Syllabus outline

Syllabus component	Recommended teaching hours
Core	100
1. Nutrition 1.1 The contribution to the diet of macronutrients 1.2 Sources and nutritional properties of micronutrients 1.3 The digestion, absorption and metabolism of food 1.4 Nutritional and dietary requirements. 1.5 Influences on nutritional status. 1.6 Nutritional awareness and responsibilities	25
2. Materials, components and their application 2.1 Functional properties of protein in foods 2.2 Functional properties of carbohydrate in foods 2.3 Functional properties of fat in foods 2.4 Functional properties of additives 2.5 Functional properties of additional ingredients 2.6 Food fortification	25
3. Food quality and safety 3.1 Food Spoilage 3.2 Food Poisoning 3.3 Principles of temperature control 3.4 Safe food handling and preparation 3.5 Organoleptic properties 3.6 Packaging and food quality	25
4. Food process engineering 4.1 Food processing methods 4.2 Food processing: preservation by temperature control 4.3 Food processing: preservation by dehydration and irradiation 4.4 The effect of processing on colour 4.5 The effect of food processing on flavour 4.6 The effect of food processing on texture	25
Practical scheme of work:	**50**
• Food Investigation (internal assessment – IA)	10
• Group 4 project	10
• Practical activities	30
Total teaching hours	**150**

Syllabus content

Topic 1: Nutrition — 25 hours

Essential idea: Macronutrients are vital to good health and achieving a satisfactory balance is essential to well-being.

1.1 The contribution to the diet of macronutrients

Nature of food science and technology:	Understandings:	International mindedness:
An excess or deficient intake of protein, carbohydrate or fat is detrimental to health. To maintain health, it is therefore necessary to understand and implement the nutritional properties, sources and recommended daily amounts of these macronutrients. (1.7)	• Sources and nutritional properties of macronutrients • High and low biological values of protein (HBV and LBV) • Indispensable and dispensable amino acids • Classifications of carbohydrates • Sources and nutritional properties of fibre (non-starch polysaccharide) • Classifications of fats • Essential fatty acids • Recommended daily amounts of macronutrients. • Malnutrition may be caused by a deficiency, imbalance or excess of nutrients in the diet **Application and guidance** Students should understand and where appropriate, be able to discuss and evaluate: • the nutritional properties and sources of plant, animal and novel proteins, and their biological values (HBV, LBV). Indispensable and dispensable amino acids, and protein complementation e.g. rice and beans in Central America. • the nutritional properties and sources of sugars (intrinsic, extrinsic and non-milk extrinsic sugars) and starches. Starches are staple foods (e.g. cassava, rice, wheat, maize) significance to energy intakes.	There are short and long term socio-economic implications of macronutrient malnutrition in less economically developed countries (LEDC) and more economically developed countries (MEDC) countries. **Theory of Knowledge:** What role does intuition play in knowing what nutrients your body needs? **Utilization:** Biology - Topic 2.3 Biology - Topic 2.4 Biology - Option D.1 Sports, exercise and health science - Topic 3.1 **Aims:** 1. a sense of curiosity as they acquire the skills necessary for independent and lifelong learning and action through inquiry into the world of food science and technology. 8. understand how food science and technology promote intellectual, physical and emotional balance and contribute to personal and social well-being.

1.1 The contribution to the diet of macronutrients		
	• the function of soluble and insoluble Fibre (Non Starch Polysaccharide) in the diet. E.g. reducing blood cholesterol levels and risks of coronary heart disease (CHD). • the nutritional properties and sources of animal and plant fat. How monounsaturated, polyunsaturated and saturated fats impact on health, role of essential fatty acids. • the impact of macronutrient excess e.g. obesity, coronary heart disease, dental decay and diabetes. • Consider the impact of macronutrient deficiency diseases (malnutrition) on MEDC and LEDC countries e.g. obesity, kwashiorkor, marasmus, pellagra, beri beri, scurvy and rickets.	

Essential idea: Micronutrients are vital to good health and obtaining the recommended balance is essential to well-being.

1.2 The use and contribution to the diet of micronutrients		
Nature of food science and technology: A deficient intake of vitamins and minerals is detrimental to health. To maintain health, it is therefore necessary to understand the nutritional properties, sources and recommended daily amounts of these micronutrients. (1.7)	**Understandings:** • The nutritional properties of micronutrients • Sources of micronutrients • Bioavailability and absorption of micronutrients • Classification of vitamins • Classification of minerals • Different recommended daily amounts of micronutrients • Excess and deficiency of micronutrients • The interrelationship between nutrients **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate:	**International mindedness:** The Vitamin and Mineral Nutrition Information System (VMNIS), formerly known as the Micronutrient Deficiency Information System (MDIS), was established in 1991 following a request by the World Health Assembly to strengthen surveillance of micronutrient deficiencies at the global level. **Theory of Knowledge:** How does classification and categorization help or hinder our interpretation of nutritional knowledge? **Utilization:** Biology - Option D1

