

	MAHATMA GANDHI UNIVERSITY Kottayam, Kerala Undergraduate Programmes (HONOURS) 2026 Admission Onwards
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SYLLABUS									
SIGNATURE COURSE									
Name of the College	SSV College, Valayanchirangara P.O, Perumbavoor								
Faculty/ Discipline	Chemistry								
Programme	BSc (Hons) Chemistry								
Course Coordinator	Dr. Sreedevi K.								
Contributors	Dr. Sreedevi K., Dr. Anju Paul, Poornima M. P.								
Course Name	Food Chemistry and Composition								
Type of Course	DSE								
Specialization title	Analytical Tools in Food Chemistry								
Course Code	MG3DSECHEA08								
Course Level	200								
Course Summary	This course aims to provide fundamental knowledge of the chemical composition and function of food constituents including water, carbohydrates, proteins, lipids, vitamins, minerals, and enzymes.								
Semester	3	Credits	4						
Course Details	<table><tr><td>Learning Approach</td><td>Lecture</td><td>Total Hours</td></tr><tr><td>Credits</td><td>4</td><td>60</td></tr></table>			Learning Approach	Lecture	Total Hours	Credits	4	60
	Learning Approach	Lecture	Total Hours						
Credits	4	60							
Pre-requisites, if any									

Course Outcomes (CO)

Number of COs			4
CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Identify the properties, types, chemical behavior, and functional roles of water and carbohydrates in foods and the human body	K	PO1, PO2, PO3
2	Recognize the structure, classification, properties, and analytical tests, of amino acids and proteins, with emphasis on their role in food systems.	K	PO1, PO2, PO3
3	Explain the classification, sources, properties, dietary functions, processing, and basic analytical methods of lipids, including fats and oils used in foods.	U	PO1, PO2, PO3
4	Understand the sources, classification, biological functions, deficiency conditions, and nutritional importance of vitamins, minerals, and enzymes, including enzyme classification, mechanism of action, and their role in food systems.	U	PO1, PO2, PO3

*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	2	2	1	-	-	-	-	-	-	-
CO 2	2	2	1	-	-	-	-	-	-	-
CO 3	2	2	1	-	-	-	-	-	-	-
CO 4	2	2	1	-	-	-	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Water and Carbohydrates			
	1.1	Water and its uses in the body- Structure of water and ice, Chemical properties of water, types of water- free water, bound water, water activity and shelf life, properties and functions of water.	5	["1"]
	1.2	Classification and structure of carbohydrates- Monosaccharides-Glucose, fructose, oligosaccharides, polysaccharides. Important polysaccharide - Starch, glycogen, gums, pectin, cellulose.	6	["1"]
	1.3	Functions of carbohydrates -Test for carbohydrates- Molisch's test, Iodine test, Barfoed's test. Browning reaction - enzymatic and non-enzymatic.	6	["1"]
2	Amino acids and Proteins			
	2.1	Amino acids, basic structure of amino acid, essential and non-essential amino acids, peptides, peptide bonds, classification-based on chemical composition, based on globular shape, based on function. Structure of proteins-primary, secondary, tertiary, quaternary.	8	["2"]
	2.2	Denaturation of proteins-Test for proteins- reaction with ninhydrin, Biuret test. Colloidal property of proteins and its significance. Proteins in nutrition	7	["2"]
3	Lipids			
	3.1	Classification of Lipids-simple lipids, complex lipids, derived lipids, sources of fats and oils, property of lipids-physical, chemical, nutritional, function of lipids in the diet, processing of fats and oils, general methods for analysis of fats and oils- solubility test, translucent spot test, Acrolein test.	10	["3"]
4	Vitamins and Enzymes			
	4.1	Vitamins- Sources of vitamins-Classification of vitamins- fat soluble vitamins and water soluble vitamins, biological function of vitamins, Vitamin deficiency, Hypervitaminosis. Essential mineral elements, nutritional aspects of minerals (Ca, P, Fe, Na, K)	10	["4"]
	4.2	Enzymes-major classes, characteristics, mechanism of enzyme action-lock and key model, induced fit model. Food enzymes- natural sources and functions. Enzymes acting on carbohydrates, proteins and lipids.	8	["4"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture involving chalk & board method, multimedia presentation, group discussion, peer teaching, hands on experiment
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Assessment Types	MODE OF ASSESSMENT Mode of Assessment: Theory
	A. Continuous Comprehensive Assessment (CCA) • Theory - 30 Marks Assignment/Class test/ MCQ/Viva
	B. End Semester Evaluation (ESE) • Theory - 70 Marks Assessment Methods - Written examination Duration of Examination - N/A Pattern of examination for Theory - Non-MCQ Different parts of written examination - Part - A , B , C Answer Type: ◦ PART - A ◦ Short answer - (5 out of 7) - $5 \times 4 = 20$ ◦ PART - B ◦ Short Essays - (5 out of 7) - $5 \times 7 = 35$ ◦ PART - C ◦ Essays - (1 out of 2) - $1 \times 15 = 15$

