VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY
JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in

INDUSTRIAL CHEMISTRY

SYLLABUS

Master of Science
(IV 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

IV-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem. Exam	Total	L	T	P		
FOURTH	DSC11	21 ICH4C11L	Inorganic Industrial materials	30	70	100	4	-	-	4	3
	DSC12	21 ICH4C12L	Unit Processes	30	70	100	4	-	-	4	3
	DSE3	21 ICH 4E3LA	DSE 3/1:Pharmaceutical Industrial Chemistry	30	70	100	4	-	-	4	3
		21 ICH 4E3LB	DSE 3/2 : Advanced Topics in Chemistry								
		21 ICH 4E3LC	DSE 3/3 : Manufacturing of Common Materials								
	DSE4	21 ICH 4E4LA	DSE 4/1 : Environmental Impact Assessment	30	70	100	4	-	-	4	3
		21 ICH 4E4LB	DSE 4/2 : Food Industry and Agrochemicals								
		21 ICH 4E4LC	DSE 4/3 : Chemistry in Biology								
	GEC2	21 ICH 4G2LA	GEC 2/1 : Water Harvesting and Renewable Energy Sources	20	30	50	2	-	-	2	1
		21 ICH 4G2LB	GEC 2/2 : Basics of Chemistry								
		21 ICH 4G2LC	GEC 2/3 : Impact of Chemical Fertilizers and Pesticides on Agriculture								
	DSC11P	21 ICH 4C9P	Analysis of Inorganic Materials	20	30	50	-	-	4	2	2
	Project	21 ICH 4C1R	Research Project /In-Plant Training	30	70	100		-	8	4	4
Total Marks for IV Semester						**600**				**24**	

DSC 11: Inorganic Industrial materials

Course Code: 21ICH4C11L **Course Credits: 04**
Total Contact hours: 56 **4Hours/week**
Internal assessments: 30 Marks **End semester exam Marks: 70**

Course objective: To expose the students on the theory and principles of important industrial material production. Process of refining of metals and petrochemical industries.

Course outcome: students should be able to

1. Classify the ceramics and have a knowledge on manufacturing process of ceramics.
2. Should be able to describe the industrial carbon and its manufacturing
3. Should have a knowledge on refractories
4. Should be able to write the different forms, properties and manufacturing of glass
5. Gain a knowledge on chemistry of cement, manufacturing and setting
6. Able to explain the metallurgical process of Cu, Fe and Steel

Course outlines

Unit I: Refractories and Allied Materials

Ceramics: Classification and general properties of ceramics, basic raw materials, chemical conversions, manufacturing process, white wares and porcelain – manufacturing process.
Industrial carbon, Lampblack, carbon black, activated carbon, natural graphite, manufactured graphite and carbon, Industrial diamonds.
Refractories: Classification, properties and manufacture of refractories, vitreous – enamel, raw materials, manufacture of enamel glass and application of enamel.

[12 Hours]

Unit II: Glass and Cement

Glass: Commercial glass, composition of glass, Properties of glass, raw materials and methods of manufacturing of some special glasses.
Portland cement: Types, raw materials, manufacture and process of Portland cement, Setting and hardening of cement, Other cements, gypsum, calcium and magnesium compounds.
Chlor-alkali Industries: Manufacture of soda ash, sodium bicarbonate, chlorine and caustic soda, Bleachng powder, calcium and sodium hypochlorites, sodium chlorite.

[12 Hours]

Unit III:Metallurgy of Cu, Fe and Steel

Copper– occurrence, extraction, hydrometallurgy and pyrometallurgical methods, refining of copper-electrolytic, alloys of copper – brass, German silver, bell metal and bronzes.
Iron – Raw materials, manufacture of pig iron, cast iron and wrought iron.Steel – manufacture steel by different methods
Extraction and refining of zinc and nickel, extraction of Magnesium.

[10 Hours]

Unit IV: Refining of Metals

Definition, procedures for purification of metals-Liquation, distillation, vapour phase refining, chromatographic methods, zone refining, electrolytic refining. Electrolytic refining of Copper. Zone refining of Bismuth.

[12 Hours]

Unit V: Fuels and Petroleum Products

Fuels – essential requirements of fuels, modern concept of fuels, origin, classification and selection of solid, liquid and gaseous fuels.
Coal – composition and carbonization of coal, proximate and ultimate analysis of coal – moisture, ash, crude, proteins, calcium, potassium, sulphur and phosphorus.
Analysis of petrol and petroleum products – flash point, fire point, cloud point, pour point,aniline point, viscosity, specific gravity and vapour pressure.
Detection and estimation of lead an antiknock compound in gasoline and sulphur in petroleumproducts.

[10 Hours]

References:

1. Industrial Chemistry – B.K. Sharma, Goel publishing House, Meerut, 2010
2. Standard Methods of Chemical Analysis – F.J. Welcher, 6th Edn. Vol.3, Part-B, D. Van Nostrand Company, Inc.,
3. Petrochemical Industries – A.V.C. Hann,
4. Roger's Manual of Industrial Chemistry Furnas, Vol. I & II.
5. Engineering Chemistry – P.C. Jain and M.Jain.
6. Shreve's Chemical Process Industries, George T Austin, 5th Ed., McGraw-Hill,

DSC 12: Unit Processes

Course Code: 21ICH4C12L | Course Credits: 04

Total Contact hours: 56 | 4Hours/week

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

Course objective: students should know the basics of unit process used in the industries. It is important to learn the various methods for the manufacturing of chemicals via different reaction pathways. Student should also gain the knowledge on modern material production industries.

