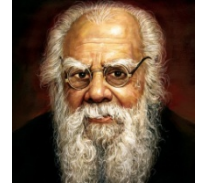




**PERIYAR UNIVERSITY**  
Periyar Palkalai Nagar, Salem-636011  
State University – NAAC Reaccredited A++ Grade – NIRF 63 – ARIIA 10



School of Professional Studies

## DEPARTMENT OF FOOD SCIENCE AND NUTRITION

**M.Sc.**

**FOOD SCIENCE, TECHNOLOGY AND NUTRITION**

**[Choice Based Credit System (CBCS) and Outcome Based Education (OBE)]**



### REGULATIONS AND SYLLABUS 7.0

[2005-06 (1.0); 2008-09 (2.0); 2012-13 (3.0); 2014-15 (4.0); 2016-17 (5.0); 2018-19 (6.0); 2022-23 (7.0)]

***(Effective from the academic year 2022-2023 and thereafter)***

## M. Sc. FOOD SCIENCE TECHNOLOGY AND NUTRITION

### OBE REGULATIONS AND SYLLABUS

(With effect from the academic year 2022-2023 onwards)

#### Preamble

The Department of Food Science and Nutrition was established in the year 2005 and fosters learning, imparts job specific skills, execute society oriented research and extension activities in the major thrust areas like Food Science and Chemistry, Food Processing and Technology, Public Health and Clinical Nutrition.

#### Vision

Inculcation of knowledge, productive learning, life and entrepreneurship skills and employability among the youth related to Food Science, Technology and Nutrition

#### Programme Objectives and Outcomes

To inculcate the importance in developing Food and Nutritional Science among the budding Food Scientists, Nutritionists and Food Processing Industrialists, the *M.Sc., Food Science Technology and Nutrition* programme is proposed with the following objectives and outcomes.

##### **Programme Specific Objectives**

- PSO1:** To engineer the students on theoretical and practical aspects of the entire food business and value chain management
- PSO2:** To promote interactions with food industries and other societal organizations/institutions for learning, problem analyzing/solving and innovation
- PSO3:** To gain insight into the national/global nutritional problems and its management
- PSO4:** To generate evidence based nutrition knowledge through research and disseminate to the agrarian and general community

##### **Programme Educational Objectives**

- PEO1:** To upskill the learners on technical knowledge, practical experience and field expertise for discipline specific career opportunities in institutions, organisations, industries, laboratories, corporates and government sectors
- PEO2:** To ascertain the learners on theories, models and approaches in innovative research for new product development, food safety management and quality assurance, nutrition intervention in the community and nutrition care process of the individual
- PEO3:** To enable the learners to equip themselves on food and nutriprenurship skills
- PEO4:** To update the learners on emerging trends in food science, technology and nutrition and equip themselves emotionally and intellectually stronger

##### **Programme Outcomes**

The learners can able to explore and attain the following theoretical (T), experiential (Practical) (E), professional (Transferable) (P) and attitudinal (A) skills

- PO(T):** Define and recognise the terms and concepts in food science and technology, food safety and quality control, public health nutrition and personalised nutrition
- PO(E):** Apply the principles and perform the food science and quality control tests, biochemical

tests, data analysis, food safety experiments, diet planning for healthy and diseased individual

**PO(P):**

1. Disseminate and fulfil the job requirements in teaching and learning institutions, food industries, food testing laboratories, nutrition intervention programmes, fitness centres, diet clinics and hospitals
2. Develop innovative food products, business plan, food quality assurance system, nutrition care process model for a community and individual cases.
3. Evaluate the food products in the market, hygiene, sanitation and quality control in food manufacturing and catering establishments, performance/implementation of government nutritional programmes/schemes and nutritional profile of the community and individual
4. Educate the population on nutritional conservation, food safety measures and initiatives, nutrition and health care, eat right initiatives and food as medicine
5. Operate and create an enterprise in the domain of food, nutrition and dietetics

**PO(A):** The learners can also able to acquire the graduate attributes of

- Leading the team
- Execution of work in team
- Globally competitive
- Emotionally intelligent to counsel the individuals
- Communicate effectively
- Digitally literate
- Sense of inquiry
- Job creator instead of only a job seeker
- Identify and innovate a solution to the problem
- Educate individual and community

**Mapping of Programme Specific Objectives (PSOs) with Programme Outcomes (POs)**

Programme Specific Objectives (PSOs)	Programme Outcomes (POs)							
	Theoretical	Experiential	Professional					Attitudinal
	PO(T)	PO(E)	PO(P1)	PO(P2)	PO(P3)	PO(P4)	PO(P5)	PO(A)
PSO1	X	X		X			X	X
PSO2		X	X	X	X	X		X
PSO3	X	X		X		X		X
PSO4		X	X	X	X	X	X	X

**Mapping of Programme Educational Objectives (PEOs) with Programme Outcomes (POs)**

Programme Educational Objectives (PEOs)	Programme Outcomes (POs)							
	Theoretical	Experiential	Professional					Attitudinal
	PO(T)	PO(E)	PO(P1)	PO(P2)	PO(P3)	PO(P4)	PO(P5)	PO(A)
PEO1	X	X	X		X	X		X
PEO2		X		X				X
PEO3		X		X	X		X	X
PEO4	X	X	X	X	X	X	X	X

## Programme Pattern

This programme is offered under Choice Based Credit system (CBCS). Students can earn 94 credits with mandatory credit to MOOC/SWAYAM courses as supportive course. The programme is integrated with NSDC courses from FICSI Sector Skill Council under Core Courses. Elective courses as optional are framed in the two different field of specialization such as Food Technology and Nutrition and Health Care.

## Candidate's Eligibility for Admission

B.Sc. Degree in Nutrition and Dietetics/Food Science and Nutrition/Food Technology, B.Tech./B.Sc. (H) in Food Technology, B.Voc. in Food Science and Nutrition related discipline and B.Sc./B.A. Home Science approved by the Association of Indian Universities are eligible to seek admission.

## Duration of the Programme

Two years with four semesters.

## Structure of the Programme

The programme structure comprises of two parts.

Course Component	No. of Courses	Marks	Credits
<b>Part A (Credit Courses)</b>			
<b>A. Core Courses</b>	<b>25</b>	<b>2500</b>	<b>70</b>
Theory and Practical Courses	17	1700	54
Skill Courses	04	400	08
Research and Innovation	04	400	08
<b>B. Elective Courses (Optional)</b>	<b>04</b>	<b>400</b>	<b>16</b>
Option 1: Food Technology	04	400	16
Option 2: Nutrition and Health Care	04	400	16
<b>C. Supportive/Extra-disciplinary Courses</b>	<b>02</b>	<b>200</b>	<b>06</b>
Supportive Courses	01	100	04
MOOC/SWAYAM Courses	01	100	02
<b>D. Value Education Courses</b>			
Human Rights	<b>01</b>	<b>100</b>	<b>02</b>
<b>Total</b>	<b>32</b>	<b>3200</b>	<b>94</b>
<b>Part B (Self-Learning Extra Credit Courses)</b>			
Internship in Food Establishments	01	S/US	01
Internship in Multispecialty Hospital	01	S/US	01
Add-on Course (Extension/Outreach) – Part I and II	02	S/US	02
<b>Total</b>	<b>04</b>	<b>S/US</b>	<b>04</b>

## Semester I

S.No.	Course Code	Course Title	Hrs/week	L	T	P	C
<b>Part A</b>							
<b>Core Courses (C)</b>							
<b>Theory (T) and Practical (P) Courses</b>							
1.	22FSTNCT01	Food Science and Chemistry	4	3	1	0	4
2.	22FSTNCT02	Food Processing Technology	4	3	1	0	4
3.	22FSTNCT03	Research Methodology	4	3	1	0	4
4.	22FSTNCP01	Food Science and Chemistry Practical	3	-	1	2	2
5.	22FSTNCP02	Data Management and Statistics Practical	3	-	1	2	2
<b>Skill Courses (S)</b>							
1.	22FSTNCS01	Food Regulatory Affairs Manager (FIC/N9011)	3	-	1	2	2
<b>Research and Innovation (R)</b>							
1.	22FSTNCR01	Part 1: Food Product Development and Quality Evaluation	5	-	1 (L)*	4	2
<b>Elective Courses (E) (Optional)</b>							
1.	22FSTNE01	Technology of Non – Perishable Foods	4	3	1	-	4
2.		Physiology of Nutrition					
<b>SWAYAM course registration is mandatory</b>							
<b>Total</b>			<b>30</b>	<b>12</b>	<b>08</b>	<b>10</b>	<b>24</b>

Note:- L- Lecture, T-Tutorial/Demonstration, P- Practical, C- Credit; (L)\* - Library

## Semester II

S.No.	Course Code	Course Title	Hrs/week	L	T	P	C
<b>Part A</b>							
<b>Core Courses (C)</b>							
<b>Theory (T) and Practical (P) Courses</b>							
1.	22FSTNCT04	Food Microbiology and Preservation	4	3	1	-	4
2.	22FSTNCT05	Food Safety and Quality Control	4	3	1	-	4
3.	22FSTNCP03	Food Safety and Quality Control Practical	3	-	1	2	2
4.	22FSTNCP04	Food Composition Analysis Practical	3	-	1	2	2
<b>Skill Courses (S)</b>							
1.	22FSTNCS02	Food Regulatory Affairs Manager (FIC/N9012 and FIC/N9013)	3	-	1	2	2
<b>Research and Innovation (R)</b>							
1.	22FSTNCR02	Part 2: Business Plan and Quality Assurance System for the New Product	5	-	1 (L)*	4	2
<b>Elective Courses (E) (Optional)</b>							
1.	22FSTNE02	Technology of Semi-Perishable and Perishable Foods	4	3	1	-	4
2.		Nutritional Medicine					
<b>Supportive Courses (S)</b>							
1.	22FSTNS01	Food Safety Management / Nutrition for the Community (Practical)	4	1	2	1	4
2.	22FSTNS02	SWAYAM Course (Extra hours of learning)	-	-	-	-	2
<b>Value Education Courses (V)</b>							

1.	22FSTNV01	Human Rights (Self-learning through e-learning materials)	-	-	-	-	2
<b>Total</b>			<b>30</b>	<b>10</b>	<b>09</b>	<b>11</b>	<b>28</b>
<b>Part B Extra Credit Courses (Self-Learning)</b>							
<b>Add-on Courses (A) (Internship/Extension/Outreach)</b>							
1.	22FSTNA01	Outreach Activity in Food Establishments	15 days	-	3	12	1
2.	22FSTNA02	Internship in Food Establishments	15 days	-	-	15	1
<b>Total</b>			<b>30 days</b>	<b>-</b>	<b>3</b>	<b>27</b>	<b>2</b>

Note:- L- Lecture, T-Tutorial/Demonstration, P- Practical, C- Credit; (L)\* - Library

### Semester III

S.No.	Course Code	Course Title	Hrs/week	L	T	P	C
<b>Part A</b>							
<b>Core Courses (C)</b>							
<b>Theory (T) and Practical (P) Courses</b>							
1.	22FSTNCT06	Nutritional Biochemistry	4	3	1	0	4
2.	22FSTNCT07	Nutrition in Life Cycle	4	3	1	0	4
3.	22FSTNCT08	Public Health Nutrition	4	3	1	0	4
4.	22FSTNCP05	Computer Aided Diet Planning Practical	3	-	1	2	2
<b>Skill Courses (S)</b>							
1.	22FSTNCS03	Sports Nutrition Practical	3	-	1	2	2
<b>Research and Innovation (R)</b>							
1.	22FSTNCR03	Part 3: Nutrition and Health Care Process of the Community	5	-	1 (L)*	4	2
<b>Elective Courses (E) (Optional)</b>							
1.	22FSTNE03	Food Testing and Certification	4	3	1	-	4
2.		Nutrition Care Process					
<b>Sports/Diet Counselling/Soft Skills (one hour to each)</b>			3	-	-	3	-
<b>Total</b>			<b>30</b>	<b>12</b>	<b>07</b>	<b>11</b>	<b>22</b>
<b>Part B Extra Credit Courses (Self-learning)</b>							
<b>Add-on Courses (A) (Internship/Extension/Outreach)</b>							
1.	22FSTNA03	Outreach activity in adopted village	15 days	-	3	12	1
<b>Total</b>			<b>15 days</b>	<b>-</b>	<b>3</b>	<b>12</b>	<b>1</b>

Note:- L- Lecture, T-Tutorial/Demonstration, P- Practical, C- Credit; (L)\* - Library

### Semester IV

S.No.	Course Code	Course Title	Hrs/week	L	T	P	C
<b>Part A</b>							
<b>Core Courses (C)</b>							
<b>Theory (T) and Practical (P) Courses</b>							
1.	22FSTNCT09	Clinical Nutrition I	4	3	1	-	4
2.	22FSTNCT10	Clinical Nutrition II	4	3	1	-	4

3.	22FSTNCP06	Biochemical Analysis Practical	3	-	1	2	2
4.	22FSTNCP07	Computer Aided Clinical Nutrition Practical	3	-	1	2	2
<b>Skill Courses (S)</b>							
1.	22FSTNCS04	Innovation and Startup Practical	3	-	1	2	2
<b>Research and Innovation (R)</b>							
1.	22FSTNCR04	Part 4: Nutrition Care Process of an Individual	5	-	1 (L)*	4	2
<b>Elective Courses (E) (Optional)</b>							
1.	22FSTNE04	Foodpreneurship	4	3	1	-	4
2.		Nutripreneurship					
<b>Sports/Diet Counselling/Soft Skills/Career Guidance (one hour to each)</b>			4	-	-	4	-
<b>Total</b>			<b>30</b>	<b>09</b>	<b>07</b>	<b>14</b>	<b>20</b>
<b>Part B Extra Credit Courses (Self-Learning)</b>							
<b>Add-on Courses (A) (Internship/Extension/Outreach)</b>							
1.	22FSTNA04	Internship in Multispecialty Hospital	15 days	-	-	15	1
<b>Total</b>			<b>15 days</b>	<b>-</b>	<b>-</b>	<b>15</b>	<b>1</b>

Note:- L- Lecture, T-Tutorial/Demonstration, P- Practical, C- Credit; (L)\* - Library

### Credit Calculation

Method of teaching	Hours	Credits
Lecture	1	1
Tutorial/Demonstration/Activities	1	1
Practical	2	1
Internship/Apprenticeship/ Field Visit/Extension Activity	3 - 6	1

### Scheme of Examinations

#### Semester I

S.No.	Course Code	Course Title	Hrs.	CIA	ESE	T	C
<b>Part A</b>							
<b>Core Courses (C)</b>							
<b>Theory (T) and Practical (P) Courses</b>							
1.	22FSTNCT01	Food Science and Chemistry	3	25	75	100	4
2.	22FSTNCT02	Food Processing Technology	3	25	75	100	4
3.	22FSTNCT03	Research Methodology	3	25	75	100	4
4.	22FSTNCP01	Food Science and Chemistry Practical	3	40	60	100	2
5.	22FSTNCP02	Data Management and Statistics Practical	3	40	60	100	2
<b>Skill Courses (S)</b>							
1.	22FSTNCS01	Food Regulatory Affairs Manager (FIC/N9011) (Theory + Practical)	3	40	60	100	2
<b>Research and Innovation (R)</b>							
1.	22FSTNCR01	Part 1: Food Product Development and Quality Evaluation (Viva Voce)	6	40	60	100	2
<b>Elective Courses (E) (Optional)</b>							
1.	22FSTNE01	Technology of Non – Perishable Foods	3	25	75	100	4

