

Curriculum
of
Diploma Programme
in
Food Processing & Preservation



State Board of Technical Education (SBTE)
Bihar

Semester – III

Teaching & Learning Scheme

Board of Study	Course Codes	Course Titles	Teaching & Learning Scheme (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2449301	Bakery and Confectionery Technology	3	-	4	2	9	6
	2449302	Technology of Food Preservation	3	-	4	2	9	6
	2449303	Fruits and vegetable Technology	3	-	4	2	9	6
	2449304	Food Analysis	3	-	4	2	9	6
	2449305	Food Additives	-	-	4	2	6	3
	2449306	Summer Internship – I (After 2 nd Sem) (Common for all programmes)	-	-	2	2	4	2
	2400208	Sports, Yoga and Meditation (Common for All Programmes)	-	-	1	1	2	1
Total			12	-	23	13	48	30

Legend:

- CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)
- LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/implementation strategies)
- Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.
- TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)
- SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.
- C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

Semester - III

Assessment Scheme

Board of Study	Course Codes	Course Titles	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
	2449301	Bakery and Confectionery Technology	30	70	20	30	20	30	200
	2449302	Technology of Food Preservation	30	70	20	30	20	30	200
	2449303	Fruits and vegetable Technology	30	70	20	30	20	30	200
	2449304	Food Analysis	30	70	20	30	20	30	200
	2449305	Food Additives	-	-	20	30	20	30	100
	2449306	Summer Internship – I (After 2 nd Sem) (Common for all programmes)	-	-	10	15	10	15	50
	2400208	Sports, Yoga and Meditation (Common for All Programmes)	-	-	25	-	10	15	50
Total			120	280	135	165	120	180	1000

Legend:

- PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)
- PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)
- TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

- A) **Course Code** : 2449301(T2449301/P2449301/S2449301)
- B) **Course Title** : Bakery and Confectionery Technology
- C) **Pre- requisite Course(s)** : Food Processing and Preservation
- D) **Rationale** :

This course imparts the knowledge of utilization, milling of cereals baking and confectionary. It deals with different processes methods used to prepare bakery and confectionery products. This knowledge shall be used for selecting proper ingredients to preparing particular type of food (bread, cake, biscuits, cookies, toffees, hard boiled candy and chocolates).

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- CO-1 State the importance, nutritional composition and verities of cereal grains.
- CO-2 Draw the flow diagrams of milling of cereal grains
- CO-3 Select proper ingredient to prepare different bakery products and their roles
- CO-4 Describe production process pasta product and snack food processing.
- CO-5 Utilization of sugar and other ingredients to prepare hard boiled candy and chocolate.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	3	-		2	2	-	2		
CO-2	3	3	3	3	2	2	2		
CO-3	3	3	3	3	2	2	2		
CO-4	3	3	3	3	2	2	2		
CO-5	3	-	-	2	2	2	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Food Processing and Preservation	2449301	Bakery and Confectionery Technology	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Food Processing and Preservation	2449301	Bakery and Confectionery Technology	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

- I) **Course Curriculum Detailing:** This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units: T2449301**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 1a.</i> Importance of cereals grains <i>TSO 1b.</i> List the major and minor cereals grains in India <i>TSO 1c.</i> Describe the nutritional composition of cereal grains <i>TSO 1d.</i> List the varieties of wheat grains and their uses <i>TSO 1e.</i> List the varieties of rice and their uses. <i>TSO 1f.</i> List the varieties of corn and their uses	Unit-1.0 Structure, Varieties of Cereal Grains 1.1 Importance of Cereals, Major and minor cereal grains in India, 1.2 Nutritional composition of cereal grains- wheat, rice corn 1.3 utilization of cereals, structure of wheat grain 1.4 Varities of cereal grains : Wheat, Rice, Corn, Sorghum, Barley	CO1, CO2, CO3
<i>TSO 2a.</i> Differentiate between traditional and modern milling process. <i>TSO 2b.</i> Draw process flow diagram of modern milling of wheat <i>TSO 2c.</i> List the types and grades flours. <i>TSO 2d.</i> State the application grades of wheat flours. <i>TSO 2e.</i> Draw a flow diagram of rice milling <i>TSO 2f.</i> Draw process flow diagram parboiling of rice <i>TSO 2g.</i> Define parboiling <i>TSO 2h.</i> Process flow diagram of dry corn milling <i>TSO 2i.</i> Process flow diagram of wet corn milling <i>TSO 2j.</i> Enlist wheat milling by product and its utilization <i>TSO 2k.</i> Enlist rice milling by product and its utilization <i>TSO 2l.</i> Enlist corn milling by product and its utilization	Unit-2.0 Milling of Cereal Grains 2.1 Wheat milling : Traditional milling , Modern milling- Grain cleaning, Tempering or conditioning, Break and reduction rolls, types and grades of flour and their application 2.2 Rice milling: Define paddy, cleaning, dehusking, milling, polishing, grading , aging of rice, Parboiling of rice- steeping, steaming, drying 2.3 Corn milling : production Process Dry and wet milling of corn.	CO1, CO2, CO3
<i>TSO 3a.</i> List major and minor ingredients in bakery processing <i>TSO 3b.</i> Calculate the percentage of gluten. <i>TSO 3c.</i> calculate percentage of water absorption <i>TSO 3d.</i> calculate percentage of moisture content <i>TSO 3e.</i> Importance of gluten in baking <i>TSO 3f.</i> List bread making ingredients <i>TSO 3g.</i> Construct formula for manufacturing of bread of desired quantity. <i>TSO 3h.</i> Draw flow diagram straight dough method <i>TSO 3i.</i> Draw flow diagram sponge dough method	Unit-3.0 Bakery 3.1 Bakery Processing : Role of bakery ingredients- flour, sugar, Shortenings ,leavening agents, Eggs, water, salt 3.2 importance of wheat gluten in baking, testing of wheat flour-color test, water absorption , moisture content, gluten content, total ash. 3.3 Bread making- essential ingredients, formula construction , processing methods of bread- straight dough and Sponge dough method ,bread faults and their remedy, 3.4 Biscuits- definition, types of biscuits and steps	CO1, CO2, CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 3j.</i> List the bread faults and their remedy <i>TSO 3k.</i> Differentiate between soft wheat and hard wheat <i>TSO 3l.</i> Define biscuits and cookies <i>TSO 3m.</i> List the types of biscuits <i>TSO 3n.</i> Discuss the processing steps of biscuits <i>TSO 3o.</i> Describe cake making methods <i>TSO 3p.</i> Draw the flow diagram of sponge cake <i>TSO 3q.</i> List the types of cakes <i>TSO 3r.</i> Describe production process of cookies <i>TSO 3s.</i> List cake faults and remedies <i>TSO 3t.</i> List the equipment used in bakery industry <i>TSO 3u.</i> Application of equipment in bakery industry <i>TSO 3v.</i> Discuss the present status of baking industry in India	involved in biscuits making, 3.5 cookies- batter type cookies and foam type cookies, 3.6 cake- types of cakes-sponge cake, angel cake, pound cake 3.7 cake making methods- sugar batter method, flour batter method, blending method, boiled method, sugar water method and all in process, cake faults and remedies 3.8 Processing equipment's – Application of equipment in bakery industry	
<i>TSO 4a.</i> List the raw materials used in pasta product. <i>TSO 4b.</i> Discuss the processing steps involved in pasta making <i>TSO 4c.</i> State the characteristic of durum wheat <i>TSO 4d.</i> Define first and second generation snack food <i>TSO 4e.</i> Draw flow diagram of processing of corn chips. <i>TSO 4f.</i> Draw flow diagram of processing of tortilla chips <i>TSO 4g.</i> Draw flow diagram of extrusion processed snacks <i>TSO 4h.</i> List the products of first, second and third generation <i>TSO 4i.</i> List breakfast cereals Process flow diagram of RTE cereal flakes	Unit-4 Pasta, Snack and Breakfast Food Processing 4.1 Pasta products : role of raw materials- Durum wheat, semolina, water, production process of noodle, steps involved in pasta production – extrusion, drying and packaging 4.2 snack food processing: production process of corn chips and tortilla chips, 4.3 Extruded snacks - processing steps of extrusion snacks, Definition of first second and third generation 4.4 Breakfast cereals: categories of breakfast cereals, ready to eat (RTE)- cereal flakes	CO2, CO4
<i>TSO 5a.</i> List the role of ingredients in confectionary <i>TSO 5b.</i> Describe the role of ingredients in confectionary. <i>TSO 5c.</i> Describe the cake icing <i>TSO 5d.</i> Define fondants and creams. <i>TSO 5e.</i> Define toffees and caramels <i>TSO 5f.</i> Discuss production process of hard boiled candy with respect to ingredients and temperature <i>TSO 5g.</i> List the equipment used in confectionary industry <i>TSO 5h.</i> Draw a flow diagram of cocoa processing to produce cocoa powder and cocoa butter <i>TSO 5i.</i> Outline the chocolate processing with respect to ingredients, mixing, refining and conching.	Unit-5.0 Confectionary 5.1 Role of ingredients : sugar, liquid glucose, milk product, fat, colors, flavors 5.2 Sugar confectionary : cake icing-crumb coat and final icing coat, definition – fondants and creams, gelatin sweet, toffee and caramels, sugar boiled sweet , 5.3 Production process of hard boiled candy, 5.4 Processing equipment: application of processing equipment in confectionary 5.5 Cocoa processing: Processing of Cocoa fruit, beans, nibs. 5.6 Cocoa powder and butter, 5.7 Chocolate processing-ingredients, mixing, refining, conching	CO5

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2449301

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number (s)
<i>LSO 1.1.</i> Use of standard nutritional chart	1.	Prepare chart of nutritional values of wheat, rice, corn	CO1
<i>LSO 2.1.</i> Use of modern milling equipment <i>LSO 2.2.</i> Use of varieties of wheat grains	2	Demonstration of wheat milling process	CO2
<i>LSO 2.3.</i> Observe the industrial rice milling process <i>LSO 2.4.</i> Identify the different broken rice	3	Demonstration of rice milling process at plant	CO2
<i>LSO 3.1.</i> Use of glass ware <i>LSO 3.2.</i> Use of different types of flour	4	Calculate the percentage of water absorption of given flour sample	CO2
<i>LSO 4.1.</i> Use of hot air oven <i>LSO 4.2.</i> Use of FSSAI standards specification.	5	Determine the percentage of moisture content of given flour sample	CO2
<i>LSO 5.1.</i> Use of hot air oven, weighing balance <i>LSO 5.2.</i> Use of different flour sample	6.	Calculate percentage of gluten content of given flour sample.	CO2
<i>LSO 6.1.</i> Use of muffle furnace <i>LSO 6.2.</i> Use of FSSAI specification.	7.	Calculate percentage of total ash content of given flour sample	CO2
<i>LSO 7.1.</i> Use of dough mixer, molder, weighing balance, oven, slicer <i>LSO 7.2.</i> Use of FSSAI specification.	8.	Prepare bread by straight dough with assessment of its quality and sensory	CO3
<i>LSO 8.1.</i> Use of dough mixer, molder, oven, weighing balance <i>LSO 8.2.</i> Use of FSSAI specification	9.	Prepare biscuits with assessment of its quality and sensory	CO3
<i>LSO 9.1.</i> Use of dough mixer, molder, weighing balance, oven, cutter	10.	Prepare cookies with assessment of its quality and sensory	CO3
<i>LSO 10.1.</i> Use of cream maker, mixer, oven <i>LSO 10.2.</i> Observe the quality parameter	11.	Prepare sponge cake with assessment of its quality and sensory	CO3
<i>LSO 11.1.</i> Use of extruder, oven, frier <i>LSO 11.2.</i> Check the quality of puffed snack	12	Prepare puffed snack any one food product and sensory	CO4
<i>LSO 11.3.</i> Use of cooker, kneader, molder, wrapper machine	13	Demonstrate preparation of hard boiled candy and sensory	CO5
<i>LSO 11.4.</i> Use of mixer, blender, molder, freezer <i>LSO 11.5.</i> Observe the quality parameter of chocolate	14	Demonstrate preparation of cocoa chocolate and sensory	CO5

L) Suggested Term Work and Self Learning: S2449301 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Prepare bakery product using different cereal grain flours
2. Carryout market survey on bakery products available in local market and prepare report on it.
3. Collect the information of pasta industry and prepare report
4. Prepare confectionary products using different flavor and colors
5. Prepare review report on novel methods of preservation and their applications in bakery industry
6. Collect the information of supply chain of bakery and confectionary ingredients and storage

c. Other Activities:

1. Seminar Topics:

- Current status of bakery industry in India
- Differentiate between hard wheat and soft wheat
- Modern milling process.
- Application of bakery equipment's.
- Cocoa processing

2. Visits: Visit nearby bakery industry /confectionery industry /snack processing industry /drying industry prepare report of visit with respect to processing and preservation of food.

