VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in

INDUSTRIAL CHEMISTRY

SYLLABUS

Master of Science

(III Semester)

With effect from

2021-22

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Department of Industrial Chemistry

Jnana Sagara, Ballari - 583105

Distribution of Courses/Papers in Postgraduate Programme I to IV Semester as per Choice Based Credit System (CBCS) Proposed for PG Programs

III – SEMESTER

With Practical

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
THIRD	DSC9	21ICH 3C9L	Spectroscopy	30	70	100	4	-	-	4	3
	DSC10	21ICH3C10L	Unit Operations	30	70	100	4	-	-	4	3
	DSE1	21ICH3E1AL	DSE 1/1 :Polymer Chemistry	30	70	100	4	-	-	4	3
		21ICH3E1BL	DSE 1/2 :Water Management in Industries								
		21ICH3E1CL	DSE 1/3 :Quality control and environment, health and safety measures								
	DSE2	21ICH3E2AL	DSE 2/1 : Industrial materials	30	70	100	4	-	-	4	3
		21ICH3E2BL	DSE 2/2 : Industrial Management and Pollution monitoring and control								
		21ICH3E2CL	DSE 2/3 : Chemical Analysis in Agro, Food and Pharmaceutical Industries								
	GEC1	21ICH3G1AL	GEC 1/1 : Green chemistry	20	30	50	2	-	-	2	1
		21ICH3G1BL	GEC 1/2 : Bio Inorganic Chemistry								
		21ICH3G1CL	GEC 1/3 : Adsorption and Surface Phenomena								
	SEC3	21ICH3S3 LP	Instrumental methods of Analysis (1L + 1P)	20	30	50	1	-	2	2	1
	DSCL	21ICH3C7P	Interpretation of Spectra of the compounds	20	30	50	-	-	4	2	4
	DSCL	21ICH3C8P	Analysis of Industrial Materials	20	30	50	-	-	4	2	4
Total Marks for III Semester						**600**				**24**	

III SEMESTER

DSC 9: Spectroscopy

Course Code: 21ICH3C9L **Course Credits: 04**

Total Contact hours: 56 **4Hours/week**

Internal assessments: 30 Marks

End semester exam Marks: 70

Course objective:

Students to get the in depth knowledge on the interaction of molecules and atoms with the light. Behaviour of the atoms and molecules, energy levels of molecules and to characterize the molecules based on their electromagnetic interactions with light.

Students also should understand the Mossbauer and spin resonance effects of the compounds

Course outcomes:

Students should be able to differentiate between various spectroscopic principles

1. Able to characterize the molecule by identifying the absorption mode in the infra-red region
2. Understand the principles of various spectroscopic techniques
3. Have a clarity on interpretation of the spectra of the compound
4. Understand the factors affecting the spectra of the compounds
5. Understand the NMR appearance of organic compounds
6. Able to Explain the Mossbauer principles and ESR principles
7. Know the instrumentation of various spectroscopic techniques

Course outlines Unit

I: Rotational, Vibrational and Raman Spectroscopy

Microwave Spectroscopy

The rotation of molecules – rotation spectra of diatomic molecules – the rigid diatomic molecule – rotational energy levels – selection rules – effect of isotopic substitution – the non rigid rotator – spectrum of a non rigid rotator – polyatomic linear molecules – techniques and instrumentation.

Vibrational Spectroscopy

Vibrating diatomic molecule – simple harmonic oscillator – vibrational energy levels – anharmonic oscillator selection rules – fundamental vibrations, overtones and hot bands – diatomic vibrator rotator, vibration rotation spectra of carbon monoxide – interaction of rotation and vibration – Breakdown of Born – Oppenheiner approximation

Raman Spectroscopy:

Classical theory of Raman Effect – rotational Raman spectra – Linear – Vibrational Raman Spectra – Instrumentation

[12 Hours]

Unit II: Infrared Spectroscopy

Introduction – Molecular vibrations – Mode of Vibrations, calculation of vibrational frequencies, instrumentation-– FT – IR Spectrometer. Sampling techniques, interpretation of IR spectra factors affecting group frequencies and band shapes – Physical state of samples vibrational coupling, electrical and inductive effects, Hydrogen bonding and ring structures, co-relation chart, important regions in the IR spectrum – H stretching, triple bond, double band stretching, finger print region, applications of IR spectroscopy in the structural elucidation of organic. Compounds, application of far IR spectroscopy – Limitations of IR spectroscopy. (Problems & Exercise). IR spectra of coordination modes of ligands like nitrate, thiocynate, sulphate, carbonate (bridging, bidentate etc.,), and water.

[12 Hours]

Unit III: Electronic Spectroscopy and Mass Spectrometry

Electronic Spectroscopy

Types of absorption bands, modes of electronic transitions, simple chromophoric –auxochrome theory, Solvent effect and choice of solvent. Prediction of □-max value by using Wood-Ward and Fieser rules for conjugated diens, trienes and cyclic □, □ unsaturated aldehydes and ketones, Instrumentation (single beam and double beam spectrophotometers). Quantitative applications of UV-Visible spectroscopy in structural determination

Mass Spectrometry:

Introduction – Basic theory, ionsation, types of ions – molecular ion, fragment ion, meta stable ion, base peak, instrumentation, factors affecting fragmentation, intensity of M^+ peaks of alkanes, alkenes, alkynes, alcohols, amines, aldehydes and other compounds, Mc Laffarty rearrangement nitrogen rule, some simple examples of fragmentations, applications of mass spectrometry. GC-MS and LC-MS

[12 Hours]

Unit IV: NMR Spectroscopy

HNMR Spectroscopy

Introduction – Nuclear spin and magnetic moment, origin of NMR spectra, Theory of NMR spectroscopy, resonance flipping, instrumentation and sampling, inter preparation of NMR spectrum, equivalent and non-equivalent protons, chemical shifts(down field and up field), factors influencing chemical shifts, anisotropic effects, NMR scale, units, internal references, simple and complex splitting / coupling, coupling constant, correlation chart of chemical shifts, spin-spin relaxations, deuterium exchange techniques limitations of H NMR spectroscopy – Introduction and applications of ^{13}C NMR spectroscopy, 2 DNMR spectroscopy, use of PMR spectrum in structural elucidation of organic compound.^{31}P and ^{10}F NMR spectra of simple organic molecules, phosphates, polyphosphates, PH_3, phosphor halides, fluoro acetic acid, SF_4, P_4S_4, HPF_2.