Course outcome

After the completion of the course students should be able to

1. Explain the basics of organic unit processes
2. Able to perform nitration process
3. Able to perform sulphonation process
4. Carry out the Esterification, Halogenation and Oxidation
5. Carry out manufacturing process of liquid crystals and soft materials
6. Able to differentiate different types of liquid crystals
7. Understanding and applications of thin films

Course outlines

Unit I: Unit Processes:

Introduction, relevance of various organic unit processes in chemical industries. Le-Charlie's principle, types of process, types of reactors, effect of shape and design of reactors. Factors influencing the optimum yield, I law of thermodynamics, process principles – Thermodynamics kinetics, reagents – their application, back mixing etc.,
Introduction to unit processes in pharmaceutical industries: preparations of formulations from bulk drugs. Parameters involved in formulation process.

[10 Hours]

Unit II: Nitration and Sulfonation,

Nitration: Introduction, nitrating agents, aromatic nitration, nitration of organic solvents, effect of HNO_2 on nitration, Gas phase and liquid phase nitration, thermodynamics of nitration, Batch and continuous nitration, manufacture of nitrobenzene, m-dinitrobenzene, p-nitroacetanilide.
Sulfonation: Introduction, classification of sulfonates,
General procedures for preparation of sulfonates, sulfonating agents, manufacture of benzene sulfonic acid, naphthalene-β-sulfonic acid.

[10 Hours]

Unit III: Esterification, Halogenation and oxidation

Esterification: Kinetics and mechanism. Esterification of carboxylic acid derivatives, Esters by addition to unsaturated systems, Industrial esterifications, Ethyl acetate, butyl acetate, Vinyl acetate, methyl methacrylate, Cellulose acetate, xanhate and nitroglycerin.
Halogenation: Kinetics and mechanism, Survey of methods, Catalytic chlorination, photohalogenation, Manufacturing processes for chlorohenzene, BHC, Chlorinated methanes, monochloroacetic acid, chloral, vinyl chloride.
Oxidation: Oxidising agents with typical applications of each, Liquid phase oxidation with oxidising compounds, Typical manufacturing processes.

[12 Hours]

Unit IV: Soft Materials and liquid crystals

Soft Materials:Thin Films and Langmuir – Boldgett Films, Preparation techniques, vaporation/sputtering, chemical process, MOCVD, sol-gel etc. growth technique, photolithography, properties and applications of thin and L-B films.
Liquid Crystals:Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientation, ordernematic&smecticmesophases, nematic transition & clearing temperature- homotropic, planer &schlieren textures, twisted nematic, chiral nematic, molecular arrangement in smectic A &Smectic B phases, optical properties of liquid crystals, Dielectric susceptibility &dielectic constants, Lyotropic phases & their description or ordering in liquid crystals.

[12 Hours]

Unit V: Electrolysis

Definition, electrolytic process, cell potential, Faraday's law of electrolysis, products of electrolysis, factors affect for electrolysis, Electrolysis of water: high-pressure electrolysis, low- pressure electrolysis, high-temperature electrolysis, Electrolyzers, High-temperature electrolysis, Hydrogen energy-electrolysis, applications-metallurgy of alkali and alkaline earth metals, manufacture of pure gases, electroplating for corrosion resistance, ornaments etc., simple problem solving of electrolysis.

[12 Hours]

References:

1. Roger's Manual of Industrial Chemistry, C.C. Furnas (Edition), 6th edition, Vol.I, D. Van Nostrand Company, Inc.
2. Industrial Chemistry by B.K. Sharma.
3. Chemistry in Engineering and Technology, J.C. Kuriacose and J. Rajaram Vol.-II, Tata Mc. Graw Hill Publishing Company Ltd., New Delhi.
4. Engineering Chemistry, 4thEdition, V.P. Mehta, Jain Brothers, New Delhi.
5. Engineering Chemistry, by P.C. Jain and M. Jain.
6. Industrial Microbiology – L.E. Casida Jr.
7. Dryden's Outlines of Chemical Technology – Gopal Rao and Marshal Sitting.
8. Alcohols, their chemistry, properties and manufacture – John A Monick.
9. Theory and Practice of Industrial Pharmacy – Lachmann et., al.
10. Pharmaceutics-I & II – Mehata, Asgar Ali and Mahamuni

DSE 3: A: Pharmaceutical industrial chemistry

Course Code: 21ICH4E3L **Course Credits: 04**
Total Contact hours: 56 **4Hours/week**
Internal assessments: 30 Marks **End semester exam Marks: 70**

Objectives: In this course students have to learn about the involvement of chemistry/chemicalsin the pharmaceutical industries. Also should have a knowledge on therapeutic techniques and important drug catagories.
Course outcomes: 1.Able to identify and quantify the impurities in pharmaceuticals and gain aknowledge on various testing parameters

2. Aware of chemical reactions involved in the synthesis of drug molecule
3. Able to optimize the conditions of production of drugs in good yield
4. Able to determine the structure activity relationships
5. Able to recognize the important drug categories

Course outlines

Unit I: Basic pharmaceutical chemistry:

Introduction, Accuracy, precision, significant figures, Impurities in Pharmaceuticals: Source and effect of impurities in Pharmacopoeial substances, importance of limit test, Principle and procedures of Limit tests for chlorides, sulphates, iron, heavy metals and arsenic.

