NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

COURSE CONTENT

Academic Year	2022/2023	**Semester**	2
Course Coordinator	Adjunct Associate Professor Benjamin Smith		
Course Code	CH5220		
Course Title	Food Standard – Food Safety & Risk Assessment		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	35 hours lecture (interactive format including industry guest lectures), 3 hours tutorial/discussion		
Proposal Date	5 Jan 2022		

Course Aims

This course will give an introduction into the principles behind food safety hazard and risk assessment as well as the different existing national and international systems for food safety, food control and food standard setting. It will provide background on the current approaches and systems in place and stimulate discussion on how these need to evolve to keep pace with new and novel food innovations whilst meeting the needs of industry and regulatory safety assessors. The increasing globalisation of the food trade, changing consumption patterns, the intensification of agriculture, increasing travel and tourism, and new types of production and manufacturing systems are just some of the trends that are having a serious impact on food production and food safety in many countries. At the same time, several existing and new food safety hazards are of increasing concern and new pathogens are frequently emerging and being transferred from animal to human populations, primarily through food. These new challenges need to be addressed are best dealt with in new safety and regulatory frameworks and approaches; these frameworks and their background will be explained and described.

Major theoretical topics of the course include:

- Risk Analysis as the basis for food standards
- Risk Assessment – Chemical and Microbiological Hazards; integrated risks & “One Health”
- New/Novel ingredient/food assessment
- Safety by design concept
- HACCP – A standardized system for Hazard Control in food production

  Key international and national Food Safety Policies (including ASEAN & SFA)

Intended Learning Outcomes (ILO)

By the end of this course, you are expected to be able to:

1. Analyze food production chains and new/novel; products and processes. Understand the background for hazards and risks in food
2. Use science-based risk principles to understand food safety problems and solutions (emphasis on novel foods and future food tech safety methods and principles of key disciplines e.g. microbiology & toxicology)
3. Design solutions utilizing major principles guiding food control systems and following safety and regulatory frameworks. Understand the principles of “safety by design” and how it can be implemented into novel food innovation.
4. Link food standards from regulatory authority and industry to foodborne disease prevention and safe consumption
5. Explain scientific background and select solutions based on the set-up of the food control

system in Singapore, regulatory frameworks (including Singapore Novel Food Framework and Singapore Food Act) and future food (SFS 30 by 30) goals

Course Content

Introduction to food safety in the context of food systems and standards (as well as their evolution). Description of the risk concept (and the key underlying principles and core areas of toxicology, exposure assessment and risk communication) as well as international food policy based on the risk analysis framework. Understanding the application of food safety principles to new product innovation as well as new product production, including the application of HACCP (Hazard Analysis Critical Control Points) principles. Discussion around the need for integrated, holistic risk assessment strategies.

The increasing globalisation of the food trade, changing consumption patterns, the intensification of agriculture, increasing travel and tourism, and new types of production and manufacturing systems are just some of the trends that are having a serious impact on food production and food safety in many countries. At the same time, a number of existing and new food safety hazards are of increasing concern and new pathogens are frequently emerging and being transferred from animal to human populations, primarily through food. These new challenges are best dealt with in new regulatory frameworks; these frameworks and their background will be explained and described.

A large number of Engineers will be exposed to the use of regulatory systems based on scientific and engineering knowledge. This means that Engineers in a number of areas will be involved in regulatory developments as well as regulatory decisions. It is thus relevant for engineers to understand the set-up of regulatory systems, such as food safety regulatory systems – both in under to understand the risk assessment background as well as the risk management decisions relevant to mitigate such risks. The food safety regulatory system is relevant in international, regional and national setting and the understanding of such systems will enable a more coherent knowledge base not only related to food production but also to other related areas, including water technology, drug production, chemical engineering etc.

Assessment (includes both continuous and summative assessment)

Component	Course ILO Tested	Related Programme LO or Graduate Attributes	Weighting	Team /Individual	Assessment rubrics
1. Video Exercise – "Tic Tox"	1, 2, 3, 4,5	a, b, c, d, f, j	15%	Individual	Appendix 1
2. Annotated bibliography/Summary – challenge question	1, 2, 3, 4, 5	a,b,c,d,e,f	25%	Individual	Appendix 1
3. Tutorial discussion/ In-class participation	1, 2, 3, 4, 5	a,b,c,d,e,f,g,h,i	10%	Individual/ Group	N.A.
3. Final Examination (2 hrs Closed Book)	1, 2, 3, 4, 5	a, b, c, f, g, h, j	50%	Individual	N.A.
Total			100%		

Mapping of Course ILOs to EAB Graduate Attributes

Course Intended Learning Outcomes	Cat	EAB's 12 Graduate Attributes*											
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	Core	●	●	●	◐		●	◐	š		š		š
1. Analyze food production chains and new/novel products and processes for hazards and risks in food													a, b, d,
2. Use science-based risk principles to understand food safety problems and solutions (emphasis on novel foods and future food tech safety methods and principles of key disciplines e.g. microbiology & toxicology)													a, b, c, e,
3. Design solutions utilizing major principles guiding food assessment methodologies and control systems. Understand the principles of "safety by design" and how it can be implemented into novel food innovation.													c, d, f, e, j
4. Link food standards from regulatory authority and industry to foodborne disease prevention and safe consumption													c, f, g, h, l
5. Apply knowledge and select solutions based on the set-up of the food control systems, regulatory frameworks (including Singapore Novel Food Framework and Singapore Food Act) and future food (SFS 30 by 30) goals													f, g

