

**MAHATMAGANDHI
UNIVERSITY**
School of Food Science and Technology
Mahatma Gandhi University
Kottayam-686560



**Learning Outcomes based Curriculum Framework
(LOCF) for Post Graduate Programme
Revised**

**Under the CSS scheme for University
(EFFECTIVE FROM 2026 ADMISSIONS)**

Preface

Mahatma Gandhi University

Mahatma Gandhi University is a premier public university in Kerala, established in 1983 and recognized by the University Grants Commission (UGC). Accredited with NAAC A++ Grade with a CGPA of 3.61 in the fourth cycle, the University is the first in Kerala to achieve this distinction. Renowned for its academic excellence, research productivity, and innovation-driven higher education, the University has consistently secured prominent positions in national and international rankings. In the NIRF 2025 rankings, Mahatma Gandhi University secured the 43rd position among Indian universities, while it has also earned recognition in global ranking frameworks including the Times Higher Education World University Rankings. The University has been granted UGC Category-I Graded Autonomy status and continues to distinguish itself through quality teaching, interdisciplinary research, industry collaborations, and extension activities. With a wide network of affiliated colleges, research centres, and academic departments, the University remains committed to fostering inclusive, socially relevant, and globally competent higher education.

At present, Mahatma Gandhi University offers research programs in forty disciplines through its own Schools and approved Research Centers. It has close collaboration for academic, research and extension programs with a number of national agencies and institutions including the UGC, DST-FIST, DRS, ISRO, COSIT, DIT, DST (Nano Mission), CSIR, DAAD, STEC, ICMR, BARC and MOEF. The University is also involved in active collaboration with research institutions of international reputation such as the Max Planck Institute of Technology, Germany; Brown University, USA; University of Nantes, France; California Institute of Technology, USA; University of Toronto, Canada; Catholic University, Belgium; Heidelberg University, Germany; the Institute of Political Studies, Rennes, France; Trent University, Canada; IPF Dresden, Germany; University of Paris and University of Strasbourg.

Mahatma Gandhi University has made immense strides in the fields of interdisciplinary teaching and research. The faculty comprises of outstanding scholars, many of whom have made original contributions in their respective fields of specialization. The faculty and research scholars of several departments have gained widespread recognition for the commendable quality of their research publications.

The web enabled University library has large collection of books, journals, e-journals and online theses. The digital library provides open access to its enviable collection of digitized Ph.D dissertations. All these work in tandem with the academic business transacted by the University, making the whole experience a holistic one. The University has a well established instrumentation facility with many sophisticated equipments functioning at the various departments and also at the platform provided by the common Inter University Instrumentation Centre (IUIIC). The University also has an Inter University Centre for Organic Farming and Sustainable Agriculture (IUCOFSA) which is a renowned centre for promoting interdisciplinary research in organic farming and conservation of traditional knowledge base, through effective networking and innovative extension activities among the public. The centre has developed many organic methods of agricultural activities for the cultivation of different varieties of rice and vegetables.

The University has well established and internationally reputed facility and academic expertise in various areas like Nanoscience, Environmental science, Bioscience, Chemical science, Physics, Arts and Humanities. The Centre for Nanoscience and Nanotechnology focus on the enhancement of research and higher studies in the cutting edge areas of Nanoscience and Nanotechnology. The Centre is motivated to thrust its research and development focusing on developing novel materials and devices prospering the outrage of Nanoscience. With a vision to consolidate the existing and to pay focus attention to the frontier areas of Environmental Science, the University has established the School of Environmental Sciences as a Centre of learning for advanced studies in different branches of environmental science. The major mandate of the School is to develop appropriate technologies and skilled human resource for sustainable utilization, management and conservation of natural resources. The school has established a Centralized Remote Sensing and GIS facility, the first of its kind in a University in the state, with the support of Indian Space Research Organization (ISRO). It has also established a regional center, the Highrange Environmental Research center (HERC) at Nedumkandam, Idukki district. The School has a live laboratory named as “Jeevaka” which consists of areas with rich biodiversity within the Mahatma Gandhi University Campus.

Vision and Mission of MGU

Vision of Mahatma Gandhi University

“Mahatma Gandhi University envisions to excel in the field of higher education and cater to the scholastic and developmental needs of the individual, through continuous creation of critical knowledge base for the society’s sustained and inclusive growth.”

Mission of Mahatma Gandhi University

- To conduct and support undergraduate, postgraduate and research-level programmes of quality in different disciplines**
- To foster teaching, research and extension activities for the creation of new knowledge for the development of society**
- To help in the creation and development of manpower that would provide intellectual leadership to the community**
- To provide skilled manpower to the professional, industrial and service sectors in the country so as to meet global demands**
- To help promote the cultural heritage of the nation and preserve the environmental sustainability and quality of life**
- To cater to the holistic development of the region through academic leadership**

Preamble

OUTCOME BASED EDUCATION (OBE) FROM THE ACADEMIC YEAR 2020-21 MAHATMA GANDHI UNIVERSITY SCHOOL OF FOOD SCIENCE AND TECHNOLOGY

1. Introduction

A high priority task in the context of education in India is improvement of quality of higher education for equipping young people with skills relevant for global and national standards and enhancing the opportunities for social mobility. Mahatma Gandhi University has initiated an Outcome Based Education (OBE) for enhancing employability of graduates through curriculum reforms based on a learning outcomes-based curriculum framework, upgrading academic resources and learning environment.

Learning outcomes specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study. The fundamental premise underlying the learning outcomes-based approach to curriculum development is that higher education qualifications are awarded on the basis of demonstrated achievement of outcomes, expressed in terms of knowledge, understanding, skills, attitudes and values. Outcomes provide the basis for an effective interaction among the various stakeholders. It is the results-oriented thinking and is the opposite of input-based education where the emphasis is on the educational process.

Benefits of OBE

The OBE Framework is a paradigm shift from traditional education system into OBE system where there is greater focus on programme and course outcomes. It guarantees that curriculum, teaching and learning strategies and assessment tools are continuously enhanced through a continuous improvement process. All decisions including those related to curriculum, delivery of instruction and assessment are based on the best way to achieve the predetermined outcomes. Traditionally, educators have measured learning in terms of standardised tests. In contrast, outcome-based education defines learning as what students can demonstrate that they know.

Benefits of OBE:

- *More directed & coherent curriculum.
- *Graduates will be more “relevant” to industry & other stakeholders (more well-rounded Graduates)
- *Continuous Quality Improvement is in place.
- *OBE shifts from measuring input and process to include measuring the output (outcome)

Outcome Based Education (OBE) process

OBE is a comprehensive approach to organise and operate a curriculum that is focused on and defined by the successful demonstrations of learning sought from each learner. The term clearly means focusing and organising everything in an education system around “what is essential for all learners to be able to do successfully at the end of their learning experiences”.

OBE is an approach to education in which decisions about the curriculum and instruction are driven by the exit learning outcomes that the students should display at the end of a programme or a course. By the end of educational experience, each student should have achieved the outcomes.

Learning Outcomes based Curriculum Framework (LOCF) for Post Graduate Programmes- IQAC MG University

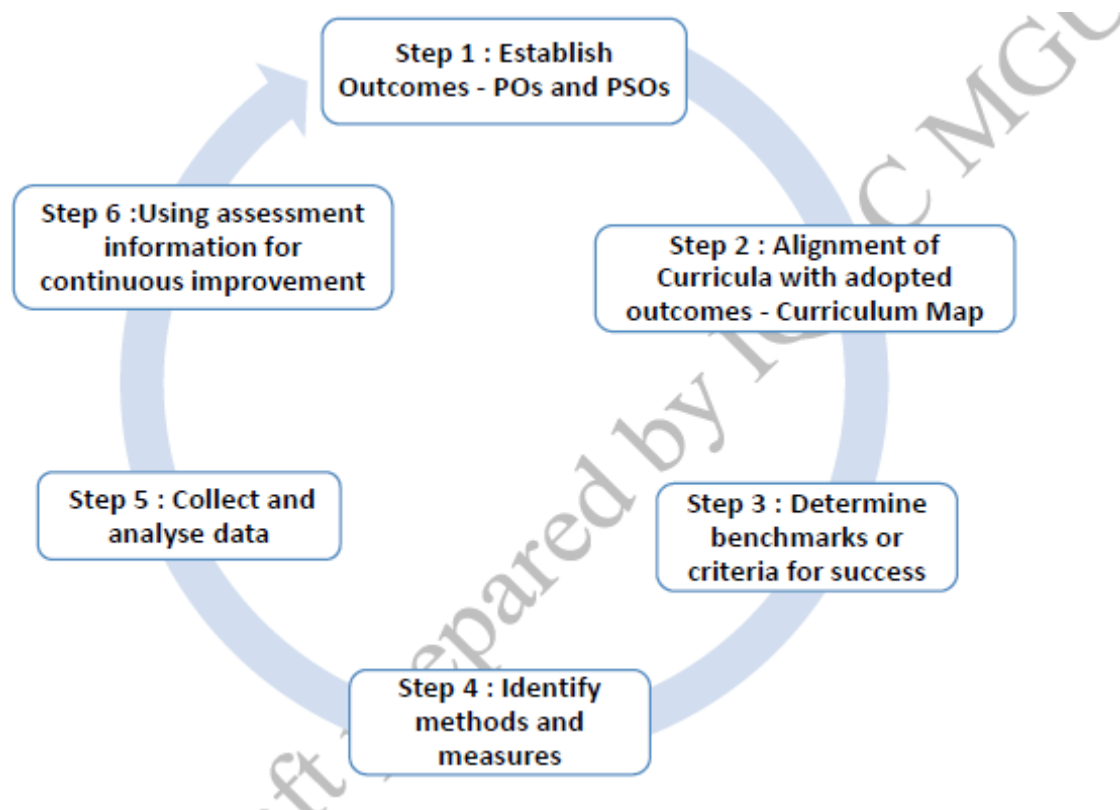
One of the main objectives of OBE is to ensure continuous improvement of programmes in terms of maintaining the relevance in curriculum as well as responding to the requirements of the stakeholders. In other words, it ensures that Post graduate programme next year is better than Post graduate programme this year, offered by a department.

An OBE system has been proposed and to be implemented at various Departments of Mahatma Gandhi University, as a quality-assurance approach to improve teaching and learning outcomes and processes. This OBE plan incorporates the “outcomes assessment” process to be followed in the departments. OBE should be a key driver of the curriculum management in all the departments of the university.

The OBE is a 6 step process as shown in the figure

Figure: OBE Process

The process is presented as a cycle or a loop. The cycle represents the continuous nature of assessing learning outcomes.



As envisaged by the IQAC of Mahatma Gandhi university, an OBE based curricular framework has been proposed for the School of Food Science and Technology from the academic year 2026-2027 which is presented hereafter.

SCHOOL OF FOOD SCIENCE AND TECHNOLOGY

The need of a sustainable and quality food system is getting more important now a days. The food system must be reliable, flexible and consumer driven. It should conserve natural resources and environment. Improvement in food supply is important to produce a healthier population and feed the future. Food must be designed in such a way that it should optimize health and reduce the risk of hazards and diseases. In this context the foods technology professionals has an important role in advancing the food system, minimizing the food wastage and hazards, maximizing the nutritional quality of food, and ensuring safe, nutritious and abundant food supply. Food science and technology is a multidisciplinary science having the goal to enhance the quality of food and agriculture sector.

School of Food Science And Technology is the new department of Mahatma Gandhi University to provide academic expertise to students in the areas of Food science, Food Technology, Nutrition and Dietetics. The research areas at School of Food Science and Technology include new Food Product Development, processing and packaging technology development, Subjective and objective quality analysis of foods, and microbiological analysis of foods. etc.

Our Vision

To evolve and establish itself as an internationally recognized research and education center in the field of food science and technology and to produce and disseminate the multi -disciplinary approaches for safe, nutritious, and sustainable foods through Innovative Research, Teaching and Outreach for the prosperity of society.

Key points

1. Evolve and establish itself as an internationally recognized research and education center
2. Produce and disseminate the multi- disciplinary approaches for safe, nutritious and sustainable foods
3. Research, teaching and outreach
4. Prosperity of the society.

Our Mission

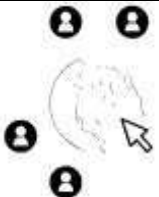
- ❖ To provide advanced knowledge and training to individuals preparing for careers in food science and technology in the food industry, academia and health sector.
- ❖ To utilize the expertise of faculty in area of food science and technology for benefitting the students in achieving their career goals.
- ❖ To conduct basic and applied research in food science and technology, nutrition for the ultimate benefit of the food industry and people.
- ❖ Develop knowledgeable critical thinkers who contribute to the food community through leadership, service, and life-long learning.

Key points

1. Provide advanced knowledge and training
2. To utilize the expertise of faculty
3. Benefitting the students in achieving their career goals.
4. Conduct basic and applied research
5. Develop knowledgeable critical thinkers



Mahatma Gandhi University
Graduate attributes

	Critical thinking and analytical reasoning	Capability to analyze, evaluate and interpret evidence, arguments, claims, beliefs on the basis of empirical evidence; reflect relevant implications to the reality; formulate logical arguments; critically evaluate practices, policies and theories to develop knowledge and understanding; able to envisage the reflective thought to the implication on the society.
	Scientific reasoning and Problem solving	Ability to analyze, discuss, interpret and draw conclusions from quantitative/qualitative data and experimental evidences; and critically evaluate ideas, evidence and experiences from an unprejudiced and reasoned perspective; capacity to extrapolate from what one has learned and apply their competencies to solve problems and contextualize into research and apply one's learning to real life situations.
	Multidisciplinary/ Interdisciplinary/ Transdisciplinary approach	Acquire interdisciplinary /multidisciplinary/ transdisciplinary knowledge base as a consequence of the learning they engage with their programme of study; develop a collaborative-multidisciplinary/interdisciplinary/transdisciplinary-approach for formulate constructive arguments and rational analysis for achieving common goals and objectives.
	Intra and Interpersonal skills	Ability to work effectively and respectfully with diverse teams; facilitate collaborative and coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team; lead the team to guide people to the right destination, in a smooth and efficient way.
	Digital literacy	Capability to use ICT in a variety of learning situations, demonstrate ability to access, choose, collect and evaluate, and use a variety of relevant information sources; structure and evaluate those data for decision making.
	Global Citizenship	Building a sense of belonging to a common humanity and to become responsible and active global citizens. Appreciation and adaptation of different sociocultural setting and embrace and promote equity.

	Social competency	Possess knowledge of the values and beliefs of multiple cultures, appreciate and adapt to a global perspective; and capability to effectively engage in a multicultural society and interact respectfully, manage and lead with diverse groups.
	Equity, Inclusiveness and Sustainability	Appreciate and embrace equity, inclusiveness and sustainability and diversity; acquire ethical and moral reasoning and values of unity, secularism and national integration to enable to act as dignified citizens; able to understand and appreciate diversity
	Lifelong learning	Continuous acquisition of knowledge and skills. Learn, unlearn and re-learn based on changing ecosystem. "Learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.



Mahatma Gandhi University

Programme Outcome

Programme Outcomes (PO)

PO 1: Critical Thinking and Analytical Reasoning

Capability to analyse, evaluate and interpret evidence, arguments, claims, beliefs on the basis of empirical evidence; reflect relevant implications to the reality; formulate logical arguments; critically evaluate practices, policies and theories to develop knowledge and understanding; able to envisage the reflective thought to the implication on the society.

PO 2 : Scientific Reasoning and Problem Solving

Ability to analyse, discuss, interpret and draw conclusions from quantitative/qualitative data and experimental evidences; and critically evaluate ideas, evidence and experiences from an unprejudiced and reasoned perspective; capacity to extrapolate from what one has learned and apply their competencies to solve problems and contextualise into research and apply one's learning to real life situations.

PO 3: Multidisciplinary/Interdisciplinary/Transdisciplinary Approach

Acquire interdisciplinary /multidisciplinary/transdisciplinary knowledge base as a consequence of the learning they engage with their programme of study; develop a collaborative-multidisciplinary/interdisciplinary/transdisciplinary-approach for formulate constructive arguments and rational analysis for achieving common goals and objectives.

PO 4: Communication Skills

Ability to reflect and express thoughts and ideas effectively in verbal and nonverbal way; Communicate with others using appropriate channel; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner and articulate in a specific context of communication.

PO 5: Leadership Skills

Ability to work effectively and lead respectfully with diverse teams; setting direction, formulating an goal, building a team who can help achieve the goal, motivating and inspiring team members to engage with that goal, and using management skills to guide people to the right destination, in a smooth and efficient way.

PO 6: Social Consciousness and Responsibility

Ability to contemplate of the impact of research findings on conventional practices, and a clear understanding of responsibility towards societal needs and reaching the targets for attaining inclusive and sustainable development.

PO 7: Equity, Inclusiveness and Sustainability

Appreciate equity, inclusiveness and sustainability and diversity; acquire ethical and moral reasoning and values of unity, secularism and national integration to enable to act as dignified citizens; able to understand and appreciate diversity, managing diversity and use of an inclusive approach to the extent possible.

PO 8: Moral and Ethical Reasoning

Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work and living as a dignified person in the society.

PO 9: Networking and Collaboration

Acquire skills to be able to collaborate and network with scholars in an educational institutions, professional organizations, research organizations and individuals in India and abroad.

PO 10: Lifelong Learning

Ability to acquire knowledge and skills, including "learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Programme specific outcomes of M.Sc.Food Science and Technology

- PSO1.** Acquire a deep scientific knowledge regarding the chemical and microbial characteristics, nutritive and functional properties, processing, preservation. Packaging, engineering and quality control techniques of various type of food items.
- PSO2.** Able to apply these knowledge and technology to for development of safe, nutritious and high- quality food products
- PSO3.** Able to contribute trained human resource with the sound knowledge and skills of food quality assurance and modern food processing technologies, to work in industrial, educational and health sectors
- PSO4.** Generate the ability to design and conducts research for solving both health/ nutritional and food safety problems of the society and also for contributing to the development of scientific and technical knowledge in food science and technology
- PSO5.** Develop students into vibrant and internationally competitive food science and technology professional with entrepreneurial skills, good reasoning skills, communication abilities and societal consciousness

SCHEME OF MSc FOOD SCIENCE AND TECHNOLOGY PROGRAMME

FIRST SEMESTER SCHEME

Course Code	Course Title	Credits
FS M 26 C 29	Food Science and Nutrition	3
FS M 26 C 02	Food Chemistry	3
FS M 26 C 03	Food Microbiology	3
FS M 26 C 04	Food Processing and Preservation	3
Elective- I	To be selected from among the elective courses offered	4
FS M 26 C 05	Lab 1-Food chemistry & Food microbiology	4
Total Credits of the 1st Semester Programme in M Sc Food science and technology		20

SECOND SEMESTER SCHEME

Course Code	Course Title	Credits
FS M 26 C 28	Bio-Statistics & Research Methodology	3
FS M 26 C 10	Food safety and Quality Assurance	3
FS M 26 C 11	Advanced Food Analysis and Instrumentation	4
FS M 26 C 12	Food Packaging Technology	3
Elective - II	To be selected from among the elective courses offered	4
FS M 26 C 13	Lab-2 Techniques in Food Analysis, Food additives and Packaging Technology	4
Total Credits of the 2nd Semester Programme in M Sc Food science and technology		21

THIRD SEMESTER SCHEME

Course Code	Course Title	Credits
FS M 26 C 17	Cereals, Pulses and Oilseeds Technology	3
FS M 26 C 18	Technology of Milk, Meat, Poultry and Fish	3
FS M 26 C 19	Technology of Fruits, Vegetables and Plantation Crops	3
FS M 26 C 20	Bakery and Confectionery Technology	3
Elective – III	To be selected from among the elective courses offered	4
Elective IV	Open course (Course taken by the student from other departments)	4
FS M 26 C 21	Lab-3 Food Processing And preservation Technology	3
Total Credits of the 3rd Semester Programme in M Sc Food science and technology		23

FOURTH SEMESTER SCHEME

Course Code	Course Title	Credits
FS M 26 C 26	Major Research Project	12
FS M 26 C 27	Comprehensive Viva-voce	4
Total Credits of the 4th Semester Programme in M Sc Food science and technology		16