References

- 1. Subalakshmi, G., & Udipi, S. A. (2001). Food processing and preservation. New Age International Publishers.
- 2. Srilakshmi, B. (2003). Food science. New Age International Publishers.
- 3. Potter, N. N., & Hotchkiss, J. H. (1996). Food science. CBS Publishers and Distributors.
- 4. Aurand, L. W., & Woods, A. E. (1973). Food chemistry. AVI Publishing Company.
- 5. Damodaran, S., Parkin, K. L., & Fennema, O. R. (2017). Fennema's food chemistry (5th ed.). CRC Press.
- 6. Belitz, H. D., Grosch, W., & Schieberle, P. (2009). Food chemistry (4th ed.). Springer.
- 7. Nielsen, S. S. (2019). Food analysis laboratory manual (3rd ed.). Springer.

Suggested Readings

- 1. Parker, R. (2003) Introduction to Food Science. Thomson Learning Inc. New York.
- 2. Potter, N.N. (1987) Food Science. S.K. Jain for CBS Publishers & Distributors, New Delhi.

Affidavit

- We, SSV College, Valayanchirangara P.O, Perumbavoor and Dr. Sreedevi K., retain the copyright of this syllabus and expressly prohibit its distribution in complete form to any institution outside our own.
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MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS) 2026 Admission Onwards

SYLLABUS

SIGNATURE COURSE

Name of the College	SSV College, Valayanchirangara P.O, Perumbavoor		
Faculty/ Discipline	Chemistry		
Programme	BSc (Hons) Chemistry		
Course Coordinator	Dr. Sreedevi K.		
Contributors	Dr. Sreedevi K., Dr. Anjana V. N., Dr. Sreekala S. Sharma		
Course Name	Food Additives and Adulterants		
Type of Course	DSE		
Specialization title	Analytical Tools in Food Chemistry		
Course Code	MG4DSECHEA08		
Course Level	200		
Course Summary	This course aims to provide fundamental knowledge of food additives used in food processing and their functional roles in improving quality and shelf life. It also builds understanding of food adulterants, methods for their detection, associated health risks, and the regulatory framework ensuring food safety and quality control.		
Semester	4	Credits	4
Course Details	Learning Approach	Lecture	Total Hours
	Credits	4	60
Pre-requisites, if any			

Course Outcomes (CO)

