AMRITA VISHWA VIDYAPEETHAM
M.Phil. CHEMISTRY PROGRAM
(Effective from 2019 admission onwards)

Programme Objectives:

After studying the M.Phil. program, the students will be able to

(i) Introduce the purpose and importance of research for future development.
(ii) Know the different types of literature search and indexes.
(iii) Understand the error analysis, correlation methods and computer application
(iv) Enrich the knowledge in various types of spectral techniques and scientific analysis.
(v) Develop their skills for carrying out the project.
(vi) Make awareness in social and industrial relevant issues.
(vii) Present their findings in national and international seminars and conferences.

Programme Outcome:

After completing the M.Phil program the students will be able to

1. Pursue research program
2. Qualify as Chemist/Scientist in various industries and research Institutions

Curriculum

SEMESTER – I

Course Code	Name of the Course	Hrs/week	Credits
19CHE701	Research and Teaching Methodology	4	4
19CHE702	Advance Scientific techniques in chemical analysis	5	5
	Project oriented elective course*	4	4
19CHE798	Seminar, Field work & Review Writing	5	5
		Total	**18**

SEMESTER – II

Course Code	Name of the Course	Hrs/week	Credits
19CHE799	Project work, dissertation and Viva-voce	-	20
		Total	20
		Total Credits	**38**

LIST OF ELECTIVES

Course Code	TITLE	L T P	Credits	ES
19CHE731	Retrosynthetic Analysis	4 0 0	4	E
19CHE732	Dyes and Pigments*			
19CHE733	Trends in Nanoscience and Nanotechnology*			
19CHE734	Polymer Nanocomposite*			
SS830	Introduction to Nanocomposites	3 1 0	4	E
SS831	Polymer Science	3 1 0	4	E
SS832	Polymer Technology	3 1 0	4	E
SS836	Electro and Photocatalytic Material	3 1 0	4	E
SS837	Industrial galvanization	3 1 0	4	E
SS838	Coating technology	4 0 0	4	E
SS839	Silicon chemistry and drug design	4 0 0	4	E
SS819	Introduction to photochemistry	4 0 0	4	E

* Syllabus will be prepared later

Detailed Syllabus for M.Phil. in Chemistry

19CHE701 RESEARCH AND TEACHING METHODOLOGY 3 1 0 4

1. To introduce the purpose and importance of research for future development.

2. To know the various indexes and abstracts in science and technology as a source of all information in chemistry.

3. To learn the ways of carrying out literature search for current awareness and for the retrospective survey.

4. To know the methodology of writing thesis and journal articles.

5. To know about the teaching methodology for teaching the scientific concepts and techniques to students

Scientific Research Introduction to Research, Selection of a research topic, reviewing the literature, preparing the proposal and design of study Experimentation and interpretation of results. Formation, testing and rejection of hypothesis. Preparation and presentation of reports, dissertation and thesis writing.

Chemical Literature Primary and secondary literature: Journals, Patents, Reviews, Chemical abstracts, treatises, monographs and online journals. Web browsing for Research. ASAP alerts, CA Alerts, Scifinder, Chemport, Science direct, STN international, Journal home pages. Impact factor, citations and h-index. Scopus, Web of Science and Google scholar.

Error Analysis Limitation of analytical methods, accuracy, precision & minimization of errors – systematic and random errors and reliability of results – Mode – Median – Mean – Standard deviation- Variance & Covariance, normal distribution and the normal probability curve Confidence interval, Q test, F test, t test, paired t test.

Correlation methods & Non-parametric tests Scatter diagram and linear regression line: Spearman rank order correlation, Pearson's product moment correlation - Correlation co-efficient. Non-parametric tests - $\chi 2$ test, Median test, Mann-Whitney test, Sign test, Wilcox on matched-pairs signed ranks test.

Methodology of Teaching- Objectives of Teaching, Phases of Teaching – Teaching methods: Lecture Method, Discussion Method, Discovery Learning,Inquiry, Problem Solving Method, Project method, Seminar – Integrating ICT in Teaching: Individualized Instruction, Ways for Effective Presentation with Power Point- Documentation – Evaluation: Formative,Summative& Continuous and comprehensive Evaluation- Later Adolescent Psychology: Meaning,Physical, Cognitive, Emotional,Social and Moral Development– Teaching later adolescents, hands on experience on software handling – chemdraw, origin..

Reference:

1. J. Anderson, B.H. Durstan and M. Poole, Thesis and assignment writing, Wiley Eastern, New Delhi, 1977.
2. R.O. Butlet, Preparing thesis and other manuscript.
3. R. L. Dominoswki, *Research Methods*, Prentice Hall, 1981.