[10 Hours]

Unit V: ESR and Mossbauer spectroscopy

Electron Spin Resonance Spectroscopy:

Introduction - Presentation of spectrum – ESR transitions and selection rules Hyperfine splitting in various structures – Factors affecting “g” values. Zero field splitting and Kramer’s degeneracy Anisotropy in Hyperfine coupling constant – Nuclear Quadrupole interactions – Spin Hamiltonian – Electron delocalization instrumentations and applications

Mössbauer Spectroscopy

Introduction – Mössbauer effect – Resonance absorption of gamma rays conditions for Mössbauer spectroscopy – Mössbauer parameters – Isomer shift – electric quadruple interaction – Magnetic interactions – Instrumentation & applications to $Fe_3(CO)_{12}$, Prussian blue, Oxyhemerythrin, Hexacyano ferrates, Netroprusside and Tin halides

DSC 10: Unit Operations

Course Code: 21ICH3C10L **Course Credits: 04**

Total Contact hours: 56 **4Hours/week**

Internal assessments: 30 Marks **End semester exam Marks: 70**

Course objectives: Students should learn the engineering and industrial aspects of chemistry. Acquire a knowledge on industrial measurement systems. Understand the basic reactions principles. Different methods employed in the industrial production, construction materials and designing of industrial equipments

Course outcomes: students will be able to

1. Gain a knowledge on material balance equation and solve the problems related to material balance and energy balance
2. Know about the different types of thermometers and the measurements systems
3. Know the principle and types of extractions. Able to solve the problems related to extractions
4. able to understand the evaporation process in industries
5. Explain the evaporation process, types and equipments for evaporation
6. should be able to understand the drying process and different types of dryers used in industries

7 Able to understand the crystallization and filtration process

Course outlines

Unit I: Material and energy balance and Industrial Measurements

Material balance: Process classification, Choice of system and basis of molecular processes with chemical reactions, Material balance calculations, Multiple unit processes, Recycle and bypass
Energy balance: Forms of energy, Energy balance, Energy changes in physical processes, Energy changes in reactions, Energy balance Calculations
Measurement of temperature, Thermo couples and pyrometers, High temperature thermometers, Optical pyrometers
Measurement of pressure and vacuum, Manometric and Bourdon gauges, Vacuum gauges, Ionization and pirani gauges. Flow measurement, Pitot tube, Rotameters
Liquid level indicators. Hook Type, Sight glass, Float type, Capacitance level indicator, Radiation level indicator

[10 hours]

Unit II: Extraction, Evaporation, and Drying

Extractions:

Liquid equilibria, Extraction with reflux, Extraction with agitation equipment, it's use and performance, continuous contact equipment, agitator extractors, packed spray extractors, Leaching, flow sheets of solid-liquid extraction,
continuous leaching, counter current extraction
Evaporation;

Types of evaporators, jacketed, horizontal and vertical tube evaporators, forced circulation evaporations, entrainment separators (upturned, deflector type, tangential type), effect of scale formation, multiple effect evaporators
Drying:
General Principles (Significance, moisture content), Rate of drying (Constant & falling rate period, factors affecting drying), Drying equipments, Tray dryers, Rotary dryers, Single Drum dryer & Spray dryers.

[12 hours]

Unit III : Filtration, Distillation and Crystallization

Filtration:
Classification of filters, Sand filters, filter press, plates & frame press, filter aids, principles of leaf filters
Distillation:
Boiling and distillation, vapor-liquid equilibria, Rault's law & Henry's law, relative volatility, azeotropic mixtures, flash distillation, steam distillation, vacuum distillation, fractional distillation, plate columns (Bubble cap, Sieve plate & Valve plate)
Crystallization:
Growth of Crystal, saturation, nucleation supersaturation, (Mier's theory), Caking of crystals, effect of impurities, Classification of crystallizers, Agitated tank, Swenson walkers, Krystal, Oslo, continuous vaccum crystallizers

[10 hours]

Unit IV: Equipment design: Materials of construction and design of vessels

Material of constructions: Mechanical properties, Corrosion resistance. Plastics, Ceramics. Metals and alloys, Stainless steel, Special material for food and pharmaceutical equipment. Protective coatings, Surface treatment to metals for corrosion resistance
Design of Vessels: Classification of chemical reactors, pressure vessels for internal or external pressure, Maintenance, Storage vessels for liquids and gases.
Design of chemical reactors, Reactors with chemical addition, agitation, heating, removal of vapours, gas addition

[12 hours]

Unit V: Heat and mass Transfer

Flow of Heat:
Introduction, Conduction (Fourier law, Thermal conductivity, thermal insulation & problems), Convection (rate of heat transfer and heat transfer coefficients), Radiation (Absorptive, Reflectivity, & Transmissivity, Kirchoff's law concept of
black body & examples)

Heat Exchange Equipments:
Introduction, Double Pipe, Shell& tube, Fixed tube, U tube heat exchangers

[12 hours]

References:

1. Roger's Manual of Industrial Chemistry, C.C. Furna's (Editor) VI Edition, Vol.-I, D. Van Nostrand Co., Inc.
2. Unit Operations of Chemical Engineering, W.L. Mc. Cab & J.C. Smith.
3. Chemical Engineer Operations, Rumford.
4. Shrev's Process Industry, George T Austion.
5. Transport Phenomenon, R.B. Bird, E.W. Stewuart and E.N. Lightfort.
6. Principles of Management, R.C. Tripathi and P.N. Reddy.
7. Essentials of Management, I.L. Hessie.
8. The Practice Management, P.F. Drucker.

