROCHEMICAL PROCESS TECHNOLOGY L T P C
3 0 0 3

UNIT I ELECTRODES AND SEPARATORS 9
Electrodes and separators for the electrolytic production of inorganic chemicals – preparation, characteristics and applications of graphite, magnetite, lead dioxide coated anodes, noble metal coated anodes, noble metal oxide coated anodes, spinal anodes, Perovskite anodes, steel cathodes, coated cathodes, diaphragms and ion exchange membranes.

UNIT II ELECTROLYTIC PRODUCTION OF IN-ORGANIC CHEMICALS 9
Electrolytic production of sodium hypochlorite, sodium and potassium chlorates, bromates and iodates. Sodium, potassium and ammonium perchlorates, perchloric acid. Potassium, and ammonium persulphates, hydrogen peroxide, potassium permanganate, cuprous oxide and manganese dioxide – Basic principles, reaction mechanisms, effect of operating variables, cell design and operating characteristics of industrial cells.
UNIT III    BASICS OF ELECTRO ORGANIC CHEMISTRY AND ELECTRODIALYSIS

Production of hydrogen by water electrolysis. Electrodialysis and its application to desalination of water electrolysis and waste recovery. Basic principles of Electro organic chemistry, constant current electrolysis, controlled potential electrolysis, material yield, current efficiency, selectivity and energy consumption for electro organic synthesis. Paired synthesis with example.

UNIT IV    ELECTROCHEMICAL REDUCTION AND OXIDATION OF FUNCTIONAL GROUPS


UNIT V    INTRODUCTION TO ELECTRO POLYMERIZATION AND INDUSTRIAL ELECTRO ORGANIC PROCESSES

Electro polymerization. Anodic and cathodic polymerization with example (anionic polymerization, cationic polymerization and radical polymerization). Electrochemical preparation of conducting polymers such as polyacetylene, polypyrrole, polythiophene, polyaniline and their applications (excluding mechanism of polymerization). Industrial Electro organic processes such as adiponitrile from acrylonitrile, dimethyl sebacate from monomethyl adipate, Tetra alkyl lead from alkyl chloride, perfluorooctanoic acid from octanoylchloride, Aromatic aldehydes from toluenes. Electrochemical fluorination of organic compounds - Electrochemical perfluorination, Electrochemical selective/partial fluorination with examples.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
CORROSION
1. Determination of efficiency of the given inhibitor by gravimetric method
2. Efficiency of cathodic protection by impressed current method
3. Determination of anodic efficiency in sacrificial anode system
4. Standard Test Methods for specific gravity of pigments (3 pigments)
5. Determination of corrosion rate measurements by gravimetric method.
6. Determination of corrosion rate by galvanostatic polarization method [Tafel and linear Polarization methods]

ELECTROCHEMICALS

Electrochemical preparation of the following compounds:

1. Potassium chlorate from potassium chloride
2. Sodium perchlorate from sodium chlorate
3. Sodium hypochlorite from sodium chloride
4. Calcium gluconate from glucose
5. Succinic acid from maleic acid
6. Manganic sulphate from manganous sulphate

TOTAL : 60 PERIODS

EL3318 ELECTROCHEMICAL REACTION ENGINEERING LABORATORY

1. Electrochemical batch reactor-constant current operation.
2. Factorial design for investigating the current efficiency of copper deposition.
3. Monopolar and bipolar cells.
4. Electrochemical semi batch reactor
5. Electrochemical batch reactor - constant voltage operation.
6. Continuous flow stirred tank electrochemical reactor (CSTER)
7. Axial flow electrochemical reactor (PFER)
8. Packed bed reactor-flow through configuration
9. Local mass transfer on the wall of stirred tank reactor

TOTAL : 60 PERIODS
Globalisation has brought in numerous opportunities for the teeming millions, with more focus on the students’ overall capability apart from academic competence. Many students, particularly those from non-English medium schools, find that they are not preferred due to their inadequacy of communication skills and soft skills, despite possessing sound knowledge in their subject area along with technical capability. Keeping in view their pre-employment needs and career requirements, this course on Communication Skills Laboratory will prepare students to adapt themselves with ease to the industry environment, thus rendering them as prospective assets to industries. The course will equip the students with the necessary communication skills that would go a long way in helping them in their profession.

OBJECTIVES:

- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

<table>
<thead>
<tr>
<th>I. PC based session</th>
<th>(Weightage 40%)</th>
<th>24 periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. ENGLISH LANGUAGE LAB</td>
<td>(18 Periods)</td>
<td></td>
</tr>
<tr>
<td>1. LISTENING COMPREHENSION:</td>
<td>(6)</td>
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<tr>
<td>Listening and typing – Listening and sequencing of sentences – Filling in the blanks – Listening and answering questions.</td>
<td></td>
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<tr>
<td>2. READING COMPREHENSION:</td>
<td>(6)</td>
<td></td>
</tr>
<tr>
<td>Filling in the blanks - Close exercises – Vocabulary building - Reading and answering questions.</td>
<td></td>
<td></td>
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<tr>
<td>3. SPEAKING:</td>
<td>(6)</td>
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<td>Conversations: Face to Face Conversation – Telephone conversation – Role play activities (Students take on roles and engage in conversation)</td>
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<tr>
<td>B. DISCUSSION OF AUDIO-VISUAL MATERIALS</td>
<td>(6 PERIODS)</td>
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<tr>
<td>(Samples are available to learn and practice)</td>
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</tr>
<tr>
<td>1. RESUME / REPORT PREPARATION / LETTER WRITING</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td>Structuring the resume / report - Letter writing / Email Communication - Samples.</td>
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<tr>
<td>2. REPRESENTATION SKILLS:</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td>Elements of effective presentation – Structure of presentation - Presentation tools – Voice Modulation – Audience analysis - Body language – Video samples</td>
<td></td>
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</tbody>
</table>
3. **SOFT SKILLS:**
   - Time management – Articulateness – Assertiveness – Psychometrics –
     Innovation and Creativity - Stress Management & Poise - Video Samples