2.		Physiology of Nutrition					
<b>SWAYAM course registration is mandatory</b>							
<b>Total</b>			<b>27</b>	<b>260</b>	<b>540</b>	<b>800</b>	<b>24</b>

Note:- CIA – Continuous Internal Assessment, ESE – End Semester Examination, T - Total, C- Credit

### Semester II

S.No.	Course Code	Course Title	Hrs.	CIA	ESE	T	C
<b>Part A</b>							
<b>Core Courses (C)</b>							
<b>Theory (T) and Practical (P) Courses</b>							
1.	22FSTNCT04	Food Microbiology and Preservation	3	25	75	100	4
2.	22FSTNCT05	Food Safety and Quality Control	3	25	75	100	4
3.	22FSTNCP03	Food Safety and Quality Control Practical	3	40	60	100	2
4.	22FSTNCP04	Food Composition Analysis Practical	3	40	60	100	2
<b>Skill Courses (S)</b>							
1.	22FSTNCS02	Food Regulatory Affairs Manager (FIC/N9012 and FIC/N9013) (Theory + Practical)	3	40	60	100	2
<b>Research and Innovation (R)</b>							
1.	22FSTNCR02	Part 2: Business Plan and Quality Assurance System for the New Product (Viva Voce)	6	40	60	100	2
<b>Elective Courses (E) (Optional)</b>							
1.	22FSTNE02	Technology of Semi-Perishable and Perishable Foods	3	25	75	100	4
2.		Nutritional Medicine					
<b>Supportive Courses (S)</b>							
1.	22FSTNS01	Food Safety Management / Nutrition for the Community (Practical)	3	25	75	100	4
2.	22FSTNS02	SWAYAM Course (Extra hours of learning)	3	-	100	100	2
<b>Value Education Courses (V)</b>							
1.	22FSTNV01	Human Rights (MCQ)	3	25	75	100	2
<b>Total</b>			<b>33</b>	<b>285</b>	<b>715</b>	<b>1000</b>	<b>28</b>
<b>Part B Extra Credit Courses</b>							
<b>Add-on Courses (A) (Internship/Extension/Outreach)</b>							
1.	22FSTNA01	Outreach activity in food establishments (Viva Voce)	6	-	-	S/US	1
2.	22FSTNA02	Internship in Food Establishments (Viva Voce)	6	-	-	S/US	1
<b>Total</b>			<b>12</b>	<b>-</b>	<b>-</b>	<b>S/US</b>	<b>2</b>

Note:- CIA – Continuous Internal Assessment, ESE – End Semester Examination, T - Total, C- Credit

### Semester III

S.No.	Course Code	Course Title	Hrs.	CIA	ESE	T	C
<b>Part A</b>							



<b>Core Courses (C)</b>							
<b>Theory (T) and Practical (P) Courses</b>							
1.	22FSTNCT06	Nutritional Biochemistry	3	25	75	100	4
2.	22FSTNCT07	Nutrition in Life Cycle	3	25	75	100	4
3.	22FSTNCT08	Public Health Nutrition	3	25	75	100	4
4.	22FSTNCP05	Computer Aided Diet Planning Practical	3	40	60	100	2
<b>Skill Courses (S)</b>							
1.	22FSTNCS03	Sports Nutrition Practical	3	40	60	100	2
<b>Research and Innovation (R)</b>							
1.	22FSTNCR03	Part 3: Nutrition and Health Care Process of the Community (Viva Voce)	6	40	60	100	2
<b>Elective Courses (E) (Optional)</b>							
1.	22FSTNE03	Food Testing and Certification	3	25	75	100	4
2.		Nutrition Care Process					
<b>Total</b>			<b>24</b>	<b>220</b>	<b>480</b>	<b>700</b>	<b>22</b>
<b>Part B Extra Credit Courses</b>							
<b>Add-on Courses (A) (Internship/Extension/Outreach)</b>							
1.	22FSTNA03	Outreach Activity in Adopted Village (Viva Voce)	6	-	-	S/US	1
<b>Total</b>			<b>6</b>	<b>-</b>	<b>-</b>	<b>S/US</b>	<b>1</b>

Note:- CIA – Continuous Internal Assessment, ESE – End Semester Examination, T - Total, C-Credit

#### Semester IV

S.No.	Course Code	Course Title	Hrs.	CIA	ESE	T	C
<b>Part A</b>							
<b>Core Courses (C)</b>							
<b>Theory (T) and Practical (P) Courses</b>							
1.	22FSTNCT09	Clinical Nutrition I	3	25	75	100	4
2.	22FSTNCT10	Clinical Nutrition II	3	25	75	100	4
3.	22FSTNCP06	Biochemical Analysis Practical	3	40	60	100	2
4.	22FSTNCP07	Computer Aided Clinical Nutrition Practical	3	40	60	100	2
<b>Skill Courses (S)</b>							
1.	22FSTNCS04	Innovation and Startup Practical	3	40	60	100	2
<b>Research and Innovation (R)</b>							
1.	22FSTNCR04	Part 4: Nutrition Care Process of an Individual (Viva Voce)	6	40	60	100	2
<b>Elective Courses (E) (Optional)</b>							
1.	22FSTNE04	Foodpreneurship	3	25	75	100	4
2.		Nutripreneurship					
<b>Total</b>			<b>24</b>	<b>235</b>	<b>465</b>	<b>700</b>	<b>20</b>
<b>Part B Extra Credit Courses</b>							
<b>Add-on Courses (A) (Internship/Extension/Outreach)</b>							
1.	22FSTNA04	Internship in Multispecialty Hospital (Viva Voce)	6	-	-	S/US	1
<b>Total</b>			<b>6</b>	<b>-</b>	<b>-</b>	<b>S/US</b>	<b>1</b>

Note:- CIA – Continuous Internal Assessment, ESE – End Semester Examination, T - Total, C-Credit

## Programme Guidelines

### A. General

The students has to adopt the guidelines prescribed in the academic calendar of the University for the respective academic year and fulfil the minimum requisites to complete the programme.

### B. Online Courses

The students are required to complete one mandatory course in the second semester by registering in the online education portal in the first semester itself (SWAYAM/e-skill). The completion certificate is recorded in the second semester marks statement. If they are not able to complete it in the first year, they are permitted to register for any other SWAYAM course/e-skill course in the third semester and can submit the completion certificate in the second year.

### C. Extra Credit Courses (Self-Learning)

The students are required to undertake two internship courses (second and fourth semester break) in a reputed food industry/establishment/hospital/health centre mandatorily for 15 days. On completion of the course, the students are required to submit the report. The departmental committee will assess the student's performance on the basis of attendance certificate from the industry/establishment/hospital/health centre, training report and viva voce examination and will be awarded Satisfactory/Unsatisfactory grade.

### D. NSDC Certification

The skill course (FIC/Q9002: Food Regulatory Affairs Manager, NSQF Level 6) taught in the first year is also assessed by the concerned Sector Skill Councils of NSDC or industrial partners by following the rules and regulations of NSDC and the separate certificate will be issued to the students certified by SSC of NSDC and the University.

### E. Value Education Courses

The students are required to complete one mandatory course entitled 'Human Rights' in the second semester.

### F. Co-Curricular Activities

#### 1. Short –term Courses (e-Skill Courses)

The Department offers the following e-skill courses as value added course which can be learnt by the students and scholars from any discipline, industry personnel and common public through registration.

S.No.	Short term course Code	Title of the course	Duration (Hours)	L	T	P	C
1.	22FSTNST01	Food Safety Initiatives	42	6	12	24	1
2.	22FSTNST02	Quality Control in Food Establishments	42	6	12	24	1
3.	22FSTNST03	Nutrition Intervention	42	6	12	24	1

## Modules for the short term courses (e-Skill Courses)

### *Food Safety Initiatives (22FSNeS01)*

#### Objectives

1. To enable the students to learn on food safety initiatives of FSSAI and its implementation in food business operations

#### Learning Modules

Modules	L	T	P	Total hours
FSSAI Act, Rules and Regulations	1	2	6	9
FoSTaC and FICSI	1	2	6	9
Eat Right India Movement	-	1	2	3
Supply side Initiatives	-	1	6	7
Demand side Initiatives	-	1	6	7
Sustainability Initiatives	-	1	6	7
<b>Total</b>	<b>2</b>	<b>8</b>	<b>32</b>	<b>42</b>

#### Outcome

1. Students can able to implement FSSAI initiatives in food establishments, community and service enterprises and evaluate the progress.

### *Quality Control in Food Establishments (22FSTNeS02)*

#### Objectives

1. To update the practical knowledge of the students on food quality control

#### Learning Modules

Modules	L	T	P	Total hours
Quality indicators of Perishable foods	1	2	4	7
Quality indicators of Non-Perishable foods	1	2	4	7
Quality indicators of Semi-Perishable foods	1	2	4	7
Food Quality Standards	1	3	-	4
Instrumental quality analysis	1	-	7	8
Quality control measures at food manufacturing units	-	-	3	3
Quality control measures at catering establishments/ institutional kitchens	-	-	3	3
Quality control measures at hospitals, orphanages, temples and old age homes	-	-	3	3
<b>Total</b>	<b>5</b>	<b>9</b>	<b>28</b>	<b>42</b>

#### Outcome

1. Students can able to perform quality checking and audits in compliance with FSSAI in various food establishments.

## **Nutrition Intervention (22FSTNeS03)**

### **Objectives**

1. To enable the students to learn on design thinking, material development and nutrition intervention in the selected village

### **Learning Modules**

Sub Modules	L	T	P	Total hours
Identification of nutritional problems in a community	1	1	3	5
Nutrition diagnosis and PES Statement	1	1	6	8
Nutrition intervention Plan	1	1	12	14
Implementation steps of nutrition intervention	-	1	4	5
Monitoring the effectiveness of implementation	-	1	4	5
Feedback evaluation/follow-up and re-planning of implementation	-	1	4	5
<b>Total</b>	<b>3</b>	<b>6</b>	<b>33</b>	<b>42</b>

### **Outcome**

1. Students can able to do nutrition intervention in a village/school/institution/group of individuals.

### **2. UGC – NET/TN - SET Coaching**

The students have to undergo minimum 50 hours of learning in a year to empower them to appear and succeed in the UGC – NET/TN - SET examination.

### **3. Bridge Course**

The first year students are oriented on curriculum framework, SWOT analysis of the Department, student welfare measures and the comprehensive contribution of the students for the growth and fame of the Department as bridge course on the starting three days of the programme.

### **G. Extra-Curricular Activities**

#### **1. Student Engagement Activities**

The students are motivated to participate in the following activities of the University Departments or outside the University (minimum of 10 hours in a semester) and it is mandatory that the students have to submit two participation/winner certificate in any one of the activity every year to the Department.

- a. NSS/NCC/YRC camps and its competitions
- b. Inter-institutional/Inter-departmental competitions
- c. Personality Development programmes
- d. Student Seminar
- e. Placement training
- f. IAS coaching class
- g. Typewriting class
- h. Language coaching class

- i. Paper presentation in conferences/seminar/workshop etc.

## **2. Remedial Coaching**

In order to improve the knowledge, skills and linguistic proficiency of the students who need special attention, remedial coaching classes on

- a. Basic laboratory techniques
- b. Oral presentation skills
- c. Notes taking and exam preparation techniques

is conducted for one hour in a week. The hour will be mentioned in the time table to motivate the students to attend the remedial classes. The

## **3. Mentor-Mentee System**

The students are facilitated by all faculty in the Department personally and professionally through peer mentor and mentee system under the umbrella of Food and Nutri Youth Club. All students will become the member of the Youth Club and can forecast the activities to build their graduate attributes. The cooperative learning groups are formed by electing peer mentor for each group comprising of 5 members will cooperatively learn on LSRW skills, computer skills, discipline specific software, learning platforms like foodtech pathshala, NPTEL, Coursera, e-Learning zone of FICSI etc. and e-magazines. The hour will be mentioned in the time table to motivate the students to organize mentor mentee activities.

## **4. Innovation/Incubation/Sponsored Projects/Consultancy**

The students are motivated to participate in the following activities and it is mandatory that the students have to submit two participation/winner certificate in any one of the activity every year to the Department.

- a. Innovation contests
- b. Student projects
- c. Startup/Industry consultancy projects
- d. Pre-incubation/co-working activities at the incubation centre
- e. Innovation and Entrepreneurship courses
- f. Special trainings/internships on innovation and self-employment

## **H. Examinations**

Examinations are conducted in semester pattern. The examination for the Semester I & III will be held in November/December and that for the Semester II and IV will be in the month of April/May. 75% attendance is mandatory to appear for the assessment of theoretical knowledge, practical experience, performing skills, field expertise and outreach activities.

Candidates failing in any subject (both theory, practical and skill) will be permitted to appear for such failed subjects in the same syllabus structure at subsequent examinations within next 5 years. Failing which, the candidate has to complete the course in the present existing syllabus structure.

## **I. Scheme for Evaluation and Attainment Rubrics**

Evaluation will be done on a continuous basis and will be evaluated as per assessment matrices of OBE for Continuous Internal Assessment (CIA) and University End Semester Examination (ESE). CIA Evaluation may be by activities, assignments, seminars, e-learning material development, objective type questions, short answers, essays or a combination of

these, and the end semester examination is by University norms with prescribed question paper pattern.

**Attainment Criterion for Theory Courses (K1, K2, K3, K4, K5)**

**CIA (Max. Marks - 25)**

- Test documents in CO1, CO2, CO3, CO4 and CO5 - 10 Marks
- Presentation skill + e-material development (Student Seminar) – 05 Marks (Graduate attribute attainment assessment)
- Two activity/problem solving exercises (Assignment) (K3, K4, K5) - 10 (Each 5 Marks)

**ESE (Max. Marks - 75)**

**Question Paper Pattern (Theory)** (Updated as per amendments by COE)

Section	Approaches	Mark Pattern	K Level	CO Coverage
A	One word (Answer all questions)	20X1 = 20 (Multiple Choice Questions)	K1, K2	CO1 – 20%, CO2 – 20%, CO3 – 20%, CO4 – 20 % and CO5 – 20%
B	100 to 200 words (Answer any three out of five questions)	3X5 = 15 (Analytical type questions)	K3, K4, K5	CO1 – 20%, CO2 – 20%, CO3 – 20%, CO4 – 20 % and CO5 – 20%
C	500 to 1000 words	5X8 = 40 (Essay type questions)	K1, K2	CO1 – 20%, CO2 – 20%, CO3 – 20%, CO4 – 20 % and CO5 – 20%

**Attainment Criterion for Practical Courses (K3, K4, K5, K6)**

**CIA (Max. Marks-40)**

- Adopting Good Laboratory Practices - 05 Marks
  - Standard Operating Procedure Creation - 10 Marks
  - Performance evaluation of all mandatory experiments - 15 Marks
  - Internal Tests (two tests: each 05 Marks) – 10 Marks
- Each test components are
- Conduct of experiment (5 marks)
  - Precision of results (5 marks)
  - Result analysis and interpretation (5 marks)
  - Framing of SOP for an experiment proposed for the candidate (5 marks)

**ESE (Max. Marks - 60)**

External examination components are

- Knowledge on GLP and SOP – ten multiple choice questions (10 marks) (K1)
- Understanding on handling of chemicals, glasswares and equipments – ten multiple choice questions (10 marks) (K2)
- Conduct of experiment (10 marks) (K3)
- Precision of results (10 marks) (K4)
- Result analysis and interpretation (10 marks) (K5)
- Framing of SOP for experiment proposed for the candidate (10 marks) (K6)

Note: Student can perform one experiment for 3 hours of examination from the learned experiments.