[12 Hours]

Unit II: synthesis of drugs and testing techniques

Synthesis of drugs: 1,3-pyrazole, 1,3-oxazole, Benzimidazole, Benztriazole, 2,3-diphenyl quinoxaline, Benzocaine, Phenytoin, Phenothiazine, Barbiturate
Testing techniques: Impurity and Stability Studies, Stability Testing Protocols, Impurity Profiling and Degradent Characterization, Stability testing of Phytopharmaceuticals, Biological Tests and Assays- Adsorbed Tetanus vaccine, Adsorbed Diphtheria vaccine, Human anti

haemophilic vaccine, Rabies vaccine, Tetanus Antitoxin, Tetanus Anti serum, Oxytocin,Heparin sodium IP, Antivenom. PCR, Immunoassays (IA).

[12 Hours]

Unit III: Structure-activity relation, Docking studies

Introduction, Discovery of Mycobacterium tuberculosis InhA Inhibitors Using structure based virtual screening, (SBVS) andPharmacophore Modeling, Discovery of Proteasome Inhibitors by SBVS, Identification of a New Series of STAT3 Inhibitors by virtual screening(VS), Discovery of Pim-1 Kinase Inhibitors by a Hierarchical Multistage VS, Identification of Aldose Reductase Inhibitors by MD and SBVS, Design of Selective Cyclooxygenase-2 Inhibitors.

[12 Hours]

Unit IV: Advanced therapeutic techniques

Sacroiliac Dysfunctions and Muscle Energy, Sacroiliac and Spinal Stabilization Exercise Programs Temporomandibular Joint and Thoracic Outlet Soft Tissue, Neural and Joint Mobilization Proprioceptive Neuromuscular Facilitation Neurodynamics Proprioceptive and Vestibular Balance, Upper Extremity Therapeutic Exercise, Lower Extremity Therapeutic Exercise.

[10 Hours]

Unit V: Important drug categories

Introduction to medicinal chemistry historyand development ofmedicinal chemistry Physicochemicalproperties inrelationtobiological action, Drugmetabolism, Drugs acting on Autonomic Nervous System, Cholinergic neuro transmitters, Drugs acting onCentral NervousSystem-Morphine andrelated drugs, Narcotic antagonists, Anti-inflammatoryagents:

[10 Hours]

References

1. A Textbook of Pharmaceutical ChemistryTextbook by Jayashree Ghosh
2. The art of drug synthesis Douglas S. JohnsonJie Jack LiPfizer Global Research and Development
3. **Molecules 2015, 20, 13384-13421; doi:10.3390/molecules200713384**

DSE 3: B: Advanced topics in chemistry

Course Code: 21ICH4E3L | **Course Credits: 04**

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

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

Objectives: Students to have a knowledge on current progress in chemistry that will help the students to face the competitive examinations and make them eligible to teach chemistry and industrial chemistry subjects at college and university level.

Course outcomes: 1.students are able to know the pollution and toxic free synthesis

2. Able to make hazard assessment
3. Understand the action of organocatalysis
4. Able to construct the solar cells from different materials
5. Able to draw the various structures of solar cell materials
6. Understanding the working principles electrochemical energy devices

Course outlines

Unit I: Concepts of green chemistry:

Introduction, Atom Economy, Principles of Green Chemistry, Alternative Solvents/Energy Effici ency, Catalysis, Abiotic Depletion of Elements, Renewable Feed stocks, Biodegradation, Introduction to Toxicology, Toxicology, Designing Safer Chemicals, Risk vs. Hazard Assessment, Chemical Alternatives Assessment, Environmental Laws,Policies, Regulations

[10 Hours]

Unit II: Supramolecular chemistry

Fundamentals of Supramolecular Chemistry-Terminology and definitions in supramolecularchemistry. Intermolecular forces: Ion pairing, ion-dipole and dipole-dipole interactions; Molecular Recognition-Principle of molecular recognition, host-guest complementarity,preorganisation, chelate effect, cooperativity. Synthesis and applications of supramolecular host(crown ethers, lariat ethers, podands, cryptands) as cation and anion binding receptors and receptors for ion-pair recognition.

Supramolecular Reactivity and Catalysis-Organocatalysis mediated through hydrogen bonding,preconcentration, self-assembly of catalysts and preorganisation of catalyst-substrate systems.

[10 Hours]

Unit III: Chemistry of nanomaterials

Introduction, synthesis of nanoparticles, size effects on structure and morphology of nanoparticles- Fundamental Properties - Size Effects on Structure and Morphology of Free or Supported Nanoparticles - Size and Confinement Effects - Fraction of Surface Atoms - Specific Surface Energy and Surface Stress - Effect on the Lattice Parameter - Effect on the Phonon Density of States- Nanoparticle Morphology - Equilibrium Shape of a Macroscopic Crystal – Equilibrium Shape of Nanometric Crystals - Morphology of Supported Particles.

[12 Hours]

Unit IV: High energy materials

High efficiency solar cells, PERL Si solar cell, high efficiency solar cells, GaAs solar cells, tandem and multi-junction solar cells, solar PV concentrator cells and systems, III-V, II-VI thin- film solar cells (GaAs, Cu(In,Ga)Se2, CdTe) Nano-, micro- and poly-crystalline Si for solar cells, mono-micro silicon composite structure, crystalline silicon deposition techniques, material and solar cell characterization, advanced solar cell concepts and technologies (Porous Si layer transfer, Metal induced crystallization, etc.).

Basic of electrochemical energy devices; mechanism and materials for different types of batteries, supercapacitor and hybrid; fuel cells (Polymer membranes for fuel cells, PEM fuel cell,Acid/alkaline fuel cells.), electrochemical and photoelectrochemical water splitting. Details of Pb-acid Nickel-metal hydride (Ni-MH), NiCd-alkaline battery, Ni-iron, Li/Na-ion, Mg-ion, Li/Na-S batteries.