4. J. W.Best, *Research in Education*, 4th ed. Prentice Hall of India, New Delhi, 1981.
5. H. F. Ebel, C. Bliefert and W.E. Russey, *The Art of Scientific Writing*, VCH, Weinheim, 1988.
6. Rajammal P. Devadas, A Handbook of Methodology of Research, S.R.K. Vidyalaya Press, Chennai, 1976.
7. Joseph, A. *Methodology for Research*; Theological Publications: Bangalore, 1986.
8. Sampath, K., Panneerselvam, A. &Santhanam, S. (1984). Introduction to educational technology. (2nd revised ed.). New Delhi: Sterling Publishers.
9. Sharma, S.R. (2003). Effective classroom teaching modern methods, tools & Techniques. Jaipur: Mangal Deep
10. Vedanayagam, E.G. (1989). Teaching technology for college teachers. New York: Sterling Publishers.

19CHE702 ADVANCED SCIENTIFIC TECHNIQUES IN CHEMICAL ANALYSIS 4 1 0 5

1. To master the basic principles of spectroscopy to apply for structural elucidation.
2. To learn the methods of characterizing compounds by spectroscopic techniques.
3. To learn the various instrumental methods studying a given compound.
4. To learn the separation techniques for organic and inorganic compounds.
5. To learn about industrial analytical processes.

Absorption Spectroscopy Infrared and Raman Spectroscopy: FT-IR, basic principles, quantitative IR, resonance Raman and laser Raman spectroscopy, applications of IR and Raman spectroscopy to organic and inorganic compounds. Electronic Spectroscopy: term symbols, spin-orbit coupling in free ions, electronic spectra of *Oh* and *Td* complexes, charge transfer transition, structural evidence from electronic spectra.Chromatographic techniques, HPLC, GC-MS, MS-MS, Woodward-Fischer techniques.

Applications of Advanced Organic Spectroscopy NMR: Basic principles of two-dimensional NMR spectroscopy – HOMOCOSY, HETCOSY and NOESY spectra and their applications – use of INEPT and DEPT methods and their applications. Mass: Molecular ions, isotope peaks, fragmentation pattern – McLafferty rearrangement - measurement techniques (EI, CI FI, FD, FAB, SIMS, MALDI) – M + 1 and M + 2 ions – calculation of molecular formula from PM+1 and PM+2 Road-map problems covering UV, IR, 1H-NMR, 13C-NMR and mass spectral data.

EPR, NQR, Raman, XPS, PES and Mossbauer Spectroscopy: Electron Paramagnetic Resonance Spectroscopy. Principles involved in EPR; Zeeman splitting, energy levels involved. Hyperfine and super-hyperfine interactions, hyperfine splitting constants, g-factor, anisotropy in *g*-value. Instrumental details. Applications of EPR spectroscopy to organic and inorganic compounds. Analysis of EPR spectra; evaluation of g values and hyperfine splitting constants from EPR spectra of both organic and inorganic compounds. Spin-trap reagents like nitrones and the nature of the EPR spectra of spin-trapped compounds. EPR spectra of systems with more than one unpaired electrons, Kramer's degeneracy, Zero field splitting.Raman spectroscopy, principled involved in Raman spectroscopy. Surface Enhanced Raman Spectroscopy (SERS) and its applications. XPS, principles and applications, PES, principles and applications. Nuclear Quadruple Resonance Spectroscopy, principles involved. Mossbauer Spectroscopy, principles involved, isomer shifts, structural elucidation.

Diffraction & Surface Techniques: Principles and applications of XRD, Neutron and electron diffraction – Scanning electron microscopy (SEM)- Instrumentation – applications – surface area analysis, particle size determination – Scanning Probe Microscopes – Scanning Tunneling Microscopes – Atomic force microscopes (AFM) – Principle &applications. BET and Langumir isotherm, SEM-EDX, SIMS, ISS, AES and TOF SIMS.

