Nanyang Technological University
Division of Chemistry and Biological Chemistry

Academic Year	2022/23	**Semester**	2
Course Coordinator	Alessandra Bonanni (Dr)		
Course Code	CM5102[1]		
Course Title	Food Analysis and Safety		
Pre-requisites	(CM1031 and CM1051) or CM9001/CM5000 or CY1101 or CM1002 or by permission		
No of AUs	3		
Contact Hours	Lectures: 26 (2 hours per week), Laboratories: 30 hours (10 weeks, 3 hours per week)		
Proposal Date	21 October 2021		

Course Aims

This course aims to develop your ability to analyse food and assess food safety.

You will be able to analyse foodstuffs to determine the content of the principle food components such as proteins, carbohydrates, lipids and moisture, as well as additives and contaminants. You will be able to suggest the best methods for sample preparation and analysis, and identify likely sources of error. You have will have a basic knowledge of the methods to assess chemical, physical and biological contamination of food.

Laboratory work will give you practical skills in the subject. The concepts espoused in the course will be applied during the lab sessions for the analysis of specific foodstuff. Sample preparation as well as analysis of both major and minor food components and characteristic will be carried out using several food samples. You will have hands on different equipment currently used by food industry. You will also and learn how to optimize the procedure and represents the results obtained with each method tested.

Intended Learning Outcomes (ILO)

By the end of this course the students should be able to:

1. **<u>Introduction, Nutrition Labelling and Regulations</u>**
    a) Explain the importance of food analysis
    b) Describe the reasons for food analysis
    c) List the main steps in food analysis
    d) Read and interpret the labels of pre-packed food
    e) Describe food labeling system in Singapore

2. **<u>Sampling, Sample Preparation and Evaluation of Analytical Data</u>**
    a) Define the meaning of sampling
    b) Explain the steps involved in sampling procedures
    c) List the basic steps for sample preparation

[1] Previously listed as CM9102

d) Evaluate the obtained analytical data in order to provide the final result

3. **Review of Principal Techniques for Food Analysis: Chromatography**

a) Describe different chromatography methods in food analysis

b) Identify the best chromatographic technique for the analysis of specific analytes in food samples

4. **Review of Principal Techniques for Food Analysis: Spectroscopy**

a) Describe different spectroscopy methods used in food analysis

b) Identify the best UV-vis or IR spectroscopy technique for the analysis of specific analytes in food samples

5. **Compositional Analysis of Food: Protein Analysis**

a) Describe protein composition

b) Explain the importance of protein analysis in food

c) Explain different approaches for protein analysis

d) Indicate how to analyze food stuffs in order to determine the protein content

6. **Compositional Analysis of Food: Carbohydrate Analysis**

a) Define carbohydrates structure and classifications

b) Describe their importance and occurrence in food

c) Indicate how to analyze foodstuffs in order to determine the carbohydrates content

7. **Compositional Analysis of Food: Lipid Analysis**

a) Describe lipid composition, functions and classification

b) Explain the importance of lipid analysis in food

c) Indicate how to analyze foodstuffs in order to determine the lipid content

8. **Compositional Analysis of Food: Moisture Analysis**

a) Explain the importance of moisture analysis

b) Describe different approaches for moisture analysis

c) Indicate how to analyze foodstuffs in order to determine the moisture content

9. **Analysis of Food Contaminants: Introduction, Pesticides, Mycotoxins and Antibiotics Analysis**

a) Describe the four classes of food hazards

b) List the methods for the analysis of food contaminants

c) Explain the sample preparation steps for the analysis of food contaminants
d) Describe how pesticides, mycotoxins and antibiotics can contaminate foodstuff
e) Identify the best method in order to analyse food samples for the presence of pesticides, mycotoxins and antibiotics

10. Analysis of Food Contaminants: Allergens, Sulfites, Bacteria and Extraneous Matter Analysis

a) Find information on contaminants in the food labels
b) Describe the different methods for the analysis of allergens, sulfites, bacteria and extraneous matter in food stuffs

11. New Trends in Food Analysis: Sensor and Biosensor Technologies

a) Define chemical sensors and biosensors
b) Explain how chemical sensors and biosensors can be used for the assessment of food quality and safety

12. **Physical Properties of Food: Rheological Principles for Food Analysis**

a) Describe the basic concepts of rheology
b) Explain the difference between Newtonian and non-Newtonian fluids
c) Apply rheological principles to determine the viscosity of chocolate

