CES-112: Chemistry for Civil Engg.

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Unit - I : Structure of Materials

Space lattice and unit cells, crystal system, Symmetry operation, Structures of common metallic, Semiconductor ceramic and superconductor materials, Miller Indices, Representation of Directions and planes, Packing fractions, Structure determination using X-ray diffraction, Braggs law, and lattice parameter determination, Bonding in solids, coordination number, ceramics, silicates and clay structures, glass transition temperature, non-crystalline materials.

Unit – II: Materials Science

Classification of engineering materials and their applications: Metals and alloys, Ceramics and glasses, Polymers, Composites and Novel Materials, Price and availability of materials, Processing of engineering materials, Chemical bonding and properties of materials: Mechanical, Electrical, Magnetic, Optical, Thermal, Oxidation and degradation behaviour of engineering materials. Levels of structure: Nuclear structure, Crystal structure, Nanostructure, Microstructure and Macrostructure, Processing structure property correlations.

Unit – III: Corrosion and Protective Coatings

Corrosion, Types and causes of corrosion, factors influencing corrosion, electrolysis, electrode potential, reference electrode, theories of corrosion, corrosion control, protective coatings, pretreatment of surface, metallic coating, electro less plating, inorganic non metallic coatings, organic coatings, special paints.

Unit – IV: Electronic Properties and Band Theory

Metals, insulators and semiconductors, electronic structure of solids-band theory, band structure of metals, insulators and semiconductors. Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors. Optical properties- Optical reflectance, photoconduction, Magnetic Properties- Classification of materials: quantum theory of paramagnetic cooperative phenomena-magnetic domains, hysteresis.

Unit – V: Water Technology

Water, Impurities in water and sources of impurities, Hard water, Boiler feed water, Boiler, corrosion, Prevention of scale formation, softening of water, potable water, desalination, and chlorination of water.

Books/References:

1. Applied Chemistry- A textbook for engineers and technologist by H.D. Gesser.

2. Engineering Chemistry: by P C Jain & Monika Jain
3. A Text Book of Engineering Chemistry: by Shashi Chawla
4. Engineering Chemistry by N. Krishnamurty, P. Vallinayagam, D. Madhavan

CHS-112: Chemistry for Chemical Engineering

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WATER: Sources, hard & soft water, estimation of hardness by EDTA method, softening of water, zeolite process & demineralization by ion exchangers, boiler feed water, internal treatment methods, specifications for drinking water, BIS & WHO standards, treatment of water for domestic use, desalination - reverse osmosis & electrodialysis.

POLYMERS: Introduction, classification, tacticity, types of polymerization, coordination polymerization, mechanisms of polymerization, synthesis and applications of some important polymers Effect of polymer structure on properties, Moulding of plastics into articles, Conducting polymers: preparation, types, properties and applications.

ELECTROCHEMISTRY: Reference electrodes, Ion selective electrodes, Chemically modified electrodes as sensors, Electrochemical energy systems, lithium batteries, Fuel cells corrosion and its prevention.

SCIENCE OF COMPOSITE MATERIALS: Introduction, Classification, constituents of composites, Fiber reinforced composites, unidirectional fibre reinforced composites, short fibre reinforced composites, particle reinforced composites, important types and failures of fiber reinforced composites, Advantages and applications of composites.

NANOCHEMISTRY: Introduction to nano chemsitry, synthesis, characteristics and applications of carbon nanostructures fullerenes, carbon nanotubes and graphene.

CORROSION AND ITS CONTROL: Introduction, Types of corrosion – chemical and electrochemical, Mechanisms of corrosion, factors affecting corrosion and different protection techniques for corrosion control.

CHARACTERIZATION TECHNIQUES: Introduction to spectroscopy; UV-Visible spectroscopy: Absorption laws, Instrumentation, formation of absorption bands, Theory of electronic spectroscopy, Chromophore and auxochrome concept, fluorescence & phosphorescence, application of UV-Visible spectroscopy ; IR spectroscopy- Principle, theory of molecular vibrations, selection rules, spectral features of some classes of compounds, important features of IR spectroscopy and applications; NMR- Principle, relaxation processes, Instrumentation, shielding-deshielding effects, spin-spin coupling, coupling constant, applications of NMR; MS spectroscopy- Basic principle, Instrumentation, determination of molecular formulae, important features of mass spectroscopy; Chromatography- Introduction, types, gas

chromatography ; thermal method- instrumentation, fundamental principles and applications of TGA, DTA and DSC.