1.2 The use and contribution to the diet of micronutrients		
	• the properties of the water soluble vitamins B (B1 Thiamin, B2 Riboflavin, B3 Niacin, B5 Pantothenic acid, B6 Pyridoxine, B7 Biotin, B9 Folic Acid and B12 Cobalamins) and C (Ascorbic Acid). • the properties of the fat-soluble vitamins A (Retinol), D (Cholecalciferol), E (Tocopherols) and K Phylloquinone). • the factors affecting the bioavailability and absorption of micronutrients. • the impact of vitamin deficiency or excess intake e.g. cases of excess vitamin A intake in children in Western Europe, effect of lack of Vitamin A on eyesight in parts of Central Africa. • minerals (calcium, magnesium, potassium, sodium, phosphorus, and zinc) and trace elements (iodine, fluorine, iron, manganese, and selenium). • the impact of deficiency mineral intake. e.g. globally - anaemia, and in Central Asia - osteoporosis, iodine deficiency. • the interrelationships between nutrients e.g. Iron and vitamin C, Vitamin D and calcium, B vitamins and energy release from carbohydrates.	Chemistry - Option B.5 Sports, exercise and health science - Topic 3.1 **Aims:** 1. a sense of curiosity as they acquire the skills necessary for independent and lifelong learning and action through inquiry into the world of food science and technology. 8. understand how food science and technology promote intellectual, physical and emotional balance and contribute to personal and social well-being.

Essential idea: When food is consumed, it must be broken down, physically and chemically so that nutrients can be absorbed

1.3 The digestion, absorption and metabolism of food		
Nature of food science and technology science: Nutrients required by the body are digested, which breaks down large insoluble food molecules into smaller water soluble food molecules, which are then absorbed into the bloodstream. (1.1)	**Understandings:** • Mechanical and chemical digestive processes • Absorption into the blood and lymphatic systems • Distinguish between absorption and assimilation of nutrients • Understand how the macronutrients are broken down and utilised • The rate of transit of materials through the large intestine is positively correlated with their fibre (non starch polysaccharide) content **Application and guidance:**	**International mindedness:** Lactose intolerance more prevalent in people of Asian, Native American and African descent. **Theory of Knowledge:** Collective wisdom has differing opinions on digestion e.g. a digestif in France, drinking tea in China. To what extent is this thinking based on science?

1.3 The digestion, absorption and metabolism of food		
	Students should understand and where appropriate, be able to discuss and evaluate: • the mechanical and chemical processes at each stage of the digestive system: mouth, oesophagus stomach, peristalsis through the small intestine and large intestine. • The role of bile in emulsifying fats, as well as the need for enzymes as catalysts in digestion, including: amylase, pepsin, invertase (sucrase), lactase and maltase. • the chemical process of metabolism through catabolism and anabolism. • the process of absorption through the intestine, including the structure of ileum and the structure of the villi. • that starch, glycogen, lipids and nucleic acids are digested into monomers and that cellulose remains undigested. • the different methods of membrane transport are required to absorb different nutrients. • how the amount of dietary fibre (non starch polysaccharide) aids bowel movement and colonic transit time.	To what extent has food preparation throughout the ages had digestion as a priority? **Utilization:** Biology - Topic 6.1 Biology - Option D.2 **Aims:** 3. apply and use a body of knowledge, methods and techniques, methods and techniques that characterize food science and food technology.

Essential idea: Nutrients are needed by the body and vital to good health but amounts can vary according to specific dietary needs.

1.4 Nutrition and dietary requirements		
Nature of food science and technology: Recommended nutrient intakes are estimates of the energy and nutritional requirements of different groups by age, gender and within a specific stage of a person's life cycle. They are not rigid recommendations for individuals	**Understandings:** • Explain dietary requirements • Explain the energy balance and recommended nutrient intakes (including fibre (NSP) and water) • Explain the function of Water, fluids and hydration • Explain the factors affecting food and nutritional requirements: age, gender, stage in the life cycle e.g. pregnancy and health status • Explain and Interpret nutritional requirements	**International mindedness:** The World Health Organisation (WHO) compiles statistics about how countries are achieving optimal nutritional targets as set out in the Millennium Development Goals. **Theory of Knowledge:**

1.4 Nutrition and dietary requirements		
but assist consumers with interpreting nutritional data. (1.6, 3.7)	**Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • why the recommended nutrient intakes vary between countries e.g. Dietary Reference Values (DRV) in the UK, Dietary Reference Intake (RDI) in the USA, References Values in HK. • the functions of water and other fluids in the diet and factors that impact on hydration • the factors effecting energy balance in terms of calorie input and output • the different dietary requirements of different age groups, occupations, and life stages including of pregnant and lactating women, young children and teenagers. • how statutory food labelling aims to give consumers dietary and nutritional requirements in easy to understand form. Consumer information in the form of labels and advertising requires interpretation.	To what extent might a lack of knowledge be relevant to making poor nutritional food choices? **Utilization:** Biology - Option D1 **Aims:** 7. develop and apply 21st Century communication and collaboration skills in the of and participation in food science and technology activities.

Essential idea: Making optimal nutritional decisions involves a complex interrelationship between physiological, psychological, social, economic, and moral factors.