Electrochemical Techniques Polarography – Chronopotentiometry – Chronoamperometry – chronocontometry- Linear Potential Sweep voltametry – Cyclic Voltametry – Impendence Measurements – AC Voltametry – Principles and their applications, Coulomerty, Pulse voltammetry, stripping techniques

Reference:

1. L. Antropov, Theoretical Electrochemistry, Mir Publication, Moscow, 1972.
2. D.A. Skoog and J.J. Leary, Principles of Instrumental Analysis, 4th Edn., Saunders College Publishing, 1992.
3. D.A. Skoog, F.S.Holler, S.R.Crouch, Principles of Instrumental Analysis, 6th Edn., Thomson Brooks/cole, 2007.
4. G. E. Bacon, Neutron diffraction, Oxford Universtiy Press, Oxford, 1975.
5. R.S. Drago, Physical Methods in Chemistry, Saunders, 1999.
6. Spectrometric Identification of Organic Comounds – Silverstein, Bassler and Morril.
7. Organic Spectroscopy – William Kemp
8. Introduction to Nanoscience- Gabor. L, Hornyak. Joydeep Dutta CRC Press 2008.
9. A.K. Cheetham, P.Day, Solid State Chemistry: Techniques, Oxford University Press, Oxford, 1987.

19CHE798 Seminar, Field work & Review Writing 4 1 0 5

1. **Seminar** : Seminar to be delivered on a relevant theme **(01 credits)**
2. **Field Work** : Visit to industry/National institutes and interaction with experts. (Reportto be submitted) **(01 credits)**
3. **Review** : Preparation and submission of review article based on research papers addressing a contemporary research problem. **(02 credits)**
4. **Other activities** : Attending National / International workshop / Symposium / Conferences or participation for oral / poster presentation or interaction with M.Sc. students for problem solving approaches / Work of Nobel laureates in last ten years in Science. **(01 credits)**

Electives

19CHE731 Retrosynthetic Analysis 4 0 0 4

Unit I Introduction

The disconnection approach, designing a synthesis, FGI, synthons, order of events, choosing a disconnection, synthesis of aromatic compounds, Chemoselectivity in synthesis – One group C-X disconnections – alcohols, ethers, sulphides, alkyl halides, Two group C-X disconnections – 1,1-, 1,2- and 1,3-difunctionalozed compounds. protection and deprotection of functional group including C-C multiple bonds

Unit II C-C bond formations and disconnections

Reversal of polarity, protecting groups in synthesis, cyclisation and radical reactions, amine synthesis, 1,1 and 1,2 C-C disconnections, synthesis of alcohols, carbonyl compounds and carboxylic acids, synthesis of other compounds from alcohols, carbonyl compounds by one group C-C disconnections, enolate chemistry.

Unit III Two group disconnections

Diels-Alder reactions, 1,3-difunctionalized and α, β-unsaturated carbonyl compounds, base catalysed reactions, 1,5-difunctionalized compounds, Michael addition and Robinson annulations, 1,2-difunctionalized compounds, methods using acyl anion equivalents, 1,4- and 1,5-difunctionalized reactions, reconnections,.

Unit IV Ring synthesis

Three, four and five membered ring synthesis and retrosynthesis, pericyclic reactions for ring synthesis, radical and photochemical reactions, six membered rings, aromatic heterocycles, aromatic heterocycles with two heteroatoms, rearrangements in synthesis, electrophilic substitution reactions, named reactions in heterocyclic synthesis.

Unit V Retrosynthesis in action

Advanced strategies, retrosynthesis in industry, stereoselectivity and regioselectivity in synthesis, using alkenes, alkynes and nitro compounds in synthesis, retrosynthetic analysis and synthesis – practice problems. Seminar

Text Books:

1. Organic Synthesis – The disconnection approach by Stuart Warren, John Wiley and Sons, 2004.
2. Organic Chemistry by Clayden, Greeves, Warren and Wothers, Oxford University press, 2001.

References:

1. R. O. C. Norman, Principles of Organic Synthesis, Chapman and Hall 2nd Edition, 1995.

2. Jerry March, Advanced Organic Chemistry, Wiley Interscience, 2001.

SS830 Introduction to Nanocomposites 3 1 0 4

Introduction to Nanomaterials

Introduction to nanomaterial science, Interdisciplinary nature, Structure of nanomaterials, Length scales, de-Broglie wavelength &exciton Bohr radius, Fundamentals of Quantum Mechanics: wave function, Schrödinger equation, uncertainty principle, quantum wells, quantum dots, quantum wires.

Characterization techniques

Introduction to materials and characterization techniques; Spectroscopic methods-UV-Visible and vibrational spectroscopy- Infrared and Raman, Electron spectroscopies- X-ray photoelectron spectroscopy, Ultra-violet photoelectron spectroscopy, Auger electron spectroscopy; X-ray techniques- X-ray diffraction, X-ray fluorescence spectrometry; Optical microscopy, Electron microscopy- SEM, TEM; Scanning Probe microscopies- STM and AFM.

Nanocomposites

Introduction to Nanocomposites, Composite material, Mechanical properties of Nano composite material: stress - strain relationship, toughness, strength, plasticity. Introduction to Nanocomposites, Structure and Properties - Dispersion, Matrix Bonding, and Functionalization, matrix-nanomaterial interactions. Thin film nanocomposites; Modeling of nanocomposites.

