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 2021 ADMISSIONS)

Preface

Mahatma Gandhi University

Mahatma Gandhi University is an Indian collegiate public University based in Kerala, established in 1983, approved by UGC, and accredited with NAAC "A" Grade, 3.24 CGPA. With its academic excellence, the University has bagged Chancellor's Award twice for the best University (2015-16 and 2017-18) within the state of Kerala. It has also secured 30th position in NIRF ranking (April 2019) and 11th position in India Today-MDRA ranking, 2018. CSIR has ranked the University 13th for its intellectual productivity and NISTADS has rated it as 19th in terms of h-index.

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 inter disciplinary 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 (IUIC). 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 ofstandardised 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.

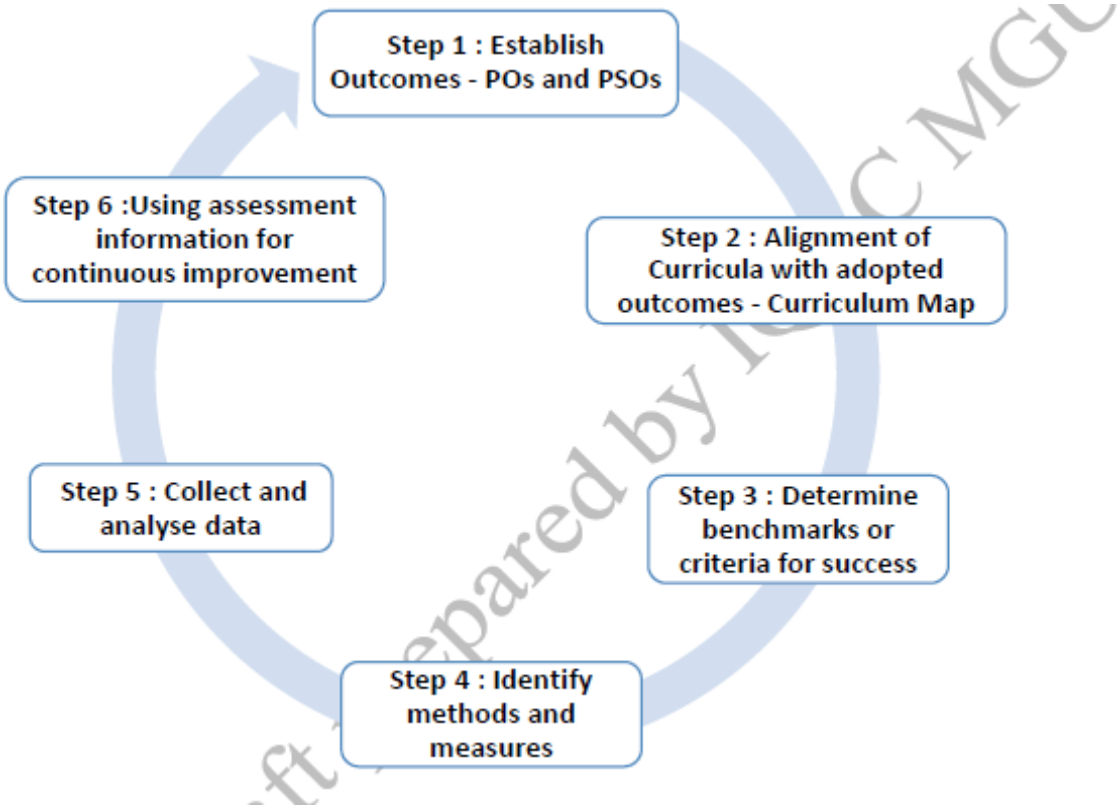
An OBE system has been proposed and to be implemented at various Departments of Mahatma Gandhi University, as a quality-assurance approach to improve teaching and learning outcomes and processes. This OBE plan incorporates the "outcomes assessment" process to be

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 Biosciences from the academic year 2020-2021 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.

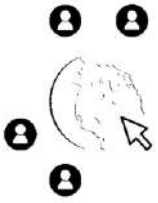
Our Mission

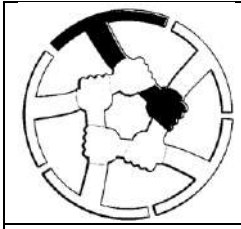
- To provide advanced knowledge and training to individuals preparing for careers in food science and technology in the food industry, academia and health sector.
- To utilize the expertise of faculty in area of food science and technology for benefitting the students in achieving their career goals.
- 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 researchand 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
	**Lifelonglearning**	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 researchand 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 atpersonal 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 characteristcs, nutritive and functional properites, processing, presrvation. 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 devoplomen of scientific and technical knowledge in food science and technology

PSO5. Devolop 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 21 C 01	Foundation to Food Science & Technology	3
FS M 21 C 02	Food Chemistry	3
FS M 21 C 03	Food Microbiology	3
FS M 21 C 04	Food Processing and Preservation	3
Elective- I	To be selected from among the elective courses offered	4
FS M 21 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 21 C 09	Food product Development and Quality Evaluation	3
FS M 21 C 10	Food safety and Quality Assurance	3
FS M 21 C 11	Techniques in Food analysis and Biostatistics	4
FS M 21 C 12	Food Additives andPackaging Technology	3
Elective - II	To be selected from among the elective courses offered	4
FS M 21 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 21 C 17	Cereals, Pulses and Oilseeds Technology	3
FS M 21 C 18	Technology of Milk, Meat, Poultry and Fish	3
FS M 21 C 19	Technology of Fruits, Vegetables and Plantation Crops	3
FS M 21 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 21 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 21 C 26	Major Research Project	12
FS M 21 C 27	Comprehensive Viva-voce	4
Total Credits of the 4thSemester 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 21 E 06	Nanotechnology –Concepts and applications in Food science	4
FS M 21 E 07	Nutritional Biochemistry	4
FS M 21 E 08	Food Toxicology	4
FS M 21 E 14	Food Biotechnology	4
FS M 21 E 15	Fundamentals of Food Engineering	4
FS M 21 E 16	Technology of Beverages	4
FS M 21 E 22	Waste Management in food industry	4
FS M 21 E 23	Food Business Management and Entrepreneurship	4
FS M 21 E 24	Nutraceuticals and Functional Foods	4
FS M 21 E 25	Spices & Flavor technology	4

FIRST SEMESTER

MAHATMA GANDHI UNIVERSITY

FS M 21 C 01: FOUNDATION TO FOOD SCIENCE AND TECHNOLOGY

SchoolName	**School of Food Science and Technology**					
Programme	**M Sc Food Science and Technology**					
Course Name	**FOUNDATION TO FOOD SCIENCE AND TECHNOLOGY**					
Type of Course	Core					
Course Code	FS M 21 C 01					
Course Summary & Justification	• The objective of this course is to impart the basic knowledge in the branch of food science and technology. • To develop a very good understanding about characteristics of different classes of foods, constituents and properties of foods, flavours and toxins in foods etc. • To enable students gain knowledge regarding food security, malnutrition and Food, agricultural policies					
Semester	First					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	**Basics of nutrition and food science**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.

1	Understandthe classification of foods,and different techniques to improve the nutrient content of foods	U /E	1
2	Understanding of various physical and chemical properties of food	U/ An	1
3	Exemplify basic tools to study the properties of food in the laboratory	S	2,3
4	Understanding different types of food flavors, colors, toxins and allergens	U/R	1,
5	Understand worldwide scenario of food security and malnutrition	U/R	4
6	Create an insight to food and agricultural policies, research and development in food and agriculture.	U/An/ C	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	**Unit I: Introduction** : Food: Classification of foods, Health foods, Natural foods, Organic food, Functional food, Nutraceuticals, Specialty Foods, Fast Foods, space foods, Food fortification, Restoration and enrichment, Anti-nutritional factors, GM food and its safety concern, Nutritional status of world population, National and international programs for nutritional improvement.	1	15
2	**Unit II: Food Properties**: Constituents of Food-Physical (Color, Density, Specific gravity, Temperature, pH, Water activity, Pressure, Viscosity) and chemical properties (moisture content, Acidity, basicity, buffers, molarity, normality, molality, colloidal system) Dispersion phase and continuous phase (sol, gel, foam, emulsion), Solution and its properties.	2	15
3.	**Unit III: Flavors and toxins in food:** Food flavor chemistry, Chemical structure and taste, Process flavors,Chemistry of flavor deterioration, **Food colorants:** Pigments in animal and plant tissues.Food Toxicology-Naturally occurring plant and animal toxins, Food allergens-types and causes.	3 & 4	10

4	**Unit IV: Food Security** : Hunger and malnutrition, Definition and measurement, Food security model, Food availability, Foreign aid, Food aid and development, Global sustainability: Environmental impacts of the world food system, hunger, conflicts, government failure, and international intervention, globalization of food system, Food Security in Indian Scenario.	5	10
5	**Unit V: Food and Agricultural Policies :** Food and agricultural policies including supply side policies, Agricultural research and development, Infrastructure and production policies, Demand side policies, Income support and redistribution, Food assistance programs.	5 & 6	10
	Total Credits of the Course	3	60

TeachingandLearningApproach	**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)** 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

- Frederick, J.F, 2000, Encyclopedia of Food Science and Technology. Second edition vol l-4, awidely inter science publication.
- Goldberg, I., 1999 Functional foods, Designer foods, pharma foods and nutraceuticals. An aspen publication, gaithers burg, Maryland.
- Roday, S., 2008, Food science and nutrition. Third edition, Oxford University Press, New Delhi.
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- Manay, N.S,2004, Shadaksharaswamy, M., Foods- Facts and Principles, New Age

Intemational Publishers, New Delhi.
- Srilakshmi, B, 2003, Food Science (3rd edition), New Age International (P) Limited Publishers, New Delhi.
- Reddy Y.S, 2006, Newer concept and applications for food industry. Gene tech Books, New Delhi 110002.
- Leathers, H D. and Fosters, P. The World Food Problem: Tacking the Causes of Undernutrition in The Third World, 3rd edition, lynne rienner publications,2004.
- Asbjorn, E.2007.Freedom from Hunger as a basic Human Right, in Ethics, Hunger and Globalization, edited by Per Pinstrup -Anderson and Peter Sandoe. The Netherlands: Springer press.