4. **GROUP DISCUSSION:**
   - Why is GD part of selection process ? - Structure of GD – Moderator – led and other
     GDs - Strategies in GD – Team work - Body Language - Mock GD -Video samples

5. **INTERVIEW SKILLS:**
   - Kinds of interviews – Required Key Skills – Corporate culture – Mock interviews-
     Video samples.

<table>
<thead>
<tr>
<th>II. Practice Session</th>
<th>(Weightage – 60%)</th>
<th>24</th>
</tr>
</thead>
</table>

1. **Resume / Report Preparation / Letter writing:** Students prepare their own resume and report.
2. **Presentation Skills:** Students make presentations on given topics.
3. **Group Discussion:** Students participate in group discussions.
4. **Interview Skills:** Students participate in Mock Interviews

**TEXT BOOKS**

**REFERENCES**

**LAB REQUIREMENT**
1. Teacher console and systems for students.
2. English Language Lab Software
3. Career Lab Software
### REQUIREMENT FOR A BATCH OF 60 STUDENTS

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description of Equipment</th>
<th>Quantity required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Server</strong>&lt;br&gt;o PIV system&lt;br&gt;o 1 GB RAM / 40 GB HDD&lt;br&gt;o OS: Win 2000 server&lt;br&gt;o Audio card with headphones (with mike)&lt;br&gt;o JRE 1.3</td>
<td>1 No.</td>
</tr>
<tr>
<td>2.</td>
<td><strong>Client Systems</strong>&lt;br&gt;o PIII or above&lt;br&gt;o 256 or 512 MB RAM / 40 GB HDD&lt;br&gt;o OS: Win 2000&lt;br&gt;o Audio card with headphones (with mike)&lt;br&gt;o JRE 1.3</td>
<td>60 No.</td>
</tr>
<tr>
<td>3.</td>
<td><strong>Handicam Video Camera (with video lights and mic input)</strong></td>
<td>1 No.</td>
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<tr>
<td>4.</td>
<td>Television - 29”</td>
<td>1 No.</td>
</tr>
<tr>
<td>5.</td>
<td>Collar mike</td>
<td>1 No.</td>
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<td>6.</td>
<td>Cordless mikes</td>
<td>1 No.</td>
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<tr>
<td>7.</td>
<td>Audio Mixer</td>
<td>1 No.</td>
</tr>
<tr>
<td>8.</td>
<td>DVD Recorder / Player</td>
<td>1 No.</td>
</tr>
<tr>
<td>9.</td>
<td>LCD Projector with MP3 /CD /DVD provision for audio / video facility - <strong>Desirable</strong></td>
<td>1 No.</td>
</tr>
</tbody>
</table>

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**GE2025**

**PROFESSIONAL ETHICS IN ENGINEERING**

**L T P C**

**3 0 0 3**

**UNIT I**

ENGINEERING ETHICS

9


**UNIT II**

ENGINEERING AS SOCIAL EXPERIMENTATION

9

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study
UNIT III  ENGINEER’S RESPONSIBILITY FOR SAFETY  9
The Government Regulator’s Approach to Risk - Chernobyl Case Studies and Bhopal.

UNIT IV  RESPONSIBILITIES AND RIGHTS  9
Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality –
Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights –
Intellectual Property Rights (IPR) - Discrimination

UNIT V  GLOBAL ISSUES  9
Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics -
Role in Technological Development – Weapons Development – Engineers as Managers –
Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral
Leadership – Sample Code of Conduct

TOTAL: 45 PERIODS

TEXT BOOKS
   2005.

REFERENCES
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, “Business Ethics – An Indian Perspective”,
   Biztantra, New Delhi, 2004.
5. David Ermann and Michele S Shauf, “Computers, Ethics and Society”, Oxford University

EL3402  NANOMATERIALS TECHNOLOGY  L T P C
   3 0 0 3

UNIT I  PROPERTIES OF MATTER  12
Size effects, structure of solids, energy bands, localized particles. Synthesis and properties of:
metal, metal oxide, semiconductor and magnetic nanoparticles. Carbon nanostructures –
brief notes on synthesis, properties and application.

UNIT II  METHODS OF CHARACTERIZATION  6
Nanoparticle characterization: X-ray Diffraction (XRD), Small Angle X-ray scattering (SAXS),
Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Energy
Dispersive Spectrum (EDS), Scanning Probe Microscopy (SPM), and other spectroscopy
techniques (UV-Vis, IR and Raman)

UNIT III  TYPES OF NANOSTRUCTURES  9
Nanostructures in zeolites cages, quantum wells, wires and dots. Preparation of quantum
nanostructures, size and dimensionality effects, single electron tunneling
UNIT IV  MAGNETIC PROPERTIES  9  
Nanostructured ferromagnetism – basics of ferromagnetism, effect of nanostructuring of bulk magnetic materials, dynamics of nanomagnets, nanopore containment of magnetic particles, nanocarbon ferromagnets, giant and colossal magneto-resistance, ferrofluids

UNIT V  NANOPARTICLE SYNTHESIS  9  

TOTAL : 45 PERIODS

TEXT BOOKS
1. Catherine Brechignac, Philipe Houdy, Marcel Lahmani “Nanomaterials and Nanochemistry”, Springer.