Ceramic Matrix Nanocomposites (CMNC)

Mechanical alloying, thermal spray powder method; Polymer precursor route; Spray pyrolysis; Vapour techniques (CVD and PVD) and Chemical methods, which include the sol-gel process, colloidal and precipitation approaches and the template synthesis synthesis

Metal Matrix Nanocomposites (MMNC)

Spray pyrolysis; Liquid metal infiltration; Rapid solidification; Vapour techniques (PVD, CVD); Electrodeposition and Chemical methods, which include colloidal and sol-gel processes.

Polymer Matrix Nanocomposites (PMNC)

Nano coatings, Nano particle dispersion in polymer matrix-processing of polymer nano composites, processing of organic-inorganic hybrid materials. Intercalation of the polymer or pre-polymer from solution; In-situ intercalative polymerization; Melt intercalation; Direct mixture of polymer and particulates; Template synthesis; In-situ polymerization; Sol-gel process. Chemical and electrochemical methods.

TEXTBOOKS/ REFERENCES:

1. T. Pradeep, nano the essentials: UnderstandingNanoscience and Technolgy, McGraw-Hill professional publishing, 2008.
2. Charles P.Poole.Jr.& Frank J.ownes, Introduction to Nano technology - John wielly&sonsInc.Publishers -2006
3. Guozhong Cao, Nano structures and Nano materials: Synthesis, properties and applications, Imperial College press.
4. P.M. Ajayan, L.S. Schadler and P.V. Braun, Nanocomposite Science &Technology,-Wiley-VCH GmbH Co.
5. Z.L. Wang, Characterization of nanostructured materials
6. B. Roszek , The Handbook of Nanotechnology –Wiley, 2005
7. Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers and Architects- Daniel L. Schodek, Paulo Ferreira, Michael F. Ashby (Butterworth - Heinemann
8. Nanostructures and Nanomaterials: Synthesis, Properties, and Applications" (2 nd Edition) (World Scientific Series in Nanoscience and anotechnology) -Guozhong Cao and Ying Wang (Imperial College Press))

SS831	Polymer Science	3 1 0 4

Polymerisation mechanisms

Chemistry of condensation polymerisation, types of condensation polymers. Types of stepwise reactions. Interfacial condensation, Ring opening polymerisation reactivity and molecular size. Poly functional condensation polymerisation gelation, gel point experimental observation, Molecular weight distribution, ring scission polymerisation, Metathesis polymerisation, group transfer polymerisation

Heat and free energy of polymerisation, Cationic polymerisation – mechanisms and kinetics of anionic polymerisation, examples, kinetics and mechanism, co -ordination polymerisation, polymerisation with supported metal oxides. Different types of catalysts, kinetics of step polymerisation, copolymerisation, and reactivity ratios.

Methods of polymerisation

Copolymerization: types of copolymers, the copolymer composition equation,monomer

reactivity ratio and copolymer structure, influence of structural effectsof monomers on monomer reactivity ratios, the Q-e scheme, synthesis ofalternating, block and graft copolymers.Step reaction(condensation) polymerization-kinetics and mechanism of stepreaction polymerization, Carothers equation, number distribution and weightdistribution functions, polyfunctional step reaction polymerization, prediction of gel point. Controlled polymerization methods-nitroxide mediated polymerization, AtomTransfer Radical Polymerization(ATRP), Reversible Addition Fragmentation Termination(RAFT), electrochemical polymerization, metathetical polymerization, group transfer polymerization.

Polymer reactions

Hydrolysis, acidolysis, aminolysis, hydrogenation, addition and substitution reactions, Reaction of various specific groups, cyclisation reaction, cross linking reactions, reactions leading to graft and block copolymer.

Polymer viscoelasticity, introduction to the viscoelastic properties of polymers,some simplelinear viscoelastic models-Maxwell model, Voigt model, seriescombination of Maxwell and Voigt model, generalized linear viscoelasticity, the Boltzman principle, the linear viscoelastic behavior of polymer solids, creepexperiments, stress relaxation experiments, stress-strain experiments, oscillatoryexperiments, the elastic modulus, time temperature equivalence, time-temperaturesuperposition principle.

Rheological properties of polymers -introduction to polymer melt rheology,Newtonian fluids,non-Newtonian fluids, pseudoplastic, thixotropy, St. Venantbody, dilatant, complex rheological fluids, rheopectic fluids, time dependentfluids, time independent fluids, power law, Weissenberg effect, laminar flow,turbulent flow, die swell, shark skin, viscous flow, melt flow index.Transport in polymers-diffusion, liquid and gas transport, Fick's law, theories ofdiffusion.

