

SARVAJANIK UNIVERSITY

SURAT



SARVAJANIK
UNIVERSITY

INCLUSIVE | INTEGRATED | INNOVATIVE

Master of Science

(Chemistry)

[Applicable for Academic Session 2020-21]

[As per CBCS guidelines given by UGC]

SARVAJANIK UNIVERSITY
M.Sc. Organic Chemistry Syllabus (CBCS)
FIRST SEMESTER

M.Sc. Organic Chemistry Syllabus				
	Semester-1	Semester-2	Semester-3	Semester-4
Core-1 (DSC)	Theoretical organic chemistry (DSC I)	Organic synthesis and mechanism (DSC III)	Organic Spectroscopy (DSC V)	Dissertation (SEC Component)
Core-2 (DSC)	Industrial Processes, Waste Management & Quality Control (DSC II)	Chemistry of Natural Products (DSC IV)	Designing organic synthesis (DSC VI)	
Skill Enhancement Course (SEC)	Advance analytical chemistry (SEC I)	Instrumentation and analytical techniques (SEC II)	Analytical Techniques in Applied Chemistry (SEC III)	Physical Organic Chemistry (DSC- VII)
Discipline Centric Electives (DSE)	Food Chemistry (DSE I)	Forensic Chemistry & Toxicology (DSE II)	Applications of Green Chemistry (DSE III)	Medicinal Chemistry/Dyes (DSE-IV)

Semester	Discipline Specific Elective Courses
1	1. Food Chemistry 2. Energy and Environment 3. Laboratory safety and management 4. Bioethics
2	1. Forensic Chemistry & Toxicology 2. Bioinformatics 3. IPR 4. Biostatistics.
3	1. Forensic biology and DNA typing 2. Research Methodology 3. Bio-entrepreneurship 4. Application of Green Chemistry
4.	1. Medicinal Chemistry 2. Dyes

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Program: M.Sc. Organic Chemistry	Type: Theory
Semester: II	
Subject: DSC-I- Theoretical Organic Chemistry	
Credit: 04(T) + 02 (P)	Total learning hours: 60
Course description: This course paper is about Substitution, Addition, Elimination, Pericyclic Reactions, Stereochemistry, Photochemistry, Organic Reagents.	
Student learning outcome: At the end of the course students will be able to learn...about <ul style="list-style-type: none"> • Different mechanisms of substitution reaction. • Addition, Elimination reactions. • Pericyclic Reactions, Stereochemistry, Photochemistry, Organic Reagents. 	

Unit 1 Substitution Reactions

(10 Hours)

- 1.1 The SN₂, SN₁, mixed SN₁ and SN₂ and SET mechanism, SE₂ and SE₁ mechanism
- 1.2 Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium; ambident nucleophile, regioselectivity
- 1.3 S_NAr, benzyne and S_Ni mechanism
- 1.4 Arenium ion mechanism, ipso attack, orientation in other ring systems

Unit 2 Elimination and Addition Reactions

(12 Hours)

- 2.1 The E₂, E₁ and E₁cB mechanisms
- 2.2 Hoffman and Saytzeff modes of elimination
- 2.3 Orientation of the double bond, reactivity effects of substrate structures, attacking base, the leaving group and the medium, pyrolytic elimination
- 2.4 Regio- and chemo selectivity, orientation and reactivity
- 2.5 Reactivity of carbonyl group, nucleophilic addition of hetero-atoms (N,O)

Unit 3 Organic Reaction Mechanisms

(08 Hours)

- 3.1 Methods of determination of reaction mechanism
- 3.2 Neighboring group participation
- 3.2.1 Mechanism and effects of a chimeric assistance NGP by unshared/ lone pair electrons, π – *electrons*, aromatic rings, σ -bonds with special reference to norbornyl and bicyclo [2.2.2] octyl cation systems (formation of non-classical carbocation)
- 3.3 Role of FMOs in organic reactivity
- 3.3.1 Reactions involving hard and soft electrophiles and nucleophiles, ambident nucleophiles, ambident electrophiles, the α -effect