REFERENCES

EL3403  PROCESS DYNAMICS AND CONTROL  L T P C
3 1 0 4

UNIT I  LINEAR OPEN-LOOP SYSTEM  9  
An introductory example – response of first order systems – physical examples of first order systems – response of first order systems in series – higher order systems, second order and transportation lag.

UNIT II  LINEAR CLOSED LOOP SYSTEM  9  
The control system – development of a block diagram process – measuring element – controller- controllers and final control elements –Ideal transfer functions-control valve, controller - proportional, proportional integral, proportional derivative and proportional integral derivative control, block diagram of a chemical reactor control system, closed loop transfer functions for change in load and set point – overall transfer function for multi loop control system.

UNIT III  STABILITY  9  

UNIT IV  FREQUENCY RESPONSE  9  
Introduction to frequency response – substitution rule – bode diagrams first order system – first order system in series – control system design by frequency response – bode stability criterion – gain and phase margin – Ziegler-Nichols controller setting.

UNIT V  CONTROLLER TUNING  9  

L : 45   L : 15 TOTAL : 60 PERIODS
<table>
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<th>EL3404 ELECTROCHEMICAL ENERGY CONVERSION &amp; STORAGE</th>
<th>L T P C</th>
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**UNIT I FUNDAMENTALS**

- EMF, reversible cells and irreversible cells, reversible electrodes, relationship between electrical energy and energy content of a cell, free energy changes and emf in cells, relationship between the energy changes accompanying a cell reaction and concentration of the reactants, effect of cell temperature on batteries, derivation of number of electrons involved in a cell reaction, thermodynamic calculation of the capacity of a battery, calculations of energy density of cells, heating effects in batteries, spontaneous reaction in electrochemical cells, pressure development in sealed batteries.

**UNIT II FACTORS AFFECTING BATTERY PERFORMANCE**

- Factors affecting battery capacity, voltage level current drain of discharge, types of discharge continuous, intermittent, constant current, constant load, constant power, service life, voltage regulation, changing methods, battery age & storage condition, effect of battery design.

**UNIT III STORAGE BATTERIES**

- Principle design construction, advantage and disadvantages. Primary batteries - Zn-MnO₂ system, carbon-zinc and carbon-zinc chlorides performance characteristics and zinc-silver oxide. Secondary batteries – lead acid, nickel cadmium, nickel metal hydride, silver oxide zinc system, lithium ion, lithium polymer.

**UNIT IV TESTING & EVALUATION**


**UNIT V FUEL CELLS & SUPER CAPACITOR**

- Introduction to super capacitors, types of super capacitors, introduction to fuel cells, types of fuel cells and technology development, current versus potential issues.

**TOTAL : 45 PERIODS**
TEXT BOOKS

REFERENCES

EL3405 ELECTROCHEMICAL MATERIALS SCIENCE L T P C 3 0 0 3

UNIT I FUNDAMENTALS OF SEMICONDUCTORS
Semiconductors, n-type and p-type semiconductors, conductivity of semiconductors (no derivation of equations only formulae), applications of semiconductors, photoconductivity, photoconducting materials, electronic transitions in photoconductors, trapping and recombination, general mechanism of photoconductivity, life-time of majority carriers, preparation of CdS photoconductors by the sintering technique, ohmic contacts, fabrication of photo conductive cells and their applications.

UNIT II METHODS OF PREPARATION
Thin films of semiconductors, methods of preparation, vacuum evaporation, sputtering, molecular beam epitaxy, hot wall epitaxy, chemical bath deposition, spray pyrolysis, electrodeposition, liquid phase epitaxy, chemical vapour deposition, structural, electrical and optical characterization, mechanical properties of thin films, effect of grain boundaries.

UNIT III SUPERCONDUCTIVITY
Superconductivity (only elementary treatment of theories of superconductivity, no derivations), properties of superconducting materials, synthesis of high temperature superconducting materials and their applications.

UNIT IV BASICS OF PHOTOVOLTAICS
Basics of photovoltaics (no derivation for (i) minority carrier lifetime (ii) continuity equations and (iii) p-n junction equation or dark characteristics of a diode (iv) photovoltaic effect equation (v) total photocurrent generation in pn solar cell), homo and heterojunctions, preparation of single crystal and polycrystalline silicon solar cells, Metal-Insulator-Metal and semiconductors – Insulator – semiconductors solar cells, photovoltaic measurements, I-V characteristics, spectral response and capacitance measurements.
UNIT V  SOLAR CELLS & PHOTO ELECTROCHEMICAL (PEC) CELLS  9
Preparation of CdS/Cu2S solar cells, amorphous Si solar cells, GaAs solar cells and their characteristics. Semiconductor- electrolyte interface. Photo-electrochemical cells for conversion of light energy to electrical energy. PEC cells based on CdSe, Si and GaAs and their output characteristics. Estimation of flat band potential from Mott-Schottky plots.

TEXT BOOKS

REFERENCES

EL3406  ELECTROMETALLURGY AND THERMICS  L T P C 3 0 0 3

UNIT I  INTRODUCTION  9
Survey of Indian scene of ores and metallurgical industries with special reference to electrometallurgical industries. Preparation of cell feed for copper, zinc, aluminium, magnesium and titanium electrolytic cells. Principles of solvent extraction/ ion exchange for the recovery of metallic values. Pollution and control measures adopted/recommended in electrometallurgical Industries like Al, Mg & Cr.