TEXTBOOKS/ REFERENCES:

1. F.W. Bilmeyer, Textbook of polymer science, Wiley Interscience,1971
2. H. R. Allock and F.W. Lampe, contemporary polymer chemistry, Prentice hall,1981
3. G. Odian, Principles of Polymerisation, McGraw Hill,1970
4. Polymer science and technology, Fried
5. Physical Chemistry of Macromolecules, Tanford, C. John Wiley,1961
6. P.J.flory, Principles of Polymer Chemistry, University Press, London, 1953

SS832 Polymer Technology 3 1 0 4

Polymer processing

Processing methods for the manufacture of products with dry rubber, blending and mastication, master batching of of polymers, mixing and compounding in mills and internal mixers, calendaring, sheeting, fabric coating, extension, moulding. Batch curing methods: autoclave curing, gas curing, over curing, water curing, lead curing, cold curing. Processing methods for plastic products manufacture: methods of mixing, injection, compression and transfer moulding, extrusion, calendaring, thermoforming, blow moulding, rotational moulding and slush moulding.

Polymerization techniques

Bulk polymerization, solution polymerization, emulsion polymerization, suspension polymerization, interfacial polymerization, melt polycondensation, solution polycondensation, solid and gas phasepolymerization.

Polymer testing

Importance of standards and standard organisations. Processability and performance, testing of plastics and rubbers, material characterisation tests such as melt flow index, capillary rheometer test, viscosity test, gel permeation, chromatography, and thermal analysis.

Material characterisation tests for thermosets. Apparent bulk density, bulk factor and pourability of plastics materials. Flow tests such as spiral blow, cup flow, viscosity tests for thermoset resins bubble viscometer, Brookefield viscometer, gel time and peak exothermic temperature of

thermosetting resins.

Polymer properties

Mechanical properties: Tensile strength, flexural and compression properties, creep properties, stress relaxation, impact properties, shear strength, abrasion, fatigue and hardness etc. Thermal properties: heat deflection temperature, vicat softening temperature, torsion pendulum test, thermal conductivity, thermal expansion, brittleness temperature.

Electrical properties; dielectric strength, dielectric constant, dissipation factor, electrical resistance, arc resistance etc. Weathering properties: UV, IR, X-ray, microorganisms, humidity, ozone oxygen, water, thermal energy, chemical factors.

Optical properties: Refractive indices, luminous transmittance and haze, colour, gloss.

Polymer characterisation

Functional group analysis, use of chemical reactions and degradation for structural analysis, various microscopic techniques such as light microscopy, electron microscopy etc. and spectroscopic techniques such as IR, FTIR, NMR,EPR,UV-Visible, Raman, fluorescence etc.

TEXTBOOKS/ REFERENCES:

1. J.A. Brydson, Plastics Materialsa,Butterworths,1989
2. F.W. Bilmer, Textbook of polymer science, Wiley interscience,1971
3. W.A. Holmes Walker, Polymer Conversion, Applied Sciences 1975
4. Maurice Morton, Rubber technology
5. M. Blow, Rubber Technology and Manufacture, Newness, Butterworths,1977
6. R.T Fenner, Principles of polymer processing, Macmillan,1979

SS836 Electro and photocatalytic material 3 1 0 4

Unit 1: Basics of Electrochemistry

Electrochemical cells: Galvanic cell. Half reactions and reversible electrodes: metalmetal ion lectrodes, Gas electrodes – hydrogen electrode, oxygen electrode, oxygen electrode, Metal – insoluble metal salt electrodes – calomel electrode, oxidation – reduction electrode. Over potential. Butler – Volmer equation. The Nernst equation.

Concentration cells: Electrode concentration cells, Electrolyte concentration cells. Ion –solvent interaction. Ion transport. Debye – Huckel treatment. Onsagar equation.

Unit 2: Catalysis

Theories of catalysis: Intermediate compound formation theory of catalysis, Adsorption theory of catalysis. Heterogeneous catalysis: classic gas/solid system, the concept of the active site, promoters, modifiers and poisons. Homogeneous catalysis: elementary steps in homogeneous catalysis, ligand exchange, oxidative addition, reductive elimination, insertion and migration, de-insertion and beta –elimination, nucleophilic attack on a coordination site, industrial examples: Wacker oxidation process.