Total Credits for the M Sc Programme : 80

ELECTIVE COURSES

Course Code	Course Title	Credits
FS M 26 E 06	Nanotechnology –Concepts and applications in Food science	4
FS M 26 E 08	Food Toxicology	4
FS M 26 E 14	Industrial Microbiology	4
FS M 26 E 15	Fundamentals of Food Engineering	4
FS M 26 E 16	Technology of Beverages	4
FS M 26 E 22	Waste Management in food industry	4
FS M 26 E 23	Food Business Management and Entrepreneurship	4
FS M 26 E 24	Nutraceuticals and Functional Foods	4
FS M 26 E 25	Spices & Flavor technology	4

FIRST SEMESTER



MAHATMA GANDHI UNIVERSITY

FS M 26 C29: Food Science and Nutrition

SchoolName	School of Food Science and Technology					
Programme	M.Sc. Food Science and Technology					
Course Name	Food Science and Nutrition					
Type of Course	Core					
Course Code	FS M 26 C29					
Course Summary & Justification	This course equips students with essential knowledge in human nutrition, nutrients, and nutrient deficiencies. It enables identification of India's major nutritional problems and influencing factors. Students develop skills in planning balanced diets for different age groups and gain foundational knowledge in therapeutic diet planning. This prepares them for research, learning, and job opportunities in the evolving field of Food and nutrition..					
Semester	First					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial		Others	Total Learning Hours
	Authentic learning	60	20			120
	Collaborative learning					
	Independent learning					
Pre-requisite	Basics of food science and nutrition					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
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1	Explain the role of nutrition in maintaining health and describe the basic concepts of nutrients and energy	U / E	1
2	Identify major nutritional problems in India and explain the factors affecting nutritional status.	U / An	1, 4
3	Describe the classification, functions, sources, digestion, absorption, metabolism, and deficiency disorders of major nutrients	U / R	1, 3
4	Explain energy metabolism, BMR, BMI, water balance, and dietary fiber in relation to human nutrition.	U / A	1, 3
5	Apply nutritional principles in balanced diet planning, therapeutic nutrition, and nutritional enhancement of foods for different population groups.	S	1, 3, 4
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Introduction to Food and Nutrition: Definition, History, concepts of health and characterization, and role of nutrition in maintaining health. Nutritional problems in India and National Nutritional Policy, Factors affecting food and nutrition (socioeconomic, cultural, traditional, production, distribution systems, lifestyle, food habits), Role of food classification of foods; food standards, Elements of nutrition: Macronutrients and micronutrients	1	10
2	Carbohydrates and protein: Carbohydrates, Classification, Caloric value, Recommended daily allowances, Dietary sources. Functions, Digestion, absorption and storage, metabolism of carbohydrates, Malnutrition: Deficiencies and Overconsumption Proteins, Classification, amino acid scoring (PDCAAS), Caloric value, recommended daily allowances, Dietary sources, Functions, Digestion, absorption and storage, metabolism, Malnutrition: Deficiencies and Over consumption	3,4	15
3.	Fats and Energy	3,4	

	Fats -Classification, Caloric value, Recommended daily allowances, Dietary sources., Functions, Digestion, absorption and storage, metabolism, Malnutrition: Deficiencies and Overconsumption Energy, Unit of Energy – Kcal, Energy requirements of different categories of people., Measurements of energy, Body Mass Index (BMI) and basic metabolism, Basal Metabolic Rate (BMR) – determination and factors affecting		
4	Vitamins, Minerals and Water Vitamins, Classification, Recommended daily allowances, Dietary sources, Functions, Absorption, synthesis, metabolism storage & excretion, Deficiencies, Hypervitaminosis Minerals, Classification, Recommended daily allowances, Dietary sources. Functions, Absorption, synthesis, metabolism storage & excretion, Deficiencies, Over consumption and toxicity Water & electrolytes, Water: Daily requirements, regulation of water metabolism, distribution of body water, Electrolytes: Types, sources, composition of body fluids, Maintenance of fluid & electrolyte balance, Over hydration, dehydration and water intoxication, Electrolyte imbalances	3,4	15
5	Balanced Diet, Therapeutic Nutrition, and Nutritional Enhancement Balanced diet, Elements, Food groups, Recommended Daily Allowance, Estimated Average requirement, Nutritive value of foods, Calculation of balanced diet for different categories of people, Factors influencing food selection, marketing and budgeting for various cultural and socioeconomic groups, Planning menu, Introduction to therapeutic diets, Types of Therapeutic diet, Enteral and parenteral feeding, Role of nutrition in the prevention of lifestyle disorders, Nutritional enhancement, Methods to improve nutritional quality: Fermentation, Supplementation, Fortification.		10
Total Credits of the Course		4	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative
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Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks B. Semester End examination – 60 marks
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REFERENCES

Recommended Text Books • Shubhangi Joshi, Nutrition and Dietetics 2nd edition, Tata McGraw – Hill publishing company Limited, New Delhi, 2002. • Dr. M. Swaminathan, Handbook of Food and Nutrition, The Bangalore printing and publishing Co. Ltd. (Banglore press) 2004. • Joshi V.D. Handbook of Nutrition and Dietetics vora medical publications, 1999. • Mahtab S. Bamji, N. Rao & V. Reddy, Textbook of Human Nutrition. • Indian Food Composition Tables (IFCT-2017), National Institute of Nutrition, ICMR. • Nutrient Requirements for Indians: RDA and EAR 2020, ICMR-NIN.
Recommended References • C. Gopalan, B. V. Ramasastri and S.C. Balasubramanian Nutritive value of Indian Foods, National Institute of Nutrition, Indian Council of Medical Research, Hyderabad 1999. Fellows, Food Process Technology: Principles and Technology, CRC publications. • Kusum Gupta (L. C. Guple, Abhishek Gupta) Food and Nutrition Facts and Figures, 5th edition Jaypee brothers Medical publications (P) Ltd., New Delhi, India 2003. • T. K. Indrani, Nursing Manual of Nutrition and Therapeutic Diet, 1st edition Jaypee Brothers medical publishers (P) Ltd., 2003. • Antia – Clinical Dietetics and Nutrition, ed., 4th.

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	MAHATMA GANDHI UNIVERSITY
	FS M 26 C 02: FOOD CHEMISTRY

SchoolName	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Name	FOOD CHEMISTRY					
Type of Course	Core					
Course Code	FS M 26 C 02					
Course Summary & Justification	• The course is designed to get a clear idea on the biomolecules that composes food. • To study their role in various chemical reactions during food processing and spoilage and their contribution towards organoleptic properties of food. • The course builds a base for the students to understand the concept of Nutrition and health. • This course is designed to equip students the essential knowledge in human nutrition .nutrients and nutrient deficiencies.					
Semester	First					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basic understanding of chemical groups and bonding, basics of biochemistry					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Explain the structure, properties and interactions of major food components (water, carbohydrates, lipids and proteins) in food systems	U	1

2	Analyze the physicochemical and functional properties of carbohydrates, lipids and proteins and their role in determining food quality and stability	An	1, 2
3	Evaluate the chemical reactions occurring in foods, including browning, lipid oxidation and protein denaturation, and their impact on food quality	E	1, 2, 3
4	Analyze the interactions among food components and their influence on texture, flavor and overall food behavior..	An	1, 2, 3
5	Assess the stability of micronutrients and the overall chemical changes in foods during processing and storage.	E	1, 2, 3, 4
Module No	Module Content	Course Outcome	Hrs
1.	Water and Dispersed Systems Structure and physicochemical properties of water, Water–solute interactions , Water activity and sorption isotherms, Glass transition concept Dispersed systems: Surface phenomena, Colloidal systems, Emulsions, foams and gels, Emulsifiers, stabilizers and hydrocolloids	1, 4	10
2	Carbohydrates Classification: mono-, oligo-, polysaccharides, Structure and properties of starch, cellulose, pectins, gums Functional and chemical properties: Gelatinization, retrogradation Hydrolysis and modification Chemical reactions: Caramelization, Maillard reaction	1, 2, 3	12
3	Lipids Classification and structure of lipids, Physical and chemical properties Lipid reactions: Oxidation (autooxidation, photooxidation), Hydrolytic rancidity, Factors affecting lipid stability, Antioxidants: classification and mechanism of action Functional aspects: Role in texture and flavor Chemical modification of lipids	1, 2, 3, 4	12
4.	Proteins Structure of proteins, Functional properties: Solubility, Gelation, Emulsification, Foaming Protein chemistry: Denaturation and aggregation, Protein–protein and protein–water interactions Enzymes: Classification and mechanism, Factors affecting enzyme activity, Enzymatic browning, Anti-browning agents	1, 2, 3, 4	12
5.	Micronutrients and Chemical Changes in Foods Vitamins: Classification (fat and water-soluble), Stability and degradation, Factors affecting retention Minerals: Basic classification, Chemical interactions in foods (binding, chelation) Chemical changes during processing and storage: Heat-induced changes in food components, Interactions among carbohydrates, proteins and lipids Flavor chemistry (formation of flavor compounds – introductory)	3, 4, 5	14

Total Credits of the Course	3	60
<i>*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i>		

COURSE CONTENT

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction, Explicit Teaching, E-learning, interactive Instruction, Active co-operative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks B. Semester End examination – 60 marks

REFERENCES

Recommended Text Books

- Beltz, H.D. 2008. Food Chemistry. 4th edition, Springer Verlag.
- Fennema, O.R, 2017, Food Chemistry, 5th edition, CRC Press.
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Approval Date	
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Approval by	
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MAHATMA GANDHI UNIVERSITY

FS M 26 C 03: FOOD MICROBIOLOGY

School Name	School of Food Science and Technology					
Programme	M. Sc Food Science and Technology					
Course Name	FOOD MICROBIOLOGY					
Type of Course	Core					
Course Code	FS M 26 C 03					
Course Summary & Justification	- The objective of this course is to impart the basic knowledge in the branch of food microbiology. - To develop a very good understanding about characteristics of different types of microorganisms with desirable and undesirable actions in different categories of food. - To enable students gain knowledge regarding food spoilage, food production using microorganisms and food borne infections					
Semester	First					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of food science and nutrition					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand the different categories of microorganism relevant to food system	U	1
2	Explain various factors affecting the microbial growth in food and their nutritional requirements and will be acquainted with methods to	U/ A	1,3,4

	Prevent the microbial growth in food.		
3	Understand basic laboratory tools to identify food borne microbes	U	2,3
4	Analyse various methods for determination and isolation of microorganisms in food.	An	2,3,4
5	Understand and apply different methods for the use of Microorganisms for the production of food.	U/A/C	2,4

	Explain different kind of food spoilage and characteristics of microorganism during food spoilage and food preservation		
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Microbiology of Food: Introduction to food microbiology Factors influencing microbial growth in food: Intrinsic and extrinsic factors, combined intrinsic and extrinsic factors, lactic antagonism, microbial growth kinetics.	1,2 & 5	10
2	Enumeration and identification of microorganisms in food: Collection of food samples, transport and storage. Enumeration of microorganisms. Direct count, Selective media. Identification of pathogenic microorganisms – Selective media, PCR based identification, ELISA, Biochemical tests.	3 & 4	15
3.	Role of microorganisms in the preparation of food: Microbiology of cultured dairy products, Yogurt, cultured butter milk, Sour cream, Kefir and cheese. Vegetable fermentation: Microbial succession during production of fermented vegetables. Manufacture of sauerkraut, kimchi, Soy sauce and Tempeh. Microbial cell factories – vitamins, proteins, omega-3 fatty acids Microorganisms as food sources: Probiotics, Prebiotics, Synbiotics, SCP and Edible mushrooms.	5	15
4	Food spoilage: Classification of foods based on spoilage, Food spoilage and its sources (pre and post harvest): Microbial spoilage of cereals, Pulses, Fruits and Vegetables, Meat, fish, egg, poultry, Milk and milk Products, Canned foods and Beverages.	6	10
5	Food-borne diseases and control: Food borne infections including bacterial, viral and fungal infections. Study of infections due to food borne parasites. In depth study of various types and causes of food intoxication. Summary of prevention and control of microbial food infections. Identification and first aid for specific types of food infections	7	10
Total Credits of the Course		3	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative
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Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks B. Semester End examination – 60 marks
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REFERENCES

Recommended Text Books

Pelezar M.I and Reid, R.D. (2001) Microbiology McGraw Hill Book Company, New York, 5th Edition.

Frazier W.C. (2025) Food Microbiology, McGraw Hill Inc. 7th Edition

Recommended References

Jay, James, M(2000) Modern Food Microbiology, 2nd Edition. CBS Publisher

Adams, M.R. and M.G. Moss (1995): Food Microbiology, 1st Edition, New Age International

	MAHATMA GANDHI UNIVERSITY
	FS M 26 C 04: FOOD PROCESSING AND PRESERVATION

School	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Title	FOOD PROCESSING AND PRESERVATION					
Course Type	Core					
Course Code	FS M 26 C 04					
Course Overview	• Provides fundamental and advanced knowledge of food processing and preservation techniques used to enhance food safety, quality, and shelf life. • Covers thermal, non-thermal, chemical, and biological preservation methods along with their effects on nutritional and sensory properties of foods. • Introduces emerging processing technologies and sustainable practices relevant to modern food industry applications.					
Semester	1		Credit	3		
Total Student Learning Time	Learning Approach	Lecture	Tutorial	Practical	Others	Total learning hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics understanding of food science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	<i>Upon completion of this course, students will be able to;</i>		
1	Explain the principles of food processing and preservation and their role in enhancing food safety and shelf life.	U	1
2	Analyze the effects of thermal, low-temperature, and dehydration processing methods on the quality and stability of foods.	An	1,2,3
3	Evaluate the applications of chemical, biological, and traditional preservation techniques in food systems.	E	1,2,3
4	Compare conventional and emerging non-thermal processing technologies used in modern food industries.	An	1,2,3,4
5	Design appropriate processing and preservation strategies for different food products considering quality, safety, and sustainability aspects.	C	1,2,3,4,5

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module No	Module Content	Course Outcome	Hours
1	Module I: Fundamentals of Food Processing and Preservation:	1,5	12
	Scope and importance: Need for food processing in modern food systems, historical evolution of preservation techniques, Food supply chain and post-harvest losses, Relationship between processing, safety and shelf life Principles of Food Preservation: Concept of preservation and, shelf-life extension. Role of: Temperature (high and low), Water activity, pH, Chemical preservatives, Irradiation Role of Packaging and Asepsis: Aseptic handling and contamination control, Packaging as a preservation tool		
2	Module II: Thermal Processing of Foods	2,5	12
	Principles of Heat Processing: Heat transfer mechanisms, thermal resistance of microorganisms, D-value, Z-value and thermal death kinetics Heat Processing Methods: Blanching, Pasteurization, Sterilization and retorting, Canning technology and container systems Frying and Baking Technologies: Frying principles and oil quality changes, Oil uptake mechanisms, Baking and roasting fundamentals Effect of Heat Processing: Nutritional changes, Texture and sensory changes, Shelf life and safety considerations		
3	Module III: Low Temperature and Moisture Control Technologies	2,5	12
	Refrigeration and Freezing: Principles of refrigeration, Freezing curves and freezing rate, Changes during freezing and thawing, Freezing methods. Dehydration and Concentration: Drying mechanisms and drying curves, Types of dryers, Concentration techniques. Intermediate Moisture Foods: Principles and characteristics, Role of humectants, Shelf stability. Hurdle technology: Types of hurdles, advantages and application.		4

4	Module IV: Chemical, Biological and Household Preservation Methods	3,5	10
	Chemical preservatives: types and applications (organic acids, nitrites, sulfites) Food additives in processing and preservation: role in shelf-life extension and quality retention (antioxidants, stabilizers, emulsifiers, humectants, anti-browning agents) Natural vs synthetic preservatives; clean label concepts Biological preservation: fermentation, starter cultures, bacteriocins Household preservation methods: pickling, salting, sugaring, use of vinegar Regulatory aspects of food additives and preservatives (FSSAI, Codex Alimentarius)		
5	Module V: Emerging and Non-Thermal Processing Technologies	4,5	14
	Food Irradiation: Principles and types of radiation, Applications and limitations, Regulatory aspects. Novel Non-Thermal Technologies: High Pressure Processing (HPP), Pulsed Electric Field (PEF), Cold plasma processing, Ultrasound processing, Ohmic heating. Extrusion Technology: Principles of extrusion, Types of extruders, Applications in cereal and snack processing. Sustainability and Modern Trends: Minimal processing and clean label foods, Energy efficient processing, Waste valorization, Green food processing technologies	:	
Total Credits of the Course		3	60

Mode of Transaction	Classroom activities: Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Mode of Assessment	A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment/Seminar – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks B. Semester End examination – 60 marks

Learning Resources

1. Fellows, P, 2022, Food Processing and technology: Principles and Practice. Fifth edition, Woodhead publishing limited.
2. Food science :Norman.N.Potter,Joseph. H. Hotchkis
3. Manany S, N S. Swamy Food Facts and Principles. New Age International Publishers
4. Sivasankar B. (2002): Food Processing And Preservation, Prentice Hall of India Pvt Ltd., New delhi
5. Khetarpaul N.(2005). Food Processing and Preservation, Daya Publishing House, New Delhi.
6. Frazier W C and Westhoff D C (2025). Food Microbiology, 7th edition, Medtech Science Press.



MAHATMA GANDHI UNIVERSITY

FS M 26 C 05 : LABORATORY COURSE 1: FOOD CHEMISTRY AND FOOD MICROBIOLOGY

SchoolName	School of Food Science and Technology					
Programme	M.Sc. Food Science and Technology					
Course Name	LABORATORY COURSE 1: FOOD CHEMISTRY AND FOOD MICROBIOLOGY					
Type of Course	Core					
Course Code	FS M 26 C 05					
Course Summary & Justification	The course is designed to equip students with the essential skills in laboratory techniques that are important in chemical and microbial analysis of food. This will enhance the practical abilities of the students to carry out the quality analysis of food in food industries.					
Semester	First					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	10	10	120	-	140
Pre-requisite	General idea on reagents and solvents					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	To prepare reagents, buffers and other solutions in required concentrations and required pH.	A/S	2
2	Perform laboratory experiments to study the physicochemical properties of water and carbohydrates in food systems.	A/S	2
3	Determine sugar composition, starch gelatinization temperature, and retrogradation behavior using standard analytical methods.	A/An/S	1,2
4	Evaluate protein functionality through experiments such as gluten estimation, protein denaturation, and determination of isoelectric point.	An/E/S	2,3

5	Analyze lipid quality and stability using chemical indices such as peroxide value, saponification value, and iodine value.	An/E/S	2,3
6	Assess the presence and significance of bioactive compounds in foods through estimation of total polyphenols and enzymatic browning reactions.	An	2,3
7	Students will acquire skills on practice of sterile and safety precautions in a food microbiology laboratory	Ap	2,3
8	Students will be able to prepare and sterilize media and to culture bacteria and fungi in laboratory	Ap/S	2,3
9	Students will be able to examine morphological, physiological and biochemical properties of bacteria and fungi in different types of food.	S	2,4
10	Students will be able to identify the microbiology of processed and unprocessed food	S	2,5
11	Students will be able to identify the microbiology of hand and the effect of hand sanitation and will be able to perform the isolation of a specific culture of microorganism	S	2,3
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hours
1	Food Chemistry <u>Water & Carbohydrate</u> 1. Determination of Boiling Point Elevation & Freezing Point Depression 2. Estimation of Reducing and Total Sugars 3. Stages of Sugar Cookery 4. Starch Gelatinization Temperature Determination 5. Retro gradation Study of Starch	1, 2 & 3	35
2	<u>Protein, Lipid & Bio active compounds</u> 6. Estimation of Gluten Content in Wheat Flour 7. Denaturation of Proteins 8. Determination of isoelectric point of proteins 9. Determination of Peroxide Value 10. Saponification Value 11. Iodine Value 12. Estimation of Total Polyphenols 13. Enzymatic Browning in Fruits	1,4, 5 & 6	35

3.	Food Microbiology 1. Preparation of common laboratory media and special media. 2. Staining: Staining techniques- Monochrome staining, Differential staining, Negative Staining, Endospore staining, Volutin Granule staining, Motility of bacteria, Staining of yeast and molds. 3. Identification of important molds and yeast.	7, 8 & 9	35
4	4. Microbiology of milk-MBRT, APC 5. Microbiology of water. 6. Microbiological analysis of typical processed food. 7. Microbiological analysis of a typical unprocessed food. 8. Isolation of specific culture. 9. Observation of microbial activity in fermented products.	10 & 11	35
Total Credits of the Course		4	140