DSE 1: A: Polymer Chemistry

Course Code: 21ICH3E1AL **Course Credits: 04Total Contact hours: 56** **4Hours/week**

Internal assessments: 30 Marks **End semester exam Marks: 70**

Course objective: student should learn about polymers and polymer processing techniques. Basic concepts, types of polymers and polymer characterization.

Course outcome:

Students should be able to explain

1. Polymerizations, types of polymerizations and meaning of different terminologies of polymers
2. Testing of polymers
3. Characterize the polymers
4. Different polymers production (commercial polymers)
5. Morphology and order in crystalline polymers
6. Properties of commercial polymers
7. Solution properties of polymers

Course outlines

Unit I: Importance of polymers. Basic Concepts

Importance of polymers. Basic Concepts:

Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: Condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogenous and heterogeneous systems, Polymerization Techniques.

Polydispersion-average molecular weight concept.
Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance.

[12 Hours]

Unit II: Morphology and order in crystalline polymers

Morphology and order in crystalline polymers - configurations of polymer chains. Crystal

structures of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting.
Polymer structure and physical properties-crystalline melting poit Tm-melting points of homogenous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, Tg-Relationship between Tm and Tg, effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization

[12 Hours]

Unit III: Testing of Polymers

Testing of Polymers: Need for testing-specifications and standards, mechanical-short term (tensile, fluxural, impact, tear resistance, abrasion resistance etc.,) long term (creep and fitigue). Electrical-conductivity, volume resistivity, surface, breakdown voltage, dielectric constant, loss factor, thermal coefficient of thermal expnasion, heat distortion temperature, vicat softening point, low temperature, properties, thermal conductivity.

Solution properties of polymers:
Polymer dissolution, criteria, thermodynamics, Floury-Huggins theory, nature of polymer molecules in solution, their size and shape, theta solvent, theta temperature, thermodynamics of mixing, solution viscosities

[12 Hours]

Unit IV: Polymer production

a. Polyethylene (HDPE, MDPE, LDPE, LLDPE, UHMWPE, chlorinated PE),
b. Polypropylene (PP),
c. Polyisobutylene (PIB)),
d. Acrylics (PMMA & PAN)
e. Polyvinyles (PVC, PVDC & CPVC),
f. Polystyrene & copolymer (HIPS, SBR, SAN & ABS)
g. Poly(vinyl acetate)
   i. Phenol formaldehyde (PF- Novolak and resol)
   ii. Urea formaldehyde (UF)
   iii. Melamine formaldehyde(MF)
   iv. Polyamides:- Nylon-6, Nylon-6, 6 & Kevlar.

[10 Hours]

Unit V: Polymer processing and Properties of commercial polymers

Polymer processing:

Plastics, electomers and fibres, compounding. Processing techniques; calendaring, die casting, rotational casting, film casting, injection molding, blow molding extrusion molding, thermoforming, foaming reinforcing and fiber spinning

Properties of commercial polymers:

Polyethylene, polyvinyl chloride, polyamides, polyester, phenolic resins, epoxy resins

and silicon polymers. Functional polymers- fire retarding polymers and electrically conduction polymers, Biomedical polymers: contact lens, dental polymers, artificial heart, kidney skin and blood cells.

[10 Hours]

References:

1. Text book of Polymer Science (3rd edition) F.W.Billmayer, A Wiley-Interscience, 1984
2. Contemporary Polymer Chemistry (2nd edition), H.R.Allcock and F.W.Lampe, Prentice Hall, Englewood Cliff's, NewJersy 1981
3. Polymer Science, V.R.Gowswamy424784ariker, N.V.Viswanathan and Jayadev Sreedhar, New Age International (P) Limited, August 1996.
4. Introductory Polymer Chemistry, G.S.Misra, Wiley Eastern Limited, 1993
5. Polymer Science and Technology of Plastics and Rubbers, Premamoy Ghosh, Tata McGraw Hill,1990
6. Polymer characterisation, Physical Techniques, D.Campbell and J.R. White, Chaopman and Hall,1989.
7. Principles of Polymer Science Systems, F.Rodriguez, McGraw Hill Book co., 1970.

DSE 1: B: Water Management in Industries

Course Code: 21ICH3E1BL | Course Credits: 04

Total Contact hours: 56 | 4Hours/week

Internal assessments: 30 Marks | End semester exam Marks: 70

Course objective: water is the important solvent used in the industries for the various purposes. Hence quality of the water and purification and recycling are of paramount important. This paper focus on giving the detailed knowledge to students on properties and quality of water, water management, purification of water, water pollution and treatment of effluents.

Course outcomes:

Students should

1. Know the sources, industrial uses of water
2. Aware the water pollution and causes of pollution
3. Know the different water polluting chemicals
4. Able to manage the effective use of water
5. Able to understand the different water purification techniques
6. Able to analyse the water pollution and gain a knowledge on prevention of pollution

Course outlines

Unit I: Properties and Quality of water:

Properties of water:Introduction, chemistry, uses, sources and quality of water, water for industry, water in human body, effect of water on rocks and minerals, organic, humic and colloidal matter in water. Water pollution: Definition, types of water pollution (Physical, Chemical, biological and physiological), water pollutants. Ground water pollution and its protection, Surface, river, sea and lake water pollution, effect of excess nutrients and oil on water pollution,

Marine pollution and episodes, measures against oil spills, Sewage, domestic, agricultural thermal, radioactive, industrial pollutants and siltation, Effect of toxic metals, fertilizers and detergents on water pollution, Inorganic and organic pollutants and their effects on pollution, eutrophication and pesticide pollution.