Number of COs		4	
CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Demonstrate the use of food additive classification to assess their functions, benefits, risks, and safety considerations, including preservatives, in food products. antioxidants in relation to food spoilage and preservation.	A	PO1, PO2, PO3, PO6
2	Evaluate the properties, quality control practices, and health implications of sensory food additives such as food colours, flavours, flavour enhancers, and sweetening agents, including analytical aspects related to food colourants	A	PO1, PO2, PO3, PO6
3	Interpret the mechanism of action of emulsifiers and analyse the functions of emulsifiers, stabilisers, thickeners, gelling agents, food acids, flour improvement agents, leavening agents, and anti-caking agents in food systems	U	PO1, PO2, PO3, PO6
4	Describe the types of food adulterants, methods for detection of adulteration, adulteration of milk and milk products, and the key provisions of food laws and standards governing food quality and safety	U	PO1, PO2, PO3, PO6, PO8

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	2	2	2	-	-	1	-	-	-	-
CO 2	2	2	2	-	-	1	-	-	-	-
CO 3	2	2	2	-	-	1	-	-	-	-
CO 4	2	2	2	-	-	1	-	1	-	-

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Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Food Additives – Concepts, Preservatives and Antioxidants			
	1.1	Food additives-Definitions and the need of food additives. E-number. Types of food additives-natural and synthetic. Benefits and risk food additives.	3	["1"]
	1.2	Preservatives-introduction, food spoilage, food preservation- traditional, modern food preservatives. Classification of preservatives-Class I and Class II. Class II – organic and inorganic preservatives. Safety concerns of food preservatives.	6	["1"]
	1.3	Antioxidants-definition, types of antioxidants- natural antioxidant, synthetic anti-oxidant, enzyme-based antioxidants, Function of antioxidants in food processing, mechanism of action of antioxidants, safety concerns of synthetic antioxidants, alternatives to synthetic antioxidants.	6	["1"]
2	Sensory Additives – Colours, Flavours and Sweeteners			
	2.1	Importance of food colours, Synthetic food colours, natural food colours, non-permitted dyes, health effect of synthetic food colours, quality assurance of food colourants. Methods of analysis	5	["2"]
	2.2	Importance of flavours, Natural flavours, synthetic flavours, Flavour enhancers-monosodium glutamate, vinegar, maltol, quality control of flavourants, flavour stabilisation and flavour encapsulation	5	["2"]
	2.3	Natural and artificial sweeteners, nutritive and non-nutritive sweeteners, properties and uses of saccharin, acesulfame-K, aspartame. Corn sweeteners, invert sugar sucrose and sugar alcohols (polyols) as sweeteners in food products.	5	["2"]
3	Functional and Processing Additives			
	3.1	Emulsifiers-definition and types-Natural emulsifiers and synthetic emulsifiers. Functions and mechanism of action of emulsifiers. Definition, functions, applications and examples of stabilisers, thickeners, glazing agents and gelling agents.	6	["3"]
	3.2	Definition of food acids and acidity regulators; examples, sources, uses, and functions; health considerations of food acids and acidity regulators. Definition, function and examples of flour treatment agents, Definition of leavening agents; functions of baking powder and yeast. Definition of anti-caking agents and their action with example	9	["3"]

Module	Units	Course Description	Hrs	CO No.
4	Food Adulteration, Detection and Food Laws			
	4.1	Types of adulterant- intentional adulterants and incidental adulterants, Detect Adulteration with Rapid Test , Adulteration of milk-carbohydrates, neutralisers and preservatives, fertilizers and salts, detergents, Adulteration of milk products, Analysis of milk and milk products- Clot-on-boiling test, alchohol-alizarin test	10	["4"]
	4.2	Prevention of food adulteration act (PFA), Essential commodities act, Fruit Products Order (FPO), Milk and Milk products order, Meat food products order	5	["4"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture involving chalk & board method, multimedia presentation, group discussion, peer teaching, hands on experiment
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Assessment Types	MODE OF ASSESSMENT Mode of Assessment: Theory
	A. Continuous Comprehensive Assessment (CCA) • Theory - 30 Marks Assignment/Class test/ MCQ/Viva
	B. End Semester Evaluation (ESE) • Theory - 70 Marks Assessment Methods - Written examination Duration of Examination - 2.00 Hrs Pattern of examination for Theory - Non-MCQ Different parts of written examination - Part - A , B , C Answer Type: ◦ PART - A ◦ Short answer - (5 out of 7) - $5 \times 4 = 20$ ◦ PART - B ◦ Short Essays - (5 out of 7) - $5 \times 7 = 35$ ◦ PART - C ◦ Essays - (1 out of 2) - $1 \times 15 = 15$