Unit 4 Pericyclic reactions -I

(06 Hours)

- 4.1 Classification of Pericyclic reactions
- 4.2 Thermal and photochemical reactions
- 4.3 Three approaches: Evidence for the concertedness of bond making and breaking
- 4.4 Symmetry-allowed and Symmetry -forbidden Reactions
- 4.5 The wood ward -Hoffmann Rules
- 4.6 The Aromatic Transition structure [Huckel & Mobius]
- 4.7 Frontier orbitals correlation Diagrams
- 4.8 Frontier orbital of ethylene, 1,3-butadiene & 1,3,5-Hexatriene and allyl system

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Unit 5 Pericyclic Reaction-II

(06 Hours)

- 5.1. Cycloaddition reactions: Supra and antarafacial addition
- 5.2. $4n$ and $4n+2$ systems
- 5.3. 1,3- Dipolar cyclo addition and cheletropic reactions
- 5.4. Sigmatropic rearrangements: H-shifts and C-shifts
- 5.5. Supra and antarafacial migrations
- 5.6. Cope and Azacope rearrangements
- 5.7. Claisen and Ene rearrangements

Unit 6 Stereochemistry

(06 Hours)

- 6.1 Classification of point groups based on symmetry elements with examples (non mathematical treatment)
- 6.2 Conformational analysis of medium rings: eight to ten membered rings and their unusual properties, I-strain, transannular reactions
- 6.3 Stereochemistry of fused ring and bridged ring compounds: decalins, hydrindanes, perhydroantracenes, steroids and Bredt's rule.
- 6.4 Anancomeric systems
- 6.5 Effect of conformation on reactivity of cyclohexane derivatives in the following reactions (including mechanism) electrophilic addition, elimination, molecular rearrangements, reduction of cyclohexanones. (with LiAlH_4 , selectride MPV Reduction) and oxidation of cyclohexanols

Unit 7 Photochemistry

(06 Hours)

- 7.1 Principles of photochemistry: quantum yield, electronic states and, transitions, selection rules, of dissipation of energy (Jablonski diagram), electronic energy transfer, photosensitization and quenching process.
- 7.2 Photochemistry of carbonyl compounds: $\pi\pi$ Norish -I and Norish -II Cleavages, Paterno-Buchi reaction, photo reduction Calculation quantum yield, photochemistry of enones, photochemical rearrangements of α, β unsaturated ketones and cyclohexadienones, photo Fries rearrangement, Borton reaction
- 7.3 Photochemistry of olefins: cis-trans isomerizations, dimerisations, hydro abstraction, addition and Di- π methane rearrangement including azo -di- π methane. Photochemical cross-coupling of alkenes, photodimerization of alkenes.
- 7.4 Photochemistry of arenes ; 1,2-1,3- and 1,4 additions, photocycloaddition of aromatic rings
- 7.5 Singlet oxygen and photo-oxygenation reaction, photo chemically induced radical reactions, Chemiluminescence

Unit 8 Organic Reagents

(06 Hours)

- 8.1 Organo-metallic Reagents: Principle, preparation, properties and applications of the following in organic synthesis with mechanistic details:
 - 8.1.1 Gilman's Reagent (Lithium Dimethyl cuprate), Organocerium Reagents, Organochromium Reagents, Organosilicon Reagents.
- 8.2 Organo-nonmetallic Reagents. Principle, preparation, properties and applications of the following in organic synthesis with mechanistic details:
 - 8.2.1 Trimethylsilyl iodide, Diazomethane, Polyphosphoric acid, Dicyclohexylcarbodiimide, Borane

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References:

1. Advanced Organic Chemistry Part A and Part B, Carey B. F. A., Sundberg R.J., 5th Edition, 2007, Springer.
2. Stereochemistry: Conformation and Mechanism, Kalsi, P.S., 2010, New Age International (p) Ltd. New Delhi.
3. Organic Chemistry, Morrison, R.T., Boyd, R.N., 6th Edition, 2011, Prentice- Hall of India, New Delhi, 2011.
4. March's Advanced Organic Chemistry, Smith, M. B., March J., 6th Edition, John Wiley and Sons, New York.
5. A Guide Book to Mechanism in Organic Chemistry, Sykes, P., 6th Edition, Prentice Hall, 1997.
6. Stereochemistry of carbon compounds, Eliel, E. L., S. H. Wiley, 2008.
7. Organic Chemistry, Clayden, J.; Greeves, N.; Warren, S., Oxford University press, 2nd Edition, 2012.
8. Organic Chemistry, Bruice Paula, Y., 7th Edition, 2015, Pearson Edition.