**Attainment Criterion for Innovative Learning Courses/ Research (Part 1, 2, 3 and 4) (K5 and K6)**

**CIA (Max. Marks - 40)**

- First review - Problem Statement and Idea in Brief – 25% (10 marks)
- Second review - PoCs – 25% (10 marks)
- Third review - Prototype in Brief – 25 % (10 marks)
- Manuscript and Report on Idea/PoCs/Prototype Template of IIC – Yukti – 25 % (10 marks)

**Research Review and Evaluation Committee Composition for ESE**

1. Head of the Department
2. Research Colloquium Coordinator
3. Faculty Facilitators
4. IIC Representative (Internal Innovation Ambassador)

**ESE (Max. Marks – 60)**

- Problem Statement and Idea in Brief – 10 marks
- PoCs – 10 marks
- Prototype in Brief – 10 marks
- Manuscript and Report on Idea/PoCs/Prototype Template of IIC – Yukti - 10 marks
- Pitching the idea – 5 marks
- Pitching the PoCs – 5 marks
- Pitching the Prototype – 10 marks

**Research Review and Evaluation Committee Composition for ESE**

5. Head of the Department
6. Research Colloquium Coordinator
7. Incubation CEO
8. Start-up/Industry Representative
9. IIC Representative (External Innovation Ambassador)

**Attainment Criterion for NSDC Courses/Skill Component (02) (K1, K2, K3, K4, K5, K6)**

**CIA (Max. Marks - 40)**

- Two quiz based assessment in each NOS – 20 marks
- Creation of Templates for Performance Criteria – 5 marks
- Activity based Self Learning (e-content development) – 5 marks
- Field Project – 10 marks

**ESE (Max. Marks - 60)**

- Multiple choice questions (Technical knowledge) – 20 marks
- Performing the exercises on acquired technical skills – 20 marks
- Performing the exercises on generic and professional skills – 20 marks

**Attainment Criterion for Experiential Learning Courses/Field Visit and Internship (K4 and K5)**

**ESE (Max. Marks – 100) – graded as Satisfactory if secured 50%**

Criterion	Weightage	Rubrics
Attendance	20%	Based on the total number of days allotted and total number of days present
Involvement in execution of proposed activity	30%	Based on the total number of activities proposed and executed
Leadership responsibility	10%	Based on the volunteership and leadership quality

Submission of activity report on daily basis	20%	Based on quality of the daily report
Final report evaluation through viva voce	20%	Organogram – 5%, Governance – 5%, Workflow and Production Management – 5%, Case studies – 5%

## J. Grading System

Evaluation of performance of students is based on ten-point scale grading system as given below.

Ten Point Scale			
Grade of Marks	Grade points	Letter Grade	Description
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
00-49	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

## K. List of Measurable Verbs Used to Assess Learning Outcomes

**Revised Bloom's Taxonomy of Educational Objectives (1956; Anderson, L. W. & Krathwohl, D.R., et al., 2001)**

Knowledge Level (K1): The successful student will recognize or recall learned information (K1).

list	record	underline
state	define	arrange
name	relate	describe
tell	recall	memorize
recall	repeat	recognize
label	select	reproduce

Comprehension Level (K2): The successful student will restate or interpret information in their own words (K2).

explain	describe	report
translate	express	summarize
identify	classify	discuss
restate	locate	compare
discuss	review	illustrate
tell	critique	estimate
reference	interpret	reiterate

Application Level (K3): The successful student will use or apply the learned information (K3).

apply	sketch	perform
use	solve	respond
practice	construct	role-play
demonstrate	conduct	execute
complete	dramatize	employ



Analysis Level (K4): The successful student will examine the learned information critically (K4).

analyze	inspect	test
distinguish	categorize	critique
differentiate	catalogue	diagnose
appraise	quantify	extrapolate
calculate	measure	theorize
experiment	relate	debate

Evaluation Level (K5): The successful student will assess or judge the value of learned information (K5).

review	appraise	choose
justify	argue	conclude
assess	rate	compare
defend	score	evaluate
report on	select	interpret
investigate	measure	support

Creation Level (K6): The successful student will create new models using the learned information (K6).

develop	revise	compose
plan	formulate	collect
build	propose	construct
create	establish	prepare
design	integrate	devise
organize	modify	manage

#### **L. Assessment Metrics for OBE at the Completion of the Programme**

The impact of OBE is assessed by evaluating the satisfactory remark achieved by the learners with respect to Applied Knowledge and Skills, Interpersonal abilities and Personal Attributes. A defined questionnaire framed by OECD, 2008.

S.No.	Criteria	Grades of Criteria		
		To great extent	To some extent	To a little extent
1.	Useful knowledge of facts			
2.	Good study habits			
3.	Cultural understanding			
4.	Tolerance			
5.	Job specific knowledge			
6.	Written communication skills			
7.	Oral communication skills			
8.	Analytical skills			
9.	Societal understanding			
10.	Numerical skills			
11.	Interpersonal skills			
12.	Innovation and Creativity			

The percentage of students reveal to each grade of criteria is summarized for assessing the impact of OBE.

## Semester I Syllabus

### Core Courses - Theory

<b>Course Name</b>	Food Science and Chemistry	<b>Programme Name</b>	M.Sc. Food Science, Technology and Nutrition
<b>Course Code</b>	22FSTNCT01	<b>Academic Year Introduced</b>	2022 - 23
<b>Type of Course</b>	Theory	<b>Semester</b>	I

#### COURSE OUTCOMES

On completion of the course, the students will be able to	
CO1:	define the role of colloidal system in daily diet
CO2:	differentiate the role of cereals, millets, pulses in cookery and complementary food preparation
CO3:	identify and define the serving principles of sugar, fruits and vegetables in the daily diet
CO4:	differentiate the nature of protein in the egg, meat, poultry, fish and its changes during cooking
CO5:	appraise the types of milk, fats and oils, spices based products and non-alcoholic beverages in the market

#### Mapping of COs with POs, PSOs

COs / POs & PSOs	PO(T)	PO(E)	PO(P1)	PO(P2)	PO(P3)	PO(P4)	PO(P5)	PO(A)	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1	1	1	2	3	1	1	3
CO2	3	1	1	1	1	1	1	2	3	1	1	3
CO3	3	1	1	1	1	1	1	2	3	1	1	3
CO4	3	1	1	1	1	1	1	2	3	1	1	3
CO5	3	1	1	1	1	1	1	2	3	1	1	3

1 – Slight, 2 – Moderate, 3 – Substantial

#### COURSE OBJECTIVES AND HOURS OF INSTRUCTION

Unit/Module	Objectives	Hours of Instruction TL+Ac+As = T
Colloidal System	To provide learning on types and application of colloidal system	8+5+1=14
Cereals, Millets and Pulses	To impart knowledge on science and cooking principles of different cereals, millets and pulses and its complementary role	7+6+1=14
Sugars, Fruits and Vegetables	To illustrate the types, science in cooking of sugar, fruits and vegetables	8+5+1=14
Egg and Fleshy Foods	To elaborate the science and chemistry of fresh and cooked egg, meat, poultry and fish	5+5+1=11
Milk, Fats and Oils, Spices and Beverages	To inculcate the technical knowledge on the nature of milk protein, fats and oils, spices and non-alcoholic aromatic beverages	10+5+4=19
<b>Total Hours of Instruction</b>		72 (18x4)

TL-Teaching and Learning, Ac-Activities, As-Assessment, T-Total Hours

#### COURSE PLAN

Unit/Chapters	Intended Learning Chapters	CO(s) Mapped	Cognitive Level / KD	Psychomotor domain activities	Psychomotor domain level
<b>UNIT I: Colloidal System</b>					
1.	Concept of food and nutrients, types of water in the food, structure and properties of water and ice	CO1	K1, F	List the 5 nutrient rich food for each nutrient	K4, S1
2.	Colloidal system in foods- Types & Properties	CO1	K1, F	Identify the type of colloidal system in our daily diet	K5, S1
3.	Sols - types and properties	CO1	K2, F	Demonstrate the nature of true solution with an example	K5, S1
4.	Gels-theory of gel formation and factors influencing gel formation	CO1	K2, F	Differentiate sol and gel	K5, S1
5.	Emulsion- types & nature, types of surface film & activity, common food emulsifiers, functions of emulsifying agents, emulsification capacity, factors affecting emulsion stability	CO1	K2, F	Identify the common emulsifying agents used in packed foods	K4, S1
6.	Foams- theory of foam formation, factors affecting foam formation, foaming capacity & stability	CO1	K2, F	List food foams available in the market	K5, S1
7.	Hydrocolloids	CO1	K2, C	Identify and list the thickeners & stabilizers in packed food	K5, S1
<b>UNIT II: Cereals, Millets, Pulses, Nuts and Oil Seeds</b>					
8.	Classification, nutritional composition, structure	CO2	K1, F	Prepare a scrap book of all the cereals, pulses, nuts and oilseeds with nutritional information	K6, S3

Cognitive Process: K1 - Remembering K2 - Understanding K3 - Applying K4 - Analyzing K5 – Evaluating K6 - Creating  
 Knowledge Dimension: F - Factual C - Conceptual P - Procedural MC - Meta Cognitive  
 Psychomotor Domain: S1-Imitation S2-Manipulation S3-Precision S4-Articulation S5-Naturalization

9.	Types of starch in cereals	CO2	K2, C	Tabulate the types of starch in cereals, pulses, millets, nuts and oilseeds	K3, S1
10.	Principles of starch cookery- gelatinization, gelation, retrogradation, syneresis & dextrinization	CO2	K2, P	Demonstrate the changes in rice flour on cooking and storage	K4, S2
11.	Starch uses in food systems	CO2	K1, C	List the food starches available in the market	K5, S4
12.	Toxic constituents in pulses	CO2	K2, F	Infograph the toxins present in the food	K5, S4
13.	Factors influencing cooking quality of pulses	CO2	K2, C	Identify the major factor affecting the cooking quality of any one pulse	K3, S1
14.	Complementary proteins	CO2	K2, C	Generate a list of food with complementary proteins	K6, S4
<b>UNIT III: Sugars, Vegetable and Fruits</b>					
15.	Sugars- sources, properties	CO3	K1, F	Tabulate the kinds of sugar as per its sources	K3, S3
16.	Stages of cookery, crystalline and non-crystalline candies	CO3	K2, C	Infer about the crystalline and non-crystalline candies in the market	K4, S3
17.	Sugar substitutes	CO3	K1, C	Interpret on each sugar substitute	K5, S4
18.	Vegetables and fruits- composition, classification	CO3	K1, C	Prepare a scrap book on fruits and vegetables in the local market	K6, S1
19.	Pigments, enzymes, tannins, pectin, acids & flavors	CO3	K2, C	Tabulate the presence of pigments, enzymes, tannins, pectin, acids and flavours in any one fruit and a vegetable	K3, S1
20.	Changes during the cooking, effect of cooking on pigments	CO3	K2, C	Demonstrate the effect of cooking on pigments any one fruit and a vegetable	K3, S1
21.	Enzymatic browning reaction in fruits and vegetables	CO3	K1, F	Catalogue the bioactive compounds responsible for enzymatic browning in any one fruit and a vegetable	K4, S1
22.	Ripening of fruits	CO3	K1, F	Criticize on different ripening agents used by a fruit industry	K4, S4
<b>UNIT IV: Egg, Poultry, Meat and Fish</b>					
23.	Egg - structure, composition	CO4	K1, F	Pictograph the different types of egg in the market	K3, S1
24.	Coagulation of egg protein, Factors effecting coagulation of egg protein, egg quality	CO4	K2, P	Experiment the fresh and coagulated egg quality using any one method	K4, S1
25.	Meat- structure, composition	CO4	K1, F	Tabulate the type of protein present in different meat	K3, S1
26.	Postmortem changes, tenderness of meat, changes during cooking	CO4	K2, P	Sketch on the tenderizers in meat preparation	K4, S1
27.	Poultry & fish- classification, composition, structure	CO4	K1, F	Picturize the poultry and fish varieties	K3, S1
<b>UNIT V: Milk, Fat and Oils, Coffee, Tea and Cocoa beans</b>					
28.	Milk- types, composition and physical and chemical properties	CO5	K1, F	Categorize different types of milk according to their nutritional content and source	K4, S2
29.	Effect of heat, acids & enzymes on milk component, non-enzymatic browning reaction	CO5	K2, C	Experiment on effect of various agents on milk component	K3, S1
30.	Milk substitutes	CO5	K2, C	Criticize on the commercial milk substitutes and its nutritional claims	K5, S3
31.	Fats and oils - sources, properties	CO5	K1, F	Differentiate fat and oil with examples	K3, S2
32.	Effects of heating on fat	CO5	K2, C	Flip chart the changes in fatty acids on continuous cooking of oil	K4, S4
33.	Rancidity & its prevention	CO5	K2, C	Collect the evidence based practice to prevent the rancidity of an oil	K5, S1
34.	Spices and condiments - types, uses & abuses	CO5	K1, F	Interpret the therapeutic role of any one spice or condiment	K5, S3
35.	Coffee, tea & cocoa beans- types and composition	CO5	K1, F	Compare the different brands of coffee, tea and cocoa beans in the market	K5, S2

## REFERENCES

### TEXTBOOKS

1	Sri Lakshmi, B. (2018), Food Science, New Age International [P] Limited, New Delhi, Seventh Edition
2	Vaclavik, V. & Christian, E.W. (2014), Essentials of Food Science, XXIV edition, www.springer.com/978-1-4614-9137-8.
3	M. Swaminathan, (1999), Food Science Chemistry and Experimental Foods, Bangalore Printing and Publishing Co., Second Edition

### REFERENCE BOOKS

1	Rick Parkar (2002), Introduction to Food Science, Library of Congress Cataloging-in- Publication Data, First Edition.
2	Potter, N.N. & Hotchkiss, H.J., (1998), Food Science, Aspen Publishing Co. Cunncticut. Fifth Edition
3	Shakuntalamanay, N. & Shadakcheraswamy, M., (2004), Foods, Facts and Principles, Wiley Easterd Ltd.
4	Ahmed, M.N. (2005), Food Science and Nutrition, 1 <sup>st</sup> Edition, Anmol Publications Pvt. Ltd, New Delhi.
5	SunetraRoday (2012), Food Science and Nutrition, Second Edition, Oxford University Press, India.