Legend: ● Fully consistent (contributes to more than 75% of Intended Learning Outcomes)

◐ Partially consistent (contributes to about 50% of Intended Learning Outcomes)

š Weakly consistent (contributes to about 25% of Intended Learning Outcomes)

Blank Not related to Student Learning Outcomes

Formative feedback

Examination results;
Marker's report on overall examination performance will be uploaded to NTUlearn;

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Interactive Lecture/Tutorial format	Demonstrate how to carry out a procedure such as working through a problem, use incomplete handouts which enabling students participating in class.

Reading and References

Reference reading (articles, websites etc) will be linked to key topics. These will provide background information on the topic and could be used to draw questions for the exam.

Course Policies and Student Responsibilities

General: You are expected to complete all online activities and take all scheduled assignments and tests by due dates. You are expected to take responsibility to follow up with course notes, assignments and course related announcements. You are expected to participate in all tutorial discussions and activities.

Continuous assessments: You are required to attend all continuous assessments.
Absenteeism: Continuous assessments make up a significant portion of your course grade. Absence from continuous assessments without officially approved leave will result in no marks and affect your overall course grade.

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
Bennjamin Smith	TBD	9336 8734 (HP)	ben.smith@ntu.edu.sg

Week	Lecture Topic	General subject	LO
Week 1	Lecture 1: Introduction to Food Safety	Principles of food safety – hazards associated with foods, food production & food storage/handling	1
	Lecture 2: Food Standard vs Food Standards	Intro into the concept of the global standard of safety (definition of food safety & levels of acceptance) vs national and global standards to manage food safety (guidelines & policies)	1, 4
	Lecture 3: Food supply chain/global food systems & future challenges	Organisation/complexity of global food supply chains and the challenges being faced	4, 5
Week 2	Lecture 4: HACCP & TACCP 101	Fundamentals of food control systems and hazard/threat	1, 3, 4, 5

		analysis in production	
	Lecture 5: Emerging challenges with novel foods	Top level introduction to different types of novel foods, their processing and challenges posed: Plant-based, Fermentation, Insect, Cultivated Meat	1, 2, 3
	Lecture 6: Emerging challenges with novel foods (Guest – TBD)	Continued from lecture 4	1, 2, 3
Week 3	Assignment Tutorial:	Case study: Application of HACCP to future food production	2, 5
	Lecture 7: Fundamentals of risk analysis	Principles of risk analysis – risk assessment, risk management, risk comms	1, 2, 3, 4, 5
	Lecture 8: Overview Risk Assessment	Risk = hazard x exposure	1, 2, 3, 4, 5
Week 4	Lecture 9: Food Microbiology 101	Principles of microbiology (focus food pathogens)	1, 2, 3, 4, 5
	Lecture 10: Microbial risk assessment	General principles	1, 2, 3, 4, 5
	Lecture 11: Risk Assessment Approaches to setting thermal process in food manufacture (an example)	Example – link to HACCP	3
Week 5	Lecture 12: Toxicology 101	History and overview of (food) toxicology – general principles	2, 4
	Lecture 13: Introduction to food chemicals & their potential adverse effects	– Types of food additives – Nutrients & Anti-nutrients	1, 2, 4
	Lecture 14: Introduction to food chemicals & their potential adverse effects cont.	– Contaminants – Natural Toxins	1, 2, 4
Week 6	Lecture 15: Organs and endpoints	Understand key toxic modes of action, endpoints of concern, approaches to measure – genotoxicity, local GIT toxicity, systemic toxicity, allergenicity etc	1, 2, 4
	Lecture 16: Novel Proteins & allergenicity	Deeper dive into the specifics of novel protein safety assessment and food allergy	1, 2, 4
	Lecture 17: ADME & Exposure	Adsorption & distribution of toxicants Metabolism & elimination of toxicants	1, 2, 4
Week 7	Lecture 18: The Dose makes	Understanding types of exposure	1, 2, 4