1.5 Influences on nutritional status		
Nature of food science and technology: Decisions about food choice are complex because of an interplay of physiological, psychological, social, economic and moral factors, which is further complicated by potentially contradictory or confusing nutritional advice in the media. (1.11, 2.6, 3.3).	**Understandings:** • Optimal nutrition and nutritional status • Physiological, psychological, social, economic and moral factors • Allergies and intolerances • Reliability and validity of nutritional information **Application and guidance:** Students should understand: and where appropriate, be able to discuss and evaluate:	**International mindedness:** Food producers need to be cognizant of cultural and religious differences that will impact on food choice and acceptability. **Theory of Knowledge:** There are positive effects of exposure to sun such as the production of Vitamin D as well as health risks associated with exposure to

1.5 Influences on nutritional status		
	• how optimal nutrition and nutritional status varies due to physiological, psychological, social, economic and moral factors. • the physiological factors specifically relating to needs of people with food allergies and intolerances, including coeliac; and people with medical conditions linked to diet, such as diabetes. • how optimal nutrition and nutritional status varies due to social, economic and moral factors such as religion, ethical issues and disposable income. • the reliability and validity of sources of nutritional information that could be misleading due to potential conflicting interests of the food industry, government and media. • the effects of contemporary diets on a person's health and well being. • the psychological issues of comfort eating, body image and peer pressure.	UV rays. How can conflicting knowledge claims be balanced? To what extent are religious belief systems responsible for the preparation and cooking of food in different cultures? **Utilization:** Biology - Option D1 **Aims:** 6. develop an ability to analyse, evaluate and synthesize scientific information and research data to inform food science and technology decisions. 9. understand and appreciate the impact of culture in terms of food science and food technology development

Essential idea: Societies may have both individual and collective organisations providing health support and advice. Local, national and international policies are aimed at achieving optimal public health.

1.6 Nutritional awareness and responsibilities		
Nature of food science and technology: Governments have a responsibility towards public health; individuals have a role to play in this endeavour. Food and diet are key issues in relation to public health. Local, national and international agencies act in the consumer's' interest during food production and supply, to promote public health initiatives and to regulate food advertising. Levels of consumer protection vary between countries for	**Understandings:** • Overweight and obesity • Public health and health services • Raising public awareness of food-related health issues • The role of governments in promoting public health • Modifiable and non-modifiable factors • Levels of consumer protection **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • the terms overweight and obesity, and the way these can be measured to track public health.	**International mindedness:** Health campaigns and messages from governments vary from country to country e.g. Healthy Eating Pyramid in Hong Kong, Eat-Well Plate in UK. **Theory of Knowledge:** What role does emotion and reason play in public health initiatives? **Utilization:** Geography - Option F **Aims:**

1.6 Nutritional awareness and responsibilities		
economic and political reasons. (1.2, 2.8, 3.5, 3.6)	• the impact of chronic food-related issues, for example obesity, on health services. • the impact of acute food-related issues, for example, a food poisoning outbreak, on health services. • different government campaigns that promote public health, raise awareness about the health risks e.g. diet related cancers, cardiovascular disease, and be able to evaluate their efficacy • the difference between modifiable (dietary decisions) and non-modifiable factors that impact on health (genetics, gender, age, socio-economic status). • why political and economic factors affect the level of consumer protection around the world e.g. European Union food regulations are used by all member states.	2: appreciate the scientific study of food and food technology in personal, local and global contexts through stimulating and challenging opportunities.

Topic 2: Materials, Components and their application — 25 hours

Essential Idea: The ability of protein to denature and coagulate is widely exploited in the preparation of a diverse range of products.

2.1 Functional properties of proteins in foods

Nature of food science and technology: There are many different protein foods from animal and vegetable sources. By understanding the effect of agitation, or the addition of acids or heat, the structure of protein is altered and impacts on the sensory qualities of finished products (1.1, 3.1)	**Understandings:** • The chemical composition and structure of proteins • Denaturation and coagulation • Maillard reaction • Gelation of protein • Gluten formation **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • how amino acids are joined by peptide bonds to form polypeptide chains. • the difference in structure of globular and fibrous proteins. • denaturation and coagulation of proteins through: heat, acid, agitation, enzymes and salt. • the effects of preparation and cooking methods of meat, fish and eggs. • how browning occurs through the Maillard reaction (non-enzymic browning) between protein chains and reducing sugars. • the gelation of proteins in products such as custard and cheese. • the role of gluten when making bread and pasta.	**International mindedness:** The impact of geography, climate, culture and religion on protein availability and choice. **Theory of Knowledge:** To what extent does food science share a common glossary of terms with other areas of knowledge? **Utilization:** Biology - Topic 2.4 Chemistry - Option B.2 Food science and technology - Topic 1.1 **Aims:** 6. develop an ability to analyse, evaluate and synthesize scientific information and research data to inform food science and technology decisions.

Essential Idea: Understanding the effect of heat on carbohydrates is particularly important to food preparation.