[12 Hours]

Unit V: Electrometallurgy

Introduction to Electrometallurgy, Electrochemical principles and basic concepts,Important milestones in the development of electrometallurgy, Conductivity,Electrolytic conduction, Molar conductivity, Transport numbers, Chemical changesin electrolysis, Examples of electrolysis, Electrode reactions, Stoichiometry ofelectrolysis (Faraday's Laws), Technological applications;

Leaching,Precipitation, Metal extraction and refining, Electrorefining and Electrowinning ofmetals, Fused salt electrolysis of aluminium and magnesium, Electroplating,Electroforming, Electrochemical polishing, Batteries, Fuel cells.

[12 Hours]

References

1. Lancaster, M. Green Chemistry: An Introductory Text, Third Edition; RSC Publishing; 2 016. ISBN: 978-1-78262-294-9
2. Supramolecular Chemistry: from Molecules to Nanomaterials Eds. by P.A. Gale and J.W. Steed (2012).
3. Modern Supramolecular Chemistry by F. Diederich, P. J. Stang, R. T. Tykwinski (2008).

. Page 20 of 21

4. Core Concepts in Supramolecular Chemistry and Nanochemistry by J. W. Steed, D. R. Turner, K. J. Wallace (2007).
5. Supramolecular Chemistry by J.W. Steed and J.L. Atwood (2011).
6. Supramolecular Chemistry: Concepts and Perspectives by J.-M. Lehn, Wiley VCH, Weinheim (1995).
7. Supramolecular Chemistry by V. Balzani (Editor), L. De Cola, Kluwer, Dordrecht (1992).
8. Introduction to Supramolecular Chemistry by H. Dodziuk, Kluwer Academic Publishers, The Netherlands (2002).
9. Supramolecular Assemblies Y. Murakami (Editor), Mita Press, Tokyo, (1990).
10. Advances in Supramolecular Chemistry, Vol 1 (1990), Vol 2 (1992), Vol 3 (1993) by G.

W. Gokel (Editor), JAI Press, Greenwich.

11. Supramolecular Chemistry – Fundamentals and Applications. Advanced Textbook by T. Kunitake, K Ariga, Berlin: Springer-Verlag Heidelberg, 2006. 208 p. ISBN 978-3-54001298-6.
12. C. Brechignac, P. Houdy, M. Lahmani, “Nanomaterials and Nanochemistry”, Springer publication 2007.
13. Kenneth J. Klabunde, “Nanscale materials in chemistry”, Wiley Interscience Publications 2001.
14. C. N. Rao, A. Muller, A. K. Cheetham ,“Nanomaterials chemistry”, Wiley-VCH 2007.
15. Solar cells: Operating principles, technology and system applications, by Martin A. Green, Prentice-Hall Inc, Englewood Cliffs, NJ, USA, 1981.
16. Adrian Kitai, Principles of Solar Cells, Leds And Related Devices: The Role Of The Pn Junction, 2nd Edition. John Wiley
17. JOHN WILEY, Vasilis M. Fthenakis, Paul A. Lynn, Electricity From Sunlight: Photovoltaic-Systems Integration And Sustainability, 2nd Edition
18. Juan Bisquert, Physics Of Solar Cells : Perovskites, Organics, And Photovoltaic Fundamentals, T&F/Crc Press
19. Fundamental Aspects of Electrometallurgy, 2002, Popov K.I.,DjokićS.S., GrgurB.N., Kluwer Academic/Plenum Publishers, New York

DSE 3: C: Manufacturing of common materials

Course Code: 21ICH4E3L **Course Credits: 04**
Total Contact hours: 56 **4Hours/week**
Internal assessments: 30 Marks **End semester exam Marks: 70**

Objectives: Students should know the chemistry and techniques of manufacturing of commonmaterials using simple raw materials and technology

Course outcomes: 1. Course enable students to start their own small scale or home industriesof common chemicals

2. Gain knowledge on various guidelines and regulatory aspects for starting the small scaleindustries

4. Students are also able to work in the large scale industries like paper and leather industries
5. Students know the process of production of fertilizers

Course outlines

Unit I: History and general introduction

Oils, fats, waxes, mineral oils, essential oils, their sources, composition and structures. Constituents of natural fats Glycerides and fatty acids, their nomenclature, classification and principle sources; theories of glyceride structure.Production and consumption pattern of various Oils & Fats in the Country vis-à-vis world.Non–glyceride components, important minor constituents and contaminants Phosphatides, sterols, gossypol, carotenoids, hydrocarbons, coloring matter, natural pigments, vitamins, antioxidants, Fatty Alcohols, Sterols, Tocopherols, Tocotrinols, Oryzanols, Triterpine Alcohols Waxes etc. Gossypol, Sesamol and Sesamoline, Flavoring compounds. Some minor important constituents of oilseeds: ricin, sinigrin, linamarine, saponin, allylisothiocyanate, gossypol, sesamol and sesamoline; environmental contaminants.

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

[12 Hours]

Unit II: Cosmetic Industries

Classification of raw materials and raw materials used in the cosmetic industry for the manufacture of finished products. Method of sampling, Indian Standard specification laid down for sampling and testing of various cosmetics in finished form by the bureau of Indian standards. Factors affecting stability of a formulation, ICH guidelines, Methods of stabilizations and Methods of stability testing.Concept of development of stability indicating analytical methods.