Course Content

1. Introduction, Nutrition Labelling and Regulations
2. Sampling, Sample Preparation and Evaluation of Analytical Data
3. Review of Principal Techniques for Food Analysis: Chromatography
4. Review of Principal Techniques for Food Analysis: Spectroscopy
5. Compositional Analysis of Food: Protein Analysis
6. Compositional Analysis of Food: Carbohydrate Analysis
7. Compositional Analysis of Food: Lipid Analysis
8. Compositional Analysis of Food: Moisture Analysis
9. Analysis of Food Contaminants: Introduction, Pesticides, Mycotoxins and Antibiotics Analysis

10. Analysis of Food Contaminants: Allergens, Sulfites, Bacteria and Extraneous Matter Analysis
11. New Trends in Food Analysis: Sensor and Biosensor Technologies
12. Physical Properties of Food: Rheological Principles for Food Analysis

Assessment (includes both continuous and summative assessment)

Component	Course ILO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/Individual	Assessment rubrics
1. Midterm Test 1	1, 2, 3, 4, 5	Competence, Creativity	10%	Individual	Appendix 1
2. Midterm Test 2	6, 7, 8	Competence, Creativity	10%	Individual	Appendix 1
3. Final Examination	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	Competence, Creativity	50%	Individual	Appendix 1
4. Laboratory (Team work)	1, 2, 4, 7, 8, 12	Competence, Creativity, Communication and Character	30%	Individual	Appendix 2
Total			*100%*		

Formative feedback

Formative feedback: Lecturers and TAs will be closely working with you to monitor your learning progress. They will provide you with timely feedback to improve your understanding of concepts. Furthermore, you will be given opportunities to express your ideas and discuss them with lecturers and TAs.

Summative Feedback: Summative feedback on laboratory reports and mid-term tests will be given. For laboratory reports, you will be provided with comments on mistakes, areas of improvement and examples of good practice in scientific writing etc.

This will help you to achieve the intended learning outcomes 1 to 12 above.

Learning and Teaching approach

Lectures (26 hours)	A "blended" learning approach will be adopted, involving both online and face-to-face lectures. Online knowledge clips containing basic food science background will be uploaded every week, for you to watch and complete a LAMS sequence before each face-to face lecture. During the lectures, you will learn detailed principles and protocols for food analysis and safety. The concepts will be illustrated with worked examples and with real world applications to show the relevance and importance of learning food science and its links to our daily life. In addition, you will be encouraged to ask questions or have discussions during and after the lecture.
Laboratory (30 hours)	You will be required to complete a risk assessment before starting the actual lab session. During the actual lab session, you will typically work in groups and conduct the assigned experiment under the supervision of a laboratory TA and the course instructor, following the instructions provided in the lab manual. Subsequent to the lab session you are required to submit an individual post-lab report in the prescribed format which will help to develop your critical thinking ability, ability to assimilate, evaluate and present the data gathered during a lab experiment.

Reading and References

Recommended textbook: Food Analysis, by Suzanne Nielsen 5th Ed (2017), Springer Ed.; ISBN 978-3-319-45776-5

Course Policies and Student Responsibilities

You are expected to read the lecture/tutorial/laboratory materials prior to the respective lecture/tutorial/laboratory session. This will help you to learn much more efficiently as you will already have an impression on the topics to be covered. For laboratory sessions, besides reading the laboratory manual and understanding the experimental procedure, you should also complete the risk assessment component of the lab report in which you should list possible hazards and their prevention steps. You are also advised to read through the recommended textbooks as outlined in the Weekly Schedule.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your

instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Alessandra Bonanni (Dr)	SPMS CBC-04-19	6316 8757	a.bonanni@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course ILO	Readings/Activities
1	Introduction to Food Analysis: Introduction, Nutrition Labelling and Regulations	1	Nielsen Ch 1, 3
2	Introduction to Food Analysis: Sampling, Sample Preparation and Evaluation of Analytical Data	2	Nielsen Ch 4, 5
3	Review of Principal Techniques for Food Analysis: Chromatography	3	Nielsen Ch 27, 28, 29
4	Review of Principal Techniques for Food Analysis: Spectroscopy	4	Nielsen Ch 21, 22, 23
5	Compositional Analysis of Food: Protein Analysis	5	Nielsen Ch 9
6	Compositional Analysis of Food: Carbohydrate Analysis	6	Nielsen Ch 10
7	Compositional Analysis of Food: Fat Analysis	7	Nielsen Ch 8
8	Compositional Analysis of Food: Moisture Analysis	8	Nielsen Ch 6
9	Analysis of Food Contaminants: Introduction, Pesticides, Mycotoxins and Antibiotics Analysis	9	Nielsen Ch 17, 18
10	Analysis of Food Contaminants: Allergens, Sulfites, Bacteria and Extraneous Matter Analysis	10	Nielsen Ch 17, 18, 19
11	New Trends in Food Analysis: Sensor and Biosensor Technologies	11	Nielsen Ch 17
12	Physical Properties of Food: Rheological Principles for Food Analysis	12	Nielsen Ch 30

CBC Programme Learning Outcome

The Division of Chemistry and Biological Chemistry (CBC) offers an undergraduate degree major in Chemistry that satisfies the American Chemical Society (ACS) curricular guidelines and equips students with knowledge relevant to the industry. Graduates of the Division of Chemistry and Biological Chemistry should have the following key attributes:

1. Competence

Graduates should be well-versed in the foundational and advanced concepts of chemical science, be able to evaluate chemistry-related information critically and independently, and be able to use complex reasoning to solve emergent chemical problems.