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M.Sc. Organic Chemistry Syllabus (CBCS)
FIRST SEMESTER

Program: M.Sc. Organic Chemistry	Type: Theory
Semester: I	
Subject: DSC-II- INDUSTRIAL PROCESSES, WASTE MANAGEMENT & QUALITY CONTROL	
Credit: 04(T) + 02 (P)	Total learning hours: 60
Course description: This course will provide the student with an introduction to the concepts and technologies of the principal manufacturing processes utilized by industry. Subjects include the manufacturing system and its operating principles, and advanced manufacturing processes, industrial effluent treatment, solid and hazardous waste management. Course provides the idea about quality control and quality management and safety in chemical industries.	
Student learning outcome: At the end of the course students will be able to...learn <ul style="list-style-type: none"> • The different unit processes, different separation techniques. • Effluent treatment, Waste management and process Instrumentation. • Also learn about quality control techniques, assurance and management in chemical industry 	

Unit 1 Unit Processes and Chemical Reactions in Organic Chemistry (10 Hours)

- 1.1 Unit processes: Nitration, Halogenation, Sulphonation, Sulphanation, Oxidation, Hydrogenation Esterification, Hydrolysis, Alkylation, Aminolysis, Amination, Cyanation, Will –Meyer reaction, Formylation, Polymerization
- 1.2 Aerobic and Anaerobic Fermentation: Production of Ethyl Alcohol and Citric Acid, Antibiotics: Penicillin, Cephalosporin, Chloromycetin and Streptomycin, Amino Acids: Lysine, Glutamic Acid, Vitamins: Vitamin B2, Vitamin B12 and Vitamin C
- 1.3 Important Chemical Reaction & Their Applications in Chemical Process Industries

Unit 2 Unit Operations (04 Hours)

- 2.1 Principle and Method of Distillation, Solvent Extraction, Solid-Liquid Leaching, Liquid - Liquid Extraction, Membrane Processes, Absorption, Adsorption, Crystallization Process
- 2.2 Physical techniques in chemical industries: Filtration, Centrifugation, Drying
- 2.3 Equipment needed in chemical technology: Reactors, Distillation columns, Extruders, Pumps, Mills, Emulators

Unit 3 Process Instrumentation (04 Hours)

- 3.1 Principle and Applications of:
 - 3.1.1 Flowmeter
 - 3.1.2 Temperature & Pressure
 - 3.1.3 pH, Oxidation Reduction Potential
 - 3.1.4 D.O. & Turbidity
 - 3.1.5 Other Sensors for Water Quality Monitoring

Unit 4 Industrial Effluent Treatment (08 Hours)

- 4.1 Need for effluent treatment and principle of ETP
- 4.2 Primary Treatment
- 4.3 Secondary Treatment

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- 4.4 Tertiary Treatment
- 4.5 Gaseous pollution control in ETP
- 4.6 Indian standards for disposal of industrial effluents

Unit 5 Solid & Hazardous Waste Management (10 Hours)

- 5.1 Introduction of Solid & Hazardous Waste generated in Chemical Industry
- 5.2 Sources and Classification
- 5.3 Identification: Characteristics and types of listed hazardous waste
- 5.4 Treatment and Disposal
- 5.5 Management and Handling Rules

Unit 6 Quality Control & Assurance in Chemical industry (12 Hours)

- 6.1 Statistical Treatment of data
- 6.2 Control charts
- 6.3 Performance Evaluation uncertainties in measurement
- 6.4 Validation of analytical Methods, instrumentation, persons
- 6.5 Elements of quality assurance
- 6.6 Quality management concepts and principles
- 6.7 Quality Management System: ISO 9001:2016

