

Bachelor of Sciences in Industrial Chemistry

SEMESTER VI

DISCIPLINE SPECIFIC CORE COURSE – 16: (DSC-16) FOOD ADDITIVES, CONTAMINATION AND SAFETY

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Food Additives, Contamination and Safety (DSC-16: Industrial Chemistry - VI)	04	02	--	02	Physics, Chemistry, Mathematics, in Class XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To understand the chemistry of food additives and their applications.
- To impart theoretical and practical knowledge on common food additives, contaminants and adulterants.
- To enhance the understanding of safety measures of food and evaluation techniques to determine toxicity of additives.
- To enhance knowledge about regulations and monitoring agencies of food.

Learning Outcomes:

By the end of this course, students will be able to:

- Understand and describe applications of various food additives in food processing and preservation.
- Know the merits and demerits of synthetic and natural colouring, flavouring and sweetening agents as food additives.
- Identify and prevent potential sources of food contamination
- Know Safety measures of food additives, regulations and monitoring agencies and toxicological evaluation of additives.

Unit 1: Food Additives

Hours: 12

Introduction, need of food additives in food processing and preservation. Characteristics and classification of food additives.

Antimicrobial agents. -Nitrites, sulphides, sulphur dioxide, sodium chloride, hydrogen peroxide.

Antioxidants - Introduction, mechanism of action, natural and synthetic antioxidants, technological aspect of antioxidants.

Sweeteners- Introduction, importance, classification- natural and artificial, chemistry, technology and toxicology, consideration for choosing sweetening agents.

Colors- Introduction, importance, classification- natural, artificial, and natural identical, FD&C Dyes and Lakes. polymeric colors.

Unit 2: Food Contamination & adulterants

Hours: 12

Contamination in Food: Physical, chemical contaminants- heavy metals, pesticide residues, agrochemicals, Antibiotics and Veterinary Drug residues, environmental pollutants, radionuclides, solvent residues, NOTS (Naturally Occurring Toxic Substances)

Contaminants formed during processing & packaging – nitrosamines, acrylamide, alloys, benzene, dioxins, furans, persistent organic pollutants, polymers, PAH (Polycyclic Aromatic Hydrocarbons) in smoked foods, food. fumigants, autoxidation products.

Food adulteration - Common adulterants in foods and tests to detect common adulterants.

Unit 3: Food Safety, Risks and hazards

Hours: 6

Food related hazards, regulations and monitoring agencies, interaction of additives with food ingredients and their toxicological aspects, quality evaluation of additives and contaminants, Acute and chronic studies, NOEL, ADI, LD50

Practical

Credits: 02, Laboratory periods: 60)

1. Determination of moisture content of foods by oven drying.
2. Determination of reducing and total sugar content in foods.
3. Chromatographic Separation and identification of sugars and amino acids.
4. Testing of turmeric powder, milk and mustard oil for adulterants.
5. Extraction of natural coloring and flavoring agent from flowers and fruits
6. Inspection of various food grains- cereals and coarse cereals
7. Determination of quality standards and inspection of spices and condiments.
8. Qualitative tests for hydrogenated fats, butter, and ghee.
9. Estimation of sulphur dioxide in beverages.
10. Qualitative estimation of benzoic acid in ketchup and sauces.
11. Chromatographic estimation of colour.
12. Study the effect of aerial oxidation of food.

References (Theory):

1. DeMan. (2007). **Principles of Food Chemistry**. Springer, 3rd edition
2. Emerton, V, (2008). **Food Colours**. Blackwell Publishing.
3. Wilson, R. (2007). **Sweeteners**. Blackwell Publishing.
4. Fennema OR.(1996). **Food Chemistry**. Marcel Dekker.
5. Pieterneel A, Luning. & Willem, J. Marcelis. (2009). **Food Quality Management Technological and Managerial principles and practices**. Wageningen.

References (Practical):

1. Ranganna, S., & Ranganna, S. (2003). **Handbook of analysis and quality control for fruit and vegetable products**. New Delhi: Tata McGraw-Hill
2. Nielsen, S. S. (2017). **Food analysis**.
3. Vogel, Arthur I. (Arthur Israel). (1989). **Vogel's textbook of quantitative chemical analysis**. Harlow, Essex, England : New York :Longman Scientific & Technical ; Wiley,

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

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		Lecture	Tutorial	Practical/ Practice		
Quantum Chemistry and Spectroscopy DSC-16: Chemistry- VI	04	02	--	02	Class 12th with Physics, Chemistry, Mathematics	NA

Learning Objectives

The Learning Objectives of this course are as follows:

- To introduce the concepts and methodology of quantum mechanics
- Application of Quantum chemistry to spectroscopy
- To establish the relation between structure determination and spectra.