Text Books:

1. P.C. Jain, M. Jain, Engineering Chemistry Dhanpat Rai Publishing Company, New Delhi, 2005.
2. P. W. Atkins and Julio de Paula, Atkins Physical Chemistry l Chemistry,7th Edition, Oxford University Press, New York, 2002.
3. H.D. Gesser. Applied Chemistry- A textbook for engineers and technologist.
4. Shashi Chawla, A Text Book of Engineering Chemistry

MES - 112: Chemistry for Mechanical Engineering

L	T	P
3	1	0

1. POLYMERS:

Introduction, classification, tacticity, types of polymerization, coordination polymerization, mechanisms of polymerization, synthesis and applications of some important polymers Effect of polymer structure on properties, Molding of plastics into articles, Conducting polymers: preparation, types, properties and applications.

2. SCIENCE OF COMPOSITE MATERIALS:

Introduction, Classification, constituents of composites, Fiber reinforced composites, unidirectional fiber reinforced composites, short fiber reinforced composites, particle reinforced composites, important types and failures of fiber reinforced composites, Advantages and applications of composites.

3. CHARACTERIZATION TECHNIQUES:

Introduction to spectroscopy; UV-Visible spectroscopy- Absorption laws, Instrumentation, formation of absorption bands, Theory of electronic spectroscopy, Chromophore and auxochrome concept, fluorescence & phosphorescence, application of UV-Visible spectroscopy ; IR spectroscopy: Principle, theory of molecular vibrations, selection rules, spectral features of some classes of compounds, important features of IR spectroscopy and applications; NMR- Principle, relaxation processes, Instrumentation, shielding - deshielding effects, spin- spin coupling, coupling constant, applications of NMR; MS spectroscopy- Basic principle, Instrumentation, determination of molecular formulae, important features of mass spectroscopy; Chromatography- Introduction, types, gas chromatography ; thermal method- instrumentation, fundamental principles and applications of TGA, DTA and DSC.

4. NANOCHEMISTRY:

Introduction to nanochemsitry, synthesis, characteristics and applications of carbon nanostructures fullerenes, carbon nanotubes and graphene.

5. FUELS AND COMBUSTION:

What is fuel, types of fuel, thermodynamics of combustion, stoichiometry, thermochemistry, adiabatic flame temperature, chemistry of combustion, elementary reactions, chain reactions, multistep reaction mechanism, quantification of emissions, emission control methods.

6. CORROSION AND ITS CONTROL:

Introduction, Types of corrosion – chemical and electrochemical, Mechanisms of corrosion, factors affecting corrosion and different protection techniques for corrosion control.

7. LUBRICANTS: Introduction, Mechanisms of lubrication, Types and selection of lubricants, synthetic lubricants, properties and different methods for testing of lubricating oils and greases.

TEXT BOOKS:

1. Engineering Chemistry: by P C Jain & Monika Jain
2. A Text Book of Engineering Chemistry: by Shashi Chawla

L	T	P
3	1	0

EES - 112: Chemistry for Electrical Engineering

1. POLYMERS:

Introduction, classification, tacticity, types of polymerization, coordination polymerization, mechanisms of polymerization, synthesis and applications of some important polymers Effect of polymer structure on properties, Molding of plastics into articles, Conducting polymers: preparation, types, properties and applications.

2. SCIENCE OF COMPOSITE MATERIALS:

Introduction, Classification, constituents of composites, Fiber reinforced composites, unidirectional fiber reinforced composites, short fiber reinforced composites, particle reinforced composites, important types and failures of fiber reinforced composites, Advantages and applications of composites.

3. CHARACTERIZATION TECHNIQUES:

Introduction to spectroscopy; UV-Visible spectroscopy- Absorption laws, Instrumentation, formation of absorption bands, Theory of electronic spectroscopy, Chromophore and auxochrome concept, fluorescence & phosphorescence, application of UV-Visible spectroscopy ; IR spectroscopy: Principle, theory of molecular vibrations, selection rules, spectral features of some classes of compounds, important features of IR spectroscopy and applications; NMR- Principle, relaxation processes, Instrumentation, shielding - deshielding effects, spin- spin coupling, coupling constant, applications of NMR; MS spectroscopy- Basic principle, Instrumentation, determination of molecular formulae, important features of mass spectroscopy; Chromatography- Introduction, types, gas chromatography ; thermal method- instrumentation, fundamental principles and applications of TGA, DTA and DSC.

4. NANOCHEMISTRY:

Introduction to nanochemsitry, synthesis, characteristics and applications of carbon nanostructures fullerenes, carbon nanotubes and graphene.