Determination of Physical and chemical constants such as extractive values, moisture content, alcohol content, volatile oil content, ash values, bitterness values, foreign matters, and physical constants applicable to the lipid containing drugs. Microbial counts, bioburden and Pharmacopoeial microbial assays.

[12 Hours]

Unit III: Rubber and Leather Industries

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 IV: Fertilizer 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.

[10 Hours]

Unit V: Paper Industries

Introduction, qualities of pulp for papers, raw materials, manufacture of pulp by Kraft's process (sulphite process), bleaching of pulp, recovery of chemicals, paper making by Frurdniner process. Manufacture of rayon by viscose process.

[10 Hours]

References:

1. Industrial Chemistry – B.K. Sharma, Goel publishing House, Meerut, 2010
2. Standard Methods of Chemical Analysis – F.J. Welcher, 6th Edn. Vol.3, Part-B, D. Van Nostrand Company, Inc.,
3. Petrochemical Industries – A.V.C. Hann,
4. Roger's Manual of Industrial Chemistry Furnas, Vol. I & II.
5. Engineering Chemistry – P.C. Jain and M.Jain.
6. Shreve's Chemical Process Industries, George T Austin, 5th Ed., McGraw-Hill,

DSE 4: A: Environmental Impact assessments

Course Code: 21ICH4E4L **Course Credits: 04**
Total Contact hours: 56 **4Hours/week**
Internal assessments: 30 Marks **End semester exam Marks: 70**

Objectives: Students should aware of current environmental problems and the rules, regulationsand other measures to control the impact of environmental problems
Course outcomes: After the completion of the course, students should be able to
1. Understand the objectives of environmental policy
2. Able to guide on the disposal of Hazardous wastes
3. Able to appreciate the sustainable development
4. Well versed with the Impact assessment methodologies
5. Gain a knowledge on pollution controlling method

Course outlines

Unit I: National environmental policy

The environmental policy act 1986. Objectives of anti-pollution acts
National policy on EIA and regulatory framework: Rule, regulations of central and state government. Central and State pollution control boards for safeguard for environmental protection. Rules, regulations and guidelines given for disposal of hazardous waste, municipal solid waste and biomedical waste. Case study of current issue requirements of rule 14 for environmental audit under environmental policy act 1986

[10 Hours]

Unit II: sustainable Developments:

Definition and concepts of sustainable development. Integration of (a) economic, social and environmental sustainability (b) Biodiversity and(c) Availability of natural resources in development. Critical review of drawbacks in traditional(based on economics) evaluation of development. Cost benefit analysis. Introduction of ecological growth factor for sustainable developments.

[12 Hours]

Unit III: Methodologies of Impact assessments

Baseline collection of data, significant impacts. Assessment of impacts of physical biological and socio economic environment. Impact prediction. Tootls and techniques such as adhoc method, checklist method etc. Deevelopment of environment manage plans-post project monitoring.EIA report and EIS, Review process, EIA case studies/histories for industrial projects. Water resources and irrigation projects, ports and harbours, mining, transportation and other project sectors.

[10 Hours]

Unit-IV- Pollution monitoring and control

Definition, Sources, classification and characterization of air pollutants. Effects of air pollutionon health, vegetation & materials. Types of inversion, photochemical smog. Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants (PM2.5, PM10, SOX, NOX, CO, NH3) Particulate matter and gaseous pollutants- settling chambers, cyclone separators, scrubbers,filters & ESP.

[12 Hours]

Unit V: Report Writing and case studies

Stockholm Conference 1972; United Nations Conference on Environment and Development 1992; Rio de Janeiro (Rio Declaration, Agenda 21); Convention on Biological Diversity, Montreal Protocol 1987; Kyoto Protocol 1997; Copenhagen and Paris summits. 19 Role of Ministry of Environment, Forests & Climate; role of central and state pollution control boards. National Green Tribunal: Ganga Tanneries Case: M.C. Mehta vs. Union of India 1988.

[12 Hours]

References:

1. Larry W. Carter," Environmental Impact Assessment" Tata-Mc Grow Hill Co. Singapore
2. Suresh. K "Environment engineering and management" S,K Kotharia and sons, New Delhi-2004
3. Abraham, C.M. 1999. Environmental Jurisprudence in India. Kluwer Law International.
4. Agarwal, V.K. 2005. Environmental Laws in India: Challenges for Enforcement. Bulletin of the National Institute of Ecology 15: 227-238.
5. Divan, S. & Rosencranz, A. 2002. Environmental Law and Policy in India: Cases, Materials and Statues (2nd edition). Oxford University Press.
6. Gupta, K.R. 2006. Environmental Legislation in India. Atlantic Publishers and Distributors.
7. Leelakrishnan, P. 2008. Environmental Law in India (3rd edition). LexisNexis India.
8. Naseem, M. 2011. Environmental Law in India Mohammad. Kluwer Law International

DSE 4: B: Food industries and agrochemicals

Course Code: 21ICH4E4L | **Course Credits: 04**
Total Contact hours: 56 | **4Hours/week**
Internal assessments: 30 Marks | **End semester exam Marks: 70**

Course Objectives:

1. **To understand the basic principles involved in food process engineering.**
2. **To apply the principles in food processing.**
3. **To perform calculations for basic operations in food processing.**

Course Outcomes:

The students will be able to

1. Enumerate the units and dimensions of various physical quantities.
2. Express the laws and theory of gases and vapours.
3. Describe the types and properties of fluid flow.
4. Calculate the material balance in food processing units.
5. Appraise the performance of processing units

Course outlines

Unit I:

Carbohydrates- composition, classification, sources, functions, structure, physical & chemical properties. Other sweetening agents, functions of sugar in food (Browning reaction), changes during cooking and processing. Lipids – composition, nomenclature, saturated, unsaturated fatty acids, classification, food sources, functions of fats. Physical and chemical properties, emulsions, chemistry & technology of fat and oil processing. Role of food lipids in flavor Proteins – composition, classification sources, functions, denaturation, and protein deficiency, determination of protein quality. Amino acids – classification, Physio-chemical properties, modification of food protein through processing and storage.