[10 Hours]

Unit II: Water Management

Water Management: Introduction, use and conservation of water resources, water quality management, rainwater harvesting, water management in agriculture rain fed systems, irrigated systems, industries, Sea water for agriculture, remedial measures for water pollution.

Industrial waste treatment: Characteristics and types of industrial waste, principles of industrial waste treatment and disposal, protection of

biosphere and surface water form industrial pollution.

[10 Hours]

Unit III: Purification of water

Purification of water: portability of water, removal of coarse, dispersed and colloidal impurities, clarification and coagulation (Contact and electrochemical) of water, determination of hardness, Flocculants, Sterlization (Chemical and physical methods) fluoridation, defluoridation and disinfection of water, softening of water (Clark's, lime soda, modified lime soda, Permutit and ion exchange process)

Demineralization, desalting (electro dialysis and reverse osmosis methods) and deoxygenation of water, removal of slime, algae, smack, iron, manganese, silicic acid and odour from water, Magnetic treatment of water.

[12 Hours]

Unit IV: Prevention and analysis of water pollution

Prevention, control of water pollution and its best use, Chemical and physical examination and measurement of quality of water, chemical substances affecting potability, odour, taste, temperature and electrical conductivity of water,suspended and dissolved solids, acidity and alkalinity of water, free carbon dioxide and chlorine. Chlorine demand. Analysis of calcium, magnesium, iron, manganese, silver and zinc in water. Determination of ammonia, nitrate, nitrite, cyanide, sulphate, sulphide, chloride and fluride. Determination of arsenic, beryllium, chromium, copper, lead, selenium and mercury

[12 Hours]

Unit V: Treatment of Industrial Effluents

Pollutants from industrial effluents –sources, effects on streams, sewers, land – organic load on rivers. Basic theories of Industrial waste water management. Inplant survey– composite sampling

– Tolerance limits for eflluents discharges into inland surface water's public sewers, and on land for irrigation – standards.

Volume and strength reduction, neutralization, equalization and proportioning, recovery and recyle of waste products and bye products – joint treatment of Industrial wastes and domestic sewage – discharge into water bodies, consequent problems.

Treatment of Industrial waste from distilleries, dairy, fertilizer plant, steel plant. Oil refiners, pharmaceutical plants, Thermal Power Plants, and radioactive wastes. Treatment units for the above industrial effluents.

[12 Hours]

References:

1. Wastewater Treatment by M. N. Rao and A. K. Datta–Oxford I. B. H publishers
2. Handbook of Industrial Waste Disposal by Richard A. Conway Richard Ross– Van Nostrand publisher (1980)
3. Industrial Waste Treatment: Contemporary Practice and Vision for the Future by Nelson Leonard Nemerow, Nemerow – Butterworth Weinemann publisher (2006)

DSE 1: C: Quality control, environment, health and safety measures

Course Code: 21ICH3E1CL | Course Credits: 04
Total Contact hours: 56 | 4Hours/week
Internal assessments: 30 Marks | End semester exam Marks: 70

Course objectives: students should learn about various quality management systems and their importance. Students should know about the essential practice of a laboratory and safety measurements. Students should also learn about air pollution

Course outcomes:

1. Students should be able to adhere a strict safety rules in the laboratories
2. Should be able to perform the error free preparation of different chemicals of varying concentration
3. Gain the knowledge quality control aspects of industries
4. Gain a knowledge on air pollution analysis and control of air pollution
5. Understand the concepts of soil pollution
6. Understand the causes of soil pollution

Course outlines

Unit I : Quality Control and Quality Assurance

Statistical Quality Control Techniques: Statistical treatment of data. Control charts, Performance Evaluation uncertainties in measurement. Validation of analytical methods. Quality Assurance: Elements of quality Assurance, Quality Management System Quality management concepts and principles: ISO 9001:2000 QMS Case studies on ISO 9001: 2000 in chemical industries. ISO 14000 Series of Standards. TQM in Chemical Industry. Six Sigma Approach to Quality: Applying Six Sigma to chemical Industries. Good Laboratory Practices: Principles of GLP, GMP (erosion, chemical degradation and physical degradation). Sources of pollution (e.g. urban areas, industrial areas, agriculture and livestock, landfills, sewage sludge, municipal solid waste dumps and hazardous waste) and types of contaminants expected. Soil quality.
Irrigation water as a source of soil contamination.
Applying fertilizer to the soil: The case of phosphorus, nitrogen and nitrates. Typical dose-response curve for the macro, meso and micro-nutrients and toxic trace elements. Risks of soil contamination. Risk of groundwater contamination. Eutrophication. Good Agricultural Practices

[10 Hours]

References

1. M. N. Rao and H V N Rao, “Air pollution”, Tata Mc-G raw Hill Publication.
2. H. C. Perkins, “Air pollution”. Tata McGraw Hill Publication
3. Mackenzie Davis and David Cornwell, “Introduction t o Environmental Engineering” McGraw-Hill Co.
4. S Banerjee, Industrial Hazard and Plant Safety, Tayor & Francis, 2003.
5. DanielA. Crowl, Joseph F. Louvar, Chemical Process Safety: Fundamentals with Applications - Prentice Hall, 2002.
6. David.L. Goetsch,“The Safety and Health Handbook” Prentice Hall, 2000.