UNIT II  ELECTROCHEMICAL PRINCIPLES  9
Cell voltage and its components- types of anodes and cathodes-necessity of diaphragms. Physicochemical properties of molten & aqueous electrolytes like conductivity, decomposition potential, density etc. Current and energy efficiency- features of aqueous and molten salt electrolysis distinction between electro winning and refining. Anode effect.

UNIT III  AQUEOUS SYSTEM  9
UNIT IV  MOLTEN SALT ELECTROLYSIS

UNIT V  THERMICS
Modes of electrical heating. Design criteria of arc furnaces. Description of furnaces used and the process for production of calcium carbide. Calcium silicide, Calcium cyanamide, fused alumina, ferroalloys, phosphorous, graphite and Silicon carbide.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

EL3408  ELECTROCHEMICAL ENGINEERING LABORATORY II

BATTERIES:
1. Porosity determination of unformed and formed positive and negative plates by theoretical and experimental methods.
2. Measurement of electrical resistance of battery separators by d.c voltage drop method.
3. Characteristics of lead acid cell/battery during constant current discharge
4. Characteristics of lead acid cell/battery during constant current charge
5. Measurement of internal resistance of a lead acid cell/battery by d.c voltage drop method and graphical methods.

ELECTROCHEMICAL MATERIAL SCIENCE:
1. Chemical deposition of lead sulphide films and determining the thickness of the films deposited.
2. Current voltage characteristics of the given photo-conductive cell in darkness as well as in light and estimation of photosensitivity.
3. Intensity-photocurrent characteristics of the given photoconductive cell for different bias voltage conditions.
4. Power characteristics of the given silicon at specified intensities.
5. Estimation of the diode parameters of a silicon solar cell.
6. Preparation of CdSe films by the electrochemical route and find the growth rate of thickness for different time intervals.
7. Power Characteristics of Photoelectrochemical cell
8. Mott-Schottky plot from capacitance measurements and estimation of the flat-band potential and carrier concentration (Demonstration)

TOTAL : 60 PERIODS

EL3409 ELECTROCHEMICAL ENGINEERING LABORATORY III

INDUSTRIAL METAL FINISHING:
1. Anodizing of Aluminium
2. Electroforming of Metal Foil
3. Hull Cell Studies in Electroplating Bath
4. Throwing Power Studies in Electroplating Bath
5. Nickel Plating
6. Analysis of nickel plating solution

ELECTRO HYDRO METALLURGY:
1. Electro winning of zinc.
2. Electrolytic preparation of copper powder.
3. Determination of limiting current for electrodeposition of copper.
4. Determination of decomposition potential for electrodeposition of copper
5. Stripping and extraction efficiency of D2EHPA for zinc ion.
6. Recovery of metals by ion exchange resins.

TOTAL : 60 PERIODS

EL3410 PROCESS DYNAMICS AND CONTROL LABORATORY

1. Resistance Temperature Detector transmitter
2. Pressure transmitter
3. Level transmitter
4. I/P converter and pneumatic control valve
5. Flow transmitter
6. Direct digital control for pressure control
7. Direct digital control for level control
8. Direct digital control using process temperature analyzer
9. Effect of load disturbance over the bath and controller output action
10. Direct digital control using flow process analyzer

TOTAL : 60 PERIODS
GE3411   ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL   L T P C  
                                                                  3 0 0 3

UNIT I  GENERAL CONCEPTS OF ENVIRONMENT  9
Introduction, pollution categorization, forms of pollution, air, water and solid; effects of air 
pollution on human health, materials, eco-system, and plants, ozone depletion, climatic 
changes, air pollution and its control, solid wastes and their disposal.

UNIT II  CHARACTERIZATION AND CLASSIFICATION OF WASTES  9
Industrial process water: hardness of water and its effects, volume reduction, strength 
reduction, classification of wastes, characterization of industrial wastewater, sampling 
techniques and preservation of effluent.

UNIT III  WASTEWATER TREATMENT TECHNIQUE  9
Treatment methods, treatment technique for industrial process water, degree of treatment 
required, physical, chemical and physico-chemical methods of treatment of industrial 
effluent neutralization, equalization and proportioning, coagulation, sedimentation, flotation, 
filtration, ion exchange, absorption, adsorption, oxidation and disinfections. Treatment 
methods for industrial waste waters, preliminary treatment such as bar screen, grit chamber 
and sedimentation tank methods, primary secondary and tertiary treatment methods, 
conventional methods of effluent treatment, biological treatment methods, aerobic and 
aerobic oxidation stabilization pond, oxidation pond oxidation ditch and lagoons.

UNIT IV  CASE STUDIES  9
General and specific pollution control with respect to a few chemical industries such as 
tanneries, textile, fertilizer, pickle wastes, petroleum and petrochemical, Soap and detergent 
and electroplating industries.

UNIT V  POLLUTION MANAGEMENT AND CONTROL  9
Effluent management, recycling of industrial wastewater, pollution control boards state and 
central boards, tolerance limits and specifications, environmental Impact assessment and 
methodology.

TOTAL : 45 PERIODS

TEXT BOOKS
   1986 (Chapter 1 and 18) 
   Delhi 1987. 
3. C.S Rao, “Environmental Pollution and Control”, Wiley Eastern Engineering Limited, 

REFERENCES
   Disposal, Reuse (Metcalf & Eddy Inc., California),Tata McGraw-Hill Publishing company 
   Limited, New Delhi, 1995.

