



ہائیر ایجوکیشن کمیشن

## HIGHER EDUCATION COMMISSION

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No. HEC/NCRC/FST/2025/7954  
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**SUBJECT: REVISED CURRICULUM FOR DEGREE PROGRAMS IN THE DISCIPLINE OF FOOD SCIENCE & TECHNOLOGY**

The Higher Education Commission (HEC) of Pakistan, as mandated by its law, provides guidance to Higher Education Institutions (HEIs) on curricula for tertiary education levels in alignment with the National Qualifications Framework (NQF). To address evolving academic trends and market demands, HEC has revised the curriculum standards for Food Science & Technology programs at NQF levels 5 & 6. These updated standards are aligned with HEC's Undergraduate Education Policy V 1.1 (2023) ensuring coherence with national priorities and adherence to international benchmarks.

2. The revised curriculum for the Food Science & Technology degree program is hereby notified. All universities offering this program are required to align their Food Science & Technology curriculum with these updated standards/framework as the minimum benchmark for quality and compliance. Additionally, the respective departments must develop course contents in accordance with the prescribed framework, ensuring that the programs address both national and local industry needs. The finalized course contents be submitted electronically to this office at the earliest. An electronic copy of the revised curricula is available on HEC's official website.

HIDAYATULLAH KASI

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**CURRICULUM**  
**FOR**  
**FOOD SCIENCE & TECHNOLOGY**  
**ASSOCIATE DEGREE | BS**  
**(2025)**



**HIGHER EDUCATION COMMISSION**  
**ISLAMABAD – PAKISTAN**

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## PREFACE

The curriculum, with varying definitions, is said to be a plan of the teaching-learning process that students of an academic program are required to undergo to achieve some specific objectives. It includes a scheme of studies, objectives & learning outcomes, course contents, teaching methodologies and assessment/ evaluation. Since knowledge in all disciplines and fields is expanding at a fast pace and new disciplines are also emerging; it is imperative that curricula be developed and revised accordingly.

Higher Education Commission, since its inception, has been involved in developing /revising the curricula on periodic basis through National Curriculum Revision Committees (NCRCs) comprising of eminent academics, researchers from HEC recognized universities/DAIs, professional councils, R&D organizations of repute and industry professionals. So far, HEC has developed and revised curricula of 150+ disciplines for undergraduate and graduate programs in various fields of Natural Sciences, Applied Sciences, Social Sciences, Art & Humanities, Engineering & Technology, Medical, Allied Health Sciences, Agriculture, Computing, Law, and Administration.

Over the period of time, labor markets in the world have substantially changed, hence, the demand for workforce skills has also altered. Due to these transformations, there is a need to produce well-rounded individuals who not only have the required knowledge base of specific discipline but also possess the required skills to increase their market readiness for them to contribute to the overall socio-economic development of the country. HEC has introduced the Undergraduate Education Policy 2023, which provides an overarching framework for undergraduate programs. This curriculum document is prepared in light of the UGE Policy 2023.

The revised Food Science and Technology curriculum has been designed to incorporate the latest global trends in the field, with a stronger emphasis on practical and industry-oriented training. It also introduces specialization tracks, enabling HEIs and students to pursue focused areas that expand their professional opportunities. Furthermore, the integration and encouragement of international certifications in relevant domains of Food Science and Technology will enhance the global recognition and competitiveness of Pakistani graduates.

I extend my sincere gratitude to the Global Alliance for Improved Nutrition (GAIN) and GCUF for supporting this activity of curriculum development and revision. The partnership between HEC, academia, and industry will play a pivotal role in advancing the standards of Food Science and Technology in Pakistan, aligning them with international best practices and the evolving needs of the global food sector.

**Dr. Amjad Hussain**  
Director General  
Academics Division

## **GUIDING PRINCIPLES**

### **Minimum Standards**

The curriculum standards and guidelines prescribed under this policy are mandatory at minimum level. Universities or the concerned departments may however set higher standards provided that the standards prescribed herein are not reduced or compromised.

### **Course Sequence, Titles and Credits**

For BS in Food Science & Technology, the sequence of courses prescribed under this document is logically arranged and is suggestive only. The offering department may rearrange the sequence and alter the course titles and credits provided that the essence of the courses prescribed in policy remains intact. The department may add more courses as and when required subject to approval of university's relevant statutory body.

### **Course Learning Outcomes**

Course learning outcomes (CLOs) are the bare minimum standards of learning that students must achieve upon completing a specific course. These outcomes serve as essential benchmarks, ensuring consistency in the quality of education across institutions. The CLOs prescribed herein represent the minimum level of competency and understanding expected from students. While these standards must not be compromised, departments are encouraged to enhance the rigor of the CLOs by incorporating additional learning outcomes, provided these do not alter the essence of the prescribed standards. In this policy, CLOs are exclusively developed for major field courses within the program. For interdisciplinary courses, departments offering these courses are responsible for developing their CLOs in alignment with their respective disciplines and program requirements. Moreover, CLOs for elective courses are not prescribed here, as these are advanced or specialized courses. The development of CLOs for electives is the responsibility of the respective departments, taking into account the course's advanced nature and relevance to the program. For general education courses as required under the HEC Undergraduate Education Policy V 1.1., departments may adopt the CLOs prescribed in the HEC-developed model courses.

### **Course Syllabus**

This document serves as a comprehensive guideline describing the course learning outcomes (CLOs) for each course offered in the Associate Degree, BS in Food Science & Technology as minimum standards. The offering department is mandated to meticulously prepare, modify, and tailor the syllabus of each course, ensuring alignment with the stipulated learning outcomes. It is in this regard imperative that the department utilizes instructional, reference, and reading materials that it deems appropriate to effectively meet the CLOs.

### **General Education**

For Associate degree and BS in Food Science & Technology, the courses prescribed for General Education component must mandatorily be offered with the same titles and credits as prescribed under HEC Undergraduate Education Policy V 1.1. The concerned departments may adopt and follow the learning outcomes and study contents developed by HEC for these courses as available on its website. The requirement of general education is not valid for MS in Food Science and Technology other than Fehm e Quran.

### **Requirement of Field Experience / Internship**

It is a mandatory degree award requirement of three (03) credit hours for BS in Food Science & Technology. Internship of six (06) to eight (08) weeks (preferably undertaken during semester or summer break) must be graded by a faculty member in collaboration with the supervisor in the

field. This requirement cannot be substituted with additional course work, capstone or project work.