7. F P Lees, Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control,ButterworthHeinemann, 1996
8. McBride, M.B. (1994). Environmental Chemistry of Soils. Oxford University Press. International Edition.
9. Kearney, P.C., Roberts, T. (Editors) (1998). Pesticide Remediation in Soils and Water. John Wiley and Sons. International Edition.

DSE 2: A: Industrial materials

Course Code: 21 ICH3 E2AL | Course Credits: 04

Total Contact hours: 56 | 4Hours/week

Internal assessments: 30 Marks | End semester exam Marks: 70

Course objective: students to learn on common and special industrial materials namely Drugs, Dyes and detergents, Rubber and Rubber like products, leather chemistry, fertilizers, paints and emulsions, explosives and adhesives**.**

Course outcomes:

1. Students must be able to know the chemistry of different dyes, their constituents and classification
2. Students should be able to know important drugs, their production and uses
3. Students should be able to classify the detergents and manufacturing
4. Student able to write the chemical equations for the production of various types of rubber
5. Students able to work in leather industries
6. Able to know the production of nitrogen, phosphorous and potassium containing fertilizers
7. Students gain a knowledge on different types of explosive and their production and use
8. Able to produce and use the adhesive

Course outlines

Unit I: Dyes, Drugs and Detergents:

Dyes-colour and constitution, classification, dyeing, some typical dyes-nitroso, nitro, azo, anthene and anthro-quinone dyes. Methods of application of dyes of fibres.

Drugs; Definition, Classification, nomenclature,drug action, methods of drug action assay, synthesis and applications of Antiseptics- chloramines-T,vioform , antihistamines-benadryl, phenandamine , CNS stimulants-coramine,amphetamine, Antibiotics-pencillin,chloroamphenicol , Antineoplastic agents-chlorambucil, mechlorethamine , Anesthetics-thiopental sodium, fentylcitrate,benzocaine, Antipyretic&analgesic drugs-chinchophen,phenacitin.

Detergents– Introduction, classification-anionic, cationic, non-ionic and amphoteric detergents, biodegradability of surfactants and manufacture of shampoos.

[10 Hours]

Unit II: Rubber and Rubberlike Products:

Rubber plantation, manufacture of natural rubber from latex, chemistry of natural rubber, compounding of rubber, vulcanization of rubber, Rubber products, synthetic rubbers-synthesis and applications of-Buna-S, Buna-N, styrene rubber, butyl rubber, neoprene rubber, Thiokol rubber, Hyplon rubber, poly acrilonitrile, polyisoprene rubber**.**

Leather Chemistry;

Hides and skins, classification of hides and skins, structure of animal skin, hide damages, pre-tannage processes, inhairing, bating and pickling. The tanning processes-chrome tanning, vegetable tanning, vegetable tanning materials, tanning extracts, miscellaneous tannages and finishing processes. Commercial aspects of the leather industry and the Fur industry.

[12 Hours]

Unit III: Phosphorous, potassium and nitrogen Industries

Phosphate rock, superphosphate, phosphoric acid, phosphates, baking powders, fire retardant chemicals.

Potassium chloride, sulphate, bisulphate, hydroxide, carbonate, acid tartarate, permanganate and dichromate.

Synthetic ammonia, ammonium nitrate, sulphates, phosphates, urea, nitric acid, cyanamide

[12 Hours]

Unit IV: Paints and Emulsions

Paints – Introduction and Definitions of paints, pigments, varnishes, lacquers, Anatomy of paints, functions & requirements of constituents of paints, classification of paints on the basis of order of application/ methods of curing / nature of solvent/ uses etc.

Paint Properties - color, tinting strength, reducing power, pigments classification of pigments, pigments properties-oil absorption, refractive index, particle size shape, bleeding, resistance to light and heat.

Manufacture of Paints

Ball mill, triple roll mill, bead mill, titrator, high speed and heavy-duty disperser.

[12 Hours]

Unit V: Adhesives and Explosives

Adhesives:

Introduction, theories of adhesion, advantages and disadvantages of using adhesives, chemistry and uses of adhesives, natural product based adhesives, pressure sensitive adhesives, hot melt adhesives, solvent and emulsion based adhesives.

Explosives:
Classification, characteristics, preparation of explosives, nitro cellulose, TNT, Dynamite, Cardite, Gun Powder, Lead azide and RDX.

[10 Hours]

References

1. Outlines of Paint Technology, W. M Morgan 3rd edn CBS Publishers.
2. Paints, Coatings and solvents, Dieter Stoye, Werner Freitag, Wiley VCH Pub

DSE 2: B: Industrial Management and Pollutionmonitoring and control

Course Code: 21 ICH3 E2BL | Course Credits: 04

Total Contact hours: 56 | 4Hours/week

Internal assessments: 30 Marks | End semester exam Marks: 70

Course objective: students should have the awareness of industrial management and environmental policy that helps for a start ups in chemical industries and for establishment of small scale industries. Students should also aware of removal of health hazardous and prohibited chemicals from the mother products.

Course outcomes: after the completion of course, students should be able to

1. Have a clarity on the governmental policy pertaining to environmental protection
2. Get an idea of establishing the industries
3. Able to solve the management problems while setting up of industries
4. Able to solve the management problems in established industries.
5. Able to identify the sourses of sulphur contaminants and their removal techniques
6. Knowledge on removal of phenolic residues and analytical methods for quantification of phenolic residue
7. Able to analyze and quantify the heavy metals

Course outlines

Unit I*:* Industrial Management:

Rational Industrialization – Factors favouring and inhibiting industrial action.
Industrial Location – Weber's theory, factors of location and selection of site.
Personal Management – Concept, scope, role and functioning.
Human Resource Development – Contents.
Personnel Problems – Absenteeism, employees turnover, motivation, morale enforcement and discipline.
Industrial Relations – Meaning, nature and significance.
Industrial Disputes – Methods of settling industrial disputes. Collective bargaining, workers participation in management.