3. Self-learning topics:

- Varieties of wheat grain, rice, corn etc.
- Bread/ biscuit/ cookies
- Modern milling process
- Extruder process
- Chocolate manufacturing process.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	10%	10%	10%	10%
CO-2	20%	20%	25%	20%	25%	20%	20%
CO-3	35%	30%	30%	35%	25%	30%	40%
CO-4	15%	15%	15%	20%	20%	20%	15%
CO-5	15%	20%	15%	15%	20%	20%	15%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Structure, Varieties of Cereal Grains	08	CO1	10	4	2	4
Unit-2.0 Milling of Cereal Grains	08	CO2	14	4	4	6
Unit-3.0 Bakery	12	CO2, CO3	20	4	8	8
Unit-4 Pasta, Snack and Breakfast Food Processing	10	CO2, CO4	16	4	6	6
Unit-5.0 Confectionary	10	CO5	10	4	4	2
Total	48	-	70	20	24	26

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Prepare chart of nutritional values of wheat, rice, corn	CO1	40	50	10
2.	Demonstration of wheat milling process	CO2	40	50	10
3.	Demonstration of rice milling process at plant	CO2	30	60	10
4.	Calculate the percentage of water absorption of given flour sample	CO3	30	60	10
5.	Determine the percentage of moisture content of given flour sample	CO3	40	50	10
6.	Calculate percentage of gluten content of given flour sample.	CO3	40	50	10
7.	Calculate percentage of total ash content of given flour sample	CO3	40	50	10
8.	Prepare bread by straight dough with assessment of its quality and sensory	CO3	40	50	10
9.	Prepare biscuits with assessment of its quality and sensory	CO3	30	60	10
10.	Prepare cookies with assessment of its quality and sensory	CO3	40	50	10
11.	Prepare sponge cake with assessment of its quality and sensory	CO3	40	50	10
12.	Prepare puffed snack any one food product and sensory	CO4	30	60	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
13.	Demonstrate preparation of hard boiled candy and sensory	CO4	40	50	10
14.	Demonstrate preparation of cocoa chocolate and sensory	CO5	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Weighing Machine	One digital weight balance up to 20 kg and one digital analytical balance upto 500gm maximum	6,7,8,9,10,11,12,13,14,15,16,17
2.	Digital Thermometer	Standard specification	10,11,13,16,17
3.	Deck oven of	Standard specification	10,11,12,13,
4.	Rice mill of	Standard specification	3
5.	Hot air oven	Standard specification	4
6	Spiral dough mixture	Standard specification	10,11,12,13
7	Dough kinder	Standard specification	10,11,12
8	Flour shifter	Standard specification	10,11,12
9	Planetary cake mixture	Standard specification	10,11,12,13,14,
10	Dough divider	Standard specification	13
11	Bread slicer	Standard specification	10,11,
12	Dough sheeter	Standard specification	10,11

R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Handbook of cereal science and Technology	Klaus J. Lorenz, Karel kulp	Marcel Dekker, Inc 270 Madison Avenue, New York 1006 ISBN 0-8247-8358-1
2.	Bakery science and Cereal Technology	Neelam Khetarpaul, Raj Bala Grewal, Sudesh jood	Daya Publishing House New Delhi 110002
3.	Foods facts and principles	Manay, S. & Shadaksharaswami	New Age International PVT Publishers New Delhi
4.	Chocolate, cocoa and Confectionery	Bernard W. Minifie	CBS publishers & Distributors New Delhi-110002 ISBN: 81-239-0505-X
5.	Cereal Grain Quality	R.J Henry , P.S Kettlewell	Chapman & Hall , ISBN 0 412 61180 5

(b) Online Educational Resources:

- <https://www.youtube.com/watch?v=TIQB1xJ2XLk> (Structure, composition and nutritive value of Cereals, Millets and Pulses)
- <https://www.youtube.com/watch?v=F4h41Atyty8> (wheat milling process)
- <https://www.youtube.com/watch?v=QtT6ICj3Yjw> (bread process)
- https://www.youtube.com/watch?v=5vSP7oRBv_c (Extrusion technology)
- <https://www.youtube.com/watch?v=pOfu3EWXm1E> (bakery and confectionary Technology)

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. Material Handbook
2. Lab Manuals

- A) **Course Code** : 2449302(T2449302/P2449302/S2449302)
- B) **Course Title** : Technology of Food Preservation
- C) **Pre-requisite Course(s)** :
- D) **Rationale** :

This course focuses on food preservation techniques, aiming to equip students with comprehensive knowledge and practical skills in preserving food using various methods. It covers the general principles of preservation, including high-temperature processing techniques like pasteurization, sterilization, and canning, as well as low-temperature methods such as chilling, freezing, drying, and dehydration. Additionally, the course explores the use of chemical preservatives and recent advancements like high-pressure processing (HPP), pulsed electric field (PEF), ultrasound, and irradiation. By understanding these methods, students can actively contribute to reducing food waste, ensuring food security, and significantly extending the shelf life of food products.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- CO-1** Outline general principle of food preservation
- CO-2** Preserve the foods using high temperature processing techniques
- CO-3** Preserve the foods using low temperature processing techniques
- CO-4** Preserve the foods using drying and chemical preservatives
- CO-5** Outline principle of preservation of recent methods of processing

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	3	2	-	-	2	-	2		
CO-2	3	2	2	2	2	-	3		
CO-3	3	2	2	2	2	-	3		
CO-4	3	2	2	2	2	-	3		
CO-5	3	2	2	2	2	-	3		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Food Processing and Preservation	2449302	Technology of Food Preservation	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = $(1 \times \text{CI hours}) + (0.5 \times \text{LI hours}) + (0.5 \times \text{Notional hours})$

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Food Processing and Preservation	2449302	Technology of Food Preservation	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

- I) **Course Curriculum Detailing:** This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units: T2449302**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 1a.</i> Define shelf life and food preservation <i>TSO 1b.</i> Explain causes of food spoilage <i>TSO 1c.</i> Classify foods based on ease of spoilage <i>TSO 1d.</i> Draw and explain growth curve of microorganism <i>TSO 1e.</i> State general principles of food preservation <i>TSO 1f.</i> List methods of preservation <i>TSO 1g.</i> State major preservation factors	Unit-1.0 Introduction to Principles of Preservation 1.1 Definition- Food, Shelf life, spoilage, and Preservation 1.2 Causes of spoilage, classification of foods based on ease of spoilage, need for food preservation 1.3 Growth curve of microorganism, factors affecting 1.4 General principles of food preservation 1.5 List of methods of preservation, major preservation factors	CO1
<i>TSO 2a.</i> State principle of preservation of high temperature <i>TSO 2b.</i> Define- TDT , D value, z value and F value <i>TSO 2c.</i> Explain factors affecting TDT <i>TSO 2d.</i> Explain factors affecting heat penetration <i>TSO 2e.</i> Describe methods of pasteurization <i>TSO 2f.</i> State objectives of blanching <i>TSO 2g.</i> Describe working of continuous retort <i>TSO 2h.</i> Draw and explain canning as preservation technique <i>TSO 2i.</i> Identify processing parameters for preservation different food products <i>TSO 2j.</i> Explain effect of heat processing on quality of food	Unit-2.0 Use of High Temperature for Preservation 2.1 Principle of preservation of high temperature 2.2 Definitions-TDT, D value, z value, and F value 2.3 Factors affecting TDT 2.4 Factors affecting heat penetration 2.5 Pasteurization- Definition, purpose, methods, equipment's used, processing parameters for different foods 2.6 Blanching-Definition, objective, equipment's used, processing parameters for different foods 2.7 Sterilization- Definition, working of batch & continuous retort, processing parameters 2.8 Canning- Definition, typical flow diagram, equipment used, processing parameters 2.9 Effect of heat processing on quality of food	CO1, CO2
<i>TSO 3a.</i> State principle of preservation of low temperature <i>TSO 3b.</i> Identify the chilling temperature employed for storage of different foods <i>TSO 3c.</i> Draw and explain freezing curve <i>TSO 3d.</i> Explain preservative action of freezing <i>TSO 3e.</i> Describe IQF method of freezing <i>TSO 3f.</i> Explain working of different equipment's used for freezing of foods <i>TSO 3g.</i> State factors affecting chilling and frozen storage of foods <i>TSO 3h.</i> Define thawing and state the changes occur during thawing of foods	Unit-3.0 Use of low Temperature for Preservation 3.1 Principle of preservation of low temperature 3.2 Chilling -Definition, purpose, equipment used and temperature employed for different foods 3.3 Freezing-Definition, principle of preservation, freezing curve, Slow & quick freezing methods, Ice crystal formation, volume changes, equipment's used & temperature employed 3.4 Factors affecting chilling and frozen storage of food, temperature employed 3.5 Thawing- Definition, process, changes during thawing 3.6 Effect of freezing on quality of food, effect of	CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 3i.</i> Explain the effect of freezing on quality of food	frozen storage, recrystallization, freezer burn, drip, leakage	
<i>TSO 4a.</i> Define water activity and state minimum a_w values of different microbes <i>TSO 4b.</i> Explain mechanism of drying with diagram <i>TSO 4c.</i> Explain drying rate curve with diagram <i>TSO 4d.</i> Explain working of different driers <i>TSO 4e.</i> Differentiate between class I and class II preservatives <i>TSO 4f.</i> Explain the preservative mechanism of Salt and sugar <i>TSO 4g.</i> Explain preservative mechanism of Sulphur dioxide and benzoates <i>TSO 4h.</i> Explain preservative mechanism of antioxidant <i>TSO 4i.</i> Identify the permissible level of addition of chemical preservatives as per FSSAI for different foods	Unit-4.0 Use of Drying and Chemical Preservatives for Preservation 4.1 Definition- Drying, Dehydration, Concentration, Concept of water activity & minimum a_w values of different microbes, principle of preservation of drying 4.2 Mechanism of drying, Drying rate curve, factors affecting 4.3 Pretreatments given before dehydration; Equipment's (driers) used for dehydration; process parameters employed 4.4 Class I and Class II preservatives, preservative mechanism of sugar, salt & acids, concept of osmotic pressure 4.5 Preservative mechanism of Sulphur dioxide, benzoates, Nitrates and nitrites, antioxidants, mold inhibitors, Permissible level of addition as per FSSAI.	CO4
<i>TSO 5a.</i> Explain principle of preservation of irradiation <i>TSO 5b.</i> Give irradiation dose level and its purpose as per FSSAI <i>TSO 5c.</i> Explain principle of preservation of HPP. <i>TSO 5d.</i> Explain principle of preservation of Ultrasound processing. <i>TSO 5e.</i> Explain principle of preservation of PEF. <i>TSO 5f.</i> Explain principle of preservation of Hurdle technology with suitable example.	Unit-5.0 Recent Methods in Processing of Foods 5.1 Irradiation- Principle of preservation, Dose levels (kGy) and its purpose for different foods as per FSSAI, advantage, limitation, and application 5.2 High Pressure Processing (HPP)-Principle of preservation, processing parameters, advantage, limitation, and application 5.3 Ultrasound processing- Principle of preservation, limitation, and application 5.4 Pulsated Electric Field (PEF) processing - Principle of preservation, limitation, and application 5.5 Hurdle Technology- Principle, advantage, limitation, and application	CO5

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2449302

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 1.1.</i> Identify method of preservation used in given food products	1.	Identify the preservation factor and method(s) of preservation used in given food products (Any 10 samples)	CO1
<i>LSO 2.1.</i> Use pasteurization as preservation technique	2.	Preserve the given food sample using pasteurization technique (e.g. Milk)	CO1, CO2
<i>LSO 3.1.</i> Use blanching as a processing technique	3.	Demonstrate effect of blanching on quality of given food sample. (e.g., Potato)	CO2
<i>LSO 4.1.</i> Test efficacy of blanching	4.	Determine efficacy of blanching using peroxide test.	CO2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 5.1. Use freezing as a preservation technique	5.	Preserve the given food sample using freezing technique (e.g. Green peas)	CO1,CO3
LSO 6.1. Use sugar as a preservative.	6.	Prepare a food product using drying as preservation technique (e.g., Dehydrated onion powder)	CO1,CO4
LSO 7.1. Use salt a preservative	7.	Prepare a food product using sugar as a preservative. (e.g., Fruit jam)	CO1, CO4
LSO 8.1. Preserve foods using chemical preservatives	8.	Prepare a food product using salt as a preservative. (e.g., Pickle)	CO1, CO4
LSO 9.1. Estimate concentration of chemical preservative	9.	Prepare a food product using Sulphur dioxide/sodium benzoate as preservative. (e.g., Squash/Crush)	CO1, CO4
LSO 10.1. Use drying as a preservation technique	10.	Estimate the concentration Sulphur dioxide/sodium benzoate in given food sample.	CO4
LSO 11.1. Identify irradiation dose levels for different purposes for irradiation of foods.	11.	Identify irradiation dose levels for different purposes used for irradiation of foods as per FSSAI	CO5

L) Suggested Term Work and Self Learning: S2449302 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Identify the shelf life and methods of preservation used in food products available in local market.
2. Prepare a 3D model demonstrating hurdle technology
3. Prepare a food product using drying as a preservation technique
4. Prepare a food product using chemical preservatives.

c. Other Activities:

1. Seminar Topics:
 - Hurdle technology as a technique of preservation
 - Equipment's used in heat processing of food
 - IQF as preservation technique
 - Non-thermal methods of preservation
2. Visits: Visit nearby food processing industry and identify their method preservations.
3. Self-learning topics:
 - Equipment's used for sterilization
 - Equipment's used for freezing
 - Equipment's used for drying
 - Permissible limits of chemical preservatives as per FSSAI
 - Application of HPP, PEF, Ultrasound