### JOURNALS AND DOCUMENTS

Cognitive Process: K1 - Remembering K2 - Understanding K3 - Applying K4 - Analyzing K5 - Evaluating K6 - Creating  
 Knowledge Dimension: F - Factual C - Conceptual P - Procedural MC - Meta Cognitive  
 Psychomotor Domain: S1-Imitation S2-Manipulation S3-Precision S4-Articulation S5-Naturalization

1	Journal of Food Science and Technology, AFSTI Publication
2	Annals. Food Science and Technology, Valahia University Press
3	Food Science and Human Wellness, Beijing Academy of Food Sciences
4	Journal of Food, Agriculture and Environment, WFL Publisher Ltd.
5	Natural Products and Bioprospecting, Springer
6	Indian Journal of Dairy Science, Indian Dairy Association

<b>Course Name</b>	Food Processing Technology	<b>Programme Name</b>	M.Sc. Food Science, Technology and Nutrition
<b>Course Code</b>	22FSTNCT02	<b>Academic Year Introduced</b>	2022 - 23
<b>Type of Course</b>	Theory	<b>Semester</b>	I

## COURSE OUTCOMES

On completion of the course, the students will be able to												
CO1:	Adapt suitable techniques/methods for processing of cereals, millets and pulses/legumes and product development											
CO2:	Infer the technical aspects of milk and egg processing and production of milk and egg products											
CO3:	Select appropriate techniques for processing of fleshy foods and oil seeds and its product development											
CO4:	Define suitable processing and preservation methods for fruits and vegetables and plantation products											
CO5:	Define the appropriate technique for manufacturing of sugar, starch isolate, modified starch and spices											
<b>Mapping of COs with POs, PSOs</b>												
COs / POs & PSOs	PO(T)	PO(E)	PO(P1)	PO(P2)	PO(P3)	PO(P4)	PO(P5)	PO(A)	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	1	3	-	2	3	3	1	1	1
CO2	2	3	3	3	3	1	2	3	3	3	3	2
CO3	2	3	3	3	3	1	2	3	3	3	3	2
CO4	2	3	3	3	3	1	2	3	3	3	3	2
CO5	3	2	2	3	3	-	1	3	3	1	2	2
1 – Slight, 2 – Moderate, 3 – Substantial												

## COURSE OBJECTIVES AND HOURS OF INSTRUCTION

Unit/Module	Objectives	Hours of Instruction TL+Ac+As = T
Cereals, Millets and Pulses/legumes	To interpret the various steps and techniques involved in milling and processing of cereals, millets and pulses/legumes	7+6+1=14
Milk and Egg	To familiarize with different technologies applied in manufacturing of egg and dairy products	7+5+1=13
Fleshy Foods and Oilseeds	To illustrate the concepts involved in the processing of fleshy foods and oil seeds	8+5+1=14
Fruits, Vegetables and Plantation Products	To learn and adapt the various processing and preservation techniques of fruits and vegetables as well as processing of plantation products such as coffee, tea leaves and cocoa beans	7+6+1=14
Sugar, Starch and Spices	To impart the knowledge of raw sugar manufacturing, isolation and modification of starch and processing of spices	8+5+4=17
<b>Total Hours of Instruction</b>		72 (18x4)

TL-Teaching and Learning, Ac-Activities, As-Assessment, T-Total Hours

## COURSE PLAN

Unit/Chapters	Intended Learning Chapters	CO(s) Mapped	Cognitive Level / KD	Psychomotor domain activities	Psychomotor domain level
<b>UNIT I: Cereals, Millets and Pulses/legumes</b>					
1.	Cereal Processing: Rice - preprocessing, parboiling, milling, by products of rice milling	CO1	K2, P	Visit to a modern and traditional rice milling unit, evaluate the process and report it	K5, S2
2.	Wheat- preprocessing, milling, by products of wheat milling; malting of cereals	CO1	K2, P	Picturize the byproducts of wheat milling in the local market	K3, S3
3.	Manufacture of breakfast cereals, extruded products, puffed and flaked cereals	CO1	K2, P	Video capture the manufacturing of puffed or flaked cereal	K3, S3
4.	Processing of millets - cleaning, decortication, milling and fractions	CO1	K2, P	Explore the different types of millets of Indian origin	K4, S5
5.	Pulse/legume processing- cleaning, decortication, splitting, grading, milling and germination	CO1	K2, P	Schematize the ways to enrich the nutrients in pulses/legumes and ways to reduce the anti-nutritional factors at home level and industrial level	K5, S2
<b>UNIT –II: Milk and Egg</b>					
6.	Milk Processing – preprocessing, separation, standardization, pasteurization, homogenization, sterilization, evaporation, drying, condensation, membrane fractionation	CO2	K2, P	Sketch the processing protocol in milk collection centre and milk processing industry	K4, S1
7.	Milk products-butter, ghee, cream, paneer, yoghurt and cheese	CO2	K2, P	Identify the most familiar brand of each milk product and compare with other brands	K5, S2
8.	Egg processing – preservation of egg by different methods, egg powder processing –	CO2	K2, P	Extrapolate the GMP for the manufacture of egg powder	K3, S1

Cognitive Process: K1 - Remembering K2 - Understanding K3 - Applying K4 - Analyzing K5 - Evaluating K6 - Creating  
 Knowledge Dimension: F - Factual C - Conceptual P - Procedural MC - Meta Cognitive  
 Psychomotor Domain: S1-Imitation S2-Manipulation S3-Precision S4-Articulation S5-Naturalization

	spray drying and foam mat drying				
<b>UNIT - III: Fleshy Foods and Oilseeds</b>					
9.	Meat – preprocessing, canning, dehydro freezing, drying, processed meat products – hamburgers, sausages and meat balls	CO3	K2, P	Collect the photographs of the processed meat products in the market	K4, S1
10.	Poultry - chemical treatments, microwave heating, IR heating, freeze drying and irradiation	CO3	K2, P	Identify the best video lesson on processing of poultry	K4, S1
11.	Fish - chilling, freezing, canning, smoking, salting and fish oil extraction	CO3	K2, P	Identify the best video lesson on fish oil capsule preparation	K4, S1
12.	Fats and Oils - Oil Seeds Processing– preprocessing, milling, extraction of oil and it's processing, production of meal concentrates and isolates	CO3	K2, P	Display different types of oils and define its characteristics	K5, S1
13.	Specialty fats from non-traditional oilseeds, modification of fat, fat substitutes and replacers and fat mimetics	CO3	K1, C	Identify the fat mimetics, replacers and other non-conventional fat sources in the market	K4, S1
<b>UNIT – IV: Fruits, Vegetables and Plantation Products</b>					
14.	Fruits and vegetables processing– preprocessing, drying and dehydration, juice extraction, concentrate preparation, minimal processing and hurdle technology, meat analogues and textured vegetable protein	CO4	K2, P	Exhibit the processed products of fruits and vegetables	K3, S2
15.	Production of mushroom and its processed products	CO4	K2, P	Visit and report on mushroom production unit	K5, S4
16.	Plantation products processing- processing of coffee, tea leaves and cocoa beans	CO4	K2, P	Document on coffee, tea and cocoa based beverages with preparation	K6, S4
<b>UNIT V: Sugar, Starch and Spices</b>					
17.	Sugar – manufacturing of sugar from sugarcane and palm, sugar cubes and powdered sugar	CO5	K2, P	Prepare a scrapbook on natural sweeteners	K5, S4
18.	Starch – starch isolation, modification of starch	CO5	K2, C	Develop an SOP on isolation of starch	K6, S2
19.	Manufacturing of food Hydrocolloids – CMC and gaur gum	CO5	K1, C	Exemplify the industrial application of hydrocolloids	K5, S1
20.	Spices technology – decortication, splitting, extraction of essential oils and colors and masala products	CO5	K2, P	Design a pamphlet describing the health benefits of spices	K6, S3

## REFERENCES

<b>TEXTBOOKS</b>	
1	Fellows P.J., (2017), Food Processing Technology – Principles and Practices, Fourth Edition, New Woodhead Publishers, USA.
2	Ohlsson, T., & Bengtsson, N. (Eds.). (2002). Minimal processing technologies in the food industries. Elsevier.
3	Jelen, P. (2005). Introduction to Food Processing. Prentice Hall
4	Heldman, D. R., & Hartel, R. W. (1997). Principles of food processing. Springer Science & Business Media.
5	Sivasankar, B. (2002). Food processing and preservation. PHI Learning Pvt. Ltd..
<b>REFERENCE BOOKS</b>	
1	Parker, R., & Pace, M. (2016). Introduction to Food Science and Food Systems. Nelson Education.
2	Bhatti, S., & Varma, U., (2003), Fruit & Vegetable Processing Organizations and Institutions, CBS Publishers and Distributors, New Delhi, Reprint.
3	Richardson, T., & Finley, J. W. (Eds.). (2012). Chemical changes in food during processing. Springer Science & Business Media.
4	Pomeranz, Y. (Ed.). (2013). Food analysis: theory and practice. Springer Science & Business Media.
5	Knoerzer, K., Juliano, P., Smithers, G., (2016), Innovative Food Processing Technologies-Extraction, Separation, Component Modification and Process Intensification, Woodhead Publishing.
<b>JOURNALS AND DOCUMENTS</b>	
1	Annual review of Food science and technology, Annual review Inc.
2	Innovative Food Science and Emerging Technologies, Elsevier
3	Journal of Food Science and Technology, Springer Nature
4	Journal of Food Process Engineering, Blackwell Publishing Inc.

<b>Course Name</b>	Research Methodology	<b>Programme Name</b>	M.Sc. Food Science, Technology and Nutrition
<b>Course Code</b>	22FSTNCT03	<b>Academic Year Introduced</b>	2022 - 23
<b>Type of Course</b>	Theory	<b>Semester</b>	I

### COURSE OUTCOMES

On completion of the course, the students will be able to												
CO1:	Conceptualize the steps in research											
CO2:	Identify a new research problem, define objectives and frame hypothesis											
CO3:	Formulate a research framework for the food science and nutrition research											
CO4:	Adapt and validate various tools and techniques in sampling and collection of data											
CO5:	Plan and justify the method of presentation of collected data in a research report											
<b>Mapping of COs with POs, PSOs</b>												
COs / POs & PSOs	PO(T)	PO(E)	PO(P1)	PO(P2)	PO(P3)	PO(P4)	PO(P5)	PO(A)	PSO1	PSO2	PSO3	PSO4
CO1	2	-	-	3	3	2	3	3	-	3	1	2
CO2	2	-	-	3	1	-	-	3	2	2	2	3
CO3	3	-	-	2	2	-	-	3	3	3	3	3
CO4	-	3	-	3	3	-	2	3	3	3	2	2
CO5	3	-	2	2	2	3	1	3	1	2	1	3
1- Slight, 2- Moderate, 3-Substantial												

### COURSE OBJECTIVES

Unit/Module	Objectives	Hours of Instruction TL+Ac+As = T
Research Process	To illustrate the types of research and steps in research process	5+4+1=10
Conceptualizing the Research Problem	To define research problem from research ideas	8+4+1=13
Research Design	To categorize and discriminate research designs in food science and nutrition research	10+4+1=15
Research Methods and Data Collection	To learn and compare various methods of sampling, collection and valid measurement of data	11+5+1=17
Processing of Data and writing a research report	To infer and experiment the processing and representation of data in a research report	8+5+4=17
<b>Total Hours of Instruction</b>		72 (18x4)

TL-Teaching and Learning, Ac-Activities, As-Assessment, T-Total Hours

### COURSE PLAN:

S. No.	Intended Learning Chapters	CO(s) Mapped	Cognitive Level/ KD	Psychomotor domain activities	Psychomotor domain level
<b>UNIT I: Research Process</b>					
1.	Meaning of research	CO1	K1, C	Collect the various definitions of research	K3, S1
2.	Purpose of research	CO1	K2, C	Differentiate research, invention and innovation	K4, S3
3.	Types of research – Application Research; Objective Research; Mode of Enquiry Perspective based Research	CO1	K1, C	Ideate research questions in the field of food science, technology and nutrition on each type of research	K6, S2
4.	Steps in research process	CO1	K1, C	Prepare a story board on eight steps of research	K4, S3
<b>Unit II: Conceptualizing the Research Problem</b>					
5.	Identification and formulation of research problem	CO2	K2, C	List the problems in the field of food science, technology and nutrition to be solved	K6, S3
6.	Reviewing the literature and research gap analysis	CO2	K2, F	Schematize the systematic literature review for a research title with the list of key words used for search	K6, S3
7.	Conceptualization of research – from ideas to action	CO2	K2, MC	Learn on design thinking model for idea generation	K2, S4
8.	Research objectives	CO2	K2, C	Frame an objective for a research problem	K6, S1
9.	Identifying variables and constructing the hypothesis	CO2	K2, C	Formulate a null hypothesis for a research objective	K6, S5
<b>UNIT III: Research Design</b>					
10.	Qualitative Research Designs – key features, uses and limitations	CO3	K1, C	Collect a research article for each qualitative research design	K5, S4
11.	Types of Qualitative Research Design – case studies, ethnographic research, narrative research, action research	CO3	K1, F	Appraise the type of research design suitable for a research problem	K4, S4

Cognitive Process: K1 - Remembering K2 - Understanding K3 - Applying K4 - Analyzing K5 - Evaluating K6 - Creating  
Knowledge Dimension : F - Factual C - Conceptual P - Procedural MC - Meta Cognitive  
Psychomotor Domain : S1-Imitation S2-Manipulation S3-Precision S4-Articulation S5-Naturalization

12.	Quantitative Research Designs – key features, uses and limitations	CO3	K1, C	Collect a research article for each quantitative research design	K5, S4
13.	Types of Quantitative Research Design - Experimental and non-experimental research design	CO3	K1, C	Differentiate the experimental and non-experimental research	K4, S1
14.	Mixed research design – key features, uses and limitations	CO3	K2, C	Propose the research design for a given research problem using mixed research design	K6, S5
15.	Cross sectional and longitudinal studies	CO3	K1, F	Compare the features of cross sectional and longitudinal study	K4, S1
16.	Epidemiological methods	CO3	K1, F	Audit the advancement in studying nutrition epidemiology	K4, S3
<b>UNIT IV: Research Methods and Data Collection</b>					
17.	Research methods in food science and technology research– Good Laboratory Practices	CO4	K1, P	Demonstrate GLP among the peer learners	K4, S4
18.	Standard Operating Procedures (SOP) for laboratory experiments	CO4	K2, P	Collect SOP templates and create a feasible template	K6, S5
19.	NABL accredited laboratory	CO4	K2, F	Visit an NABL Accredited Laboratory and report it	K5, S5
20.	Research methods in Nutrition – Good Clinical Practice, Methods of collecting the data in qualitative and quantitative research	CO4	K1, C	<ul style="list-style-type: none"> <li>Frame a questionnaire for a nutrition survey using google form and validate it</li> <li>Exemplify the GCP in nutrition counselling centre</li> </ul>	K6, S3
21.	Primary and secondary data, measurement scales, construction of the research tools	CO4	K2, C	Conduct a pilot survey for pre-testing of questionnaire in the class room	K5, S5
22.	Reliability and validation of research tools, pilot testing	CO4	K2, C	Validate the pretested questionnaire using a discussion forum	K5, S3
23.	Sampling design – principles of sampling, sampling terminology	CO4	K2, C	Identify the sampling method for a research problem	K3, S2
24.	Types of sampling and calculating the sample size	CO4	K2, C	Calculate the sample size for a nutrition survey	K4, S3
25.	Ethical issues in data collection	CO4	K2, F	Frame the informed consent form and validate it	K5, S1
<b>UNIT V: Processing of Data and Writing a Research Report</b>					
26.	Editing and coding the data	CO5	K1, C	Code a Nutrition data of your choice	K4, S3
27.	Organization of data- Classification, meaning and objectives, types of classification	CO5	K1, C	Classify the given data using cross tabulation	K4, S1
28.	Tabulation – parts of a table, general rules of tabulation, types of tables	CO5	K1, C	Represent a research findings in a tabular format	K3, S3
29.	Representation of data – Diagrammatic and graphical representation, Significance of diagrams and graphs, General rules for constructing diagrams, types of diagrams and graphs	CO5	K1, C	Represent the a nutrition data using different forms of graphs	K3, S1
30.	Scientific writing – research article, review article, monographs, dissertation/thesis and reports, different referencing system and writing the bibliography	CO5	K2, C	Analyze the reference and bibliography in a research article using mendeley	K4, S3