Books for Reference

1. Sadasivam S, Manickam A (1996) Biochemical Methods, Second edition, New Age International Ltd, New Delhi.
2. Pearson, D, 2002 The Chemical Analysis of Foods, Churchill Livingstone, New York,
3. Food Microbiology: A Laboratory Manual, Ahmed E. Yousef, Carolyn Carlstrom, John Wiley & Sons, 05-May-2003
4. Practical Microbiology R.C.Dubey and D.K. Mahaswari 2nd Edition S.Chand& Company Pvt. Ltd. New Delhi, 2002
5. Experiments in Microbiology, Plant Pathology and Biotechnology, K.R.Aneja, New Age International Pvt.Ltd. Publishers NewDelhi, 2003
6. Practical Food Microbiology, 3rd Edition, Diane Roberts, Melody Greenwood , ISBN: 978-1-4051-0075-5, , Wiley-Blackwell, 2002.
7. Laboratory Manual of Food Microbiology, Neelima Garg, K. L. Garg, K. G. Mukerji, Neelima Garg, K. L. Garg, K. G. Mukerji . K. International Pvt Ltd, 2010

Teaching and Learning Approach	Laboratory Procedure (Mode of transaction) Direct Instruction: lecture, Explicit Teaching, Demonstration, Hands on experimental sections, Skill acquisition by laboratory training
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) Assessment of the performance of student in the lab- 10 marks Internal Test -20 marks Project report (student needs to perform experiments on a specific project and report should be prepared)– 10 marks B. Semester End examination – 60 marks

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	MAHATMA GANDHI UNIVERSITY
	FS M 26 E 15: FUNDAMENTALS OF FOOD ENGINEERING

SchoolName	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Name	FUNDAMENTALS OF FOOD ENGINEERING					
Type of Course	Elective					
Course Code	FS M 26 E 15					
Course Summary & Justification	- The objective of the course is to give an insight into various aspects of food engineering. - This is course helps the students to get a deep understanding regarding principles of fluid flow, heat transfer in food processing, psychrometrics and principles of different type of mechanical operations in food industry and its applications.					
Semester	Second					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of food technology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Explain the role and scope of engineering principles in food processing systems.	U	1
2	Apply basic material and energy balance concepts to simple food processing operations.	A	1,2
3	Describe fluid flow behaviour and pumping systems used in food industries.	An	1,2
4	Explain mechanisms of heat transfer and their applications in food	U/A	1,2

	processing.		
5	Interpret psychrometric properties of air and understand the basic principles of food plant layout and utilities.	An	1,2,3
<i>*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i>			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	fundamentals of food engineering Role of engineering in food processing, Scope and importance of food engineering, Units, dimensions and conversion of units, Physical properties of foods relevant to processing: density, viscosity, specific heat, thermal conductivity. Process flow diagrams in food industry, Preliminary operations in food processing: Cleaning, Sorting and grading, Role in process efficiency and product quality	1	10
2	Material and Energy Balances Concept of mass balance in food processing systems, Total mass balance and component mass balance, Steady state and unsteady state systems (basic idea), Simple material balance problems in: mixing, dilution, evaporation, drying, size reduction. Introduction to energy balance, Heat balance in simple food processing operations	2	12
3.	Fluid Flow in Food Processing Properties of fluids used in food processing, Newtonian and non-Newtonian fluids in foods, Laminar and turbulent flow, Reynolds number and its significance, Measurement of pressure and flow rate, Introduction to liquid transport systems, Pumps used in food industry: centrifugal pumps, positive displacement pumps. Filtration: principle and applications, Centrifugation: principle and industrial use	3	12
4	Heat Transfer in Food Processing Importance of heat transfer in food processing, Modes of heat transfer: conduction, convection, radiation, Thermal properties of foods, Simple heat transfer calculations, Basic concept of heat exchangers: plate heat exchangers, tubular heat exchangers. Introduction to thermal processing of foods: pasteurization, sterilization. Basic concept of D, Z and F values. Introduction to membrane separation: Ultrafiltration (UF), Reverse osmosis (RO, Basic principles and applications in food industry	4	14

5	Psychrometrics and Food plant layout Psychrometrics- Composition of air, Humidity concepts: absolute humidity, relative humidity, dew point, wet bulb temperature. Psychrometric chart and its applications, Importance in food drying and storage Food Plant Layout- Importance of plant layout in food industries, Factors affecting plant location, Types of plant layout: product layout, process layout, combination layout. Basic considerations in food plant design: material flow, personnel flow, hygienic design. Utilities in food processing plants (water, steam, refrigeration, electricity)	5	12
Total Credits of the Course		4	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 marks

REFERENCES

- Singh, R.P and Heldman, D.R. (2023). Introduction to Food Engg., 6th edition, Academic Press, INC, London.
- Toledo, R.T. (2018). Fundamentals of Food Process Engineering, 4th edition, Springer.
- Heldman, D. R, 2007, and Lund, D.B. Handbook of Food Engineering 2nd edition. CRC press, New York.
- Rao M.A. and Rizvi S.S. and Datta A. K. (2005) .Engineering properties of foods: CRC Press.
- Smith, P. G. (2011). Introduction to food process engineering. Springer



MAHATMA GANDHI UNIVERSITY

FS M 26 E 06: NANOTECHNOLOGY –CONCEPTS AND APPLICATIONS IN FOOD SCIENCE

SchoolName	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Name	NANOTECHNOLOGY –CONCEPTS AND APPLICATIONS IN FOOD SCIENCE					
Type of Course	Elective					
Course Code	FS M 26 E 06					
Course Summary & Justification	- The content in this course has been designed with an objective to provide detailed understanding on the techniques, principle and applications of nanotechnology in food - Course also enable students to study regarding the different type of nano materials for food processing , food preservation and increasing the organoleptic and nutritive properties of foods - This will enable the students to identify the research, learning and job opportunities based on the latest developments in this subject of food technology.					
Semester	First					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basic knowledge in food science and bio technology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.

1	Understand the basic principles and techniques in the field of nano technology	U /E	1
2	Identify the latest techniques in nanotechnology for the food industry	U/ An	1,3,4
3	Understand the application of nanomaterials in food processing	An	1,3
4	Create an insight to the application of nano technology in food packaging	U/E	1,3
5	Understand the application of nano technology in food safety	An	1,3
6	Create an insight to regulatory framework for food nanotechnology	U/R	1,3,5
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Basics of Nanotechnology: History of nanotechnology, Definitions and scales, seeing the Nano scale, nature of light, electron microscope, scanning probe microscope in seeing the nano scale. Nanomaterials – formation of materials, carbon nanomaterials, Buckyball, Graphene (2D), Carbon nano tubes, Inorganic nano materials, Zero Dimensional Nano-Structures, One Dimensional Structures, Two Dimensional and three-dimensional Structures.	1	10
2	Nanotechnology in Food industry: Nanoencapsulation & microencapsulation- flavour & aroma encapsulation- Nano formulations for the delivery of bioactive compounds- Nanocarriers- Lipid Nanocarriers for Phytochemical Delivery in Foods- Nano-emulsions- Nano-dispersions Characterization & stability- Bioavailability studies- limitations- Electrospinning and Electrospraying Technologies- Applications in the food Industry, Nano-filtration, Nanoclusters, Nanochelates. Bio availability of nanoparticles in nutrient and nutraceutical delivery.	1 & 2	15
3.	Applications in Food Processing: Nano Ingredients, additives and nano food processing. Nano materials for food applications- metal oxides, functionalized nanomaterials, nano additives, encapsulation and release efficiency of nanoparticles, applications of nanoencapsulation in food industry, importance of nanotechnology in food processing in terms of	3	15

	food texture, appearance and taste, nutritional value and shelf-life, Nanoparticles as ingredients and additives in nutrients and food supplements.		
4	Nano packaging : Potential of nanomaterials in food packaging- Nanopolymers, Nanocomposites, Nanolaminates and Nanostructured Coatings in Food Packaging- Smart/Intelligent packaging- Nano antimicrobials in enhancement of shelf-life of foods	4 & 5	10
5	Nano sensors: Nanotechnology in Microbial Food Safety & bio-security- Electrochemical sensors for food analysis and contaminant detection- Monitoring and separation of food-borne pathogens using nanoparticles- Safety Assessment for Use of Nano materials in Food and Food Production- Efficacy Evaluation and Risk Assessment- Regulatory Framework for Food Nanotechnology	5 & 6	10
Total Credits of the Course		4	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks B. Semester End examination – 60 marks

REFERENCES

Recommended Text Books • Introduction to nanotechnology - Charles P. Poole; Frank J. Owens – 2008 – Wiley. • Bionanotechnology by David S Goodsell, John Wiley & Sons, 2004. • Nanobiomaterials Handbook by Balaji Sitharaman, Taylor & Francis Group,
Recommended References • Nanotechnologies in Food – Qasim Chaudhary, Laurence Castle, Richard Watkins -2010- RSC

Publishing Data Book. • Nanoparticle Assemblies and Superstructures by Nicholas A. Kotov, CRC, 2006. • Nanotechnology in agriculture and food production by Jennifer Kuzma and Peter VerHage,, Woodrow Wilson International, 2006. • Nanotechnologies in Food – Qasim Chaudhary, Laurence Castle, Richard Watkins -2010- RSC Publishing Data Book. • Nanoparticle Assemblies and Superstructures by Nicholas A. Kotov, CRC, 2006. • Nanotechnology in agriculture and food production by Jennifer Kuzma and Peter VerHage,, Woodrow Wilson International, 2006.
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SECOND SEMESTER



MAHATMA GANDHI UNIVERSITY

FS M 26 C 10: FOOD SAFETY AND QUALITY ASSURANCE

School Name	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Name	FOOD SAFETY AND QUALITY ASSURANCE					
Type of Course	Core					
Course Code	FS M 26 C 10					
Course Summary & Justification	- The course is designed to get a deep knowledge of concept of food safety and food quality assurance. - This course provide an insight to food adulteration and its types, techniques and principles of food quality assurance - This course also gives a basic knowledge of HACCP system for quality assurance. - It also equips students with a sound knowledge on both international and national food laws and regulations and agencies for food safety.					
Semester	Second					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of food science and quality control					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Students will be able to understand the concept of food quality, food safety, food quality assurance and food quality management	U /An/E	1
2	Create an insight to Total Quality Management ,Good Manufacturing Practices, Good Hygienic Practices And Good Lab Practices	U/ An/E	3,5
3	Understand microbial and statistical quality control in food industry	U/A	3,5

4	Students will be equipped with a basic knowledge in HACCP	U/A/S	3,5
5	Understand national and international food laws and regulations for food safety	U/R	3,4,5
6	Create an insight to the national and international agencies in the field of food safety	U/R	1,5
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Introduction To Food Safety and Quality Introduction to concepts of food safety, food safety system, total quality management, quality control and quality assurance. Current challenges in food safety. Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents. Food sanitation and hygiene in food industries.	1	10
2	Food Quality Assurance Principles of food quality assurance, total quality management (TQM) - Good Manufacturing Practices - Risk Analysis, Risk Management, Risk Assessment, Risk Communication - Traceability and authentication, good hygienic practices, good lab practices, general awareness and role of management practices in quality control.	2 & 3	10
3.	Microbial quality control and HACCP Microbial quality control: determination of microorganisms in foods by cultural, microscopic, physical and chemical methods. History of HACCP, seven principles of HACCP ,HACCP –Manuel ,preparation, validation, implementation- internal audit, verification audit, deficiencies, corrective and preventive actions.	4	10
4	International Food Regulatory Agencies Codex Alimentarius Commission (CAC), Codex standards. Advantages of Utilizing International Standards. European Committee for Standardization (CEN), PAN American Standards Commission (COPANT), Euro-Asian Council for Standardization, FDA,EPA, EU, ASEAN, EFSA (European Food Safety Authority), WTO,TBT and SPS agreements, Australian quality standards, codex- JECFA, JEMRA, JMPR. International organization for standards (ISO) and its standards for food quality and safety (ISO 9000 series, ISO 22000, ISO 15161,ISO 14000).	5 & 6	15

5	National standards Food Safety and Standard Authority of India (FSSAI) regulations, Packaging and labeling regulation Bureau of Indian Standards (BIS), AGMARK, Agricultural and Processed food Export Development Authority, Marine Product Export Development Authority, Export Inspection council and Export Inspection Agency. Export & Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963.	5 & 6	15
Total Credits of the Course		3	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction, Explicit Teaching, E-learning, interactive Instruction:, Active cooperative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks B. Semester End examination – 60 marks

REFERENCES

Recommended Text Books

- Kuddus, M, Ashraf, S.A. and Rahman, P. (Eds). (2024) Food safety: quality control and management. CRC Press.
- Sivasankar B. (2002): Food Processing And Preservation, Prentice Hall of India Pvt Ltd., New delhi.
- Desrosier N W & James N. (2007). Technology of food preservation. AVI. Publishers
- Lawley, R., Curtis, L. and Davis, J. (2015). The food safety hazard guidebook. Royal society of Chemistry.

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- Earle R.L (1983), Unit Operations In Food Processing, 2nd edition, Pergamon press, Oxford, UK
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- Khetarpaul N.(2005). Food Processing and Preservation, Dya Publishing House, New Delhi.
- Frazier W C and Westhoff D C (1996). Food Microbiology, 4th edition, Tata Mc Graw Hill Publications, New Delhi.
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- Piggot J.R. 1984. Sensory Evaluation of Foods. Elbview Applied Science.
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- Early R.1995.*Guide to Quality Management Systems for Food Industries*. Blackie Academic.
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	MAHATMA GANDHI UNIVERSITY
	FS M 26 C 11: ADVANCED FOOD ANALYSIS AND INSTRUMENTATION

School	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Title	ADVANCED FOOD ANALYSIS AND INSTRUMENTATION					
Course Type	Core					
Course Code	FS M 26 C 11					
Course Overview	• Provides fundamental knowledge on principles and applications of classical and instrumental methods for the analysis of major food components. • Develops skills in selection, interpretation and evaluation of analytical techniques for accurate determination of food quality, composition and safety. • Introduces advanced analytical technologies, chemometric tools and quality assurance systems (ISO/GLP) relevant to modern food testing laboratories and industry.					
Semester	2		Credit	3		
Total Student Learning Time	Learning Approach	Lecture	Tutorial	Practical	Others	Total learning hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics understanding of food science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	<i>Upon completion of this course, students will be able to;</i>		
1	Explain the principles and working of classical and instrumental methods used for food analysis.	U	2,4
2	Apply appropriate analytical methods for the quantitative determination of major food components such as carbohydrates, proteins, lipids, moisture, vitamins and minerals.	A	1,2,3,4
3	Evaluate analytical results and select suitable techniques based on accuracy, sensitivity and application requirements.	An	1,2,4
4	Interpret data obtained from advanced analytical techniques including chromatographic, spectroscopic and rapid non-destructive methods using basic chemometric concepts.	An	2,4
5	Assess quality assurance practices, method validation parameters and laboratory accreditation requirements (ISO 17025/GLP) for industrial food testing laboratories.	E	2,4,5

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module No	Module Content	Course Outcome	Hours
1	Module I: Principles of Analytical Instrumentation	1	13
	Importance of biomolecular analysis, Sampling and sample preparation techniques. Principles, instrumentation and applications of: UV–Visible spectroscopy, Infrared spectroscopy, Atomic Absorption Spectroscopy, NMR, Electrophoresis (SDS-PAGE), Chromatography: Physico-chemical principles, Paper, TLC, HPLC, GC. Colorimetry, Gravimetry, Refractometry		
2	Module II: Analysis of Carbohydrates	2,3	10
	Extraction and clarification, Chemical methods (Lane & Eynon, Munson & Walker method, Alkaline ferricyanide method, Phenol-sulphuric acid method Nelson–Somogyi), Enzymatic methods, Sugar profiling, Starch and dietary fiber analysis		
3	Module III: Analysis of Lipids and Moisture	2,3	12
	Soxhlet, Goldfisch, Mojonnier methods Babcock, Gerber methods Moisture analysis: Oven, Karl Fischer, Physical and rapid methods		
4	Module IV: Analysis of Proteins, Vitamins and Minerals	2,3	15
	Kjeldahl, Biuret, Lowry, Bradford, UV 280 nm method Vitamin analysis: HPLC, fluorometric, colorimetric methods Mineral analysis: Sample preparation (dry ashing, wet digestion, microwave digestion); Determination of minerals by EDTA titration (Calcium, Magnesium), colorimetric methods (Phosphorus, Iron) and instrumental techniques such as AAS and ICP-OES/ICP-MS (principle and applications).		
5	Module V: Advanced Analytical Techniques and Industrial Applications	4,5	10

	Thermal analysis (DSC, TGA), Texture Analyzer and Rheology basics, Hyperspectral imaging, Electronic nose and electronic tongue, Biosensors and immunoassays, Rapid microbial detection methods. AI and Digital Tools in Food Analysis: Basics of chemometrics, Machine learning applications in food quality prediction, Image analysis for defect detection, Digital data management (LIMS – Laboratory Information Management System) Industrial Analytical Systems: Quality control laboratories in food industries, Method validation (accuracy, precision, LOD, LOQ), Calibration and standardization, Regulatory frameworks: ISO 17025, GLP, NABL, Food safety testing for contaminants, residues, adulterants		
Total Credits of the Course		3	60

Mode of Transaction	Classroom activities: Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Mode of Assessment	A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment/Seminar – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks B. Semester End examination – 60 marks

Learning Resources

1. Nielsen, S.S, (2024) Food analysis. Sixth edition, Springer
2. Skoog, Holler & SR crouch, (2007), Principles of Instrumental Analysis, seventh

edition, Cengage learning

3. Damodaran, S., Parkin, K. L., & Fennema, O. R. (Eds.). (2007). Fennema's food chemistry. CRC press.
4. Gemperline, P. (2006). Practical guide to chemometrics. CRC press.
5. Vasconcellos J.A, (2000), Quality Assurance for the Food Industry, CRC press
6. Shaw, I. C. (2018). Food safety: the science of keeping food safe. John Wiley & Sons.

