

Syllabus of
3-Year/4-Year B.Sc. Chemistry
(Multidisciplinary Course)
Revised 2024
As Per NEP 2020
(Up-to 8th Semester)



University of Gourbang
Malda – 732 101
West-Bengal

Semester Wise Course Distribution

Chemistry (Multidisciplinary)
[Credit: 03]

Semester	Interdisciplinary Minor Course
SEM-I	MDC -101: Chemistry in Daily Life -I
SEM-II	MDC -201: Chemistry in Daily Life -II
SEM-III	MDC -301: Chemistry in Daily Life -III

FM: 50 (Theory: 40 + Internal:10)

Question Pattern:

Q. 1 [(a) – (j)]: Very Short Answer Type Question (@ 01 Mark): **08 Questions** to be attempted out of **10 questions = 08**

Q. 2 [(a) – (j)]: Short Answer Type Question (@ 02 Mark): **06 Questions** to be attempted out of **08 questions = 12**

Q. 3 [(a) – (d)]: Long Answer Type Question (@ 10 Mark): **02 Questions** to be attempted out of **04 questions = 20**

Paper: MDC -100 (Chemistry in Daily Life -I)
Theory: 45 L (45 Hours)

Objectives

1. Understand the composition of milk and milk products.
2. Learn principles of dairy safety and milk processing.
3. Conduct tests for milk quality and content analysis.
4. Identify food preservatives and artificial sweeteners.
5. Explore food flavorings and their applications.
6. Distinguish between food adulteration and contamination.
7. Analyze artificial and natural food colorants.
8. Evaluate the effects of coal tar dyes in food and cosmetics.

Learning Outcomes

After completion of this course the student will learn to:

1. Understand the composition and processing of milk and milk products.
2. Conduct tests like alcohol and dye reduction on milk for quality analysis.
3. Analyze effects and presence of food additives and artificial sweeteners.
4. Identify and differentiate food adulterants and contaminants.
5. Evaluate the application and impacts of artificial food colorants.
6. Perform qualitative analysis for caffeine and detect adulterants in products.

Food additives

(10 L)

Benzoates: Sodium benzoate, acidic pH, antimicrobial spectrum, **Propionates:** Calcium propionate, mold inhibition, bread preservation, **Sorbates:** Potassium sorbate, yeast inhibition, pH dependence, **Disulphites:** Sulphur dioxide, antioxidant, bleaching action, **Aspartame:** Dipeptide sweetener, phenylalanine, heat instability, **Saccharin:** Sulfoimide, heat stability, carcinogenic debate, **Dulcin:** P-ethoxyurea, banned status, sweetness profile, **Sucralose:** Chlorinated sucrose, heat stability, baking, **Sodium cyclamate:** Cyclamic acid, regulatory ban, calcium salt, **Vanillin:** Phenolic aldehyde, synthetic production, flavor profile, **Alkyl esters:** Fruit flavors, esterification, volatile compounds, **Monosodium glutamate:** Umami taste, glutamate receptor, safety controversy.

Food Adulterants, and Contaminants

(10 L)

Food processing and packaging: Unit operations, thermal processing, dehydration, freezing, packaging materials, aseptic packaging, shelf life, quality control, **Food adulteration:** Definition, importance, health hazards, economic impact, legal framework, **Adulterants in coffee:** Chicory, date seeds, tamarind seeds, color, starch, **Adulterants in tea:** Exhausted leaves, artificial color, iron filings, foreign matter, **Adulterants in milk:** Water, starch, urea, detergent, vegetable fat, **Adulterants in spices:** Metanil yellow, brick powder, grass seeds, argemone, **Adulterants in grains:** Ergot, sand, stone dust, foreign seeds, **Adulterants in food colour:** Non-permitted dyes, heavy metals, industrial pigments, **Difference between food adulteration and contamination:** Intentional vs unintentional, source differences, health impact, prevention.

Artificial Food Colorants

(11 L)

Natural colors: Plant sources, animal sources, extraction methods, stability factors, regulatory status, **Synthetic colors:** Azo dyes, triphenylmethane dyes, xanthene dyes, production methods, stability, **Fake colors:** Definition, detection methods, common adulterants, health hazards, **Inorganic pigments:**

Titanium dioxide, iron oxides, chromium compounds, food applications, toxicity, **Application of colors in food industry:** Beverages, confectionery, dairy products, meat products, regulatory limits, **Flavoring agents:** Natural flavors, synthetic flavors, extraction methods, regulatory status, examples, **Coal tar dyes:** Azo compounds, synthesis, permitted list, analytical detection, **Non-permitted colors:** Rhodamine B, metanil yellow, malachite green, Sudan dyes, detection, **Metallic salts:** Lead salts, arsenic salts, chromium salts, copper salts, toxicity limits, **Utility of coal tar dyes in food and cosmetics:** Food coloring, cosmetic applications, product types, concentration limits, **Harmful effect of coal tar dyes:** Carcinogenicity, hyperactivity, allergic reactions, regulatory bans, toxicology.