### **Requirement of Capstone Project**

It is a mandatory degree award requirement of three (03) credit hours for BS in Food Science & Technology. A capstone project is multifaceted body of work that serves as a culminating academic and intellectual experience for students. The capstone project must be supervised and graded by a faculty member as per the protocols prescribed by the concerned department. This requirement cannot be substituted with additional course work or internship.

### **Associate Degree in Food Science & Technology**

The first-four semesters of the BS Food Science & Technology as prescribed in this policy are aligned with the structure of Associate Degree Program in Food Science & Technology. Capstone Project and Field experience is not a mandatory requirement for the Associate Degree in Food Science & Technology.

### **Entry and Exit Provisions at Undergraduate Level**

#### **a. Pathway for Graduates with Associate Degree**

- Students having completed Associate Degree in Food Science & Technology or related disciplines are allowed admission in the fifth semester of the BS in Food Science & Technology.
- Students having completed Associate Degree in disciplines other than Food Science & Technology and related disciplines may be offered deficiency courses from 15-18 credits through bridging semester prior to enrollment in 5<sup>th</sup> Semester of BS Food Science & Technology Program. The bridging courses shall be determined by the concerned admitting department.
- The minimum eligibility for admission in the fifth semester in above cases is 2.00/4.00 CGPA in the prior qualification i.e., Associate Degree. The concerned university may, however, set higher eligibility and admission criteria for admission in the fifth semester of BS in Food Science & Technology.

#### **b. Pathway for Graduates with Conventional BSc/Equivalent Degree Programs**

- Students having completed two-year conventional BSc/equivalent degree programs are allowed admission in the fifth semester of BS in Food Science & Technology in which case, such students shall be required to complete deficiency courses from 15-18 credit hours through bridging semester. The bridging courses shall be determined by the concerned admitting department.
- The minimum eligibility for admission in the fifth semester in this case is 45% cumulative score in the prior qualification i.e., two-year conventional BSc/equivalent degree programs. The concerned university may however set higher eligibility and admission criteria for admission in the fifth semester of BS Food Science & Technology.

#### **c. Exiting from BS in Food Science & Technology with the Associate Degree**

- Students enrolled in BS Food Science & Technology are allowed to exit the program with Associate Degree in Food Science & Technology provided that they have completed the requirements of the first-four semesters of the BS Food Science & Technology program as prescribed in this policy.

## BACHELOR OF SCIENCE – FOOD SCIENCE & TECHNOLOGY

### PROGRAM DESCRIPTION

The Bachelor of Science in Food Science and Technology (BS-FST) program, structured in line with the HEC Undergraduate Education Policy V 1.1. is a dynamic four-year degree that prepare students for careers in the food industry, focusing on food processing, product development, safety, quality assurance and sustainability for food security, safety, systems and nutrition; through a combination of theoretical knowledge, laboratory skills, research projects, and industrial training, students gain the expertise needed to develop innovative, safe, and high-quality food products, understand regulatory frameworks, and address global challenges like food security and public health, leading to diverse career opportunities in manufacturing, quality control, research, regulatory affairs, and entrepreneurship within the rapidly evolving food sector.

### STANDARD NOMENCLATURE

For the sake of standardization, all the undergraduate degree programs (NQF level 6 qualifications) in the discipline of Food Science & Technology must have the title of **“Bachelor of Science Food Science & Technology”**. Henceforth all the degree programs at equivalent level with same purpose and scope having different nomenclatures shall accordingly be renamed.

### PROGRAM LEARNING OUTCOMES

By the end of a degree in BS Food Science and Technology, a graduate shall be able to

- Apply core principles of food chemistry, microbiology, engineering, and nutrition to understand and optimize food systems, processing, and safety across various product and categories.
- Design, implement, and evaluate food processing and preservation through modern techniques and quality assurance systems, enhance shelflife and sustainability in alignment with national and international standards for consumer health and industrial compliance
- Demonstrate practical skills in laboratory, analytical, and industrial settings, integrating multidisciplinary knowledge relevant to specialized areas such as dairy, meat, cereals, halal science, food safety, and biotechnology.
- Critically analyze and solve food-related problems using scientific reasoning, data interpretation, and technological innovations to contribute to sustainable food system development.
- Communicate effectively, uphold professional ethics, and engage in lifelong learning and research to contribute meaningfully to academia, industry, policy, and public health in the context of Pakistan’s and global food challenges

### ELIGIBILITY CRITERIA

Higher Secondary School Certificate/A-levels (involving minimum 12 years of schooling) or an IBCC equivalent qualification as per following details is the eligibility criteria for admission;

- FSc (Pre Medical)
- FSc (Pre Eng )
- FSc (Pre-Agri)
- FSc (Food related subjects)
- A-Levels (having equivalency of any of above offshoot)
- DAE in Food related subjects

## PROGRAM STRUCTURE

The degree program follows HEC Undergraduate Education Policy 2023 V 1.1 and comprises a minimum of 08 regular semesters (04 years). Universities may offer courses consisting of a minimum of 140 credit hours provided that the total number of credit hours are reasonably set to achieve the Program Learning Outcomes.

Minimum Credit Hours		140
General Education Courses		34 credit hours (14 courses)
Discipline Related Courses / Major	Total	<b>88 credit hours (32 courses)</b>
	Compulsory Major	70 credit hours (26 courses)
	Electives Major	18 credit hours (06 courses)
Interdisciplinary/ Allied Courses		12 credit hours (4 courses)
Field Experience/Internship		3 credit hours
Capstone Project		3 credit hours
Program Duration		Minimum: 4 Years Maximum: 6 Years (Further extendable to another year subject to the approval of the university's statutory body following the provisions of HEC Undergraduate Education Policy 2023 V 1.1)
Semester Duration		16-18 weeks for regular semesters (1-2 weeks for examination) 8-9 weeks for summer semesters (1 week for examination)
Course Load (per semester)		15-21 credit hours for regular semesters Credit hours to be offered in Summer/winter semesters, as per HEC guidelines (For remedial/deficiency/failure/repetition courses only)
3 Credit Hours (Theory)		3 classes (1 hour each) OR 2 classes (1.5 hours each) OR 1 class (3 hours) per week throughout the semester.
1 Credit Hours (Practical Work)*		1 Credit hour of practical work requires three contact hours per week throughout the semester.