Unit 7 TQM in Chemical Industry (06 Hours)

- 7.1 Six sigma approach to Quality
- 7.2 Applying six sigma to chemical Industries
- 7.3 Good Laboratory Practices: principles of GLP
- 7.4 GMP in Drugs & Pharmaceutical Industries
- 7.5 Accreditation of QC laboratories
- 7.6 Tools and Mechanisms ICH Guidelines on Drug substances & products

Unit 8 Safety in Chemical Industries (06 Hours)

- 8.1 Need of Safety in Chemical Industries
- 8.2 Indian Standards
- 8.3 Types of Chemical Hazards & Controls
- 8.4 Storage Hazards & controls
- 8.5 Process Hazards and Control,
- 8.6 Safe Transfer and Transportation of chemical
- 8.7 NFPA, GHS

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References:

1. Handbook of Quality Assurance for the analytical chemistry laboratory, James P. Dux, Van Nostrand Reinhold, 1986, New York.
2. Applying ISO-9000 Quality Management Systems, International Trade Centre Publishing, UNCTAD/WTO. Geneva, Switzerland, Indian Edition Printed by D. L. Shah Trust.
3. How to practice GLP, PP Sharma, 2000, Vandana Publications, New Delhi.
4. Training Manuals on ISO 9000 / 2000 PQM, Girdhar J Gyani, 2001, Raj Publishing House
5. Quality Assurance in Analytical Chemistry, B.W. Wenclawiak, 2004, Springer, India.
6. Separation Methods, M. N. Sastri, 1st Edition, 1991, Himalaya Publishers.
7. Analytical Chemistry, - Gary D. Christian, 6th Edition, John Wiley and sons. Inc., New York, 1994.
8. Quality Assurance and Quality Management in Pharmaceutical Industry, Y. Anjaneyulu and R. Marayya, 2005, Pharma Book Syndicate.
9. Quality Assurance and Quality Control in the Analytical Chemical Laboratory, Piotr Konieczka and Jacek Namiesnik, 2009, CRC Press.
10. Guide to ISO 9001: 2000, A. K. Chakraborty, P. K. Basu, S.C. Chakravarty, 2005, Asian Books Pvt. Ltd.
11. Quality Assurance in Analytical Chemistry, B.W. Wenclawiak, M.Koch and E. Hadjicostas, 2004, Springer.

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FIRST SEMESTER

Program: M.Sc. Organic Chemistry	Type: Theory
Semester: I	
Subject: SEC I: ADVANCED ANALYTICAL CHEMISTRY	
Credit: 04(T) + 02 (P)	Total learning hours: 60
Course description: This Course Paper proposes to teach about: Analytical chemistry basic principles and classical theory, sampling methods, various volumetric analysis, gravimetric analysis and about the reliability of analytical data generated in a statistical manner.	
Student learning outcome: At the end of the course students will be able to... Learn <ul style="list-style-type: none"> • The quantitative and qualitative aspects of analytical chemistry • Sampling techniques • Principle, method of gravimetric analysis and • Principle, method of volumetric analysis: • Acid-base titrations, precipitation titrations, redox titrations, complexometric titrations • Statistical methods to check the reliability of generated analytical data • Applications in various fields 	

Unit 1 Introduction to Analytical Chemistry

(08 Hours)

- 1.1 Importance of Analytical Chemistry
- 1.2 Methods of Quantitative Analysis
- 1.3 Selection of method of Analysis
- 1.4 Chemical Analysis & Analytical chemistry
- 1.5 Quantitative Analysis & scale of operation
- 1.6 Various steps in Quantitative Analysis
- 1.7 Methods of Analytical Determination
- 1.8 The Role of Instrumentation
- 1.9 Application of Analytical Chemistry in Agriculture, Pharmaceuticals, Medical Technology, Food & Beverages, Other Fields

Unit 2 Reliability of Analytical Data

(08 Hours)