EL3414 PROJECT WORK AND VIVA VOCE L T P C
0 0 12 6

PROJECT REPORT

Each student is required to submit a project report on the research and the design and development of Industrial plant selecting the best process with optimum equipment sizes and operating conditions. The Project report will be treated as test of ability of the student to tackle a practical problem in the same way as might be expected of him if he were required to report as a Electrochemical Engineer on a new manufacturing proposal.

VIVA – VOCE

The objects of the viva-voce examination are to test the performance of a student for his attainment for the profession of an Electrochemical Engineer.

TOTAL : 180

CH3001 PROCESS MODELLING AND SIMULATION L T P C
3 0 0 3

UNIT I PRINCIPLES OF MODELING

UNIT II HYDRAULIC TANK
Simple Hydraulic tank, variable flow hydraulic tank, enclosed tank, adiabatic compression in gas space, mixing vessel, mixing with reaction, reversible reaction, steam jacketed vessel, continuous – flow boiling system.
UNIT III GAS FLOW AND LIQUID FLOW SYSTEMS

UNIT IV EXTRACTION, DISTILLATION AND HEAT EXCHANGER

UNIT V ANALOG SIMULATION
Analog simulation: Introduction, basic components, operational blocks, simple examples, three CSTR’s in series, gravity flow tank, digital simulation: numerical methods – implicit function convergence, numerical integration – Euler, Runge Kutta fourth-order methods. Simple examples: three CSTR’s in series, nonisothermal CSTR, binary distillation column, batch reactor.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE

EL3004 CHEMICAL PROCESS OPTIMIZATION

UNIT I OPTIMIZATION
Introduction; formulation of objective functions; fitting models to data; classification of functions; necessary and sufficient conditions for optimum; unimodal, multimodal functions, analytical methods Lagrange multiplier methods.

UNIT II NUMERICAL METHODS
Unimodal functions: Newton’s quasi, Newton secant methods, region elimination methods, polynomial approximation; quadratic and cubic interpolation techniques for optimum. Multimodal functions; direct methods; random, grid. Hooke’s Nelder and Mead methods; Powell’s technique; indirect methods; gradient and conjugate gradient methods; secant methods.

UNIT III LINEAR AND NON-LINEAR PROGRAMMING
Review on basic concepts of LP formulations; simplex methods; integer, quadratic, geometric and dynamic programming.
UNIT IV APPLICATIONS
Heat Transfer and energy conservation; separation processes; fluid flow systems; reactor design and operation; large scale systems.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

EL3006 PLANT UTILITIES

UNIT I WATER
Water resources, treatment and cooling. Storage and distribution of water. Re-use and conservation of water.

UNIT II COMPRRESSED AIR & VACUUM

UNIT III REFRIGERATION
Refrigeration systems and their characteristics. Production of cryogenic temperatures.

UNIT IV AIR CONDITIONING & VENTILATION
Characteristics of Air-water systems. Humidification and Dehumidification equipment. Exhaust Ventilation.

UNIT V STEAM

TOTAL : 45 PERIODS

TEXT BOOKS
REFERENCES


EL3007 ADVANCED ELECTROCHEMICAL REACTION ENGINEERING L T P C 3 0 0 3

UNIT I FUNDAMENTALS OF ELECTROCHEMICAL REACTION KINETICS 9
Fundamentals of reaction kinetics, rate of electrochemical reaction, thermodynamics-heat of reaction and reaction equilibria, electrochemical thermodynamics, practical cell voltage requirements and polarization. Reactor classification, configuration and production capacity. Basic electrode kinetics, Ideal isothermal reactors: single electrochemical reactions, potentiostatic operations of first order reaction and galvanostatic operations of first order reactions. CSTR with general order reactions, Effect of mass transport and side reaction.

UNIT II PLUG FLOW REACTORS WITH AND WITHOUT MASS TRANSPORT 9
Plug flow and recycle reactors, Kinetics of electrochemical reactions: multistep electrochemical reactions, multistep electrode processes with mass transport, series and parallel reactions, interaction of chemical reaction, electrochemical reactions involving adsorption, electro analytical methods.

UNIT III MULTIPLE ELECTROCHEMICAL REACTIONS 9
Multiple electrochemical reactions with inter-phase mass transport-reaction classification, consecutive reactions, parallel reaction and complex reaction. Potentiostatic and galvanostatic operation of series and parallel electrochemical reactions, reversible reaction. RTD analysis, dispersed plug flow, tank in series model, multi parameter models, reactor dynamics of isothermal CSTR and PFR.

UNIT IV SIMULTANEOUS MASS TRANSFER AND ELECTROCHEMICAL REACTION 9
Simultaneous mass transfer and chemical reaction; mathematical model of interphase mass transport-film model, penetration model, regimes of operation, fast and intermediate chemical reaction. Multiple chemical reaction, multiple electrochemicals and chemical reaction. Batch recycle and continuous recycle operation, multiple fluid phases at the electrode surface and in the electrolyte phase. Reactor for multiple phase reactions.
UNIT V  MIGRATION AND CURRENT DISTRIBUTION  9
Migration effects on mass transport, influence of migration in the reactor design, current and potential distribution, primary current distribution, current and potential distribution arising from polarization, three dimensional electrodes, diaphragm cell reactor models, energy balance, heat transfer and technical optimizations.

