



**Rayat Shikshan Sanstha's**

**YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA**  
(An Autonomous College)

**Reaccredited by NAAC with 'A+' Grade**

**Syllabus for**

**Master of Science**

**Part - I**

**M.Sc. Food Technology**

**Syllabus**

**to be Implemented from June, 2023 onwards**

**(As Per NEP-2020 Guidelines)**

## **Syllabus for Master of Science Part I**

1. **Title:** M.Sc. Food Technology
2. **Year of Implementation:** 2023-24
3. **Preamble:**

M.Sc. Food Processing and Packaging course under autonomy has been prepared keeping in view the unique requirements of M. Sc. Food Processing and Packaging students. The emphasis of the contents is to provide students the latest information along with due weightage to the concepts of classical trends in Processing and Packaging in food so that they are able to understand the Post-Harvest Technology of Fresh Horticulture Produce, New Food Product Development Introduction to paper and paperboard, Plastics and Polymer, Research Methodology. Technology of Cereals, Legumes and Oil Seeds, Food Plant Organization Layout, Also includes important topic like Packaging Laws and Regulation, Instrumentation and Process Control.

The course content also lists new practical exercises so the students get hands on experience of the latest techniques that are currently used in Food industries. Project curriculum spanning over the one year of the course is designed in a way to give the students first hand research experience as it consists of writing of synopsis, literature review along with actual table work. Along with students are also provided with an opportunity to peruse internship in industry or research centers. The course will also inspire students to pursue higher studies and research in Food Processing and Packaging, for becoming an entrepreneur and deniable students to get employed in Food, Nutraceutical and Agriculture Industries.

### **4. General Objectives:**

- Construction and designing of the courses to suite industrial needs.
- More emphasis on applied aspects of Food Processing and Packaging.
- To develop aptitude of students in the field of research.
- Enrichment of basic knowledge in areas of Food Processing and Packaging.

### **5. Program Specific Objectives:**

- Develop critical, analytical thinking and problem-solving abilities for a smooth transition from academia to industry.
- Provide adequate understanding and cognitive abilities to design food product.
- Develop technologies for food processing, preservation and packaging as per legal and safety requirements.
- Develop multidisciplinary skillsets to execute academia/industry projects and also enable them to pursue doctoral research.

- Inculcate entrepreneurship aptitude.

6. **Program Specific Outcomes (PSOs) :**

- To impart knowledge in various aspects of Food Technology through Theory and Practical knowledge.
- To impart the knowledge about various compounds such as protein, carbohydrates, lipids amino acids, minerals, vitamins etc. associated with the chemical compositions of food, their structures and functions.
- The students can gain knowledge about some very essential topic of nutrition and its metabolism balance inside the body.
- To make the students familiar with the technologies of food processing and preservation of plant and animal foods, cereals, pulses, oilseeds, fruits vegetables, spices, meat, fish, poultry, sea food, milk and dairy products.
- To gain concepts of food safety and quality managements, national and international food laws and regulations as well as importance of food engineering and packaging in food industry.
- To gain knowledge about advanced technologies adapted in various food industries by physically visiting different food industries.
- To develop broader understandings on various aspects of management of waste coming from food Industries as well as from homes starting from its generation to processing with options for reuse and recycle, transport, and disposal practices so as to contribute towards sustainable development.
- To development students' understanding and communication skills through various assignments which will enable them to develop skills in writing and effective's interpersonal skills. Presentations in different topics enhances their confidence, ability to express themselves & presentation skills
- Give students assistance in preparing for competitive exams e.g. NET, GATE, etc.

7. **Duration:** Two Year

8. **Pattern:** Semester wise Medium of  
Instruction:English

9. **Structure of Course:**

Level	Sem	Major			RM	OJT	RP	Total
		DSC Mandatory		DSE Elective				
		T	P	T				
6	I	12 (3 Papers)	2	4 (1 paper out of two)	4	---	---	22
	II	12 (3 Papers)	2	4 (1 paper out of two)	---	---	4	22
6.5	III	12 (3 Papers)	2	4 (1 paper out of two)	---	---	6	22
	IV	12 (3 Papers)	---	4 (1 paper out of two)	---	4	---	22
Total		48	6	16	4	4	10	88
		70			8		10	

**DSC: Discipline Specific Course, DSE: Discipline Specific Elective, RM: Research Methodology, OJT: On Job Training, RP: Research Project, T: Theory, P: Practical**