Policy for Probation in Semester	<p>i) The students acquiring less than 2.00/4.00 GPA in a semester but passing in all papers will be promoted with the condition to achieve more than 2.0 GPA in the next semester and s/he will be put on probation for the next semester.</p> <p>ii) The students acquiring GPA 1.7 and above but failing in any paper(s) will be placed on probation and promoted to the next semester conditionally. They will have to be registered for summer semester to improve the grade.</p> <p>iii) Students acquiring GPA less than 1.7 in two consecutive semesters and failing in any paper(s) even after attending summer semester for one academic year will be dropped from university rolls.</p>
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### General Education Courses: 34 Credits (14 Courses)

As per HEC UGE Policy V 1.1 and subsequent notifications, following courses are mandatory to be part of every undergraduate degree program including Associate Degree, hence the same are included in the schemes of BS Food Science and Technology;

Serial No.	GE Course Category	No. of Courses	Credit Hours
1	Arts & Humanities *	1	02
2	Natural Sciences *	1	03 (2+1)
3	Social Sciences *	1	02
4	Functional English, Expository Writing	2	06
5	Quantitative Reasoning	2	06
6	Islamic Studies / Ethics	1	02
7	Ideology & Constitution of Pakistan	1	02
8	Application of ICT	1	03 (2+1)
9	Entrepreneurship	1	02
10	Civics and Community Engagement	1	02
11	Pakistan Studies	1	02
12	Fehm e Quran	1	02
	<b>Total</b>	<b>14</b>	<b>34</b>

*Note: In the course categories from Serial Number 4-12, HEC has developed the model course outlines for guidance of the Institutions. In the course categories from Serial Number 1-3, as the Choice in selection of courses is available, the same was deliberated in detail in the NCRC Food Science and Technology, the recommended courses are given below.*

### **Major Courses (Compulsory): 70 Credit Hours (26 Courses)**

The Core Mandatory courses in a BS Food Science and Technology program helps to provide students with a strong and comprehensive foundation in the fundamental areas of food science and technology

<b>S.No.</b>	<b>Courses</b>	<b>Credit hours</b>
1	Introduction to Food Science and Technology	3 (2-1)
2	Food Microbiology and Biotechnology	3 (2-1)
3	Analytical Techniques in Food and Nutrition	3 (1-2)
4	Food Safety & Quality Management	3 (3-0)
5	Food & Drug Laws and Regulations	2 (2-0)
6	Food Product Development	3 (1-2)
7	Functional Foods & Nutraceuticals	2 (2-0)
8	Research Methods in Food and Nutrition	2 (1-1)
9	Fundamentals of Human Nutrition and Dietetics	3 (3-0)
10	Community and Public Health Nutrition	3 (3-0)
11	Food Service Management	2 (1-1)
12	Fundamentals of Food Systems	3 (3-0)
13	AI in Food and Nutrition	2 (1-1)
14	Food and Nutrition Policies	3 (3-0)
15	Food and Nutrition Certifications****	3 (3-0)
16	Macro and Micro Nutrients	3 (3-0)
17	Post Harvest Handling of Food Commodities	3 (2-1)
18	Unit operations in Food processing	3 (2-1)
19	Fundamentals of Dairy Science and Technology	3 (2-1)
20	Meat, Poultry and Marine Foods	3 (2-1)
21	Food Process Engineering	3 (2-1)
22	Grain Milling and Baking Technology	3 (2-1)
23	Beverage Technology	2 (1-1)
24	Technology of Fats and Oils	3 (2-1)
25	Sugar and Confectionery Technology	2 (1-1)
26	Fruits and Vegetables Processing	2 (1-1)
	<b>Total</b>	<b>70</b>

### Interdisciplinary Courses: Min 12 Credits

As per HEC UGE Policy V 1.1, interdisciplinary courses of 12 credit hours are required in four year Undergraduate Degree Programs, to complement holistic understanding of the major. The item was thoroughly deliberated in the NCRC of FST it was emphasized that in order to effectively utilize the compartment of interdisciplinary courses, the list be given so that no important area is left unattended. Universities are at liberty to add more courses to it after approval of HEIs' relevant statutory bodies.

Interdisciplinary Courses*	Credit hours
Food Supply Chain Management	3 (2-1)
Exploratory Data Analysis and Visualization	3 (2-1)
Environmental and Occupational Health	3 (2-1)
Food Business Management	3 (2-1)
Bioethics, Biosafety & Biosecurity	3 (2-1)
Biostatistics	3 (2-1)
Quality Management System and Standards	3 (2-1)
Essentials of Biochemistry	3 (2-1)

### SCHEME OF STUDIES

The suggestive scheme of studies for BS Food Science and Technology program is given below;

SEMESTER I			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	Quantitative Reasoning-I*	3 (3-0)	General Education
2	Functional English*	3 (3-0)	General Education
3	Applications of Information and Communication Technologies*	3 (3-0)	General Education
4	Introduction to Food Science and Technology	3 (2-1)	Major
5	Fundamentals of Human Nutrition and Dietetics	3 (3-0)	Major
6	IDS-I	3 (3-0)	Interdisciplinary
<b>Total Credits (18)</b>			

<b>SEMESTER II</b>			
<b>S. No</b>	<b>COURSE</b>	<b>CREDIT HOURS</b>	<b>CATEGORY</b>
1	Quantitative Reasoning-II*	3 (3-0)	General Education
2	Social Science**	2 (2-0)	General Education
3	Expository Writing*	3 (3-0)	General Education
4	Natural Science**	3 (2-1)	General Education
5	Fehm-e-Quran – I (for Muslim Students)	1 (0-1)	General Education
6	Food Service Management	2 (1-1)	Major
7	Food Microbiology and Biotechnology	3 (2-1)	Major
<b>Total Credits ( 17)</b>			

<b>SEMESTER III</b>			
<b>S. No</b>	<b>COURSE</b>	<b>CREDIT HOURS</b>	<b>CATEGORY</b>
1	Arts and Humanities**	2 (2-0)	General Education
2	Islamic Studies (Religious Education / Ethics for non-Muslim students) *	2 (2-0)	General Education
3	Pakistan Studies*	2 (2-0)	General Education
4	Fehm-e-Quran – II (for Muslim Students)	1 (0-1)	General Education
5	Functional Foods & Nutraceutical	2 (2-0)	Major
6	Food Safety & Quality Management	3 (3-0)	Major
7	Macro and Micro Nutrients	3 (3-0)	Major
8	IDS-II	3 (2-1)	Interdisciplinary
<b>Total Credits (18)</b>			

SEMESTER IV			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	Civics and Community Engagement*	2 (2-0)	General Education
2	Ideology and Constitution of Pakistan*	2 (2-0)	General Education
3	Entrepreneurship*	2 (2-0)	General Education
4	Fundamentals of Food Systems	3 (3-0)	Major
5	AI in Food and Nutrition	2 (1-1)	Major
6	Fruits and Vegetables Processing	2 (1-1)	Major
7	IDS-III	3 (2-1)	Interdisciplinary
8	IDS-IV	3 (2-1)	Interdisciplinary
<b>Total Credits (19)</b>			

\* The student may Exit with Associate Degree in Food Science and Technology after completion of 04 Semesters in BS FST degree program subject to given terms and conditions.