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MAHATMA GANDHI UNIVERSITY

FS M 21 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 21 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 comprehend and articulate the advanced concepts in food science					
Semester	First					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	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	Understand the chemistry and properties of water, ice and dispersed systemsin foods.	U /E	1
2	To identify the different types of biomolecules such as carbohydrates, proteins, lipids, vitamins and mineralsin various kind of food.	U/ An	1

3	To compare the structure and functions of carbohydarates, proteins, lipids, vitamins and minerals in contributing the organoleptic and nutritional properties of foods.	A	2
4	To understand various kinds of desirable and undesirable chemical reactions involving these bio moleculesthat occurs during food processing and food spoilage.	U/A/E	1
5	To understand various enzymes and their reactions in foods	U/R	1
6	To create an insight to the various chemical reactions responsible for changes of food during cooking, preservation and processing.	S/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	**Water :** Physical properties, structure of water and ice, water soluble interaction, water activity and relative vapor pressure. **Dispersed systems:** Surface phenomena, colloidal interactions, Liquid dispersions, gels, emulsions and Foam.	1	10
2	**Carbohydrates:** Monosaccharides, Oligosaccharides, Polysaccharides, Starch, Cellulose, Guar and Locust Bean Gum, Xanthan, Carrageenans, Algins, Pectins, Gum Arabica and Dietary fiber, Caramelization, Non-enzymatic browning: desirable and undesirable effects	2, 3, 4 & 6	15
3.	**Lipids:** Classification, Physical Aspects, Chemical Aspects, Chemistry Of Fats And Oil Processing, Role Of Food Lipids In Flavor, Lipolysis, Rancidity, Test for Rancidity Reversion, Trans-fat formation, Hydrogenation, Inter esterification, Winterization, Fat Characterization, Waxes, Chemistry Of Frying Oils, Sterols.	2,3, 4 & 6	10
4	**Amino Acids, Peptides and Proteins:** Physiochemical properties of amino acids, protein structure, protein denaturation, functional properties of proteins, nutritional properties of proteins, processing induced physical and chemical changes of protein, novel protein foods and its uses. Enzymes in foods, Modification of foods in endogenous enzymes, Enzymatic browning reactions.	2,3, 4 , 5 & 6	10
5	**Vitamins and Minerals:** Vitamins-fat soluble and water soluble vitamins-classification, structure, bioavailability, sources, chemical properties, general causes for losses of vitamins in food, deficiency diseases. Minerals- classification, sources, bioavailability, functions and deficiency, major elements - Ca, P, Mg, Na, K, F, trace minerals - Fe,	2,3&4	15

	Cu, I, Mn.		
	Total Credits of the Course	3	60

TeachingandLearningApproach	**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. 2005. Food Chemistry. Springer Verlag.
- Fennema, O.R, 2006, Food Chemistry, Academic Press.
- Meyer, L.H. 1987. Food Chemistry. CBS publishers and Distributors, New Delhi.

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- Potter, N.N. and Hotchikiss, J.H. (2006), Food Sciences, Fifth edition, CBS publishers and Distributors, New Delhi.
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- Lee, F. (2012). *Basic food chemistry*. Springer Science & Business Media.
- Srinivasan, Damodaran, Kirk, L. Park and Owen R. Fennema. 2008. *FoodChemistry*, CRC Press, Taylor and Francis Group, New York.

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MAHATMA GANDHI UNIVERSITY

FS M 21 C 03: FOOD MICROBIOLOGY

SchoolName	**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 21 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 StudentLearningTime (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 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 /E	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

	preventthe microbial growth in food.		
3	Exemplify basic tools to study these in the laboratory	S	2,3
4	Analyse various methods for determination and isolation of microorganismsin 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
6	Explain different kind of food spoilage and characteristics of microorganism during food spoilage and food preservation	U/An	1, 3
7.	Create a deep understanding of food born infections and intoxication and techniques for its prevention	U/ I	1,4,5
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	**Microbiology of Food:**Microbial habitat of specific food materials, adaptations and changes in microbiome of vegetables, fruits, milk, fermented and non-fermented milk products, fresh meats, poultry and non-dairy fermented foods. Factors influencing microbial growth in food, Intrinsic and extrinsic factors, combined intrinsic and extrinsic – lactic antagonism and hurdle concept; growth kinetic. Probiotics, Prebiotics, Synbiotics, Health benefit and mechanism of action of probiotics, SCP, Edible mushrooms, Physical and chemical methods to control microorganisms	1,2 & 5	10
2	**Determination of microorganisms in food:** Collection of food samples, transport and storage. Enumeration of microorganisms. Direct count, Total aerobic count, Selective media. Identification of pathogenic microorganisms – Selective media, PCR based identification, ELISA. Isolation and identification of virulent E. coli from foods. Culture independent techniques - PCR Based, DGGE, Metagenomics, etc.; Analytical methods for microbial metabolites- microbial toxins and metabolites. Detection methods for food pathogens	3 & 4	15
3.	**Role of microorganisms in the preparation of food:** Dairy products, Microbiology of cultured dairy products, Yogurt manufacture, cultured butter milk, Sour cream, Kefir and microbiology of kefir grains, cheese, vegetable fermentation, Microbial succession during production of fermented vegetables, Manufacture of sauerkraut, kimchi, cucumber fermentation, Soy sauce production, Tempeh fermentation. Microbial cell factories – vitamins, proteins, omega-3 fats	5	15

4	**Food spoilage:** Types and causes of spoilage of cereal, Pulses, Fruit and Vegetable, Meat, fish egg, poultry and their processed products, Milk and milk Products, Canned foods and Beverages. Study of microorganisms responsible for spoilage and microbial succession during spoilage; principles of structural, mechanical and dynamic characteristics of food systems; introduction to predictive microbiology.	6	10
5	**Food-borne diseases:** 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 of microbial food infections. Identification and first aid for specific types of food infections	7	10
	Total Credits of the Course	3	60

TeachingandLearningApproach	**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

- Pelezar M.I and Reid, R.D. (1993) Microbiology McGraw Hill Book Company, New York, 5th Edition.
- Frazier W.C. (1988) Food Microbiology, McGraw Hill Inc. 4th Edition

Recommended References

- Jay, James, M(2000) Modern Food Microbiology, 2nd Edition. CBS Publisher
- Adams, M.R. and M.G. Moss (1995): Food Microbiology, lst Edition, New Age International

(P) Ltd.

- Doyle, P. Bonehat, L.R. and Mantville, T.J-(1997): Food Microbiology, Fundamentals and Frontiers, ASM Press, Washington DC.
- Garbutt J. 1997. *Essentials of Food Microbiology*. Arnold Heinemann.
- Jay JM, Loessner MJ & Golden DA. 2005. *Modern Food Microbiology 7* Ed.Springer.
- Ray B. 2004. *Fundamentals of Food Microbiology*.3rd Ed. CRC.