**Rubrics of RP: 1. For Semester III: 2 Credits for Project Phase I + 2 Credits for Dissertation**

**2. For Semester III: 2 Credits for Project Practical + 2 Credits for Project + 2 Credits for Dissertation**

## M.Sc. Part I

### Semester I

<b>Nature of the Course</b>	<b>Course Code</b>	<b>Name of the Course</b>
Theory	MFTT 411	Post-Harvest Technology of Horticulture Produce
	MFTT 412	New Food Product Development
	MFTT 413	Introduction to Paper and Paperboard, Plastics and Polymer
	MFTT 414 E-I	Entrepreneurship in Food Processing
	MFTT 414 E-II	Marketing Management and International Trade
	MFTT 415	Research Methodology
Practical	MFTP 416	Practical Course: Based On (MFPT 411, 412, 413)

### Semester II

<b>Nature of the Course</b>	<b>Course Code</b>	<b>Name of the Course</b>
Theory	MFTT 421	Technology of Cereals, Legumes and Oil Seeds
	MFTT 422	Food Plant Organization and Layout
	MFTT 423	Packaging Laws and Regulation
	MFTT 424 E-I	Instrumentation and Process Control
	MFTT 424 E-II	Fluid Mechanics and Hydraulics
	MFTP 425	Research Project
Practical	MFTP 426	Practical Course: Based On (MFPT 421, 422, 423)

## SEMESTER I

### MFTT 411: Post-Harvest Technology of Horticulture produces

**Course Objective: student will be able to**

1. understand and learn the relevance of post-harvest management of fruits and vegetables.
2. impart knowledge about best practices in fruits and vegetables to reduce post-harvest losses.
3. study and learn evaluation and management of quality.
4. explain export regulations and requirement for fresh fruits.

<b>Credits = 4</b>	<b>SEMESTER I MFTT 411: Post-Harvest Technology of Horticulture produces</b>	<b>No. of hours per unit</b>
<b>Credit I</b>	<b>UNIT I: Introduction of post-harvest technology</b>	<b>15</b>
	Introduction of post-harvest technology (India and abroad); Need of post-harvest technology. Effect of pre-harvest factors (soil, water, climatic factors etc.) on the quality of fresh horticultural produce; Postharvest biology of horticultural crops; Maturity, Maturity indices, ripening, climacteric phenomena and senescence; Harvesting and harvesting systems.	
<b>Credit I</b>	<b>UNIT II: General post-harvest considerations</b>	<b>15</b>
	Effects of temperature on post-harvest life of horticultural produce (impact of temperature, cooling of produce, methods of cooling); Storage atmosphere (oxygen & carbon dioxide, storage in plastic films, hypobaric storage, ethylene in storage and management.	
<b>Credit I</b>	<b>UNIT III: Post-harvest commodity treatments</b>	<b>15</b>
	Post-harvest commodity treatments: Introduction; precooling; waxing; sprout inhibition; disinfestation; fungicide application; hot water treatment; vapour heat treatment; irradiation; ripening and degreening; delaying ripening; curing of roots and tubers; dryings of root crops; commodity treatments for apple	
<b>Credit I</b>	<b>UNIT IV: Post-harvest handling operations</b>	<b>15</b>
	Post-harvest handling for fruits; Preparation for market; Measuring quality; Evaluation and management of quality; Methods for determining quality of fresh commodities, Export regulations and requirement for selected fresh fruits - banana, pomegranate, citrus, mango, guava, apples, lichi and selected vegetables of national importance - lady finger, chilies, tomato, sweet corn.	

**Course outcomes: Student should be able to**

1. analyze the need for post-harvest technology
2. apply the harvest and harvesting techniques.
3. illustrate the effect of temperature on post-harvest horticulture produce.
4. implement the storage and its management.

**References:**

1. Pereira, Ricardo N., and António A. Vicente. "Environmental impact of novel thermal and non-thermal technologies in food processing." *Food Research International* 43, no. 7 (2010): 1936-1943.
2. Lopez-Rubio, Amparo, Eva Almenar, Pilar Hernandez-Muñoz, Jose M. Lagarón, Ramón Catalá, and Rafael Gavara. "Overview of active polymer-based packaging technologies for food applications." *Food Reviews International* 20, no. 4 (2004): 357-387.
3. Handbook of Packaging Engineering J. F. Hanlon, R. J. Kelsey, and H. R. Forcinia, 1985, 3ded., Technomic Publishing, Basel.
4. Kader, Adel A. *Postharvest technology of horticultural crops*. Vol. 3311. University of California Agriculture and Natural Resources, 2002.
5. Wills, R., B. McGlasson, D. Graham, and D. Joyce. "An introduction to the physiology and handling of fruit, vegetables and ornamentals." *Postharvest*. CAB International, Oxford, UK (1998): 56.
6. Srivastava, R. P., and Sanjeev Kumar. *Fruit and vegetable preservation: principles and practices*. CBS Publishers & Distributors Pvt. Limited, 1994.
7. Pantastico, Er B. "Postharvest physiology, handling, and utilization of tropical and subtropical fruits and vegetables." (*No Title*) (1975).
8. Thompson, A. Keith. "Postharvest technology of fruit and vegetables." (*No Title*) (1996).
9. Director, ICAR-IIHR. "ICAR-IIHR News Letter January-June, 2015." (2015).
10. Paltrinieri, Gaetano, and F. A. O. Staff. "Handling of fresh fruits, vegetables and root crops: A training manual for grenada." *Rome, Italy: Food and Agriculture Organization of the United Nations* (2014).