SEMESTER V			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	Analytical Techniques in Food and Nutrition	3 (1-2)	Major
2	Community and Public Health Nutrition	3 (3-0)	Major
3	Post Harvest Handling of Food Commodities	3 (2-1)	Major
4	Unit Operations in Food Processing	3 (2-1)	Major
5	Fundamentals of Dairy Science and Technology	3 (2-1)	Major
6	Beverage Technology	2 (1-1)	Major
<b>Total Credits (17)</b>			

<b>SEMESTER VI</b>			
<b>S. No</b>	<b>COURSE</b>	<b>CREDIT HOURS</b>	<b>CATEGORY</b>
1	Food & Drug Laws and Regulations	2 (2-0)	Major
2	Food Product Development	3 (1-2)	Major
3	Meat, Poultry and Marine Foods	3 (2-1)	Major
4	Food Process Engineering	3 (2-1)	Major
5	Research Methods in Food and Nutrition	2 (1-1)	Major
6	Elective-I***	3 (3-0)	Major
<b>Total Credits (16 )</b>			
<b>Summer</b>			
1	Field Experience/Internship	3 credit hours	Major
<b>Total Credits (3 )</b>			

<b>SEMESTER VII</b>			
<b>S. No</b>	<b>COURSE</b>	<b>CREDIT HOURS</b>	<b>CATEGORY</b>
1	Technology of Fats and Oils	3 (2-1)	Major
2	Food and Nutrition Certifications****	3 (3-0)	Major
3	Sugar and Confectionery Technology	2 (1-1)	Major
4	Elective-II***	3 (3-0)	Major
5	Elective-III***	3 (3-0)	Major
6	Elective-IV***	3 (3-0)	Major
<b>Total Credits (17)</b>			

SEMESTER VIII			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	Food and Nutrition Policies	3 (3-0)	Major
2	Grain Milling and Baking Technology	3 (2-1)	Major
3	Elective-V***	3 (3-0)	Major
4	Elective-VI***	3 (3-0)	Major
5	Capstone Project	3 (3-0)	Capstone Project
<b>Total Credits (15)</b>			

**Note:** Internships of three (03) credit hours must be completed in accordance with HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework, capstone, research, or project work.

\* The university may use HEC-designed model courses.

\*\* The university/offering department may offer any course within the broader subject domain/cluster to meet the given credits.

\*\*\* The university/offering department may offer any advanced course in FOOD SCIENCE & TECHNOLOGY as an elective based on available academic and physical resources, depending on its geographical location and program objectives.

\*\*\*\* BS Food Science & Technology students are required to complete three certifications (equivalent to 3 credit hours in total) over the period of four-year program as a mandatory condition for degree completion. Each certification will be considered equivalent to 1 credit hour if it comprises at least 16 hours. The respective department will guide students in selecting relevant certifications, ensuring alignment with current market needs and the program's objectives.

## SPECIALIZATION IN FOOD SCIENCE TECHNOLOGY:

### Specialization 1: Grain Science and Technology

SR NO	COURSES	CR HR
1.	Grain Physiology	3(3-0)
2.	Grain Quality and Grading	3(2-1)
3.	Postharvest Grain Handling and Storage	3(2-1)
4.	Milling Science and Technology	3(2-1)
5.	Grain Chemistry and Technology	3(2-1)
6.	Baking Science and Technology	3(2-1)

**Specialization 2: Dairy Technology**

SR NO	COURSES	CR HR
1.	Principles of Milk Production and Procurement	3(3-0)
2.	Innovative Dairy Processing Technologies	3(3-0)
3.	Ice cream and Frozen Desserts	3(2-1)
4.	Cheese Technology and Fermented Dairy Products	3(2-1)
5.	Condensed and Dried Milk Products	3(2-1)
6.	Traditional Dairy Products	3(3-0)

**Specialization 3: Meat Technology**

SR NO	COURSES	CR HR
1.	Meat Animal Production and Welfare	3(3-0)
2.	Meat Biochemistry	3(2-1)
3.	Meat and Meat Product Processing	3(2-1)
4.	Sea Foods and Poultry Processing	3(2-1)
5.	Meat Slaughtering & Inspection	3(3-0)
6.	Meat Hygiene and Public Health	3(3-0)
7.	Cultivated Meat and Analogue	3(2-1)

**Specialization 4: Food Safety and Quality Management**

SR NO	COURSES	CR HR
1.	Pre-Requisite Programs in Food Safety & Quality	3(3-0)
2.	Food Fraud Control and Management	3(3-0)
3.	Risk Assessment and Control Plans	3(2-1)
4.	Audit and Inspection Techniques	3(2-1)
5.	Food Safety and Quality Systems	3(3-0)
6.	Quality Tools and Techniques	3(2-1)
7.	Consumer Preferences and Perception	3(3-0)

**Specialization 5: Food Microbiology and Biotechnology**

SR NO	COURSES	CR HR
1.	Probiotics and Prebiotics	3(2-1)
2.	Microbial Genetics and Molecular Biology	3(2-1)
3.	Industrial Fermentation and Enzyme Technology	3(2-1)
4.	Foodborne Pathogens and Toxicology	3(2-1)
5.	Bioprocess Engineering in Food Systems	3(2-1)
6.	Genetically Modified Organisms in Food Biotechnology	3(3-0)
7.	Environmental and Industrial Microbiology	3(3-0)

**Specialization 6: Hospitality Management**

SR NO	COURSES	CR HR
1.	Introduction to Hospitality Management	3(3-0)
2.	Hotel Operations and Management	3(2-1)
3.	Tourism Principles and Practices	3(3-0)
4.	Event Planning and Management	3(2-1)
5.	Food and Beverage Management	3(2-1)
6.	Culinary Arts and Kitchen Management	3(2-1)
7.	Sustainable Tourism and Hospitality	3(3-0)