## REFERENCES

<b>Text Books</b>	
1.	Kothari, C.R., (2004), Research Methodology, Methods and Techniques, Second Revised Edition, New Age International Publishers, New Delhi.
2.	Ranjit Kumar, (2011), Research Methodology: a step-by-step Guide for Beginners, Third Edition, SAGE Publications, New Delhi.
3.	Beverley Moriarty, (2018), Research Skills for Teachers – From Research Question to Research Design, Allen & Unwin Publishers, Australia.
<b>Reference Books</b>	
1.	Rajendra Kumar, C. (2008), Research Methodology, APH Publishing Corporation, New Delhi
2.	Pagadala Suganda Devi (2017), Research Methodology: A Handbook for Beginners, Notion Press, Chennai
3.	Vijayalakshmi Ponnuraj and Sivaprakasam, C. (2008), Research Methods: Tips and Techniques, MJP Publishers
4.	Anantarayanan Raman and Jayashree Nimmagadda, (2006), A Handbook of Research Process, Macmillan Publishers.
5.	Gina Wisker, (2008), Post Graduate Research Handbook, Second Edition, Palgrave Macmillan, New York
<b>Journals and Documents</b>	
1.	International Journal of Social Research Methodology, Taylor and Francis
2.	International Journal of Science and Research Methodology, Human Journals
3.	Journal of Food, Agriculture and Environment, WFL Publisher Ltd.
4.	Journal of Innovation and Entrepreneurship, Springer
5.	The Journal of Global Entrepreneurship Research, Springer

Cognitive Process: K1 - Remembering K2 - Understanding K3 - Applying K4 - Analyzing K5 – Evaluating K6 - Creating  
Knowledge Dimension : F - Factual C - Conceptual P - Procedural MC - Meta Cognitive  
Psychomotor Domain : S1-Imitation S2-Manipulation S3-Precision S4-Articulation S5-Naturalization



## Core Courses - Practical

<b>Course Name</b>	Food Science and Chemistry Practical	<b>Programme Name</b>	M.Sc. Food Science, Technology and Nutrition
<b>Course Code</b>	22FSTNCP01	<b>Academic Year Introduced</b>	2022 - 23
<b>Type of Course</b>	Practical	<b>Semester</b>	I

### COURSE OUTCOMES

On completion of the course, the students will be able to												
CO1	Determine the colloidal nature and chemical content of food items											
CO2	Justify the reason for changes in chemical nature of food during cooking in different conditions											
CO3	Interpret the reason for changes in structure and components of food on application of heat, acid, alkali, enzymes or any cooking additives											
<b>Mapping of COs with POs, PSOs</b>												
COs / POs & PSOs	PO(T)	PO(E)	PO(P1)	PO(P2)	PO(P3)	PO(P4)	PO(P5)	PO(A)	PSO1	PSO2	PSO3	PSO4
CO1	1	3	3	2	3	1	3	3	3	2	3	3
CO2	1	3	3	3	3	1	3	3	3	2	3	3
CO3	1	3	3	3	3	1	3	3	3	2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial												

### COURSE OBJECTIVES AND HOURS OF INSTRUCTION

Unit/Module	Objectives	Hours of Instruction TL+Ac+As = T
Colloidal Properties	To understand colloidal nature of different food items	1+8+0 = 9
Carbohydrates	To gain knowledge on microscopic structure, gelatinization, retrogradation and pasting properties of flour/starches	1+8+3 = 12
Protein	To study the nature of protein in cereals, milk and meat; effect of tenderizers on meat protein	1+8+0 = 9
Fat	To apprehend the smoking point, iodine number and saponification number of various used and unused oils	1+5+3 = 9
Fiber	To perceive the content of soluble fiber (pectin) in different fruits	0.5+2.5+0 = 3
Food Pigments	To realize the effect of cooking on loss of pigments in fruits and vegetables and to conserve it	0.5+2.5+0 = 3
Phytochemicals and Enzymes	To seize the enzymes responsible for browning of fruits and vegetables	0.5+2.5+6 = 9
<b>Total Hours of Instruction</b>		54 (18x3)

TL-Teaching and Learning, Ac-Activities, As-Assessment, T-Total Hours

### COURSE PLAN

Module No.	Intended Learning Chapters	CO(s) Mapped	Cognitive Level / KD	Psychomotor domain activities	Psychomotor domain level
<b>Module I: Colloidal Properties</b>					
1.	Least gelation concentration of flour	CO2	K4, P	Compare the least gelation concentration of any two flour	K5, S4
2.	Emulsification capacity of a natural emulsifier	CO1	K4, P	Define the concentration of a natural emulsifier to be added to food preparations	K5, S3
3.	Foaming capacity and foaming stability of egg white foam	CO1	K4, P	Measure the foaming capacity and stability of the different variant egg white	K5, S3
<b>Module II: Carbohydrates</b>					
4.	Microscopic examination of flour / starches	CO1	K4, P	Compare the microscopic structure of different starches	K5, S1
5.	Gelatinization and retrogradation properties of cereal / pulse flour ( <i>Demonstration</i> )	CO2	K4, P	Demonstrate the gelatinization and retrogradation properties of the given sample using DSC	K3, S1
6.	Pasting properties of cereal / pulse flour ( <i>Demonstration</i> )	CO2	K4, P	Demonstrate and interpret the pasting properties of the flour using RVA	K3, S1
<b>Module III: Protein</b>					
7.	Gluten content in wheat flour	CO1	K4, P	Examine the variation in wet and dry gluten content in the different wheat flour variant	K5, S3
8.	Relative density and casein content in milk	CO1, CO2	K4, P	Justify the variation in relative density and casein content of milk before and after cooking	K5, S3
9.	Effect of tenderization of meat	CO3	K3, P	Identify the best tenderizer for meat	K5, S3
<b>Module IV: Fat</b>					
10.	Smoking point of oil ( <i>Technical Knowledge</i> )	CO1	K4, P	Justify the reason for changes in smoking	K5, S4

Cognitive Process: K1 - Remembering K2 - Understanding K3 - Applying K4 - Analyzing K5 - Evaluating K6 - Creating  
 Knowledge Dimension: F - Factual C - Conceptual P - Procedural MC - Meta Cognitive  
 Psychomotor Domain: S1-Imitation S2-Manipulation S3-Precision S4-Articulation S5-Naturalization

				point of different oil and used oils	
11.	Iodine number of oil ( <i>Technical Knowledge</i> )	CO1	K4, P	Compare the iodine number of different oil and used oils	K5, S4
12.	Saponification number of oil ( <i>Technical Knowledge</i> )	CO1	K4, P	Compare the saponification number of different oil and used oils	K5, S4
<b>Module VI: Fiber</b>					
13.	Pectin content in fruits	CO1	K4, P	Test and Identify the fruits rich in pectin content	K6, S3
<b>Module VII: Food Pigments</b>					
14.	Effect of cooking and preprocessing on pigments in fruits and vegetables	CO2, CO3	K4, P	Define the best method of cooking and preprocessing to preserve pigments in fruits and vegetables	K6, S4
<b>Module VIII: Phytochemicals and Enzymes</b>					
15.	Enzymatic browning reaction in fruits and vegetables	CO3	K4, P	Define the best method to prevent browning in selected fruits and vegetables	K6, S3

## REFERENCES

<b>TEXTBOOKS</b>	
1	Mohini Sethi and Eram S. Rao (2005), Food Science Experiments and Applications, CBS Publishers & Distributors, New Delhi.
2	Weaver, C. (1996), The Food Chemistry Laboratory: a Manual for Experimental Foods, Dietetics and Food Scientists. CRC Press, LLC.
3	Paul, M. (2007), Experimental Food Chemistry, Gene Tech Books, New Delhi
<b>REFERENCE BOOKS</b>	
1	Pomeranz, Y.(Ed), (1991), Functional Properties of Food Components, (2 <sup>nd</sup> Edition), Academic press, New Delhi.
2	Bowers, J. (1992), Food Theory and Applications, (2 <sup>nd</sup> Edition), Macmillan Publishing Co., New Delhi.
3	Wrolstad, R.E. (2012), Food Carbohydrate Chemistry, John Wiley & Sons, Inc., and Institute of Food Technologists.
4	American Association of Cereal Chemists (AACC), (2000), Approved Methods of the AACC Method 22-08.10 <sup>th</sup> ed. St. Paul, MN.
5	Potter, N.N. and Hotchikiss, J.H. (2006), Food Sciences, Fifth edition, CBS publishers and Distributors, New Delhi.
6	Ranganna, S. (1986), Handbook of Analysis and Quality Control for Fruit and Vegetable Products, 2 <sup>nd</sup> edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
<b>JOURNALS AND DOCUMENTS</b>	
1	Journal of Food Measurement and Characterisation, Springer Nature
2	Food Chemistry, Function and Analysis, Royal Society of Chemistry
3	Food Analytical Methods, Springer Nature

<b>Course Name</b>	Data Management and Statistics Practical	<b>Programme Name</b>	M.Sc. Food Science, Technology and Nutrition
<b>Course Code</b>	22FSTNCP02	<b>Academic Year Introduced</b>	2022 - 23
<b>Type of Course</b>	Practical	<b>Semester</b>	I

### COURSE OUTCOMES

On completion of the course, the students will be able to												
CO1	Manage the processing of collected data											
CO2	Analyse the coded data statistically and interpret the results											
CO3	Define the statistical quality control measures to be followed in food industries											
<b>Mapping of COs with POs, PSOs</b>												
COs / POs & PSOs	PO(T)	PO(E)	PO(P1)	PO(P2)	PO(P3)	PO(P4)	PO(P5)	PO(A)	PSO1	PSO2	PSO3	PSO4
CO1	1	3	3	2	3	1	3	3	3	2	3	3
CO2	1	3	3	3	3	1	3	3	3	2	3	3
CO3	1	3	3	3	3	1	3	3	3	2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial												

### COURSE OBJECTIVES AND HOURS OF INSTRUCTION

Unit/Module	Objectives	Hours of Instruction TL+Ac+As = T
Processing of data	To understand and apply the guidelines to edit, code, tabulate and organize the collected data	2+7+0 = 9
Descriptive Statistics	To perceive and practice the application of descriptive statistics in analyzing the data	1+2+3 = 6
Sampling distribution	To study the nature of distribution of collected data and testing of hypothesis	2+7+0 = 9
Correlation and Regression	To apprehend the role of correlation and regression in predicting the nature of collected data	1+5+6 = 12
Statistical Quality Control	To realize the need for statistical quality control in food processing industries/food service operations	2+12+6 = 18
<b>Total Hours of Instruction</b>		54 (18x3)

TL-Teaching and Learning, Ac-Activities, As-Assessment, T-Total Hours

### COURSE PLAN

Module /Experiment No.	Intended learning Chapters	CO(s) Mapped	Cognitive Level / KD	Psychomotor domain activities	Psychomotor domain level
<b>Module I: Processing of Data</b>					
1.	Types and kinds of data, manual calculations, use of formulas and function wizard in calculations	CO1	K4, P	Create the nutrition datasheet indicating different types and kinds of data Exhibit the application of manual calculation, formulas and function wizard in Microsoft Excel	K6, S4 K3, S3
2.	Protecting the data, creating tables and charts	CO1	K4, P	Create different types of tables and charts using edited and coded data	K5, S3
3.	Creating pivot tables	CO1	K4, P	Create a pivot table for a nutrient database	K5, S3
4.	Use of commands like macro, database, goal seek and data analysis	CO1	K4, P	Calculate nutrient content of a product using commands like macro, database and goal seek Calculate the average and standard deviation using the food industry oriented and nutrition data	K4, S3 K4, S3
<b>Module II: Descriptive Statistics</b>					
5.	Measures of Central Tendency	CO2	K4, P	Calculate and interpret the results on mean, median and mode using Excel/SPSS	K5, S1
6.	Measures of Dispersion	CO2	K4, P	Calculate and interpret the results on mean deviation and standard deviation using Excel/SPSS	K5, S1
<b>Module III: Sampling Distribution</b>					
7.	Standard Error	CO2	K4, P	Calculate the standard error for the given data and interpret the results based on framed hypothesis using Excel/SPSS	K5, S3
8.	't' distribution	CO2	K4, P	Exhibit the application of suitable t test to test the framed hypothesis using Excel/SPSS	K5, S3
9.	Chi-square distribution	CO2	K4, P	Apply chi-square test and interpret the results on tested hypothesis using Excel/SPSS	K5, S3
10.	F- distribution	CO2	K4, P	Exhibit the application of suitable ANOVA test to test the framed hypothesis using Excel/SPSS	K5, S3
<b>Module IV: Correlation and Regression</b>					

Cognitive Process: K1 - Remembering K2 - Understanding K3 - Applying K4 - Analyzing K5 - Evaluating K6 - Creating  
Knowledge Dimension: F - Factual C - Conceptual P - Procedural MC - Meta Cognitive  
Psychomotor Domain: S1-Imitation S2-Manipulation S3-Precision S4-Articulation S5-Naturalization

11.	Types of correlation and its application	CO2	K4, P	Define the nature of correlation exist in the given data using Excel/SPSS	K4, S4
12.	Types of regression and its application	CO2	K4, P	Predict the value using regression equation of X on Y or Y on X	K5, S4
<b>Module V: Statistical Quality Control (3 Day workshop certificate is mandatory)</b>					
13.	Forecasting models	CO3	K4, P	Demand/Sales forecasting of a product in a food industry and a restaurant	K6, S3
14.	Time series analysis	CO3	K4, P	Time series analysis for supply chain planning in Restaurants/Canteens	K4, S4
15.	Automation	CO3	K4, P	Visit a food industry/restaurant which is automated for production process and report on it	K3, S4
16.	Sampling plan	CO3	K4, P	Apply the suitable sampling plan to select the sample for testing the quality of raw material, intermittent products and finished products in a food industry/restaurant/canteen	K3, S3

## REFERENCES

<b>TEXTBOOKS</b>	
1	Gupta, S.P. (2014), Statistical Methods, Sultan Chand & Sons, 43 <sup>rd</sup> Edition.
2	Shukla, S.M. and Sahai, S.P. (2017), Statistical Methods, Sahitya Bhawan Publications.
3	Douglas C.Montgomery (2009), Introduction to Statistical Quality Control, Sixth Edition, John Wiley & Sons, Inc.
4	www.egyankosh.ac.in, IGNOU Chapters on Statistics.
5	Paul Singh R., (1996), Computer Application in Food Technology, Elsevier Science and Technology Books.
<b>REFERENCE BOOKS</b>	
1	Gupta A. (2009), Statistical Data Management. In: LIU L., ÖZSU M.T. (eds) Encyclopedia of Database Systems. Springer, Boston, MA. <a href="https://doi.org/10.1007/978-0-387-39940-9_1290">https://doi.org/10.1007/978-0-387-39940-9_1290</a>
2	Md Ramim Tanver Rahman, Yuxia Tang, Qiangwei Wang and Nabil Qaid M. Al-Hajj, (2014), Short Review: Statistics and Different Departments of Food Industry, International Journal of Biological and Chemical Sciences, Vol.1(3): 41-47.
3	<a href="https://www.researchgate.net/publication/285219852_Demand_forecasting_for_production_planning_in_a_food_company">https://www.researchgate.net/publication/285219852_Demand_forecasting_for_production_planning_in_a_food_company</a>
4	<a href="https://www.7shifts.com/blog/restaurant-forecasting-guide/">https://www.7shifts.com/blog/restaurant-forecasting-guide/</a>
5	<a href="https://ieeexplore.ieee.org/document/9276872">https://ieeexplore.ieee.org/document/9276872</a>
<b>JOURNALS AND DOCUMENTS</b>	
1	Journal of Data, Information and Management, Springer
2	Statistics and Computing, Springer



# Food Regulatory Affairs Manager

QP Code: FIC/Q9002

Version: 1.0

NSQF Level: 6

Food Industry Capacity & Skill Initiative || Shriram Bharatiya Kala Kendra, 3rd floor, 1, Copernicus Marg, Mandi House, New Delhi  
Delhi 110001



## Qualification Pack

### Contents

FIC/Q9002: Food Regulatory Affairs Manager .....	3
<i>Brief Job Description</i> .....	3
Applicable National Occupational Standards (NOS) .....	3
<i>Compulsory NOS</i> .....	3
<i>Qualification Pack (QP) Parameters</i> .....	3
FIC/N9011: Design, develop and implement regulatory system .....	5
FIC/N9012: Manage change in food regulatory system .....	14
FIC/N9013: Prepare representations to regulatory authorities and for new product registrations .....	22
Assessment Guidelines and Weightage .....	29
<i>Assessment Guidelines</i> .....	29
<i>Assessment Weightage</i> .....	30
Acronyms .....	31
Glossary .....	32



## Qualification Pack

### FIC/Q9002: Food Regulatory Affairs Manager

#### Brief Job Description

A Food Regulatory Affairs Manager is responsible for designing, developing, implementing and changing food regulatory systems in the organisation. S/he acts as a liaison between organisation and government regulatory agencies and authorities to ensure that the products produced and distributed comply with regulatory standards.