TOTAL : 45 PERIODS

TEXT BOOK

REFERENCE

EL3009  CATHODIC PROTECTION ENGINEERING  L T P C
UNIT I  BASIS OF CATHODIC PROTECTION  9
Basis of cathodic protection - working of cathodic protection system - factors leading to corrosion of underground metallic structures - electrical basis of cathodic protection - electrochemical theory of cathodic protection - definition of cathodic protection using Evans diagram and Pourbix diagram, derivation of protective potential for steel - anodic polarization

UNIT II  SACRIFICIAL ANODE SYSTEM  9
Cathodic protection system - components of galvanic systems - galvanic anodes - life, current output - magnesium, aluminium and zinc : electrochemical properties - composition, fields of application : backfills for sacrificial anodes - calculation of current output of sacrificial anodes - calculation of number of anodes - advantages and disadvantages of sacrificial anode system.

UNIT III  IMPRESSED CURRENT SYSTEM  9
Impressed current system - power source, cables, rectifier - components of rectifier, types of ground bed - required properties of impressed current anode - major impressed current anodes – high silicon, cast iron, scrap steel, graphite anodes, platinised titanium, platinised Niobium, platinised tantalum, metal oxide anode - lead alloy anode - properties - composition, consumption, fields of application. Backfills for impressed current anodes.

UNIT IV  FIELD SURVEY  9

UNIT V  DESIGNING OF CP SYSTEM  9
Stray current corrosion - sources of stay current - cathodic protection interferences – examples of interferences - design charts - ground bed design with illustrative examples - designing of sacrificial anode system - designing of impressed current system - designing of cathodic protection to ship hull - calculations in cathodic protection design.

TOTAL : 45 PERIODS
TEXT BOOKS

REFERENCES

EL3011 PROTECTIVE PAINT COATINGS L T P C 3 0 0 3

UNIT I BINDERS, PIGMENTS AND OTHER RAW MATERIALS FOR PAINTS 9
Variable types of binders used in paint making – natural resins – shellac, rosin, oils and rubber-chemistry and properties; preparation and properties of synthetic resins – alkyds, phenolics, vinyls, amino resins, acrylics, epoxies, urethanes and silicones - Pigments and Extenders – Inorganic, organic and metallic pigments and extenders-corrosion inhibiting pigments-properties and functions.

UNIT II SOLVENTS 9
Solvents, additives, plasticizers and driers used in paints – solvency power, toxicity, Kauri-butanol and aniline point values for solvents-various additives and purpose of each considerations in formulation of a paint – concept of Pigment Volume Concentration and volume solids – rheological characteristics of paint – water based paints – composition and properties – factors affecting water dispersibility-Manufacture of paints – ball and pebble mills, attritors, sand and bead mills, three roller mills.

UNIT III TESTING AND EVALUATION OF PAINTS 9

UNIT IV SURFACE PREPARATION AND APPLICATION OF PAINTS 9

UNIT V PAINTS FOR FUNCTIONAL APPLICATION 9
Paints for rural atmospheres, industrially polluted atmospheres, marine atmospheres offshore applications, chemical paints, automobiles and air crafts. Coating for pipelines – coatings for concrete, wood and plastics. ceramic coatings , powder coating- principle, basics and application.

TOTAL : 45 PERIODS
TEXTBOOKS

REFERENCES

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<th>ADVANCED COMPUTER PROGRAMMING</th>
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UNIT I GETTING STARTED WITH VISUAL BASIC
Front end – back end concepts introduction to VB – VB programming environment – objects – properties, methods, events – VB programming fundamentals – modules, data types, variables – public & local variable – control structure – if, then, select… case, do… while loop, for … next loop.

UNIT II CONTROLS AND EVENTS IN VB
Creating and using controls – control categories – control properties – control arrays – events associated with controls.

UNIT III DATABASE ACCESSING IN VB

UNIT IV INTRODUCTION TO VC++
VC++ components, Microsoft developer studio, VC++ graphics editor, VC++ and Microsoft foundation class library, project creation in VC++, application architecture, design a program.

UNIT V APPLICATION DEVELOPMENT IN VC++
VC++ controls, customizing controls, C static class – styles, introduction to Appwizard, classwizard and the resource editors, database accessing using VC++

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

68
UNIT I  SURFACE CLEANING  9
Classification and selection of cleaning processes – alkaline cleaning – solvent cold
cleaning and vapour degreasing – emulsion cleaning - molten salt bath cleaning -
ultrasonic cleaning - acid cleaning – mechanical cleaning systems – pickling and descaling.

UNIT II  SURFACE MODIFICATION PROCESSES  9
Thermal spray coatings – chemical vapour disposition coating processes –
nonsemiconductor Materials – semiconductor materials – plasma-enhanced chemical
vapour deposition – physical vapour deposition coating processes – vacuum deposition –
reactive evaporation and gas evaporation – sputter deposition – ion plating - ion-beam-
assisted deposition – arc deposition – ion implantation – diffusion coatings.

UNIT III  SURFACE ENGINEERING OF FERROUS & NON FERROUS METALS  9
Cast irons – carbon and alloy steels – stainless steel – specialty steels – heat-resistant
alloys –aluminium and aluminium alloys – copper and copper alloys – magnesium alloys –
titanium and titanium alloys – nickel and nickel alloys.

UNIT IV  TESTING AND CHARACTERIZATION OF COATINGS AND THIN FILMS  9
Film thickness measurements using optical techniques – corrosion testing – evaluation of
mechanical properties of thin films – stress determination of coatings – testing of stability and
thermal properties of thermal barrier coatings – surface and interface analysis of coatings
and thin films

UNIT V  ENVIRONMENTAL PROTECTION ISSUES  9
Environmental regulation of surface engineering – cadmium elimination – vapour degreasing
alternatives – compliant organic coatings – compliant wipe solvent cleaners.