- 2.1 Errors in Chemical Analysis
- 2.2 Classification of Errors
- 2.3 Determining the Accuracy of Methods
- 2.4 Improving the Accuracy of analysis
- 2.5 Statistical Analysis
- 2.6 Rejection of Results
- 2.7 Presentation of Data
- 2.8 Confidence Limit
- 2.9 Q-Test for Rejection of Results
- 2.10 Standard 't' Test

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Unit 3 Sampling in Analysis (06 Hours)

- 3.1 Theory of sampling
- 3.2 Techniques of sampling
- 3.3 Statistical Criteria of Good sampling
- 3.4 Stratified Sampling versus Random Sampling
- 3.5 Minimization of variance in stratified sampling
- 3.6 Transmission and storage of samples.

Unit 4 Gravimetric Analysis (08 Hours)

- 4.1 Precipitation methods
- 4.2 Purity of precipitation-co precipitation
- 4.3 Optimum conditions for precipitation
- 4.4 Precipitation from homogeneous solution
- 4.5 Washing of the precipitate
- 4.6 Ignition of the precipitate
- 4.7 Role organic precipitants in gravimetric analysis
- 4.8 Criteria for choice of an organic Reagent
- 4.9 Some Important organic precipitants

Unit 5 Volumetric Analysis (07 Hours)

- 5.1 Volumetric analysis in chemistry
- 5.2 Classification of volumetric methods
- 5.3 Acid Base Titration
- 5.4 Acid Base indicators
- 5.5 Mixed indicator
- 5.6 Fluorescent indicators

Unit 6 Redox Titrations (07 Hours)

- 6.1 Theory of Redox Titration curves
- 6.2 Some Oxidizing Agents as Titrants
- 6.3 Application of Iodine as Redox Reagent
- 6.4 Redox indicators
- 6.5 Detection of Endpoint in Redox Titrations.

Unit 7 Precipitation Titration (08 Hours)

- 7.1 Theory of Precipitation, Titration Curve
- 7.2 Factors Influencing solubility of the precipitate
- 7.3 Titration by Turbidity without an indicator
- 7.4 Volhard's Method
- 7.5 Mohr's Method
- 7.6 Adsorption Indicators in Precipitation Titration
- 7.7 Miscellaneous Indicators for titrations

Unit 8 Complexometric EDTA Titrations (08 Hours)

- 8.1 Complexometric EDTA Titrations
- 8.2 Complexometric Titration curves
- 8.3 Metallochromic Indicators

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- 8.4 Selectivity in Complexometric Titrations
- 8.5 Typical EDTA Titrations
- 8.6 Advantages of Complexometric Titrations

References:

1. Chemistry for Environmental Engineering and Science, C. N. Sawyer and P. L. McCarty, G.F. Parkin, 5th Edition, 21st Reprint, 2015, Mc Graw Hill Education (India) Private Limited.
2. Quantitative Analysis, R.A Day, A. L. Underwood, 6th Edition, 1991, Prentice-Hall.
3. Standard Methods for Examination of Water & Wastewater, Andrew D. Eaton, Lenore S. Clesceri, Eugene W. Rice, Arnold Greenberg, 23rd Edition, 2017, published by APHA, AWWA, WEF.
4. Official Methods of Analysis, Dr. William Harwitz, Dr. George W Latimer, 18th Edition, 2005, published by Association of Officiating Analytical Chemists (AOAC).
5. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, 9th Edition, Reprint 2014, Cengage Learning.
6. Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, 2009, New Age International Private Limited.