[14 hours]

Unit II: National environmental policy

The environment protection act 1986. Objectives of anti-pollution acts. National policy on EIA and regulatory frame work. Rules, regulations of central and state government. Central and state pollution control boards for safeguardingthe environment. Rules, regulations and guidelines given for disposal of hazardous waste, municipal solid waste and biomedical waste. Case study of current issuerequirements of rule 14 for environmental audit under environmental protectionact 1986.

[12 hours]

Unit III: Removal of Phenolic residue

Sources of Phenolic residues, Analytical methods, treatment by using stream gasstripping, ion – exchange, solvent extraction, oxidation methods, Microbiological treatment General nature of organic residue not mentioned so far. Role of vapor pressure, role of solubility, effect of pH on solubility extractive methods of recovery and recycle, Chemical methods of conversion to less soluble nontoxic or biodegradable products, carcinogens,Economics of recovery and recycle methods. Incineration of nonrecyclable concentrates and residues.

[10 hours]

Unit IV: Removal of sulphur dioxide and Nitrogeneous pollutants

Origin of SO2 and its hazard, Analysis of SO2, SO2 control methods, desulphurization of fuels, Indian cola and Indian Crude oil. Economics of SO2 control measures NOx, dissolved NOx, nitrites, ammonia, Urea and other nitrogene containing compounds in the effluents ,fertilizer and explosive, industrial effluents, effluents from nitro aromatic industries, analytical methodology, Photochemistry of air pollution.

[10 hours]

Unit-V: Removal of heavy toxic metals

Metallic and non-metallic pollutants, Cr,Hg,Pb,Cd,Cu,As etc. Their physiological manifistation, source, analysis and control of inorganic compounds. Effect of heavy toxic metals on living organisms, Chromium, Merqury, Lead, Cadmium, Arsenic analytical methods of determination of small amounts of the metal pollutants, copper recovery,treatment of waste to remove heavy metals, recovery techniques.

[10 hours]

Reference:

1. S.P. Mahajan: Pollution control in processes iIndustries (J.W)
2. P.N.Chennsioff and R. A Young: Air Pollution control and design Hand Book and recovery (J.W)
3. J.R. Holmes: Refuse recycling and recovering (J.W)

4. M. Sitting: Resources recovery and recycling Hand Book and Industrial Wastes (NDS)
5. J.O. Niagh: Sulphur in the Environment Vol. I & II (J.W)
6. P.S.Minor: The Industry/EPA controntation (MGH)
7. R.B.Pojaselc: Toxic and Hazardous waste disposal Vol. I &II (AAS)
8. S.M.Khopkar: environmental pollution analysis
9. A.K.Dey: Environmental Chemistry
10. W.Handley: Industrial safety Handbook
11. J.E.Huneey etal. (1993) Inorganic Chemistry.
12. Principles of Management, R.C. Tripathi and P.N. Reddy

DSE 2: C: Chemical Analysis in Agro, Food and Pharmaceutical Industries

Course Code: 21 ICH3 E2CL Course Credits: 04
Total Contact hours: 56 4Hours/week
Internal assessments: 30 Marks End semester exam Marks: 70

Course objective: students should learn on various analytical aspects of food, pharmaceuticals, fuel, biological samples, assay of nuclear wastages, instrumentation and labelling.

Course outcomes:

1. Students are able to analyze the drugs and pharmaceutical ingradients
2. Students are able to analyse the polymers for weight determination
3. Students can identify the pesticide residues and also adultration in food
4. students are able to analyze the dfferent parameters for soil and fuel
5. Students are able to work in clinical laboratories
6. students are able to anlyse the biological samples by fluroscence spectroscopy
7. students learn on radioisotope tracer methodology
8. students get a knowledge on radiometric analysis.

Course outlines

Unit I : Chemical analysis in Industries

Parameters of analysis of the end products in the pharmaceutical industries, Different experimental methods used in the analysis of following drugs: aspirin, nimesulide, metformin, and glimepride.
Analysis of polymers: weigh average molecular weight determination, end group analysis;
Analysis of pesticide residues in the food products; adultration identification methods in food products.

[10 Hours]

Unit II : Analysis of soil & Fuel

Analysis of soil: Moister, pH, total nitrogen, phosphorous, silica, lime, Magnesia, Manganese, sulfur & alkali salts.
Fuel analysis: Solid, liquid and Gas , ultimate and proximate analysis heating values , grading of cool , liquid fuels , flasks points , aniline point , octane number and carbon residue , gaseous fuels – producer gas and water gas – calorific value

[10 Hours]

Unit III : Clinical Chemistry and drug analysis:

Composition of blood collection, and preparation of samples, clinical analysis – serum electrolytes, blood glucose, blood urea nitrogen , uric acid , albumin , globulin , barbiturates , acidic and alkaline phosphates , Immunoassay , principles ofradiimmunoassy and applications . Blood analysis – trace elements in the body.
Drug analysis: Narcotics and dangerous drugs, classification of drugs, screening by gas m thin layer chromatography and spectrophotometric analysis.

[12 Hours]

Unit IV: Food analysis

Moister, ash, crude protein, fat, crud fiber, carbohydrate, calcium, potassium, sodium, and

phosphates, food adulteration – common adulteration in food, contamination of food stuffs

microscopic examination of foods for adulterants, Pesticide analysis in food products, extractionand purification of sample, HPLC, gas chromatography for organo– phosphates, thin layer chromatography for identification of chlorinated pesticides in food products

[12 Hours]

Unit V:Fluorescence in Biological, Medical and Drug Development

Fluorescence instrumentation for analysis, flurophors and their modification , pH –indicators , membrane potential probes , lipid membrane protein, labeling of protein and DNA.