#### Personal Attributes

A Food Regulatory Affairs Manager must have the ability to read, write, communicate, mathematical ability to calculate, organizational & analytical skills, ability to plan, organize and prioritize, concentration, physical stamina, handling pressure, team work, mechanical aptitude and trouble shooting skills, understanding on food safety standards and requirements, personal and professional hygiene.

#### Applicable National Occupational Standards (NOS)

##### Compulsory NOS:

1. [FIC/N9011: Design, develop and implement regulatory system](#)
2. [FIC/N9012: Manage change in food regulatory system](#)
3. [FIC/N9013: Prepare representations to regulatory authorities and for new product registrations](#)

#### Qualification Pack (QP) Parameters

<b>Sector</b>	Food Processing
<b>Sub-Sector</b>	Fruits and Vegetables, Food Grain Milling, Dairy Products, Meat and Poultry, Fish and Sea Food, Bread and Bakery, Alcoholic Beverages, Aerated Water/Soft Drinks, Soya Food, Packaged Foods
<b>Occupation</b>	Quality Assurance
<b>Country</b>	India
<b>NSQF Level</b>	6
<b>Aligned to NCO/ISCO/ISIC Code</b>	NCO-2004/NIL

### Qualification Pack

<b>Minimum Educational Qualification &amp; Experience</b>	Post Graduate (Food Technology/Food Science (Preferably)) with 5-10 Years of experience Minimum 8 years experience in a food processing unit in a food regulatory role
<b>Minimum Level of Education for Training in School</b>	
<b>Pre-Requisite License or Training</b>	1. Food Safety Standards and Regulations (as per FSSAI)2. Total Quality Management3. Occupational Health & Safety Advisory Services4. Environmental Management System
<b>Minimum Job Entry Age</b>	30 Years
<b>Last Reviewed On</b>	03/08/2021
<b>Next Review Date</b>	31/03/2022
<b>Deactivation Date</b>	31/03/2022
<b>NSQC Approval Date</b>	03/08/2018
<b>Version</b>	1.0
<b>Reference code on NQR</b>	2018/FI/FICSI/02465
<b>NQR Version</b>	1.0



## Qualification Pack

### FIC/N9011: Design, develop and implement regulatory system

#### Description

This OS unit is about designing, developing and implementing regulatory systems in food processing units to ensure product compliance to national and international food regulatory system.

#### Scope

This unit/task covers the following:

#### Elements and Performance Criteria

##### *Design and develop regulatory system for the organisation (for food products produced)*

To be competent, the user/individual on the job must be able to:

- PC1.** understand food safety regulations and develop regulatory policies for the organisation with clear definitions to increase consistency, legal security and to provide high level of food safety
- PC2.** design regulatory system with focus on risk reduction, risk-based priorities, reflect integrated and economically feasible initiatives, and ensure high quality and transparency
- PC3.** design and develop regulatory system with intuitive approach to food safety such that problem are recognized, understood, dealt, and checked to ensure problem has been dealt efficiently and effectively
- PC4.** design regulatory system with contingency planning like product traceability and product recall in case of problems, procedures for handling containment, with clear attribution of roles like lines of authority and co-ordination mechanism across food chain (from procuring raw materials, production until product reaching consumers)
- PC5.** design regulatory system with improved communication on food safety information in marketing materials, product labels etc, providing science based information to clear up the unjustified fear among consumers
- PC6.** set food safety system involving food producers, processors, distributors, retailers and consumers to recognize their primary responsibility and to share a common goal of ensuring food safety at all stages
- PC7.** design food regulatory system involving GMP, GHP, and monitoring systems like HACCP
- PC8.** design regulatory system that improve efficiency and compliance, build consumer confidence in the safety and quality of food products produced, processed, marketed, distributed and sold
- PC9.** design and develop regulatory system ensuring food and health standards are followed in each stage of production and produce food products that meet national and international regulatory standards and protect the health of consumers
- PC10.** design regulatory system including provisions for the right of consumers to have access to accurate and sufficient information and make adequate choices
- PC11.** provide strategic advice and cost effective strategies on regulatory aspects/requirements to senior management and project managing teams throughout the development of a new product

##### *Develop, monitor and audit regulatory system in the organisation (for food products produced)*

## Qualification Pack

To be competent, the user/individual on the job must be able to:

- PC12.** interpret regulatory standards and develop organisation standards meeting national and international food safety regulations like fssai, fda, eu food safety regulations, codex alimentarius etc for products produced, exported and imported, and labels of products packed by the organisation
- PC13.** develop and review standard operating procedures (sops) and ensure that they are in compliance with current regulatory requirements and provide regulatory support for corporate quality assurance efforts
- PC14.** develop organisation standards for labels of food products produced and packed, promotional marketing materials, products imported and exported by the organisation to meet national and international food regulatory
- PC15.** evaluate labels of packed food products to ensure it meets national and international food regulatory standards and provide approval or recommend changes
- PC16.** evaluate promotional and materials for regulatory impact and provide approval
- PC17.** provide support for review of essential documents, development and review of consent forms for submission to regulatory authorities for clearance
- PC18.** initiate and contribute to process improvements which have an impact on regulatory affairs, quality assurance and other departments
- PC19.** conduct audits on food processing unit for compliance with regulatory, safety and hygiene standards implemented and followed in the organisation
- PC20.** conduct periodic audits to evaluate haccp plans and their implementation in the organisation and ensure it meets the regulatory standards
- PC21.** review internal and external audit reports to check the effectiveness of the present regulatory system and recommend necessary changes in the policies and procedures to reduce failures in the future
- PC22.** identify reason for consumer cases in court related to non-compliance of food products to regulatory standards, collect relevant informations and documents transmitting evidence to produce in court to assist prosecution
- PC23.** monitor company progress toward fulfillment of regulatory commitments

*Provide training on regulatory system (for food products produced)*

To be competent, the user/individual on the job must be able to:

- PC24.** provide training to department managers on organisation policies on food and safety regulations, national and international food laws and regulations, methods and procedures for implementing regulations for procuring raw materials, producing food products, marketing and selling quality products to the consumers
- PC25.** provide training to all department managers on the importance of food regulatory standards and need for its compliance, statutory and regulatory requirements for the products produced, labels of packed products and promotional materials, and the consequences for not following the regulatory requirements
- PC26.** provide training on procedures for collecting evidence in case of problems/consumer complaints/consumer cases in court and handling them with technical and scientific approach
- PC27.** provide training to all department managers on methods to implement and monitor regulatory system in their area of function, writing reports with relevant information and data to present to local food regulatory authorities for any concerns raised / clarification required, methods to approach and maintain relationship with food regulatory authorities

## Qualification Pack

- PC28.** provide training on upgradation and changes in the food regulatory system and methods to implement, monitor and achieve them

### Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** principles and processes of organization
- KU2.** organisaiton goals and policies
- KU3.** business processes of the organisation
- KU4.** food regulatry system related to the process and products produced in the organisation
- KU5.** policies and proecdures for designing regulatory system for the organisaiton
- KU6.** training system in the organisation for implenting food regulatory system
- KU7.** research and project management techniques
- KU8.** code of business conduct
- KU9.** risk and information management
- KU10.** national and international legal and regulatory systems like FSSAI, FDA, CODEX alimentarius, EU food safety regulations etc, and GMP, GHP, HACCP, OHSAS etc
- KU11.** policies and procedures to be followed to meet the national and international regulatory requirements like GMP, GHP, HACCP etc
- KU12.** relevant legal requirements related to the products produced in the organisation
- KU13.** food microbiology and its standards and regulations for products produced in the organisation
- KU14.** current and emerging regulatory concerns and expectations on the organisation
- KU15.** methods to deal with current and emerging social concerns and expectations
- KU16.** processes for maintaining relevant policies and procedures and methods to ensure sustainability and effectiveness
- KU17.** methods to meet the consequence due to failure in policies and procedures and methods to review and take corrective action on people and policies
- KU18.** reporting and reviewing system to understand the effectiveness of the regulatory system implemented

### Generic Skills (GS)

User/individual on the job needs to know how to:

- GS1.** note the information communicated
- GS2.** note the raw materials used for production and the finished products produced
- GS3.** note the readings of the process parameters and provide necessary information to fill the process chart
- GS4.** note down observations (if any) related to the process
- GS5.** write information documents to internal departments/ internal teams
- GS6.** note down the data for online ERP or as per applicability in the organization

## Qualification Pack

- GS7.** read and interpret the process required for producing various types of products
- GS8.** read and interpret and process flowchart for all products produced
- GS9.** read equipment manuals and process documents to understand the equipments operation and process requirement
- GS10.** read internal information documents sent by internal teams
- GS11.** discuss task lists, schedules and activities
- GS12.** effectively communicate with team members
- GS13.** question in order to understand the nature of the problem and to clarify queries
- GS14.** attentively listen and comprehend the information given by the speaker
- GS15.** communicate clearly on the issues being faced
- GS16.** analyse critical points in day to day tasks through experience and observation and identify control measures to solve the issue
- GS17.** handle issues in case the manager is not available (as per the authority matrix defined by the organization)
- GS18.** plan and organize the work order and jobs received
- GS19.** organize raw materials and packaging materials required for all products
- GS20.** plan and prioritize the work based on the instructions received
- GS21.** plan to utilise time and equipment's effectively
- GS22.** organize all process/ equipment manuals so as to access information easily
- GS23.** support the manager in scheduling tasks for helper(s)
- GS24.** understand customer requirements and their priority and respond as per their needs
- GS25.** support manager in solving problems by detailing out problems
- GS26.** discuss the possible solutions with the manager for problem solving
- GS27.** apply domain information about maintenance processes and technical knowledge about tools and equipment
- GS28.** use common sense and make judgments on day to day basis
- GS29.** use reasoning skills to identify and resolve basic problems
- GS30.** use intuition to detect any potential problems which could arise during operations
- GS31.** use acquired knowledge of the process for identifying and handling issues

## Qualification Pack

### Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Design and develop regulatory system for the organisation (for food products produced)</i>	<b>16.5</b>	<b>27.5</b>	-	-
<b>PC1.</b> understand food safety regulations and develop regulatory policies for the organisation with clear definitions to increase consistency, legal security and to provide high level of food safety	1.5	2.5	-	-
<b>PC2.</b> design regulatory system with focus on risk reduction, risk-based priorities, reflect integrated and economically feasible initiatives, and ensure high quality and transparency	1.5	2.5	-	-
<b>PC3.</b> design and develop regulatory system with intuitive approach to food safety such that problem are recognized, understood, dealt, and checked to ensure problem has been dealt efficiently and effectively	1.5	2.5	-	-
<b>PC4.</b> design regulatory system with contingency planning like product traceability and product recall in case of problems, procedures for handling containment, with clear attribution of roles like lines of authority and co-ordination mechanism across food chain (from procuring raw materials, production until product reaching consumers)	1.5	2.5	-	-
<b>PC5.</b> design regulatory system with improved communication on food safety information in marketing materials, product labels etc, providing science based information to clear up the unjustified fear among consumers	1.5	2.5	-	-
<b>PC6.</b> set food safety system involving food producers, processors, distributors, retailers and consumers to recognize their primary responsibility and to share a common goal of ensuring food safety at all stages	1.5	2.5	-	-
<b>PC7.</b> design food regulatory system involving GMP, GHP, and monitoring systems like HACCP	1.5	2.5	-	-
<b>PC8.</b> design regulatory system that improve efficiency and compliance, build consumer confidence in the safety and quality of food products produced, processed, marketed, distributed and sold	1.5	2.5	-	-

### Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<b>PC9.</b> design and develop regulatory system ensuring food and health standards are followed in each stage of production and produce food products that meet national and international regulatory standards and protect the health of consumers	1.5	2.5	-	-
<b>PC10.</b> design regulatory system including provisions for the right of consumers to have access to accurate and sufficient information and make adequate choices	1.5	2.5	-	-
<b>PC11.</b> provide strategic advice and cost effective strategies on regulatory aspects/requirements to senior management and project managing teams throughout the development of a new product	1.5	2.5	-	-
<i>Develop, monitor and audit regulatory system in the organisation (for food products produced)</i>	<b>13.5</b>	<b>27.5</b>	-	-
<b>PC12.</b> interpret regulatory standards and develop organisation standards meeting national and international food safety regulations like fssai, fda, eu food safety regulations, codex alimentarius etc for products produced, exported and imported, and labels of products packed by the organisation	1.5	2.5	-	-
<b>PC13.</b> develop and review standard operating procedures (sops) and ensure that they are in compliance with current regulatory requirements and provide regulatory support for corporate quality assurance efforts	1.5	2.5	-	-
<b>PC14.</b> develop organisation standards for labels of food products produced and packed, promotional marketing materials, products imported and exported by the organisation to meet national and international food regulatory	1.5	2.5	-	-
<b>PC15.</b> evaluate labels of packed food products to ensure it meets national and international food regulatory standards and provide approval or recommend changes	1	3	-	-
<b>PC16.</b> evaluate promotional and materials for regulatory impact and provide approval	1	3	-	-

### Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<b>PC17.</b> provide support for review of essential documents, development and review of consent forms for submission to regulatory authorities for clearance	1	2	-	-
<b>PC18.</b> initiate and contribute to process improvements which have an impact on regulatory affairs, quality assurance and other departments	1	2	-	-
<b>PC19.</b> conduct audits on food processing unit for compliance with regulatory, safety and hygiene standards implemented and followed in the organisation	1	2	-	-
<b>PC20.</b> conduct periodic audits to evaluate haccp plans and their implementation in the organisation and ensure it meets the regulatory standards	1	2	-	-
<b>PC21.</b> review internal and external audit reports to check the effectiveness of the present regulatory system and recommend necessary changes in the policies and procedures to reduce failures in the future	1	2	-	-
<b>PC22.</b> identify reason for consumer cases in court related to non-compliance of food products to regulatory standards, collect relevant informations and documents transmitting evidence to produce in court to assist prosecution	1	2	-	-
<b>PC23.</b> monitor company progress toward fulfillment of regulatory commitments	1	2	-	-
<i>Provide training on regulatory system (for food products produced)</i>	<b>5</b>	<b>10</b>	-	-
<b>PC24.</b> provide training to department managers on organisation policies on food and safety regulations, national and international food laws and regulations, methods and procedures for implementing regulations for procuring raw materials, producing food products, marketing and selling quality products to the consumers	1	2	-	-

### Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<b>PC25.</b> provide training to all department managers on the importance of foodregulatory standards and need for its compliance, statutory and regulatoryrequirements for the products produced, labels of packed products andpromotional materials, and the consequences for not following theregulatory requirements	1	2	-	-
<b>PC26.</b> provide training on procedures for collecting evidence in case of problems/consumer complaints/consumer cases in court and handling them with technical and scientific approach	1	2	-	-
<b>PC27.</b> provide training to all department managers on methods to implement and monitor regulatory system in their area of function, writing reports with relevant information and data to present to local food regulatory authorities for any concerns raised / clarification required, methods to approach and maintain relationship with food regulatory authorities	1	2	-	-
<b>PC28.</b> provide training on upgradation and changes in the food regulatory system and methods to implement, monitor and achieve them	1	2	-	-
<b>NOS Total</b>	<b>35</b>	<b>65</b>	-	-





## Qualification Pack

### National Occupational Standards (NOS) Parameters

<b>NOS Code</b>	FIC/N9011
<b>NOS Name</b>	Design, develop and implement regulatory system
<b>Sector</b>	Food Processing
<b>Sub-Sector</b>	Fruits and Vegetables, Food Grain Milling, Dairy Products, Meat and Poultry, Fish and Sea Food, Bread and Bakery, Alcoholic Beverages, Aerated Water/Soft Drinks, Soya Food, Packaged Foods
<b>Occupation</b>	Quality Assurance
<b>NSQF Level</b>	6
<b>Credits</b>	TBD
<b>Version</b>	1.0
<b>Last Reviewed Date</b>	03/08/2021
<b>Next Review Date</b>	31/03/2022
<b>Deactivation Date</b>	31/03/2022
<b>NSQC Clearance Date</b>	03/08/2018

## Core Courses – Research and Innovation

<b>Course Name</b>	Food Product Development and Quality Evaluation	<b>Programme Name</b>	M.Sc. Food Science, Technology and Nutrition
<b>Course Code</b>	22FSTNCR01	<b>Academic Year Introduced</b>	2022 - 23
<b>Type of Course</b>	Part 1 Research	<b>Semester</b>	I

### COURSE OUTCOMES

On completion of the course, the students will be able to												
CO1	develop a concept for new food product using design thinking process											
CO2	design a new food product with the application of systematic experimental research designs											
CO3	standardise and generate the process flow chart for a new food product											
CO4	evaluate the nutritional and sensory quality of a newly developed food product											
<b>Mapping of COs with POs, PSOs</b>												
COs / POs & PSOs	PO(T)	PO(E)	PO(P1)	PO(P2)	PO(P3)	PO(P4)	PO(P5)	PO(A)	PSO1	PSO2	PSO3	PSO4
CO1	2	-	-	3	3	3	3	3	2	3	2	1
CO2	1	-	-	3	3	3	3	3	2	3	2	1
CO3	2	-	-	3	3	3	3	3	2	3	2	1
CO4	2	-	-	3	3	3	3	3	2	3	2	1
1 – Slight, 2 – Moderate, 3 – Substantial												

### COURSE OBJECTIVES AND HOURS OF INSTRUCTION

Unit/Module	Objectives	Hours of Learning and CIA F+I+PR = T
Concept Development	To learn the design thinking process to develop a concept for new food product	1+8+0 = 9
Design a New Food Product	To perceive the market need and design a new food product by applying systematic experimental design	1+11+3 = 15
Process Flow Determination	To standardize and mind map the process flow for the production of newly developed food product	4+8+0 = 12
Quality Evaluation	To evaluate the nutritional and sensory quality of the newly developed food product	1+8+3 = 12
Scientific Writing	To become competent in manuscript preparation with relevant data analysis and presentation	1+5+0 = 6
<b>Total Hours of Instruction</b>		<b>54 (18x3)</b>

F – Facilitation, I – Innovation, PR – Progress Review, T – Total, CIA – Continuous Internal Assessment

### COURSE PLAN

Module /Experiment No.	Intended Learning Chapters	CO(s) Mapped	Cognitive Level / KD	Psychomotor domain activities	Psychomotor domain level
1.	Concept Development	CO1	K3, P	Identify the market need and develop the new product concept using design thinking process	K5, S4
2.	Design a New Food Product	CO2	K4, P	Design a new food product and define the formula to meet the market need using systematic experimental designs	K6, S3
3.	Process Flow Determination	CO3	K4, P	Create a flow chart for the processing of ingredients and production of newly developed product as per the defined formula	K6, S3
4.	Quality Evaluation	CO4	K3, P	Determine the nutritional quality of new food product with defined formula and level of ingredients (Nutrify India Now App – ICMR NIN)	K4, S3
				Determine the sensory quality of the new food product	K4, S1
6.	Scientific Writing	CO6	K3, P	Preparation of competent manuscript in the designed template for publication	K5, S1

### REFERENCES

WEB REFERENCES	
1	<a href="https://bit.ly/30GcCBI">https://bit.ly/30GcCBI</a> , <a href="https://bit.ly/30DtEjZ">https://bit.ly/30DtEjZ</a> , design thinking process – Stanford D school format, <a href="https://stanford.io/3ePtVD">https://stanford.io/3ePtVD</a> ; <a href="https://static.wixstatic.com/media/87ae64_969a463e789349a7bd95bbf888590032.jpg">https://static.wixstatic.com/media/87ae64_969a463e789349a7bd95bbf888590032.jpg</a> , <a href="https://empathizeit.com/wp-content/uploads/2019/06/dschool_ProcessHexDiagram_Tool_Behaviors_final_2019.png">https://empathizeit.com/wp-content/uploads/2019/06/dschool_ProcessHexDiagram_Tool_Behaviors_final_2019.png</a> , <a href="https://www.smartsheet.com/sites/default/files/IC-defining-your-product-questionnaire.pdf">https://www.smartsheet.com/sites/default/files/IC-defining-your-product-questionnaire.pdf</a> , accessed on 23.07.2020
2	<a href="https://core.ac.uk/reader/6909038">https://core.ac.uk/reader/6909038</a> , New Product Development using Experimental Design; <a href="https://nzifst.org.nz/resources/creatingnewfoods/documents/CreatingNewFoodsCh5.pdf">https://nzifst.org.nz/resources/creatingnewfoods/documents/CreatingNewFoodsCh5.pdf</a> ; <a href="https://www.destechpub.com/wp-content/uploads/2015/01/Methods-for-Developing-New-Food-Products-preview.pdf">https://www.destechpub.com/wp-content/uploads/2015/01/Methods-for-Developing-New-Food-Products-preview.pdf</a> , accessed on 23.07.2020

Cognitive Process: K1 - Remembering K2 - Understanding K3 - Applying K4 - Analyzing K5 – Evaluating K6 - Creating  
 Knowledge Dimension: F - Factual C - Conceptual P - Procedural MC - Meta Cognitive  
 Psychomotor Domain: S1-Imitation S2-Manipulation S3-Precision S4-Articulation S5-Naturalization

3	<a href="https://online.visual-paradigm.com/de/diagrams/templates/process-flow-diagram/food-manufacturing/">https://online.visual-paradigm.com/de/diagrams/templates/process-flow-diagram/food-manufacturing/</a> , process flow preparation templates preparation software, accessed on 23.07.2020
4	Nutrify India Now App (NIN ICMR) installation through google playstore, <a href="https://bit.ly/32H5OGK">https://bit.ly/32H5OGK</a> , accessed on 23.07.2020
5	PDST, Sensory Analysis Teacher's Manual, Dublin, 2017; <a href="https://www.pdst.ie/sites/default/files/A4%20Sensory%20Analysis%20Manual.pdf">https://www.pdst.ie/sites/default/files/A4%20Sensory%20Analysis%20Manual.pdf</a>
6	<a href="https://www.scimagojr.com/journalrank.php?category=1106&amp;area=1100&amp;page=1&amp;total_size=301">https://www.scimagojr.com/journalrank.php?category=1106&amp;area=1100&amp;page=1&amp;total_size=301</a> , accessed on 09.05.2020

## *Elective Specialization 1 : Food Technology*

COURSE 1 (22FSTNE01): Technology of Non Perishable Foods

COURSE 2 (22FSTNE02): Technology of Semi Perishable and Perishable Foods

COURSE 3 (22FSTNE03): Food Testing and Certification

COURSE 4 (22FSTNE04): Foodpreneurship

<b>Course Name</b>	Technology of Non Perishable Foods	<b>Programme Name</b>	M.Sc. Food Science, Technology and Nutrition
<b>Course Code</b>	22FSTNE01	<b>Academic Year Introduced</b>	2022 - 2023
<b>Type of Course</b>	Theory	<b>Semester</b>	I

### COURSE OUTCOMES

<b>On completion of the course, the students will be able to</b>												
CO1:	Define and determine the properties of non-perishable foods											
CO2:	Value add the non-perishable foods by applying the suitable primary processing techniques											
CO3:	Value add the non-perishable foods by applying the suitable secondary and tertiary processing techniques											
CO4:	Prescribe, design and develop packaging and labelling as per FSSAI and suggest suitable storage conditions											
CO5:	Provide consultancy on plant layout, production flow, instrumentation and process control and market strategy for a food product											
<b>Mapping of COs with POs, PSOs</b>												
COs / POs & PSOs	PO(T)	PO(E)	PO(P1)	PO(P2)	PO(P3)	PO(P4)	PO(P5)	PO(A)	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	3	3	1	3	2	3	1	1	1
CO2	3	1	1	3	3	1	3	2	3	1	1	1
CO3	3	1	1	3	3	1	3	2	3	1	1	1
CO4	3	1	1	3	3	1	3	2	3	1	1	1
CO5	3	1	1	3	3	1	3	2	3	1	1	1
1 – Slight, 2 – Moderate, 3 – Substantial												

### COURSE OBJECTIVES AND HOURS OF INSTRUCTION

Unit/Module	Objectives	Hours of Instruction L+Tu+Te=To
Properties of non-perishable foods	To understand the physical, chemical and functional properties of non-perishable foods	10+3+1=14
Primary processing of non-perishable foods	To familiarize with different types of primary processing techniques, instrumentation and process control of non-perishable foods	10+3+1=14
Secondary and tertiary processing of non-perishable foods	To learn the secondary and tertiary processing techniques, instrumentation and process control on production of value added non-perishable food products	10+3+1=14
Packaging, labelling and storage of non-perishable foods	To gain knowledge and skills prescribe, design and develop packaging, labelling and storage technique of processed non-perishable foods	7+6+1=14
Production and Market Plan	To acquire professional knowledge about plant layout, production unit, logistic mechanism, market feasibility, viability and desirability of a food product from non-perishable foods	10+3+3=16
<b>Total Hours of Instruction</b>		<b>72 (18x4)</b>

L-Lecture, Tu-Tutorial, Te-Tests, To-Total Hours

### COURSE PLAN

Unit/Chapters	Intended Learning Chapters	CO(s) Mapped	Cognitive Level/KD	Psychomotor domain activities	Psychomotor domain level
<b>UNIT I: Properties of Non-Perishable Foods</b>					
1.	Introduction to non-perishable foods – cereals, millets, pulses, nuts, oilseeds, spices and condiments	CO1	K1, F	Exhibit the non-perishable foods	K3, S3
2.	Physical and Structural Properties	CO1	K2, C	Infograph on physical and structural properties of any one non-perishable food	K3, S3
3.	Chemical Properties	CO1	K2, C	Tabulate the rich source of chemical component of any one non-perishable food	K4, S3
4.	Mechanical and Thermal Properties	CO1	K2, C	Pitch on any one mechanical or thermal property of a food	K5, S4
5.	Rheological Properties	CO1	K2, C	Collect the video on determination of rheological properties of any one non-perishable food	K4, S1
6.	Optical and Electromagnetic Properties	CO1	K2, F	Script on application of	K2, S2

Cognitive Process : K1 - Remembering K2 - Understanding K3 - Applying K4 - Analyzing K5 – Evaluating K6 - Creating  
 Knowledge Dimension : F - Factual C - Conceptual P - Procedural MC - Meta Cognitive  
 Psychomotor Domain : S1-Imitation S2-Manipulation S3-Precision S4-Articulation S5-Naturalization

				optical/electromagnetic property in designing a product	
7.	Sensory Properties	CO1	K2, C	Picturize the sensory characteristics of any product objectively and subjectively	K5, S3
8.	Therapeutic Properties	CO1	K2, M	List the dietary supplements, nutraceuticals and functional foods from non-perishable foods	K4, S1
<b>UNIT II: Primary Processing of Non-Perishable Foods</b>					
9.	Instrumentation and process flow on post-harvest handling, cleaning and grading of raw materials	CO2	K2, F	Document the post-harvest farm practices of any one non-perishable food	K3, S1
10.	Instrumentation and process flow for preconditioning, decortication/dehulling of raw materials	CO2	K2, F	Videograph the preconditioning and Dehulling process of any one non-perishable food	K6, S1
11.	Instrumentation and process flow for size reduction/grinding and milling/oil expulsion of raw materials	CO2	K2, F	Videograph the milling/oil expulsion process of any one non-perishable food	K6, S1
12.	By-products management on milling/oil expulsion	CO2	K2, C	Mind map the handling of by-products on milling/oil expulsion of any one non-perishable food	K4, S1
13.	Industrial waste management from primary processing	CO2	K2, C	Pictograph the waste management from any one primary processing industry	K6, S1
<b>UNIT III: Secondary and Tertiary Processing of Non-Perishable Foods</b>					
14.	Introduction to secondary and tertiary processing of cereals, millets, pulses, nuts, oilseeds, spices and condiments	CO3	K1, C	Infograph the secondary and tertiary processed products from any one non-perishable food	K4, S4
15.	Manufacturing process, instrumentation and process control of fermented, germinated, baked, puffed, flaked, canned, fried, hydrogenated and extruded products from non-perishable foods	CO3	K2, C	Videograph the manufacturing process of any one secondary products	K6, S1
16.	Manufacturing process, instrumentation and process control of fortified foods, protein concentrates and isolates, coated, coloured and flavored products, composite and blended products, analogues and mimetics from non-perishable foods	CO3	K2, C	Videograph the manufacturing process of any one tertiary products	K6, S1
<b>UNIT IV: Packaging, Labelling and Storage of Non-Perishable Foods</b>					
17.	Packaging, labelling and storage of primary products from non-perishable foods	CO4	K1, F	Pictograph the storage mechanism of any one primary product	K4, S3
				Analyse and report the compliance of package and labelling of any one primary product	K4, S3
18.	Packaging, labelling and storage of secondary products from non-perishable foods	CO4	K1, F	Pictograph the storage mechanism of any one secondary product	K4, S3
				Analyse and report the compliance of package and labelling of any one secondary product	K4, S3
19.	Packaging, labelling and storage of tertiary products from non-perishable foods	CO4	K1, F	Pictograph the storage mechanism of any one tertiary product	K4, S3
				Analyse and report the compliance of package and labelling of any one tertiary product	K4, S3
<b>UNIT V: Production and Market Plan</b>					
20.	Plant design and layout for production of primary, secondary and tertiary products from non-perishable foods	CO5	K1, C	Infograph the plant layout of production of any one product from non-perishable foods	K4, S1
21.	Logistic mechanism of primary, secondary and tertiary products from non-perishable foods	CO5	K1, C	Mind map the logistic mechanism followed to distribute products locally, national and international wide	K4, S1
22.	Market potential of primary, secondary and tertiary products from non-perishable foods	CO5	K2, C	Evaluate and report the primary, secondary and tertiary products available in domestic/retail/digital market	K5, S1

## REFERENCES

### TEXTBOOKS

1	Durvesh Kumari, Samsher, Suneel Kumar Goyal and Suresh Chandra, (2021), Engineering Properties of Agricultural Produce, Routledge Taylor & Francis Group
2	Fellows P.J., (2009), Food processing Technology: Principles and Practice, 3 <sup>rd</sup> Edition, Woodhead Publishing Ltd., New Delhi.