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	10%	20%	-	20%	20%
CO-2	30%	30%	15%	20%	-	20%	20%
CO-3	20%	20%	20%	20%	33%	20%	20%
CO-4	25%	25%	25%	20%	33%	20%	20%
CO-5	10%	10%	30%	20%	34%	20%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**.: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Introduction to principles of preservation	10	CO1	10	4	4	2
Unit-2.0 Use of High Temperature for Preservation	12	CO1, CO2	14	4	6	4
Unit-3.0 Use of low temperature for preservation	8	CO1, CO3	18	6	6	6
Unit-4.0 Use of Drying and Chemical Preservatives for Preservation	10	CO1, CO4	18	4	4	10
Unit-5.0 Recent methods in processing of foods	8	CO1, CO5	10	2	4	4
Total	48	-	70	20	24	26

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Identify the preservation factor and method(s) of preservation used in given food products (Any 10 samples)	CO1	30	60	10
2.	Preserve the given food sample using pasteurization technique (e.g. Milk)	CO1, CO2	40	50	10
3.	Demonstrate effect of blanching on quality of given food sample. (e.g., Potato)	CO2	30	60	10
4.	Determine efficacy of blanching using peroxide test.	CO2	30	60	10
5.	Preserve the given food sample using freezing technique (e.g. Green peas)	CO1, CO3	30	60	10
6.	Prepare a food product using drying as preservation technique (e.g., Dehydrated onion powder)	CO1, CO4	30	60	10
7.	Prepare a food product using sugar as a preservative. (e.g., Fruit jam)	CO1, CO4	30	60	10
8.	Prepare a food product using salt as a preservative. (e.g., Pickle)	CO1, CO4	40	50	10
9.	Prepare a food product using Sulphur dioxide/sodium benzoate as preservative. (e.g., Squash/Crush)	CO1, CO4	40	50	10
10.	Estimate the concentration Sulphur dioxide/sodium benzoate in given food sample.	CO4	40	50	10
11.	Identify irradiation dose levels for different purposes used for irradiation of foods as per FSSAI	CO5	30	60	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Lab scale Pasteurizer	A bench top miniature High Temperature Short Time (HTST) system for the demonstration of the industrial pasteurisation process Includes a transparent feed tank, a feed pump, a three stage heat exchanger, a holding tube, a divert system and a hot water circulator Holding time is 15 seconds at 10 l/hr, in a stainless-steel holding tube	2
2.	Water bath	Constant Temperature Water Bath. Rectangular double walled in construction. Inner chamber made of stainless steel & outer body made of mild steel duly powder coated. Temperature range 5°C	3

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
		above ambient to 95°C. Fitted with immersion type heater, digital temperature controller cum indicator accuracy $\pm 0.5^\circ\text{C}$. Operating on 230 V AC. Fitted with circular pump with stirrer to re-circulate water at constant temperature.	
3.	Lab scale blast freezer	SS body, single door, temperature range 60 to -40°C , capacity 10 kg, air cooled	5
4.	Lab scale cabinet drier	8 tray, Maximum oven temperature capacity of 250°F (121.11°C), 36.66 cubic feet of workspace, Voltages: 240V 1-Phase, 3-Phase, 480V 1-Phase, 3-Phase, 200 lb. capacity perforated steel shelving	6
5.	Hand Refractometer	Hand refractometer of range 0 to 90°Bx	7,9
6.	Kitchen Blender	Standard kitchen blending machine	7.9

R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Food Microbiology	Food Microbiology Frazier, W.C. and Westhoff,	18th Edition, Tata McGraw Hill, Inc., New York. ISBN-10. 9781259062513
2.	Food Processing Technology Principles and Practice	P. J. Fellows	Published by Woodhead Publishing Limited ISBN 1 85573 533 4
3.	Handbook of Analysis and Quality Control for Fruit	S. Ranganna	Tata McGraw-Hill ISBN 9780074518519
4.	Handbook of Food Preservation	Shafiur Rahman M.	CRC Press, 2007 ISBN: 9781420017373
5	Emerging Technologies for Food Processing	Da-Wen Sun	Academic Press, 2005 ISBN: 9780080455648

(b) Online Educational Resources:

1. <https://www.youtube.com/watch?v=shWayTlt4hk&list=PLwdnzlV3ogoVjMjiPFEA-a-lzKPuU-L29>
2. <https://www.youtube.com/watch?v=XF4qE0pE5ZA&list=PLwdnzlV3ogoVjMjiPFEA-a-lzKPuU-L29&index=3>
3. <https://www.youtube.com/watch?v=shWayTlt4hk&list=PLwdnzlV3ogoVjMjiPFEA-a-lzKPuU-L29&index=2>
4. <https://www.youtube.com/watch?v=3qEwflif89U>
5. <https://www.youtube.com/watch?v=0XpSnRXkmCE&t=153s>
6. <https://www.youtube.com/watch?v=MIT5EU4U4sQ>
7. <https://www.youtube.com/watch?v=a4aKLHCLyD8>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

(c) Others:

1. Technology of Food Preservation by Desroiser N.W AVI Pub. Co1997
2. Food Processing Handbook by Brennan JG , ISBN: 9783527634378
3. Food Processing and Preservation by B. Sivasankar, ISBN: 9788120320864

- A) **Course Code** : 2449303(T2449303/P2449303/S2449303)
- B) **Course Title** : Fruits and Vegetables Technology
- C) **Pre- requisite Course(s)** : Food Processing and Preservation
- D) **Rationale** :

The rationale behind fruits and vegetables technology lies in addressing various challenges and opportunities associated with the production, processing, preservation, and consumption of these Fruits and vegetables are seasonal in nature, highly perishable commodities and having shortest shelf life. Fruits and vegetables are essential components of a healthy diet and contribute to overall human nutrition and well-being. This technology aims to improve efficiency, increase yield, enhance quality, extend shelf life, and minimize post-harvest losses.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- CO-1** Identify ripening changes and control ripening process.
- CO-2** Outline the manufacture process of Vegetable products as per the FSSAI standards.
- CO-3** Outline the manufacture process of fruit products as per the FSSAI standards.
- CO-4** Describe canning process and drying/dehydration of fruit and vegetable.
- CO-5** Classify the spices based on economic, origin and climatic condition.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	3	-		2	2	-	2		
CO-2	3	3	3	3	2	2	2		
CO-3	3	3	3	3	2	2	2		
CO-4	3	3	3	3	2	2	2		
CO-5	3	-	-	2	2	2	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
FPP	2449303	Fruits and Vegetables Technology	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Food Processing and Preservation	2449303	Fruits and Vegetables Technology	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

- I) **Course Curriculum Detailing:** This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units: T2449303**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 1a.</i> Outline the maturity indices of fruit and vegetables by physical, chemical, and physiological. <i>TSO 1b.</i> Explain the current scenario of fruits and vegetables in India <i>TSO 1c.</i> Identify the factors affecting ripening of fruit and vegetable. <i>TSO 1d.</i> Enlist the climacteric and non-climacteric fruit <i>TSO 1e.</i> Describe maturity Indices of fruits and vegetables. <i>TSO 1f.</i> Describe the uses of ethylene and its mechanism <i>TSO 1g.</i> Explain the preprocessing of fresh fruits and vegetables. <i>TSO 1h.</i> Differentiate between MAS and CAS <i>TSO 1i.</i> Describe the hypobaric storage and , cool storage	Unit-1.0 Maturity Indices and Ripening 1.1 Current scenario of fruits and vegetables in India. 1.2 Climacteric and non-climacteric fruits 1.3 Physiology of maturity, ripening, and senescence in fruits, and vegetables. 1.4 Maturity indices and harvesting of fruits and vegetables (physical & chemical, Physiological, etc.). 1.5 Ripening of fruits & vegetables - Respiratory changes during ripening, Physiology of ripening, 1.6 Use of ethylene and its mechanism, Use of plant growth regulators and hormones 1.7 Preservation, handling, packing and transport of fresh fruits and vegetables processing, grading, cleaning 1.8 Storage of fresh fruits and vegetables - MAS, CAS, Hypobaric storage, cool storage.	CO1
<i>TSO 2a.</i> Outline the manufacture process of various potato products <i>TSO 2b.</i> Uses of sweet potato. <i>TSO 2c.</i> Describe the manufacture process of carrot and mushroom products. <i>TSO 2d.</i> Describe the freeze drying mushroom <i>TSO 2e.</i> Explain canning of carrot <i>TSO 2f.</i> Outline the manufacture process of various tomato products. <i>TSO 2g.</i> Differentiate between tomato puree and tomato paste.	Unit-2.0 Vegetable Processing 2.1 Potato and Sweet potato Processing: Potato-Chips, Frozen patties, French fries processing, Flours and Granules Sweet potato - Chips, Flakes, Uses of sweet potato 2.2 Carrot and mushroom Processing: Carrot Processing- Toffee and Canning, Mushroom processing - Freeze drying, Pickles, Dehydration and Canning 2.3 Tomato Processing: Selection of tomatoes, pulping & processing of tomato juice, tomato puree, paste, chutney, ketchup, sauce.,	CO2
<i>TSO 3a.</i> Uses of equipment's for fruit juice processing. <i>TSO 3b.</i> Outline the manufacture process and preservation of various fruit juice products <i>TSO 3c.</i> Describe the straining, filtration and clarification process	Unit-3.0 Fruit Processing 3.1 Fruit beverages: - Types of Fruit beverages, Equipment's used for fruit juice processing, Preparation of fruit Juice- selection of fruit, preprocessing, extraction of juice, de-aeration, straining, filtration, and clarification.	CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 3d.</i> Describes the chemicals use in fruit product as a preservatives <i>TSO 3e.</i> Explain the mechanism of sulphur dioxide as a preservatives. <i>TSO 3f.</i> Outline the manufacture process of squash/ cordials/ nectars. <i>TSO 3g.</i> Outline the manufacture process of jam, jelly, and marmalades and yield calculation. <i>TSO 3h.</i> Explain fruit bars and fruit leathers	3.2 Preservation of fruit juices-Pasteurization, use of chemical preservatives, Preservation by sugars, Freezing, Drying, irradiation, Aseptic processing, carbonation, Production process of Fruit Juice, RTS, squash, cordials, nectars, concentrates and powder. 3.3 Jam, Jellies, Marmalades and Fruit preserves: role of ingredient sugar, pectin, acid, Production process of Jam, Jelly and Marmalades, Fruit preserves, Candies, Fruit leathers, bars & toffees. Calculation of jam yield from different combination of fruit and sugar.	
<i>TSO 4a.</i> Principles of canning for fruits and vegetables <i>TSO 4b.</i> Draw flow diagram of canning process. <i>TSO 4c.</i> Identify spoilage of canned foods. <i>TSO 4d.</i> Explain the types of cans use in canning process. <i>TSO 4e.</i> Principles of drying and dehydration of fruits and vegetables. <i>TSO 4f.</i> Outline the production process of drying and dehydration of fruit and vegetables <i>TSO 4g.</i> Differentiate between drying and dehydration	Unit-4. Canning and Dehydration 4.1 Canning: Principles of canning, Types of can, lacquering of can, Syrups and brines for canning, 4.2 Canning process of fruits and vegetables, 4.3 spoilage of canned food. 4.4 Drying & dehydration of fruits & vegetables : Principles of drying and dehydration, 4.5 Production process of -Raisin, Anardana, Mango bar, onion slice, Jackfruit bar, dried fig and leafy vegetables	CO2, CO3, CO4
<i>TSO 5a.</i> Describe curing techniques. <i>TSO 5b.</i> Identify defect and their causes. <i>TSO 5c.</i> Classify the spices based on economic, origin and climatic condition. <i>TSO 5d.</i> Uses and value added products of spices <i>TSO 5e.</i> Differentiate between essential oil and oleoresins. <i>TSO 5f.</i> Outline the production process of essential oil and oleoresins. <i>TSO 5g.</i> Application of essential oils and oleoresins.	Unit-5.0 Pickles, Chutneys and spices 5.1 Pickles & Chutneys : Methods of preparation, Curing techniques, Defects, their causes and prevention 5.1 Spices: Definition of spices and condiments, Classification of spices (based on economic importance, Based on origin & flavor, climatic requirement), 5.2 Uses and value added products of spices (Turmeric, Ginger, Black Pepper, Cardamom, Cloves, Cinnamon, coriander and Cumin Fenugreek, Chillies) 5.3 Essential oil and oleoresins: Definition of essential oil & oleoresins, Production process of Essential oils and oleoresins.	CO2, CO3, CO5