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MAHATMA GANDHI UNIVERSITY

FS M 21 C 04: FOOD PROCESSING AND PRESERVATION

SchoolName	**School of Food Science and Technology**					
Programme	**M.Sc Food Science and Technology**					
Course Name	**FOOD PROCESSING AND PRESERVATION**					
Type of Course	Core					
Course Code	FS M 21 C 04					
Course Summary & Justification	• This course is designed to provide an overview of food processing and preservation • Course topics will include the food preservation by high and low temperature, freezing, dehydration, frying, emulsification, chemical preservation and irradiation. • The course also provides inputs regarding different classes of food items prepared using each preservation methods					
Semester	First					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	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.
1	Understand various methods for the preservation of different kind of food items	U /C	1
2	Understand the role of temperature, pH, moisture in preserving	U/ An/E	1,

	foodsand study the characteristics of food system under these preservation methods.		
3	Explain food preservation by frying and emulsification	U/A	1,2
4	Create a deep insight to different types of chemicals for the preservation of food	U/A	1,4
5	Understanding the principles regarding preservation by irradiation of food and its legal aspects	U/R	1,5
6	Provide a basic knowledge in the preparation of different type of foods using these preservation methods	U/An/ C	1,2

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	Hrs
1	**Unit I : Basic concept of food processing and preservation:** Scope and importance of food processing; historical developments in food processing; food spoilage: microbial, physical, chemical & miscellaneous. Food pathogens. Principles of food preservation.Food processing equipments: material handling, cleaning and grading, conveyors, size reduction, food grain storage, milling, Separation Technique: filtration, agitation and mixing. Baking, Roasting, Frying. Extrusion Technology-(principle, types of extruders).	1	15
2	**Unit II:Processing and preservation by heat:** Role of temperature in food preservation. Heat resistance of microorganisms, thermal death curve, types of heat treatments and effects on foods, canning of foods, cans and container types, spoilage of canned foods, heat penetration, brief concept of different heat processing methods: blanching, roasting, frying, baking etc.***Preservation by low temperature:*** (refrigeration, freezing, and dehydro freezing; cold storage, frozen food), changes during freezing-physical and chemical changes.:Freezing curves, Slow and quick freezing, Factors determining freezing rate, freezing methods.	1& 2	10
3.	**Unit III: Dehydration :** Dehydration: drying, dehydration and concentration, Drying curves, Drying methods and type of dryers; food concentration, methods of concentration of fruit juices, liquid food concentrates, Changes in food during dehydration and concentration.Water activity: Role of water activity in food preservation, Intermediate moisture foods (IMF), Principles, Characteristics,	1 & 2	10

	Advantages and problems of IM foods. Role of pH in food preservation.		
4	**Unit IV: Frying, Emulsification and Chemicals:** ***Food frying:*** general principles, frying process; Shallow frying and deep frying, Frying oils, Factors affecting oil uptake during frying. ***Emulsification in food processing:*** Principles, Examples of emulsification in food; Milk, Ice-cream mix, coffee/tea whiteners, Salad dressings, Meat sausages, Margarine and spreads. ***Chemical preservation:*** Types, Uses and effects of class I and class II preservatives in foods. House hold preservation methods: Pickling, Salt curing, Oiling and Smoking, Sugar addition.	1,3 & 4	15
5	**Unit V: Irradiation :**Food Irradiation: history and mechanism, The electromagnetic spectrum, Forms of radiant energy, Principles of using electromagnetic radiations in food processing, Ionizing radiations and non-ironizing radiations, Advantages and disadvantages, Controlling undesirable changes in food during irradiations, Legal aspects of gamma radiation. ***Processing by non-thermal method:*** high pressure, pulsed electric field, hurdle technology	1 ,5 & 6	10
	Total Credits of the Course	3	60

TeachingandLearningApproach	**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)** 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

- Kalia M and Sangita, S. (1996) Food Preservation And Processing, first edition, kalyani publishers, New Delhi.

- 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

Recommended References

- Earle R.L (1983), Unit Operations In Food Processing, 2nd edition, Pergamon press, Oxford, UK
- Fellows, Food Process Technology: Principles and Technology, CRC publications.
- 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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MAHATMA GANDHI UNIVERSITY

FS M 21 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 21 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 StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Eg. 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.	Ap	2
2	To estimate different bio-molecules (sugar, polyphenols, gluten) in food samples	Ap/S	2
3	To study the different stages of sugar cookery	Ap/S	1,2
3	To determine boiling point and freezing point of water	S	2,3

4	To determine acidity and natural pigments in given food samples	S	2,3
5	To determine gelatinization of the given food sample	S	2,3
6	To determine the refractive index of fat sample	S	2,4
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** 1. Determination of boiling point and freezing point of water 2. Estimation of sugars 3. Stages of sugar cookery 4. Estimation of gluten content 5. Estimation of polyphenols	1, 2 & 3	35
2	6. Determination of acidity 7. Determination of gelatinization 8. Determination of natural pigments in foods 9. Fat acidity in foods-flour 10. Determination of refractive index of fats	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.	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

TeachingandLearningApproach	**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 21 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 21 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 StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	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 nanoencapsualtion 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

TeachingandLearningApproach	**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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MAHATMA GANDHI UNIVERSITY

FS M 21 E 07: NUTRITIONAL BIOCHEMISTRY

SchoolName	**School of Food Science and Technology**					
Programme	**M.Sc Food Science and Technology**					
Course Name	**NUTRITIONAL BIOCHEMISTRY**					
Type of Course	Elective					
Course Code	**FS M 21 E 07**					
Course Summary & Justification	• This course is designed to equip students the essential knowledge in human nutrition, nutrients, and nutrient deficiencies. • It also helps students identify various nutritional problems in India and factors affecting it. • This course also helps students to develop skills in planning balance diet for people of different age groups. • This course also gives the basic knowledge about the therapeutic diet planning and preparation. • This will enable the students to identify the research, learning and job opportunities based on the latest developments in this subject of nutrition.					
Semester	First					
Total StudentLearningTime (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 nutrition**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.

1	Students will be able to identify role of nutrition in maintain health	U /E	1
2	Students will be able to identify the major nutritional problems of India and factors affecting it	U/ An	1,4
3	Students will be able understand type ,functions, sources, digestion, absorption and metabolism and effect of deficiency of nutrients in food (carbohydrates, protein, fat, vitamins and minerals)	U/R	1,3
4	Students will be able to understand the concept of energy and fluid requirement for different classes of people	U/A	1,3
5	Students will be able to calculate the basal metabolic rate and body mass index and nutritive value of foods	S	1,3,4
6	Students will be able to understand the metabolism of water and electrolytesin the body.	U/R	1,3,4
7	Students will be able to understand different type of therapeutic diets and nutraceuticals	U/An/ C	1,3
8	Students will be able to plan nutritive menu for different classes of people	S/C	2,5
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 nutrition :**Introduction , Nutrition: History Concepts , Role of nutrition in maintaining health , Nutritional problems in India, National nutritional policy , Factors affecting food & nutrition: socioeconomic, cultural, tradition, production, system of distribution, life style & food habits etc., Role of food & its medicinal value , Classification of foods , Food standards , Elements of nutrition: macro and micro , Calorie, BMR	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 Over consumption Proteins, Classification, Caloric value, recommended daily allowances,	2 & 3	15

	Dietary sources. , Functions, Digestion, absorption and storage, metabolism, Malnutrition: Deficiencies and Over consumption		
3.	**Fats and Energy** FATS,Classification, Caloric value, Recommended daily allowances, Dietary sources., Functions, Digestion, absorption and storage, metabolism, Malnutrition: Deficiencies and Over consumption 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	3 & 4	10
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 & 6	15
5	**Balanced diet and therapeutic diet** Balanced diet, Elements, Food groups, Recommended Daily Allowance , 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 group, Planning menu, Introduction to therapeutic diets: Naturopathy-Diet, Demonstration: Fluid diet, Egg flip, Soup, barley water, whey water, Soft diet: custard, Caramel custard, kanji, jelly, Semisolid diet: Khichadi, mashed potatoes, kheer. Neutraceuticals: their mode of action and metabolism, Food as a medicine	5 & 7	10
	Total Credits of the Course	4	60

TeachingandLearningApproach	**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

- 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 Banglore printing and publishing Co. Ltd. (Banglore press) 2004.
- Joshi V.D. Handbook of Nutrition and Dietetics vora medical publications, 1999.

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 21 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 21 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 aresult 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 StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
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

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 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

TeachingandLearningApproach	**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

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

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

Recommended References

- Shibamato 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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SECOND SEMESTER

MAHATMA GANDHI UNIVERSITY

FS M 21 C 09: FOOD PRODUCT DEVOLOPMENT AND QUALITY EVALUATION

SchoolName	**School of Food Science and Technology**					
Programme	**M.Sc Food Science and Technology**					
Course Name	**FOOD PRODUCT DEVOLOPMENT AND QUALITY EVALUATION**					
Type of Course	Core					
Course Code	**FS M 21 C 09**					
Course Summary & Justification	• This course is designed to develop a very good understanding regarding the stages and techniques of new food product development process • This will enable the students to identify the research, learning and job opportunities based on the latest developments in this subject • Course also gives an account on different kinds of specialty foods. • This course also equips students with a basic theoretical knowledge of different techniques of sensory evaluation, which is needed for food quality evaluation in food industries.					
Semester	Second					
Total StudentLearningTime (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 biotechnology**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.