Unit 3: Hydrogen evolution

Sustainable energy source; renewable energy, hydrogen energy economy, hydrogen production, methods of hydrogen storage, hydrogen as an engine fuel. Hydrogen evolution:,Electrocatalytic and photocatalytic water splitting. Properties of electro/photocatalytic materials. Role of cocatalyst in hydrogen evolving reaction.

Advantages of electro/photo catalyst in hydrogen evolution. Difficulties in the development of electro and photocatalyst.

Unit: 4: Materials and its characterization

Doping with metals- nonmetals as modifiers. Dye sensitized Titania, Coupled semiconductors, conducting polymers as dopant, Supported Titania catalysts. Advanced techniques used in electrocatalysis: Electrochemical impedance analyzer-principle, OCP measurement, UV Visible spectro photometer, Photo simulator. GC analysis for hydrogen evolution rate.

Unit5: Advanced electrochemical methods

Principle and applications of potentio dynamic polarization. Electrochemical impedance analysis : principle, applications, Nyquist and Bode plots, Different circuit used in impedance analysis. Principle of cyclic voltametry. Linear sweep voltametry – linear potential wave form

TEXT BOOKS/ REFERENCES:

1. J.O.M. Bokris and A.K.N. Reddy "Modern Electrochemistry", Plenum.
2. D.R.Crow "Principles and Applications of Electrochemistry" S. Thomes.
3. Hans-Jurgen Butt, Karlheinz Graf, Michael Kappl ;Physics and Chemistry of interfaces,Wiley-VCH VerlagGmbh& Co.
4. Leite, Edson Roberto; Nano Structured Materials for Electrochemical Energy
5. R.de Levie, P.Delahay, Adv.Electrochem.Eng, Vol-6, Inter science, 1967. Production and Storage-2009
6. Antoni Llobet, "Molecular water oxidation catalysis", Wile

SS837 Industrial galvanization 3 1 0 4

Unit 1

Galvanic coatings

Hot dip galvanic coatings: Principle and process, Pretreatment methods – degreasing, pickling, fluxing, Bath modifications – addition of metals and composites. Alloy layer formation (Eta, Zeta, Delta, Gamma) and percentage composition of zinc and iron. Barrier protection. Cathodic protection. Advantages and disadvantages of galvanic coatings. Applications.

Unit 2

Corrosion and its control

Fundamentals of corrosion. Mechanism of corrosion. Types of corrosion, Cause of corrosion Area of corrosion, Corrosion due to utility. Methods of corrosion prevention: cathodic prevention, Anodic prevention, Addition of inhibitors, Protective coatings: Metallic, Organic and Inorganic coatings

Unit 3

Corrosion Kinetics

Faradays laws of electrolysis and its applications in determining corrosion rates, The laws, Corrosion kinetics, Mixed potential theory and its applications, Determination of corrosion by electrochemical measurements, Kinetics of passivity**.**

Unit 4

Selection of materials for corrosive environment

Types of Steel: Plain carbon steels, Alloy steels. Classification of Plain carbon steels: Low carbon steel, Medium carbon steel, High carbon steel - percentage weight of carbon and uses. Manufacturing of steel: Bessemer process, Open hearth process, Heat treatment of steel: Annealing, Quenching, Tempering, Casehardening, Flame hardening, Nitriding and Cyaniding, Design rules for corrosion prevention..

Unit 5

Material characterization methods
Microstructural characterization: Atomic absorption spectroscopic analysis (AAS), hollow cathode lamp, Electrochemicalcharacterization: OCP decay analysis, Self-corrosion rate determination,Polarization analysis and AC Impedence analysis. Advanced techniques used: Polarography: Principle of polarography, Dropping mercury electrode- Advantages and Disadvantages,Ilkovicequation,Residualcurren. Principle and applications of potentiodynamic polarization. Electrochemical impedence analysis: principle, applications, Nyquist and Bode plots, Different circuit used in impedence analysis. Principle of cyclic voltametry. Linear sweep voltametry – linear potential wave form.

TEXT BOOKS/ REFERENCES:

1. Metallurgy and Applications - David Llewellyn, Roger Hudd; Butterworth-Heinemann Publishing
2. Electrochemical methods Fundamentals and applications – Allen J.Bard, LarryR.Faulkner; John Wiley and Sons;Inc.
3. Analytical Chemistry: Principles – John H. Kennedy; Saunders College Publishing
4. Nanotechnology Applications in coatings – Raymond H. Fernado, Li-Piin Sung; ACS
5. Introduction to materials chemistry – Harry. R. Allock: A John Wiley & sons, Inc; Publishing