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2449303

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number (s)
LSO 1.1. Use of plant growth regulator LSO 1.2. Use of Penetrometer,	1.	Demonstrate the ripening of fruits by natural and artificial • Texture • Color	CO1
LSO 2.1. Use of color meter, Penetrometer LSO 2.2. Use of refractometer.	2	Determine the maturity indices by physical and chemical method	CO1
LSO 2.3. Select best quality of potato LSO 2.4. Use of deep fryer	3	Prepare potato chips	CO2
LSO 3.1. Use stem jacketed kettle LSO 3.2. Use of refractometer.	4	Demonstrate preparation of carrot toffee	CO2
LSO 4.1. Use of pupler, refractometer, steam kettle LSO 4.2. Use of FSSAI specification	5	Demonstrate preparation of tomato ketchup and sauce by using preservative.	CO2
LSO 5.1. Select of juicer, refractometer LSO 5.2. Use of FSSAI specification	6.	Demonstrate preparation of orange/ mango squash.	CO3
LSO 6.1. Use of Juicer, peeler, stem jacketed kettle, refractometer. LSO 6.2. Use of FSSAI specification	7.	Prepare the apple jam or mix fruit jam	CO3
LSO 7.1. Use of Juicer, peeler, stem jacketed kettle, refractometer LSO 7.2. Use of FSSAI specification.	8.	Prepare the guava Jelly as per FSSAI standards	CO3
LSO 8.1. Use of refractometer	9.	Demonstrate the preparation of amla candy.	CO3
LSO 9.1. Use of filler, exhaust LSO 9.2. Calculate the strength of brine and sugar syrup	10.	Demonstrate the canning process	CO2, CO3, CO4
LSO 10.1. Use of try dryer LSO 10.2. Observe the color changes	11.	Prepare raisin from grapes by using drying	CO3, CO4
LSO 11.1. Use of cutter, spices, oil LSO 11.2. Check the quality of pickles and chutneys.	12	Prepare of different types of pickles & chutneys. .	CO2, CO3, CO4
LSO 11.3. Outline the chart of value added spices.	13	Prepare chart of value-added products of spices	CO5
LSO 11.4. Use of solvent extractor LSO 11.5. Observe the extraction of oleoresins from spices	14	Demonstrate the extraction of oleoresins from spices	CO5

L) Suggested Term Work and Self Learning: S2449303 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Comparative study of natural and artificial ripening of fruits and vegetables.
2. Prepare different types of fruits and vegetables products as per FSSAI standards.
3. Survey and collect information types of fruits and vegetables products available in local market.
4. Prepare chart or model of canning process of fruits and vegetables industry.
5. Collect the information of spices/pickles/chutneys available in local market.

c. Other Activities:

1. Seminar Topics:

- Uses of ethylene and its mechanism.
- FSSAI Standards of Vegetables products.
- Fruit juice preparation and methods of juice extraction.
- Spoilage of canned food and its prevention.
- Classification of spices.

2. Visits: Visit nearby vegetables industry/fruits processing industry/canning industry/drying industry prepare report of visit with respect to processing and preservation of food.

3. Self-learning topics:

- Fruit ripening
- Prepare different types of vegetables product.
- Prepare different types of fruit product.
- Canning and drying process of fruit and vegetables
- Uses of different varieties of spices.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	10%	10%	10%	10%
CO-2	25%	25%	25%	30%	25%	25%	30%
CO-3	30%	25%	30%	30%	25%	25%	30%
CO-4	15%	15%	15%	15%	20%	20%	15%
CO-5	15%	20%	15%	15%	20%	20%	15%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

** : Mentioned under point- (N)

: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Maturity Indices and Ripening.	8	CO1	08	2	4	2
Unit-2.0 Vegetable Processing	10	CO2	16	4	6	6
Unit-3.0 Fruit Processing	12	CO3	18	4	6	8
Unit-4. Canning and Dehydration	8	CO2,CO3,CO4	14	4	4	6
Unit-5.0 Pickles, Chutneys and spices	10	CO2, CO3,CO5	14	6	4	4
Total	48	-	70	20	24	26

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Demonstrate the ripening of fruits by natural and artificial - Texture - Color	CO1	40	50	10
2.	Determine the maturity indices by physical and chemical method	CO1	40	50	10
3.	Prepare potato chips	CO2	30	60	10
4.	Demonstrate preparation of carrot toffee	CO2	30	60	10
5.	Demonstrate preparation of tomato ketchup and sauce by using preservative.	CO2	40	50	10
6.	Demonstrate preparation of orange/ mango squash.	CO3	40	50	10
7.	Prepare the apple jam or mix fruit jam	CO3	40	50	10
8.	Prepare the guava Jelly as per FSSAI standards	CO3	40	50	10
9.	Demonstrate the preparation of amla candy.	CO3	30	60	10
10.	Demonstrate the canning process	CO2, CO3, CO4	40	50	10
11.	Prepare raisin from grapes by using drying	CO3, CO4	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
12.	Prepare of different types of pickles & chutneys. .	CO2, CO3, CO4	30	60	10
13.	Prepare chart of value-added products of spices	CO5	40	50	10
14.	Demonstrate the extraction of oleoresins from spices	CO5	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Weighing Machine	One digital weight balance up to 20 kg and one digital analytical balance upto 500gm maximum	All
2.	Hot air Oven	Laboratory Hot air oven with standard specification temperature maximum 250 degree Cel.	2,3,4,11,
3.	Steam Jacketed Kettles	Both jacket and pan are fabricated with S.S.-304 grade stainless steel of heavy gauge. The pan is 2/3 jacketed which provides Maximum steam utilization and efficiency. It is available in the following capacities:25 gallons	4,5,6,7,8,9,10,
4.	FRUIT CRUSHER (CRUSHING MACHINE)	This fruit Crusher is ideal for various fruits and vegetables processing. It can be used to crush a variety of fruits and vegetables, such as berry, pear, apple, carrot, tomato, etc. Technical Parameters: • Production Capacity: 1-2T/hr • Cutter Rotational Speed: 310 rpm • Motor Power: 2.2 kW • Dimensions: 910x600x1175 (mm)	4,5,6,7,8,10,
5.	Bottle Filling Machine	This machine is suitable for accurate filling of liquids like medicines, syrups, ketchup, solutions etc. In bottles, machine consists of two/four filling heads with vaccum pump and 1/2 H.P. motor. All contact parts are of stainless steel	5,6,7,8,10,12,

R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Fruit & Vegetable Preservation	Giridharilal Sidappa and Tandon	ICAR New Delhi, ISBN-10 : 9788171640904 ISBN-13 : 978-8171640904
2.	Fruit & Vegetable Preservation Principles & Practices	R.P. Srivastava & Sanjeev Kumar	International Book distributing Co., Lucknow ISBN-10 : 8123924372 ISBN-13 : 978-8123924373
3.	Handbook of Vegetable Science & Technology	D.K. Salunkhe & S.S. Kadam	Marcel Dekker Inc., New York, ASIN : 0824701054 ISBN-10 : 8126525665 ISBN-13 : 978-0824701055
4.	Food Processing and Preservation	G. Subbulakshmi	New Age International Publishers, New Delhi, ISBN-10 : 8122412831 ISBN-13 : 978-8122412833
5	Handbook of Quality Analysis and Quality Control of Fruit & Vegetable Products	Ranganna	Tata McGraw Hill Publishing Co. Ltd., New Delhi ISBN-10 : 9780074518519 ISBN-13 : 978-0074518519

(b) Online Educational Resources:

- <https://youtu.be/Mq3fVA083L0> (Ripening of fruit)
- <https://youtu.be/xCxUjdAmQak> (Maturity Index)
- <https://youtu.be/7ksooSp2Fys> (Tomato ketchup)
- <https://youtu.be/ZozA1gHNoDA> (Jam)
- https://youtu.be/ggA7F_L-1D8 (Canning processing)
- <https://youtu.be/paDdBQYdjLU> (Drying process)
- https://youtu.be/bLw4NbJa_Rs (Spices)
- <https://youtu.be/UQk955IIjA> (Oleoresins)

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

(c) Others:

1. Material Handbook
2. Lab Manuals

- A) **Course Code** : 2449304(T2449304/P2449304/S2449304)
- B) **Course Title** : Food Analysis
- C) **Pre- requisite Course(s)** :
- D) **Rationale** :

This course is designed to provide students with a comprehensive understanding of food analysis techniques, covering both theory and practical skills. It deals with analytical techniques used for qualitative and quantitative analysis of food. This course essentially imparts the knowledge regarding sampling, proximate analysis, adulteration and advanced analytical techniques like spectroscopy and chromatography used for analysis of food. This knowledge shall be used in analysis of different constituents and parameters of food using standard test methods.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- CO-1** Draw sample for analysis of food and report the results
- CO-2** Determine the proximate constituents of food
- CO-3** Detect adulteration in food
- CO-4** Outline the principle and application of spectroscopy in analysis of food
- CO-5** Outline the principle and application of chromatography in analysis of food

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	3	-	3	2	-	-	2		
CO-2	3	2	-	2	-	-	-		
CO-3	3	3	-	2	3	-	-		
CO-4	3	3	-	2	-	-	-		
CO-5	3	-	3	3	-	3	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
FPP	2449304	Food Analysis	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
	2449304	Food Analysis	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- .
- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

- I) **Course Curriculum Detailing:** This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units: T2449304**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 1a.</i> State the accreditation requirements for FSSAI recognition of food analysis laboratory <i>TSO 1b.</i> State the safety measure to be followed inside analytical laboratory <i>TSO 1c.</i> Describe sampling procedure for different foods <i>TSO 1d.</i> Explain the factors affecting reliability of results <i>TSO 1e.</i> Define Normality, Molarity, ppm solution	Unit-1.0 Introduction to Food Analysis 1.1 Food analysis Laboratory- layout, Accreditation requirements, Staff requirement Infrastructure and Equipment requirement, Storage and Waste disposal, Safety measures 1.2 Sampling -Definition of Sample, Sampling procedure, Errors in sampling, Sample preparation of fresh, Canned Dried and pureed Fruits and vegetable. Sampling of powdery materials 1.3 Reporting results-Specificity, Accuracy, Precision, Sensitivity, Reliability and Reproducibility of results, Errors in analysis and precautions to be taken 1.4 Basics-Normality, Molarity, Percent Solution, Parts per million (ppm), Parts per billion (ppb), pH scale, buffer solution	CO1
<i>TSO 2a.</i> Explain principle of oven method and reflux distillation method of moisture estimation <i>TSO 2b.</i> Describe procedure of estimation of ash by dry ashing method <i>TSO 2c.</i> Describe procedure of estimation of titrable acidity <i>TSO 2d.</i> Explain the principle of estimation of sugar by Lane Eynon method & DNSA method. <i>TSO 2e.</i> Explain principle of working of hand refractometer <i>TSO 2f.</i> Explain the principle of estimation of protein by Micro-Kjeldahl method <i>TSO 2g.</i> Explain the principle of estimation of fat by Soxhlet method <i>TSO 2h.</i> Describe procedure to estimate crude fibre	Unit-2.0 Analysis of Proximate Constituents of Food 2.1 Moisture- Forms of water in food, Wet basis & Dry basis calculation, moisture Oven method, Reflux distillation method and Rapid infrared heating method 2.2 Ash- Definition and principle of estimation of ash, Determination of ash by dry ashing and wet ashing method 2.3 Titrable acidity-Principle of estimation of Volatile, Fixed and Total acidity, principle & method, acid factors for different types of organic acids 2.4 Sugar- Definition of reducing and non-reducing sugars, principle & procedure of Lane Eynon method & DNSA method. Measurement of ⁰Bx by Hand Refractometer 2.5 Protein- Definition of protein, Principle, Assembly & Procedure of Micro-Kjeldahl method, Protein factors for different foods 2.6 Fat- Definition of fat, Solvents used for extraction of fat, Principle, Assembly & Procedure of Soxhlet method. 2.7 Crude Fibre- Definition and significance of Crude	CO1, CO2

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	fibre, principle & procedure of crude fibre estimation.	
<i>TSO 3a.</i> Define adulteration as per FSSAI <i>TSO 3b.</i> State common adulterant and its purpose. <i>TSO 3c.</i> Explain the testing methods used to detect adulteration in Milk & Milk products <i>TSO 3d.</i> Explain the testing methods used to detect adulteration in Spices. <i>TSO 3e.</i> Explain the testing methods used to detect adulteration in Tea & Coffee <i>TSO 3f.</i> Explain the testing methods used to detect adulteration in Honey.	Unit-3.0 Adulteration in Food 3.1 Adulteration definition as per FSSAI and penalty provision in the regulation 3.2 Adulteration status in India and around the world 3.3 Purpose of adulteration and common adulterants used for adulteration 3.4 Physical and Chemical methods used for adulteration Testing of- Milk and Milk Products, Spices, Oil, Tea, Coffee, Rava, Pulses, Maida, Honey.	CO3
<i>TSO 4a.</i> Define Spectroscopy, Wavelength, Frequency <i>TSO 4b.</i> Explain Lambert's, law & Beer's law. <i>TSO 4c.</i> Describe procedure to prepare standard curve. <i>TSO 4d.</i> Explain construction, working and application of U.V. spectrophotometer. <i>TSO 4e.</i> Explain application in food analysis	Unit-4.0 Spectroscopy in Analysis of Food 4.1 Basics- Spectroscopy, Wavelength, Frequency, Monochromator, Transmittance, Absorbance, Lambert's, law, Beer's law, Standard Curve 4.2 Spectrum of light and wavelength ranges- UV, Visible and Infrared 4.3 Principle. Construction and working of U.V spectrophotometer 4.4 Preparation of standard curve/calibration curve 4.5 Application in analysis of food	CO4
<i>TSO 5a.</i> Define chromatography, Mobile phase, Stationary phase, R_f value. <i>TSO 5b.</i> Explain Paper Chromatography <i>TSO 5c.</i> Explain Thin Layer Chromatography (TLC) <i>TSO 5d.</i> Explain HPLC <i>TSO 5e.</i> Explain Gas Chromatography (GC)	Unit-5.0 Chromatography in Analysis of Food 5.1 Basics- Chromatography, Mobile phase, Stationary phase, Partition coefficient, R_f value, Retention time, Chromatogram 5.2 Paper Chromatography-Types of papers used, Principle, Construction, Working and application in analysis of food 5.3 Thin Layer Chromatography- Types of material used, Principle, Construction, Working and application in analysis of food 5.4 HPLC- Types of column used, Principle, Construction, Working and application in analysis of food 5.5 Gas Chromatography- Types of column used, Principle, Construction, Working and application in analysis of food	CO5