SARVAJANIK UNIVERSITY
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FIRST SEMESTER

Program: M.Sc. Organic Chemistry	Type: Theory
Semester: I	
Subject: DSE-I: Food Chemistry	
Credit: 04(T) + 02 (P)	Total learning hours: 60
Course description: This course presents concise and relevant information on the composition of foods and the reactions they undergo during processing and storage. The course will deal with the chemistry of the principal components of foods, their properties and interactions. This will provide basic information regarding the food analysis also.	
Student learning outcome: At the end of the course students will be able to: <ul style="list-style-type: none"> • Explain the importance of water for stability and quality of foods. • Understand the relationship between nutrition and human well being • Know the major and minor components of foods • Know composition and properties of food • Explain the basic structures of food constituents • Understand the basic chemical reaction food constituents undergo during processing • Identify additives added to foods for different purposes 	

Unit 1 Water in Food

(06 Hrs)

- 1.1 Moisture in foods, definition of water in food, Water as a nutrient
- 1.2 Types of water and their specific function
- 1.2 Sorption phenomenon
- 1.3 Water activity and food stability
- 1.4 Water activity and packaging
- 1.6 Water activity and spoilage

Unit 2 Carbohydrates

(10 Hrs)

- 2.1 Definition, classification and physical properties
- 2.2 Nutritive roles of carbohydrate
- 2.3 Sweetness of sugars, relation of structure to sweetness
- 2.4 Important carbohydrates in food
(glucose, sucrose, starch, agar, glycogen, cellulose, pectin, gums and resins)
- 2.5 Carbohydrates: digestion, absorption, metabolism (glycolysis, citric acid cycle, glycogenesis, Glycogenolysis, Gluconeogenesis, hexose monophosphate pathway)
- 2.6 Retro gradation and staling
- 2.7 Modified celluloses and starches
- 2.8 Pectic substances and dietary fibre
- 2.9 Nonenzymatic browning and Mailard reaction

Unit 3 Lipids

(08 Hrs)

- 3.1 Characteristics and classification
- 3.2 Physical properties-melting point, softening point, specific gravity, refractive index, smoke, flash and fire point, turbidity point
- 3.1 Chemical properties- reichert meissel value, polenske value, iodine value, peroxide value, saponification value
- 3.4 Effect of frying on fats

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- 3.5 Changes in fats and oils- rancidity, lipolysis, flavor reversion
- 3.6 Auto-oxidation, factor affecting rate of oxidation and its prevention,
Methods of measuring lipid oxidation- solid fat index, peroxide value, thiobarbituric acid test, anisidine value, Kreis test, oxirane test
- 3.7 Technology of edible fats and oils- Refining, Hydrogenation and Interesterification

Unit 4 Proteins **(08 Hrs)**

- 4.1 Protein classification and structure
- 4.2 Nature of food proteins (plant and animal proteins)
- 4.3 Denaturation of protein and its implications
- 4.4 Functional properties of proteins (organoleptic, solubility, viscosity, binding gelation/ texturization , emulsification , foaming)
- 4.5 Supplementary value of food proteins
- 4.6 Modification of food protein in processing and storage and its implications
- 4.7 Reaction of protein in food (Reaction with lipids, sulphites enzymatic hydrolysis, plastein reaction)

Unit 5 Minerals **(04 Hrs)**

- 5.1 Mineral functions, sources
- 5.2 Solubility and bioavailability of minerals
- 5.3 Nutritional aspects of minerals
- 5.4 Fortification: Iron sources used in fortification

Unit 6 Vitamin **(06 Hrs)**

- 6.1 Classification, stability, toxicity and sources
- 6.2 Distribution in foods, loss during processing
- 6.3 Mechanism of degradation
- 6.4 Functions and deficiency diseases caused by following vitamins:
 - 6.4.1 Fats soluble vitamins – Vitamin A, D, E and K
 - 6.4.2 Water soluble vitamins – Vitamin C and B-complex

Unit 7 Food additives **(08 Hrs)**

- 7.1 Definition, need and classification of food additives
- 7.2 Permitted food additives and their role
 - 7.2.1 Preservatives-Natural and Artificial (Class-I and class-II preservatives)
 - 7.2.2 Antioxidants, Chelating agents, Colouring agents
 - 7.2.3 Curing agents, Emulsions
 - 7.2.4 Flavors and flavor enhancers
 - 7.2.5 Non-nutritive sweeteners
 - 7.2.6 pH control agents
 - 7.2.7 Stabilizer and thickeners
 - 7.2.8 Humectants, Anti-caking agents
 - 7.2.9 Firming agent, Clarifying agent, Flour bleaching agents