## MFTT 412: New Food Product Development

### Course Objective: Student will be able to

1. define New Product, Classification, and reason for food product development.
2. understand product development process, Product launch process.
3. know the nutritional and sensory analysis, shelf life study of new product.
4. illustrate the marketing of food product.

<b>Credits = 4</b>	<b>SEMESTER I MFTT 412: New Food Product Development</b>	<b>No. of hours per unit</b>
<b>Credit I</b>	<b>UNIT I: Introduction and Definition of New food Product Development</b>	<b>15</b>
	Introduction, Definition of New Products, Reason for new food product development, Types new product, Concept of Novel food, Life cycle for a food product, Ideas for the development of a New Food Product: internal and external sources, Advantages and disadvantages of new product development process, Marketplace studies- Focus groups, Interviews, Consumer testing.	
<b>Credit I</b>	<b>UNIT II: Process of product development</b>	<b>15</b>
	Concept of product development - product success and failure, factors for success, managing for product's success. Innovation strategy. Product development process - product strategy, product design and process development, product commercialization, product launch and evaluation.	
<b>Credit I</b>	<b>UNIT III: Analysis and Legal requirement for new product</b>	<b>15</b>
	Nutritional and sensory evaluation of a new product, Shelf life testing- Static, accelerated and use/abuse tests, Packaging requirements of new product, Cost estimation, Direct and indirect costs, Legal aspects to be applied in New Food Product Development - Composition, labelling and claims.	
<b>Credit I</b>	<b>UNIT IV: Marketing of new product</b>	<b>15</b>
	Role of consumers in product development, managing the product development process, improving the product development process - evaluating product development, innovative matrices, striving for continuous improvement, improving success potential of new products, market exploration and acquisition, legal aspects of new product launch.	



**Course outcomes: Student should be able to**

1. define new product, its classification.
2. apply the reason and shelf life study of new product.
3. identify the product success and failure.
4. implement the process of product development, product launch and evaluation.

**Referances-**

1. Paltrinieri, Gaetano, and F. A. O. Staff. "Handling of fresh fruits, vegetables and root crops: A training manual for grenada." *Rome, Italy: Food and Agriculture Organization of the United Nations* (2014).
2. Earle, Mary, and Richard Earle. *Creating new foods*. Chandos, 1999.
3. Moskowitz, Howard R., Michele Reisner, and Andrea Maier. "10 Creating Food." *An Integrated Approach to New Food Product Development* (2009): 175.
4. Earle, Richard, and Allan Anderson, eds. *Food product development: Maximizing success*. CRC press, 2001.
5. Fuller, Gordon W. *New food product development: from concept to marketplace*. CRC Press, 2016.
6. Moskowitz, Howard R., I. Sam Saguy, and Tim Straus, eds. *An integrated approach to new food product development*. CRC Press, 2009.
7. Stewart-Knox, Barbara, and Peter Mitchell. "What separates the winners from the losers in new food product development?." *Trends in food science & technology* 14, no. 1-2 (2003): 58-64.
8. Khan, Rao Sanaullah, John Grigor, Ray Winger, and Alan Win. "Functional food product development—Opportunities and challenges for food manufacturers." *Trends in food science & technology* 30, no. 1 (2013): 27-37.
9. Fuller, Gordon W. *New food product development: from concept to marketplace*. CRC Press, 2016.
10. Linnemann, Anita R., Marco Benner, Ruud Verkerk, and Martinus AJS van Boekel. "Consumer-driven food product development." *Trends in Food Science & Technology* 17, no. 4 (2006): 184-190.

