Subject Description Form

Subject Code	FSN3101
Subject Title	Food Chemistry and Analysis
Credit Value	3
Level	3
Pre-requisite	FSN2001 Organic Chemistry for Food Science
Co-requisite	FSN3102 Food Chemistry and Analysis Laboratory
Objectives	This subject aims to provide students with the understanding of the basic chemistry of the major food constituents (water, carbohydrates, lipids and proteins) and the minor food components (vitamins, pigments and food additives), as well as to familiarize students with the principles and techniques of food analysis by using physical, chemical and biological methods. The chemical reactions and changes in the constituents of major food products during harvesting, handling, processing, and storage will be emphasized.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) understand the chemistry underlying the properties and reactions of various food components; b) recognize the impacts of chemical reactions occurring in foods on their safety, shelf life, sensory and nutritional qualities and control chemical reactions in food; c) integrate chemistry with the quality attributes of food and apply knowledge to solve real-life problems in food preparation, processing and storage; d) recognize clearly the principles behind the analytical methods associated with food analysis; e) select an appropriate analytical technique when presented with a practical problem; f) demonstrate abilities in analytical, problem-solving and critical thinking.
Subject Synopsis/ Indicative Syllabus	<u>Introduction</u> Major and minor components in foods; examples of chemical reactions occurring in foods and the impacts on their safety, sensory and nutritional qualities. <u>Water</u> Structure and properties; interactions of water with food components and food materials; water binding; water determination. <u>Carbohydrates</u> Structure, properties and reactions; mono-, oligo- and polysaccharides and their

	roles in foods; gelatinization and retrogradation of starch; modified starches; fibres and gums; pectin and fruit pectin gels; caramelization and Maillard reactions; composition and properties of cereals, fruits and vegetables. Lipids Classification, structure and properties; deteriorative reactions of lipids – autoxidation and lipolysis; modification of fats – hydrogenation, interesterification, acetylation and winterizing. Proteins Amino acids; protein structure and properties; reactions during processing – denaturation, non-enzymatic browning and cross-linking; functional properties; structure and composition of milk, eggs and meat; milk proteins – effect of heat, acid and rennin; meat proteins – chemistry of meat colour and effect of cooking on meat quality; wheat proteins – properties of wheat protein; chemical and physical changes during bread-making. Vitamins Water-soluble and fat-soluble vitamins; effect of processing and storage on vitamins; technical roles of vitamins. Pigments Chlorophylls, carotenoids and flavonoids; chemical structures; changes in plant pigments during processing; enzymatic browning reactions and their inhibition. Food flavour Chemical structure and taste; sulphur compounds in vegetables; process and reaction flavours; flavour enhancers. Chemical additives Chemistry and technical roles of food additives: preservatives, antioxidants, anti-browning agents, emulsifiers/stabilizers, sweetening agents and others. Experimental data analysis Accuracy and precision, experimental errors, bias and uncertainty of Measurement. Food Testing and Certification Test methods and validation; quality management and laboratory accreditation; measurement uncertainty and interpretation of test results; comparability and traceability of test results and chemical metrology; principles of product certification. Sample Preparation and Cleanup Techniques in Food Testing Sampling and test portion; principles of extraction and cleanup, recovery consideration; liquid-liquid extraction, solid phase extraction and cleanup, gel permeation chromatographic cleanup, dispersive solid phase extraction. Characterization of Food Properties Measurement of food colour: CIE colour system; determination of food texture

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<tr><td></td><td>by rheological method; determination of moisture by Karl Fischer titration, distillation methods, and drying by moisture balance/analyzer and other heating methods.

<u>Analysis of Lipids</u>
Quantitative extraction and chromatographic methods in lipid analysis; iodine, saponification, acid and peroxide values; determination of total fat, saturated fat, trans-fat and cholesterol contents for food labeling.

<u>Analysis of Vitamins</u>
Titrimetric and colorimetric methods; fluorimetry and microbiological assay in vitamin analysis; determination of vitamin contents for nutrition labeling.

<u>Analysis of Food Additives</u>
Food classification, determination of preservatives, colouring matters and artificial sweeteners in food.

<u>Other Techniques for Analysis of Carbohydrates, Protein and Energy</u>
Use of chromatography, electrophoresis and polarimetry in carbohydrate analysis; enzyme hydrolysis in starch determination; chromatographic and electrophoretic methods in amino acids analysis; measurement of energy content of food by bomb calorimetry.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td><u>Lectures:</u>
The principles and concepts of the chemistry of foods are introduced to the students through lectures.
The basic principles of various analytical methods/techniques for food analysis will be also introduced in lectures.

<u>Tutorials:</u>
Tutorial questions will be used to help students gain a better understanding on the lecture materials. For example, questions related to the analysis of common food nutrients will be provided to students to strengthen their learning.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td></tr>
<tr><td>1. Test</td><td>35%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Assignments</td><td>15%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>3. Final examination</td><td>50%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
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	Total	100 %	

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Exam and tests will be used to assess students' understanding in various topics in food chemistry and analysis in this course. These tools will also be used to assess the ability of students to analyze problems in food analysis and select appropriate analytical techniques/methods to solve the problems.

Assignments will be assigned to facilitate student's comprehension of key analytical principles and techniques, and solve real-life questions. The assignment questions will be discussed during tutorials.

Student Study	Class contact:	
	▪ Lectures	26 hours
	▪ Tutorials	12 hours
	Other student study effort:	
	▪ Self-study	86 hours
	Total student study effort	124 hours

Reading List and References

Essential

Coultate, T.P	Food: The Chemistry of Its Components (6th ed.)	RSC 2016
Nielsen, S.S. (Ed.)	Food Analysis – Food Science Texts Series (5th ed.)	Springer 2017
Skoog, D.A., Holler, F.J. andCrouch, S.R.	Principles of Instrumental Analysis (7th ed.)	Thomson 2018

Supplementary

McWilliams, M.	Food – Experimental Perspectives (5th ed.)	Prentice Hall 2005
Bruice, P.Y.	Organic Chemistry (6th ed.)	Prentice Hall 2011

	Pomeranz, Y. and Meloan, C.E.	Food Analysis: Theoryand Practice (3rd ed.)	Chapman & Hall1994
	Multon, J.L.	Analysis of Food Constituents	Wiley-VCH 1997
	Jeon, I.J. andIlkins, W.G.	Analyzing Food for Nutrition Labelling & Hazardous Contaminants	Marcel Dekker1995