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2449304

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Prepare Normal, Molar, Percent Solutions	1.	Preparation of 0.1 N HCL, 0.1 N H ₂ SO ₄ , 0.1N NaOH, 0.1N KOH, 2% boric acid solution, 1.25 % H ₂ SO ₄ %, solutions.	CO1
LSO 2.1. Measure pH of any given sample of food	2.	Calibrate the pH meter and measure the pH of given food samples.	CO1
LSO 3.1. Determine moisture content in food	3.	Estimate the moisture content in given food sample by oven method	CO2
LSO 4.1. Determine °Bx of given food sample	4.	Calibrate the hand refractometer and measure °Bx of given food sample.	CO2
LSO 5.1. Determine sugar content using Lane & Eynon / DNSA method.	5.	Estimate the sugar content in given food sample using Lane & Eynon / DNSA method.	CO2
LSO 6.1. Determine protein content by Micro-Kjeldahl Method.	6.	Estimate the protein content in given food sample by Micro-Kjeldahl Method.	CO2
LSO 7.1. Determine Fat content using Soxhlet apparatus	7.	Estimate the crude fat content in given food sample using Soxhlet apparatus	CO2
LSO 8.1. Determine ash content by Dry Ashing method.	8.	Estimate the ash content in given food sample by dry ashing method.	CO2
LSO 9.1. Calculated titrable acidity of given fruit juice sample	9.	Estimate the titrable acidity of given fruit juice sample.	CO2
LSO 10.1. Test food sample for adulteration	10.	Detect the adulteration in given samples of milk & milk product/ Tea & Coffee/ Spices & Honey	CO3
LSO 11.1. Use Spectrophotometer for analysis of food	11.	Estimate Vitamin C content in given fruit juice sample by colorimetric method.	CO4
LSO 11.2. Use paper chromatography for analysis of food.	12.	Identify the food colour present in given food sample using paper chromatography.	CO5

L) Suggested Term Work and Self Learning: S2449304 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Estimate titrable acidity, pH, °Bx, and vitamin C content of fruit juice (minimum three) available in local market
2. Determine the moisture content of chocolates (minimum three) available in local market.
3. Determine the percentage of crude fat of chips (minimum three) available in local market.
4. Identify the color present in jams (minimum three) available in local market using paper chromatography.

c. Other Activities:

1. Seminar Topics:
 - Food Adulteration and its detection methods
 - Spectroscopy as a analytical technique in food technology
 - HPLC and its application in food analysis
2. Visits: Visit nearby tool room/industry with food analysis laboratory. Prepare report of visit with special comments of food analysis technique used.

3. Self-learning topics:

- Preparation of Standard solution and pH calibration
- Working of Hand refractometer
- Detection of adulteration in maida, flour
- Application of Spectroscopy in food analysis
- Application of chromatography in food analysis

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	-	-	20%	20%
CO-2	30%	30%	20%	25%	25%	40%	20%
CO-3	25%	25%	20%	25%	25%	20%	20%
CO-4	15%	15%	25%	25%	25%	10%	20%
CO-5	15%	15%	30%	25%	25%	40%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Introduction to food Analysis	8	CO1	10	4	4	2
Unit-2.0 Analysis of Proximate Constituents of Food	12	CO1, CO2	14	4	4	6
Unit-3.0 Adulteration in Food	8	CO3, CO4	18	4	6	8
Unit-4.0 Spectroscopy in Analysis of Food	10	CO3, CO4	16	4	6	6
Unit-5.0 Chromatography in Analysis of Food	10	CO4, CO5	12	4	4	4
Total	48	-	70	20	24	26

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Preparation of 0.1 N HCL, 0.1 N H ₂ SO ₄ , 0.1N NaOH, 0.1N KOH, 2% boric acid solution, 1.25 % H ₂ SO ₄ %, solutions.	CO1	30	60	10
2.	Calibrate the pH meter and measure the pH of given food samples.	CO1	50	40	10
3.	Estimate the moisture content in given food sample by oven method	CO2	60	30	10
4.	Calibrate the hand refractometer and measure °Bx of given food sample.	CO2	60	30	10
5.	Estimate the sugar content in given food sample using Lane & Eynon / DNSA method.	CO2	60	30	10
6.	Estimate the protein content in given food sample by Micro-Kjeldahl Method.	CO2	60	30	10
7.	Estimate the crude fat content in given food sample using Soxhlet apparatus	CO2	60	30	10
8.	Estimate the ash content in given food sample by dry ashing method.	CO2	60	30	10
9.	Estimate the titrable acidity of given fruit juice sample.	CO2	60	30	10
10.	Detect the adulteration in given samples of milk & milk product/ Tea & Coffee/ Spices & Honey	CO3	40	50	10
11.	Estimate Vitamin C content in given fruit juice sample by colorimetric method.	CO4	60	30	10
12.	Identify the food colour present in given food sample using paper chromatography.	CO5	60	30	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Analytical balance	Measures mass to a high degree of precision with a weighing capacity typically 200 g and a readability of 0.1 mg and protected by a draft shield or an enclosure.	1 to 12
2.	pH meter	Consisting of Tri-combination pH/ATC electrode with an electrode holder/arm with smooth movement and protection cover, Working pH Range 0-14 pH,	2
3.	Hot Air Oven	Temperature should be thermostatically controlled, It should be Ambient +5°C to 250°C with temperature setting accuracy ± 0.5 °C with forced air circulation for temperature uniformity, Separate PT 100 sensor and display for temperature	3
4.	Hand Refractometer of standard specification	Hand refractometer range 0-96 °Bx	4
5.	Micro-Kjeldahl Assembly of standard specification	3 racks with Kjeldahl tubes 250 ml or 400 ml, distillation capacity 40 ml/min, fully automated with digestion, distillation and titration facility	6
6.	Soxhlet apparatus	3 sample automatic solvent extracted Soxhlet apparatus with distillation unit	7
7.	Muffle furnace	Standard specification with Temperature range 0-800 °C.	8
8.	U.V. Spectrophotometer	Single beam spectrophotometer with Standard specification	11
9.	Paper chromatography chamber	Glass chamber of standard specification	12

R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Food analysis	Y. Pomeranz C. E. Meloan	CBS Publishers & Distributors, New Dehli ISBN- 8123904746
2.	Handbook of analysis of fruits & vegetables	S. Ranganna	Tata MacGraw-Hill ISBN-0074518518
3.	Food Analysis	Dr. S. Suzanne Nielsen	Springer New York Dordrecht Heidelberg London ISBN 978-1-4419-1477
4.	Quick methods for detection of adulterants/contaminants in common food products	BIS, New Delhi	Bureau Of Indian Standards, New Delhi. https://archive.org/details/gov.in.is.15642.1-2.2006/page/n9

(b) Online Educational Resources:

1. <https://www.youtube.com/watch?v=YP7Sai2BbZQ> (Estimation of moisture)
2. <https://www.youtube.com/watch?v=0j8DpLjImeA> (Preparation of sample)
3. <https://www.youtube.com/watch?v=SEicK9UT7pY> (Crude fat extraction)
4. <https://www.youtube.com/watch?v=TWaPfYqAt4c> (Protein estimation)
5. https://www.youtube.com/watch?v=dnyX_EVnUcM (Reducing sugar by DNSA method)
6. https://www.youtube.com/watch?v=SOl6RpPpq_0 (Crude fibre estimation)
7. <https://www.youtube.com/watch?v=xQ4FVBn63FA> (Adulteration in milk)
8. <https://www.youtube.com/watch?v=1mrUHz-0zk> (UV spectroscopy)
9. https://www.youtube.com/watch?v=9P_SliMheZk (HPLC)
10. <https://www.youtube.com/watch?v=6BJImA0M4Jo> (pH Meter calibration)

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

(c) Others:

1. [https://fssai.gov.in/upload/uploadfiles/files/Manual_Milk_25_05_2016\(1\).pdf](https://fssai.gov.in/upload/uploadfiles/files/Manual_Milk_25_05_2016(1).pdf)
2. <https://fssai.gov.in/upload/uploadfiles/files/Manual%20on%20Cereal%20and%20Cereal%20Products.pdf>
3. https://fssai.gov.in/upload/uploadfiles/files/Manual_Dairy_07_10_2022.pdf

A) Course Code	: 2449306(P2449306/S2449306)
B) Course Title	: Summer Internship -I (Common For all Programmes)
C) Pre- requisite Course(s)	:
D) Rationale	:

Diploma students are required to give exposure of their own diploma programme related industrial hardware, software and practices, just after completing one semester, so that they can correlate this industrial exposure with the concept being taught in the branch specific specialized engineering courses in forthcoming semesters. Mentors/Coordinators/ Teachers need to map the academic contents of the programme of study with the activities of this industrial exposure and are advised to follow the 'Whole to Part' approach to make the students aware about the potential industry's expected outcomes & setup ('Whole') from the diploma programme – and then teaching the related concepts ('Part') of the same in subsequent semesters. In this way before actually being exposed to academic input specific to diploma programmes, the students need to be sent to the nearby/local industries and also may be advised to explore information related to their programme of study using different sources related to potential employment opportunities of both wage and self-employment, job function, job position, nearby relevant industries and so on.

The summer internship will provide the direction to the students and also help in mind mapping to plan their futuristic course of action, after passing the diploma. This would also bridge the gap between their virtual imagination about the outcome of the programme and real happenings related to the diploma programme.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

After completion of the course, the students will be able to-

- CO-1** Comprehend the practices of identified industry or world of work related to diploma engineering programme of study.
- CO-2** Map real equipment, processes, product, management, operations etc. to the course of study through various glimpses of input, process and output in different type of industries.
- CO-3** Identify the probable enterprises /startups for futuristic planning and self-growth.
- CO-4** Identify the probable job function and job position in their relevant programme of study.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	3	-	-	1	-	-	1		
CO-2	3	-	-	1	-	-	1		
CO-3	3	-	-	-	1	-	2		
CO-4	3	-	-	-	1	-	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2449306	Summer Internship -I	-	-	02	02	04	02

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
	2449306	Summer Internship -I	-	-	10	15	10	15	50

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) **Suggested Instructional/Implementation Strategies:** Mentors/ Coordinators/ Teachers need to plan and implement the summer internship in their respective programme as per the outcome expected from the programme. However in general, summer internship would help in exploring and exposing the student to the below mentioned dimensions of the world of work. These dimensions can further be explored in depth as per the need and advancement in respective programmes in later stages. Mentors/Coordinators/ Teachers need to map the academic contents of the programme of study with the activities of this industrial exposure and are advised to follow the whole to part approach to make the students aware about the potential industry's expected outcomes & setup ('Whole') from the specific diploma programme and then teaching the related concepts ('Part') of the same in subsequent semesters.