SS838 Coating technology 4 0 0 4

Unit 1 Introduction to Paints

General introduction to paint industry - definition of paints, varnishes and lacquers their constitution and functions, general classification of surface coatings - decorative and protective coatings**,**

Unit 2 Coatings

Coating methods: Roll coating, spray coating, powder coating, fluidised bed coating, electrostatic powder spray coating, electrostatic fluidised bed coating, vacuum coating, coating materials, binder oils

Unit 3 Binding media, solvents and additives

Fundamentals of film formers, chemical structure of monomers, functionality and its determination, degree of polymerization and molecular weight, non-convertible and convertible film formers, linear, branched and cross linked film formers, homopolymers and copolymers - Manufacture, chemistry and applications of alkyd resins, Polyester resins, Phenolic Resins, amino resins, epoxy resins, polyamide resins, polyurethanes, silicone resins, vinyl and acrylic resins - emulsions - polystyrene and styrene-acrylic emulsions. Solvents, dryers, surfactants and other additives in paints.

Unit 4 Adhesives

Mechanism of adhesion, mechanical interlocking, inter diffusion, adsorption and surface reaction, electrostatic attraction. Surface and interfacial properties, surface topography, surface tension and energy, wetting and setting, thermodynamic work of adhesion. Surface characterization, profilometry, low energy electron diffraction, attenuated total reflection spectroscopy, XFS, ESCA, ion scattering spectroscopy, secondary ion mass spectroscopy. Surface treatment CASING (Crosslinking by Activated Species of Inert Gas) or plasma treatment, corona discharge, acid etching, trans crystallisation growth.
Interfacial chemical bonding, coupling agents, strength of adhesive joints, fracture mechanism of simple joints,

Modes of failure peeling separation, lap shear, tensile detachment from a rigid plane. Tack and auto adhesion, pressure sensitive adhesion, tackifiers, rate of peel and temperature effects in pressure sensitive adhesion, auto adhesion of elastomers.

Unit 5 Durability and ageing

Ageing properties of coatings, weatherometery, natural outdoor durability test accelerated outdoor weathering, artificial weathering tests, defects observed in paint film on exposure.

TEXTBOOKS/ REFERENCES:

1. *Australian OCCA, 'Surface Coating Technology Volume 1', Chapman and Hall, 1974.*
2. *W.M.Morgan, 'Outline of Paint Technology', John Wiley sons, 1990.*
3. *L. S. Pratt, 'Physics & Chemistry of Organic Pigments', Wiley, 1947.*
4. *H.Y. Payne, 'Organic Coating Technology Vol, 1 & 11', John Wiley & Sons, 1954.*
5 *Skiest (Ed) Handbook of Adhesion 111 Ed.VanNonstrand Reinhold, 199.*

SS839 Silicon Chemistry and Drug Design 4 0 0 4

Unit 1 Physicochemical properties of drugs in relation to biological action

Acid-Base Properties, Water solubility, Partition coefficient, drug administration, drug distribution, metabolism (Phase I and Phase II) and toxicity of drug receptor interaction, conformational flexibility and multiple mode of action, optical isomerism and biological activity, selected physico-chemical properties (Ionization, hydrogen bonding and biological action, chelation and biological action, oxidation - reduction potential and biological action, absorption and orientation at surfaces) Enzymes, hormones and Vitamins - representative cases, nomenclature, classification and characteristics of enzymes, mechanism of enzyme action, factors affecting enzyme action, co-factors and co-enzymes, enzymes in organic synthesis, mechanism of enzyme catalysis, enzyme inhibition.

Unit 2 Essentials of drug design

Molecular mimetics, drug-lead modification, drug design using QSAR and computer assisted design, assessment of drug activity, receptors and drug action, mechanism of drug action, drug metabolism pathways, Drug potentiation, drug antagonism and drug resistance

Unit 3 Silicon in medicinal chemistry

Organosilicon molecules with medicinal applications, chemical properties of organic silicon relevant for medicinal chemistry, silicon containing amino acids and analogues, Organosilicon based fluoride acceptors for imaging, Trialkyl silyl derivatives of drugs and biologically active molecules, Hydrophobic quaternary silanes, Increased hydrophobicity of silyl groups & effect on biological activity,

Unit 4 Silicon derivatives

Disilyl&disilacyclic compounds & related derivatives, spirosilanes& other silacyclic derivatives, Diphenyl silane derivatives, Silyl groups as isosteres of quaternary ammonium groups, Silyl ethers as hydrophobic substituents, silicates, silanols, silanediols&silanetriols, Hypervalent silicon compounds, stability of organo silicon compounds, silyl ethers and drug delivery strategies related to silicon, metabolism of organosilicon molecules.