	MAHATMA GANDHI UNIVERSITY
	FS M 26 C12: FOOD PACKAGING TECHNOLOGY

School	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Title	FOOD PACKAGING TECHNOLOGY					
Course Type	Core					
Course Code	FS M 26 C 12					
Course Overview	- Provides comprehensive knowledge on the principles and functions of food packaging, properties and selection of packaging materials, and their application based on food characteristics and storage conditions. - Covers conventional and advanced packaging systems including MAP, aseptic, active, intelligent and sustainable packaging technologies for modern food applications.					
Semester	2		Credit	3		
Total Student Learning Time	Learning Approach	Lecture	Tutorial	Practical	Others	Total learning hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics understanding of food science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	<i>Upon completion of this course, students will be able to;</i>		
1	Explain the principles, functions and regulatory aspects of food packaging systems	U	1
2	Analyze the properties and suitability of different packaging materials for food applications	An	1,2
3	Evaluate the performance of packaging materials using standard testing and quality parameters	E	1,2,3
4	Apply appropriate packaging systems for different food categories based on product characteristics	A	1,2,3
5	Assess advanced and sustainable packaging technologies for modern food systems	E	1,2,4,5

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module No	Module Content	Course Outcome	Hours
1	Module I: Fundamentals of Food packaging	1	10
	Definition and functions of food packaging Role in food preservation, storage and distribution Levels of packaging: primary, secondary and tertiary Factors influencing selection of packaging materials Packaging environment and shelf life concepts Safety considerations and regulatory aspects of food packaging		
2	Module II: Packaging Materials – Properties and Characteristics	2	15
	Paper and Paperboard: types, properties, coatings, laminates, applications Plastic Packaging: classification of polymers, structure–property relationships, barrier and mechanical properties, food-grade plastics Metal Packaging: tinsplate, aluminium, container fabrication, corrosion and protection Glass Packaging: composition, properties, advantages and limitations, closures Additives in packaging materials: types and functions Comparison of materials and selection criteria		
3	Module III: Testing and Evaluation of Packaging Materials	3	10
	Mechanical strength tests Barrier properties: permeability to gases, moisture and light Migration and compatibility testing Shelf life evaluation and package performance Quality assurance in packaging		4
4	Module IV: Packaging Materials and Food Applications	4	15
	Packaging requirements for: Cereals and bakery products, Snack foods, Milk and dairy products, Meat, poultry and fish, Fruits and vegetables, Frozen foods, Beverages and ready-to-eat foods Interaction between food and packaging materials Selection of packaging systems based on product characteristics		
5	Module V: Packaging Applications and Advanced Systems	5	10

	Vacuum packaging, Modified Atmosphere Packaging (MAP) and Controlled Atmosphere Storage (CAS), Aseptic packaging systems, Active and intelligent packaging, Edible films and coatings, Biodegradable and sustainable packaging materials, Trends in eco-friendly and smart packaging	:	
Total Credits of the Course		3	60

Mode of Transaction	Classroom activities: Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Mode of Assessment	A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment/Seminar – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks B. Semester End examination – 60 marks

Learning Resources

1. Richard Coles, Derek McDowell, Mark J. Kirwan, Food Packaging Technology, Blackwell Publishing, CRC Press LLC, 2008
2. Food packaging, principles and practice, Gordon L Robertson, CRC press, 2013
3. Ahvenainen, R. (Ed.) 2003. Novel Food Packaging Techniques. CRC Press.
4. Han, J.H. (Ed.) 2005. Innovations in Food Packaging, Elsevier Academic Press

	MAHATMA GANDHI UNIVERSITY
	FS M 26 C 13: LABORATORY COURSE 2: TECHNIQUES IN FOOD ANALYSIS, FOOD ADDITIVES AND PACKAGING TECHNOLOGY

SchoolName	School of Food Science and Technology					
Programme	M.Sc. Food Science and Technology					
Course Name	LABORATORY COURSE 2: TECHNIQUES IN FOOD ANALYSIS, FOOD ADDITIVES AND PACKAGING TECHNOLOGY					
Type of Course	Core					
Course Code	FS M 26 C 13					
Course Summary & Justification	- The main objective of the course is to give practical training to the students in quality analysis of different categories of food, estimation of additives in food and quality testing of food packaging. - This course enhances the practical abilities of the students in food quality control and gives a good exposure to the methodologies significant to food industry					
Semester	Second					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Eg. Authentic learning Collaborative learning Independent learning	10	10	120	-	140
Pre-requisite	Basic knowledge in techniques of food analysis, food additives and food packaging					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	On completing this course students will be able: Perform safe laboratory practices, sample preparation, and standard analytical procedures for food analysis	A	2
2	Determine proximate composition and physicochemical characteristics of foods using classical methods	A	2
3	Detect food adulterants and evaluate the quality of market	An	2,4

	food samples.		
4	Estimate selected food additives using titrimetric and spectrophotometric techniques	A/An	2,3
5	Evaluate food packaging materials using basic tests and interpret outsourced analytical reports.	An/E	2,4
6	Record, analyze, and interpret experimental data and prepare scientific laboratory reports in comparison with standards.	An/C	2
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hours
1	Basic Food Analysis 1. Moisture determination (Hot air oven method) 2. Ash determination 3. Crude fat (Soxhlet method) 4. Crude protein (Micro-Kjeldahl) 5. Crude fibre estimation 6. Total soluble solids (Refractometer) 7. pH and titratable acidity 8. Reducing and total sugars 9. Ascorbic acid estimation 10. Peroxide value / Acid value of oils 11. Water quality testing (hardness, alkalinity, chloride)	1,2,6	30
2	Market Sample Evaluation & Adulteration Detection 1. Detection of adulterants in milk (starch, urea, detergent, neutralizers) 2. Adulteration tests in edible oils (argemone oil, mineral oil) 3. Detection of artificial colours in foods 4. Adulteration tests in spices and condiments 5. Quality evaluation of pulses and cereals 6. Quality tests for bakery products 7. Sensory evaluation of selected food products 8. Basic statistical analysis of results (mean, SD, comparison)	1,3,6	30
3.	Analysis of Food Additives 1. Estimation of iodine in iodized salt	1,4,6	40

	2. Estimation of common salt (Mohr's method) 3. Estimation of sulphur dioxide 4. Estimation of sodium benzoate 5. Estimation of sorbic acid (qualitative/quantitative) 6. Estimation of saccharin (qualitative method) 7. Estimation of permitted synthetic colours 8. Estimation of natural pigments (chlorophyll/carotenoids) 9. Qualitative test for gums and stabilizers		
4	<u>Testing of Packaging materials</u> 1. Bursting strength 2. Puncture resistance 3. Drop test 4. Identification of plastics 5. Thickness 6. Water vapor transmission rate 7. Gas transmission rate 8. Tear strength 9. Migration test	1,5,6	40
Total Credits of the Course		4	140
Books for Reference			
1. Nielsen, S.S, 2004 Introduction to the chemical analysis of foods. Jones and Bartlett Publishers, Boston, London. 2. Sharma, B.K, 2004, Instrumental Methods of Chemical Analysis. Goel Publishing House, New Delhi 3. Richard Coles, Derek Mcdowell, Mark J. Kirwan, Food Packaging Technology, Blackwell Publishing, CRC Press LLC, 2003 4. Mahindru ,S N, Food Additives : Characteristics, detection , and estimation , A P H Publishing Corporation, New Delhi. 5. Larry Branen, P. Michael Davidson, Seppo Salminen, John Thorngate, Food Additives, Marcel Dekker Inc., 2002			

Teaching and Learning Approach	Laboratory Procedure (Mode of transaction) Direct Instruction: lecture, Explicit Teaching, Demonstration, Hands on experimental sections, Skill acquisition by laboratory training
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) Assessment of the performance of student in the lab- 10 marks Internal Test -20 marks Project report (student needs to perform experiments on a specific project and report should be prepared)– 10 marks B. Semester End examination – 60 marks



MAHATMA GANDHI UNIVERSITY

FSM26C28:BIOSTATISTICS & RESEARCH METHODOLOGY

School Name	School of Food Science and Technology					
Programme	M.Sc. Food Science and Technology					
Course Name	BIO-STATISTICS & RESEARCH METHODOLOGY					
Type of Course	Core					
Course Code	FS M26 C28					
Course Summary & Justification	- Learning the contents of the paper is expected to provide the basic understanding of the Bio-Statistics and research methodology. In addition to basic understanding, the paper is expected to equip the learners with necessary skill sets to manage and interpret data for food technology. - The objective of the paper is to impart the basic knowledge pertaining to Bio-Statistics and data analysis using a Statistical software. - The core contents of the paper is designed with an objective to train the students both in theoretical and practical applications of Bio-Statistics and Research Methodology. - The topics will also enable the students to get an idea about the recent developments taking place in the domains of both Bio-Statistics and Research methodology. - The paper is expected to enhance the employability skills and research aptitude of the students by equipping them with industry relevant knowledge and skills.					
Semester	Second					
Total Student Learning Time(SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	75	15	15	15	120
Pre-requisite	Basics of Bio-Statistics and research methodology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	This will help to remember and understand the basic concepts / Principles of Bio- Statistics. Students will be equipped with the basic knowledge regarding measures of central tendency, dispersion, graphical representations of data and how these tools can be used to gather, organize, analyze and interpret data. It will help to understand and analyze the various concepts of correlation and regression through case studies.	U/An/S/Ap	1,5
2	It will help to understand the basic concepts in probability, random variables and distribution models like binomial and normal distributions and their applications in food science and technology.	U/An/S	1,2,4
3	To equip the learners with right understanding of key concepts relating to Inferential Statistics, including parametric and non-parametric tests for mean and proportion. Extending the knowledge gained to the food science industry. To improve the data interpretational abilities of the learners	S/An/Ap	2,3,5
4	Empowering the learners to plan and design experiments in food science and carry out data analysis and interpretation pertaining to Food Industry. This will also make them familiar with quality control concepts and tools which are essential in food industry.	U/An/Ap/S	1,2,5
5	To promote further learning and exploration through research. To impart knowledge about various types of research, research design, formulation of research problems, and methodological approaches as well as writing of project reports and research papers, plagiarism checks etc..	U/An/C	1,4,5
<i>*Remember(R), Understand(U), Apply(A), Analyse(An), Evaluate(E), Create(C), Skill(S), Interest(I) and Appreciation (Ap)</i>			

COURSECONTENT

Module No	ModuleContent	Course Outcome	Hrs
1	Descriptive Statistics and Data Visualization: Scope and applications, Variables & attributes, Qualitative & quantitative variables. Collection, Classification, Tabulation and frequency distribution of data. Graphical and diagrammatic representation. (Bar charts, Histograms, Frequency polygons, Box plots, two way scatter plots and line graphs) Measures of central tendency: Arithmetic mean, median and mode. Relation between mean, median and mode. Measures of dispersion: Range, standard deviation, standard error, variance and Coefficient of variation. Correlation: Meaning and definition, Scatter diagram, Different types of correlation, Karl Pearson's correlation coefficient, Rank correlation, partial and multiple correlation. Regression analysis: Regression in two variables, regression equations and regression lines, Coefficient of determination, Multiple regression, Applications in Food Science.	1, 2, 3	15
2	Probability and Probability distributions: Random Experiment, Outcome and Event, Conditional Probability and Independence of Events, Addition and Multiplication Rules, Bayes' Rule, sensitivity, specificity, and simple numerical problems. Random Variables, discrete and continuous, Binomial and Normal distribution and applications using illustrative problems.	2, 3,4	15
3.	Statistical Inference, Estimation, Estimate of Population mean and proportion, Random sampling, Stratified Samples, Testing, Sample size determination Null and Alternative Hypothesis, Rejection and Acceptance Region, Type I and II errors, level of significance, power of test. Parametric Tests for means- Both Large sample and Small sample tests for Testing of single mean, proportion, equality of two means and Paired- t in small samples. Non-parametric Tests, Application Chi-square test in food technology, Test for independence, Goodness of fit, Kolmogorov-Smirnov Test, Signed rank tests, Mann-Whitney-Wilcoxon Rank Test.	1,2, 3 &4	15

4	Design of Experiments: Basic Principles, Analysis of Variance (ANOVA): Concept and Analysis of CRD, RBD, LSD and Factorial Experiments with simple numerical data sets. Quality Control, Basic concepts, quality, specification limits, Control Charts: X- bar chart, R Chart.	1,2, 3 &4	15
5	Research Methodology: Meaning, aim, objectives and significance of research. Research Designs – Features of good designs, Types of Research and research designs, Formulation of research problem, Review of Literature, Research protocol, synopsis, Different Steps in Writing Reports and research papers, Interpretation of results, Significance of Report Writing, Layout of Research Reports and Research Papers, ethics in research, plagiarism checks.	1,5	15
Total Credits		4	75
Biostatistics Practical Lab: Practical Lab for about 10- 15 hours may be given for Analysis of Data from Food Science contexts and Practical Record may be prepared. This may form a part of Internal Assessment with 10 marks.			15
Familiarity with EXCEL for computing Descriptive Statistics, Correlation And Regression (CORREL, SLOPE, LINEST). Hypothesis Testing (t-.TEST, F-TEST, CHISQ.TEST), Knowledge of Jamovi / SPSS/ R Program/ Python - Entering data, importing data from other formats, introduction to various charts - histogram, Bar chart, line chart, bar chart, pie chart, generating frequency table and cross tables and summary measures, scatter diagram and correlation – Pearson and Spearman's Correlation in Regression Analysis, t-test (one sample, paired sample t-test, independent sample t-test)–Interpreting results, one way and two way ANOVA, Assumptions of t-test and verifying the assumptions, Chi-square test for independence, ANOVA.			

Teaching and Learning Approach	Class room Procedure(Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, Interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student / Group representative; Practical Works and Practical Record
Assessment Types	Mode of Assessment A. Continuous Internal Assessment(CIA) 1. Two Internal Tests of maximum 20 marks 2. Seminar Presentation– a theme is to be discussed and presented in the seminar Maximum marks 10 3. Practical Record based on the Biostatistics Questions and Data Analysis– 10 marks B. Semester End Examination–60 marks

REFERENCES

Recommended Text Books

- John A. Bower (2013): Statistical Methods for Food Science, Edition 2, Wiley Blackwell
- Marcello Pagano (2010) Principles of Biostatistics, Kimberlee Gauvreau, Duxbury Press
- Zar, Jerrold, H.(1998).Biostatistical Analysis, Prentice Hall, NJ
- Levin and Rubin (2015) : Statistics for Management,Owls Books,Toledo,USA
- Microsoft Excel Formulas and Functions (Office 2021 and Microsoft 365),1st Edition by Paul Mc Fedries.
- Conrad Carlberg (2018): Statistical Analysis, Microsoft Excel2016, Addison-Wesley Professional
- Navarro DJ and Foxcroft DR (2022).Learning Statistics with JAMOV: A Tutorial for Psychology Students and other beginners. (Version 0.75).

Recommended References

- Mahindru,S.N, (2000),Food additives. Characteristics, detection and estimation. TataMcGraw-Hill Publishing Company Limited, New Delhi.
- Pearson,D,2002 The Chemical Analysis of Foods, Churchill Livingstone, NewYork,
- HarryT, Lawless, Hildegard Heymann(2010) Sensory evaluation of Food: Principles and Practices, Second Edition, Springer, New York.
- Sarah Kemp, Tracey Hollywood, Joanne Hort (2011) Sensory evaluation: A Practical Handbook, Wiley-Blackwell, New York
- S.P.Gupta, Statistical Methods, Sultan Chand &Sons Publisher, New Delhi
- C.R. Kothari,Research Methodology, Methods and Techniques, Wiley Eastern Limited, New Delhi

Approval Date

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Implementation Date



MAHATMA GANDHI UNIVERSITY

FS M 26 E 14: INDUSTRIAL MICROBIOLOGY

School Name	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Name	INDUSTRIAL MICROBIOLOGY					
Type of Course	Elective					
Course Code	FS M 26 E 14					
Course Summary & Justification	- The objective of this course is to impart the basic knowledge in industrial microbiology - The course gives a basic knowledge in principle and techniques in microbiology with industrial application. - To develop a very good understanding about the fermentation technology and its application in food industry. - The course also gives a sound knowledge regarding genetic engineering with emphasis on its applications for improving foods and safety issues.					
Semester	Second					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of food science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1.	Students will be able to : Understand the fundamental concepts and techniques in Industrial Microbiology	E	1
2	Acquire a sound knowledge in process of fermentation and different types of fermented foods	An	1

3	Understand the benefits and functional properties of fermented foods	U/E	1,2
4	Understand the application of fermentation technology in food industries	U/C	2
5	Create an insight to genetic engineering, use of genetically modified plants and animals for food production	An/I	2,5
<i>*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i>			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Fundamentals of Industrial Microbiology History of Industrial Microbiology: Primary and secondary metabolites produced by the microorganisms. Screening of microorganisms Applications of Industrial Microbiology, OMICS technologies	1	10
2	Fermentation technology History and scope of food fermentation. Fermentation, Fermentation media, Types of fermentation process, Fermentor; Components of a fermentor, Parts of fermentor, peripheral parts and accessories, additional accessories. types of fermenters. High cell density cultivation strategies. Downstream processing: Cell disruption methods, mechanical and non mechanical disruption methods, extraction, purification, concentration, product recovery, chromatographic methods and drying techniques.	2 & 3	15
3.	Fermented Foods Production of fermented milk and milk products, plant-based products, fish products and meat products. Traditional and non-traditional fermented foods. Introduction to the concept of bioactive compounds and brief study of such compounds from fermented foods including malt beverages, wines, distilled liquors and vinegar, Fermented Indian Foods, Fermented oriental foods.	3	10

4	Applications in Food Industry Microbial production of ethanol, beer, wine, distilled liquors, acetone, butanol, Citric acid, acetic acid, lactic acid and baker's yeast. Polysaccharides- Microbial, Bacterial and other polysaccharides. Enzymes, Sweeteners, flavors and amino acids, Vitamins and pigments	4	10
5	Genetically modified Plant and animal products Improvement of the food crops by genetic engineering; genetically modified plants and animals for enhanced food production; safety of GM food crops. Biotechnological approaches to Improve Nutritional Quality and Shelf Life of Fruits and Vegetables. Recombinant milk, Transgenic Fish Technology in Sea Food Production, Fish Protein Hydrolysates. International Aspects of the Quality and Safety Assessment of Foods derived by Modern Biotechnology. Intellectual property rights (IPR)-ethics and biopiracy problems	5	15
Total Credits of the Course		4	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 marks

REFERENCES

Recommended Text Books

- Modern Food Microbiology by James M Jay, (2000), seventh edition. Aspen Publishers.
- Essentials of Food Sciences Vickie A. Vaclavik, Elizabeth W. Christian, fourth edition, (2013) Springer.

- An introduction to Food Science and food systems by Rick Parker and Miriah Pace, (2020). Second edition. Thomson Learning.
- The technology of Food Preservation by N W Desroisier, (2017). Third edition. Medtech.

Recommended References

- Food microbiology by William C Frazier and Westhoff Dennis C, Tata McGraw Hill publication.
- Food Biotechnology by J Polak, J Tramper and S Bielecki, Elsevier Science
- Food Science & Food Biotechnology by Gustavo F & Lopez, CRC Press.
- Food Engineering by Dennis Heldman & R Paul Singh, Academic Press.
- Food Biotechnology by Kalidas Shetty. CRC Press

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MAHATMA GANDHI UNIVERSITY

FS M 26 E 08: FOOD TOXICOLOGY

SchoolName	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Name	FOOD TOXICOLOGY					
Type of Course	Elective					
Course Code	FS M 26 E 08					
Course Summary & Justification	- The content in this course has been designed with an objective to provide detailed understanding of different types of toxins in food (natural , agricultural/industrial contaminants, toxins as a result of processing and packaging) - This course helps to develop a very good understanding regarding the toxic food additives. - Understanding these is highly essential for a student to explore its theoretical and practical aspects for the benefit of society					
Semester	First					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20			
Pre-requisite	Basic knowledge of food science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	To understand the classification, dose and determinants of toxins in food	U /E	1,3

2	Understanding toxic constituents and anti-nutritional factors naturally present in foods	U/ R	1,3
3	To identify the toxins in food as a result of agricultural and industrial contamination	U/E	1,5
4	To identify the toxic constituents in food due to processing and packaging	U/E	1,5
5	Create an insight to the toxic food additives	U/R	1,4
6	Give an understanding on the toxic implications of nano technology in food	U/An	3,4
<i>*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i>			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Introduction to food toxicology Introduction to food toxicology: classification, dose, determinants of toxins in foods; naturally occurring toxins from animals, bacterial and fungal and sea food sources, Anti-nutrients: their effects and removal from foods. Risk assessment in food toxicology; laws and regulation of safety assessment of foods including food additives, environmental contaminants, pesticides and antibiotic residues, HACCP: principles, steps and application..	1 & 2	10
2	Natural toxins in food Allergens, toxic constituents and anti nutritional factors of plant foods (enzyme inhibitors, trypsin and chymotrypsin inhibitor, amylase inhibitor, flatulence causing sugars, phytolectins)	2	10
3.	Agricultural contaminants Agricultural and industrial contaminants in foods: pesticides residues in fruits and vegetables, metal contaminants in foods and their toxicity in	3	15
	human body; animal drug residues in food and water, dioxins and related compounds in food; metals such as lead, arsenic and mercury. Pests, different type of pests, Methods of pest control.		
4	Toxins from processing and packaging Toxins produced during food processing: polycyclic aromatic hydrocarbons, heterocyclic amines, acrylamide. Food contamination and toxic effects. Toxins from materials in contact with food: wood, glass, ceramics, elastomers and polymeric material, metal packaging.	4	10

5	Food additives as toxicants Food additives as toxicants: artificial colors, preservatives, sweeteners; toxicants formed during food processing such as nitrosamines, Maillard reaction products acrylamide, benzene, heterocyclic amines and aromatic hydrocarbons and irradiation; risk of genetically modified food, food supplements, persistent organic pollutants, toxicity implications of nanotechnology in food.	5 & 6	15
Total Credits of the Course		4	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction, Explicit Teaching, E-learning, interactive Instruction; Active co-operative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks B. Semester End examination – 60 marks

Recommended Text Books

- Deshpande, S. S. (2002). Handbook of Food Toxicology, Marcel Dekker Inc. NY ISBN 0-8247-0760-5.