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Unit 8 Food Analysis

(10 Hrs)

- 8.1 Analysis of Chemical Additives in foods
 - 8.1.1 Division of colour additives
 - 8.1.2 Chromatographic identification of colours, quantitative estimation of added dyes in foods (Titanium Trichloride Method)
- 8.2 Chemical preservatives and synthetic sweetening agents (Organic-ether extractable and non- ether extractable)
 - 8.2.1 Analysis of SO₂ & Sodium Benzoate (Chemical Methods), Sorbic Acid (Chromatography)
- 8.3 Types of Antioxidants used in Foods
 - 8.3.1 Analysis of Butylated Hydroxy Toluene (BHT) (Spectrophotometry)
- 8.4 Moisture analysis in food
- 8.5 Common adulterants in food
- 8.6 Pesticide analysis of food products

Reference:

1. Fennema's food chemistry, Damodaran, S., Parkin, K. L., & Fennema, O. R., 2007, CRC press.
2. Food science, Potter, N. N., & Hotchkiss, J. H., 2012, Springer Science & Business Media.
3. Principles of food chemistry, DeMan, J. M., Finley, J. W., Hurst, W. J., & Lee, C. Y. 2018, Springer.
4. Food chemistry, Aurand, L. W., Woods, A. E., & Wells, M. R., 1987, Springer, Dordrecht.
5. Food Chemistry, Meyer, L. H., 1982, AVI Publising Company.
6. Foods facts and principles, N. Shakuntala Manay, M. Shdakshara Swamy, 2008, New age International Publisher, New Delhi.
7. Introduction to Chemical Analysis of Foods, S. Suzanna & Nielsen, CBS Publishers & Distributor.
8. Food chemistry, Belitz, H. D., Grosch, W., & Schieberle, P., 2004, Springer, Berlin, Heidelberg.

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Laboratory Practical

1. Determination of pH, Turbidity and TDS of water sample.
2. Determination of D.O. and Conductivity of water sample.
3. Preparation of p-Nitro Chloro benzene from Acetanilide.
4. Preparation of Eosin from Phthalic Acid.
5. Organic synthesis of Paracetamol
6. Organic synthesis of 6 - methyluracil.
7. Organic synthesis of Acridone.
8. Organic synthesis of Methyl Orange.
9. Determination of Zn^{+2} / Cu^{+2} by Complexometric titration.
10. Gravimetric estimation of Ni as Ni (Dimethyl Glyoxime)₂ /Ba as BaSO₄.
11. Determination of COD of water sample by redox titration.
12. Analysis of fats/oils – Any two of the following:
Acid value, Iodine number, Reichert Meissel number and Saponification value of fats
13. Determination of riboflavin from curry leaves (fluorimetric method).
14. Determination of salt content in commercial table butter.
15. Determination of Moisture in food sample.

References:

1. Standard Methods for Examination of Water & Wastewater, Andrew D. Eaton, Lenore S. Clesceri, Eugene W. Rice, Arnold Greenberg, 23rd Edition, 2017, published by APHA, AWWA, WEF.
2. Official Methods of Analysis, Dr. William Harwitz, Dr. George W Latimer, 18th Edition, 2005, published by Association of Officiating Analytical Chemists (AOAC).
3. Analytical Techniques in Agriculture, Biotechnology and Environmental Engineerin; A. Nag; 1st Edition, 2006, Prentice Hall of India.
4. Laboratory Manual in Biochemistry – J. Jayaraman, 2011, New Age Publication.
5. Manual of analysis of fruits and vegetable products, Central food technological research institute, Mysore, S. Ranganna, 1977, Tata McGraw Hill publishing company Ltd, New Delhi.
6. Biochemical Methods, S. Sadasivam, and A. Manikam, 2nd Edition, 1996, New Age International(p) Ltd. Publishers and Tamil Nadu Agricultural University (Coimbatore).
7. Laboratory techniques in food analysis, D. Pearson, 1973, John Wiley & Sons, New York.
8. Analytical Chemistry, H. Kaur, 1st Edition, 2013, Pragati Prakashan.