**Specialization 7: Sustainable Food Systems**

SR NO	COURSES	CR HR
1.	Introduction to Sustainable Food Production	3(3-0)
2.	Ethics, Equity & Food Justice	3(3-0)
3.	Life Cycle Assessment of Foods	3(2-1)
4.	Research, Policy & Economics of Sustainable Diets	3(2-1)
5.	Circular Bioeconomy in Food Processing	3(3-0)
6.	Climate Risk Mitigation in Food Production	3(3-0)

**Specialization 8: Community Nutrition**

SR NO	COURSES	CR HR
1.	Community Nutrition Assessment and Program Planning	3(2-1)
2.	Maternal, Infant, and Young Child Nutrition	3(3-0)
3.	Nutrition in Emergencies and Vulnerable Populations	3(2-1)
4.	School and Adolescent Nutrition	3(2-1)
5.	Nutrition Policy and Advocacy	3(3-0)
6.	Food Fortification, Enrichment, and Supplementation	3(3-0)
7.	Community-Based Nutrition Interventions	3(2-1)

**Specialization 9: Food Business Management**

SR NO	COURSES	CR HR
1.	Management of Food Organizations	3(3-0)
2.	Food Marketing & Consumer Behavior	3(2-1)
3.	HRM in Food & Agri-Businesses	3(3-0)
4.	Food Retail & E-Commerce Strategies	3(2-1)
5.	Food Business Finance & Cost Control	3(2-1)
6.	Global Food Supply Chain & Logistics Management	3(3-0)
7.	Sustainable Food Branding & Innovation	3(3-0)

**Specialization 10: Halal Science**

SR NO	COURSES	CR HR
1.	Halal Food Laws & Shariah Compliance	3(3-0)
2.	Halal Food Chemistry & Ingredient Analysis	3(2-1)
3.	Fundamentals of Halal Slaughtering & Meat Hygiene	3(2-1)
4.	Halal Supply Chain & Traceability Systems	3(2-1)
5.	Halal Certification & Global Regulations	3(3-0)
6.	Introduction to Halal Food Biotechnology	3(2-1)

**Specialization 11: Food Innovation**

SR NO	COURSES	CR HR
1.	Entrepreneurship and Innovation in Food	3(3-0)
2.	Global Food Safety and Risk Management	3(3-0)
3.	Data Science for Food Systems	3(2-1)
4.	Food Product Design and Consumer Behaviour	3(3-0)
5.	Sustainable Food Systems and Circular Economy	3(3-0)
6.	Introduction to Food Ethics and Policy	3(3-0)
7.	Food and Society: A Global Perspectives	3(3-0)

**Specialization 12: Food Science and Nutrition**

SR NO	COURSES	CR HR
1.	Nutrient Metabolism & Interaction	3(2-1)
2.	Global Trends in Nutrition & Dietetics	3(3-0)
3.	Nutrition Education & Awareness	3(3-0)
4.	Innovations in Food and Nutritional Sciences	3(3-0)
5.	Diet Planning for Special Populations	3(2-1)
6.	Nutritional and Processing Aspects of Probiotics and Prebiotics	3(2-1)
7.	Nutritional Food Safety and Processing	3(2-1)
8.	Culinary Nutrition & Gastronomy	3(2-1)

**Specialization 13: General Food Science and Technology**

SR NO	COURSES	CR HR
1	Extrusion Technology	3(2-1)
2	Fundamentals of Halal foods	3(3-0)
3	Food Business Management	3(2-1)
4	Industrial Food Microbiology	3(2-1)
5	Audit and Inspection in Food Industry	3(2-1)
6	Food Packaging	3(2-1)
7	Food Chemistry	3 (2-1)

Note: *The list of courses given in the general FST are replaceable with the courses (one course from any of the specialization) to the maximum six courses (18 credit hours) keeping in view HEIs at liberty after approval of relevant statutory bodies.*

## DEGREE AWARD REQUIREMENTS

The following minimum requirements are prescribed for the award of a BS Food Science and Technology /Specializations

- a) All courses in the General Education category must be completed as prescribed by HEC Undergraduate Policy 2023 V 1.1.
- b) As prescribed in this document as per recommendation of the NCRC, 140 credit hours must be completed in a minimum of 08 semesters spread over a minimum of four years.
- c) The capstone project (03 credit hours) must be completed following HEC-prescribed guidelines for the degree award. This requirement cannot be substituted with additional coursework.
- d) Internships of three (03) credit hours must be completed in accordance with HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework, capstone, research, or project work.
- e) CGPA must not be below 2.00/4.00 at the completion of the degree program. The university may, however, set a higher standard in this regard.

## GUIDELINES

1. The listed specializations and courses are not exhaustive. Higher Education Institutions (HEIs) are encouraged to offer additional specializations and/or courses, if available. It's essential to note that all BS Food Science and Technology programs, regardless of specialization, are considered equivalent under this scheme of studies. There is no inherent difference between the specializations. However, employers may prefer specific specializations, depending on their requirements.
2. It is noteworthy that universities can redistribute courses across the first four and last four semesters. This adjustment can be made based on factors such as teaching staff availability and other facilities. The course distribution outlined is not rigid and is subject to modification by the concerned universities.
3. All universities are directed to implement this revised scheme of studies and align their degree programs and degree nomenclature accordingly, with effective from spring 2026. The degrees offered with other nomenclature shall not be considered equivalent / relevant to BS Food Science and Technology and will not be attested by HEC.
4. BS (Hons) Agriculture with a major Food Technology will be considered equivalent to BS Food Science & Technology if the university adopts the curriculum of BS Food Science & Technology in 5th to 8th semesters however, they are not eligible to take the specialization/s in BSc (Hons.) Agriculture with Major Food Technology.
5. Degrees awarded in the relevant discipline before this notification will be treated as per the existing HEC equivalence procedure.

## RECOMMENDATIONS / DECISIONS

Following decisions are made by NCRC Food Science & Technology to improve the quality of Food Science and Technology programs keeping in view the latest trends and demands of the market;

- a) The NCRC committee recommended establishment of the National Food and Nutrition Education Accreditation Council (**NFNEAC**) in order to accredit the food science and human nutrition related degree programs for uniform quality education policy in Pakistan.