1	Students will be able to understand the need, stages and techniques in new food product development	U /An/ E	1
2	Students will be able to perform the standardisation of recipe	S	2
3	Students will be equips with the basic knowledge in different type of quality evaluation of food	U/An	2
4	Students will be able to understand the importance of plant layout of food industry	U/E	2,3
5	Students will be able to understand different kinds of speciality and novel food products	U/R/E	2,3
6	Create an insight to the categories , techniques and methods in sensory evaluation of food products	U/An/ C	2,4

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	**New Food Product Development (NPD) Process:** Advantages of processed food in an urbanized modern society. Product Development-Definition, objectives and need of product development, new food product design, food innovation case studies, market oriented NPD methodologies, organization for successful NPD, recipe development, use of traditional recipe and modernization, involvement of consumers, chefs, and recipe experts, selection of materials /ingredients for specific purposes, modifications for the production of large scale , cost effectiveness, nutritional needs and uniqueness. Standardization and large scale production, process designs, equipment needed and design, statistical analysis; application in product development and comparison of market sample: stages of integration of market and sensory analysis. Consumer acceptance studies	1 & 2	15
2	**Quality, safety and regulatory aspects:** product stability; evaluation of shelf life; changes in sensory attributes and effects of environmental conditions; accelerated shelf life determination; developing packaging systems for maximum stability and cost effectiveness; interaction of package with food: regulatory aspects;	3	10

	whether standard product and conformation to standards; approval of proprietary products , Types of food quality evaluation-subjective and objective methods. Plant Layout- Introduction, Definition, types of plant layout, objectives and advantages. Specialty foods – medical foods, sports nutrition, foods for geriatrics, infant foods, foods for immunity, foods for diabetics, convalescence, cancer. Alternate proteins – seaweeds, algal, insect, plant based.		
3.	**Fundamentals of Sensory Evaluations** Subjective evaluation, sensory evaluation: definition, and applications and sensory attributes of food: Appearance, texture and flavor; difference between objective and subjective evaluation, sensory perception: mechanism of taste, smell, retronasal smell, somethesis, kinethesis, chemesthesis- pepper heat, carbonation, metallic taste etc. mechanism of color perception	3 & 4	10
4	**Sensory evaluation requirements .** Requirements of sensory evaluation: Sensory laboratory design, sensory booths, sensory panels- types of panels, requirements, recruitment criteria & selection, training. Sample preparation and serving procedures such as sample size, sample serving temperature palate cleansers, swallowing and expectoration, score card, sensory scaling- line scales, numeric scales, hedonic scales.	4	15
5	**Sensory measurements** Kinds of sensory tests- difference: - triangle, duo-trio tests, paired comparison tests, descriptive tests: - texture profile, flavor, profile, affective tests: - preference test, ranking test, hedonic tests. Quantitative descriptive analysis, E-nose, e-tongue, color measurement, texture measurements. Factors affecting sensory measurements: - psychological - expectation error, mutual suggestion effect, distraction error etc. Physiological: adaptation, mixture interactions-enhancement, synergy & suppression, health and environmental factors.	5 & 6	10
	Total Credits of the Course	3	60

TeachingandLearningApproach	**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

- Lyon D, H.; Francombe, M A.; Hasdell, T.A; Lawson, K. (eds.) (2002) : Guidelines For Sensory Analysis In Food Products Development And Quality Control . Chepman and Hall, London.
- Harry T. Lawless, Hildegarde Heymann(2010) Sensory evaluation of Food: Principles and Practices, Second Edition, Springer, NewYork.
- SarahKemp, Tracey Holly wood, Hort (2011) Sensory evaluation: A Practical Handbook, Wile Y-Blackwell, New Joanne York.
- Nielsen,S.S, 2004 Introduction to the chemical analysis of foods. Jones and Bartlett Publishers, Boston, London.

Recommended References

- Srilakshmi, B 2005. Food Science. New Age lnternational (P) Limited, New Delhi.
- Anilkumar S., Poornima S.C., Abraham N.K. & Jayasree K. 2004; Entrepreneurship Development, New Age International Publishers.
- Lawless, H.T. and Klein B.P. (2001): Sensory Science Theory and Application in Foods. Marcel Dekker Inc. New York.

- Clarke & Wright W. 1999. Managing New Product and Process Development. Free Press.
- Earle R, Earle R & Anderson A. 2001. Food Product Development. Woodhead Publ.
- Fuller 2004. New Food Product Development - from Concept to Market Place. CRC.
- Principles of Marketing- Phillip kotler
- Jellinek G. 1985. Sensory Evaluation of Food - Theory and Practice. Ellis Horwoood.
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MAHATMA GANDHI UNIVERSITY

FS M 21 C 10: FOOD SAFETY AND QUALITY ASSURANCE

SchoolName	**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 21 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 StudentLearningTime (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 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 Quality Assurance** Introduction to concepts of food quality, food safety, food quality assurance and food quality management; objectives, importance and functions of quality control, Current challenges to food safety. Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents.	1	10
2	**Techniques in 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. Food safety management, Concept of food traceability for food safety.	2 & 3	10
3.	**Microbial quality control and HACCP** Microbial quality control: determination of microorganisms in foods by cultural, microscopic, physical, chemical methods. Statistical quality control in food industry. History of HACCP, seven principles of HACCP ,HACCP –Manuel ,preparation, validation, implementation-	4	10

	internal audit, verification audit, deficiencies, corrective and preventive actions, Implementation of HACCP.		
4	**International Food Regulatory Agencies** Joint FAO/WHO Food Standards Program. Codex Alimentarius Commission (CAC), Codex standards, Other International Organizations Active in Food Standard Harmonization. Advantages of Utilizing International Standards. Rapid Alert system. European Committee for Standardization (CEN), PAN American Standards Commission (COPANT), Euro-Asian Council for Standardization, FDA,EPA, EU, ASEAN, EFSA (European Food Safety Authority), lnternational organization for standards (ISO) and its standards for food quality and safety (ISO 9000 series, ISO 22000, IS0 15161,ISO 14000). Introduction to WTO agreements: SPS and TBT agreements.	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

TeachingandLearningApproach	**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

- Kalia M and Sangita, S. (1996) Food Preservation and Processing, first edition, kalyani publishers, New Delhi.
- 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

Recommended References

- Earle R.L (1983), Unit Operations In Food Processing, 2nd edition, Pergamon press, Oxford, UK
- Fellows, Food Process Technology: Principles and Technology, CRC publications.
- 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.
- Krammer A & Twigg BA.1973. Quality Control in Food Industry. Vol. I, II. AVI Publ.
- Macrae R, Roloson R & Sadlu MJ. 1994. Encyclopedia of Food Science & Technology & Nutrition. Vol. XVI. Academic Press.
- Piggot J.R. 1984. Sensory Evaluation of Foods. Elbview Applied Science.
- Export/Import policy by Govt. of India
- Early R.1995.*Guide to Quality Management Systems for Food Industries*. Blackie Academic.
- Furia TE.1980. *Regulatory status of Direct Food Additives*. CRC Press.

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MAHATMA GANDHI UNIVERSITY

FS M 21 C 11: TECHNIQUES IN FOOD ANALYSIS AND BIOSTATITICS

SchoolName	**School of Food Science and Technology**					
Programme	**M.Sc Food Science and Technology**					
Course Name	**TECHNIQUES IN FOOD ANALYSIS AND BIOSTATITICS**					
Type of Course	Core					
Course Code	**FS M 21 C 11**					
Course Summary & Justification	• The objective of this course is to impart the basic knowledge in the branch of techniques in food analysis • The syllabus content in this paper is designed with an objective to train the students in both theoretical and practical aspects of the subject • This will also enable the students to get an idea about the latest developments taking place in this subject • The course also gives a basic knowledge regarding bio statitics.					
Semester	Second					
Total StudentLearningTime (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 nutrition**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Students will be equipped with the basic knowledge regarding the principle, instrumentation and application of Spectroscopy,Chromatography,Colorimerty ,Gravimetry and Refractometry	U /S	1,4
2	Students will be able to understand different methods of extraction and analysis of carbohydrates ,proteins, lipids , vitamin and minerals in in foods	U/ An/S	1,4

3	Exemplify basic tools of these in the laboratory	S	2
4	Students will be able to understand different methodsfor analysis of moisture content in different type of foods	U/S	1
5	Create an insight in various tools in biostatistics	U/An/ C	1,4,5
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	**Principles of Analytical Instrumentation** Importance of analysis of biomolecules, Sampling, sampling techniques, Basic principles, instrumentation and application of the following – Spectroscopy (UV-Spectroscopy, Visible, Infrared, Atomic Spectroscopy, NMR) Electrophoresis-(SDS-PAGE), Chromatography (Physio-chemical principles, chromatographic techniques-Paper, TLC, HPLC, GLC), Colorimetry, Gravimetry, refractometry,	1	10
2	**Analysis of Carbohydrates** Importance of carbohydrate analysis, Extraction of mono and oligosaccharides, Removal of interfering compounds, clarification with lead acetate. Chemical methods for Mono and oligosaccharides: Lane and Eynon Method, Munson and Walker Method, Nelson-Somogyi method, Alkaline ferricyanide method, Phenol-sulphuric acid method, Enzymatic methods for mono and oligosaccharides: D-glucose/D-fructose/D-sorbitol method, Lactose/D-galactose method, Maltose/sucrose/D-glucose method, Raffinose method, Oxidase method. Analysis of starch & fiber	1,2,3 & 4	10
3.	**Analysis of Lipids and moisture** Importance of fat analysis, Sample preparation (Pre-drying, particle size reduction, acid hydrolysis). Analysis methods: Continuous solvent extraction methods, Gold fish method (procedure and calculation), Semi continuous solvent extraction methods, Soxhlet method (Preparation of sample, Procedure and calculation), Discontinuous solvent extraction methods Modified Mojonnier method. Non - solvent wet extraction methods: Babcock method (principle, procedure, and application), Gerber method (principle, procedure, application). Analysis of Moisture- Oven drying method, Chemical method (Karl Fischer titration), Distillation procedures, physical methods	1,2, 3 &4	15