References

- 1. Mahindru, S. N. (2000). Food additives: Characteristics, detection and estimation. Tata McGraw-Hill Publishing Company Limited.
- 2. Swaminathan, M. (2005). Food science and experimental foods. Ganesh and Company.
- 3. Sreelakshmi, B. (2018). Food science. New Age International.
- 4. Leatherhead Food International. (2008). Essential guide to food additives (3rd ed.). Royal Society of Chemistry.
- 5. Msagati, T. A. M. (2013). Chemistry of food additives and preservatives. Wiley-Blackwell.

Suggested Readings

- 1. Food Safety and Standards Authority of India. (2023). Detect adulteration with rapid test (DART Book). Government of India.
- 2. Food Safety and Standards Authority of India. (2017). Manual of testing methods for food safety on wheels. Government of India.

Affidavit

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Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2026 Admission Onwards

SYLLABUS

SIGNATURE COURSE

Name of the College	SSV College, Valayanchirangara P.O, Perumbavoor		
Faculty/ Discipline	Chemistry		
Programme	BSc (Hons) Chemistry		
Course Coordinator	Dr. Sreedevi K.		
Contributors	Dr. Anju Paul, Dr. Anjana V. N.		
Course Name	Food quality analysis		
Type of Course	DSE		
Specialization title	Analytical Tools in Food Chemistry		
Course Code	MG5DSECHEA08		
Course Level	300		
Course Summary	This course introduces the principles and methods of food analysis, including sampling, nutritional labelling, physical measurements, and compositional evaluation of foods.		
Semester	5	Credits	4
Course Details	Learning Approach	Lecture	Total Hours
	Credits	4	60
Pre-requisites, if any			

Course Outcomes (CO)

Number of COs		4	
CO No.	Expected Course Outcome	Learning Domains *	PO No
1	To understand the fundamentals of food analysis, nutritional labeling, and sampling procedures used in food evaluation.	U	PO1, PO2, PO3, PO10
2	To demonstrate the application of physical methods such as rheology, refractometry, polarimetry, and density determination in food analysis.	A	PO1, PO2, PO3, PO10
3	To examine the moisture, ash, mineral, and protein composition of foods using standard analytical methods	A	PO1, PO2, PO3, PO10
4	To analyse the fat, carbohydrate, and dietary fibre content of foods using established analytical techniques.	An	PO1, PO2, PO3, PO10

*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	2	2	2	-	-	-	-	-	-	1
CO 2	2	2	2	-	-	-	-	-	-	1
CO 3	2	2	2	-	-	-	-	-	-	1
CO 4	2	2	2	-	-	-	-	-	-	1