2.2 Functional properties of carbohydrate in foods		
Nature of food science and technology: Starch is often used to form the structure of baked food products and to thicken sauces. Sugar is widely used as a sweetener and when heated it adds colour to products, such as cakes and breads. (1.1, 3.1)	**Understandings:** • The chemical composition and structure of carbohydrates • Dextrinization • Caramelisation and crystallisation • Gelatinisation • Pectin gels **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • the structure of monosaccharides, disaccharides and polysaccharides. • the impact of dry heat, acids and enzymes on dextrinization of starch. • the impact of temperature, agitation and acidity and presence of other ingredients on the Caramelisation and crystallisation of sugar. • the impact of temperature, agitation and pH on gelatinisation of starch. • how the levels of amylose and amylopectin in different starches (e.g. potato starch, rice flour, corn flour) affects the organoleptic properties of starch. • the impact of acids on pectin gelation.	**International mindedness:** Carbohydrates are often staple foods (e.g. rice, maize, wheat, cassava) because they are often a cheap and plentiful source of energy. Different types of grains used make flour in different parts of the world. **Theory of Knowledge:** How does categorization or classification help or hinder the pursuit of knowledge? **Utilization:** Biology - Topic 2.3 Chemistry - Option B.4 Food science and technology - Topic 1.1 **Aims:** 6. develop an ability to analyse, evaluate and synthesize scientific information and research data to inform food science and technology decisions.

Essential Idea: The composition of fats affects how food is prepared, and so impacts on the sensory and nutritional characteristics of a finished product.

2.3 Functional properties of fats in food		
Nature of food science and technology: Fats are obtained from plant and animal sources. The chemical composition of plant and animal fats affects the way it can be used to prepare food products e.g. smoke point, lamination of pastries. It is important to use the appropriate type of fat for the desired outcome. For example, butter is used to make pastry, and using oil would not give the desired shortening effect. (1.1, 3.1)	**Understandings:** • The chemical composition and structure of fats • Emulsification and homogenisation • Aeration and foams • Plasticity and shortening • Hydrogenation • Melting and smoke points **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • the structure of triglycerides, saturated fatty acids, unsaturated fatty acids (monounsaturated and polyunsaturated). • the impact of oil and water in the emulsification and homogenisation process. • how creaming, rubbing- in, whisking and layering are to aerate and create foams. • the role of the plasticity of different fats on shortening of food products. • the advantages and disadvantages of hydrogenating fats and oils. • how the chemical composition of fats impacts on the melting and smoke points of fats.	**International mindedness:** Cultural and generational attitudes to the types of fat used in food preparation. **Theory of Knowledge:** Do different interpretations of vocabulary pose problems for sharing knowledge? **Utilization:** Biology - Topic 2.3 Chemistry - Option B.3 Food science and technology - Topic 1.1 **Aims:** 1. a sense of curiosity as they acquire the skills necessary for independent and lifelong learning and action through inquiry into the world of food science and technology.

Essential Idea: Additives are used in small amounts and can be beneficial to extending shelf life and improving sensory qualities.

2.4 Functional properties of additives		
Nature of food science and technology: Additives are substances added to foods to perform specific functions. Their use can be controversial and consumers may be wary of their use. For example, the flavour enhancer monosodium glutamate (MSG), which has been reported to have negative side effects if consumed in large quantities. (1.1, 1.4, 3.1)	**Understandings:** • Classification of additives: natural, nature identical and synthetic additives • Functions of additives • Benefits and risks of additives in foods • Functions of sweeteners **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • classifications and uses of additives in a range of food products (e.g. ready-made sauces, low fat yoghurts, confectionery, baked products). • the function of additives: flavours, flavour enhancers, colours, preservatives, antioxidants, stabilisers, emulsifiers sweeteners, thickening and gelling agents • the advantages and disadvantages of different types of additives to both the producers and consumers, e.g. consider MSG, saccharin and aspartame.	**International mindedness:** Variations in additives permitted in some countries but banned in others due to legislative controls and enforcement **Theory of Knowledge:** How does the methodology of natural sciences aim to ensure all additives are safe for consumption? Can we ever be certain that additive safety is 'proven'? **Utilization:** Food science and technology - Topic 4 **Aims:** 3. acquire a body of knowledge, methods and techniques that characterize food science and food technology.

Essential idea: Additional ingredients have important functions for the sensory characteristics and shelf life of food products.

2.5 Functional properties of additional ingredients		
Nature of food science and technology: Additional ingredients have been used for many years to improve sensory qualities and shelf life of foods both domestically and commercially. (1.5, 1.12, 2.3)	**Understandings:** • Categories of additional ingredients: raising agents, acids and alkalis, and salt • Types of raising agents and their application • Types of acids and alkalis and their application **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • the different properties of additional ingredients used both domestically and commercially e.g. salting, pickling, fermentation and leavening. • the factors and processes that affect the function of different raising agents (yeast, baking powder, bicarbonate of soda) in the bread and cakes. • the use of adding acid to food products. e.g. ascorbic acid to prevent browning, vinegar to extend shelf life and lactic acid in cheese making, addition of acid to bicarbonate of soda.	**International mindedness:** Foods using the functional properties of salt, raising agent and acids are found throughout the world e.g. kimchi, sauerkraut, naan. **Theory of Knowledge:** How can we decide whether one ingredient is a better choice than another? **Utilization** Food science and technology - Topic 4 **Aims** 3. Acquire a body of knowledge, methods, and techniques that characterize food science and food technology.

Essential Idea: Food fortification increases the content of essential micronutrients, irrespective of whether the nutrients were originally in the food before processing.