5. FUELS AND COMBUSTION:

What is fuel, types of fuel, thermodynamics of combustion, stoichiometry, thermochemistry, adiabatic flame temperature, chemistry of combustion, elementary reactions, chain reactions, multistep reaction mechanism, quantification of emissions, emission control methods.

6. CORROSION AND ITS CONTROL:

Introduction, Types of corrosion – chemical and electrochemical, Mechanisms of corrosion, factors affecting corrosion and different protection techniques for corrosion control.

7. LUBRICANTS:

Introduction, Mechanisms of lubrication, Types and selection of lubricants, synthetic lubricants, properties and different methods for testing of lubricating oils and greases.

TEXT BOOKS:

1. Engineering Chemistry: by P C Jain & Monika Jain
2. A Text Book of Engineering Chemistry: by Shashi Chawla

ECS - 122: Chemistry for Electronics and Communication Engineering

L	T	P
3	1	0

1. POLYMERS:

Introduction, classification, tacticity, types of polymerization, coordination polymerization, mechanisms of polymerization, synthesis and applications of some important polymers Effect of polymer structure on properties, Molding of plastics into articles, Conducting polymers: preparation, types, properties and applications.

2. SCIENCE OF COMPOSITE MATERIALS:

Introduction, Classification, constituents of composites, Fiber reinforced composites, unidirectional fiber reinforced composites, short fiber reinforced composites, particle reinforced composites, important types and failures of fiber reinforced composites, Advantages and applications of composites.

3. CHARACTERIZATION TECHNIQUES:

Introduction to spectroscopy; UV-Visible spectroscopy- Absorption laws, Instrumentation, formation of absorption bands, Theory of electronic spectroscopy, Chromophore and auxochrome concept, fluorescence & phosphorescence, application of UV-Visible spectroscopy ; IR spectroscopy: Principle, theory of molecular vibrations, selection rules, spectral features of some classes of compounds, important features of IR spectroscopy and applications; NMR- Principle, relaxation processes, Instrumentation, shielding - deshielding effects, spin- spin coupling, coupling constant, applications of NMR; MS spectroscopy- Basic principle, Instrumentation, determination of molecular formulae, important features of mass spectroscopy; Chromatography- Introduction, types, gas chromatography ; thermal method- instrumentation, fundamental principles and applications of TGA, DTA and DSC.

4. NANOCHEMISTRY:

Introduction to nanochemsitry, synthesis, characteristics and applications of carbon nanostructures fullerenes, carbon nanotubes and graphene.

5. FUELS AND COMBUSTION:

What is fuel, types of fuel, thermodynamics of combustion, stoichiometry, thermochemistry, adiabatic flame temperature, chemistry of combustion, elementary reactions, chain reactions, multistep reaction mechanism, quantification of emissions, emission control methods.

6. CORROSION AND ITS CONTROL:

Introduction, Types of corrosion – chemical and electrochemical, Mechanisms of corrosion, factors affecting corrosion and different protection techniques for corrosion control.

7. LUBRICANTS: Introduction, Mechanisms of lubrication, Types and selection of lubricants, synthetic lubricants, properties and different methods for testing of lubricating oils and greases.

TEXT BOOKS:

1. Engineering Chemistry: by P C Jain & Monika Jain
2. A Text Book of Engineering Chemistry: by Shashi Chawla

CSS - 122: Chemistry for Computer Science & Engineering

L	T	P
3	1	0

1. POLYMERS:

Introduction, classification, tacticity, types of polymerization, coordination polymerization, mechanisms of polymerization, synthesis and applications of some important polymers Effect of polymer structure on properties, Molding of plastics into articles, Conducting polymers: preparation, types, properties and applications.

2. SCIENCE OF COMPOSITE MATERIALS:

Introduction, Classification, constituents of composites, Fiber reinforced composites, unidirectional fiber reinforced composites, short fiber reinforced composites, particle reinforced composites, important types and failures of fiber reinforced composites, Advantages and applications of composites.

3. CHARACTERIZATION TECHNIQUES:

Introduction to spectroscopy; UV-Visible spectroscopy- Absorption laws, Instrumentation, formation of absorption bands, Theory of electronic spectroscopy, Chromophore and auxochrome concept, fluorescence & phosphorescence, application of UV-Visible spectroscopy ; IR spectroscopy: Principle, theory of molecular vibrations, selection rules, spectral features of some classes of compounds, important features of IR spectroscopy and applications; NMR- Principle, relaxation processes, Instrumentation, shielding - deshielding effects, spin- spin coupling, coupling constant, applications of NMR; MS spectroscopy- Basic principle, Instrumentation, determination of molecular formulae, important features of mass spectroscopy; Chromatography- Introduction, types, gas chromatography ; thermal method- instrumentation, fundamental principles and applications of TGA, DTA and DSC.