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Introduction to food analysis			
	1.1	Introduction to food analysis. Nutritional labelling. Proximate analysis.	5	["1"]
	1.2	Sampling, Population, Importance of sampling. Sampling technique. Types of sampling. Sampling Plan. Preparation of samples. Problems in sampling	7	["1"]
2	Physical methods of food analysis			
	2.1	Food Rheology. Viscosity. Surface Tension. Refractometry. Polarimetry. Colorimetry Freezing point. Specific gravity-Hydrometry, Pycnometer.	12	["2"]
3	Compositional Analysis of Food - I			
	3.1	Analysis of moisture content – oven drying methods, distillation method -Dean and Stark method, chemical method-Karl Fischer titration.	5	["3"]
	3.2	Analysis of ash- dry, wet and low temperature plasma ashing, soluble and insoluble ash in water, ash Insoluble in acid.	4	["3"]
	3.3	Determination of mineral content- Mineral Analysis- Calcium- Gravimetric, EDTA and redox titration. Iron – Redox titration. Phosphorous- colorimetry	5	["3"]
	3.4	Analysis of crude protein (nitrogen)-Biuret method, Kjeldahl's method, Lowry's method, Ninhydrin analysis	4	["3"]
4	Compositional Analysis of Food - II			
	4.1	Fat analysis- Continuous Solvent Extraction Method: Goldfish Method, Semicontinuous Solvent Extraction Method: Soxhlet Method. Determination of smoke point and percent fat absorption, determination of saponification value, determination of iodine value using Wiz method. Gerber Method for Milk Fat	8	["4"]
	4.2	Analysis of Carbohydrates –Reducing and non-reducing sugars- Determination of reducing sugar using Lane Eyon Method, Somogyi-Nelson Method, Alkaline Ferricyanide Method. Phenol-sulphuric acid method, Starch analysis	7	["4"]
	4.3	Fibre analysis - Crude Fibre analysis, Dietary Fibre Analysis by AOAC method	3	["4"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture involving chalk & board method, multimedia presentation, group discussion, peer teaching, hands on experiment
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Assessment Types	MODE OF ASSESSMENT Mode of Assessment: Theory
	A. Continuous Comprehensive Assessment (CCA) • Theory - 30 Marks Assignment/Class test/ MCQ/Viva
	B. End Semester Evaluation (ESE) • Theory - 70 Marks Assessment Methods - Written examination Duration of Examination - 2.00 Hrs Pattern of examination for Theory - Non-MCQ Different parts of written examination - Part - A , B , C Answer Type: ◦ PART - A ◦ Short answer - (5 out of 7) - $5 \times 4 = 20$ ◦ PART - B ◦ Short Essays - (5 out of 7) - $5 \times 7 = 35$ ◦ PART - C ◦ Essays - (1 out of 2) - $1 \times 15 = 15$

References

- Kalia, M. Food Analysis and Quality Control. Kalyani Publishers, New Delhi. 2002.
- 2. Winton, A.L and Winton, K.B. Techniques of food analysis. Allied Scientific Publishers, New Delhi. 1999.
- 3. Nielsen, S.S. Introduction to the chemical analysis of foods. Jones and Bartlett Publishers, Boston, London. 2003.
- 4. Pearson, D, 2002, The Chemical Analysis of Foods, Churchill Livingstone, New York.

Suggested Readings

- 1. Rovina Kobun, 2015, Advanced Food Analysis Tools .1st Edition, Elsevier publisher.
- 2. James, C. S. (1995). Analytical chemistry of foods. Springer/Chapman & Hall.

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SYLLABUS

SIGNATURE COURSE

Name of the College	SSV College, Valayanchirangara P.O, Perumbavoor								
Faculty/ Discipline	Chemistry								
Programme	BSc (Hons) Chemistry								
Course Coordinator	Dr. Sreedevi K.								
Contributors	Dr. Sreekala S. Sharma, Poornima M. P.								
Course Name	Instrumental Methods of Food Analysis								
Type of Course	DSE								
Specialization title	Analytical Tools in Food Chemistry								
Course Code	MG6DSECHEA08								
Course Level	300								
Course Summary	This course introduces the principles and methods of instrumental food analysis, including measurement science, data analysis, spectroscopic, chromatographic, thermal, and electrophoretic techniques used for food evaluation.								
Semester	6	Credits	4						
Course Details	<table><tr><td>Learning Approach</td><td>Lecture</td><td>Total Hours</td></tr><tr><td>Credits</td><td>4</td><td>60</td></tr></table>			Learning Approach	Lecture	Total Hours	Credits	4	60
	Learning Approach	Lecture	Total Hours						
Credits	4	60							
Pre-requisites, if any									

Course Outcomes (CO)