	the poison	(acute, chronic) and dose-response relationships	
	Lecture 19: Food Chemical Risk Assessment	Main principles of RA and intro to approaches used in food industry e.g. TTC	1, 2, 3, 4, 5
Week 8	Lecture 20: Food Chemical Risk Assessment cont	Main principles of RA and intro to approaches used in food industry e.g. TTC	1, 2, 3, 4, 5
	Lecture 21: Industry perspective and application of FCRA (Guest - TBD)		1, 2, 3, 4
	Lecture 22: Industry perspective and application of FCRA (Guest - TBD)		1, 2, 3, 4
Week 9	Lecture 23: Safety of Cultivated Meat (Guest - TBD)	Cell line, media components, scaffolds Bring in concept of safety by design. Give some specific examples of components and concerns e.g. growth factors, heavy metal salts, latent viruses etc	1, 2, 3, 4
	Lecture 24: Insect protein safety	Bring back concepts of HACCP and quality of feedstock; understand impact of feed (including waste sources of feed)	1, 2, 3, 4
	Lecture 25: GM foods	Concepts around the safety of GM foods – link to future lectures on risk Comms	1, 2, 3, 4
Week 10	Lecture 26: Biotech safety (Guest - TBD)	Future foods – microbial fermentation and biotech	1, 2, 3, 4
	Lecture 27: Novel Food Regulations -industry considerations (Guest - TBD)	Thoughts on regulations for novel food/Biotech	3, 4
	Lecture 28: Novel Food Regulations – global frameworks	Top level overview of general regulatory structures for novel food safety assessment (comparisons of systems & requirements)	4, 5
Week 11	Discussion Tutorial part 1:	Journal based discussion around novel food safety frameworks (pre-reading and structured questions will be given). Groups of up to 5 to present brief overview of article in context of principles learnt	4, 5
	Discussion Tutorial part 2:	Journal based discussion around novel food safety frameworks	4, 5

		(pre-reading and structured questions will be given). Groups of up to 5 to present brief overview of article in context of principles learnt	
	Lecture 29: Risk Communication & Risk Perception	Overview of principles - differentiate risk vs crisis comms	1, 2, 3
Week 12	Lecture 30: Risk Communication & Risk Perception – novel foods (Guest - TBD)	Risk Communication & Novel foods – industry, regulator & consumer views	1, 2, 3
	Lecture 31: Risk-Benefit Analysis of Foods (Guest – TBD)	Industry perspective on importance of weighing risks and benefits for novel foods	1, 2, 3
	Lecture 32: International Organisations, Food Safety & One Health		4, 5
Week 13	Lecture 33: Revision Key Principles		1, 2, 3, 4, 5
	Lecture 34: Revision Key Principles		1, 2, 3,4, 5
	Lecture 35: Revision Key Principles		1, 2, 3, 4, 5

Note: Guest lectures have been secured from industry and additional guest lectures are also being considered from local and international regulatory authorities in order to introduce different perspectives for comparison. Exact topics and schedule may vary based on external lecturer availability and class interests but core content and principles will remain the same.

Appendix 1: Assessment Criteria

	Unsatisfactory: <40%	Borderline: 40% to 49%	Satisfactory: 50% to 69%	Very good: 70% to 89%	Exemplary: >90 %
Overall organization of report	Disorganised arrangement of chapters with little/no mention of supporting literature. Numerous typological and/or grammatical errors.	Reasonable organization, and some logical attempt Some literature mentioned	Clear and logical organization with all essential components. A reasonable volume of supporting literature. Few errors.	Clear and logical organization with all essential components. Supporting literature clearly listed. Easily read report, with elements of the content providing easy communication of key points with figures and tables.	Clear and logical organization with all essential components. S upporting literature clearly listed. Very few/no grammatical or typological errors. Clear presentation of ability to present own analytical capacity. Visually pleasing report, with elements of the content providing easy and quick communication of key points with figures and tables.
Identification of the problem statement and scope of the project (LO 3)	Coverage of issues totally outside the scope of the project, or topics that are related but not the actual issues expected to be covered.	Coverage of very few relevant issues, and no coherent explanation linking these issues together	Coverage of at least some relevant issues that directly fit the scope of the project, and linkages between issues.	Coverage of most relevant issues that directly fit the scope of the project and absence of irrelevant issues or attempt of “catch all” generic content.	Clear, coherent description of all parts of the problem as well as relevant linkages, leading to a well-formulated scope as well as structure of the full report
Application of the relevant concepts from the course	Ad hoc analysis of the problems without proper connecting	Relevant points made, and connections drawn to course	Demonstrate a good understanding of the concepts from the	Correct use of concepts from the course as well as clear reference to literature	Correct use of concepts from the course as well as clear reference to literature

(relevance etermined by the scope defined in the project). (LO 2, 3)	the discussion with relevant concepts from the course. No or little evidence of critical evaluation of proposed solution. Conclusions drawn or recommendations made without adequate supporting reasons or data.	concepts for some of these. Conclusions drawn or recommendations made without adequate supporting reasons or data.	course (and relevant literature identified by self-driven research) in analysing the problems, and propose some solution with degree of some justification or intuition (but a rigorous validation or exploration of and comparison with alternatives may be missing).	relevant to the scope of the project. Coherent discussion showing a critical attitude as well as suggestions as to where more or better data might be needed.	relevant to the scope of the project. Coherent discussion showing a critical attitude as well as suggestions for improvement of either concepts or data. Clear description of examples from real life linked to concepts

Appendix 2

The EAB (Engineering Accreditation Board) Accreditation SLOs (Student Learning Outcomes)

a) **Engineering knowledge:** Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems
b) **Problem Analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c) **Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
d) **Investigation:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e) **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
f) **The engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g) **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.
h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i) **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
j) **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k) **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l) **Life-long Learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.