REFERENCES

- William H.W., Essentials of Environmental Toxicology. Taylor & Francis, Philadelphia, PA. ISBN 1-56032-47A-4

Recommended References

- Shibamoto T .and Bjeldanes L., Introduction to Food Toxicology, Academic Press, Inc. San Diego, CA. ISBN 0-12640025-3.
- Fennema, O, Food Chemistry. Marcel Dekker 1997.
- Codex Alimentarius (FAO / WHO) <http://www.codexalimentarius.net>
- European Food Safety Authority (EFSA) <http://www.efsa.europa.eu>
- Joint FAO / WHO Food Additives (JECFA).
http://www.fao.org/ag/agn/agns/jecfa_index_es.asp

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	MAHATMA GANDHI UNIVERSITY
	FS M 26 E 16: TECHNOLOGY OF BEVERAGES

SchoolName	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Name	TECHNOLOGY OF BEVERAGES					
Type of Course	Elective					
Course Code	FS M 26 E 16					
Course Summary & Justification	• The objective of this course is to understand the importance of beverage industry. • To develop a very good understanding about composition and nutritional quality of different kinds of beverages • This course enable students to illustrate the processing technology and packaging requirement of various beverages.					
Semester	Second					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of food science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Students will be able to understand the science and technology of different types of beverages	U/E	1
2	Students will be able to explain the processing of alcoholic beverages ,carbonated beverages, ,tea, coffee and mineral water	U/ An	1,3

3	Students will be able to understand the permitted additives in beverages	U/E	3
4	Students will be able to understand the impact of processing on quality of beverages	U/E	1,3
5	Students will acquire knowledge of recent high value added beverages and recent trends in beverage industry	U/An	1,3
6	Students will be able to identify the packaging requirement of different types of beverages	U/S	1,3,5
<i>*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i>			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Alcoholic beverages: Beer making, fermentation process, ingredients, different types of beers, lager, pilsner, ale, stout, porter, role of hops in beer making. Wine making, history, science and technology, types- white wines, red wines, dry wines and sweet wines, champagne and sparkling wines, Distilled liquors: whisky , composition, alcoholic contents and properties, scotch whisky, irish whisky and their origin, Canadian whisky , Rum ,source and contents, gin, sources and contents, brandy, contents and properties, Vodka: sources and contents.	1 & 2	15
2	Carbonated beverages: Ingredients: carbohydrates, high intensity sweeteners, flavorings, acids, colors, preservatives and other additives, syrup room operation: syrup room design. Syrup room equipment, syrup room materials, storage and handling, syrup room CIP systems and detergents, Containers and closures: Carbonation and filling: Carbonators: Proportioners. Fillers. Container inspection equipment, secondary and tertiary packaging.	1, 2, 3 & 4	15
3.	Mineral water : Product types, water sources, bottling materials required other equipments, consumer choice, water treatments, filtration methods, deionising, additions, substitutions, bottling, shelf life, microbiology of bottled water.	1 ,2, 4, 5 & 6	10
4	Tea: History of tea, chemical constituents of tea, steps involved in processing- plucking of leaves, handling, withering, rolling, fermentation, drying, sorting, blending, standardizing, packaging.	1 ,2, 4, 5 & 6	10

5	Coffee: Composition, volatile and nonvolatile compounds in coffee, roasting of coffee and changes during coffee roasting ,bean behavior, heat and mass transfer during roasting, decaffeinated coffee, coffee brew concentrate, types, standards and specification of coffee products, chicory; technology of chicory powder and use in coffee product	1 ,2, 4, 5 & 6	10
Total Credits of the Course		4	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B.Semester End examination – 60 marks

REFERENCES

Recommended Text Books

- Srilakshmi, B. Food Science (3rd edition), New Age International (P) Limited Publishers, New Delhi, 2003.
- Manay, N.S, Shadaksharaswamy, M., Foods- Facts and Principles, New Age International Publishers, New Delhi, 2004
- Subbulakshmi. G and Udipi S.A; Food Processing and Preservation; New Age International, New Delhi, 2001
- Potter, N. N, Hotchkiss, J. H. Food Science. CBS Publishers, New Delhi. 2000.

Recommended References

- Schapira J: 1999; The book of coffee and tea : St. Martin press : New York.
- Wellmon F. L; 1999; Coffee; Inter Science Publishers; New York.
- Banerjee B.2002.*Tea Production And Processing*. Oxford Univ .Press
- Sivertz M. & Foote HE. 1963 .*Coffee Processing Technology* .AVI publications
- Woodroof, J.G.and Phillips, G.F.1974. Beverages: Carbonated and Non Carbonated. New Delhi: AVI Publication.
- Ravinder, A. Srinivas Maloo and Dr.Emmanuel, S.J. 2013. Hand Book of Fermented foods and Beverages, 1st edition. Mumbai: Himalaya Books Publishing House.
- Priest, F.G. and Stewart, G.G. 2006. Handbook of Brewing. 2nd edition. New Delhi: CRC Publication.
- Richard, P. 1981. Commercial Wine Making - Processing and Controls. New Delhi: AVI Publication.
- Varnam, A.H.and Sutherland, J.P. 1994. Beverages: Technology, Chemistry and Microbiology. Scotland: Chapman & Hall.

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THIRD SEMESTER



MAHATMA GANDHI UNIVERSITY

FS M 26 C 17: CEREALS, PULSES AND OILSEEDS TECHNOLOGY

SchoolName	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Name	CEREALS, PULSES AND OILSEEDS TECHNOLOGY					
Type of Course	Core					
Course Code	FS M 26 C17					
Course Summary & Justification	- The objective of this course is to illustrate the recent developments in cereal, pulses and oilseed technology - This course describes both traditional and modern techniques of processing of cereals, pulses and oilseeds. - To enable students gain knowledge regarding various processed product lines in food industries.					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of food science and biotechnology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand the structure, composition and functional properties of cereals, pulses and oilseeds	U /R	1
2	Explain general cereal processing techniques and milling operations	U/ An	1
3	Compare different cereals based on composition, processing behaviour and applications	An/E	3,4
4	Analyze processing methods and value addition in cereals, pulses and oilseeds	An/E	1
5	Evaluate quality characteristics and industrial applications of grain-based products	E/I	1,3

**Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Structure, Composition and Comparative Cereal Science: General structure of cereal grains: bran, endosperm and germ Major compositional components: Starch (amylose and amylopectin), Proteins (storage proteins), Lipids and minor constituents Functional properties of cereal components and their role in processing, Comparative analysis of cereals (rice, wheat and corn) with respect to: Composition Processing behavior, End-use applications, Nutritional significance of cereals, Integration of compositional characteristics with processing behaviour	1, 3, 5	12
2	General Cereal Processing and Milling Technology: General principles of cereal processing, Pre-milling operations: Cleaning, grading and conditioning Principles of milling: Dry milling and wet milling (general concepts) Milling operations and equipment: Dehulling, polishing, grinding Factors affecting milling efficiency and yield By-products of cereal milling and their utilization	2,3, 4, 5	12
3.	Commodity-Based Cereal Processing (Rice and Corn): Rice: Structure and composition Parboiling: traditional and modern methods; physicochemical changes Rice milling and drying methods, Ageing and curing of rice Quality evaluation (head rice yield, chalkiness, amylose content) Value-added products. Corn: Structure and composition Dry milling and wet milling of corn with reference to general cereal milling principles Industrial products: Corn grits, flour, starch, oil, gluten, germ, Corn syrup and high fructose corn syrup, Applications in food and fermentation industries	1, 2, 3, 4, 5	12
4	Wheat Chemistry and Cereal quality evaluation: Structure and composition of wheat grain, Gluten proteins (gliadin and glutenin) and their functional role Fundamentals of dough behavior, Wheat quality characteristics, Grain quality evaluation: physical and functional quality parameters grain defects and deterioration Introductory quality testing methods for cereals	1, 4, 5	08
5	Technology of Pulses and Oilseeds: Pulses: Composition and nutritional significance of major pulses Processing: Soaking, dehulling, milling, roasting, grinding, Germination and its effects Anti-nutritional factors (phytates, trypsin inhibitors, tannins) and their reduction, Development of value-added products: Instant mixes, quick-cooking legumes, Protein concentrates and isolates Oilseeds: Composition and nutritional aspects of major oilseeds	1, 2, 4, 5	16

	Oil extraction: Mechanical pressing and solvent extraction Oil refining: Degumming, neutralization, bleaching, deodorization Modification of oils: Hydrogenation, interesterification, winterization Utilization of by-products (oil cakes and meals), Role of edible oils in food applications		
Total Credits of the Course		3	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 marks

REFERENCES

Recommended Text Books

- Kent, N. L., & Evers, A. D. (2017). Kent's technology of cereals: An introduction for students of food science and agriculture (5th ed.). Woodhead Publishing.
- Shewry, P. R., Koksel, H., & Taylor, J. (Eds.). (2023). ICC handbook of 21st century cereal science and technology. Elsevier.
- Serna-Saldivar, S. O. (2016). Cereal grains: properties, processing, and nutritional attributes. CRC press.

Recommended References

- Manay, N.S, Shadaksharaswamy, M., Foods- Facts and Principles, New Age International Publishers, New Delhi, 2004.
- Srilakshmi, B. Food Science (3rd edition), New Age International (P) Limited Publishers, New Delhi, 2003.
- Subbulakshmi. G and Udipi S.A; Food Processing and Preservation; New Age International, New Delhi, 2001

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MAHATMA GANDHI UNIVERSITY

FS M 26 C 18: TECHNOLOGY OF MILK, MEAT , POULTRY AND FISH

SchoolName	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Name	TECHNOLOGY OF MILK, MEAT , POULTRY AND FISH					
Type of Course	Core					
Course Code	FS M 26 C 18					
Course Summary & Justification	• This course is designed to understand the importance of milk, meat ,fish and poultry industry • The course give a detailed understanding of structure , composition and nutritive quality of animal products • To illustrate the processing technology of milk, meat, fish and poultry products • To explain value addition and packaging of milk , meat, fish and poultry products					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of food science and bio technology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Explain the composition, physicochemical properties, and processing technologies of milk, meat, fish and poultry	U	1
2	Describe the manufacturing processes of various dairy, meat, fish, poultry and egg products.	U	1
3	Evaluate hygiene, sanitation and mechanized processing	An/E	1,3

	practices in animal-based food industries.		
4	Interpret food standards and regulations related to dairy, meat, fish and poultry products.	An	1,3,5
5	Apply value addition and processing techniques for developing diversified products from animal foods.	A/S	1,4
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Introduction to Dairy Technology : Definition and importance of dairy technology. Types of milk and composition (cow, buffalo, goat and human milk). Factors affecting milk composition. Physicochemical properties of milk – acidity and pH, density and specific gravity, freezing point, color and flavor. Pasteurization of milk – principles, methods, packaging and storage of pasteurized milk. Judging and grading of milk, flavor defects of milk, causes and prevention. Special milk products – homogenized milk, sterilized milk, UHT milk, flavoured milk, fortified milk, reconstituted and recombined milk, toned and double toned milk.	1, 2, 3, 4 & 5	15
2	Dairy Products : Definition, classification, composition and method of manufacture of major dairy products – condensed milk, milk powder, butter, cream, cheese (different varieties) and ice cream. Fermented dairy products – yoghurt and cultured milk products. Indigenous dairy products – paneer, chhana, khoa, chakka, shrikhand, kulfi, lassi, rabri, basundi and dahi. Defects and uses of dairy products	1, 2, 3, 4 & 5	10
3.	Meat Technology :Structure and composition of meat, nutritive value of meat. Abattoir practices and slaughter methods; stunning methods. Ante-mortem and post-mortem changes in meat. Meat pigments and meat tenderization. Meat cuts and carcass grading. Packaging of meat – vacuum packaging and modified atmosphere packaging (MAP). Meat preservation methods. PSE and DFD meat. Meat products – manufacture of sausages, ham, bacon and minced meat products. Introduction to plant-based or mock meat alternatives.HACCP in meat processing	1, 2, 3, 4 & 5	10
4	Technology of Fish and fish products : Classification and nutritional composition of fish. Methods of fish preservation – chilling, freezing,canning, salting, smoking, drying and pickling and irradiation. Sea food toxins- ciguatera toxins, shell fish. Poisoning, puffer fish toxins, scombroid poisoning. Fish products: fish meal, fish flour; fish oil, fish protein concentrates, minced fish technology and Surimi, fish glue, fish hydrolysate. Fish byproducts: ising glass, gelatin, chitin, chitosan, fish albumin, shark fin rays, squalene and collagen.	1, 2, 3, 4 & 6	15

5	Poultry Technology and products :Poultry processing and poultry meat products. Egg formation, structure, chemical composition and nutritive value.Functional properties of egg proteins.Egg grading and quality evaluation. Preservation of eggs – refrigeration, pasteurization, freezing and drying. Egg products – liquid egg, frozen egg products and egg powder. Functional properties and applications of eggs in food products.	1, 2, 3, 4 & 5	10
Total Credits of the Course		3	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 marks

REFERENCES

Recommended Text Books - Sukumar De; 2000; outlines of Dairy Technology, oxford University press, New Delhi. - Indian standards specifications, Indian standard Institution, Manak Bhavan, New Delhi. - Lampert L.M; 1999; Modern Dairy products, Eurasia publishing House(p)Ltd, New Delhi. - Winton& Winton; 1999; Milk and Milk products; Agro Bios, New Delhi. - Winton & Winton; 1999; Fish and Fish products; Agro Bios, New Delhi.
Recommended References - Cutting L.C. 1999. Fish processing and preservation. Agro Botanical publishers, New Delhi. - Iyer, T.S; 2000; Quality Assurance in sea food processing; CIFT, Cochin. - Panda P.C; 1998; Textbook on Egg and Poultry Technology. Vikas Publishers. - Pearson A.M Gillet T.A; 2000; Processed Meats, New Delhi. - Forrest JC. 1975. Principles of Meat Science. Freeman. - Govindan TK. 1985. Fish Processing Technology. Oxford & IBH. - Hui YH. 2001. Meat Science and Applications. Marcel Dekker. - Kerry J. et al. 2002. Meat Processing. Woodhead Publ. CRC Press. - Levie A. 1984. Meat Hand Book. 4th Ed. AVI Publ.

- Mead M. 2004. Poultry Meat Processing and Quality. Woodhead Publ.
- Mead GC. 1989. Processing of Poultry. Elsevier.
- Law, B. A., & Tamime, A. Y. (2010). Technology of Cheesemaking. Wiley-Blackwell.
- Fellows, P. J. (2017). Food Processing Technology.

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	MAHATMA GANDHI UNIVERSITY						
	FS M 26 C 19 : TECHNOLOGY OF FRUITS, VEGETABLES AND PLANTATION CROPS						
SchoolName	School of Food Science and Technology						
Programme	M.Sc Food Science and Technology						
Course Name	TECHNOLOGY OF FRUITS, VEGETABLES AND PLANTATION CROPS						
Type of Course	Core						
Course Code	FS M 26 C 19						
Course Summary & Justification	• This course is designed to Understand the composition, maturity, ripening behaviour and pre-processing aspects of fruits and vegetables in relation to processing quality. • Learn principles and methods for processing, preservation and shelf-life evaluation of fruit and vegetable products. • Gain knowledge on processing technologies and value addition of major plantation crops such as coffee, tea, cocoa and coconut.						
Semester	Third						
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours	
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120	
Pre-requisite	Basics of food science						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning	PSO No.
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		Domains	
1	Explain the composition, structural characteristics, maturity indices and factors affecting quality and post-harvest losses of fruits and vegetables.	U	1,2,4
2	Describe ripening behaviour, pre-processing operations and their role in maintaining quality during processing of fruits and vegetables.	U	1,2,3
3	Apply appropriate preservation principles and processing techniques for the preparation of various fruit and vegetable products.	A	1,2,3,4
4	Evaluate the storage stability and shelf life of processed fruit and vegetable products based on physicochemical, microbial and sensory parameters.	An	1,2,3,4
5	Explain the processing methods and quality characteristics of major plantation crops such as coffee, tea, cocoa and coconut and their value-added products.	U	1,3,5
<i>*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i>			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Composition and Quality of Fruits and Vegetables: Classification of fruits and vegetables, Structure and morphology of fruits and vegetables, Chemical composition and nutritional significance, Natural pigments: chlorophyll, carotenoids, anthocyanins, betalains – significance and stability during processing, Flavor components: sugars, acids, volatile compounds and their role in product quality, anti-nutritional factors and toxic constituents in selected fruits and vegetables, Physiological changes during growth, maturation and ripening, Post-harvest losses: causes and prevention.	1	10
2	Maturity, Ripening, Harvesting and Pre-processing: Growth and development of fruits and vegetables, Maturity indices: physical, chemical and physiological methods, Ripening physiology;	1,2	10

	climacteric and non-climacteric fruits, Biochemical and physical changes during ripening, Harvesting methods: manual and mechanical, Field handling and transportation considerations, Pre-processing operations: sorting, washing, peeling, and cutting. Enzymatic browning: mechanism and control methods, Blanching: purpose, methods (overview) and effect on quality		
3.	Processing and Preservation of Fruits and Vegetables: Principles of preservation: Role of heat, sugar, salt, acid and dehydration, Hurdle concept in fruit and vegetable preservation. Fruit processing: Pulp and puree preparation, Fruit beverages: juice, nectar, RTS, squash, syrup. Concentrated fruit products, Jam, jelly, marmalade and fruit preserves – principles of gel formation, Candied and crystallized fruits, Fruit bars and fruit leather. Vegetable processing: Canning and bottling of vegetables, Pickles and chutneys, Dehydrated vegetables and vegetable powders, Minimally processed and ready-to-cook vegetables. Quality considerations: Changes during processing: color, texture, flavor and nutrient retention.	3	15
4	Storage, Packaging and Shelf Life of Processed Products: Factors affecting storage stability: moisture, water activity, temperature, oxygen and light, Physiological disorders during storage: chilling injury, freezing injury, Microbial spoilage and its control in processed fruit and vegetable products, Packaging requirements for dehydrated, canned and beverage products, Selection of packaging materials (flexible and rigid) – functional requirements, Shelf life evaluation: physicochemical, microbial and sensory parameters, Storage studies and quality deterioration patterns	4	15
5	Technology of Plantation Crops: Coffee - Composition and quality characteristics, Processing methods: dry and wet processing, Roasting and grinding – effect on flavor and quality. Tea- Chemical composition and quality factors, Processing steps: withering, rolling, fermentation, drying and grading, Types of tea and their characteristics. Cocoa - Composition of cocoa beans, Fermentation and drying, Roasting and grinding, Cocoa powder and cocoa butter – processing overview. Coconut - Composition and nutritional importance Copra production and coconut oil extraction (overview), Desiccated coconut and coconut powder, Coconut milk and cream processing, Value-added products: tender coconut water processing and preservation, Utilization of coconut by-products.	5	15

Total Credits of the Course		3	60
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Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 marks

Learning resources

1. Post Harvest Technology of Horticultural Crops; K. P. Sudheer, V. Indira; Series - 7; New India Publishing Agency; 2007.
2. Hui, Y. H. (2006). *Handbook of fruits and fruit processing*. John Wiley & Sons.
3. Srivastava, R. P., Srivastava, R. P., & Kumar, S. (2005). *Fruit and vegetable preservation: principles and practices*. International Book Distributing Company.
4. Girdharilal; Siddappa G.S., Tandon G.L; 1999; preservation of fruits and vegetables ICAR, New Delhi.
5. NIIR.2004. Handbook on Spices. National Institute of Industrial Reserch Board, Asia Publ.
6. Schapira J: 1999; The book of coffee and tea : St. Martin press : New York.
7. Wellmon F. L; 1999; Coffee; Inter Science Publishers; New York.
8. Sivertz M. & Foote HE. 1963 .*Coffee Processing Technology* .AVI publications

	MAHATMA GANDHI UNIVERSITY
	FS M 26 C 20 : BAKERY AND CONFECTIONARY TECHNOLOGY

School	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Title	BAKERY AND CONFECTIONARY TECHNOLOGY					
Course Type	Core					
Course Code	FS M 26 C 20					
Course Overview	• Provides advanced knowledge on the functional properties of ingredients and their role in the formulation and quality of bakery and confectionery products. • Covers manufacturing principles and quality control of major products including bread, cakes, biscuits, wafers, pastry, sugar confectionery and chocolate. • Emphasizes industrial practices such as process control, packaging, safety regulations, plant operations and current trends in bakery and confectionery processing.					
Semester	3			Credit	3	
Total Student Learning Time	Learning Approach	Lecture	Tutorial	Practical	Others	Total learning hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics understanding of food science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	<i>Upon completion of this course, students will be able to;</i>		
1	Explain the functional role of major ingredients and additives used in bakery and confectionery products	U	1
2	Describe the processing methods involved in the manufacture of bread, cakes, biscuits, wafers, pastry and major confectionery products.	U	1,2,3
3	Apply process control principles to improve product quality and shelf life in bakery and confectionery operations.	A	2,3
4	Analyze quality characteristics and identify defects in bakery and confectionery products and suggest corrective measures.	An	2,3,4
5	Evaluate industrial practices related to equipment selection, packaging, safety and product development in bakery and confectionery processing.	E	2,3,5