- Industrial Layout
- Organizational Structure
- Corporate Communications
- Strategic, Rolling and Developmental plans
- Maintenance Procedures
- Inventory Control and Management System
- Purchase and Store Procedures
- Major Machinery, Tools, Equipment, Devices, Software, Control System etc.
- Product Development, Manufacturing, Packaging and Delivery
- Project Management
- Operation and Maintenance
- Warehouse Management
- Assembly Line
- Quality Assurance and Testing Cell
- Process/ Software Development/ Fabrication/ Construction Work Management
- Testing and Quality Assurance Practices
- Total quality management
- Callibration and Certification practices
- Safety Practices
- Industrial Acts
- Industrial Grievances
- Behavioural Aspects
- Conduction of Meetings and Discussions
- Sales and Marketing Strategies
- Forecasting and Target Setting
- Production Planning and Control
- Storage Retrieved and Material handling Practices
- Automation and Control Facilities
- Enterprise Resource Planning (ERP)
- Supply Chain
- Customer Satisfaction Strategies
- Finance and Accounts
- Research and Development
- Promotion and Capacity Building Schemes
- Reduce, Reuse and Recycling Efforts and Policies
- Recognitions and Rewards
- After Sale Services
- Promotional Avenues
- Social Corporate responsibilities

J) Assessment of Summer Internship -I

S. No.	Criteria of Assessment	% of Weightage
1.	Maintaining the log book after having exposure to different types of industry/ world of work	15
2.	Preparing the list of job functions and job positions of relevant programme	20
3.	Identify the probable enterprise/ startup for futuristic planning	15
4.	Report writing of summer internship as per the prescribed format	30
5.	Presentation of Report	20
Total		100

Note: S. no. 1 to 3 shall be considered for progressive assessment. While S. No. 4 & 5 shall be considered for end term assessment

- A) **Course Code** : 2449305(P2449305/S2449305)
- B) **Course Title** : Food Additives
- C) **Pre-requisite Course(s)** : Food Processing and Preservation
- D) **Rationale** :

Food additives are the substances which are intentionally added to food for technological benefits. They play important role in improving the quality and safety of food. Food additives are divided into functional classes depending upon their technological function. These mainly include Antioxidants, Preservatives, Acidity Regulators, Colours, Emulsifiers, Stabilizers, Thickeners, Sweeteners, Flavour Enhancers etc. This course essentially imparts the knowledge about application of food additive in different foods which will help to improve the quality and safety of foods.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- CO-1** Determine the food categorization code of any food product as per FSSAI & Codex database.
- CO-2** Outline functions of given functional classes of food additives
- CO-3** Select food additive for particular technological function.
- CO-4** Identify maximum level of use of given food additive in given type of food.
- CO-5** Enlist food additives permitted to be used in given food product.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	3	3	-	2	2	2	2		
CO-2	3	-	3	3	2	2	3		
CO-3	3	2	3	3	2	2	3		
CO-4	3	3	2	3	2	2	2		
CO-5	3	-	2	2	2	-	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Food Processing and Preservation	2449305	Food Additives	-	-	04	02	06	03

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Food Processing and Preservation	2449305	Food Additives	-	-	20	30	20	30	100

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

- I) **Course Curriculum Detailing:** This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units:**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 1a.</i> Define food additive, Acceptable daily limits and Maximum use level <i>TSO 1b.</i> Select food additive for particular technological function. <i>TSO 1c.</i> Identify the category of particular type of food in food categorization system. <i>TSO 1d.</i> Find maximum use level of particular food additives in particular food as per FSSAI. <i>TSO 1e.</i> Importance of food additives in particular category of food	Unit-1.0 Introduction to Food Additives 1.1 Definition – food additives, Acceptable daily intake (ADI), Good manufacturing practices (GMP), Maximum Use Level., INS number, Parts per million solution, Parts per billion solution, Calibration 1.2 Food additive in general- Justification for the use of Food Additives, Carry-Over of Food Additives into Foods, 1.3 Food categorization as per codex & FSSAI, Definition and technical purpose of Functional classes as per codex, Online Searching of function and maximum use level of particular food additives in particular food using codex database & FSSAI Regulation, 1.4 Importance of “note” while using particular food additive in particular category of food.	CO1
<i>TSO 2a.</i> Enlist name of food additives of given functional class in given type of food. <i>TSO 2b.</i> Select food additive of particular functional class for particular technological benefit. <i>TSO 2c.</i> Outline functions of given functional classes of food additives. <i>TSO 2d.</i> Identify maximum level of use of given food additive in given type of food	Unit-2.0 Acidity Regulator, Anticaking Agent, Antifoaming Agent Antioxidant, Sweeteners 2.1 Names, Application & Maximum level of use of different food additives in different foods of following functional classes as per FSSAI. 2.2 Preservatives 2.3 Acidity regulator 2.4 Anticaking agent 2.5 Antifoaming agent 2.6 Antioxidant 2.7 Sweeteners	CO2
<i>TSO 3a.</i> Enlist name of food additives of given functional class in given type of food <i>TSO 3b.</i> Select food additive of particular functional class for particular technological benefit. <i>TSO 3c.</i> Outline functions of given functional classes of food additives. <i>TSO 3d.</i> Identify maximum level of use of given food additive in given type of food.	Unit-3.0 Bleaching Agent, Bulking Agent, Filler Carbonating Agent, Carrier, Color, Color Retention Agent. 3.1 Names, Application & Maximum level of use of different food additives in different foods of following functional classes as per FSSAI. 3.2 Bleaching agent 3.3 Bulking agent 3.4 Filler 3.5 Carbonating agent 3.6 Carrier 3.7 Color	CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	3.8 Color retention agent	
<i>TSO 4a.</i> Enlist name of food additives of given functional class in given type of food. <i>TSO 4b.</i> Select food additive of particular functional class for particular technological benefit. <i>TSO 4c.</i> Outline functions of given functional classes of food additives. <i>TSO 4d.</i> Identify maximum level of use of given food additive in given type of food.	Unit-4. Emulsifier, Emulsifying salt, Firming agent , Flavor enhancer , Flour treatment agent , Raising agent 4.1 Names, Application & Maximum level of use of different food additives in different foods of following functional classes as per FSSAI. 4.2 Emulsifier 4.3 Emulsifying salt 4.4 Firming agent 4.5 Flavour enhancer 4.6 Flour treatment agent 4.7 Raising agent	CO4
<i>TSO 5a.</i> Enlist name of food additives of given functional class in given type of food <i>TSO 5b.</i> Select food additive of particular functional class for particular technological benefit. <i>TSO 5c.</i> Outline functions of given functional classes of food additives. <i>TSO 5d.</i> Identify maximum level of use of given food additive in given type of food.	Unit-5.0 Stabilizers, Thickeners, Foaming Agent, Gelling Agent, Glazing Agent, Humectants, Packaging Gas, Sequestrant . 5.1 Names, Application & Maximum level of use of different food additives in different foods of following functional classes as per FSSAI. 5.2 Stabilizers 5.3 Thickeners 5.4 Foaming agent 5.5 Gelling agent 5.6 Glazing agent 5.7 Humectants 5.8 Packaging gas 5.9 Sequestrant	CO5

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2449305

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number (s)
<i>LSO 1.1.</i> Use of weighing balance <i>LSO 1.2.</i> Use of standard weight	1.	Demonstrate calibration of weighing balance.	CO1
<i>LSO 3.1.</i> Use of codex database <i>LSO 3.2.</i> Prepare the chart of function of food additives	2	Identify functional classes of food additives using FSSAI & Codex database and prepare chart with their functions.	CO1
<i>LSO 3.3.</i> Use of online codex database site <i>LSO 3.4.</i> Collection of additives database	3	Determine the food categorization code of given food products as per FSSAI database & Codex database online	CO1
<i>LSO 4.1.</i> Differentiate between class I & class II preservatives <i>LSO 4.2.</i> Use of FSSAI manual	4	Differentiate and enlist Class I & Class II preservatives depending upon their Maximum use level and source using FSSAI & Codex database	CO2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number (s)
LSO 4.1. Use of FSSAI manual for procedure LSO 4.2. Estimate amount of sodium benzoate	5	Estimate amount of sodium benzoate in given food sample.	CO2
LSO 5.1. Use of FSSAI manual for procedure LSO 5.2. Estimate the amount of sulphur dioxide	6.	Estimate amount of sulphur dioxide in given food sample.	CO2
LSO 6.1. Prepare chart of food additives	7.	Prepare chart indicating Names, Application & Maximum level of use of food additives in functional class of Acidity regulator as per FSSAI and prepare a food product using any one Acidity regulator. (#Fruit juice)	CO2
LSO 7.1. List the specific food additive	8.	Enlist various 'Bulking agents', 'Fillers' and 'Carriers' with their maximum use level using FSSAI & Codex database	CO3
LSO 8.1. Identify and differentiate between natural and artificial colour. LSO 8.2. Use of Codex and FSSAI database	9.	Enlist & Differentiate Natural & Artificial Colours depending upon its source using FSSAI & Codex database and prepare a food product using any one 'Colour'. (#Synthetic syrup)	CO3
LSO 9.1. List the flour and raising agent LSO 9.2. Use of FAASI and codex database	10.	Identify & Enlist various 'Flour treatment agent' and 'Raising agents' with their maximum use level using FSSAI & Codex database.	CO4
LSO 10.1. Uses of Emulsifier & Emulsifying agent LSO 10.2. Use of FSSAI and Codex database	11.	Determine the maximum use level of various 'Emulsifier & Emulsifying salt' using FSSAI & Codex database and prepare a food product using any one of it. (#Ice cream)	CO4
LSO 11.1. Use of Stabilizers & Thickeners agent LSO 11.2. Use of FSSAI and Codex database	12	Determine the maximum use level of various 'Stabilizers & Thickeners' using FSSAI & Codex database and prepare a food product using any one of it. (#Milk shakes)	CO5
LSO 11.3. List the various specific additive	13	Enlist various 'Packaging gas', 'Glazing agents' and 'Sequestrants' with their maximum use level using FSSAI & Codex database	CO5
LSO 11.4. Use of Humectants and Foaming agents LSO 11.5. Use of FSSAI and codex database	14	Determine the maximum use level of various 'Humectants and Foaming agents' using FSSAI & Codex database and prepare a food product using any one "Humectant".	CO5

L) **Suggested Term Work and Self Learning: S2449305** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. **Assignments:** Questions/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Conduct survey on food products available in market having Class II preservatives and their maximum use level in that food as per FSSAI.
2. Conduct survey on food products available in market having natural & artificial colours and their maximum use level in that food as per FSSAI.
3. Conduct survey on food products available in market having antioxidants and their maximum use level in that food as per FSSAI.
4. Conduct survey on food products available in market having acidity regulators and their maximum use level in that food as per FSSAI.
5. Conduct survey on food products available in market having stabilizers & thickeners and their maximum use level in that food as per FSSAI.
6. Prepare report on the mechanism /mode of action of different preservatives.
7. Prepare report on the mechanism /mode of action of Emulsifiers.
8. Prepare report on the mechanism /mode of action of Stabilizers.

c. Other Activities:

1. Seminar Topics:

- Differentiate Natural & Artificial Colours
- Functional classes of food additives.
- Function of additives.
- Application of various additives.
- codex database & FSSAI Regulation,

2. Visits: Visit nearby vegetables industry/fruits processing industry/canning industry/drying industry prepare report of visit with respect to processing and preservation of food.

3. Self-learning topics:

- Natural and artificial colors
- Prepare different types fruit product using preservatives.
- Role of food additives.
- Differentiate between class I and Class II preservatives.
- Permitted level of sodium benzoate and sulphur dioxide in fruit product

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	-	-	15%	10%	10%	10%	10%
CO-2	-	-	25%	30%	25%	25%	30%
CO-3	--	-	30%	30%	25%	25%	30%
CO-4	-	-	15%	15%	20%	20%	15%
CO-5	-	-	15%	15%	20%	20%	15%
Total Marks	-	-	20	20	10	50	50
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: (Not Applicable)

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Demonstrate calibration of weighing balance.	CO1	40	50	10
2.	Identify functional classes of food additives using FSSAI & Codex database and prepare chart with their functions.	CO1	40	50	10
3.	Determine the food categorization code of given food products as per FSSAI database & Codex database online	CO1	30	60	10
4.	Differentiate and enlist Class I & Class II preservatives depending upon their Maximum use level and source using FSSAI & Codex database	CO2	30	60	10
5.	Estimate amount of sodium benzoate in given food sample.	CO2	40	50	10
6.	Estimate amount of sulphur dioxide in given food sample.	CO2	40	50	10
7.	Prepare chart indicating Names, Application & Maximum level of use of food additives in functional class of Acidity regulator as per FSSAI and prepare a food product using any one Acidity regulator. (#Fruit juice)	CO2	40	50	10
8.	Enlist various 'Bulking agents', 'Fillers' and 'Carriers' with their maximum use level using FSSAI & Codex database	CO3	40	50	10
9.	Enlist & Differentiate Natural & Artificial Colours depending upon its source using FSSAI & Codex database and prepare a food product using any one 'Colour'. (#Synthetic syrup)	CO3	30	60	10
10.	Identify & Enlist various 'Flour treatment agent' and 'Raising agents' with their maximum use level using FSSAI & Codex database.	CO4	40	50	10
11.	Determine the maximum use level of various 'Emulsifier & Emulsifying salt' using FSSAI & Codex database and prepare a food product using any one of it. (#Ice cream)	CO4	40	50	10
12.	Determine the maximum use level of various 'Stabilizers & Thickeners' using FSSAI & Codex database and prepare a food product using any one of it. (#Milk shakes)	CO5	30	60	10
13.	Enlist various 'Packaging gas', 'Glazing agents' and 'Sequestrants' with their maximum use level using FSSAI & Codex database	CO5	40	50	10
14.	Determine the maximum use level of various 'Humectants and Foaming agents' using FSSAI & Codex database and prepare a food product using any one "Humectant".	CO5	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Weighing Machine	One digital weight balance up to 20 kg and one digital analytical balance up to 500gm maximum	All
2.	Hot air Oven	Laboratory Hot air oven with standard specification temperature maximum 250 degree Cel.	2,3,4,5,6,7,8,,
3.	Steam Jacketed Kettles	Both jacket and pan are fabricated with S.S.-304 grade stainless steel of heavy gauge. The pan is 2/3 jacketed which provides Maximum steam utilization and efficiency. It is available in the following capacities:25 gallons	4,7,10,
4.	FRUIT CRUSHER (CRUSHING MACHINE)	This fruit Crusher is ideal for various fruits and vegetables processing. It can be used to crush a variety of fruits and vegetables, such as berry, pear, apple, carrot, tomato, etc. Technical Parameters: • Production Capacity: 1-2T/hr • Cutter Rotational Speed: 310 rpm • Motor Power: 2.2 kW • Dimensions: 910x600x1175 (mm)	4,5,6,7,8,10,
5.	Bottle Filling Machine	This machine is suitable for accurate filling of liquids like medicines, syrups, ketchup, solutions etc. In bottles, machine consists of two/four filling heads with vacuum pump and 1/2 H.P. motor. All contact parts are of stainless steel	4,5,6,7,8,10,
6	Computer and printer	Computer and printer with high-speed internet connection of standard specification	3,4,5,6,7,8,9,10,11,12,13,14,