4	**Analysis of Proteins, vitamins and minerals** Importance of protein analysis, Methods of analysis (Principle, procedure, application) Kjeldahl Method, Biuret method, Lowry method, Bi-cinchoninic Acid method, Ultraviolet (UV) 280nm Absorption, Dye binding method, Bradford method, Ninhydrin method & Turbidimetric method Importance of vitamin analysis: Extraction methods, Bio assay method for vitamin D, Physico - chemical Methods: Vitamin A (Carr – Price method Thiamine by thio chrome method, Riboflavin – fluorometric method, Niacin-colorimetric method, Vitamin D – HPLC method , Analysis of minerals: Microwave digestion. Analysis of the following minerals (Principle and procedure), Calcium – EDTA titration. Phosphorus – colorimetric method. Copper, Iron and zinc by ICP. Vitamins: thiamin and riboflavin, Niacin by colorimetric method. Analysis of ash.	1,2, 3 &4	15
5	**Bio- statistics** Introduction to bio statistics – meaning and its scope,probability and probability distribution analysis. Variables in biology- collection, classification and tabulation of data.Descriptive statistics- measures of central tendency, Arithmetic mean, median, mode, geometric mean, harmonic mean. Measures of dispersion, standard deviation, standard error, variance, coefficient of variation. Correlation and Regression.Basic idea of significance test- hypothesis testing, levels of significance.Testing of single mean, double mean and Paired- t in small sample. ANOVA-One way and Two way; Chi-square test of goodness of fit and Chi-square test of independence, comparison of means of two samples, three or more samples.	5	10
	Total Credits of the Course	4	60

TeachingandLearningApproach	**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

- Nielsen, S.S, 2004 Introduction to the chemical analysis of foods. Jones and Bartlett Publishers, Boston, London.
- Sharma, B.K, 2004, Instrumental Methods of Chemical Analysis. Goel Publishing House, New Delhi
- Fundamentals of Biostatistics: Irfan.A. khan, Atiya Khanum, Ukaaz publications
- Principles of Biostatistics: Marcello Pagano, Kimberlee Gauvreau, Duxbury Press

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- Mahindru, S.N, 2000, Food additives. Characteristics, detection and estimation. Tata Mc Graw-Hill Publishing Company Limited, New Delhi.
- Pearson, D,2002The Chemical Analysis of Foods, Churchill Livingstone, New York,
- Harry T Lawless, Hildegarde Heymann (2010) Sensory evaluation of Food: Principles and Practices, Second Edition, Springer, New York.
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- Rossi R.J. (2010). Applied Biostatistics for Health Sciences, Wiley.
- Wilcox, R. R. (2009). Basic statistics: understanding conventional methods and modern insights,Oxford University Press on Demand.

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MAHATMA GANDHI UNIVERSITY

FS M 21 C 12: FOOD ADDITIVES AND PACKAGING TECHNOLOGY

SchoolName	**School of Food Science and Technology**					
Programme	**M.Sc Food Science and Technology**					
Course Name	**FOOD ADDITIVES AND PACKAGING TECHNOLOGY**					
Type of Course	Core					
Course Code	**FS M 21 C 12**					
Course Summary & Justification	• This course is designed toprovide abasic knowledge regarding the type of food additives their safety, health aspects and regulations • It also gives a detailed account regarding food packaging, its categories , safety and health aspects and testing of packaging materials • The course also enable students to gather a sound knowledge in advanced techniques in food packaging such as edible packaging and smart packaging, CAPand MAP					
Semester	Second					
Total StudentLearningTime (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 nutrition**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand categories and functions of food additives	U /E	1
2	Understanding of safety, healthy and regulatory aspects of each food additive	U/ An/A	1,5

3	Understand the categories and properties, safety aspects of different type of food packaging materials	U/An	1,5
4	Identify the packaging requirement of different categories of food	U/E	1,3
5	Create an insight to the testing of packaging materials	U/S	1,3
6	Understand advanced packaging technologies such as asceptic packaging, smart packaging edible packaging and bio degradable packaging	U/An/ C	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 food additives:** Food additives- definitions, classification and functions, need for food additives. safety and health aspects, regulatory issues in India, international legal issues, food uses and functions in formulations, Generally recognized as safe(GRAS) and acceptable daily intake	1 & 2	10
2	**Types of food additives:** Food preservatives, classifications, antimicrobial agents (types, mode of action and their application), Nutrient supplements & thickeners, polysaccharides, bulking agents, antifoaming agents, synergists, antagonists, Antioxidants (synthetic and natural, mechanism of oxidation inhibition), chelating agents: types, uses and mode of action, Coloring agents, Flavoring agents, Flour improvers: leavening agents, humectants and sequesterants, hydrocolloids, acidulants, pH control agents, buffering salts, anticaking agents, Sweeteners: natural and artificial sweeteners, nutritive and non-nutritive sweeteners, Emulsifiers: Types, selection of emulsifiers, emulsion stability, functions and mechanism of action.	1 & 2	15
3.	**Introduction to Food Packaging:** Food packaging:- definition, factors involved in the evolution and selection of food package, functions of food packaging. Safety considerations in food packaging-types of safety problems associated with package, package labeling and food safety. Additives in packaging and toxicity. Primary, secondary and tertiary packaging of foods. Packaging requirements of selected foods: cereals and snack food, beverages, milk and dairy products, poultry and eggs, red meat, frozen foods, horticultural products and microwavable foods.	3 & 4	10

4	**Types of packaging materials** Plastic packaging materials, classification of polymers, Functional and mechanical properties of thermoplastic polymers, Food grade plastics. Metal packaging materials: container making process, functional properties of metal containers. Glass packaging materials: composition and manufacture of glass containers, closure terminology and construction, properties of glass containers Testing of packaging materials: plastic, metal, glass.	3, 4 & 5	15
5	**Aseptic packaging, MAP and edible films** Aseptic packaging of foods: sterilization of packaging materials, food contact surfaces and aseptic packaging systems. Modified atmospheric storage and packaging, Controlled atmospheric storage and packaging. Edible films and coating – use of edible active layers to control water vapor transfer, gas exchange, modification of surface conditions with edible active layers. Biodegradable packaging, Smart packaging	6	10
	Total Credits of the Course	3	60

TeachingandLearningApproach	**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

- Branen AL, Davidson PM & Salminen S. (2001). Food Additives. 2nd Ed. Marcel Dekker.
- Gerorge AB. (1996). Encyclopedia of Food and Color Additives. Vol. III. CRC Press.
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- Madhavi DL, Deshpande SS &Salunkhe DK. (1996). Food Antioxidants: Technological, Toxicological and Health Perspective. Marcel Dekker.
- Morton ID &Mcleod AJ.(1990). Food Flavours. Part A, B & C. Elsevier.
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- Crosby NT, *Food Packaging: Aspects of Analysis and Migration Contaminants*1981. App. Sci. Publ.
- Kadoya T. (Ed). 1990. Food Packaging. Academic Press.
- Mahadeviah M & Gowramma RV. 1996. *Food Packaging Materials*. Tata McGraw Hill.
- Palling SJ. (Ed). 1980. *Developments in Food Packaging*. App. Sci. Publ.
- Painy FA. 1992. *A Handbook of Food Packaging*. Blackie Academic.

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MAHATMA GANDHI UNIVERSITY

FS M 21 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 21 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 StudentLearning 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:** to prepare reagents, buffers and other solutions in required concentrations and required pH.	Ap	2
2	todetect presence of adulteration in the given food sample	Ap/S	2
3	to assess the purity of given water sample	S	2,4

4	toassess the quality of market samples of different categories of food commodities.	S	2,3
5	to perform the statistical application after the sample evaluation	S	2,4
6	to estimate iodine in iodized salt	Ap/S	2
7	to estimate food additives (Saccharin, Sodium benzoate ,Sulfur dioxide, Propyl gallate, Sorbic acid)in foods	Ap/S	2
8	to estimate chlorophyll and carotenoids in foods	S	2,5
9	to estimate salt in foods	S	2,4
10	to perform quality evaluation tests on different kinds of food packaging materials	Ap/S	2,4

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	Hours
1	**Food analysis** ***Market sample evaluation and statistical application of:*** 1. Qualitative tests for detection of adulterants 2. Test for assessment of purity of water 3. Test for assessment of quality of milk and milk products 4. Test for assessment of quality of cereals/millets 5. Test for assessment of quality of pulses	1,2 , 3 & 4	30
2	***Market sample evaluation and statistical application of:*** 6. Test for assessment of quality of fats and oils 7. Test for assessment of quality of meat/fish products 8. Test for assessment of quality of canned/bottle fruits and vegetables 9. Test for assessment of quality of baked foods	4 & 5	30
3.	**Test for food additives** 1. Estimation of iodine in iodized salt 2. Estimation of Saccharine 3. Estimation of sodium benzoate 4. Estimation of sulphur dioxide 5. Estimation of salt by Mohr's method 6. Estimation of chlorophyll 7. Estimation of carotenoids 8. Estimation of propyl gallate	6, 7, 8 & 9	40

	9. Estimation of sorbic acid 10. Qualitative test for gums		
4	**Testing of Packaging materials** 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	10	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

TeachingandLearningApproach	**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 21 E 14: FOOD BIOTECHNOLOGY