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module No	Module Content	Course Outcome	Hours
1	Module I: Functional Ingredients, Dough Rheology and Formulation Principles	1	10
	Wheat types and flour quality for bakery applications Flour composition and functional properties Role of bakery ingredients and improvers (fat, sugar, eggs, emulsifiers, enzymes) Fundamentals of dough and batter rheology, Rheological measurements and instruments: Farinograph, Extensograph, Alveograph, Amylograph and Mixograph Formulation strategies: High-ratio systems, Reduced sugar/fat, Composite flours		
2	Module II: Bread	2,3,4	12
	Dough mixing and development: effect of mixing energy on structure and gas retention. Dough handling characteristics and tolerance. Bread making methods: Straight dough, sponge dough and Continuous processes. Fermentation control: factors affecting yeast activity. Processing equipments, Baking process parameters and heat transfer considerations. Bread quality evaluation and defect analysis. Staling mechanisms and anti-staling technologies. Frozen dough and par-baked bread: process principles, quality changes during storage and industrial applications.		
3	Module III: Bakery Products	2,4	14
	Cake manufacture (foam, batter and high-ratio systems) and quality control. Biscuit and cookie manufacture and quality characteristics. Wafer manufacture and moisture migration problems. Pastry and pie manufacture, including laminated products. Defects and troubleshooting in bakery products		
4	Module IV: Sugar Confectionary and Chocolate Manufacture	2,4	12
	Manufacture and defects : hard candies, fondant, creams, fudge, toffee, caramel, aerated confectionary, chewing and bubble gums Chocolate manufacture, tempering, quality control, major quality defects.		
5	Module V: Industrial operations and Quality	3,5	12

	Bakery plant layout and process flow design, machineries required for bakery. Packaging requirements for bakery and confectionery. Quality assurance: Product specifications, Process control and HACCP. Regulatory aspects (FSSAI / international standards). Current trends: Gluten-free products, Functional & fortified bakery, Clean label, Sustainable processing	:	
Total Credits of the Course		3	60

Mode of Transaction	Classroom activities: Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Mode of Assessment	A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment/Seminar – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks B. Semester End examination – 60 marks

Learning Resources

1. Zhou. W, Hui Y,H;(2014), “Bakery Products Science And Technology” ,2nd Edition, Wiley
2. Pyler, E. J and Gorton, L. A (2009), “Baking Science and Technology” Vol.1 Fourth Edition,
3. Stanley P. Cauvain, Linda S. Young, (2008) “Baked Products: Science Technology and
4. Matz, Samuel A., “Bakery Technology and Engineering”, III Edition, Chapman and Hall,
5. Emmanuel ohene afoakwa, (2016), “Chocolate Science and Technology”, 2nd Edition, Wiley



MAHATMA GANDHI UNIVERSITY

FS M 26 C 21: LABORATORY COURSE 3: FOOD PROCESSING AND PRESERVATION TECHNOLOGY

SchoolName	School of Food science and Technology					
Programme	M.Sc. Food science and Technology					
Course Name	LABORATORY COURSE 3: FOOD PROCESSING AND PRESERVATION TECHNOLOGY					
Type of Course	Core					
Course Code	FS M 26 C 21					
Course Summary & Justification	- This laboratory course provides hands-on training in food processing, preservation techniques, and value-added product preparation. - Students gain practical exposure to thermal processing, dehydration, fermentation, packaging, and quality evaluation of processed foods. - The course also enables students to develop and standardize food products and evaluate shelf-life and sensory quality of preserved foods.					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Eg. Authentic learning Collaborative learning Independent learning	10	10	120	-	140
Pre-requisite	Basics of food processing and preservation					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Develop and standardize processing procedures for various food products.	Ap/S	2
2	Evaluate the effect of different processing techniques on the quality attributes of foods.	An/S	2
3	Apply different preservation techniques to improve the shelf life of food products.	Ap/S	5
4	Perform physical and sensory evaluation of thermally processed foods.	S	3
5	Develop and standardize traditional and fermented food products.	S/C	2

6.	Demonstrate exposure to food processing industries through industrial visit and report preparation.	I/Ap	1
<i>*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i>			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hours
1	<u>Fruit and Vegetable Processing</u> 1. Blanching of vegetables and enzymatic browning control 2. Preparation of fruit preserves – jam and jelly 3. Preparation of vegetable preserves – pickle 4. Dehydration of vegetables- by tray drying, osmotic dehydration of seasonal fruits	1,2 & 3	40
2.	<u>Beverage and Fermented Food Processing</u> 5. Tomato processing – preparation of ketchup or sauce 6. Fruit pulping and preparation of fruit beverages (RTS / squash) 7. Preparation and standardization of traditional fermented foods (e.g., idli/dosa batter) 8. Bread making and evaluation of bread texture 9. Sensory evaluation of processed food products	1,2 , 3 & 4	30
3	<u>Processing of Animal Food Products</u> 10. Preparation of egg-based products using egg as a thickening agent (custard, pudding, pies) 11. Study of changes in meat during cooking – dry heat (roasting, broiling, pan broiling, frying) and moist heat (braising , stewing, pressure cooking) methods 12. Fish cooking methods – shallow frying and deep fat frying (marine and freshwater fish) 13. Evaluation of cooking losses and texture changes in meat and fish	2 ,4 & 5	25

4	<u>Product Development, Packaging and Industrial Exposure</u> 14.Preparation of confectionery products – fudge and fondant 15.Preparation of milk-based traditional sweets – kheer, peda, rasgulla 16. Development and standardization of a value-added food product 17. Study of shelf-life changes in processed food products 18. Effect of different packaging materials on shelf stability 19. Industrial visit to a food processing and preservation unit and submission of report	2, 5 & 6	45
Total Credits of the Course		4	140
Books for Reference			
Recommended Text Books • Srivastava, R.PO and Kumar, S. Fruit and vegetable preservation, International Book distribution Company, Lucknow, 1994. • Srilakshmi, B. Food Science. New Age International Publishers, New Delhi, 2003.			
Recommended References • Subalakshmi, G and Udipi, S.A. Food processing and preservation. New Age International Publishers, New Delhi, 2001. • Girdhari Lal, Siddappa G.S., Preservation of fruits and Vegetables.,1998			

Teaching and Learning Approach	Laboratory Procedure (Mode of transaction) Direct Instruction: lecture, Explicit Teaching, Demonstration, Hands on experimental sections, Skill acquisition by laboratory training
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Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) Assessment of the performance of student in the lab- 10 marks Internal Test -20 marks Project report (student needs to perform experiments on a specific project and report should be prepared)– 10 marks A. Semester End examination – 60 marks
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MAHATMA GANDHI UNIVERSITY

School Name		School of Food Science and Technology				
Programme		M.Sc Food Science and Technology				
Course Name		NEUTRACEUTICALS AND FUNCTIONAL FOODS				
Type of Course		Elective				
Course Code		FS M 26 E 24				
Course Summary & Justification		• This elective course is designed to get the basic understanding of neutraceuticals and functional foods and their use for managing chronic diseases • It helps to gain knowledge about the neutraceutical constituents present in various food products • The course also introduces emerging trends in this subject				
Semester		Third				
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite		Basics of biotechnology and food science				
CO No.	Expected Course Outcome			Learning Domains	PSO No.	
1	After completion of the course the students will be able to: Acquire knowledge on various neutraceutical components in various food products and their health benefits			U /E	1	
2	Understand the role of various neutraceuticals and functional foods towards managing chronic diseases			U/ An	1,3	
3	Acquire knowledge on the bioactive carbohydrates, peptides and lipids.			U/A	1,4	
4	Acquire knowledge regarding health benefits of pro-biotics, prebiotics and symbiotics and postbiotics.”			U/E	1,4	

5	Comprehensive and the significance of nutraceuticals on human Health.	U/I	1,4
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Introduction to Nutraceuticals and functional Foods : Nutraceuticals and functional Foods -Definition, concept, history and market; Evolution of nutraceuticals and functional foods market. . Significance and relevance of nutraceuticals and functional foods in the management of diseases and disorders.Role of nutraceuticals in maternal nutrition,and infant formulas. Protein quality and efficacy.Nutritional and health claim validation protocol.	1 & 2	10
2	Natural occurrence of phytochemicals: Natural occurrence of certain phytochemicals- Antioxidants and flavonoids: omega - 3 fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds. Dosage for effective control of disease or health benefit with adequate safety; studies with animals and humans; acute and chronic studies. Regulatory issues.Bio-availability,Bio accessibility.	3	15
3.	Isolation of phytochemicals from plant materials : Isolation of phytochemicals from plant materials: Care in handling and storage of raw materials with minimal damage to sensitive bioactive compounds; Biological roles of bioactive carbohydrates,antioxidant,immun,omodulatory,antitumor, antidiabetic ,antimicrobial.Sourcesof bioactive peptides-.meat,dairy,collagen,egg,plant,marine and fungi,Fats and oils assources of bioactive molecules.	3	10
4	Prebiotics, probiotics, symbiotics and postbiotic: Prebiotics, probiotics symbiotics and postbiotics.- Probiotics: Definition, types and relevance; Usefulness in gastro intestinal health and other health benefits; development of probiotic products; recent advances in probiotics; Challenges and regulatory issues related to probiotic products. Prebiotics: Prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes; health benefits of prebiotics; recent development in prebiotics. Symbiotics.	4	10
5	Good manufacturing practices and safety issues in functional food industries. : HACCP in functional food industries product specifications and conformance,safety assessment,Nutritional and toxicological Market of functional foods-challenges for functional food delivery.customer and manufacturer issues-product information and customer awareness,factors affecting consumer interest.'Recent development and advances in the	5	15

	areas Of Nutraceuticals and functional foods.		
Total Credits of the Course		4	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 marks

REFERENCES

Recommended Text Books

- Brigelius-Flohe, J & Joost H.G. (2006). Nutritional Genomics: Impact on Health and Disease. Wiley VCH.
- Cupp J & Tracy TS. (2003). Dietary Supplements: Toxicology and Clinical Pharmacology. Humana Press.
- Rekha sharma (2023). -Introduction to functional foods and nutraceuticals.

Recommended References

- Goldberg I. (1994). Functional Foods: Designer Foods, Pharma Foods.
- Losso JN. (2007). Anti-angiogenic Functional and Medicinal Foods. CRC Press
- Neeser JR & German BJ. (2004). Bioprocesses and Biotechnology for Nutraceuticals. Chapman & Hall.
- Robert EC. (2022). Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.
- Shi J. (2006). Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press.
- Webb GP. (2006). Dietary Supplements and Functional Foods. Blackwell Publ.

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MAHATMA GANDHI UNIVERSITY

FS M 26 E 22: WASTE MANAGEMENT IN FOOD INDUSTRY

SchoolName	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Name	WASTE MANAGEMENT IN FOOD INDUSTRY					
Type of Course	Elective					
Course Code	FS M 26 E 22					
Course Summary & Justification	- The objective of this course is to develop a very good understanding about characteristics of bio -degradable and non-degradable wastes from the food industry, its safe and hygienic storage and disposal. - This course also gives an overview regarding different methods of utilizing wastes from food industry to make value added products. - It also enable students gain knowledge in legislations related to waste management which helps student to explore its theoretical and practical aspects for the benefit of society					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of food science and chemistry					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Students will be able to identify the characteristics of different type of wastes from food industry	U /E	1

2	Students will understand the safe and hygienic disposal methods for different classes of wastes from food industries.	U/ An/A	1,3
3	Students will acquire knowledge regarding waste water treatment and its importance	An/A	1,5
4	Students will understand the legislations related to waste management and its application in food industry	U/R/A	1,5
5	Students will acquire knowledge regarding methods of utilizing food industry wastes to make value added products.	E/S	5
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Introduction to waste management in food industry Introduction: types of waste generated; non-degradable & biodegradable wastes; food industrial wastes from fruit and vegetable processing industry, fish, meat & poultry industry and dairy industry. Utilization of waste: methods of utilizing wastes to make value added products; pectin, food colorants, antioxidants from fruit peels (citrus, mango, pomegranate), lycopene from tomato peels, enzymes from meat processing, single cell proteins.	1 & 2	15
2	Waste characterization : Temperature, pH, Oxygen demands (BOD, COD, TOD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues	1	10
3.	Storage & disposal of waste: Solid waste storage and disposal methods-land-filling, burial, incineration, recycling; biological treatment of food industry wastes, storage and disposal of liquid and gaseous waste; legal aspects related to storage and disposal.	2	10
4	Waste Water Treatment : Waste water treatment: standards for disposal of water, physical, chemical and biological characteristics of waste water; measurement of organic content in waste water; physical unit operations in waste water treatment - screening; -racks, mixing, flocculation, sedimentation, floatation, elutriation, vacuum filtration, incineration; chemical unit operations in waste water treatment-chemical precipitation, aeration and gas transfer process, rate of gas transfer, adsorption, disinfection; Biological unit operations - aerobic and anaerobic.	3 & 4	15

5	Legislations related to waste management : Environment management systems (ISP 14000) and its application in food industry; legislation related to waste management; standards for emission or discharge of environmental pollutants from food processing industries.	5	10
Total Credits of the Course		4	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment L. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks M. Semester End examination – 60 marks

REFERENCES

Recommended Text Books

- Robert R. Zall (2004), Managing Food Industry Waste: Common sense methods for Food Processors, Blackwell Publishing.
- Ioannis S. and Arvanitoyannis (2008) Waste Management in Food Industry, Academic Press.
- A.M. Martin, (2012), “Bioconversion of Waste Materials to Industrial Products”, Springer Science & Business Media Publishing

Recommended References

- Vasso Oreopoulou and Winfried Russ (2007). Utilization of byproducts and treatments of waste in Food Industry, Springer publication.
- Lawrence K. Wang (2006). Waste Treatments in Food Industry, Taylor and Francis.
- Waldron K. (2007). Handbook of waste Management and Co- product Recovery in Food Processing, Woodhead Publishing Company.
- Abbas Kazmi, Peter Shuttleworth, (2013), “The Economic Utilisation of Food CoProducts”, Royal Society of Chemistry Publishing.

- Marcos von Sperling,(2007), “Basic Principles of Wastewater Treatment”, IWA Publishing.’

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MAHATMA GANDHI UNIVERSITY

FS M 26 E 23: FOOD BUSINESS MANAGEMENT AND ENTREPREURSHIP

SchoolName	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Name	FOOD BUSINESS MANAGEMENT AND ENTREPREURSHIP					
Type of Course	Elective					
Course Code	FS M 26 E 23					
Course Summary & Justification	- This elective course is designed to provide students an overview regarding basics of management and entrepreneurship development - This course enable students to gain knowledge about functions and principles of management, functional areas of management, marketing principles, costing and pricing methods which help them to understand the need of careful management of a food business. - The course also provides a basic knowledge regarding importance of entrepreneurship, its problems and opportunities in relation to food sector.					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of food science and commerce					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Students will understand the principle, functions and functional areas of management which help them to understand the need of careful management of a food business	U /S	1

2	Students will be able to understand the market types, the marketing principles and challenges in relation to food sector	U/ An	1,4
3	Students will understand the importance of management of human resource in an industry	U/S	1,2
4	Students will get a wide knowledge regarding scope, opportunities and challenges of entrepreneurship	U/A	1,5
5	students can illustrate the entrepreneurship development policies of government in food business	An	5
6	Students will get the ability to set up their own food business	C/S	5
<i>*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i>			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Basics of management: Management: Meaning, nature, scope, significance, functions and principles; levels of management, process of management, co-ordination as an essence of management. Planning: Meaning and importance of planning; planning Process; limitations, considerations in planning; methods of planning; types of plans. Organizing: Meaning and importance, process of organizing, principles of effective organization; key elements in organizing process; formal v/s informal organization departmentation, decentralization, delegation of authority relationship - line, staff and functional.	1	15
2	Functional areas of management: Introduction to functional areas of management: personnel management, production management, financial management, Objectives and functions of personnel management, Production and financial management, Production management: plant location and layout, production planning and control.	1	10
3.	Marketing management: Introduction to marketing management, fundamentals of marketing principles, costing and cost management, pricing methods; fundamentals of operations and supply chain management; opportunity identification and feasibility studies, financial studies; marketing challenges and approaches for new products and services.	2 & 3	10
4	Introduction to Entrepreneurship development: Entrepreneur-meaning – importance –qualities, nature, types, traits, culture, difference between entrepreneur and intrapreneur, Role of entrepreneur in economic development; Nature, scope and importance of entrepreneurship. Business ideas, source of business ideas, feasibility studies, problem solving and decision making. Features of small business; Advantages of	4 & 5	15

	small business; Setting up small scale industrial unit.		
5	Entrepreneurship in food sector : Agricultural sector and food processing industry problems and opportunities; self-employment need and entrepreneurship in foods sector, project sizing, fund management and enterprise management issues in food entrepreneurship, entrepreneurship development policies of government in food business, Factors affecting growth of Entrepreneurship in India	6	10
Total Credits of the Course		4	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment N. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks O. Semester End examination – 60 marks

REFERENCES

Recommended Text Books - Singh B.P., Management Concepts & Practices, Dhanpat Rai & sons, Nai Sarak, Delhi. - Naidu NVR and Krishna Rao T (2009). Management and Entrepreneurship, I.K. International Pvt. Ltd. - Jane Eastham, Liz Sharples & Stephen Ball (2001). Food Supply Chain Management, Elsevier Science.
Recommended References - Dwivedi R.S. Management - An Integrated Approach, National Publishing Co., Delhi. - Small scale food entrepreneurship: A technical guide for food ventures, authored & published by Northeast Centre for Food Entrepreneurship. - Bhaves M Patel : Project Management, Vikas Publications R. Gopal, Pradip Manjrekar -Entrepreneurship & Innovation Management – Abe Books

- Desai, Vasant – Entrepreneurship Management: Passion, Works, Wonders, Himalaya Publishing House

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MAHATMA GANDHI UNIVERSITY

FS M 26 E 25: SPICES AND FLAVOUR TECHNOLOGY

SchoolName	School of Food Science and Technology					
Programme	M.Sc Food Science and Technology					
Course Name	SPICES AND FLAVOUR TECHNOLOGY					
Type of Course	Elective					
Course Code	FS M 26 E 25					
Course Summary & Justification	- This elective course will provide students with dietary significance , chemical composition, processing and quality control of major Indian spices - The course also provides an overview of natural and artificial flavouring agents, flavour analysis, standards and specification for flavour.					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of food science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Students will be able to: understand different types and composition of various spices	U /E	1
2	Acquire knowledge regarding the post- harvest operations and processing of different spices	U/ An	1
3	Understand different pest control methods and decontamination techniques for spices	E	1,3
4	Understand flavor compounds involves in the development of flavor	An	1,4

5	Understand the analytical techniques involved in flavour analysis	An	2,5
<i>*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i>			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Spices- Form, Function, and Application: Spices: types and composition, fresh whole spices, dried spices, spice extractives, Essential (volatile oils), oleoresins(non –volatile and volatile), other spice extractives, storage conditions with spices, functions of spices, primary function of spices, flavors, taste, aroma and texture, coloring secondary functions of spices: preservative, antimicrobials, antioxidants, spice applications: marinades, Rubs and Glazes, spice blends, seasonings and condiments.	1	15
2	Post Harvest Technology of Spices: Harvesting, transport, threshing, drying, packaging and storing of spices (seeds and fruits; leaves and stems, flowers and buds, roots and rhizomes, bark wood and resins) Processing and manufacturing of major Indian spices: pepper, cardamom, ginger, chilly, and turmeric, clove, garlic, cumin, coriander, cinnamon, mint and vanilla.	2	10
3.	Pest Control: Pest control methods, decontamination techniques in spices,: irradiation, magnets, sifters, air tables, de-stoners, air –separators, indent separators, spiral gravity separators, sterilization of herbs and spices. Adulteration in spices.	3	10
4	Flavor Technology: Formation of flavors in foods such as fruits and vegetables, changes in food flavoring due to processing, flavor analysis: identification and isolation of flavoring materials, methodology of flavor evaluators, synthetic flavoring agents, problems involved in their incorporation in foods, standards and specification for flavor. Encapsulation of flavors. Oleoresins and essential oils: method of manufacture, chemistry of the volatile, enzymatic synthesis of flavor identical.	4 & 5	15
5	Flavoring Agents: Natural flavoring materials: herbs and spices, derivative of spices, artificial flavoring materials, flavoring materials made by processing : roasting, process flavors: meat –like flavors, enzymatically derived flavorings, flavors made by fermentation, flavors made by pyrolysis, smoke flavors, productions of natural flavoring materials by microbial action.	4 & 5	10
Total Credits of the Course		3	60

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment R. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks S. Semester End examination – 60 marks

REFERENCES

Recommended Text Books

- Reineccius G (2006) Flavor Chemistry and Technology, 2nd Edition, Taylor & Francis, New York
- J.S. Pruthi (2000); Quality Assurance In Spices And Spice Products : Allied Publishers Limited : New Delhi
- Reineccius G. 1999: Flavor Chemistry And Technology-Health : CBS publishers: New Delhi

- Reineccius G; 1999 ; Source Book Of Flavors, 2nd edition , CBS publishers: New Delhi

Recommended References

- Susheela Raghavan (2007) handbook of spices, seasoning and flavorings ,2nd edition Taylor & Francis, New York
- Peter K.V, (Ed.) ,(2001) Handbook of spices & herbs, Vol-1 , Wood head Publishing Ltd, England.
- Peter K.V, (Ed.), (2004) Handbook of spices & herbs, Vol-2 , Wood head Publishing Ltd, England.
- Peter K.V, (Ed.), (2006) Handbook of spices & herbs, Vol-3 , Wood head Publishing Ltd, England.