2.6 Food fortification		
Nature of food science and technology: Vitamins are added to improve the nutritional quality of the food supply and to provide a public health benefit with minimal risk to health. For	**Understandings:** • Types of food fortification • Reasons for food fortification • Criticisms and limitations of food fortification • Food supplements	**International mindedness:** International organisations, such as The World Health Organisation, (WHO), have recognized that there are over 2 billion people worldwide who suffer from a variety of micronutrient deficiencies **Theory of Knowledge:**

2.6 Food fortification		
example, Vitamin B12 in breakfast cereals. (2.7)	**Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • four types of fortification: bio-fortification, synthetic biology, commercial fortification and home fortification. • how food can be fortified by replacing nutrients which were lost during manufacture (e.g. B group vitamins, minerals such as iron and calcium). • how food can be fortified to act as a public health intervention (e.g. fluoride in drinking water). • how food can be fortified to ensure the nutritional equivalence of substitute foods (e.g. to make butter and margarine similar in content, soy milk and cow milk). • how food can be fortified ensure the appropriate vitamin and mineral nutrient composition of foods for special dietary purposes (e.g. gluten-free products, low sodium). • the criticisms and limitations related to food fortification. • how food supplements can be used for health and body development.	What are the ethical considerations associated with the fortification of food? **Utilization:** Food science and technology - Topic 1.2 **Aims:** 7. develop and apply 21st century communication and collaboration skills in the study of and participation in food science and technology activities. 10. become critically aware, as global citizens, of the ethical implications of global food science and technology developments.

Topic 3: Food Quality and Safety — 25 hours

Essential idea: Food deteriorates over time but actions can be taken to slow down the rate of spoilage, reduce food waste and prevent illness.

3.1 Food Spoilage

Nature of food science and technology: Food deterioration occurs due to microbial and chemical activity. An understanding of how and why food spoils is essential to minimising risks to health and unnecessary waste. (1.1, 1.9)	**Understandings:** • Classifications of micro-organisms • Causes of food spoilage and contamination. • Rancidity • Water Activity • Monitoring food spoilage and bacterial growth • Expiry dates **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • how micro-organisms are classified as: moulds, yeasts and bacteria. • how food spoilage and contamination can occur by means of biological, physical and chemical. Examples include enzymic, microbial activity, purification, fermentation, infestation and low temperature injury absorption. • hydrolytic and oxidative rancidity. • the importance of water activity in microbial spoilage. • how scientific principles are used to monitor food spoilage and bacteria growth. • the advantages and disadvantages of expiry dates (e.g. best before and use by dates).	**International mindedness:** Technological and economic advances enable the reduction of food spoilage in many parts of the world. **Theory of Knowledge:** How do emotion and reason establish whether or not food is safe to eat? **Utilization:** Food science and technology - Topic 4.1, 4.5 **Aims:** 8. understand how food science and technology promote intellectual, physical and emotional balance and contribute to personal and social well-being.

Essential idea: Food poisoning is an illness caused by eating harmful or contaminated foods. There are three types of food poisoning: chemical, biological and bacterial.

3.2 Food poisoning		
Nature of food science and technology: Chemical food poisoning occurs when food is contaminated with chemicals. Biological poisoning is caused by eating foods containing naturally occurring poisons. Bacterial food poisoning is caused by eating food that is contaminated with pathogenic bacteria. (1.13)	**Understandings:** • Types and causes of chemical, biological and bacterial food poisoning • High-risk foods • Symptoms of food poisoning • Lifestyle factors that cause food poisoning **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • types and causes of chemicals of food poisoning e.g. pesticides and cleaning products. • types and causes of biological of food poisoning e.g. toxins naturally occurring in plants such as poisonous mushrooms, green potatoes and rhubarb leaves. • types and causes of bacterial food poisoning e.g. salmonella, staphylococcus aureus, bacillus cereus, Escherichia coli, listeria monocytogenes, clostridium botulinum and novo virus. • foods that are high in protein and water are more susceptible to cause bacterial food poisoning e.g. meat, fish, eggs and dairy foods. • the symptoms that occur from different types of food poisoning and consider the impact on the health service. • how lifestyle factors contribute to the increased incidence of food poisoning.	**International mindedness:** Bacterial food poisoning is the most significant food-transmitted disease in developed countries and is a far greater hazard than food-borne infections. However, in developing country contexts foodborne infections are a significant cause of illness. **Theory of Knowledge:** How might technology support or contradict knowledge claims made through sensory perception with regards to food? **Utilization:** Biology - Option B.3 **Aims:** 8. understand how food science and technology promote intellectual, physical and emotional balance and contribute to personal and social well-being.

Essential idea: The growth of food poisoning bacteria can be controlled by complying to strict temperatures when storing and cooking high risk foods.