Learning outcomes

By studying this course, students will be able to:

- Understand basic principles of quantum mechanics: operators, eigen values, averages, probability distributions.
- Understand and use basic concepts of microwave, IR and UV-VIS spectroscopy for interpretation of spectra.

Syllabus

Unit 1: Quantum Chemistry

(Hours: 16)

Postulates of quantum mechanics, quantum mechanical operators.

Schrodinger equation and its application to free particle and particle in a 1-D box (complete solution), quantization, normalization of wave functions, concept of zero-point energy.

Qualitative treatment of H and H like atoms. Setting up of Schrodinger equation for many electron atoms.

Rotational Motion: Schrödinger equation of a rigid rotator and brief discussion of its results (solution not required). Quantization of rotational energy levels.

Vibrational Motion: Schrödinger equation of a linear harmonic oscillator and brief discussion of its results (solution not required). Quantization of vibrational energy levels.

Unit 2: Spectroscopy

(Hours: 14)

Electromagnetic radiation and its interaction with matter. Lambert-Beer's law, Jablonski's diagram. Florescence and Phosphorescence.

Difference between atomic and molecular spectra. Born- Oppenheimer approximation: Separation of molecular energies into translational, rotational, vibrational and electronic components.

Microwave Spectroscopy: Microwave (pure rotational) spectra of diatomic molecules. Selection rules.

Structural information derived from rotational spectroscopy.

IR Spectroscopy: Selection rules, IR spectra of diatomic molecules. Structural information derived from vibrational spectra. Effect of hydrogen bonding (inter- and intramolecular) and substitution on vibrational frequencies.

Electronic Spectroscopy: Electronic excited states. Free electron model and its application to electronic spectra of polyenes. chromophores, auxochromes, bathochromic and hypsochromic shifts.

Practical component

Credits:02

(Laboratory Periods: 60)UV/Visible spectroscopy

19. Study the 200-500 nm absorbance spectra of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule^{-1} , kJ mol^{-1} , cm^{-1} , eV).
20. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $\text{K}_2\text{Cr}_2\text{O}_7$
21. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2- propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colorimetry

22. Verify Lambert-Beer's law and determine the concentration of $\text{CuSO}_4/$ $\text{KMnO}_4/ \text{K}_2\text{Cr}_2\text{O}_7/\text{CoCl}_2$ in a solution of unknown concentration
23. Determine the concentrations of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ in a mixture.
24. Study the kinetics of iodination of propanone in acidic medium.
25. Determine the amount of iron present in a sample using 1, 10-phenanthroline.
26. Determine the dissociation constant of an indicator (phenolphthalein).

27. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.

References:

Theory:

1. Banwell, C.N.; McCash, E.M.(2006), **Fundamentals of Molecular Spectroscopy**, Tata McGraw- Hill.
2. Kapoor, K.L.(2015), **A Textbook of Physical Chemistry**, McGraw Hill Education,
, Vol 4, 5th Edition, McGraw Hill Education.
3. McQuarrie, D.A.(2016), **Quantum Chemistry**, Viva Books.
4. Chandra, A. K.(2001), **Introductory Quantum Chemistry**, Tata McGraw-Hill.
5. Dua A and Tyagi P, **Molecular Spectroscopy: Quantum to Spectrum**, (2022) Atlantic Publishers & Distributors Pvt Ltd.
6. Dua A, Singh C, **Quantum Chemistry: Classical to Computational** (2015) Manakin Press.

Practical:

7. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), **Senior Practical Physical Chemistry**,
R. Chand & Co, New Delhi.
8. Kapoor, K.L. (2019), **A Textbook of Physical Chemistry**,
Vol.7, 1st Edition, McGraw Hill Education.
9. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P.(
2003), **Experiments in Physical Chemistry**, 8th Edition, McGraw-Hill, New York.

Additional Resources:

5. Castellan, G. W .(2004), **Physical Chemistry**, Narosa.
6. Petrucci, R. H.(1989), **General Chemistry: Principles and Applications**, Macmillan Publishing

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