SchoolName	**School of Food Science and Technology**					
Programme	**M.Sc Food Science and Technology**					
Course Name	**FOOD BIOTECHNOLOGY**					
Type of Course	Elective					
Course Code	**FS M 21 E 14**					
Course Summary & Justification	• The objective of this course is to impart the basic knowledge in bio technology in relation to food system • The course gives a basic knowledge in principle and techniques in bio technology • To develop a very good understanding about the fermentation technology, its application in food industry. • The course also gives a sound knowledge regarding genetic engineering ,its applications for improving foods and safety issues.					
Semester	Second					
Total StudentLearningTime (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 biotechnology	E	1
2	Acquire a sound knowledge in process of fermentation, different types of fermented foods ,history and scope of fermentation	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
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 Biotechnology** The structure of DNA and RNA; melting of DNA, super helicity, organization of microbial genomes, organization of eukaryotic genomes.DNA Replication, Transcription and protein synthesis. Cell cycle, cancer and apoptosis. Concepts of recombinant DNA technology, Restriction endonucleases, Plasmid vectors, Gene cloning and production of recombinant proteins.	1	10
2	**Fermentation technology** History and scope of food fermentation. Types of fermentation process, batch and fed batch fermentation, type of bioreactors, designs and control parameters in a fermenter, high cell density cultivation strategies, continuous cultivation processes, measurement of growth and product formation kinetics, limiting parameters in large scale process development, oxygen mass transfer coefficient. Downstream processing in fermentation: objectives, various product recovery and purification methods.	2 & 3	15
3.	**Fermented Foods** Production of fermented milk and milk products, plant-based products, fish products, meat products and nutraceuticals. Understanding benefits of 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** Characteristics of food industry. Food manufacturing and processing, Processes to produce ethanol, alchoholic beverages viz 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, Mushrooms, Bacteriocins, Functional foods and nutraceuticals	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 approachesto Improve Nutritional Quality and Shelf Life of Fruits and Vegetables. Production Traits in Farm Animals, 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

TeachingandLearningApproach	**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, Aspen Publishers.
- Essentials of Food Sciences Vickie A. Vaclavik, Elizabeth W. Christian, Springer.
- Food Science by N. Potter & Hotchkiss, ASPEN Publication.

- An introduction to Food Science by Rick Parker and Delmar, Thomson Learning.
- Food Technology by N W Desroisier, Springer.
- Food Science & Nutrition by Sunitha Reddy, Publishing House Pvt. Ltd., Delhi.
- Enzymes in Food Processing by Paramjit S Paneswar, IK Intl. Ltd.
- Food Biotechnology by Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto Robert E. Levin, Taylor & Francis
- Biotechnology-Fermented foods and their processing by Naduka Okafor

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 21 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 21 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 StudentLearningTime (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 technology**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.

1	Apply knowledge of food engineering to design new process	A/C	2
2	Understand the velocity of flowing fluids	U/An	1
3	Understand pump selection	S	1
4	Able to calculate through different dimensions	S	2
5	Able todo thermal process calculations and calculation processing time in continuous flowsystem	S	2
6	Able to psychrometric chart to do complex air conditioning process.	S	2
7.	Understand different type of mixers used in food industry	U/An	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	**fundamentals of food engineering** Introduction to food engineering; material and energy balances: basic principles, process flow diagrams, total mass balance and component mass balance, material balance problems involved in dilution, concentration and dehydration, heat balance calculations.	1	10
2	**fluid flow principles** Fluid flow principles: fluid statics and fluid dynamics, mass and energy balances in fluid flow: Newtonian and Non-Newtonian fluids, streamline and turbulent flow: fluid flow applications- measurement of pressure and velocity. Liquid transport system- pipelines and pumps for food processing plants- positive displacement pumps, air-lift pumps, propeller pumps, centrifugal pumps and jet pumps.	2, 3& 4	10
3.	**Heat transfer in food processing** Heat transfer in food processing: modes of heat transfer- conductive, convective and radiative heat transfer; thermal properties of foods, conductive heat transfer in a rectangular slab, tubular pipe and	5	15

	multilayered systems, estimation of convective heat transfer coefficient-forced convection and free convection, estimation of overall heat transfer coefficient; heat exchangers: plate, tubular, scraped surface and steam infusion heat exchangers. Thermal process calculations: commercially sterile concept, concept of D, F and Z values, reference F value; effect of temperature on thermal inactivation of micro-organisms, thermal process calculation for canned foods; calculation of processing time in continuous flow systems.		
4	**Psychrometrics** Psychrometrics: Properties of dry air: composition of air, specific heat of dry air, enthalpy of dry air and dry bulb temperature. Properties of water-vapor: specific volume of water vapor, specific heat of water vapor, enthalpy of water vapor. Properties of air-vapor mixtures: Gibbs-Dalton law, dew-point temp, humidity ratio (or moisture content), relative humidity, wet bulb temperature. Psychrometric chart: use of psychrometric chart to evaluate complex air conditioning processes.	6	15
5	**Mechanical Operations** Mechanical Operations: Mixing and different types of mixers used in food industry, Forming, Size Reduction, Clarification and concentration, Agglomeration. Membrane separation: Electro dialysis systems, Reverse Osmosis, Ultra filtration, Mechanical Separations: Sedimentation, Centrifugation, Filtration. Phase Separations- Distillation and types, Extrusion technology. Chemical Separations: Leaching, Steeping, Extraction, Diffusion Concentration.	7	10
	Total Credits of the Course	4	60

TeachingandLearningApproach	**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** C. 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 D. **Semester End examination – 60 marks**

REFERENCES

Recommended Text Books

- Singh, R.P and Heldman, D.R. (1984). Introduction to Food Engg., Academic Press, INC, London.
- Toledo, R.T. (1997). Fundamentals of Food Process Engineering, CBS Publishers, New Delhi.
- 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.

Recommended References

- Earle R.L (1983), Unit Operations In Food Processing, 2nd edition, Pergamon press, Oxford, UK
- Batty, J.C. and Folkman, S.L. 1983. Food Engineering Fundamentals. John wiley and Sons, New York.
- Dincer, I, 1997, Heat Transfer Food Cooling Applications. Taylor and Francis Publishers, USA.
- Sahay KM & Singh KK. 1994. Unit Operation of Agricultural Processing. Vikas Publ. House.
- Singh RP &Heldman DR. 1993. Introduction to Food Engineering. Academic Press.
- Brennan JG, Butter JR, Corell ND & Lilly AVE. 1990. Food Engineering Operations. Elsevier.
- Charm SE, McCabe WL, Smith JC &Harriott P.1993. Unit Operations of Chemical Engineering. McGraw Hills.

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MAHATMA GANDHI UNIVERSITY

FS M 21 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 21 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 StudentLearningTime (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 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

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	**Alcoholic beverages:** Beer making, fermentation process, ingredients, different types of beers, lager, pilsner, ale, stout, porter, role of hopes 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, Vodhka: 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	1 ,2, 4, 5 & 6	10

	bottled water.		
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

TeachingandLearningApproach	**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 .*Cofee 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 21 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 21 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 StudentLearningTime (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 biotechnology**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.

1	Understand the structure,composition and nutritive value of different cereals, pulsesand oilseeds.	U /R	1
2	Grasp the basic and advanced milling methods of rice,wheat,corn and pulses.	U/ An	1
3	Explain the by product utilization of various grains and pulses.	E	3,4
4	Understand the toxic factors in pulses and oilseeds	U/R	1
5	Explain the influence of flour constituents on dough rheology	An	1,3
6	Comprehend the quality and processing aspects of cereals, pulses and oilseeds.	U/An/ I	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	**Chemistry and Technology of Rice :**Rice – Structure of rice grain, Chemical composition, nutritive value and rice classification. Parboiling of rice – traditional and modern methods, advantages and disadvantages of each method of parboiling, properties of parboiled rice and changes during parboiling and Rice milling and it's by products (broken grains, rice pollards, rice bran and rice hulls). Drying of rice – ultra low temperature drying, low temperature drying, high temperature drying, ultra high conduction drying, sun drying, forced air mechanical drying and deep fixed bed drying. Ageing and curing of rice.	1 ,2 &3	15
2	**Wheat Chemistry :**Wheat- Introduction to wheat chemistry. Structure of wheat grain- chemical composition, nutritive value and its relation to processing qualities. Wheat milling and by-products of wheat milling. Dough Rheology -basic approaches to dough rheology, influence of flour constituents on dough rheology, Dough testing instruments such as farinograph, mixograph, alveograph, extensograph, amylograph	1,2,3 & 5	10
3.	**Corn Chemistry:** Corn- Structure of corn, Chemical composition and nutritive value. Dry and Wet milling of corn and its byproducts (corn grits, corn meal, corn flour, corn syrup, high fructose corn syrup, corn oil, corn starch, gluten and germ)	1,2, & 3	10

4	**Technology of Pulses:** Chemical composition and nutritive value of important pulses (ground nut, soya bean, black gram, Bengal gram). Decortications of pulses – soaking, pounding, grinding, roasting, toasting, parching, milling of pulses and puffing. By products of milling - protein isolates. Germination, and agglomeration of pulses. Toxic factors in legumes. Quick cooking legumes, instant legume powders and legume protein concentrates	1, 2 & 4	15
5	**Oilseed Technology :**Chemical composition and nutritive value of oilseeds, processing of edible oil–rendering, pressing, and solvent extraction. Methods of oil refining – deodorization, hydrogenation, winterization, randomization and interesterification. Toxic factors in oilseeds and role of oilseeds in cookery.	1 & 6	10
	Total Credits of the Course	3	

TeachingandLearningApproach	**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** C. 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 D. **Semester End examination – 60 marks**

REFERENCES

Recommended Text Books

- Mats A.S. The chemistry and technology of cereal as food and feed;2nd edition ; CBS publications; New Delhi;1996
- Faridi ,Dough Rheology and baked products texture; CBS publications, New Delhi;2000
- Pandy,P.H; principles and practices of postharvest technology. Kalyani publishers, Madras;2000

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
- Pomeranz Y. 1987. Modern Cereal Science and Technology. MVCH Publ.