[12 Hours]

Unit II:

Foods as ecological niches, relevant microbial groups, Microbes found in raw materials and foods that are detrimental to quality, Factors that influence the development of microbes in food, newer and rapid methods for qualitative and quantitative assay demonstrating the presence and characterization of microbes, Stress, damage, adaptation, reparation, death. Microbial growth in food: intrinsic, extrinsic and implicit factors, Microbial interactions, Inorganic, organic and antibiotic additives. Effects of enzymes and other proteins, Combination systems, Adaptation phenomena and stress phenomena, Effect of injury on growth or survival, Commercial available databases.

[12 Hours]

Unit III: Food Analysis

a) Iodine value
b) Saponification number
c) Acid value
d) Free fatty acids value
e) Peroxide value
f) Estimation of thiamin content of foods by Fluorimetric method.
g) Estimation of riboflavin content of foods by Fluorimetric method.
h) Estimation of ascorbic acid content of different foods by 2,6 dichloro indophenol method

[12 Hours]

Unit IV: Principles of Food Preservation

1. Meaning, mode of action and changes in foods
2. Use of High temperature (Heat preservation)
    a) Moist and Dry heat methods
    b) Blanching
    c) Dehydration
    d) Concentration
    e) Canning
    f) Commercial sterilization
    g) Pasteurization
3. Use of Low Temperatures
    a) Cold Preservation: Freezing and Refrigeration- Air freezing
    b) Indirect contact freezing
    c) Immersion freezing
    d) Dehydro-freezing
    e) Cryo-freezing
    f) Changes in foods during refrigeration and frozen storage
4. Use of dehydration and Concentration
    a) Benefits and factors affecting heat and mass transfer
    b) Physical and chemical changes during dehydration and concentration
    c) Methods and techniques used (Air convection, drum driers and vacuum driers)
    d) Use of various evapourators for concentration of foods

[10 Hours]

Unit V: Agrochemicals

Insecticides – Classification, inorganic insecticides – lead arsenate, calcium arsenate, paris-green, fluorine and sulphur compounds, natural insecticides – nicotine, pyrethenrine, rolenone, allethrin, organic insecticides-DDT, dinitor phenol, methoxy-chlor, BHC, gammoxane, chlordane, heptachlor, aldrin, dialdrin, toxaphane, TEPP, melathion and parathion.

Fungicides – Inorganic and organic fungicides.

[10 Hours]

References:

1. Agrochemicals Desk Reference" by John H Montgomery
2. Agrochemicals: Composition, Production, Toxicology, Applications" by Franz Müller
3. Agrochemicals: Preparation and Mode of Action" by R J Cremlyn
4. A first course on Food Analysis: A.Y Sathe, 1999, New age international publishers
5. Food Industries: Food processing and Management: Lisa Jordon (editor) Callisto Reference; Illustrated edition (20 March 2015)

DSE 4: C: Chemical Biology

Course Code: 21ICH4E4L **Course Credits: 04**
Total Contact hours: 56 **4Hours/week**
Internal assessments: 30 Marks **End semester exam: 70 Marks**

Objectives: Students should learn the various chemicals involved in the biological system andtheir importance in biology.
Course outcomes: After the completion of the course, students are able to
1. Understand the basic chemicals structure and their importance in biology
2. Able to draw different biological cycles involving the chemical transformation and energy release
3. Understand the metabolism process
4. Able to understand the importance of Vitamins
5. Able to identify the vitamin deficiency diceses
6. Able to appreciate the importance of enzymes in metabolism
7. Able to evaluate the quality of protein

Course outlines

Unit I: Amino acids and Nucleic acids

Amino acids

General reactions of amino acid metabolism - Transamination, decarboxylation,
Oxidative and non-oxidative deamination of amino acids. Special metabolism of methionine, histidine, phenylalanine, tyrosine, tryptophan, lysine, valine, leucine, isoleucine and polyamines. Urea cycle and its regulation.
Overview of biosynthethic pathways of amino acids and thei regulation Assimilation of ammonia, biosynthesis of essential and non-essential amino acids, regulation of glutamine synthetase andaspartate family of amino acids.

Nucleic Acids

Purine and pyrimidine nucleotides: biosynthesis and it regulation Deoxyribo nucleotides: biosynthesis and regulation. Biosynthesis of nucleotide coenzymes. Catabolism of purine and pyrimidine nucleotides.

[12 Hours]

Unit II: Lipid metabolism Oxidation of fatty acids and its energetics:

oxidation of saturated and unsaturated (mono and poly unsaturated fatty acids (PUFA), Peroxisomal oxidation of fatty acids (Phytanic acid),
Refsum's disease, ketone body formation and their clinical significance, diabetic keto acidosis, Biosynthesis of fatty acids and regulation, Biosynthesis of triglycerides, cholesterol and phospholipids.

[10 Hours]

Unit III: Enzymetic Matabolism

Carbohydrate metabolism Regulatory mechanisms, bioenergetics and significance of central pathways of carbohydrate metabolism –
Glycolysis Citric acid cycle, Gluconeogenesis from TCA intermediates amino acids / acetyl-

CoA.