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MAHATMA GANDHI UNIVERSITY

FS M 26 O 01: BASICS OF FOOD SAFETY AND QUALITY MANAGEMENT

School Name	School of Food Science and Technology					
Programme	III SEM Open Course					
Course Name	BASICS OF FOOD SAFETY AND QUALITY MANAGEMENT					
Type of Course	Open course					
Course Code	FS M 26 O 01					
Course Summary & Justification	- Introduces fundamental concepts of food safety, quality, and common hazards across the food supply chain. - Explains basic hygiene practices, food safety management systems, and regulatory frameworks. - Builds consumer awareness on food labeling, adulteration, and safe food handling practices.					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	80	20	0	40	140
Pre-requisite	Basics of food science and quality control					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
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1	Explain fundamental concepts of food safety and quality	U	1
2	Identify food hazards and describe foodborne diseases and risks	U	3,5
3	Apply basic hygiene and safe food handling practices	A	3,5
4	Describe food safety management systems and quality standards	U	3,5
5	Interpret food regulations, labeling, and consumer-related issues	A	3,4,5
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	Course Outcome	Hrs
1	Fundamentals of Food Safety and Quality Concepts of food safety and food quality, Importance in public health and economy, Farm-to-fork approach in food safety, Food spoilage: causes and types (basic understanding), Food contamination: biological, chemical, physical, Current food safety challenges (global & Indian context).	1	16
2	Food Hazards, Foodborne Diseases and Risk Concepts Types of food hazards (biological, chemical, physical), Overview of major foodborne pathogens, Foodborne diseases: causes, symptoms, prevention, Food adulteration: types, common adulterants, health effects, Introduction to risk analysis: risk assessment, management, communication, Case studies of food safety incidents	2	16
3.	Food Hygiene, Sanitation and Safe Handling Practices Personal hygiene and role of food handlers, Good Hygiene Practices (GHP), Basic concepts of Good Manufacturing Practices (GMP), Cleaning and sanitation principles, Safe food handling, storage, and transportation, Water quality and waste management basics	3	16
4	Food Quality Management Systems and Standards Concepts of quality control and quality assurance, Total Quality Management (TQM) – basic principles, Introduction to HACCP (principles and applications), Concept of traceability and recall, Overview of food safety standards and certifications (ISO 22000 – concept only), Role of documentation and audits	4	16

5	Food Regulations, Consumer Awareness and Emerging Issues Overview of food laws and regulatory framework in India (FSSAI), Food labeling: components and interpretation, Food standards and quality marks (AGMARK, BIS, etc.), Consumer rights and responsibilities, Food fraud and adulteration issues, Emerging trends: sustainability, food safety in modern food systems	5	16
Total Credits of the Course		4	80

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction, Explicit Teaching, E-learning, interactive Instruction:, Active cooperative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks B. Semester End examination – 60 marks

REFERENCES

Recommended Text Books

- Kuddus, M., Ashraf, S. A., & Rahman, P. (Eds.). (2024). Food safety: quality control and management. CRC Press.
- Shaw, I. C. (2018). Food safety: the science of keeping food safe. John Wiley & Sons.
- Selamat, J., & Iqbal, S. Z. (Eds.). (2016). Food safety: basic concepts, recent issues, and future challenges. Springer.
- Lawley, R., Curtis, L., & Davis, J. (2015). The food safety hazard guidebook.
- Alli, I. (2003). Food quality assurance: principles and practices. CRC Press.

MODEL QUESTION PAPERS

SEMESTER I

**SCHOOL OF FOOD SCIENCE AND TECHNOLOGY MAHATMA GANDHI
UNIVERSITY
MSc FOOD SCIENCE AND TECHNOLOGY**

FS M 26 C29: Food Science and Nutrition

Time: 3 hours

Maximum Marks :60

SECTION A

Answer all questions. Each question carries 2 marks (12×2 = 24 Marks)

1. What does PDCAAS stand for? (CO3,CO4)
2. What percentage of body weight is water in adults? (CO3,CO4)
3. Define hypervitaminosis.(CO3,CO4)
4. Define fortification in nutritional enhancement (CO5).
5. State RDA for protein in adults (g/kg body weight) (CO5).
6. Name the nutrient deficient in kwashiorkor.(CO3,CO4)
7. Define enteral feeding (CO5).
8. Name one cultural factor affecting food habits.(CO1).
9. State the purpose of therapeutic diets (CO5).
10. Name socioeconomic factors affecting nutrition.(CO1).
11. Define Basal Metabolic Rate (BMR) (CO1).

SECTION – B

Answer any 4 questions. Each question carries 6 Marks

12. Classify carbohydrates and explain their digestion process (CO3,CO4)
13. Describe factors affecting Basal Metabolic Rate (BMR) (CO3,CO4)
14. List major nutritional problems in India and National Nutrition Policy goals.(CO1).
15. Explain Protein Digestibility Corrected Amino Acid Score (PDCAAS) (CO3,CO4)
16. Discuss functions and sources of fat-soluble vitamins.(CO3,CO4)
17. Outline steps to plan a balanced diet for sedentary adults. (CO5).
18. Describe methods of nutritional enhancement(CO5).

SECTION C

Answer any one question. Question carries 12 Marks

19. Describe in detail the classification, functions, sources, digestion, absorption, metabolism, and deficiency disorders of vitamins and minerals.(CO3, CO4)
20. Explain the principles of balanced diet planning and therapeutic nutrition. Discuss enteral feeding, parenteral feeding, and nutritional enhancement of foods.(CO5)

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M. SC. FOOD SCIENCE AND TECHNOLOGY
I SEMESTER EXAMINATION**

FSM26C02: FOOD CHEMISTRY

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Explain water activity and its significance in foods. (CO1, U/E)
2. Define glass transition temperature. (CO1, U)
3. Differentiate between monosaccharides and polysaccharides. (CO2, U)
4. Explain retrogradation in starch. (CO2, U/A)
5. What is lipid oxidation? (CO3, U)
6. Define hydrolytic rancidity. (CO3, U)
7. Explain protein denaturation. (CO4, U/E)
8. What are emulsifying properties of proteins? (CO4, U)
9. Differentiate between fat-soluble and water-soluble vitamins. (CO5, U/A)
10. Define chelation in foods. (CO5, U)
11. Explain Maillard reaction. (CO2, CO5, U/E)
12. What are anti-browning agents? (CO4, U)

SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

13. Discuss the physicochemical properties of water in foods. (CO1,2, U/A)
14. Explain gelatinization and hydrolysis of starch. (CO2, U/An)
15. Elaborate on mechanisms and factors affecting lipid oxidation. (CO3, U/An)
16. Discuss the functional properties of proteins in food systems. (CO4, U/A)
17. Explain enzymatic browning and methods of prevention. (CO4, CO5, U/An)
18. Describe the stability and degradation of vitamins during processing and storage. (CO5, U/A)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Discuss the structure, classification, functional properties, and chemical reactions of carbohydrates in foods. (CO2, An)
20. Explain the chemical changes occurring in foods during processing and storage with special reference to interactions among carbohydrates, proteins, and lipids. (CO5, An)

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FSM26C03: FOOD MICROBIOLOGY

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Explain Prebiotics (CO1, U/E)
2. Interpret Total Aerobic Count (CO5, U/A)
3. Appraise Ropiness in milk (CO4, An)
4. Explain microbiology of Sauerkraut (CO5, U/A)
5. Discuss Food Intoxication (CO7, U)
6. Classify Selective Media (CO3, CO4, S/An)
7. Explain Shigellosis (CO7, U/I)
8. Discuss on metagenomics (CO3, CO4, S/An)
9. Explain Pschychrotrophs (CO1,2, U/A)
10. Illustrate the production of Kefir (CO5, U/A)
11. Discuss on Omega 3 fats (CO5, U/A)
12. Describe Yersiniosis (CO7, U)

SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

13. What are the factors affecting growth of microorganism in food? (CO1,2, U/A)
14. Explain spoilage of fish? (CO6, U/An)
15. Discuss about isolation of virulent *E. coli* from foods? (CO3,4, S/An)
16. Elaborate on soy sauce production? (CO5, U/A)
17. Elaborate on aflatoxin poisoning? (CO7, U/I)
18. Describe microbial cell factories? (CO5, U/A)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Explain various types and causes of food borne illness? (CO7, U)
20. Explain in detail about the microbiology of canned foods? (CO6, An)

***Remember (R), Understand (Un), Apply (A), Analyse (An), Evaluate (Ev), Create (Cr), Skill (S), Interest (I), and Appreciation (Ap)**

**SCHOOL OF FOOD SCIENCE AND TECHNOLOGY
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I SEMESTER EXAMINATION**

FSM26C04: FOOD PROCESSING AND PRESERVATION

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Define Blanching (CO1,R)
2. What is Dehydro freezing? (CO 2, R)
3. Interpret IMF (CO2, Un)
4. Explain Salad Dressings (CO1, Un)
5. Define Smoking (CO4,Un)
6. Define Hurdle Technology (CO6, R)
7. Evaluate Refrigeration load (CO2, Ev)
8. What are the classification of Dryers (CO1, Un)
9. Explain on Canning of Foods (CO2, Ev)
10. Interpret Freezing Curve (CO 2, Ev)
11. Define emulsification (CO 4, Un)
12. Compare types of frying (CO3, An)

SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

13. Interpret the advantages and problems of IM foods.(CO2,Un)
14. Elaborate on the factors affecting oil uptake during frying.(CO4,Cr)
15. Explain the principles of food preservation (CO1, Ev)
16. Evaluate changes in foods during freezing. (CO2,Ev)
17. Assess the role of pH on food preservation.(CO2,An)
18. Examine the forms of radiant energy. (CO5,An)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Explain in detail the type, uses, and effects of chemical preservatives in food. (CO4, Un)
20. Analyze the controlling of undesirable changes in food during irradiations. (CO6, An)

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I), and Appreciation (Ap)**

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I SEMESTER EXAMINATION**

FSM26E15: FUNDAMENTALS OF FOOD ENGINEERING

TIME: 3 HOURS

MAXIMUM MARKS: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. What is Gibbs-Dalton Law? (CO6,R)
2. Define Reverse Osmosis. (CO7,R)
3. Describe Dehydration. (CO1,R)
4. Explain Streamline Flow. (CO2,Un)
5. Describe Propeller Pumps. (CO3,Un)
6. Summarize Triple Tube Heat Exchanger.(CO5,Un)
7. What is the Specific Heat of Dry Air?
8. Interpret Relative Humidity.(CO6,Un)
9. Define Agglomeration.(CO7,R)
10. What are Newtonian Fluids? (CO2,R)
11. What is Component mass balance? (CO1,R)
12. Define Wet bulb temperature.(CO6,R)

13. SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

14. Explain different modes of heat transfer in food processing.(CO5,An)
15. Elaborate on the properties of water vapor.(CO6,Cr)
16. Evaluate the thermal process calculation of canned foods. (CO5,Ev)
17. Briefly explain extrusion technology.(CO7,An)
18. Explain on types of distillation.(CO7,An)
19. Summarize centrifugal pumps and their application in the food industry. (CO3,Un)
- 20.

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Elaborate on the types of heat exchangers used in the food industry? (CO5,Cr)
20. Explain the use of a psychrometric chart to evaluate complex air conditioning processes.
(CO6,An)

***Remember (R), Understand (Un), Apply (A), Analyse (An), Evaluate (Ev), Create (Cr), Skill (S), Interest (I), and Appreciation (Ap)**

**SCHOOL OF FOOD SCIENCE AND TECHNOLOGY
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I SEMESTER EXAMINATION**

**FSM26E06: NANOTECHNOLOGY –CONCEPTS AND APPLICATIONS IN FOOD
SCIENCE**

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. What is Graphene (2D)? (CO1,R)
2. Explain Nano-Filtration. (CO2,Un)
3. Interpret Nanopolymers In Food Packaging.(CO4,Un)
4. Discuss Carbon Nano Tubes.(CO1,Un)
5. What is a Scanning Probe Microscope? (CO1,R)
6. Explain Nano Food Ingredients. (CO3,Un)
7. Evaluate Nano Anti-Microbials.(CO6,Ev)
8. Define Nanoemulsion.(CO2,R)
9. Summarize Electrochemical Sensors. (CO5,Un)
10. What are Zero-Dimensional Nano Structures? (CO1,R)
11. Describe Inorganic nanomaterials.(CO1,Un)
12. Define Intelligent packaging. (CO4,R)

SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

13. Summarize the history of nanotechnology.(CO1,Un)
14. Elaborate on the usage of Lipid Nanocarriers for Phytochemical Delivery in Foods.(CO2,Cr)
15. Briefly explain the regulatory Framework for Food Nanotechnology. (CO5,Un)
16. Discuss the Electrospinning and Electrospraying Technologies. (CO2,Un)
17. Elaborate on the properties of nanomaterials. (CO1,Cr)
18. Evaluate nanoparticles as ingredients in food supplements.(CO3,Ev)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Explain the importance of nanotechnology in food processing in terms of nutritional value and shelf-life? (CO3,An)
20. Evaluate in detail the potential of nanomaterials in food packaging. (CO4,Ev)

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I), and Appreciation (Ap)***

SEMESTER II

MAHATMA GANDHI UNIVERSITY KOTTAYAM
SCHOOL OF FOOD SCIENCE AND TECHNOLOGY
M.Sc. FOOD SCIENCE AND TECHNOLOGY
II SEMESTER EXAMINATION– MODEL QP
FSM 26C28–BIostatistics and Research Methodology

Time:3 hours

MaximumMarks:60

SECTION-A (Short Answer Questions) Answer all questions. 2 marks each.		CO	TL
1.	Distinguish between nominal, ordinal and ratio type scales of measurement giving examples from Food Science contexts.	1	U
2.	Explain skewness and kurtosis in a statistical data.	1	R
3.	Explain coefficient of variation and its use.	1	An
4.	Compute the median and mode of prices of biscuits: Rs.10, 20, 15, 10, 12, 15, 16, 15.	1	U
5.	Distinguish between X- bar chart and R-chart.	4	R
6.	Distinguish between significance level and power of a test.	3	A
7.	What is a random variable? Give examples of discrete and continuous random variables from Food Science.	2	A
8.	Explain one sample student's t test and its use in Food Technology.	3	U
9.	What are the basic principles of design of experiments?	4	A
10.	What are the uses of statistical quality control in food technology?	4	An
11.	Discuss on different types of research.	5	U
12.	Explain the need for review of literature in research.	5	A
12 × 2= 24 marks			
SECTION –B (Short Essay Type Questions) Answer any 4 questions. 6 marks each		CO	TL
13.	State addition and multiplication rules in probability. The probability that bread A gets decayed in a week is 0.6 and bread B gets decayed in a week is 0.7. Assuming independence, what is the probability that at least one of	2	An

	them get decayed in a week?														
14.	Define binomial and normal distributions. Describe their uses in Food Science.	2	A												
15.	Stating the assumptions, explain how you can test whether the average increase in weights for two diets are significantly different or not.	3	An												
16.	Explain the uses of Chi-square test for independence and goodness-of-fit in Food Technology giving illustrative examples..	3	A												
17.	Discuss on research protocol and give a sample protocol to study the nutritional effects of a new packaged food item.	5	A												
18.	Discuss on RBD and LSD and its use I food science.. Also state and explain the models used and provide the ANOVA table.	4	An												
4 × 6 = 24 marks															
	SECTION –C (Essay Type Questions) Answer any one question. 12 marks	CO	TL												
19.	Compute Pearson’s correlation coefficient for the following data set on weight (x) and price (y) of a food item. Also obtain the y on x regression equation and estimate the price if the weight is 75 g. <table><tr><td>Weight (g)</td><td>50</td><td>60</td><td>70</td><td>80</td><td>90</td></tr><tr><td>Price (Rs)</td><td>100</td><td>120</td><td>140</td><td>150</td><td>160</td></tr></table>	Weight (g)	50	60	70	80	90	Price (Rs)	100	120	140	150	160	1	An, C
Weight (g)	50	60	70	80	90										
Price (Rs)	100	120	140	150	160										
20.	Describe the importance of writing research reports and research papers. Explain the main steps in preparing a research report and give a sample layout for a specific research in food science and technology...	5	A, E												
1 × 12 = 12 marks															

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II SEMESTER EXAMINATION**

FSM26C10: FOOD SAFETY AND QUALITY ASSURANCE

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Explain Incidental adulteration. (CO1,Un)
2. Define GHP(CO2,R,Un)
3. Evaluate the Principles of HACCP.(CO4,R)
4. Elaborate USDA.(CO5,Cr)
5. Explain AGMARK. (CO6,An)
6. Summarize Total quality management.(CO2,Un)
7. Describe the Export inspection council.(CO6, Un)
8. Interpret COPANT (CO5,Un)
9. Define EFSA (CO5, R)
10. Describe EPA.(CO5,Un)
11. Define risk communication. (CO2,R)
12. Explain Food traceability. (CO3,Un)

SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

13. Explain briefly about good manufacturing practices. (CO1,An)
14. Elaborate on statistical quality control in the food industry. (CO4,Cr)
15. Evaluate the procedure for FSSAI registration/licensing of food business in India. (CO5,Ev)
16. Assess the role of FDA in food regulation. (CO6,Un)
17. Briefly explain the WTO SPS agreement. (CO5,An)
18. Evaluate the types of quality control. (CO2,Ev)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Explain in detail about food labeling regulations under FSSAI? (CO5, Un, R)
20. Give a detailed description of the international organization for Standards (ISO) and its standards for food quality and safety? (CO6, Un & R)

***Remember (R), Understand (Un), Apply (A), Analyse (An), Evaluate (Ev), Create (Cr), Skill (S), Interest (I), and Appreciation (Ap)**

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II SEMESTER EXAMINATION**

FSM26C11: ADVANCED FOOD ANALYSIS AND INSTRUMENTATION

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Explain Atomic Spectroscopy. (CO 1, Un)
2. Summarize the procedure of Lane and Eynon Method. (CO 2&3, Un&S)
3. Describe the principle of Gerber method. (CO 2, Un)
4. Express the principle of Ninhydrin method. (CO 2, Un)
5. Explain probability sampling. (CO 5, An)
6. Describe the procedure for analysis of ash. (CO 2&3, Un&S)
7. Explain Standard deviation. (CO 5, An)
8. Explain ANOVA. (CO 5, An)
9. Gravimetry. (CO 1, Un)
10. Express the principle of EDTA titration of calcium. (CO 2, Un)
11. Describe Harmonic mean. (CO 5, Un)
12. Explain Regression. (CO 5, Un)

SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

13. Explain any two methods for determination of moisture? (CO 4, Un)
14. Give an account in biostatistics and its scope? (CO 5, Un)
15. State a note on extraction of mono and oligosaccharides for its analysis? (CO 2, Un&An)
16. Explain Soxhlet method (Preparation of sample, Procedure and calculation). (CO 2&3, Un&S)
17. Briefly explain on UV spectroscopy? (CO 1, Un)
18. Describe in detail regarding tabulation of data? (CO 5, Un&Cr)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Define chromatography? Explain types of chromatographic techniques used for food analysis? (CO 1&3, Un&S)
20. Explain in detail on the estimation of protein by Kjeldahl method and draw a neat diagram on it? (CO 2&3, Un&S)

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I), and Appreciation (Ap)**

**SCHOOL OF FOOD SCIENCE AND TECHNOLOGY
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M. SC. FOOD SCIENCE AND TECHNOLOGY
II SEMESTER EXAMINATION**