Analysis of Dairy Products and Beverages

(14 L)

(a) Dairy Chemistry and Quality Control-

Composition of milk and milk product: Constituents, physical properties, composition factors, products overview, nutritional significance, **Principles of dairy safety:** Contamination sources, microbiological hazards, pasteurization standards, HACCP standards, **Milk processing:** Reception, standardization, homogenization, thermal processing, fermentation, **Composition:** Proximate analysis, protein estimation, lactose determination, quality grading, **Alcohol test:** Ethanol precipitation, procedure, interpretation, mastitis correlation, **Fermentation:** Lactic acid bacteria, starter cultures, Yogurt and cheese, acidity monitoring, **Dye reduction-methylene blue and resazurin tests:** MBRT grading, resazurin test, bacterial correlation, **Analysis of fat content:** Gerber method, solvent extraction, Werner-Schmid method, fat constants, **Minerals in milk and butter:** Ash content, calcium phosphorus, chloride estimation, salt butter, **Estimation of added water in milk:** Cryoscopy, lactometer, adulterants detection,

(b) Analysis of Non-Dairy Stimulants (Tea & Coffee)

Qualitative analysis of caffeine in coffee and tea: Solvent extraction, iodine test, murexide test, TLC confirmation, **Detection of chicory in coffee:** Microscopic examination, ferric chloride, iodine test, chromatography

(c) Forensic Analysis of Fermented Beverages (Toddy)

Chloral hydrate in toddy: Resorcinol test, Fujiwara reaction, silver nitrate, toxicology.

Reference Books

1. Food Science & Quality Control by SMT. B. Poornima - Centrum Press First edition 2014.
2. Post-Harvest Management of Horticultural crops - S. Saraswathy, T.L. Preethi AGROBIOS (India) 2013.
3. A Handbook of Agn. Food processing and marketing by S.C. Gaur, Agro Bios (India) 2012.
4. Quality Control for value edition in Food processing – by Dev Raj, Rakesh Sharma & V.K. Joshi New India Publishing Agency, 2011.
5. Food processing and preservation – Subbulakshmi, G. Shobha, A. Udipti, New Age International (P) Ltd., 2006

SEMESTER-II

Paper: MDC -200 (Chemistry in Daily Life -II)

Theory: 45 L (45 Hours)

Objectives

1. Understand the classification and nomenclature of vitamins and their sources.
2. Identify deficiency diseases related to vitamins A, B, C, D, E, and K.
3. Analyze the composition and purity of edible oils and fats.
4. Conduct practical experiments for detecting rancidity and adulterants in oils.
5. Learn the manufacturing process and uses of soaps and detergents.
6. Explore the structure and biological functions of proteins and nucleic acids.

Learning Outcomes

After completion of this course the student will learn to:-

1. Identify and classify vitamins, learning their sources and deficiency diseases.
2. Understand the composition and purity detection of oils and fats.
3. Conduct tests to identify adulterants in oils.
4. Explain the classification and manufacturing of soaps and detergents.
5. Describe the structure and biological value of proteins and amino acids.
6. Understand the structure and functions of nucleic acids, including DNA fingerprinting.

Vitamins

(12 L)

Classification and Nomenclature: Fat soluble vitamins, water soluble vitamins, trivial names, chemical names, coenzyme forms, **Vitamin A:** Retinol structure, β -carotene sources, visual cycle, epithelial maintenance, **Vitamin A deficiency:** Night blindness, xerophthalmia, keratinization, **Vitamin B:** Thiamine riboflavin, niacin pyridoxine, cobalamin folate, B complex sources, **Vitamin B deficiency:** Beriberi, pellagra, anemia, neurological symptoms, **Vitamin C:** Ascorbic acid structure, citrus sources, antioxidant role, collagen synthesis, **Vitamin C deficiency:** Scurvy, gum bleeding, wound healing, **Vitamin D:** Cholecalciferol structure, ergocalciferol, sunlight synthesis, calcium absorption, **Vitamin D deficiency:** Rickets, osteomalacia, bone deformities, **Vitamin E:** Tocopherol structure, antioxidant function, vegetable sources, membrane protection, **Vitamin E deficiency:** Hemolysis, neurological symptoms, muscle weakness, **Vitamin K:** Phylloquinone menaquinone, blood clotting, leafy sources, hemorrhagic disease.