## **COURSE LEARNING OUTCOMES (CLOS): MAJOR COURSES**

### **Introduction to Food Science and Technology**

By the end of this course the student will be able to:

- Describe the scope and interdisciplinary nature of food science.
- Identify the physical, chemical, and microbiological properties of food.
- Discuss key food processing and preservation techniques.
- Explain the role of food science in public health and food security.
- Evaluate food quality and safety parameters

### **Food Microbiology and Biotechnology**

By the end of this course the student will be able to:

- Understand the fundamental roles, types and characteristics of microorganisms involved in food systems. Demonstrate knowledge of probiotics, prebiotics, and gut microbiota, including their roles in human health and the development of functional foods.
- Demonstrate knowledge of probiotics, prebiotics, and gut microbiota, including their roles in human health and functional food development
- Develop proficiency in microbiological and biotechnological techniques, including the detection, isolation and enumeration of foodborne microorganisms.
- Acquire hands-on laboratory skills by following standard microbiological procedures and biosafety guidelines during food testing and experimental work. Analyze the mechanisms, detection methods, and control strategies for foodborne pathogens and toxins, ensuring food safety and public health.
- Explore the application of microbial biotechnology in the food industry focusing on enzyme production, fermented foods and the development of functional food products
- Implement the principles of food microbiology and biotechnology to ensure food safety, uphold quality standards and evaluate the efficacy of food preservation techniques.

### **Analytical Techniques in Food and Nutrition**

By the end of this course the student will be able to:

- Describe the basic principles of instrument, theories and operations of key components of the instrument used for food component analysis.
- Explain modern extraction and food analyzing techniques
- Acquire knowledge about sampling and sampling procedure, with special reference to intended instruments
- Demonstrate the basic principles behind analytical techniques
- Learn different working principles, parts and applications of different instruments used in food analysis

### **Food Safety & Quality Management**

By the end of this course the student will be able to:

- Explain principles and importance of food safety and hygiene.
- Interpret national and international food safety regulations.

- Apply HACCP, GMP, and other quality management systems in food industries.
- Assess risks and control measures for foodborne hazards.
- Evaluate food safety auditing and certification procedures.

## Food & Drug Laws and Regulations

By the end of this course the student will be able to:

- Understand the legal framework governing food and drug safety.
- Interpret food labeling, claims, and advertising laws.
- Analyze global regulatory standards (e.g., Codex, FDA, EFSA).
- Apply national regulations such as PSQCA and DRAP in food businesses.
- Evaluate the role of regulatory bodies in ensuring consumer protection

## Food Product Development

By the end of this course the student will be able to:

- Explain the stages of food product development from concept to commercialization.
- Apply sensory, nutritional, and functional criteria to design novel food products.
- Utilize ingredient technologies and formulation techniques for product optimization.
- Evaluate prototypes through sensory analysis, shelf-life testing, and consumer feedback.
- Develop a business plan and marketing strategy for launching a new food product.

## Functional Foods & Nutraceuticals

By the end of this course the student will be able to:

- Define and classify functional foods and nutraceuticals.
- Discuss bioactive components and their health benefits.
- Analyze regulatory and labeling aspects of nutraceuticals.
- Evaluate clinical evidence supporting functional food claims.
- Formulate functional food products targeting specific health issues

## Research Methods in Food and Nutrition

By the end of this course the student will be able to:

- Differentiate among various types of research (qualitative, quantitative, and mixed methods) relevant to food and nutritional sciences, and formulate clear, testable research questions and hypotheses.
- Critically evaluate scientific literature to identify research gaps, methodological strengths and weaknesses, and justify the selection of appropriate study designs and data collection methods.
- Design and implement a research study using suitable tools such as surveys, interviews, focus groups, or laboratory experiments within the context of food and nutrition.
- Analyze quantitative and qualitative data using statistical software (e.g., SPSS, R, or Excel), and interpret findings in relation to research objectives.
- Communicate research findings effectively through structured written reports and oral presentations tailored to academic and professional audiences.

## Fundamentals of Human Nutrition and Dietetics

By the end of this course the student will be able to:

- Define key concepts, terminologies, and principles of human nutrition and dietetics.
- Explain the role of essential nutrients in human metabolism and health.
- Apply dietary guidelines to assess and plan balanced diets for various age groups.

- Analyze the impact of nutrient deficiencies and excesses on public health.
- Evaluate and propose nutritional strategies to promote health and prevent disease.

## Community and Public Health Nutrition

By the end of this course the student will be able to:

- Describe the scope and objectives of public health nutrition in Pakistan.
- Interpret national and international nutritional surveillance data.
- Develop community-based nutrition interventions targeting vulnerable populations.
- Assess the effectiveness of nutrition programs in addressing malnutrition.
- Formulate policies to overcome nutrition-related challenges in different communities.

## Food Service Management

By the end of this course the student will be able to:

- List and describe the basic principles of food service operations and systems.
- Apply principles of menu planning, procurement, and budgeting in institutional settings.
- Demonstrate practical skills in food production, quality control, and hygiene management.
- Analyze the workflow, staffing, and equipment requirements in different food service models.
- Design an efficient food service operation plan tailored to local institutional needs. Evaluate the financial and human resource aspects of food service units.

## Fundamentals of Food Systems

By the end of this course the student will be able to:

- Define and explain the dimensions and determinants of food security.
- Gain insights into historical overview, components and significance of sustainable food systems.
- Evaluate impact of climate change, gender and youth mainstreaming on food, nutrition, and health
- Understand Pakistan Food System Dashboard (PFSD) and its utilization for data acquisition
- Analyze the interconnections between food production, distribution, consumption, and sustainability within local and global food systems.

## AI in Food and Nutrition

By the end of this course the student will be able to:

- Develop a comprehensive understanding of artificial intelligence methodologies and their integration into food science and nutritional research
- Apply machine learning, deep learning, and data analytics to model, predict, and optimize food quality, safety, and nutritional outcomes
- Design and implement AI-driven systems for personalized nutrition, dietary recommendations, and metabolic health monitoring
- Evaluate ethical, regulatory, and data privacy considerations in the use of AI for food and nutrition application
- Develop problem solving skills through AI-based solutions for real world challenges in food systems and nutritional health

## Food and Nutrition Policies

By the end of this course the student will be able to:

- Recall key historical milestones in food and nutrition policy development.
- Interpret existing food and nutrition policies in Pakistan and globally.
- Analyze the impact of policies on food security, safety, and public health.
- Compare and contrast policy frameworks used in different countries.
- Recommend evidence-based policy improvements for the national nutrition agenda.