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MAHATMA GANDHI UNIVERSITY

FS M 21 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 21 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 StudentLearningTime (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	**Students will be able to:** Understand the technology for handling,processing, and preservation of milk , meat ,fish and poultry	U /E	1
2	Understand different type of products from milk, meat, fish, poultry and egg.	U/ E	1
3	Apprehend the hygiene, sanitation, and mechanised practices these food commodities.	E	1,3
4	Comprehend the food standards in relation to those food commodities	U/R	1,3,5
5	Acquire the ability of value addition to milk, meat , fish and poultry	U/S	1,4
6	Acquire broad knowledge of status and scope of these food industries.	U/An	

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, types of milk and their composition (cows, buffalo, goat, human) factors affecting composition of milk, food and nutritive value, physicochemical properties of milk acidity and pH, density and specific gravity, freezing point, color and flavor, manufacture, packaging and storage of pasteurized milk. Judging and grading of milk, flavor defects of milk and their causes and prevention. Special Milks - definition,-methods of manufacturing of sterilized milk, homogenized milk, flavored milk, Vitaminised milk, irradiated milk. Frozen concentrated milk, fermented milk, standardized milk, reconstituted/ rehydrated milk, recombined milk, toned, and double toned milk.	1, 2, 3, 4 & 5	15
2	**Dairy Products :** Cottage cheese), Condensed Milk, Ice cream and Cream, Butter, Cheese (different types) Dried Milk Definition, classification, composition, method of manufacture, defects and uses. Indigenous milk products- Paneer, Chhana, Khoa, Chakka, Shrikhand, Kulfi, Lassi, Rabri, Basundi, Dahi and Yoghurt	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 and post mortem changes in meat. Meat pigments, Meat tenderization, different meat cuts. Packaging of meat- Cryovac method, chamber method, thermoforming method. MAP of meat. Meat preservation methods. DFD and PSE Meat. Meat products: Method of manufacture - sausages, ham, bacon and minced meat, Mock meat (vegan meat),	1, 2, 3, 4 & 5	10
4	**Technology of Fish and fish products :** Classification of fish, nutritional composition, Methods of preserving fish- 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: Poultry processing and poultry meat products. Egg; formation, structure, nutritive, value, chemical composition, egg grading; preservation of egg: pasteurization, freezing, drying, refrigeration and its products, Egg products	1, 2, 3, 4 & 5	10
	Total Credits of the Course	3	60

TeachingandLearningApproach	**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** E. 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 F. **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.
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- 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.
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MAHATMA GANDHI UNIVERSITY

FS M 21 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 21 C 19**					
Course Summary & Justification	• This course is developed to acquaint students with the post- harvest technologies of fruits , vegetables and plantation crops to reduce post - harvest losses and their value addition • Course gives a deep knowledge in the area of techniques of processing and preservation of fruits , vegetables and plantation crops • Course also gives an exposure in emerging trends in processing technology of fruits , vegetables and plantation crops					
Semester	Third					
Total StudentLearningTime (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	Student will be able to understand about fruit and vegetable physiology, metabolic processes and various nutritional changes in fruits and vegetable along with its post- harvest techniques	U /E	1
2	Attain an overview of post-harvest losses of fruits and vegetables and various products prepared from fruits, vegetables and plantation crops.	U/ R	1,4
3	Develop an understanding on the harvest maturity indices of fruits and vegetables	S	1,3
4	Acquire a deep knowledge regarding the post- harvest operations, storage , processing, packaging of fruits and vegetables.	U/A	1,3
5	Equip with the knowledge of emerging trending in the processing technology of fruits and vegetables.	E	1,2
6	Create an insight to production, composition,processing of various plantation crops.	U/An/ C	1,3
7.	Acquire the ability of value addition to fruits, vegetables	S	2,5

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 :**Definition of fruits, Nutritive value and Pigments (Water soluble and insoluble pigments), organic acids, enzymes, flavor compounds and bitter compounds. Anti-nutritional and toxic factors, health benefits of fruits and vegetables. Stability of nutrients - chemical changes, flavor changes, changes in nutritive value (Physical and biological changes). Post harvest losses in fruits and vegetables- definition of post harvest loss, factors affecting post harvest losses - primary causes (mechanical injury, pathological action and environmental factors) and secondary causes. Control of post harvest losses - cultural operations, harvesting and field handling, newer packaging, improved transportation, reducing moisture loss and chemical treatments. Freezing injury, chilling injury and heat injury.	1& 2	10
2	**Maturity, ripening and harvesting of fruits and vegetables :**Ripening - Changes during ripening, Classification of fruits - climacteric and non climacteric fruits. Maturity indices and its importance, determination of harvest maturity indices - Computational methods, physical methods,	3 &4	10

	chemical methods and physiological methods. Harvesting of fruits and vegetable- manual and mechanical methods and mode of transportation.		
3.	**Packing house operations and storage :** Post-harvest operations and its methods - reception, drenching, washing, cleaning, Precooling (ice cooling, room cooling, forced air cooling, hydro cooling and vacuum cooling), trimming, presorting, sorting/ grading (by size and color), waxing, physical treatments (hot water treatment, vapor heat treatment, ionizing radiation), chemical treatments, packaging and labeling. Storage-factors affecting storage, methods of storage - Traditional storage (on site storage, pit storage, high altitude storage, clamp storage, under-ground storage and evaporative cool storage) and improved storage methods (refrigerated storage, MAP, CAP, active packaging, passive atmosphere modifications, silicone membrane technology, vacuum packaging, hypobaric storage), Supply chain management.	4	15
4	**Processing of fruits and vegetables and emerging trends:** Peeling, Slicing/ dicing, blanching - factors influencing blanching, methods of blanching, nutritional quality of blanched food. Canning of fruits and vegetables and nutritional retention of canned fruits and vegetables.High Hydrostatic Pressure Technology, Oscillating Magnetic Field, High intensity pulsed electric field, Pulse Light Technology, Ultraviolet light technology, Ultra sound technology, Applications of ozone in fruit processing, Electrolysed water treatment, edible coatings, multilayer coatings, osmotic membrane coatings, Enzyme maceration,	5	10
5	**Processing of plantation crops:** Production, composition and processing of coffee and tea; tea products ; coffee products; standards and specifications of coffee and tea; classifications and beneficial properties of spices. Cocoa production and processing. Cocoa and cocoa powder, low fat cocoa. Coconut industry, Introduction, potential products from coconut palm, Copra manufacture, grades of copra, quality standards. Methods of Manufacture, traditional sun drying, smoke drying, hot air modem dryers, proximate composition of copra, methods for coconut oil extraction, machinery associated with oil manufacture. Product specifications: coconut milk cream manufacture and preservation, Molded coconut sugar, Desiccated coconut, spray dried coconut milk powder, packed tender coconut water, vinegar from coconut, alcoholic beverage, other products from coconut.	5 & 6	15
	Total Credits of the Course	3	60

TeachingandLearningApproach	**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** G. 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 H. **Semester End examination – 60 marks**

REFERENCES

Recommended Text Books

- Post Harvest Technology of Horticultural Crops; K. P. Sudheer, V. Indira; Series - 7; New India Publishing Agency; 2007.
- David Arthey; Fruit processing.second edition,2001;springer publishers
- Girdharilal; Siddappa G.S., Tandon G.L; 1999; preservation of fruits and vegetables ICAR, New Delhi.
- Kenneth T. Farrel (1985). Spices, Condiments and Seasoning. The AVI Pub. Company.
- Kenji Hirasa and Mitsno Takemasa (1998), spice science and technology, marcel dekker, Inc.
- NIIR.2004. Handbook on Spices. National Institute of Industrial Reserch Board, Asia Publ.