Pentose phosphate pathway, glyoxalate cycle, glucuronic acid pathway, Utilization of sugars such as lactose, galactose, maltose and of polysaccharides such as starch, glycogen. Biosynthesisof polysaccharides and sugar inter conversions.

[10 Hours]

Unit IV: Proteins and Peptides

Classification of protein, new discoveries in protein and their functions such as protein in Immune system, as lubricants, biological buffers and carriers, evaluation of protein quality: in vitro and in vivo methods, animal and human bioassays: amino acid pool, protein turnover in man with special reference to body size, age and various nutrition and pathological conditions, regulation of proteins, requirements; novel food sources of protein. Effect of insulin, corticosteroids, thyroids, androgen and growth hormone on protein metabolism, inheritable disorders of amino acid metabolism of protein; effect of dietary protein on cardiovascular disease and cholesterol metabolism, adaptation of body to low intake of energy and protein.

[12 Hours]

Unit V: Vitamins

General definition and history of vitamins and hormones; cause of vitamin deficiencies in India. Chronology, chemistry, distribution, functions, absorption, transport, metabolism, deficiencymanifestations,

Nutritional requirements, methods of assay. Interaction with other nutrients, antagonists and analogues of vitamins Hyper vitaminosis of water and fat soluble vitamins; vitamin fortification and supplementation; endocrine and exocrine secretion of hormonesorgans of secretion, metabolism, mechanism of action, regulation and sites of action, biological effects and interaction. Assessments of vitamin status of population; antioxidants and their relationship with aging, cancer and other metabolic disorders.

[12 Hours]

References:

1. Basu TK & Dickerson JWT. 1996. Vitamins in Human Health and Disease. CABI.
2. Combs GF. 1992. The Vitamins, Fundamental Aspects in Nutrition and Health. Academic Press.
3. Kutsky RJ. 1981. Handbook of Vitamins and Minerals and Hormones. NRC.
4. Machlin LJ. 1991. Handbook of Vitamins. Marcel Dekker.
5. Nelson, D. L.; Cox, M. M.; Lehninger Principles of Biochemistry, W.H.Freeman; 2017, 7th Edition.
6. Voet, D.; Voet, J. G.; Pratt, C. W.; Fundamentals ofBiochemistry, John Wiley & Sons Inc., 2016, 5th Edition.
7. Berg, J. M.; Stryer, L.; Tymoczko, J. L.; Gatto, G. J.;Biochemistry; W.H Freeman; 2019, 9th Edition
8. Kuchel, P.; Easterbrook-Smith, S.; Gysbers, V.; Guss, J. M.;
9. Hancock, D.; Johnston, J.; Jones, A.; Matthews, J.; Schaum'sOutline of Biochemistry, McGraw-Hill Book Co., 2009, 3rd Edition.

GEC 2: A: Water Harvesting and renewable energy sources

Course Code: 21ICH4E4L **Course Credits: 01**

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

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

Course objective: students should learn the water saving methods and should know about theenergy sources.

Course outcome:

1. Students are able to appreciate the water harvesting techniques.
2. Able to know the irrigation development methods
3. Able to understand the energy sources
4. Aware the methods of energy harvesting from solar energy

Course outlines

Unit I: Hydrology

Hydrologic cycle, definition, processes, and components of hydrologic cycle, precipitation, origin, process, forms and clouds and their formation. Air masses and stores. Measurement of rainfall, calculation of average rainfall in a field, water budget, surface and ground water hydrology and aquifers. Runoff types, factors affecting, method of computation, runoff hydrograph. Surface and ground water, factors affecting the shape of hydrograph, computation of runoff using unit hydrograph. Runoff computation by infiltration and imperialformulae.

Hydrograph and stream gauging. Use of remote sousing in data collection, water resource management

[10 Hours]

Unit II: Water resources and irrigation development in India

water convegance and control. hydraulics of open channels, design of farm channels, conveyance losses, lining of channels of water courses, hydroclic principle of water _measurement, of irrigation water velocity, area methods, water meter, weirs parshall flumes, orifices etc. water application methods irrigations system and their design pump and tube wells comparative efficiency and economics of different methods of irrigation. irrigability classification and its use in irrigation planning. Conservation drainage - Necessity, methods and design of surface and substance drainage, drainages of irrigated lands, interceptor relief drains and tile drains and their design, drainage requirements of crops, drainage in relation salinity control

[10 Hours]

Unit III: Renewable energy sources

Introduction: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India.

Energy from Sun: Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Applications

Solar Thermal Energy Collectors: Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish – Stirling Engine System, Working of Stirling or Brayton Heat

Engine, Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Space Cooing, Solar Cookers, Solar pond.

[12 hours]

References:

1. Water Resources Engineeringby Larry Mays
2. Hydrology for Water Managementby Stephen A. Thompson
3. Water Resources Engineering: Handbook of Book by Anand Prakash
4. Renewable Energy Sources and Emerging Technologies by D.P. Kothari, K.C. Singal, Rakesh Ranjan

GEC 2: B: Basics of Chemistry

Course Code: 21ICH4E4L **Course Credits: 02**
Total Contact hours: 23 **2 Hours/week**
Internal assessments: 20 Marks **End semester exam: 30 Marks**

Course objective: in this course, students will learn about basics of chemistry, history of chemistry and atomic structure.