### **Food and Nutrition Certifications\*\*\*\***

By the end of this course the student will be able to:

- Identify key national and international food and nutrition certification frameworks and their core requirements.
- Explain the role of certification in ensuring food quality, safety, and consumer trust.
- Evaluate the scientific and regulatory standards behind certifications like HACCP, ISO 22000, FSSC 22000 and Codex guidelines.
- Analyze labeling, health claims, and certification logos in relation to legal and ethical communication.
- Demonstrate knowledge of documentation, audit procedures, and compliance for nutrition-related certifications.

### **Macro and Micro Nutrients**

By the end of this course the student will be able to:

- Classify macro and micronutrients and their dietary sources.
- Describe the biochemical functions and physiological roles of each nutrient.
- Assess the nutritional status of individuals using dietary intake and biomarkers.
- Interpret the signs and symptoms of deficiency and toxicity of nutrients.
- Formulate diet plans that ensure adequate intake of essential nutrients.

### **Post Harvest Handling of Food Commodities**

By the end of this course the student will be able to:

- Describe post-harvest physiology of fruits, vegetables, and grains.
- Identify spoilage mechanisms and control measures.
- Apply packaging and storage techniques to extend shelf life.
- Evaluate post-harvest technologies for quality maintenance.
- Assess economic and nutritional losses during post-harvest handling.

### **Unit operations in Food processing**

By the end of this course the student will be able to:

- Define key food facilities, designing and unit operations in food processing.
- Explain mass and energy transfer in food processes.
- Apply mechanical and thermal processing techniques in food systems.
- Interpret process flow diagrams for food manufacturing.
- Evaluate efficiency and optimization of unit operations.

### **Fundamentals of Dairy Science and Technology**

By the end of this course the student will be able to:

- Describe the milk synthesis, composition, structure, and nutritional significance of milk from various animal sources, and explain the factors affecting its quality and variability.
- Explain the principles and practices involved in milking, milk collection, preservation, and processing; including pasteurization, homogenization, and separation techniques.

- Demonstrate understanding of key unit operations in dairy processing and their application in the manufacture of major dairy products.
- Analyze common quality assurance and safety measures in the dairy industry, including microbiological standards, spoilage mechanisms, and hygiene practices.
- Apply basic problem-solving and critical thinking skills to evaluate challenges in dairy production and technology, considering both industrial and public health **perspectives**.

### **Meat, Poultry and Marine Foods**

By the end of this course the student will be able to:

- Explain the biochemical composition, structural characteristics, and functional properties of meat, poultry, and marine foods
- Evaluate post-mortem changes, preservation techniques, and processing technologies influencing quality and safety
- Analyze factors affecting microbial stability, shelf life
- Assess nutritional value of animal-based food products
- Apply quality assurance, hygiene, and regulatory standards in the handling and processing of meat, poultry, and seafood

### **Food Process Engineering**

By the end of this course the student will be able to:

- Apply engineering principles in food processing systems.
- Calculate heat and mass balances in unit operations.
- Select suitable equipment for specific food processes.
- Design basic food processing systems and layouts.
- Analyze process parameters affecting product quality and safety

### **Grain Milling and Baking Technology**

By the end of this course the student will be able to:

- Understand grain milling processes and equipment.
- Discuss the chemistry of dough formation and leavening.
- Apply techniques in baking and formulation of baked products.
- Evaluate the quality attributes of milled and baked goods.
- Control variables affecting shelf-life and texture of bakery items.

### **Beverage Technology**

By the end of this course the student will be able to:

- Classify beverages and describe their processing methods.
- Discuss formulation and functional ingredients in beverages.
- Apply preservation and packaging techniques specific to beverages.
- Analyze sensory and physicochemical properties of beverages.
- Evaluate quality control and safety standards in beverage production.

### **Technology of Fats and Oils**

By the end of this course the student will be able to:

- Describe the chemical composition, physical properties, and nutritional significance of edible fats and oils from plant and animal sources.

- Explain the principles and processes involved in the extraction, refining, modification, and stabilization of fats and oils, including degumming, neutralization, bleaching, and hydrogenation.
- Evaluate the functional roles of fats and oils in food systems, such as flavor, texture, shelf life, and nutritional value across different food products.
- Analyze quality parameters, adulteration issues, and deterioration mechanisms (e.g., oxidation, rancidity) in fats and oils, and recommend appropriate control measures.
- Demonstrate understanding of national and international standards, regulations, and labeling requirements related to edible fats and oils

## **Sugar and Confectionery Technology**

By the end of this course the student will be able to:

- Explain the sources, composition, and unit operations involved in in sugar manufacturing and refining processes from different sources.
- Analyze the technological aspects of sugar crystallization, clarification, and centrifugation.
- Evaluate and ensure the food safety and quality parameters and standards of sugar and confectionery products.
- Explain the principles, ingredients, and processes involved in the production of various confectionery products (e.g., chocolates, candies, gums, and jellies).
- Apply appropriate processing techniques and troubleshoot issues in confectionery manufacturing, including formulation adjustments, crystallization control, and texture optimization

## **Fruits and Vegetables Processing**

By the end of this course the student will be able to:

- Identify various fruits and vegetables suitable for processing and their specific processing requirements.
- Demonstrate different processing techniques such as peeling, cutting, drying, freezing, and canning to preserve fruits and vegetables.
- Analyze quality and safety standards applicable to processed fruits and vegetables to ensure compliance and consumer safety.
- Design processing flowcharts and select appropriate equipment for efficient fruit and vegetable processing operations.
- Evaluate the nutritional and sensory quality of processed fruit and vegetable products to improve product development

## **Program Learning Outcomes (PLOs) For Specializations**

### **Specialization 1: Grain Science and Technology**

- Demonstrate in-depth understanding of grain structure, physiology, and postharvest behavior in relation to processing and end-product quality.
- Analyze grain quality parameters and apply national/international grading systems to ensure grain standardization and value addition.
- Evaluate storage techniques and handling practices to minimize postharvest losses, maintain nutritional integrity, and enhance shelf life.
- Apply principles of milling and baking technology to develop high-quality grain-based products with desired functional and sensory attributes.
- Integrate knowledge of grain chemistry and processing technologies to innovate and optimize cereal-based food systems for industry and consumer needs

## Specialization 2: Dairy Technology

- Demonstrate understanding of milk production, composition, collection, and procurement systems, including hygienic practices, quality assessment, and supply chain logistics from farm to dairy plant.
- Apply principles and techniques involved in the processing and preservation of a wide range of dairy products, including traditional, fermented, condensed, dried, frozen, and innovative dairy-based formulations.
- Evaluate and troubleshoot processing operations related to dairy product manufacture, such as homogenization, pasteurization, fermentation, concentration, drying, and freezing, using both conventional and advanced technologies.
- Analyze physicochemical, microbiological, and sensory quality parameters of various dairy products, and ensure compliance with national and international dairy standards and safety regulations.
- Demonstrate practical skills in developing value-added and region-specific dairy products, while considering consumer preferences, nutritional aspects, sustainability, and market trends.