Analytical Applications of Nuclear Chemistry

Radioisotope tracer methodology – problems of experimental design – radio analytical techniques – radiometric analysis – solubility measurements – various types of isotope dilution techniques – radio activation analysis including non-destructive analysis

[12 Hours]

References:

1. Fundamentals of analytical chemistry by D. A. Skuog , D. M. West and F. J. Honer, W. B. Saunders**.**
2. Chromic phenomenon , The Technological application of color chemistry Peter Bamfield

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GEC 1: A: Green chemistry

Course Code: 21 ICH3 G1AL | **Course Credits: 02**

Total Contact hours: 56 | **2Hours/week**

Internal assessments: 20 Marks | **End semester exam Marks: 30**

Objectives: To learn about the environmental status, public awareness in evolution, principles involved in green chemistry, bio-catalytic reactions, global warming and its control measures, availability of green analytical methods**.**

Course outcomes:

1. A functional understanding of the field of green chemistry.
2. A working understanding of the 12 principles of green chemistry.
3. An understanding of several real world examples where organizations used green chemistry to improve the sustainability performance of their products.
4. An appreciation of how the practice of green chemistry enhances competitiveness, innovation and faster time to market.

Course outlines

Unit I:

Introduction-Current status of chemistry and the Environment-Evolution of the Environmental movement: Public awareness - Dilution is the solution to pollutionPollution prevention

[10 Hours]

Unit II:

Principles of Green Chemistry – Definition – 12 Principles of Green Chemistry - Why is this new area of Chemistry getting to much attention - Why should chemist pursue the Goals of Green Chemistry - The roots of innovation – Limitations

[10 Hours]

Unit III:

Bio Catalytic Reactions Green Chemistry Using Bio Catalytic Reactions – Introduction - Fermentation and Bio transformations - Production of Bulk and fine chemicals by microbial fermentationAntibiotics – Vitamins - Bio catalyses synthesis of industrial chemicals by bacterial constructs - Future Tends.

[12 Hours]

Unit IV:

Green House Effect Green house effect and Global Warming – Introduction - How the green house effect is produced - Major sources of green house gases - Emissions of CO_2 - Impact of green house effect on global climate - Control and remedial measures of green house effect - Global warming a serious threat - Important points**.**

[12 Hours]

Unit V:

Green Analytical Methods Future trends in Green Chemistry - Green analytical methods, Redox reagents, Green catalysts; Green nano-synthesis, Green polymer chemistry, Exploring nature, Biomimetic, Proliferation of solvent-less reactions; Non-covalent derivatization, Biomass conversion, emission control

[12 Hours]

References:

1. V. Kumar, “An Introduction to Green Chemistry” Vishal publishing Co. Reprint Edition 2010
2. Rashmi Sanghi, M.M Srivastava “Green Chemistry” Fourth Reprint - 2009
3. Anastas & Warner, Green Chemistry: Theory & Practice ,Oxford Univ. Press,New York,1998

GEC 1: B: Bio-Inorganic Chemistry

Course Code: 21 ICH3 G1BL **Course Credits: 02**

Total Contact hours: 23 **1Hours/week**

Internal assessments: 20 Marks **End semester exam Marks: 30**

Course objectives: The objective of this course is student to expose the essential elements of bio inorganic chemistry. Trace elements in biological system and their functions. Photosynthesis in plants and metal deficiency dieses.

Course outcomes: After the completion of the course

1. Students should be able to draw the structure and define the functions of various biological cycles
2. Students are able to explain the metal deficiency health issues
3. Students are able to solve the competitive exam questions related to bio inorganic chemistry
4. Know the nitrogen fixation mechanism
5. Knowledge on the structures of various metallo proteins in body

Course outlines

Unit I:

Periodic survey of essential and trace elements, biological importance and relative abundance, Na+ / K+ ion pump and its mechanism. Porphyrine and metalloporphyrins, Oxygen carriers/storage-Hb and Mb: Structure and mechanism of their function, cooperativity and Bohr effect. Synthetic models of Hb, Cyanide, phosphine and carbon monoxide poisoning. Inhibition and poisoning by ligand and metal ions, hemocyanin and hemerythrin, models of iron, coalt and copper. Bioenergetic and ATP cycle process coupled to phosphate hydrolysis, Nucleotide transfer-DNA polymerase, phosphate transfer pyruvate kinase, phosphoglucomutase, creatin kinase, ATPase.

[07 hours]

Unit II:

Photosynthesis and respiration - chlorophyll : structure, function and its synthetic model. Xanthine oxidase, Gout Disease and its remedy. Enzymes and their functioning, Bioredox agents, Zn-enzymes carboxy peptidase, carbonic anhydrase, superoxide dismutase, peroxidases and catalases, Vitamin B12 coenzyme, structure, function and “Mn” mechanism and its application in organic synthesis, intake of alcohol and its remedy. Cytochromes-structure and function, Cytochrome P450 enzymes. Ferrodoxins and rubredoxins their structure and function. Abiological and biological N2fixation and mechanism.

[10 hours]

Unit III:

Ferritin, transferring and siderophores and their structure and function. Availability, competition, toxicity and nutrition of Iron, metal deficiency and diseases, toxic effects of antibiotics, chealte therapy, synthetic metal chelates as antimicrobial agents. Calcium in living cell, transport and regulation and its mechanism. Molecular aspects of intramolecular processes and their mechanisms. 2. Metal Clusters (a)Reaction at Coordinated ligands The role of metal ions in the hydrolysis of amino acid esters, peptides, and amides Molecular orbital concept of role of metal ions participation, Modified aldol condensation, Imine formation, Template and Macrocyclic effect in detail.