R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	The Food Safety and Standards Act along with Rules & Regulations.	Virag Gupta	Commercial Law Publishers (India) Pvt. Ltd ISBN-978-9389564037
2.	General Standards for food additives	WHO/FAO	CODEX STAN 192-1995, Revised 2018 http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/gafa/en
3.	Food safety and standards (food products standards and food additives) regulations, 2011	FSSAI, India	https://www.fssai.gov.in/upload/uploadfiles/files/Compendium_Food_Additives_Regulations_29_03_2019.pdf
4.	Handbook of analysis of fruits & vegetables	S. Ranganna	Tata MacGraw-Hill ISBN-0074518518

(b) Online Educational Resources:

- 1) <http://www.fao.org/fao-who-codexalimentarius/en/> (Food additive database of codex)
- 2) <https://www.fssai.gov.in/> (Food additive database of FSSAI)
- 3) <https://www.youtube.com/watch?v=ub-XdapCo18> (Introduction to food additives)
- 4) <https://www.youtube.com/watch?v=Hy3-QHhzyPE> (Food additive meaning)
- 5) https://www.youtube.com/watch?v=QwFI_PbEj1E (Role of preservative)
- 6) <https://www.youtube.com/watch?v=Ut9uSIK-f-8> (food additive functions)

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

(c) Others:

1. Material Handbook
2. Lab Manuals

- A) **Course Code** : 2400208(P2400208/S2400208)
- B) **Course Title** : Sports, Yoga and Meditation (Common for all Programmes)
- C) **Pre- requisite Course(s)** :
- D) **Rationale**

Sports or Physical Education, Yoga and Meditation is an integral part of a person's overall well-being and is imperative for a healthy mind and body balance. So, it is necessary that every educational institutes should lay ample emphasis on including sports, yoga and meditation as a necessary part of education, however, it depends on how it is introduced in the curriculum makes all the difference. Sports, Yoga and Meditation plays a very important role in overall Well-being for a good personality, develops value system, sense of friendliness, feeling of togetherness thereby developing team spirit and mutual cooperation. Its also plays a major role in reducing level of stress/anxiety and add to the mental toughness. Looking to the ample benefits there is need to inculcate sports, Yoga and meditation as a day to day habit and imparting education related to physical education is more critical than ever before.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

CO-1 Select appropriate physical activities to maintain healthy lifestyle.

CO-2 Apply basic principles and practices of Yoga and meditation for overall growth & development.

CO-3 Use fitness and wellness techniques for optimal health and wellbeing

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Developm entof Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Managem ent	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	3	3	3	-	1	-	2		
CO-2	3	3	3	-	1	-	2		
CO-3	3	3	3	-	1	-	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2400208	Sports, Yoga and Meditation	-	-	01	01	02	01

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
	2400208	Sports, Yoga and Meditation	-	-	25	-	10	15	50

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

- I) **Course Curriculum Detailing:** This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units:**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO.1a</i> Differentiate between given terms used in sports <i>TSO.1b</i> Discuss the different aspects of Mental Toughness <i>TSO.1c</i> Use Imagery Training for sports <i>TSO.1d</i> Apply motivation techniques to motivate students in sports. <i>TSO.1e</i> Use concentration techniques for playing and exercising. <i>TSO.1f</i> Manage Stress, Anxiety and Arousal during sports. <i>TSO.1g</i> Select sports and exercise for healing and developing health and mental wellness <i>TSO.1h</i> Discuss the impact of parents' involvement in their children's sports activities <i>TSO.1i</i> Select sports and exercises for physically challenged as per their need.	Unit-1.0 Sports and Exercises 1.1 Definition of play, game, sports, exercise, psychology, sports psychology and exercise psychology, psychology and common sense. 1.2 Mental toughness- mind, Imagery, use of imagery and imagery in sports, types of imagery (visual, kinesthetic, auditory and olfactory) 1.3 Motivation in sport and goalsetting in sports 1.4 Arousal regulation – self-awareness of regulation, anxiety reduction techniques- somatic anxiety reduction techniques, cognitive Anxiety reduction, multimodal anxiety reduction, coping with stress. Arousal -inducing techniques. Arousal and anxiety measurement factors, Arousal and anxiety signs recognition 1.5 Nutrition and rehabilitation, Importance of concentration and attentional focus in sports and training, Impact of health on healing from physical athletic injuries. Impact of exercise to increase mental wellness, Role of coach in sports, parents' involvement in their children's sports activities. 1.6 Adaptation of sports and exercises for physically challenged students in all levels.	CO1
<i>TSO.2a</i> Identify the physiology of yoga and meditation. <i>TSO.2b</i> Evaluate meditation and yoga as a healing modality. <i>TSO.2c</i> Select asanas and pranayama as per need. <i>TSO.2d</i> Discuss the effect of yoga and meditation on ageing, stress and hypertension. <i>TSO.2e</i> Select mediation techniques as per the need. <i>TSO.2f</i> Discuss Bandha, Mudra and Chakra <i>TSO.2g</i> Discuss the steps of Suryanamaskar. <i>TSO.2h</i> Select Yoga and Meditation for physically challenged as per their need.	Unit-2.0 Yoga and Meditation 2.1 Importance of Yoga & Meditation in daily life, Definition and meaning of the term Yoga and Meditation, Fundamentals Principles of Yoga & Fitness training 2.2 Difference between yoga asana and physical exercises, Difference between yoga and meditation 2.3 Role of Yoga and Meditation in Purificatory Process, in character building, developing concentration, will power and discipline 2.4 Types of Yoga Practices - Asanas, Pranayama, Meditation 2.5 Mindfulness – knowing the mind, training the mind, feeling the mind 2.6 Different Methods of meditation, Physiology of meditation, Mental, physical and emotional benefits of Asanas, Pranayama, Concentration and Meditation 2.7 Bandha, Mudra and Chakra	CO2

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	2.8 Effects of Asanas and pranayama on physiology of human body 2.9 Importance of "Suryanamaskar" 2.10 Adaptation of Yoga and meditations for physically challenged students in all levels. 2.11 Yoga Asanas Do's and Don'ts for Beginners	
<i>TSO.3a</i> Identify the different factors affecting the fitness and wellness in the given situation <i>TSO.3b</i> Use different methods to maintain Health and Wellness <i>TSO.3c</i> Discuss the components of Balance Diet <i>TSO.3d</i> Identify the causes of stress and anxiety in the given situation <i>TSO.3e</i> Use stress reduction techniques to manage Stress and Anxiety <i>TSO.3f</i> Manage Stress, Anxiety and Depression in the given situation <i>TSO.3g</i> Select recovery process for energy replenishment after exercise.	Unit 3.0 Fitness and Wellness 3.1 Meaning, Importance, Definition and dimensions of Health and Wellness (WHO/Yoga) 3.2 Factors affecting Fitness and Wellness 3.3 Role of Physical Activities and Recreational Games in maintaining physiological and psychological wellbeing. 3.4 Different Methods to Maintain Health, Wellness and to enhance mood 3.5 Nutrition for Health & Wellness, Relationship between Diet and Fitness Components of Balance Diet and its importance – Carbohydrates, Protein, Fat, Vitamins & Minerals, Water, Healthy Lifestyle through Diet and Fitness 3.6 Anxiety, Stress and Aging-Meaning of Anxiety, Stress and Aging, Types and Causes of Stress, 3.7 Stress, anxiety and depression reduction with exercise, yoga and meditation 3.8 Energy Continuum and Recovery Process, Metabolism and exercise, Recovery from exercise, Replenishment of energy stores during recovery process, Removal of excess lactic acid produced during exercise	CO3

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400208

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 1.1.</i> Perform various sports activities for overall growth and development <i>LSO 1.2.</i> Select suitable sport activities as per your need.	1.	Track & Field: Running, Jumping, walking and Throwing, Cycling Event to develop Endurance, Speed, Strength, Agility, Flexibility etc	CO1
	2.	Aerobics and Gymnastics to develop Strength, Agility and Flexibility	
	3.	Net/Wall Sports – Volleyball and Basketball to develop Endurance, Speed, Strength, Agility and Flexibility	
	4.	Striking & Fielding sports like Cricket, bowling, Hockey, Football Baseball etc. to develop Endurance, Speed, Strength, Agility, Flexibility and Coordination	
	5.	Racket Game- Tennis, Badminton, Table tennis etc to develop Endurance, Speed, Strength, Agility and Flexibility	
	6.	Outdoor games: Kho-Kho and Kabaddi and cycling develop Endurance, Speed, Strength, Agility and Flexibility	

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
	7.	Indoor games: Chess and Carrom, Swimming, Boxing, Karate Weightlifting, Power Lifting, Physique Training, Archery, Roller Skating etc to develop concentration.	
	8.	Prepare and organize Adapted Sports for various levels of physically challenged and impairments.	
LSOs 2.1 Perform various yogic techniques for internal purification and development.	9.	Shat Karmas: Tratakam, Jala-Neti, Sutra-Neti, Vamana Dhauti, Danda Dhauti, Agnisara, Nauli	CO2
	10.	Perform following asanas with correct posture: Ardha-Padmasana [virasana], Ardha-Halasana, Pavana-Muktasana, Naukasana, Ardha-shalabhasana, Shalabhasana, Makarasan, Bhujangasana, Dhanurasana	
	11.	Perform following asanas with correct posture: Vakrasana, Chakrasana, Paschimottanasana, Ugrasana, Gomukhasana, Padmasana, Siddhasana, Bhadrasana, Swastikkasana, Vajrasana, Supta-Vajrasana, Yoga-Mudra	
	12.	MUDRAS & SURIYANAMASKAR Brahma-Mudra, Simha-Mudra, Shanmugi Mudra, Viparithakarani-Mudra, Ashwini-Mudra, Suriyanamaskar	
	13.	BANDHAS Jalandhara-Bandha, Jihva-Bandha, Uddiyana Bandha, Moola-Bandha	
	14.	PRANAYAMAS Nadi-Shuddhi, Nadi-Shodhana, Suryabhadana, Ujjayi, Bhastrika Pranayama, Bhramari Pranayama, Sitkari, Sitali, Kapalabhati	
	15.	MEDITATION -Silent Meditation	
	16.	MEDITATION – Mantra Meditation	
LSO 3.1. Prepare diet chart for optimal health and wellbeing	17.	Prepare a diet chart for the given sport.	CO3
LSO 3.2. Use health monitoring device	18.	Measure heart rate and heart function with health monitoring device	
	19.	Measure blood sugar and blood pressure	
LSO 3.3. Use different equipment's	20.	Use massage therapy equipment, Hot and cold therapy equipment, Ultrasound therapy equipment	
LSO 3.4. Identify your own threshold and identification level for different taste Stimulations	21.	Determine the taste threshold for three different sensations- sweet salty and sour	
LSO 3.5. Check the given sample for conformance to the standard for moisture content.	22.	Determine the moisture content in the given sample of oil/fat	
LSO 3.6. Purity tests of oils/fats	23.	Determine the impurities in the given sample of oil.	
LSO 3.7. Acidity test in given sample of fat/oil	24.	Determines the acid value and free fatty acids in the given sample of oil/fat.	
LSO 3.8. Check whether any given samples of oils/fats conform to the standard.	25.	Determine the peroxide value in the given sample of fat or oil.	