Recommended References

- Achaya, K.T; 1986, every day Indian processed foods; national book trust India
- Desrosier, N.W; 1999; Technology of food preservation, the AVI publishing co, west fort.
- 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
- Lal G, Siddapa GS &Tandon GL.1986. *Preservation of Fruits and Vegetables*. ICAR**.**

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MAHATMA GANDHI UNIVERSITY

FS M 21 C 20 : BAKERY AND CONFECTIONARY TECHNOLOGY

SchoolName	**School of Food Science and Technology**					
Programme	**M.Sc Food Science and Technology**					
Course Name	**BAKERY AND CONFECTIONARY TECHNOLOGY**					
Type of Course	Core					
Course Code	**FS M 21 C 20**					
Course Summary & Justification	• The objective this course is imparts a wide knowledgein various bakery and confectionary products and their manufacturing techniques. • The course also gives an overview of quality control in bakeries and standards of bakery products					
Semester	Third					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	**Food science basics**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Students will be able to understand the manufacturing techniques of bread, cakes, biscuits, pies and pastries	U /E	1,2
2	Students will be able to understand role of baking ingredients in improving the quality of bakery products	U/ An	1,3
3	Students will get an overview of different type of confectionaries and their preparation techniques	U/An	1,2

4	Students will acquire the knowledge of chocolate processing , different type of chocolates , and quality control in chocolate industry	U/E	1,3
5	Students will be able to determine the packaging requirements for varies bakery products	U/A	1,3
6	Students will get an overview of quality standards and specifications of bakery and confectionary products, quality and hygienic standards in bakeries	U/An/ C	1,5
7.	Students will acquire the ability to prepare different type of baked products and confectionaries	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	**Baking Technology:** Major baking ingredients and their functions, role of baking ingredients in improving the quality of bread. Characteristics of flour used for making bread' biscuits and cakes. Ingredients used for bread manufacture, methods of mixing the ingredients, dough development methods – straight dough, sponge dough, moulding, proofing, spoilage, bread staling, methods to reduce bread staling and spoilage	1 & 2	10
2	**Bakery Products:** Technology of bread, biscuit and cakes – manufacturing method, function of ingredients, defects and packaging requirements. Various types ice creams, Pastry - different types and preparation. , Pie – different types and methods	1 ,2, 5, 6 & 7	10
3.	**Confectionery Science and Technology:** Introduction, present trends in the industry. Ingredients. Sugar boiled confectionery. Crystalline and amorphous confectionery, Stages of sugar cookery: Rock candy, Hard candy, Fondants and Creams, Marshmallows, toffee, lollypop, honeycomb candy, Caramel and Fudge, Indian sweets.	3, 5, 6 & 7	15
4	**Chocolate Processing :** Chocolate processing, chemical composition, quality control, manufacture of chocolate beverages. Chocolates. Sweet chocolate, Milk chocolates, white chocolate, wafer coated chocolates, cocoa butter, Fat bloom, cause and effect on quality' ways to store chocolate and candies.	4, 5 , 6 & 7	15

5	**Bakery layout and quality control :**Storage and preservation of bakery and confectionery products. Standards, regulations and quality control for bakery products. Products Specifications for bakery ingredients: BIS/FSSAI standards for ingredients and products. Plan layout and requisites for establishing bakery. Machineries required for bakery. Packaging requirement and cost economics of the bakery. Hygiene and sanitation in bakeries.	5, 6 & 7	10
	Total Credits of the Course	3	60

TeachingandLearningApproach	**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** I. 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 J. **Semester End examination – 60 marks**

REFERENCES

Recommended Text Books

- Zhou. W, Hui Y,H;(2014), "Bakery Products Science And Technology" ,2nd Edition, Wiley Blachwell Publishers,
- Pyler, E. J and Gorton, L. A (2009), "Baking Science and Technology" Vol.1 Fourth Edition, Sosland Publications
- Stanley P. Cauvain, Linda S. Young, (2008) "Baked Products: Science Technology and Practice" John Wiley & Sons Publishers

Recommended References

- Matz, Samuel A., "Bakery Technology and Engineering", III Edition, Chapman and Hall, London.
- Cauvain, Stanley P, and Young, Linda S., "Technology of Bread Making", II Edition Aspen publication. Maryland, 1999
- Edwards W.P. "Science of bakery products", RSC, UK,2007

- Dubey SC. 2002. *Basic Baking*. The Society of Indian Bakers, New Delhi.
- Francis FJ. 2000. *Wiley Encyclopaedia of Food Science & Technology*. John Wiley & Sons.
- Pyler EJ. *Bakery Science & Technology*. 3rd Ed. Vols. I, II. Sosland Publ.
- Bent A, Bennion EB & Bamford GST. 1997. The Technology of Cake Making. 6th Ed. Blackie.
- Samuel A. Matz., "Equipment for Bakers", Pan Tech International Publication. 1988.
- Jackson, E.B.1999. Sugar Confectionery Manufacture. 2nd Edition. New york: Aspen Publication.
- Junk, W.R. and Pancost, H.M. 1973. Hand Book of Sugars for Processors. Chemists and Technologists. New Delhi: AVI Publications.
- Sugar Confectionery manufacture-(Ed) E.B.Jackson, II edition, Blackie Academic and professional, Glasgow,1995.

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MAHATMA GANDHI UNIVERSITY

FS M 21 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 21 C 21**					
Course Summary & Justification	• The purpose of this laboratory course is to design and evaluate the processing procedure for preserving various food products. • It also give an experience to students to understand the effect of various preservation techniques on the quality of food products.					
Semester	Third					
Total StudentLearning 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	Student will be able to develop a processing procedure for various food products	Ap/S	2
2	Students will be able to understand the effect of different processing techniques on the quality of various food products	Ap/S	2
3	Students will develop ability to utilize different food preservation techniques	S	5
4	Students can understand physical evaluation of	S	3

	thermally processed foods		
5	Students will learn the preparation and standardization of Indian traditional fermented foods	S	2
6.	Students will get an opportunity to visit a food processing and preservation unit	I/Ap	1
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	1. Blanching and browning control 2. Preparation of fruit preserves (jam, jelly). 3. Preparation of vegetable preserves (pickle) 4. Dehydrated products - vegetables dices tray drying, osmotic dehydration of seasonal fruit.	1,2 & 3	40
2.	5. Tomato processing 6. Fruit pulping / juice / beverage preparation 7. Preparation and standardization of traditional Indian fermented foods 8. Bread making - texture.	1,2 , 3 & 4	30
3	9. Preparation of product based egg as a thickening agent: stirred custard, baked custard, cream pudding, pies 10. Changes of meat during cooking: dry heat(roasting, broiling, pan broiling, frying), moist heat (braising , stewing, pressure cooking) 11. Fish cooking: shallow frying, deep fat frying (marine and fresh water fish)	2 & 5	30
4	12. Confectionery : fudge , fondant 13. Preparation of milk based Indian sweets: kheer, peda, rasgulla 14. Visit to food processing and preservation unit	2, 5 & 6	40
	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

TeachingandLearningApproach	**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** **C. 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 **K. Semester End examination – 60 marks**

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MAHATMA GANDHI UNIVERSITY

FS M 21 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 21 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 StudentLearningTime (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 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

TeachingandLearningApproach	**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 Fod Processors, Blackwell Publishing.
- Loannis 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 21 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 21 E 23**					
Course Summary & Justification	• This elective course is designed to provide students an overview regarding basics of management and entrpreureship 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 entrepreureship, its problems and opportunites in relation to food sector.					
Semester	Third					
Total StudentLearningTime (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 commerce**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Students will understand the principle,functions and functionalareas 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

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 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

TeachingandLearningApproach	**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.
- Bhavesh 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 21 E 24: NEUTRACEUTICALS AND FUNCTIONAL FOODS

SchoolName	**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 21 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 StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	**Basics of biotechnology and food science**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	After completion of the course the students will be ableto: 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	Understand regarding methods of isolation and purification of phytochemicals and its recent developments	U/A	1,4
4	Acquire knowledge regarding health benefits of pro-biotics, prebiotics and symbiotics	U/E	1,4
5	Understand the recent development in the field of functional foods	U/I	1,4
6	Describe a healthy food choices, and explain why such choices will help prevent health problems	S	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	Hrs
1	**Introduction to Nutraceuticals and functional Foods :**Nutraceuticals and functional Foods -Definition, concept, history and market; Evolution of nutraceuticals and functional foods market. Classification of nutraceuticals and functional foods. Significance and relevance of nutraceuticals and functional foods in the management of diseases and disorders.	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.	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; Extractive methods for maximum recovery and minimal recovery and minimal destruction of active material; stability studies. Recent developments in the isolation, purification and delivery of phytochemicals.	3	10
4	**Prebiotics, probiotics and symbiotics:** Prebiotics, probiotics and symbiotics- 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.	4	10

	Symbiotics.		
5	**Functional food :** Functional foods - Definition, development of functional foods, use of bioactive compounds in appropriate form with protective substances and activators; Effect of environmental condition and food matrix; Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods; delivery of immunomodulators /vaccines through functional foods. Nutrigenomics - concept of personalized medicine. Use of nanotechnology in functional food industry.	5 & 6	15
	Total Credits of the Course	4	60

TeachingandLearningApproach	**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** P. 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 Q. **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.
- Gibson GR & William CM. (2000). Functional Foods - Concept to Products.

Recommended References

- Goldberg I. (1994). Functional Foods: Designer Foods, Pharma Foods.
- Losso JN. (2007). Angi-angiogenic Functional and Medicinal Foods. CRC Press
- Neeser JR & German BJ. (2004). Bioprocesses and Biotechnology for Nutraceuticals.Chapman & Hall.
- Robert EC. (2006). Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.
- Shi J. (2006). Functional Food lngredients 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 21 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 21 E 25**					
Course Summary & Justification	• This elective course will provide students with dietary significance , chemicalcomposition, 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 StudentLearningTime (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 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
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	**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

TeachingandLearningApproach	**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 (200);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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