[06 hours]

References:

1. Principles of Bioinorganic Chemistry, S. J. Lippard and Berg, University Science Books.
2. J.E. Huheey : Inorganic Chemistry III & IV Ed. Pearson Education Asia – (2002).
3. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 5th Edition.
4. Purcell and Kotz: Inorganic chemistry. W. B. Saunders and Co., London
5. Bioinorganic Chemistry by D. Banergia

GEC 1: C: Absorption and surface phenomenon

Course Code: 21 ICH3 G1CL **Course Credits: 02**

Total Contact hours: 23 **02Hours/week**

Internal assessments: 20 Marks

End semester exam Marks: 30

Objectives: Students should have the understanding on basic physical chemistry related to adsorption phenomenon, phase rule and polymers

Course outcomes: After the completion of the course students are able to

1. Draw the phase diagram
2. Able to derive the phase rule
3. Able to understand the natural phenomenons like capillary action
4. Able to understand the various types of adsorption phenomenon
5. Describe the polymerization process

Course outlines

Unit-I:

Phase Rule Concept of Equilibrium between phases, Derivation of phase rule, Ideal Solution, Liver Rule, Brief concept on one and two component system, Application of phase rule to three component systems of both solids and liquids.

[07 Hours]

Unit II:

Adsorption Surface tension, Capillary action, Adsorption, types of adsorption, Gibbs adsorption isotherm, Freundlich's adsorption isotherm, Langmuir's adsorption isotherm and its limitations, BET adsorption isotherm and its applications, Heat of adsorption, estimation of surface areas of solids from solution adsorption studies.

[10 Hhours]

Unit III:

Macromolecules Polymer-definition, Classification of polymer, Polymer structure, Number average and molecular weight average, Step growth & chain growth polymerization, Kinetics of polymerization, Stereochemistry of polymerization.

[06 Hours]

References:

1. Text Book of Physical Chemistry Vol-1-4 by K.L. Kapoor
2. Physical Chemistry by D.N. Bajpai
3. Physical Chemistry by A.W. Atkins
4. Introductory Quantum Chemistry by A.K. Chandra
5. Polymer Science by Gowariker, Viswanathan & Sreedhar

6. Polymer Science & Technology by J. R. Fried C

SEC: Industrial Methods of Analysis (1L+1P)

Course Code: 21 ICH3 S3LP **Course Credits: 02**

Total Contact hours: 56 **4Hours/week**

Internal assessments: 20 Marks

End semester exam Marks: 30

Objectives: Students to have a skill and knowledge on the important methods of analysis in the industries

Course outcomes: Students are able to

1. Use the chromatographic technique
2. Identify the impurities and determine the percentage purity of the compound
3. Perform the experiments using UV-Vis spectrometer
4. Able to determine the assay of drug samples by wet chemistry

Course outlines

Theory: Instrumental methods of Analysis:

Unit-I: Chromatography:

Principles, Instrumentation, theory, and types of chromatography. Determination of purity of the samples.

[08 Hours]

Unit-II: UV-Visible spectroscopy and NMR spectroscopy.

Utilization of these techniques for qualitative and quantitative analysis.

[08 Hours]

Practicals:

Standardization of solutions, Determination of assay of organic compounds. Aspirin, salysilic acid, ascorbic acid

[16 Hours]

References:

1. Analytical Chemistry – Gary D. Christian, 6th ed., John Wiley and sons. Inc., NewYork1994.
2. Instrumental methods of Analysis - Willard, Merit, Dean, 6th ed., CBS Publishers&distributors, 1986.
3. Vogel's Text book of Quantitative Chemical Analysis, J. Bassett, G. H. Jeffery andJ.Mendham, Pearson, 7th edition, (2009).

DSC 9P Interpretation of Spectra of the organic molecules

Course Code: 21 ICH3 C7P **Course Credits: 02**

Total Contact hours: 56 **4Hours/week**

Internal assessments: 20 Marks **End semester exam Marks: 30Course**

objective: Student should have the analytical ability to determine the structure of the compound from the given physical and spectroscopic data and also should predict the possible spectra of the molecule based on the structure

Course outcome: after the completion of this practical students should be able to

1. Draw a structure of the molecule based on the physical and spectral data
2. Able to understand the spectral signals appearance in the different electromagnetic regionbased on the absorption or emission
3. Able to predict the spectral appearance for the particular structure and explain
4. Able to remember all theoretical spectroscopic instrumentation principles studied indiscipline specific course

Course contents

1. Draw the structure of the compound using the Given Elemental composition, Mass,FTIR, NMR, Uv-Vis spectral Data (for any TEN organic molecule)
2. Predict the NMR, FTIR, UV-Vis, Mass and elemental composition of the Organiccompounds (for any TEN simple organic structures)

DSC10 P Analysis of Organic Industrial Materials

Course Code: 21 ICH3 C8P **Course Credits: 02**

Total Contact hours: 56 **4Hours/week**

Internal assessments: 20 Marks **End semester exam Marks: 30Course**

Objective: Students should be familiar with the quality control aspects of important organic industrial products **.**

Course outcome: 1. Students are able to perform the wet analysis

2. Students are able to perform the wet analysis of different products by knowing the techniques of wet analysis

Course contents:

Analysis of the following materials by wet analysis method(Any Six)

a. Acid value, Iodine value and Saponification value of oil ,
b. Assay of Aspirin,
c. Assay of Ascorbic acid
d. Ash and moisture contents in the coal sample

e. Estimation of citric acid

f. Analysis of ester by saponification method

g. Analysis of Pulp for copper number and moisture