4. NANOCHEMISTRY:

Introduction to nanochemsitry, synthesis, characteristics and applications of carbon nanostructures fullerenes, carbon nanotubes and graphene.

5. FUELS AND COMBUSTION:

What is fuel, types of fuel, thermodynamics of combustion, stoichiometry, thermochemistry, adiabatic flame temperature, chemistry of combustion, elementary reactions, chain reactions, multistep reaction mechanism, quantification of emissions, emission control methods.

6. CORROSION AND ITS CONTROL:

Introduction, Types of corrosion – chemical and electrochemical, Mechanisms of corrosion, factors affecting corrosion and different protection techniques for corrosion control.

7. LUBRICANTS: Introduction, Mechanisms of lubrication, Types and selection of lubricants, synthetic lubricants, properties and different methods for testing of lubricating oils and greases.

TEXT BOOKS:

1. Engineering Chemistry by P C Jain & Monika Jain
2. A Text Book of Engineering Chemistry by Shashi Chawla
3. Applied Chemistry by H. D. Gesser
4. Fundamental of Organic spectroscopy by Y. R. Sharma
5. Introduction to nanotechnology by C. P. Poole Jr. and F. J. Owens

Chemistry Courses for B.Tech. Material Science students:

[MSS-113] Chemistry I (Physical Chemistry)

L	T	P
3	1	0

Reaction Dynamics: Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to second order): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.
Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory and activated complex theory of reaction rates, Lindemann mechanism.

Solution Chemistry and Analysis: Principles of electro-chemical methods. Electrochemical reactions and types of electrochemical cells. Arrhenius theory and Debye-Huckel-Onsager theory for electrolytes. Transport numbers and their calculation. Nernst equation. Application of EMF and conductometric measurements in determining (i) free energy, enthalpy, entropy and kinetic parameters of reactions, (ii) equilibrium constants, and (iii) solubility limits of different salts. Commonly used electrode types and their functioning. Concentration cells with and without transference. Liquid junction potential; determination of activity coefficients and transference numbers. Detailed qualitative discussion of potentiometric/conductometric titrations (acid-base, redox, precipitation).

Books and references:

1. Barrow, G. M.; Physical Chemistry, Tata McGraw-Hill, 2007.
2. Castellan, G. W.; Physical Chemistry, Narosa, 2004.
3. Laidler, K. J.; Chemical Kinetics, Prentice Hall, 3rd Ed., 1997.
4. Bard, A. J.; Faulkner, L. R. Electrochemical Methods: Fundamentals and Applications, 2nd Ed., John Wiley and Sons, New York, 2002.
5. Koryta, J.; Dvorak, J.; Kavan, L. Priniciples of Electrochemistry, John Wiley and Sons; New York, 1993.

[MSS-123] Chemistry II (Inorganic Chemistry)

L	T	P
3	1	0

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.
Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods.

Coordination Chemistry: Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu
(coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC system of nomenclature. Crystal Field Theory : Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for Oh and Td complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

Books and references:

1. Huheey, J. E.; Inorganic Chemistry, Prentice Hall, 1993.
2. Shriver, D. F. & Atkins, P. W.; Inorganic Chemistry, Oxford University Press.
3. Lee, J. D.; A new Concise Inorganic Chemistry, ELBS.
4. Cotton, F. A. & Wilkinson, G,; Advanced Inorganic Chemistry. Wiley-VCH, 1999.
5. Greenwood, N.N. & Earnshaw A.; Chemistry of the Elements, Butterworth-Heinemann,1997.

[MSS-133] Chemistry III (Organic Chemistry)

L	T	P
3	1	0

Polymer Synthesis and Properties: Criteria for synthetic polymer formation, Classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems. Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, polycarbonates, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, polydienes, Conducting polymers and industrial applications.

Polymer Sample Analysis: Determination of molecular weight of polymers (Mn, Mw, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index. Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Inorganic Polymers: Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

Books and references:

1. Carraher, C.E.; Polymer Chemistry, Marcel Dekker, Inc., 2003.
2. Odian, G.; Principles of Polymerization, John Wiley, 1991.
3. Billmeyer, F. W.; Text Book of Polymer Science, John Wiley, 1984.
4. Lenz, R. W.; Organic Chemistry of Synthetic High Polymers, John Wiley, 1967.