3.3 Principles of temperature control		
Nature of food science and technology: To prevent food poisoning it is vital that food is cooked and stored at temperatures where microorganisms are inhibited or destroyed (2.4)	**Understandings:** • Classification of microorganisms according to temperature growth • The danger zone • Monitoring temperature • Cooking techniques and the effect on destroyed harmful bacteria and toxins **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • different types of microorganisms can be classified due to their optimum temperature growth range (psychrophiles, mesophiles, thermophiles). • why advice for the temperature range of the danger zone varies marginally for the processes of food storage, cooking and serving. • how temperature control is used to prevent bacterial growth at different stages of production, including critical food preparation temperatures e.g. freezing, chilling, cooking, hot-holding. • advantages and disadvantages of different cooking techniques (such as frying, roasting, barbecuing and sous vide) to destroy harmful bacteria and toxins.	**International mindedness:** There are international standards for food quality assurance but the implementation may vary. **Theory of Knowledge:** Some foods such as oysters and sushi are eaten raw but may potentially contain harmful bacteria. How can it be decided what constitutes an acceptable level of risk? **Utilization:** Biology - Option B.3 **Aims:** 8. understand how food science and technology promote intellectual, physical and emotional balance and contribute to personal and social well-being.

Essential idea: Food safety is concerned with the safe production, storage and preparation of food. Following safe and hygienic food handling practices are essential to prevent potential food contamination and poisoning.

3.4 Safe food handling and preparation		
Nature of food science and technology: Safe and hygienic food handling practices in the production, storage and preparation of food involves the application of rigorous controls at all stages of the production and supply chain. (1.9)	**Understandings:** • Basic food hygiene • Cross contamination • Food premises design for safe food preparation • Controls and scale of production • Quality assurance and risk assessment • Food laws and regulations **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • the benefits of good personal hygiene and safety the consequences or poor hygiene and safety. • how cross contamination can be avoided throughout production and the supply chain. • how the design of food preparation areas can help to prevent the contamination of food by prevention of physical, chemical and biological contamination. • how hygiene and safety controls change as scale of production increases: a comparison between domestic and large scale commercial production. • the role of environmental health officers and food premise inspections. • how throughout the supply chain and production, quality assurance is used to identify hazards and control risks. • how HACCP, COSHH and other relevant food safety legislation is used to regulating and evaluating by use of inspections to check compliance.	**International mindedness:** There are international standards for food quality assurance but the implementation may vary. **Theory of Knowledge:** International standards may be seen to impose certain requirements. Can one group of people know what is best for others? **Utilization:** Biology - Option B.3 **Aims**: 4. apply and use a body of knowledge, methods and techniques creatively to address and critically consider issues related to food science and technology.

Essential idea: Organoleptic properties have a major impact of the acceptability of food. It is therefore imperative that appropriate sensory testing is carried out to ensure foods satisfy the needs and wants the specified target groups.

3.5 Organoleptic Properties		
Nature of food science and technology: Organoleptic properties include appearance, texture, taste and odour. Sensory testing methods are used to conduct reliable results under controlled environments. The concept of fair testing is crucial to obtain sensory data.(1.3, 1.13, 3.2)	**Understandings:** • Sensory properties of food • The purpose and importance of sensory tests • Advantages and disadvantages of different types of sensory testing **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • the sensory properties of food, derived from: appearance, taste, texture, touch and smell. • how the sensory properties of food affect consumer food choices. • how sensory testing is a subjective evaluation of how people perceive a product. • the importance of sensory testing to food manufacturers. • the advantages and disadvantages of different types of sensory tests: difference tests, paired comparison test, triangle test, two out of five test, ranking test, rating tests (hedonic scales, unipolar and bipolar scales), significant results and profiling.	**International mindedness:** Increased travel has led to greater exposure to a variety of food textures and flavours which means consumers are more willing to try new foods. **Theory of Knowledge:** How might the collection and interpretation of sensory data be affected by the limitations of our senses? **Utilization:** Design technology (HL) 9.4: Market research **Aims:** 4. apply and use a body of knowledge, methods and techniques creatively to address and critically consider issues related to food science and technology. 5. develop experimental and investigative skills that generate useful qualitative and quantitative data.

Essential idea: Innovations and refinements in food packaging can extend shelf life, enable the safe transportation and increase usability.

3.6 Packaging and food quality		
Nature of food science and technology: Packaging traditionally provided protection for food products. In many countries packaging and labelling now also provides marketing opportunities for manufacturers, as well as convenience and information for consumers which relate to their lifestyles. The implications of packaging on the environment is an area of growing concern. (1.11, 1.13,2.5)	**Understandings** • Reasons for packaging foods • Advantages and disadvantages of packaging materials • Primary and secondary packaging • Packaging design • Environmental impact of packaging **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • why food is packaged e.g. transportation, containment, protection, safety and hygiene. • the advantages and disadvantages of packaging. e.g. plastic, paper, metal and glass. • why food has both primary and secondary packaging. e.g. the Ferrero Roche. • the design of packaging such as minimal use of materials, recycling, use of biodegradable materials, use of reusable containers. • the environmental impact of food packaging and transporting packaged foods; availability and choice and prevention of waste food versus environmental impact of packaging.	**International mindedness:** Legislation about packaging materials, use of bags and requiring packaging to be recycled or reused varies between countries. **Theory of Knowledge:** Experts sometimes disagree about packaging and environmental impact; on what basis might we decide between the judgments of experts if they disagree? **Utilization** Design Technology - Topic 4 **Aims** 10. Become critically aware, as global citizens, of the ethical implications of global food science and technology developments.