## Specialization 3: Meat Technology

- Demonstrate comprehensive knowledge of meat animal production, welfare, and ethical considerations in meat sourcing.
- Analyze biochemical and structural properties of muscle tissue and their transformation during meat processing and storage.
- Apply modern technologies and best practices in the processing of meat, poultry, and seafood to ensure product quality and safety.
- Evaluate slaughtering techniques, meat inspection protocols, and public health standards in line with regulatory frameworks.
- Assess emerging trends in cultivated and plant-based meat analogues, emphasizing innovation, sustainability, and consumer acceptability.

## Specialization 4: Food Safety and Quality Management

- Demonstrate thorough understanding of foundational programs (GMP, GHP, SOPs) essential for establishing robust food safety and quality systems.
- Identify, assess, and manage risks associated with food safety, including emerging threats like food fraud and contamination.
- Apply audit, inspection, and verification techniques to evaluate compliance with national and international food safety standards.
- Utilize quality tools and statistical techniques to monitor, control, and improve food production processes.
- Analyze consumer behavior and perception to align product quality and safety with market demands and regulatory expectations.

## Specialization 5: Food Microbiology and Biotechnology

- Demonstrate knowledge of probiotics, prebiotics, and gut microbiota, including their roles in human health and functional food development
- Apply principles of microbial genetics and molecular biology to understand the genetic manipulation of microbes used in food biotechnology
- Evaluate industrial fermentation processes and enzyme technologies for large-scale food production, bioconversion, and quality enhancement
- Analyze the mechanisms, detection, and control of foodborne pathogens and toxins, ensuring food safety and public health

- Design bioprocesses and assess the ethical, regulatory, and technological aspects of GMOs and environmental microbiology in food systems

### **Specialization 6: Hospitality Management**

- Demonstrate knowledge of core hospitality operations, including front office, housekeeping, food and beverage, and customer service management.
- Apply principles of hospitality marketing, branding, and guest experience design to develop customer-focused strategies.
- Manage human resources and team dynamics effectively in hospitality settings, ensuring service quality and employee satisfaction.
- Analyze financial reports and apply cost control techniques for efficient budgeting and profitability in hospitality businesses.
- Evaluate sustainable and ethical practices in hospitality management and their impact on customer satisfaction and organizational success

### **Specialization 7: Sustainable Food Systems**

- Analyze the environmental, social, and economic dimensions of food systems and their implications for sustainability.
- Apply tools such as Life Cycle Assessment and risk analysis to evaluate food production, processing, and consumption systems.
- Design circular and climate-resilient food solutions by integrating concepts of bioeconomy, low-waste processing, and regenerative agriculture.
- Interpret food policy, global frameworks, and sustainability indicators to guide decision-making at local and national levels.
- Promote ethical, equitable, and sustainable food practices through research, policy engagement, and community-based action.

### **Specialization 8: Community Nutrition**

- Assess the nutritional needs, risks, and dietary patterns of diverse population groups using community-based tools and participatory approaches.
- Design and implement culturally appropriate, evidence-based nutrition interventions targeting maternal, child, school-age, and vulnerable populations.
- Evaluate the effectiveness of nutrition programs through monitoring and impact assessment methods, considering public health goals and sustainability.
- Integrate principles of public health nutrition, food policy, and behavioral change into program planning for community nutrition improvement.
- Advocate for nutrition-sensitive policies and interventions at local and national levels, engaging stakeholders and promoting food equity and justice.

### **Specialization 9: Food Business Management**

- Demonstrate understanding of management principles and organizational behavior as applied to food and agri-business enterprises.
- Analyze food marketing strategies and consumer behavior to develop effective market-driven business models.
- Apply human resource management practices to improve performance, leadership, and workforce sustainability in food-related organizations.
- Evaluate financial principles, cost control techniques, and investment decisions in food business operations.
- Design innovative and sustainable branding, retail, and supply chain strategies to enhance competitiveness in global food markets

- Demonstrate the ability to design and implement strategic business solutions that optimize food supply chains, ensure product quality, and respond to evolving market and regulatory demands

### **Specialization 10: Halal Science**

- Demonstrate comprehensive understanding of Halal food laws, Shariah principles, and their application in modern food production systems.
- Analyze food ingredients and additives for Halal authenticity using principles of food chemistry and emerging analytical techniques.
- Apply knowledge of Halal slaughtering practices and meat hygiene in compliance with religious and food safety standards.
- Evaluate Halal supply chain management and traceability systems to ensure product integrity from source to consumer.
- Interpret global Halal certification processes, regulations, and the role of biotechnology in advancing Halal-compliant innovations

### **Specialization 11: Food Innovation**

- Apply evidence-based nutritional strategies to improve health across diverse populations
- Analyze emerging trends in global nutrition and functional food innovation
- Develop and implement nutrition education programs for public and clinical settings
- Demonstrate proficiency in managing food service operations within healthcare and wellness environments
- Integrate sports and exercise nutrition principles to support performance and recovery

### **Specialization 12: Food Science and Nutrition**

- Apply evidence-based nutritional strategies to improve health across diverse populations
- Analyze emerging trends in global nutrition and functional food innovation
- Develop and implement nutrition education programs for public and clinical settings
- Demonstrate proficiency in managing food service operations within healthcare and wellness environments
- Integrate sports and exercise nutrition principles to support performance and recovery

### **Specialization 13: General Food Science and Technology**

- Apply core principles of chemistry, microbiology, and nutrition to analyze the composition, functionality, and safety of food products.
- Utilize modern food processing and preservation technologies to develop and improve food products with enhanced quality, shelf life, and sustainability.
- Design and implement quality control protocols and safety management systems (e.g., HACCP, ISO) to ensure food products meet national and international standards.
- Critically evaluate scientific literature and employ experimental methodologies to conduct applied research in food product development and process optimization.
- Demonstrate awareness of ethical, regulatory, and environmental considerations in food production and consumption, aligning practices with global sustainability goals.