- L) Suggested Term Work/ Activities and Self Learning: S2400208** Some sample suggested assignments, micro project and other activities are mentioned here for reference.
- a. Assignments:** Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.
- Calculate your Body Composition (BMI) and Cardiovascular Assessment
 - Assessment for Muscular Endurance, Muscular Strength,
 - Flexibility, Cardio-respiratory Endurance, Body Composition
 - Rules and Regulations of different indoor and outdoor games.
- b. Micro Projects:**
- Identify and synthesize the factors that influence health in various situations (05 situations). Prepare a report with details of situations and solutions to remove the factors.
 - Visit different sports club, gyms, and schools and identify various measure taken by them for Fitness and wellness of students/ members
 - Visit different sports club, gyms, and schools and identify various measure taken by them for Fitness and wellness of physically challenged students/ members
 - Identify which type of stress, anxiety and depression students are facing and steps and solutions to overcome this.
- c. Other Activities:**
1. Seminar Topics:
 - Identify the health-related challenges in current time and able to apply the preventive measures.
 - Role of peers, community and media in health and wellbeing in each level
 - Knowledge and skills required to preserve community health and well-being
 - Effect of yoga and meditation in maintaining fitness.
 - Methods to involve physically challenged students /members in all levels in sports, yoga and meditation in community.
 - Counselling techniques to counsel players in matters of handling success and failure.
 2. Visits: Visit nearby sports complex, Gyms, stadium etc and prepare a report on hygiene maintenance, medical facilities available, facilities available for physically challenged members, facilities available for old aged members, tools and equipment available and training facilities.
 3. Self-learning topics:
 - Anatomy and physiology of human being
 - Role of Yoga and Meditation in Purificatory Process, in character building, developing concentration, will power and discipline
 - Mindfulness
 - Different Methods to Maintain Health, Wellness and to enhance mood
 - Diet and Nutrition
 - Metabolic adaptations to exercise
 - Cardio-respiratory changes

- M) Suggested Course Evaluation Matrix:** The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	-	-	35%	35%	35%	35%	35%
CO-2	-	-	35%	35%	35%	35%	35%
CO-3	-	-	30%	30%	30%	30%	30%
Total Marks	-	-	10	10	05	10	15
			25				

Legend:

- *: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
 **: Mentioned under point- (N)
 #: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: (Not Applicable)

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Track & Field: Running, Jumping, walking and Throwing, Cycling Event to develop Endurance, Speed, Strength, Agility, Flexibility etc	CO1	30	60	10
2.	Aerobics and Gymnastics to develop Strength, Agility and Flexibility		30	60	10
3.	Net/Wall Sports – Volleyball and Basketball to develop Endurance, Speed, Strength, Agility and Flexibility		30	60	10
4.	Striking & Fielding sports like Cricket, bowling, Hockey, Football Baseball etc. to develop Endurance, Speed, Strength, Agility, Flexibility and Coordination		30	60	10
5.	Racket Game- Tennis, Badminton, Table tennis etc to develop Endurance, Speed, Strength, Agility and Flexibility		30	60	10
6.	Outdoor games: Kho-Kho and Kabaddi and cycling develop Endurance, Speed, Strength, Agility and Flexibility		30	60	10
7.	Indoor games: Chess and Carrom, Swimming, Boxing, Karate Weightlifting, Power Lifting, Physique Training, Archery, Roller Skating etc to develop concentration.		30	60	10
8.	Prepare and organize Adapted Sports for various levels of physically challenged and impairments.		30	60	10
9.	Shat Karmas	CO2	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
	Tratakam, Jala-Neti, Sutra-Neti, Vamana Dhauti, Danda Dhauti, Agnisara, Nauli				
10.	Perform following asanas with correct posture: Ardha-Padmasana [virasana], Ardha-Halasana, Pavana-Muktasana, Naukasana, Ardha-shalabhasana, Shalabhasana, Makarasan, Bhujangasana, Dhanurasana		40	50	10
11.	Perform following asanas with correct posture: Vakrasana, Chakrasana, Paschimottanasana, Ugrasana, Gomukhasana, Padmasana, Siddhasana, Bhadrasana, Swastikkasana, Vajrasana, Supta-Vajrasana, Yoga-Mudra		40	50	10
12.	MUDRAS & SURIYANAMASKAR Brahma-Mudra, Simha-Mudra, Shanmugi Mudra, Viparithakarani-Mudra, Ashwini-Mudra, Suriyanamaskar		40	50	10
13.	BANDHAS Jalandhara-Bandha, Jihva-Bandha, Uddiyana Bandha, Moola-Bandha		40	50	10
14.	PRANAYAMAS Nadi-Shuddhi, Nadi-Shodhana, Suryabhadana, Ujjayi, Bhastrika Pranayama, Bhramari Pranayama, Sitkari, Sitali, Kapalabhati		40	50	10
15.	MEDITATION -Silent Meditation		40	50	10
16.	MEDITATION - Mantra Meditation		40	50	10
17.	Prepare a diet chart for the given sport.	CO3	40	50	10
18.	Measure heart rate and heart function with health monitoring device		40	50	10
19.	Measure blood sugar and blood pressure		40	50	10
20.	Use massage therapy equipment, Hot and cold therapy equipment, Ultrasound therapy equipment		40	50	10
21.	Determine the taste threshold for three different sensations-sweet salty and sour		40	50	10
22.	Determine the moisture content in the given sample of oil/fat		40	50	10
23.	Determine the impurities in the given sample of oil.		40	50	10
24.	Determines the acid value and free fatty acids in the given sample of oil/fat.		40	50	10
25.	Determine the peroxide value in the given sample of fat or oil.		40	50	10

Note: -All the above Games can be selected from the list of SGFI/AIU/IOA

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
1.	High end computers for record keeping	Processor Intel Core i7 with Open GL Graphics Card, RAM 32 GB, DDR3/DDR4, HDD 500 GB, Graphics Card NVIDIA OpenGL 4 GB, OS Windows 10	All
2.	Aerobics and Gymnastic	Basic facilities and equipment's – Balance Beams, Gymnastic Ball, Gymnastic Chalk, Gymnastic Clubs, Flex Floor Systems, High Bars, Hoops, Horizontal Bars, Leotards, Music, Parallel Bar, Pommel Horses, Ribbons, Rings, Ropes, Single Bar Trainer, Spotting Blocks, Streamers, Trampoline, Tumble Track, Uneven Bar, Vault, Vault Spring Board Gymnastic Accessories – Chalk, Grips, Wrist Supports, Mat, Tape, Socks Singlets, Pants Shoes, Shorts Aerobics- Resistance bands, Jump rope, Step bench or box, Abdominal wheel, Exercise mat, Gliding discs, dumbbells, fitness trampolines, hoops	2
3.	Striking & Fielding sports	Complete Cricket Kit, Football Kit, Bowling Kit, Hockey Kit	4
4.	Net/Wall Sports	Complete Volley Ball and basketball kit	3
5.	Racket Game	Complete Tennis Kit, Table Tennis Kit and badminton kit	5
6.	Outdoor games	Complete Kho-Kho and Kabaddi and cycling kit	6
7.	Indoor games	Complete Chess kit, Carrom kit, Swimming kit, Boxing kit, Karate kit, Weightlifting kit, Power Lifting kit, Archery kit and Roller-Skating kit	7
8.	Physique Training	Cardio Machines- Treadmills, Elliptical Trainers, Exercise Bikes, Rowing Machines, Indoor Bikes, Vibration Machines, Steppers Recumbents Dumbbells, Multi-Purpose Bench, power rack, Adjustable Dumbbell Set 2 x 3-10 kg, Exercise mat, resistance band, balance trainer	7
9.	Sports and wellbeing equipment's for physically challenged and impairments.	Fusion Wheel – all-in-one portable wheelchair gym, Pedal exerciser, Deluxe hand exerciser, Greeper sports shoelaces, Active Hands, Ramble Tag Guidance Aid, Cat Tongue Grip Tape Adaptive Cycling- Straps, Leg/ Foot Adapters, Prosthetics, Steering Dampener, Handlebar Adapters, HANDCYCLING- Wheelchairs, Bike-On Handcycles, Trikes, Racing Wheelchairs, Trikes, Recumbent Bikes, All-terrain Handcycles, Mono Cycling, Hand Bikes - Off-Road, Cross Country, Racing, Downhill Archery - Field Tripod and Quad Mounts (Archery & Gun), In-Line Draw-Loc, Mounts (Archery & Gun), Stands (Gun), Mounts (Archery & Gun) Binoculars and Rests (Gun), Crossbows (Archery), Wheelchair Platform Stabilizing Crutch Poles, Dampeners, Crossbows (Archery), Hands free shooting rest (Gun) Bowling: ramp, roll assist Fitness: Anti-Gravity Treadmill, LapMat for Wheelchairs, Strike Assist, Adaptive Treadmill	8

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
10.	Yoga	Yoga Mats, Yoga Rollers, Yoga Blocks, Aero Yoga Clothing Blankets, cloth Straps, Bolsters, Wheels	9-16
11.	Fitness and wellbeing equipment's	Health monitoring devices for overall health- Personal health monitor for heart health, Blood sugar monitoring device, Wireless blood pressure device, Smart watch to track heart function, Hot and cold therapy equipment, Massage therapy equipment, Ultrasound therapy equipment	18-20
12.	Taste kit -To test three different sensations- sweet salty and sour	Salt solution (%) -0.5, 0.8, 1.0, 1.2, 1.5, Sugar solution (%) - 0.05, 0.5, 0.7, 1.0, 1.2, Citric acid (%) - 0.02, 0.04, 0.1, 0.5, 1.0 Spoons, Bowls, Beakers, Plain distilled water	21
13.	Test kit to measure peroxide value in the oil	Reagents: Acetic acid-chloroform solution, Saturated potassium iodide solution, Sodium thiosulphate solution- 0.1 N, Starch solution (1%) Apparatus: Pipette 1ml capacity, Conical flask	25
14.	Test kit to measure acid value and free fatty acids in the oil	Sample of oil/fats namely any refined oil or hydrogenated fat. Reagents - ethyl alcohol (95%), phenolphthalein indicator solution, standard aqueous sodium or potassium hydroxide solution (0.1 N or 0.5 N), Pipette (10 ml), Conical flask	24
15.	Test kit to measure impurities in the oil	Sample of Oil/fat, Oven-electric, maintained at $100 \pm 1^\circ\text{C}$., Desiccator, Weighing balance, Filter paper	23
16.	Test kit to measure moisture content in the oil	Sample of oil/fat, Moisture dish-made of porcelain, silica, glass or aluminum, Oven-electric, maintained at $105 \pm 1^\circ\text{C}$., Desiccator Weighing balance	22

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher with ISBN
1.	Practical Applications in Sports Nutrition	Heather Hedrick Fink, Alan E. Mikesky	Jones & Bartlett Learning (2020) ISBN No: 978-1284181340
2.	Massage and Medical Gymnastics,	Lace, M. V.	London: J & A Churchill Ltd. ASIN: B000RY4YB0
3.	ACSM's Guidelines for Exercise Testing and Prescription	Gary Liguori	LWW; (2021) ISBN-13: 1975150198-978
4.	Essentials of Strength Training and Conditioning	Javair Gillett	Human Kinetics, (2021) ISBN-13: 1718210868-978
5.	Practical Applications in Sports Nutrition	Heather Hedrick Fink, Alan E. Mikesky	Jones & Bartlett Learning, (2017) ISBN-13: 1284101393-978
6.	Health Fitness Management	Mike Bates, Mike Spezzano, Guy Danhoff	Human Kinetics, (2019) ISBN-13: 1450412230-978
7.	Yoga for Every Body: A beginner's guide to the practice of yoga postures, breathing exercises and meditation	Luisa Ray, Angus Sutherland	Vital Life Books (2022) ISBN-13: 1739737009-978
8.	Science of Yoga: Understand the Anatomy and Physiology to Perfect Your Practice	Ann Swanson	DK Publisher, (2019) ISBN-13: 1465479358-978
9.	Mudras for Modern Living: 49 inspiring cards to boost your health, enhance your yoga and deepen your meditation Cards	Swami Saradananda	Watkins Publishing (2019) ISBN-13: 1786782786-978
10.	Principles and Methods of Adapted Physical Education & Recreation	Kristi Roth, Laurie Zittel, Jean Pyfer, David Auxter	Jones & Bartlett Learning, (2016) ISBN-13: 1284077810-978
11.	Adapted Physical Education and Sport Sixth Edition	Joseph P. Winnick, David L. Porretta	Human Kinetics, (2016) ISBN-13: 1492511533-978

S. No.	Titles	Author(s)	Publisher with ISBN
12.	Counselling Skills in Applied Sport Psychology: Learning How to Counsel	Paul McCarthy, Zoe Moffat	Routledge, (2023) ISBN-13: 1032592589-978
13.	Basic Counselling Skills: A Helper's Manual	Richard Nelson Jones	Sage Publication 2012, New Delhi.
14.	Advancements in Mental Skills Training (ISSP Key Issues in Sport and Exercise Psychology)	Maurizio Bertollo, Edson Filho, Peter Terry	Routledge, (2020) ISBN-13: 0367111588-978
15.	The Relaxation and Stress Reduction Workbook	Martha Davis, Elizabeth Robbins, Matthew McKay, Eshelman MSW	A New Harbinger Self-Help Workbook (2019)
16.	Patanjalis Yoga Sutras	Swami Vivekananda	Fingerprint Publishing (2023) Prakash Books India Pvt Ltd, New Delhi ISBN-13: 9354407017-978

(b) Online Educational Resources:

1. https://onlinecourses.swayam2.ac.in/aic19_ed28/preview- introduction to Yoga and Applications of Yoga
2. https://onlinecourses.swayam2.ac.in/aic23_ge09/preview- Yoga for Creativity
3. https://onlinecourses.swayam2.ac.in/aic23_ge05/preview- Yoga for concentration
4. https://onlinecourses.swayam2.ac.in/aic23_ge06/preview- yoga for memory development
5. https://onlinecourses.nptel.ac.in/noc21_hs29/preview-Psychology of Stress, Health and Well-being
6. https://onlinecourses.swayam2.ac.in/nce19_sc04/preview- Food Nutrition for Healthy Living - Course – Swayam
7. <https://www.classcentral.com/course/swayam-fitness-management-17608- Fitness Management from Swayam>
8. https://onlinecourses.swayam2.ac.in/nce19_sc04/preview-Food Nutrition for Healthy Living
9. https://onlinecourses.swayam2.ac.in/cec21_ed02/preview Health Education and Recreation
10. https://onlinecourses.swayam2.ac.in/cec22_ed31/preview Sports Administration and Management

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

(c) Others:

1. <https://www.yogajournal.com/yoga-101/philosophy/good-read>
2. <http://hdl.handle.net/123456789/38171- Yoga Philosophy>
3. <https://yoga.ayush.gov.in>