Cognitive Process : K1 - Remembering K2 - Understanding K3 - Applying K4 - Analyzing K5 – Evaluating K6 - Creating  
Knowledge Dimension : F - Factual C - Conceptual P - Procedural MC - Meta Cognitive  
Psychomotor Domain : S1-Imitation S2-Manipulation S3-Precision S4-Articulation S5-Naturalization

3	Sharma, A.K. and Kumbhar, B.K. (Accessed on July, 2022), Food Processing Plant Design and Layout, Course Content for College of Food Processing Technology and Bio-Energy, AAU, agrimoon.com.
4	Robertson G.L, (2012), Food Packaging – Principles and Practice, CRC Press Taylor and Francis Group.
5	FSSAI, Food Safety and Standards (Packaging and Labelling) Regulations, 2020 and Food Safety and Standards (Labelling and Display) Regulations, 2020, www.fssai.gov.in.
6	Amalendu Chakraverty, Arun S. Mujumdar, G. S. Vijaya Raghavan, Hosahalli S. Ramaswamy, Edited (2003), Handbook of Post Harvest Technology, Marcel Dekker, Inc. New York.
<b>REFERENCE BOOKS</b>	
1	Rao M.A., Syed S.H. Rizvi, Ashim K.Datta and Jasim Ahmed, (2014), Engineering Properties of Foods, 4 <sup>th</sup> Edition, CRC Press, New York.
2	Sahay K.M. and Singh K.K., (2012), Unit Operations of Agricultural Processing, 2 <sup>nd</sup> Edition, Vikas Publishing House Pvt. Ltd., New Delhi.
3	Susanta Kumar Das and Madhusweta Das, (2019), Fundamentals and Operations in Food Process Engineering, CRC Press.
4	Eiri, (2005), Handbook of Food Packaging Technology, Engineers India Research Institute, New Delhi.
5	Kit L.Y and Dong S.L, (2012), Emerging Food Packaging Technologies – Principles and Practices, Woodhead Publishers, USA.
6	Han J.H, (2014), Innovations in Food Packaging, Second Edition, Academic Press, UK.
7	Reading Material on Supply Chain Management in Agriculture, National Institute of Agricultural Extension Management, www.manage.gov.in.
<b>JOURNALS AND DOCUMENTS</b>	
1	Journal of Food Science and Technology, AFSTI Publication
2	Annals. Food Science and Technology, Valahia University Press
3	Food Science and Human Wellness, Beijing Academy of Food Sciences
4	Journal of Food, Agriculture and Environment, WFL Publisher Ltd.
5	Natural Products and Bioprospecting, Springer.

## *Elective Specialization II : Nutrition and Health Care*

COURSE 1 (22FSTNE01): Physiology of Nutrition

COURSE 2 (22FSTNE02): Nutritional Medicine

COURSE 3 (22FSTNE03): Nutrition Care Process

COURSE 4 (22FSTNE04): Nutripreneurship

<b>Course Name</b>	Physiology of Nutrition	<b>Programme Name</b>	M.Sc. Food Science, Technology and Nutrition
<b>Course Code</b>	22FSTNE01	<b>Academic Year Introduced</b>	2022 - 2023
<b>Type of Course</b>	Theory	<b>Semester</b>	I

### COURSE OUTCOMES

<b>On completion of the course, the students will be able to</b>												
CO1:	Integrate homeostasis of the body with nutrient assimilation and utilization											
CO2:	Inculcate the role of cells in nutrient metabolism and defense mechanism of the human body											
CO3:	Apply the knowledge on respiration, neuromuscular interaction and neurotransmitters on health and wellbeing of the individual											
CO4:	Manage the body fitness and disease conditions by applying the knowledge on cardiovascular, gastrointestinal and excretory system											
CO5:	Define the role of senses in food and nutrient intake, hormones in nutrient metabolism and puberty											
<b>Mapping of COs with POs, PSOs</b>												
COs / POs & PSOs	PO(T)	PO(E)	PO(P1)	PO(P2)	PO(P3)	PO(P4)	PO(P5)	PO(A)	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	2	3	1	1	1	3	3
CO2	2	1	1	1	1	2	3	1	1	1	3	3
CO3	2	1	1	1	1	2	3	1	1	1	3	3
CO4	2	1	1	1	1	2	3	1	1	1	3	3
CO5	2	1	1	1	2	2	3	1	1	1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial												

### COURSE OBJECTIVES AND HOURS OF INSTRUCTION

Unit/Module	Objectives	Hours of Instruction L+Tu+Te=To
Homeostasis and Blood	To understand the homeostasis throughout the body, thermoregulation, water, electrolyte and acid base balance	12+2+1=15
Cells, Integumentary and Immune System	To familiarize with cells, integumentary system, lymphatic system and immune mechanism of the body	15+1+1=17
Respiratory, Nervous and Muscular System	To visualize the parts, functions and interactions of respiratory, nervous and muscular system for effective signaling towards health and wellbeing	11+1+1=13
Cardiovascular, Gastrointestinal and Excretory System	To mind map the fitness of cardiovascular, gastrointestinal and excretory system for better assimilation and utilization of nutrients in the body	10+2+1=13
Senses, Endocrine and Reproductive System	To acquire physiological nature of senses, hormones secreted by endocrine glands and its integration with reproductive system, genetics and nutrition	10+2+2=14
<b>Total Hours of Instruction</b>		72 (18x4)

L-Lecture, Tu-Tutorial, Te-Tests, To-Total Hours

### COURSE PLAN

Unit/Chapters	Intended Learning Chapters	CO(s) Mapped	Cognitive Level/KD	Psychomotor domain activities	Psychomotor domain level
<b>UNIT I: Homeostasis and Blood</b>					
1.	Structural organisation of the human body, functions of human life, requirements for human life	CO1	K1, F	Self-identify the structural organization of your body	K4, S3
2.	Introduction to homeostasis, pathways that alter the homeostasis and maintenance of homeostasis	CO1	K1, C	Schematize the mechanism of homeostasis	K5, S1
3.	Thermoregulation	CO1	K2, C	Test and document the changes in body temperature on hourly basis and justify on it	K4, S4
4.	Body composition	CO1	K1, F	Analyse your body composition	K4, S1
5.	Body fluid distribution	CO1	K1, F	Identify your body fluid distribution	K4, S2
6.	Water balance	CO1	K2, C	Determine your one day water balance status	K4, S3
7.	Electrolyte balance – sodium, potassium, calcium and phosphate balance	CO1	K2, M	Identify the electrolyte powders and formulas available in the market	K4, S1
8.	Acid-Base balance	CO1	K1, F	List the food that regulates the acid – base balance of your body as per 24 hour dietary recall information	K3, S4

Cognitive Process : K1 - Remembering K2 - Understanding K3 - Applying K4 - Analyzing K5 – Evaluating K6 - Creating

Knowledge Dimension : F - Factual C - Conceptual P - Procedural MC - Meta Cognitive

Psychomotor Domain : S1-Imitation S2-Manipulation S3-Precision S4-Articulation S5-Naturalization

9.	Blood composition	CO1	K1, F	Evaluate your blood composition	K5, S1
10.	ABO group system and Haemostasis	CO1	K1, P	Determine your blood group with Rh factor	K4, S1
<b>UNIT II: Cells, Integumentary and Immune System</b>					
11.	Cell structure, parts of the cell, cell junctions and function	CO2	K2, F	Demonstrate the cell structure and its function using existing models	K3, S1
12.	Cell building blocks, nutrient sensing, metabolism and cell growth control	CO2	K2, F	Pictorial presentation on any one nutrient sensing and cell growth control	K6, S1
13.	Dynamic adaptation of nutrient utilization in humans	CO2	K2, M	Documenting the Behavior changes before and after a food	K4, S4
14.	Skin layers and functions, types of hair, nail structure and parts of the fingernail	CO2	K1, F	Picturize the clinical symptoms of integumentary system and its linkage with nutrient deficiency	K6, S1
15.	Exocrine glands – sudoriferous (sweat glands), sebaceous, ceruminous and mammary glands	CO2	K1, F	Infograph the glands and its secretions	K6, S1
16.	Role of integumentary system in homeostasis	CO2	K2, C	Calculate sweat rate of a day	K4, S1
17.	Lymphatic system – lymph, lymphatic vessels and ducts, pathways and functions	CO2	K1, F	Exhibit the changes in the lymphatic system during infection with one example (Video mode)	K3, S3
18.	Organs, tissues and cells of the immune system	CO2	K1, F	Presentation on types of immunity	K6, S3
19.	Three defences against infection and immune response pathways	CO2	K2, C	Interpret on biochemical parameters during infection	K5, S1
20.	Nutrition and immune system	CO2	K2, C	List the nutrients involved in immune system	K2, S1
<b>UNIT III: Respiratory, Nervous and Muscular System</b>					
21.	Structure and functions of the respiratory system	CO3	K1, C	Exhibit the parts of the lungs using a lung specimen	K3, S3
22.	Lung capacity, breathing and lung mechanics, stimulation of breathing and regulation of blood pH	CO3	K2, C	Determine your lung capacity	K4, S1
23.	Homeostasis and gas exchange – internal, external and cellular respiration	CO3	K1, F	Temperature changes in the body before and after breathing exercise	K5, S5
24.	Central, peripheral and autonomous nervous system	CO3	K1, F	Exhibit the parts of the nervous system using video	K3, S1
25.	Structure and functions of nervous tissues	CO3	K1, F	Demonstrate the reflex action of a nervous tissue using an animated video	K3, S1
26.	Structure and parts of the brain	CO3	K1, F	Exhibit the parts of the brain using a brain specimen	K3, S3
27.	Limbic system of the brain, memory and learning	CO3	K2, C	Conduct a memory test which describes your limbic system	K4, S4
28.	Muscular system and mechanics of muscle contraction	CO3	K2, C	Identify the body actions related to muscle contraction and relaxation	K6, S1
29.	Neuromuscular junction and neurotransmitters	CO3	K2, C	List the neurotransmitters related to hunger and appetite	K2, S1
<b>UNIT IV: Cardiovascular, Gastrointestinal and Excretory System</b>					
30.	Structure of the heart, circulatory system and cardiovascular pathways	CO4	K1, F	Animate the blood circulation throughout the body from and to the heart	K6, S5
31.	Cardiac cycle and ECG	CO4	K1, F	Determine your heartbeat before and after any one exercise	K5, S1
32.	Digestive system, layers of GI tract and accessory organs	CO4	K1, F	Pictograph on mechanism of digestion in the gastrointestinal tract	K3, S1
33.	Sites of absorption of nutrients in the gastrointestinal tract	CO4	K2, C	Poster presentation on nutrient absorption from a food in the gastrointestinal tract	K6, S1
34.	Hunger, appetite and satiety, circadian rhythm of salivary, gastric, pancreatic and glucocorticoid secretions	CO4	K3, F	Self-detect the factors influencing your sleep-wake cycle	K6, S1
35.	Organs and functions of urinary system	CO4	K1, F	Interpret the composition of urine	K5, S1
36.	Formation of urine and maintenance of water salt balance	CO4	K1, F	Experiment the water intake vs frequency of urination	K4, S3
<b>UNIT V: Senses, Endocrine and Reproductive System</b>					
37.	Sense of taste, smell, vision/sight, hearing, touch and space and its role in food intake	CO5	K1, C	Demonstrate on any one mindful eating exercise	K4, S5
38.	Endocrine glands and its hormones	CO5	K1, F	Differentiate exocrine and endocrine glands	K4, S1
39.	Interrelationship between nutrients and hormone signaling	CO5	K2, P	Schematize the relationship between a nutrient and a hormone	K3, S2
40.	Male reproductive system – structure,	CO5	K1, C	Compare the pubertal changes in male and	K3, S1

Cognitive Process : K1 - Remembering K2 - Understanding K3 - Applying K4 - Analyzing K5 – Evaluating K6 - Creating  
Knowledge Dimension : F - Factual C - Conceptual P - Procedural MC - Meta Cognitive  
Psychomotor Domain : S1-Imitation S2-Manipulation S3-Precision S4-Articulation S5-Naturalization



	function and puberty			female	
41.	Female reproductive system – structure, function and puberty	CO5	K1, C		
42.	Nutritional determinants of timing of puberty	CO5	K1, C	Food facts and myths on timing of puberty	K5, S5

## REFERENCES

### TEXTBOOKS

1.	Sarada Subrahmanyam, Madhavankutty, K., Singh, H.D., (Reprint 2020), Textbook of Human Physiology, S Chand and Company Ltd.
2.	H.S. Ravi Kumar Patil , H.K. Makari , H. Gurumurthy & S.V. Sowmya, (2009), Textbook of Human Physiology, I.K.International Pvt. Ltd.
3.	Nitin Ashok John (Editor) and Surrinder H Singh (Review Editor), (2018), CC Chaterjee’s Human Physiology, Volume 1 and 2, Twelfth Edition, CBS Publishers and Distributors Pvt. Ltd.
4.	John E. Hall, (2011), Guyton and Hall Text Book of Medical Physiology, Twelfth Edition, Saunders Elsevier Publication.
5.	Indu Khurana and Arushi khurana, (2018), Concise Textbook of Physiology, Elsevier, Third edition.

### REFERENCE BOOKS

1.	<a href="https://en.wikibooks.org/wiki/Human_Physiology/Nutrition">https://en.wikibooks.org/wiki/Human_Physiology/Nutrition</a> ; <a href="https://upload.wikimedia.org/wikipedia/commons/c/cd/Human_Physiology.pdf">https://upload.wikimedia.org/wikipedia/commons/c/cd/Human_Physiology.pdf</a>
2.	<a href="https://resources.saylor.org/wwwresources/archived/site/wp-content/uploads/2010/11/Nutrition.pdf">https://resources.saylor.org/wwwresources/archived/site/wp-content/uploads/2010/11/Nutrition.pdf</a>
3.	<a href="https://openstax.org/books/anatomy-and-physiology/pages/1-introduction">https://openstax.org/books/anatomy-and-physiology/pages/1-introduction</a>
4.	Indu Khurana, Arushi Khurana and Narayan Kowgi, (2019), Textbook of Medical Physiology, third edition, Elsevier India.

### JOURNALS AND DOCUMENTS

1.	Human Physiology, Springer.
2.	Applied Physiology, Nutrition and Metabolism, Canadian Science Publishing.
3.	Nutrition and Metabolism, Biomed Central Publication.
4.	A Report of the Expert Group, (2020), Nutrient Requirements for Indians, ICMR-NIN, ICMR, Department of Health Research, Ministry of Health and Family Welfare, Government of India.
5.	<a href="https://www.cell.com/molecular-cell/pdf/S1097-2765(13)00053-1.pdf">https://www.cell.com/molecular-cell/pdf/S1097-2765(13)00053-1.pdf</a>
6.	<a href="https://www.nature.com/scitable/topicpage/dynamic-adaptation-of-nutrient-utilization-in-humans-14232807/">https://www.nature.com/scitable/topicpage/dynamic-adaptation-of-nutrient-utilization-in-humans-14232807/</a>