TOTAL : 45 PERIODS

TEXT BOOK
UNIT II EVALUATION OF ELECTRO DEPOSITS 9

UNIT III ELECTROPLATING OF ALLOYS AND OTHER PLATING METHODS 9
Alloy plating principles – deposition of Brass, Palladium – Nickel and lead tin alloys electroforming – principles – pretreatments, operating conditions – application with respect to copper and nickel electroless plating – principles application operating condition for copper, tin, nickel, and gold. Heavy deposition of chromium. Barrel plating principle and application, Continuous plating with respect to Zn and Sn. Brush plating. Hot dipping, Spraying, Cladding and Vapour deposition.

UNIT IV ANODIZING 9

UNIT V ENGINEERING ASPECTS OF ELECTRO DEPOSITION 9

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT I  INTRODUCTION TO CONSEQUENCE ANALYSIS  9

UNIT II  FIRE AND EXPLOSION MODELS  9

UNIT III  RISK MANAGEMENT AND ISO 14000  9

UNIT IV  PAST ACCIDENT ANALYSIS  9

UNIT V  PRINCIPLES OF HAZOP  9

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT I  INDUSTRIAL SAFETY
Industrial safety principles, site selection and plant layout, legal aspects. Design for ventilation, emergency response systems for hazardous goods.

UNIT II  HAZARDS OF CHEMICAL INDUSTRY
Chemical hazards classification, hazards due to fire, explosion and radiation, reduction of process hazards by plant condition monitoring.

UNIT III  HEALTH HAZARDS IN CHEMICAL INDUSTRIES
Dangerous occupational diseases, poisoning, dust effect, the biomedical and engineering response to health hazards.

UNIT IV  SAFETY IN CONTROL AND INSTRUMENTATION SYSTEMS
Engineering control of plants instrumentation. Colour codes for pipelines, safety aspects of reactive chemicals.

UNIT V  SAFETY IN CHEMICAL PROCESS INDUSTRIES
Safety in operations and processes, Runaway reactions unstable products.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

UNIT I  MOMENTUM TRANSPORT

UNIT II  MOMENTUM TRANSFER
Flow of fluids in thin films, parallel plates, circular tubes and annulus, adjacent flow of two immiscible fluids, couette flow, rotating surface flow and radial flow. Flow near a wall suddenly set in motion.
UNIT III ENERGY TRANSPORT 9
Basic energy transport equations – derivations using elementary volume concept and conservation theorems in different co-ordinate systems. Dimensional analysis of equations of change. Analysis of energy transport using shell balance technique and basic transport equations – types of boundary conditions.

UNIT IV HEAT TRANSFER 9
Conductions with energy sources in fixed bed catalytic reactors and in cooling fins. Forced convection in circular tubes – natural convection from a heated plate. Unsteady state conduction of finite slab.

UNIT V MASS TRANSPORT 9
Continuity equation for a binary mixture and its derivation. Dimensional analysis of equations of change. Analysis of mass transport using shell balance technique and types of boundary conditions. Steady and unsteady state one dimensional diffusion, diffusion in porous catalyst with and without chemical reaction and diffusion in falling liquid film.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

EL3008 CHLOR-ALKALI TECHNOLOGY L T P C
3 0 0 3

UNIT I ELECTRODES AND SEPERATORS 9
Anodes, cathodes and separators for chlor-alkali production: graphite, metal anodes, steel cathodes, coated cathodes, gas diffusion cathodes, asbestos diaphragms, improved diaphragms, cation exchange membranes – different types-preparation-characteristics.

UNIT II CONVENTIONAL PROCESSES 9
Diaphragm cell process, different cell designs, deposition of diaphragm, mercury cell process. Different cell designs, reasons for hydrogen evolution in the primary cells, denuder vertical and horizontal types, Design aspects.

UNIT III MODERN PROCESS 9
Membrane cell process, different designs of membrane cell, mono polar and bipolar cells. Conversion of mercury and diaphragm cells to membrane cells. Factors affecting the performance of the membrane cells.
UNIT IV UNIT OPERATIONS
Unit operations in chlor-alkali industry, Salt washing, saturation. Brine dechlorination. Primary brine purification. secondary brine purification, caustic concentration. Separation of salt from diaphragm cell liquor, handling of hydrogen, chlorine and caustic, chlorine liquefaction.

UNIT V GENERAL TOPICS

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

EL3010 METAL COATING TECHNOLOGY

UNIT I ELECTROPLATING
Basic physical chemistry, surface chemistry, pretreatment principles – technology and control of electro deposition systems such as alloy plating, electrolysis, composites and non aqueous.

UNIT II HOT DIPCOATING

UNIT III CHEMICAL VAPOR DEPOSITION
Chemical vapour deposition – classification-techniques, metal organic type, plasma assisted, layer assisted, applications.

UNIT IV SPUTTERING TECHNIQUES
Sputtering techniques, methods, applications, plasma treatments, nitriding – carbonising – boriding, titanizing methods, applications.

UNIT V LASER COATINGS
Laser alloying – sources, variables, methods, applications, electron beam coating – evaporation materials, methods, applications.

TOTAL : 45 PERIODS
TEXT BOOKS

REFERENCES

MA3013 OPERATIONS RESEARCH

UNIT I LINEAR PROGRAMMING

UNIT II INVENTORY THEORY
Inventory management - inventory, inventory classification, inventory control, its objectives and how to achieve them, inventory factors and their analysis - economic order quantity, single product, dynamic purchase inventory models, inventory models, with infinite shortage cost and uniform demand rate, purchase inventory models with infinite short - age and different demand rates, quantity discounts, Analysis of inventory systems, - ABC analysis.