Unit 5 Medicinal agents

Medicinal agents belonging to alkaloids, steroids, polypeptides, modified nucleic acid bases, sulphonamide and sulpha drugs, antibacterials - sulpha drugs, substituted sulphonamides, anticonvulsants, anticoagulants, antiamoebic agents, antihelmintic agents, anti-malarial agents, diuretics and cardio vascular agents, drugs for AIDS, medicinal agents affecting CNS, analgesics, antipyretics, antiseptics and disinfectants.

TEXTBOOKS/ REFERENCES:

1. *John M beak and John H Block, 'T Wilson, O. Gisvold and R. F. Deorge - Text book of Organic, Medicinal and Pharmaceutical Chemistry', 7th edition, J.B. Lippincott Williams and Wilkons Company, 1977.*
2. *A.Burger, 'Medicinal Chemistry', 3rd edition, Wiley Interscience, 1970.*
3. *V.K.Ahluwalia and Madhu Chopra, 'Medicinal Chemistry', Ane Books pvt Ltd, 2008.*
4. *V.Kothekar, 'Essentials of Drug Designing', 14th edition, Dhruv publications, 2005.*
5. *V.K.Ahluwalia, LalitaS.Kumar and Sanjiv Kumar, 'Chemistry of Natural Products', Ane Books India.*
6. *L.P.Graham 'An introduction to Medicinal Chemistry', 3rd edition, Oxford University Press, 2005.*
7. *Fujii S and Hashimoto Y; Progress in the medicinal chemistry of silicon: C/Si exchange and beyond;. Future Med Chem. 2017 Apr; 9(5):485-505.*
8. *Franz AK1, Wilson SO; Organosilicon molecules with medicinal applications; J Med Chem. 2013 Jan 24;56(2):388-405*

SS819 Introduction to Photochemistry 4 0 0 4

Unit-1 Light induced processes in everyday life

The Nature of Light, Photosynthesis, Vision, Photoresponse Mechanisms in Plants and Animals, Photomedicine, Photochemical effects of Visible and UV light, Bioluminescence, Photodegradation, Imaging processes

Unit 2 - Photochemistry - Principles and Reactions

Rates of absorption,-EinsteinBeerLaw, FluorescenceLambert'slifetimes, quantumLaw, Star yield; Fluorescence, Phosphorescence, Jablonski diagram, cis-trans isomerisation, Paterno-Buchi

reaction, Norrish Type I and II reactions, photo reduction of ketones, di-pimethane rearrangement, photochemistry of arenes, Hoffmann-Loffler-Freytag reaction, Barton reaction, Photochemistry of cyclohexadienones.

Unit 3- Excited state processes

Adiabatic and Non-adiabatic processes, Monophotonic and multiohotonicproceses, Primary and secondary photochemical processes,kinetics of photochemical reactions, photo-ionization , light induced electron capture and electron transfer reactions, Intramolecular and intermolecular electron transfer, Marcus-Hush Model of Electron transfer, Electronically excited molecules-Excimers and Exciplexes, Charge transfer in excited states, twisted intramolecular charge transfer state, quenching of excited states, Stern Volmer equation, electron transfer, energy transfer,paramagnetic quenching, concentration quenching, static and dynamic quenching

Unit 4-Mechanisms of Photochemical reactions

Organic Photochemistry -Quenching, Sensitization, Unimolecular and bimolecular reactions, Photoelectrochemistry-reactions at electronically excited semiconductor electrodes, Inorganic photochemistry, photochemistry and photophysics of metal complexes, Photochemistry in solids and organized assemblies, Photochemical reactions in glasses, excitons in polymers and crystals, photochemistry in micelles, photochemical reactions of free radicals

Unit 5- Light in Industry

Photographic processes-Spectral sensitization, Colour photography, Instant photography,

Electrophotography, Photopolymerisation and photochemical degradation of polymers, Phototchemistry in synthesis –photochlorination of polymers, Synthesis of caprolactam, Vitamin D, Photochemistry of Dyes and Pigments, Phtochromism, Energy conversion and storage – photoelectrochemicalcells,Ozone layer-its photochemical formation and degradation.

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2. Chemistry and Light- P. Suppan (RSC 1999)
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4. Organic Photochemistry- James MorrissCoxon, Brian Halton, (Cambridge University Press, 1987)
5. Principles of Organic Synthesis- R.O.C. Norman &Coxon (CRC Press; 1993)
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7. Essentials of Molecular Photochemistry - A Gilbert and J Baggott (Blackwell,1991)
8. Principles and applications of photochemistry- R. P. Wayne (OUP 1988)
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