Topic 4: Food process engineering — 25 hours

Essential idea: Food processing combines raw food ingredients to produce marketable food products that can be easily prepared and served by the consumer.

4.1 Food processing methods

Nature of food science and technology: Food processing is the transformation of raw ingredients, by physical or chemical means into food, or of food into other forms. Food processing can be primary or secondary to extend the shelf life and/or add value to a product. (1.10, 1.12, 2.2)	**Understandings:** • Primary, secondary and tertiary processing • Physical processing methods • Chemical processing methods • Traditional preservation processes • Fermentation • Adding value to food commodities • Ethical food production **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • primary, secondary and tertiary processing e.g. cleaning and grading of the wheat, wheat milled into flour, flour made into bread. • physical processing methods e.g. milling. • chemical processing methods e.g. nitrates and nitrites in food preservation. • the use of salt, sugar, vinegar and smoking in the preservation of foods. • the positive and negative effects of micro-organisms and enzymes in the production of alcohol, cheeses, yoghurts, bread making and mycoproteins. • how food processing enhances the value of food commodities. • how foods are processed ethically e.g. fair-trade, organic and free range. • sustainability and food security	**International mindedness:** The opportunities for primary and secondary processing of food can be dependent on the economic development of a country. **Theory of Knowledge:** To what extent does a sense of the aesthetics of food products override engineering practicalities? **Utilization:** Biology - Option B.1 Food science and technology - Topic 3.3 Design Technology - Topic 4.5 **Aims:** 10. become critically aware, as global citizens, of the ethical implications of global food science and technology developments.

Essential idea: Food preservation is carried out to increase food choice and convenience for consumer and to add value for food producers.

4.2 Food processing: preservation by temperature control		
Nature of food science and technology: The deterioration of food products can be slowed by processing foods at different temperatures to reduce the rate of microbial growth, thereby extending shelf life. (1.1, 1.9)	**Understandings** • The principles of temperature control • Methods of heat processing • Methods of cold processing **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • methods of heat processing: pasteurisation, sterilization, canning and aseptic canning. • methods of chilling and freezing (horizontal plate freezing, blast freezing, fluidised bed freezing. Cryogenic freezing). • the advantages and disadvantages to the manufacturer and consumer of different heat and cold processing methods. • how organoleptic properties are changed during heat and cold processing.	**International mindedness:** Globalisation has impacted on local food choice because **c**onsumers have greater access to food which they can now store by refrigeration and freezing. **Theory of Knowledge:** How can we judge whether one method of food processing is better than another? **Utilization** Food science and technology Topic 3 Biology Option F **Aims** 3. Acquire a body of knowledge, methods and techniques that characterize food science and food technology.

Essential idea: Food preservation is carried out to increase food choice and convenience for consumer and to add value for food producers.

4.3 Food processing: preservation by dehydration and irradiation		
Nature of food science and technology: The deterioration of food products can be slowed by processing foods by the removal or reduction in the water content and through irradiation to change the chemical structure, thereby extending shelf life. (1.1, 1.9)	**Understandings** • The principles of dehydration • Methods of dehydration • The principles of irradiation • Advantages and disadvantages of food irradiation • Irradiation processes	**International mindedness:** Dehydration has been used to preserve food for thousands of years in many parts of the world and it continues to make an important contribution to food availability both domestically and commercially.

4.3 Food processing: preservation by dehydration and irradiation		
	Application and guidance: Students should understand and where appropriate, be able to discuss and evaluate: • how water activity impacts on dehydration of different foods. • methods of dehydration (tunnel drying, roller drying, sun drying, warm air drying, spray drying, freeze drying). • the process of food irradiation, as an application of ionizing radiation to food. • the use of irradiated foods to reduce microbial spoilage, insect damage and inhibition of sprouting and ripening of fruits and vegetables. • consumer reaction to the wholesomeness of irradiated foods. • how organoleptic properties are changed through dehydration and irradiation processing.	**Theory of Knowledge:** Do new technologies affect the beliefs of a society? **Utilization** Food science and technology Topic 3 Biology Topic 3 and Option F **Aims** 3. Acquire a body of knowledge, methods and techniques that characterize food science and food technology.

Essential idea: Colour plays a significant role in the aesthetic appeal of food, as well as an indicator of flavour, freshness and overall quality.

4.4 The effect of food processing on colour		
Nature of food science and technology: When food is processed manufacturers may attempt: to minimise colour damage, restore colour or introduce new colour. This involves an understanding of both synthetic dyes and naturally occurring colours pigments (1.13, 2.1)	**Understandings:** • Naturally occurring pigments • Synthetic food dyes • Colour restoration • Colour and the impact of heat • Colour and the impact of pH • Colour and the impact of preservation processes • Consumer attitudes to food colours • Legislation controlling the use of food colours **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate:	**International mindedness:** Synthetic food dyes are used throughout the world but the USA and Europe are the main centres for toxicological testing (Proudlove, 2001, p. 68). **Theory of Knowledge:** Are we conditioned to associate the colours of food with other particular sensory qualities? **Utilization:** Food science and technology - Topic 3.5 **Aims:** 10. become critically aware, as global citizens, of the ethical implications of global food science and technology developments.