UNIT III REPLACEMENT THEORY
Replacement decisions - introductions - reasons for replacement - factors to be considered for replacement equipments - methods used in selection of alternatives - replacement of items that deteriorate with time - replacement policy with change in money value - without change in money value - replacement of items that fail completely - group replacement policy - limitations of replacement.

UNIT IV QUEING THEORY
Queuing theory - introduction - waiting line models - characteristics and limitations of queuing models – distribution for arrival and service - single channel with finite and infinite population models multi channel models with infinite population.

UNIT V NETWORK ANALYSIS

TOTAL : 45 PERIODS
TEXT BOOK

REFERENCES

EL3014 ELECTROCHEMICAL ENGINEERING L T P C
3 0 0 3

UNIT I BASIC ELECTROCHEMICAL CONCEPTS 9
Introduction and thermodynamic in terms of electrochemical potential-phase equilibrium, chemical and electrochemical potentials, cells with solution of uniform concentration, transport processes in junction regions, cells with a single electrolyte of varying concentration. The electric potential-the electrostatic potential, intermolecular forces, outer and inner potential, potentials of reference electrode, the electric potential in thermodynamics. Activity coefficients-ionic distributions in dilute solutions, electrical contribution to the free energy, measurement of activity coefficients.

UNIT II REFERENCE ELECTRODE AND ELECTRICAL DOUBLE LAYER 9
Reference electrode-criteria of reference electrodes, hydrogen electrode, the calomel electrode and other mercury and mercurous salt electrodes, silver-silver halide electrodes. Potentials of cells with junction- the Nernst equation, types of liquid junctions, cells with liquid junction, potentials across membranes. Structure of the electric double layer-qualitative description of double layers, the Gibbs adsorption isotherm, the Lippmann equation, the diffused part of the double layer. Electrode kinetics, electrokinetic phenomena, Electro capillary phenomena.

UNIT III INFINITELY DILUTE SOLUTIONS AND THERMAL BALANCE 9

UNIT IV TRANSPORT PROPERTIES 9
Transport properties- single and multicomponent solutions. Fluid mechanics-stress in a Newtonian fluid, magnitude of electrical forces. Transport in dilutes solutions, simplification for convective transport, the Graetz problem, two-dimensional diffusion layer in laminar forced convection, axisymmetric diffusion layers in forced convection.

UNIT V POTENTIAL THEORY 9

TOTAL : 45 PERIODS
TEXT BOOKS

REFERENCE

EL3015 ADVANCED ELECTROCHEMICAL ENERGY CONVERSION AND STORAGE SYSTEMS L T P C 3 0 0 3

UNIT I MAINTENANCE FREE LEAD ACID BATTERIES 9
Concept of maintenance free batteries, thermodynamic parameters, current flow, kinetic parameters, heat effects, lead corrosion, water decomposition, self discharge, secondary reactions, internal oxygen cycle, separator, container, value design, manufacturing process, bipolar lab, recycling.

UNIT II NICKEL-BASED BATTERIES 9

UNIT III LITHIUM BATTERIES 9
Lithium ion, lithium polymer battery, principle, positive and negative materials, electrolyte, separator, reaction mechanism, performance characteristics, manufacturing process, safety, charging techniques.

UNIT IV SUPER CAPACITORS 9
Similarities and differences between super capacitors and batteries for storing electrical energy, double layer at capacitor electrode interface, electrochemical capacitors based on pseudo capacitance, Technology development.

UNIT V FUEL CELLS 9
Fuel cell thermodynamics, fuel cell reaction kinetics, fuel cell charge transport, fuel cell mass transport, fuel cell modeling, fuel cell characterization, fuel cell types.

TOTAL : 45 PERIODS

REFERENCES

TEXT BOOKS
UNIT I  CATHODIC REACTIONS OF ORGANIC COMPOUNDS  9
Principles and methods, synthetic and mechanistic aspects of cathodic reactions of organic compounds classified by electrophores, hydrocarbons, halogenated organic compounds, nitro and related compounds, carbonyl compounds, azomethine compounds.

UNIT II  ANODIC REACTIONS OF ORGANIC COMPOUNDS  9
Synthetic and mechanistic aspects of anodic reactions of organic compounds classified by electrophores, anodic oxidation of hydrocarbon, carboxylic acids, nitrogen-containing compounds, oxygen-containing compounds, sulphur-containing compounds, electrochemistry of certain comprehensive classes of compounds, electrolysis of heterocyclic compounds, natural products and pharmaceuticals, biomass, organoelemental and coordination compounds.

UNIT III  CLASSIFICATIONS OF ELECTRODE REACTIONS  9
Electrode reactions classified by reaction type, reductive coupling, oxidative coupling, cleavages and deprotection, anodic substitution, anodic fluorination.

UNIT IV  STEREOCHEMISTRY OF ELECTROCHEMICAL PROCESSES  9
Stereochemistry of organic electrode processes, amalgam and related reductions, electrogenerated reagents, electrogenerated acids and bases.

UNIT V  INDUSTRIAL APPLICATIONS OF ELECTRO ORGANIC CHEMISTRY  9
Present and future applications, industrial electroorganic chemistry, electrochemical polymerization, chemically modified electrodes and conducting polymers, photoelectrochemistry, paired electrosynthesis.

TOTAL : 45 PERIODS

TEXT BOOK

REFERENCES