Oils and Fats

(10 L)

Composition of edible oils: Fatty acid profile, triglyceride structure, phospholipids sterols, tocopherols waxes, essential fatty acids, sources classification, **Detection of purity:** Refractive index, specific gravity, saponification value, iodine value, acid value, bellier test, **Rancidity of fats and oil:** Hydrolytic rancidity, oxidative rancidity, peroxide value, anisidine value, totox value, antioxidants, **Tests for adulterants like argemone oil and mineral oils:** Argemone oil detection, nitric acid test, paper chromatography, mineral oil detection, cold test, saponification residue, **Soaps & Detergents:** Definition classification, soap manufacturing, detergent manufacturing, anionic detergents, cationic detergents, composition uses.

Proteins

(12 L)

Sources, Composition and Biological values of protein: Animal sources, plant sources, amino acid composition, biological value, protein efficiency ratio, net protein utilization, **Elementary ideas of**

proteins and amino acids: Amino acid structure, zwitterion nature, isoelectric point, protein classification, structural proteins, functional proteins, **Essential and Non-essential amino acids:** Essential amino acids, non-essential amino acids, limiting amino acids, semi-essential amino acids, lysine methionine, tryptophan deficiency, **Peptide bonds:** Amide linkage, peptide bond formation, dehydration synthesis, peptide bond planarity, resonance stabilization, trans configuration, **Polypeptides:** Oligopeptides, polypeptide chain, N-terminal C-terminal, peptide sequencing, Edman degradation, peptide synthesis, **Qualitative ideas of structure of proteins:** Primary structure, secondary structure, tertiary structure, quaternary structure, alpha helix, beta pleated sheet, **Denaturation and coagulation of proteins:** Heat denaturation, pH denaturation, organic solvents, heavy metal salts, urea guanidine, protein precipitation, **Factors contributing to denaturation and coagulation:** Temperature effect, pH effect, ionic strength, mechanical agitation, radiation effect, surface tension.

Nucleic Acids

(11 L)

Nucleic acids: Definition, biological role, types, discovery history, **Chemical composition:** Nucleotides, nitrogenous bases, pentose sugars, phosphate groups, **Nucleosides and nucleotides:** Purines, pyrimidines, nucleoside structure, phosphodiester bonds, **Classifications of nucleic acids:** DNA types, RNA types, viral nucleic acids, synthetic analogs, **DNA structure:** Double helix, Watson-Crick model, base pairing, supercoiling, **RNA structure:** mRNA structure, tRNA structure, rRNA structure, secondary folding, **Functions of nucleic acids:** Genetic storage, replication, transcription, translation, **DNA replication:** Semiconservative mode, DNA polymerase, replication fork, Okazaki fragments, **Protein synthesis:** Transcription process, translation process, codon anticodon, ribosome function, **DNA fingerprinting:** VNTR loci, STR analysis, PCR amplification, gel electrophoresis, **Applications of DNA fingerprinting:** Forensic science, paternity testing, genetic diagnostics, evolutionary studies.

Reference Books

1. Berg, J.M.; Tymoczko, J.L.; Stryer, L. (2006), Biochemistry. W.H. Freeman and Co.
2. Nelson, D.L.; Cox, M.M.; Lehninger, A.L.(2009), Principles of Biochemistry. W.H. Freeman and Co.
3. Murray, R.K., Granner, D.K., Mayes, P.A.; Rodwell, V.W.(2009), Harper's Illustrated Biochemistry. Lange Medical Books/McGraw-Hill.
4. Brown, T.A. (2018) Biochemistry, (First Indian addition 2018) Viva Books.
5. Kumar, A.; Garg, S.; Garg, N. (2012), Biochemical Tests: Principles and Protocols. Viva Books.
6. Finar, I. L. (2008), Organic Chemistry, Volume 2, 5th Edition, Pearson Education.

SEMESTER-III

Paper: MDC -300 (Chemistry in Daily Life -III)

Theory: 45 L (45 Hours)

Objectives

1. Understand principles and applications of batteries and fuel cells.
2. Learn basics of solar energy and future energy storage.
3. Study quality control and assay methods in pharmaceuticals.
4. Explore the chemistry and uses of common drugs.
5. Examine preparation and uses of cosmetics and perfumes.
6. Learn about different types and manufacture of fertilizers.

Learning Outcomes

After completion of this course, the student will learn to:

1. Understand the principles and applications of primary & secondary batteries and fuel cells.
2. Describe the basics of solar energy and future energy storage solutions.
3. Identify common drugs, their uses, and the importance of quality control in pharmaceuticals.
4. Explain the chemistry, preparation, and uses of cosmetics and perfumes.
5. Recognize the role and manufacture of essential oils in the cosmetic industry.
6. Understand different types of fertilizers and their manufacturing processes.