Number of COs		4	
CO No.	Expected Course Outcome	Learning Domains *	PO No
1	This course introduces the principles and methods of instrumental food analysis, including measurement science, data analysis, spectroscopic, chromatographic, thermal, and electrophoretic techniques used for food evaluation.	U	PO1, PO2, PO10
2	To demonstrate the application of spectroscopic instruments such as UV-Visible spectrophotometer, AAS, FTIR, and mass spectrometer based on their principles, instrumentation, and uses in food analysis.	A	PO1, PO2, PO10
3	To apply the principles of chromatographic techniques, including GC, HPLC, and HPTLC, by relating their classification, detectors, sampling methods, and applications to the separation and analysis of food components.	A	PO1, PO2, PO10
4	To demonstrate the use of thermal analytical methods and electrophoretic techniques by explaining the principles, working, and applications of thermogravimetry, DTA, DSC, and electrophoresis in food analysis.	A	PO1, PO2, PO10

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	2	2	-	-	-	-	-	-	-	1
CO 2	2	2	-	-	-	-	-	-	-	1
CO 3	2	2	-	-	-	-	-	-	-	1
CO 4	2	2	-	-	-	-	-	-	-	1

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Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Introduction to Instrumental analysis			
	1.1	Need Instrumentation in Food Analysis, Selecting an Appropriate Instrumental Technique Criteria for Selecting a Technique. SI units and their significance in analytical measurements. Scientific notation and prefix notation. Significant digits and rules for rounding off. Precision and accuracy: definitions and comparison. Types of errors in analysis: Determinate (systematic) errors Indeterminate (random) errors. Methods to reduce systematic (determinate) errors. Elementary concepts of population and sample. Statistical treatment of analytical data: Mean, Variance, Standard deviation	8	["1"]
	1.2	Graphical representation of analytical data. Calibration graphs, regression analysis and significance of coefficient of determination Introduction to software tools for data analysis: • MS Excel • Origin	7	["1"]
2	Spectroscopic techniques			
	2.1	Spectroscopic instruments UV-Visible spectrophotometer, Atomic-Absorption Spectrometer (AAS), Fourier Transform Infrared Spectrometer (FTIR), Mass Spectrometer. (Basic principle, instrumentation and application)	18	["2"]
3	Chromatography			
	3.1	Classification of chromatography based on physico-chemical properties and type of stationary phase used.	7	["3"]
	3.2	Gas Chromatography: Principle and applications. Detectors used in gas chromatography Sampling techniques - Headspace analysis, Thermal desorption, Purge and trap technique. High performance Liquid chromatography (HPLC)- Normal phase and reverse phase Detectors for HPLC. High Performance Thin Layer Chromatography (HPTLC): Principle and applications.	7	["3"]
4	Thermal methods of analysis and Electrophoresis			
	4.1	Thermal methods -Thermogravimetry, Differential Thermal Analysis and Differential Scanning Calorimetry.	7	["4"]
	4.2	Electrophoresis: theory and application of paper, starch gel, agarose, native and denaturing PAGE (basic principle and working)	6	["4"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture involving chalk & board method, multimedia presentation, group discussion, peer teaching, hands on experiment
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References

- 1. Skoog, D. A., West, D. M., & Crouch, S. R. (2013). Fundamentals of analytical chemistry (9th ed.). Cengage Learning.
- 2. Mendham, J., Denney, R. C., Barnes, J. D., & Thomas, M. J. K. (2009). Vogel's textbook of quantitative chemical analysis (6th ed.). Pearson Education.
- 3. Nielsen, S. S. (2004). Introduction to the chemical analysis of foods. Jones and Bartlett Publishers.
- 4. Ötles, S. (Ed.). (2009). Handbook of food analysis instruments. CRC Press.

Suggested Readings

- 1. Petrozzi, S. (2014). Practical instrumental analysis: Methods, quality assurance and laboratory management. Wiley-VCH.
- 2. Alfassi, Z. B. (Ed.). (1994). Instrumental multi-element chemical analysis. Springer.

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