2. Creativity

Graduates should be able to synthesize and integrate multiple ideas across the curriculum, and propose innovative solutions to emergent chemistry-related problems based on their training in chemistry.

3. Communication

Graduates should be able to demonstrate clarity of thought, independent thinking, and sound scientific analysis and reasoning through written and oral reports to audiences with varying technical backgrounds. They should also be able to effectively engage other professional chemists in collaborative endeavours.

4. Character

Graduates should be able to act in responsible ways and uphold the high ethical standards that the society expects of professional chemists.

5. Civic-mindedness

Graduates should be aware of the impact of chemistry on society, and how chemistry can be applied to benefit mankind. They should also be aware of and uphold the best chemical safety practices.

Appendix 1: Assessment Criteria for mid-term and final exam

Mid-terms 1 and 2- MCQ questions

Standards		
Fail standard (0-4 marks)	**Pass standard (5-7 marks)**	**High standard (8-10 marks)**
Answers to the questions are mostly incorrect.	Answers to the questions are mostly correct.	Answers to the questions are almost always correct.

Final exam – MCQ questions

Standards		
Fail standard (0-4 marks)	**Pass standard (5-7 marks)**	**High standard (8-10 marks)**
Answers to the questions are mostly incorrect.	Answers to the questions are mostly correct.	Answers to the questions are almost always correct.

Final exam – Open questions

Standards		
Fail standard (0-4 marks)	**Pass standard (5-7 marks)**	**High standard (8-10 marks)**
Answers demonstrate the ability to repeat factual knowledge but not to apply it outside of the lecture context. Answers do not have a strong logical underpinning or maybe attempts to answer both ways at the same time.	Answers to the standard level question are correct and show the ability to apply concepts from the course, but a high level of critical thinking is absent. Answers are reasonably logical, but with gaps.	Answers to all questions show a high and consistent level of critical analysis of the information presented and creative solutions to food science related problems. Answers are highly logical and demonstrate strong reasoning. Answers are concise and to the point.

Appendix II – Assessment criterion for lab proforma

	Exceptional (81-100%)	Admirable (61-80%)	Acceptable (41-60%)	Poor (<40%)
Overall presentation	Appropriate as a piece of scientific writing. Words were chosen carefully and appropriately. Sentence structure was clear and easy to follow. The report is free of spelling, punctuation, calculation and grammatical errors.	Minimal awkward phrasing or word choices. Minimal mistakes in calculations and explanations	Many passages are phrased poorly, contained awkward word choices, or many long sentences. Narrative is disorganized in many places. Multiple grammatical and/or spelling errors.	Poorly organized report with frequent awkward phrases, poor word choices and wrong inferences/calculations. Lacks cohesion, style and fluidity.
Answers to Proforma questions	Relevant experimental data/calculation steps are presented which are used for answering proforma questions. Demonstrates a logical, coherent working knowledge and understanding of important experimental concepts, forms appropriate conclusions based on interpretations of results, includes applications of and improvements in the experiment, collected data and analysis and demonstrates accountability by providing justification for any errors. Address all specific questions posed in the proforma.	All data and associated figures, calculations etc. are presented. Demonstrates an understanding of most important experimental concepts, forms conclusions based on results and/or analysis but either lacks proper interpretation, suggests inappropriate improvements in the experiment or lacks overall justification of error. Address most of the specific points for questions posed in the proforma.	Most figures, graphs, and tables are included, but some important or required features are missing. Certain data reported are not mentioned in the text or are missing. Captions are not descriptive or incomplete. While some of the results have been correctly interpreted and discussed, partial but incomplete understanding of results is still evident. Student fails to make one or two connections to underlying theory. Address some of the specific points or questions posed in the proforma.	Figures, graphs, and tables are poorly constructed; have missing titles, captions or numbers. Certain data reported are not mentioned in the text. Important data missing. Does not demonstrate an understanding of the important experimental concepts, forms inaccurate conclusions, suggests inappropriate improvements in the experiment and lacks overall justification of error. Address none of the specific points or questions posed in the proforma.