Course outcome:

1. Students are able to differentiate the atom, molecule, elements and compound
2. Students are able to understand the different states of matter
3. Able to differentiate between the solid, liquid and gases
4. Understand the origin of electrical and magnetic properties in the solids
5. Understand the elements of quantum mechanics
6. Understand the structure of atom based on orbital theory

Course outlines

Unit I: Some basic concepts of chemistry

Matter and its nature, Dalton's atomic theory; Concept of atom, molecule, element and compound; Physical quantities and their measurements in Chemistry, precision and accuracy, significant figures, S.I. Units, dimensional analysis; Laws of chemical combination; Atomic and molecular masses, mole concept, molar mass, percentage composition, empirical and molecular formulae; Chemical equations and stoichiometry.

[6 Hours]

Unit II: States of matter

Classification of matter into solid, liquid and gaseous states. Gaseous State: Measurable properties of gases; Gas laws - Boyle's law, Charle's law, Graham's law of diffusion, Avogadro's law, Dalton's law of partial pressure; Concept of Absolute scale of temperature; Ideal gas equation; Kinetic theory of gases (only postulates); Concept of average, root mean square and most probable velocities; Real gases, deviation from Ideal behaviour, compressibility factor, van der Waals equation, liquefaction of gases, critical constants. Liquid State: Properties of liquids - vapour pressure, viscosity and surface tension and effect of temperature on them (qualitative treatment only). Solid State: Classification of solids: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea); Electrical, magnetic properties.

[10 Hours]

Unit III: Atomic structure

Discovery of sub-atomic particles (electron, proton and neutron); Thomson and Rutherford atomic models and their limitations; Nature of electromagnetic radiation, photoelectric effect; Spectrum of hydrogen atom, Bohr model of hydrogen atom - its postulates, derivation of the relations for energy of the electron and radii of the different orbits, limitations of Bohr's model; Dual nature of matter, de-Broglie's relationship, Heisenberg uncertainty principle.Elementary ideas of quantum mechanics, quantum mechanical model of atom, its important features, and concept of atomic orbitals as one

electron wave functions; various quantum numbers (principal, angular momentum and magnetic quantum numbers) and their significance; shapes of s, p and d -orbitals, electron spin and spin quantum number; Rules for filling electrons in orbitals, aufbau principle, Pauli's exclusion principle and Hund's rule, electronic configuration of elements, extra stability of half-filled and completely filled orbitals.

[7 hours]

References

1. Inorganic Chemistry – 2nd edition, D.F Shriver, P.W.Atkins and C.H.Langtore Oxford University Press (1994).
2. Concepts and Models of Inorganic Chemistry – 3rd edition, B.E Douglas, D.H. Mc Daniel and Alexander, Wiley (2001)

GEC 2: C: Impact of Chemical fertilizers and pesticides on agriculture

Course Code: 21ICH4E4L **Course Credits: 02**
Total Contact hours: 23 **2Hours/week**
Internal assessments: 20 Marks **End semester exam: 30 Marks**

Course objective: Students should learn the impact of chemicals and fertilizers used in agriculture .

Course outcome:

1. Students gain the knowledge on residues of agrochemicals
2. Learn about the impact of pesticide residue
3. Gain awareness of pesticide residue effects on human health

Unit I: Residues of Agrochemicals:

a) Pesticides Residues in the Atmosphere:
Pesticides into the atmosphere and their fate, Transport of vapours, Precipitation, effect ofresidues on human life,
b) Pesticides residues in Water system:
Nature and origin of pollution of aquatic systems, Point and Non-Point pollution. Dynamics ofpesticides in aquatic environment.

[07 Hours]

Unit II: Pesticides residues in the Soil:

Absorption, Retention, Transport and Degradation of pesticides in the soil, Effect on microorganisms and Consequent effect on the soil condition, Fertility, Interaction in the soil

[10 Hours]

Unit III: Effect of pesticide residues on the quality of human life.

Model ecosystem, In general and consequent effect on human life. The Cases of & affectedsocieties and starving populations facing problems of health and nutrition, Traditional wisdom and Food security.

[06 Hours]

References

1. Progress in pesticides biochemistry and Toxicology V. I, II, III by D. H. Hutson and T. R.Robert.
2. Evaluation of pesticides in ground water by W. Y. Garnett, R. C. Honeycatt and others

DSC 11P: Analysis of Inorganic Materials

Course Code: 21ICH4C9P **Course Credits: 02**
Total Contact hours: 56 **4Hours/week**
Internal assessments: 20 Marks **End semester exam: 30 Marks**

Course objective: Students should have hands on experience on analysis of important Inorganic materials

Course outcome: After the completion of practical course, students should be able to

1. Analyse the contents of Cement
2. Analyse the contents of Heamatite by different methods

3. Analyze the Dolamite ore by using complex metric titration
4. Analyse the contents and percentage of Fe, Ni, Co in steel
5. Able to analyze the composition of fertilizers
6. Able to carry out the soil analysis

Course outlines

1. Analysis of Cement
2. Analysis of Heamatite
3. Analysis of Dolamite by EDTA
4. Analysis of Steel
5. Determination of Percentage composition of N, P, K in fertilizers
6. Soil analysis

21 ICH 4C1R Project work Or In-plant training

Course Code: 21ICH4C1R **Course Credits: 04**
Total Contact hours: 56 **4Hours/week**
Internal assessments: 30 Marks **End semester exam: 70 Marks**

Course objective:Students should expose to the real industrial working atmosphere by carryingthe small project work in the industries or should be able to carry a independent research after the completion of the course.

Course outcome:

1. After the completion of in plant training, students should be able to get a job in industries
2. Students should be able to secure a research position in any research and developmentorganization or institutions.

Students are expected to get hands on experience in synthesis or analysis in a reputed industries for the period of one month OR should carry out the relevant research project under the supervision of Faculty of the department.