Chemical and Renewable Energy Sources

(11 L)

Principles and applications of primary batteries: Dry cells, alkaline cells, zinc-carbon, lithium primary, cell reactions, **Principles and applications of secondary batteries:** Lead-acid, nickel-cadmium, lithium-ion, charging cycles, depth discharge, **Principles and applications of fuel cells:** Hydrogen-oxygen, PEMFC, SOFC, DMFC, applications, **Basics of solar energy:** Photovoltaic effect, solar cells, solar thermal, silicon types, energy conversion, **Future energy storer:** Supercapacitors, hydrogen storage, pumped hydro, compressed air, battery grids.

Common Drugs and their Uses

(11 L)

Importance of quality control: GMP standards, batch consistency, patient safety, **Drugs and pharmaceuticals:** Definition, classification, dosage forms, **Sources of impurities in pharmaceutical chemicals:** Raw materials, process errors, degradation, storage, **Analytical quality control in finished / final products:** Assay methods, purity testing, stability testing, **Common methods of assay:** Titrimetric, gravimetric, spectrophotometric, chromatographic, **Analgesics:** Aspirin, paracetamol, pain relief, fever reduction, **Anthelmintics:** Mebendazole, worm infection, deworming, **Antiallergics:** Chlorpheniramine malleate, histamine blocker, allergy, **Antibiotics:** Penicillin, chloromycetin, bacterial infection, **Anti-inflammatory agents:** Oxyphenbutazone, inflammation, arthritis, **Antimalarials:** Primaquine phosphate, malaria, plasmodium, **Antituberculosis's:** INH, tuberculosis, mycobacterium, **Narcotics:** Nicotine, morphine, CNS action, dependence, **Expectorants:** Benadryl, cough, mucus clearance, **Sedatives:** Diazepam, anxiety, CNS depression, **Vitamins:** B1, B2, B6, niacin, folic acid.

Chemistry of Cosmetics & Perfumes

(12 L)

Hair dye: Oxidative dyes, henna, synthetic dyes, bleaching agents, color chemistry, **Hair spray:** Polymer resins, propellants, film formation, hold mechanism, **Shampoo:** Surfactants, conditioning agents, pH

balance, detergency, **Suntan lotions**: UV filters, SPF rating, organic filters, inorganic filters, **Face powder**: Talc base, pigments, binders, coverage agents, **Lipsticks**: Wax base, pigments, oils, emollients, **Talcum powder**: Talc mineral, absorbent, fragrance, formulation, **Nail enamel**: Nitrocellulose, plasticizers, pigments, solvents, **Creams**: Cold cream, vanishing cream, shaving cream, emulsion types, **Antiperspirants**: Aluminum salts, astringent action, sweat reduction, **Artificial flavours**: Synthetic esters, aldehydes, ketones, flavor chemistry, **Essential oils**: Eugenol and Geraniol, sandalwood oil, eucalyptus oil, rose oil, phenyl ethyl alcohol, Jasmine Civetone Muscone.

Fertilizers

(11 L)

Different types of fertilizers: Nitrogenous, phosphatic, potassic, micronutrient, organic, NPK grading, **Urea**: Ammonia synthesis, CO₂ reaction, prilling, biuret control, nitrogen content, **Ammonium nitrate**: Ostwald process, neutralization, prilling, explosive hazard, storage safety, **Calcium ammonium nitrate**: Limestone addition, granulation, nitrogen calcium, storage stability, **Ammonium phosphates**: MAP DAP, phosphoric acid, ammonia reaction, granulation, solubility, **Polyphosphate**: Polyphosphoric acid, ammonium salt, sequestration, liquid fertilizer, hydrolysis, **Superphosphate**: Phosphate rock, sulfuric acid, single superphosphate, double superphosphate, P₂O₅ content, **Compound and mixed fertilizers**: NPK formulation, bulk blending, complex granulation, coating, slow release, **Potassium chloride**: Sylvinite mining, flotation separation, crystallization, muriate potash, K₂O content, **Potassium sulphate**: Mannheim process, sulfate potash, chloride sensitive, crystallization, solubility.

Reference Books

1. Barel, A.O.; Paye, M.; Maibach, H.I.(2014),Handbook of Cosmetic Science and Technology, CRC Press.
2. Garud, A.; Sharma, P.K.; Garud, N. (2012),Text Book of Cosmetics, Pragati Prakashan.
3. Gupta, P.K.; Gupta, S.K.(2011),Pharmaceutics and Cosmetics, Pragati Prakashan
4. Butler, H. (2000), Poucher's Perfumes, Cosmetic and Soap, Springer
5. Kumari, R. (2018),Chemistry of Cosmetics, Prestige Publisher.
6. Gopalan, R. Venkappayya, D.; Nagarajan, S. (2004), Engineering Chemistry, Vikas Publications.
7. Sharma, B. K. Engineering Chemistry, Goel Publishing House, Meerut, 2006
8. Pharmaceutical Analysis, T. Higuchi and E.B. Hanseen, John Wiley and Sons, New York.