4.4 The effect of food processing on colour		
	• how naturally occurring pigments give colour to food e.g. anthocyanins, carotenoids and chlorophyll. • how synthetic food dyes give colour to food e.g. tartrazine, quinoline and erythrosine. • reasons for the use of natural food colours and synthetic food dyes to restore or introduce new colour to food products. • the effect of heat, acids, alkalis and other preservation techniques on anthocyanins, carotenoids, chlorophyll. • consumer attitudes to the use of natural and synthetic food colours. • why many countries have strict legislation to control the use of colours in food.	

Essential idea: Flavour is significant to the appeal of food and is linked to taste and odour.

4.5 The effect of food processing on flavour		
Nature of food science and technology: Food processing can impact on flavour. An understanding of natural, nature identical and synthetic flavours is needed to maintain flavour uniformity and restore flavour lost through processing. (1.5, 2.1)	**Understandings:** • The five tastes • Natural flavours • Nature identical flavours • Synthetic flavours • Flavour and the impact of preservation processes • Advantages and disadvantages of flavours • Flavour enhancers/modifiers **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • the five main tastes: umami, salt, sweet, sour and bitter; other flavours are odours. • the sources and use of natural flavours e.g. spices, herbs, essential oils.	**International mindedness:** Some international brands (Coca-Cola, Nestle) modify their products to suit consumer flavour preferences in different parts of the world. **Theory of Knowledge:** To what extent can flavour trigger memory? **Utilization:** Food Science and Technology - Unit 2.4 Food science and technology - Topic 3.5 **Aims:** 9. understand and appreciate the impact of culture in terms of food science and food technology development.

4.5 The effect of food processing on flavour		
	• the sources and use of nature identical e.g. nature identical vanillin. • the sources and use of synthetic flavours e.g. strawberry flavour may contain 10 to 12 synthetic organic chemicals. • how preservation techniques impact on flavour. • the advantages and disadvantages of natural, nature identical and synthetic flavours. • the use of flavour enhancers such as MSG and ribonucleotides. • how the use of gas chromatography and spectrometry has contributed to the study of flavour and aroma.	

Essential idea: Food processing can modify the texture of food to increase its organoleptic appeal.

4.6 The effect of food processing on texture		
Nature of food science and technology: During food processing texture can be modified by the use of thickeners, stabilisers and emulsifiers, and also by mechanical action and heating. (2.3, 2.5)	**Understandings:** • Colloidal systems: suspensions, emulsions, gels and foams • Thickening and gelling • Emulsifiers and stabilisers • Preservation techniques • Mechanical action to alter texture **Application and guidance:** Students should understand and where appropriate, be able to discuss and evaluate: • colloidal systems in food and how to distinguish between suspensions, emulsions and foams. • the use of maize and wheat as a traditional thickener, and pectin as a gelling agent in jam. • the types of starch modification (e.g. cross linking, acid modified, stabilisation, pre-gelatinised) and their impact on food processing.	**International mindedness:** Cultural, as well as physiological and psychological factors help shape attitudes to food texture e.g. crispness of stir fried vegetables (Szczesniak, 2002). **Theory of Knowledge:** How do we associate the texture of food with other quality attributes? **Utilization:** Food science and technology - Topic 3.5 **Aims:** 3. acquire a body of knowledge, methods and techniques that characterize food science and food technology.

4.6 The effect of food processing on texture		
	• the reasons for modifying starch, including thickening, stabilising, and improving mouthfeel. • the reasons for using gums include thickening and stabilising. Types of gums (e.g. Xanthan gum, alginates) and their impact on food processing. • the role of emulsifiers to form stable emulsions including lecithin and glyceryl monostearate (GMS); the role stabilisers absorbing large amounts of water. • how traditional preservation techniques have an impact on the texture of food. • how mechanical action is used to create foams and heat is used to create solid foams.	

Assessment outline

First assessment 2019

Assessment component	Weighting
External assessment (3 hours)	**80%**
Paper 1 (1 hour) Short-answer and extended-response questions, based on any area of the syllabus. Assessment objectives 1 – 3 (40 marks)	**30%**
Paper 2 (2 hours) 4 questions, one on each topic. Each question is split into six parts: five short-answer and one extended response question. Assessment objectives 1 – 3 (80 marks)	**50%**
Internal assessment/individual investigation (10 hours) (24 marks) Assessment objectives 1 – 4 This component is internally assessed by the teacher and externally moderated by the IB at the end of the course.	**20%**

External assessment details

Detailed markschemes specific to each examination paper are used to assess students. The markschemes are related to the assessment objectives and the group 4 grade descriptors.

Paper 1

Duration: 1 hour

Weighting: 30%

Marks: 40

Short-answer and extended-response questions to test objectives 1, 2, and 3.

Questions will be based on all areas of the syllabus.

All of the questions are compulsory.

Paper 2

Duration: 2 hours

Weighting: 50%

Marks: 80

Four questions to assess objectives 1, 2 and 3. Each question will cover one of the four topic areas, and be worth 20 marks. The four questions include short-answer questions and extended-response questions.

All of the questions are compulsory.