FSM26C12: FOOD PACKAGING TECHNOLOGY

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Define food packaging and mention its functions. (CO1, U)
2. What is secondary packaging? (CO1, U)
3. Define barrier properties of packaging materials. (CO2, U)
4. What are biodegradable plastics? (CO2, U/E)
5. Explain migration in food packaging. (CO3, U)
6. What is shelf-life evaluation? (CO3, U)
7. List the packaging requirements for bakery products. (CO4, U)
8. What is retort pouch packaging? (CO4, U/E)
9. Define Modified Atmosphere Packaging (MAP). (CO5, U)
10. Differentiate between active and intelligent packaging. (CO5, U/A)
11. What are cushioning materials in packaging? (CO2, U)
12. Explain Controlled Atmosphere Storage (CAS). (CO5, U/E)

SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

13. Discuss the role of food packaging in preservation, storage, and distribution. (CO1, U/A)
14. Explain the properties and applications of paper and plastic packaging materials. (CO2, U/An)
15. Elaborate on the mechanical strength and barrier property tests used in food packaging. (CO3, U/An)
16. Discuss packaging systems used for milk and dairy products. (CO4, U/A)
17. Explain quality assurance and shelf-life evaluation in packaging. (CO3, CO4, U/An)
18. Describe eco-friendly and sustainable packaging materials and their significance. (CO5, U/A)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Explain the classification, properties, advantages, limitations, and applications of major food packaging materials. (CO2, An)
20. Discuss advanced food packaging systems including vacuum packaging, MAP, CAS, active packaging, intelligent packaging, and trends in smart packaging. (CO5, An)

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (Cr), Skill (S), Interest (I), and Appreciation (Ap)**

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II SEMESTER EXAMINATION**

FSM26E14: INDUSTRIAL MICROBIOLOGY

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Differentiate between primary and secondary metabolites. (CO1, U/A)
2. Define screening of microorganisms. (CO1, U)
3. What is fermentation media? (CO2, U)
4. Explain batch fermentation. (CO2, U/E)
5. What are downstream processing operations? (CO2, U)
6. Define submerged fermentation. (CO2, U)
7. Explain probiotics in fermented foods. (CO3, U/E)
8. What are bioactive compounds in fermented foods? (CO3, U)
9. Define microbial production of citric acid. (CO4, U)
10. What are microbial polysaccharides? (CO4, U)
11. Define recombinant DNA technology. (CO5, U)
12. What are intellectual property rights (IPR)? (CO5, U/E)

SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

13. Discuss the applications of industrial microbiology and OMICS technologies. (CO1, U/A)
14. Explain the components and types of fermenters used in food industries. (CO2, U/An)
15. Elaborate on downstream processing techniques used in industrial microbiology. (CO2, CO4, U/An)
16. Discuss the production and significance of fermented dairy and plant-based foods. (CO3, U/A)
17. Explain microbial production of organic acids, enzymes, and vitamins. (CO4, U/An)
18. Describe the role of genetic modification and recombinant technology in food production. (CO5, U/A)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Discuss the history, scope, media, types, and operational aspects of fermentation technology with suitable examples. (CO2, An)
20. Explain the applications of industrial microbiology in food industries with special reference to genetically modified foods, food quality and safety, and intellectual property rights. (CO4, CO5, An)

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (Cr), Skill (S), Interest (I), and Appreciation (Ap)**

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II SEMESTER EXAMINATION**

FSM26E08: FOOD TOXICOLOGY

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Explain Phytoelectins. (CO 2, Un)
2. Describe what lead Poisoning is? (CO 3, Un&Ev)
3. Elaborate Polycyclic Aromatic Hydrocarbons. (CO 4, Un)
4. Explain on toxins present in Glass Packaging. (CO 4, Ev)
5. Describe Nitrosamines. (CO 5,Un)
6. Define Permitted Food Colours. (CO 5,R)
7. Describe Mycotoxins. (CO 1, Un)
8. Elaborate Flatulence Causing Sugars. (CO 2,Un&R)
9. Summarize Maillard Reaction. (CO 6,Un&An)
10. What is Lathyrism. (CO 2,R)
11. Explain HACCP. (CO 1&2,R&Un)
12. Heterocyclic amines. (CO 4,Un)

SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

13. Give an account on risk of genetically modified foods? (CO 5&6,Un&R)
14. Elaborate on different types of allergens in food? (CO 2,Un)
15. Explain on the toxic effect of animal drug residues in food and water? (CO 3,Un)
16. Briefly explain different types of toxins produced during food processing. (CO 4,Ev)
17. Give a brief note on different methods of pest control. (CO 3,Un&Ev)
18. Write a brief note on removal of anti –nutrients from foods? (CO 1,Ev&Un)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Explain in detail regarding toxic constituents and anti -nutritional factors of plant foods?
(CO 2,Un)
20. Describe in detail on toxins from food packaging? (CO 4, Un&Ev)

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I), and Appreciation (Ap)**

**SCHOOL OF FOOD SCIENCE AND TECHNOLOGY
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II SEMESTER**

FSM26E16: TECHNOLOGY OF BEVERAGES

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. What is Pilsner? (CO1,R)
2. Explain High-Intensity Sweeteners. (CO3,Un)
3. Describe Deionising.(CO2,Un)
4. Define Withering. (CO2, R)
5. What is Decaffeinated Coffee? (CO1,R)
6. Describe Irish Whisky. (CO1,Un)
7. Evaluate the Shelf Life of Mineral Water. (CO5,Ev)
8. Interpret the Secondary Packaging of Carbonated Beverages. (CO6, Un)
9. Explain the Structure of Coffee Bean. (CO1, Un)
10. Summarize the Composition of Green Tea. (CO2, Un)
11. What is the Composition of Rum? (CO1,R)
12. FSSAI definition of tea? (CO1,R)

13. SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

14. Examine the additives used in carbonated beverages. (CO3,An)
15. Elaborate on changes during the roasting of coffee. (CO4,Cr)
16. Describe the technology of chicory powder. (CO1,Un)
17. Explain the process of manufacturing beer. (CO2, An)
18. Explain the deionization of water. (CO2,An)
19. Evaluate the standards and specifications of coffee products in India. (CO6,Ev)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Explain in detail the steps involved in the processing of tea? (CO2, An)
20. Compare in detail about types of wines? (CO5, An)

***Remember (R), Understand (Un), Apply (A), Analyse (An), Evaluate (Ev), Create (Cr), Skill (S), Interest (I), and Appreciation (Ap)**

SEMESTER III

**SCHOOL OF FOOD SCIENCE AND TECHNOLOGY
MAHATMA GANDHI UNIVERSITY
M. SC. FOOD SCIENCE AND TECHNOLOGY
III SEMESTER EXAMINATION**

FSM26C17: CEREALS, PULSES, AND OILSEEDS TECHNOLOGY

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Justify the Curing of rice. (CO3,Ev)
2. Define Rheology (CO5,R)
3. What is High fructose corn syrup? (CO3, R)
4. Explain Soy protein concentrate. (CO3, Un)
5. Summarize the Nutritive value of cashew nuts. (CO1,Un)
6. Define Rice pollard. (CO3,R)
7. What is Gelatinisation? (CO2,R)
8. Interpret the process of Germination of pulses.(CO2,Un)
9. What is the Composition of Bengal gram? (CO1,R)
10. Describe the Structure of wheat grain (CO1, Un)
11. Evaluate Interesterification. (CO6, Ev)
12. What is Deep fixed bed drying? (CO2, R)

13. SECTION B:Answer any FOUR Questions

(4 X 6=24 Marks)

14. Elaborate on methods of oil refining. (CO6, Cr)
15. Examine the influence of flour constituents on dough rheology. (CO5, An)
16. Describe the changes in rice during parboiling. (CO2, Un)
17. Interpret the methods of decortication of pulses. (CO2, Un)
18. Explain the chemical composition and nutritive value of ground nuts. (CO1, An)
19. Evaluate the byproducts of wheat milling. (CO3, Ev)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Elaborate on corn milling and by-products of corn milling. (CO1, Cr)
20. Explain in detail about dough testing instruments. (CO5. An)

***Remember (R), Understand (Un), Apply (A), Analyse (An), Evaluate (Ev), Create (Cr), Skill (S), Interest (I), and Appreciation (Ap)**

**SCHOOL OF FOOD SCIENCE AND TECHNOLOGY
MAHATMA GANDHI UNIVERSITY
M. SC. FOOD SCIENCE AND TECHNOLOGY
III SEMESTER**

FSM26C18: TECHNOLOGY OF MILK, MEAT, POULTRY AND FISH

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Explain Homogenization. (CO 1,Un)
2. Illustrate the flow diagram of preparation of kulfi. (CO 2, Un)
3. Explain Rigor mortis. (CO 1, Ev)
4. Explain Ising glass. (CO 2&5, Un&S)
5. What is the importance of Candling of egg. (CO 1, Ev)
6. Describe Double toned milk. (CO 2, Un)
7. Explain on Ciguatera toxins. (CO 1, Un)
8. Illustrate the flow diagram of preparation of basundi. (CO 2&5, Un&S)
9. Describe Surimi. (CO2&5, Un&S)
10. Summarize the composition of goat milk. (CO 2, Un)
11. Explain what is meant by Mock meat. (CO 2, Un)
12. Describe the structure of egg. (CO 1,Un)

SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

13. Describe the methods involved in poultry processing? (CO 1, Un)
14. Write a note on packaging of meat? (CO 6, Un)
15. Describe the physiochemical properties of milk? (CO1, Un)
16. Write in detail regarding the method of production of cheddar cheese?(CO 2,Un)
17. Write in brief regarding fish byproducts . (CO 2&5, Un&S)
18. Explain factors affecting quality of khoa. (CO 2, Un)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Write in detail about different methods for the preserving fish? (CO 1, Un)
20. Write an essay on flavor defects in milk, their causes and prevention. (CO1, Un&Ev)

***Remember (R), Understand (Un), Apply (A), Analyse (An), Evaluate (Ev), Create (Cr), Skill (S), Interest (I), and Appreciation (Ap)**

**SCHOOL OF FOOD SCIENCE AND TECHNOLOGY
MAHATMA GANDHI UNIVERSITY
M. SC. FOOD SCIENCE AND TECHNOLOGY
III SEMESTER EXAMINATION**

FSM26C19: TECHNOLOGY OF FRUITS, VEGETABLES AND PLANTATION CROPS

Time: 3 Hours

**Maximum Marks: 60
(12 X 2= 24 Marks)**

SECTION A: Answer ALL Questions

1. Describe the chilling injury of fruits? (CO 1, Ev)
2. Explain the changes during ripening of fruits. (CO 3&4, S& Un)
3. Explain the Silicone membrane technology. (CO 5, Ev)
4. Briefly explain the peeling of fruits and vegetables. (CO 5, Ev)
5. Explain High intensity pulsed electric field technology. (CO 5, Ev)
6. Describe the classification of spices. (CO 6, Un)
7. Explain Nutritive value of vegetables. (CO 1, Ev)
8. Describe Non-Climacteric fruits. (CO 1, Un)
9. Explain on High altitude storage. (CO 4, Un&A)
10. Summarize the bitter compounds in fruits and vegetables. (CO 1, Un)
11. Explain hypobaric storage. (CO 4, Un&A)
12. Describe what Low fat cocoa is? (CO 6, Un)

SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

13. State a note on pigments present in fruits and vegetables? (CO 1, Un&Ev)
14. Explain the factors influencing blanching? (CO 5, Ev)
15. State a note on adulteration in spices? (CO 5, Un)
16. Explain on application of ozone in fruit processing? (CO 5, Ev)
17. Elaborate on composition and grades of copra. (CO 6, Un)
18. Write a note on manufacture of coconut milk cream. (CO 6, Un)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Explain canning of fruits and vegetables and nutritional retention of canned fruits and Vegetables. (CO 5, Ev)
20. Describe the factors affecting post- harvest losses of fruits and vegetables? (CO 2, Un&R)

***Remember (R), Understand (Un), Apply (A), Analyse (An), Evaluate (Ev), Create (Cr), Skill (S), Interest (I), and Appreciation (Ap)**

**SCHOOL OF FOOD SCIENCE AND TECHNOLOGY
MAHATMA GANDHI UNIVERSITY
M. SC. FOOD SCIENCE AND TECHNOLOGY
III SEMESTER EXAMINATION**

FSM26C20: BAKERY AND CONFECTIONERY TECHNOLOGY

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Explain All-purpose flour.(CO1,Un)
2. Describe the Sponge dough method.(CO1,Un)
3. Define Caramelisation.(CO3,R)
4. Explain the Composition of Cocoa.(CO4,Un)
5. What is Fudge? (CO3,R)
6. Evaluate the Fat blooming process. (CO4,Ev)
7. Interpret Staling of Bread. (CO2,Un)
8. What is the Function of egg in cake baking? (CO1,R)
9. Describe Sandesh.(CO3,R)
10. Explain the purpose of the Flour sifter. (CO6,An)
11. Define Marshmallows. (CO3,R)
12. What is Rock Candy? (CO3,R)

13. SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

14. Explain the stages of sugar cookery. (CO3,An)
15. Elaborate on the manufacturing of chocolate beverages. (CO4,Cr)
16. Evaluate the FSSAI regulations on food handling equipment in bakeries. (CO6,Ev)
17. Compare different types of pies.(CO1,An)
18. Explain the preservation of confectionery products. (CO5,An)
19. Interpret the Composition and benefits of dark chocolates.(CO4,Un)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Elaborate on the role of baking ingredients in improving the quality of bread. (CO2, Cr)
20. Explain in detail the packaging requirements of cakes? (CO5, An)

***Remember (R), Understand (Un), Apply (A), Analyse (An), Evaluate (Ev), Create (Cr), Skill (S), Interest (I), and Appreciation (Ap)**

**SCHOOL OF FOOD SCIENCE AND TECHNOLOGY
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III SEMESTER EXAMINATION**

FSM26E22: WASTE MANAGEMENT IN FOOD INDUSTRY

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Explain Single cell proteins. (CO 1,Un)
2. Summarize what BOD is ? (CO 1,Un)
3. Explain the process of Incineration of wastes. (CO 2,A)
4. Explain Elutriation. (CO 3,An)
5. List out the biological indicators of air pollution. (CO 4,R,A)
6. Explain Vermicomposting. (CO 2, Un&A)
7. Describe the Environmental protection act ,1986. (CO 5,Un,Ev)
8. Elaborate Greenhouse gases. (CO 1,Un)
9. Give an explanation on Persistent organic pollutants. (CO 1, Un)
10. Explain Activated sludge process. (CO 3,An)
11. What are Slaughterhouse wastes. (CO 4,R)
12. Define disinfection. (CO 4, Un&R)

SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

13. Write a note on measurement of organic content in waste water. (CO 1,Ev)
14. Discuss the types of wastes from dairy processing units? (CO 1,Un)
15. Write a note on ISP 14000 and its application in food industry. (CO 5,Un)
16. Write a brief note on methods for biodegradable waste recycling. (CO 5, Ev)
17. Write a note on antioxidant recovery from fruit peel wastes. (CO 2,Un)
18. Discuss on Standards of emission for food industries. (CO 5,Ev)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Explain waste water treatment processes. (CO 3&4,Un&A)
20. Discuss legislations regarding disposal of solid waste from food industries in India. (CO5,Ev)

***Remember (R), Understand (Un), Apply (A), Analyse (An), Evaluate (Ev), Create (Cr), Skill (S), Interest (I), and Appreciation (Ap)**

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III SEMESTER EXAMINATION**

FSM26E23: FOOD BUSINESS MANAGEMENT AND ENTREPRENEURSHIP

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Explain Intrapreneur. (CO 4, Un)
2. Define Organising. (CO 1, Un)
3. Give an explanation on Market survey. (CO 2, An)
4. Describe Decentralisation. (CO 1,Un)
5. What is meant by Contingency plans? (CO 1, S)
6. Expand SIDBI. (CO 5, An)
7. Define supply chain management. (CO 3,Un)
8. Give account about fixed cost. (CO 2,Un)
9. Illustrate the Levels of management. (CO 1,Un)
10. Expand NSIC. (CO 5,An)
11. What is the principle of scalar chain? (CO 3,Un&S)
12. Define personnel management. (CO 1, Un)

SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

13. Explain objectives and functions of personnel management. (CO 1, Un)
14. Discuss the role of entrepreneur in economic development. (CO 4&5, Un&An)
15. Explain principles of management. (CO 1, Un)
16. Write a note on advantages of small business. (CO 5, An)
17. Write a note on pricing methods. (CO 2, Un)
18. What are advantages and disadvantages of planning? (CO 1,Un)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Discuss the steps in setting up of a small scale food processing industry. (CO 4&5,Un&An)
20. Write an essay on delegation of authority. (CO 1&5, Un&An)

***Remember (R), Understand (Un), Apply (A), Analyse (An), Evaluate (Ev), Create (Cr), Skill (S), Interest (I), and Appreciation (Ap)**

**SCHOOL OF FOOD SCIENCE AND TECHNOLOGY
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III SEMESTER EXAMINATION**

FSM26E25: SPICES & FLAVOR TECHNOLOGY

Time: 3 Hours

Maximum Marks: 60

SECTION A: Answer ALL Questions

(12 X 2= 24 Marks)

1. Define Oleoresins. (CO1,R)
2. What are Spice Blends? (CO2,R)
3. What is a Spiral gravity separator? (CO3,R)
4. Define Smoke flavors.(CO4,R)
5. Explain the Threshing of Spices. (CO1,Un)
6. Discuss Phenolic spices. (CO2,Un)
7. What is the Composition of turmeric? (CO2,R)
8. Summarize the Major spices. (CO2,Un)
9. Define Pyrolysis.(CO5,R)
10. Explain the Composition of clove.(CO2,Un)
11. Justify the Encapsulation of flavors. (CO5,Ev)
12. Evaluate the Composition of garlic.(CO2,Ev)

13. SECTION B: Answer any FOUR Questions

(4 X 6=24 Marks)

14. Discuss the method of processing cardamom.(CO2,Un)
15. Elaborate on the primary functions of spices.(CO1,Cr)
16. Explain the sterilization of spices and herbs.(CO3,An)
17. Evaluate the problems involved in the incorporation of synthetic flavors in foods.(CO5,Ev)
18. Explain the method of processing pepper.(CO2,An)
19. Interpret the formation of flavors in fruits and vegetables. (CO4,Un)

SECTION C: Answer any ONE Question

(1 X 12=12 Marks)

19. Evaluate in detail the flavoring materials made by processing. (CO5,Ev)
20. Explain the decontamination techniques used for spices. (CO3,An)

***Remember (R), Understand (Un), Apply (A), Analyse (An), Evaluate (Ev), Create (Cr), Skill (S), Interest (I), and Appreciation (Ap)**

SCHOOL OF FOOD SCIENCE AND TECHNOLOGY

MAHATMA GANDHI UNIVERSITY

MSc FOOD SCIENCE AND TECHNOLOGY

III SEMESTER

FSM 26 E 24 – Nutraceuticals and Functional Foods.

Time: 3 hours

Maximum Marks :60

SECTION A

Answer all questions. Each question carries 2 marks

(12×2 = 24 Marks)

1. Define nutraceuticals (CO1,U)
2. Describe Omega-3 fatty acids (CO2,E)
3. Explain lycopene. (CO1,U)
4. Outline Symbiotics (CO4,E)
5. Explain organo-sulfur compounds. (CO3,A)
6. Discuss postbiotics. (CO4,U)
7. Explain Gluconates. (CO3,A)
8. Discuss natural immunomodulators. (CO3,R)
9. Explain the health benefits of prebiotics . (CO4,A)
10. Discuss sensitive bioactive compounds.(CO3,R)
11. Discuss flavonoids. (CO3,A)

SECTION – B

Answer any 4 questions. Each question carries 6 Marks

(4×6=24 Marks)

12. Explain the steps in the mechanism of probiotic action briefly. (CO4, A)
13. Discuss the relevance of nutraceuticals and functional foods in the management of diseases (CO 5,A)
14. Discuss recent developments in the isolation of phytochemicals. (CO3,A)
15. How does nutrigenomics contribute to personalised nutrition?(CO3, A)
16. Discuss the role of nutraceuticals in maternal nutrition and infant formulas.(CO1 &2A)
17. Explain the biological role of bioactive compounds.(CO3,An)
18. Discuss the isolation of phytochemicals from plant materials.(CO3, U)

SECTION C

Answer any one question. Question carries 12 Marks

(1×12 = 12 Marks)

19. Challenges and solutions to the incorporation of nutraceuticals in foods.(CO5,U)
20. Explain the role of GMP in the functional food industry.(CO6,S)