## MFTT 413: Introductions to Paper and Paperboard, Plastics and Polymer

### Course Objectives: Students will be able to

1. understand the fundamentals of polymer science.
2. study paper and their manufacturing process
3. know the different types of plastics and their associated properties.
4. explain the various testing methods employed on plastic materials

<b>Credits = 4</b>	<b>SEMESTER I MFTT 413: Introductions to Paper and Paperboard, Plastics and Polymer</b>	<b>No. of hours per unit</b>
<b>Credit I</b>	<b>UNIT I: Introduction to Polymers</b>	<b>15</b>
	Introduction to Historical Background of Polymer Science, Various applications of polymers, Raw materials, Market and future of polymers, Classification of Polymers, Classification based on structure, origin, fabrication, properties, Introduction to polymeric blends and composites: Significance of polymeric blends and composites, miscellaneous materials used in blending and preparation of composites, applications of polymeric blends and composites.	
<b>Credit I</b>	<b>UNIT II: Introduction to paper</b>	<b>15</b>
	Types of papers, Paper properties: Optical properties – Color, brightness, smoothness, gloss, opacity and rub resistance, Strength properties–thickness, grammage, tensile, tear, bursting strength, stiffness, Grain direction, Wire and Felt sides Paper based packaging: Paper bags & Applications- Types of bags- Multiwall Paper bags – Composite containers, Manufacturing & Applications convolute/spiral/lap winding –Fiber drums- Regenerated Cellulosic films.	
<b>Credit I</b>	<b>UNIT III: Paper Board Manufacture, cartons and Boxes</b>	<b>15</b>
	Paper Board Manufacture: Forming section, wet pressing, drying, and calendaring, paperboard properties and their control during manufacture Folding Cartons – Styles and Applications- Designing and manufacturing-Set up box applications and manufacturing process- Corrugated Fiber Board(CFB) – structure and materials ,Types of flutes and their characteristics- Manufacturing process of CFB- Making of CFB box- Styles of boxes- Properties of CFB Solid Fiber board box manufacturing, materials and applications. Moulded pulp board – moulding process, applications.	
<b>Credit I</b>	<b>UNIT IV: Commodity Plastics in Packaging</b>	<b>15</b>
	Polyethylene (PE): Types, Properties and Applications. Polypropylene (PP): Varieties, Properties and Applications. Polyvinyl Chloride (PVC): Properties,	

	Compounding and Applications. Polystyrene (PS): Types, Properties and Applications. Copolymerization, Alloying and Blending, Applications of Amino plastics (Urea Formaldehyde and Melamine Formaldehyde), Phenolic, Epoxies, Unsaturated Polyesters, Polyurethane. Brief introduction on Biodegradable plastics / Bio plastics.	
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**Course outcomes: Student should be able to**

1. analyze the polymers and its market importance.
2. illustrate the applications of polymeric blends.
3. identify the papers and types of papers.
4. implement the applications of various paper bags.

**References-**

1. Papermaking Science and Technology Gullichsen J. and Paulapuro H., , *Book 12: Paper And Paperboard Converting* (Ed. Savolainen A.),( Finnish Paper Engineers' Association and TAPPI. 2012)
2. Papermaking Science and Technology Gullichsen J. and Paulapuro H., , *Book 13: Printing* (Ed. Oittinen P. and Saarelma H.), (Finnish Paper Engineers' Association and TAPPI.2012)
3. Papermaking Science and Technology Gullichsen J. and Paulapuro H., , *Book 17: Pulp and Paper Testing* (Ed. Levlin J.-E. and Söderhjelm L.), (Finnish Paper Engineers' Association and TAPPI. 2012)
4. Handbook of Physical and Mechanical Testing of Paper and Paperboard, Mark R. E. (Vol. 1&2, Marcel Dekker. 2002)
5. Marsh, Kenneth, and Betty Bugusu. "Food packaging—roles, materials, and environmental issues." *Journal of food science* 72, no. 3 (2007): R39-R55.
6. Appendini, Paola, and Joseph H. Hotchkiss. "Review of antimicrobial food packaging." *Innovative Food Science & Emerging Technologies* 3, no. 2 (2002): 113-126.
7. Coles, Richard, Derek McDowell, and Mark J. Kirwan, eds. *Food packaging technology*. Vol. 5. CRC press, 2003.
8. Han, Jung H., ed. *Innovations in food packaging*. Elsevier, 2005.
9. Han, Jung H. "Antimicrobial food packaging." *Novel food packaging techniques* 8 (2003): 50-70.
10. Risch, Sara J. "Food packaging history and innovations." *Journal of agricultural and food chemistry* 57, no. 18 (2009): 8089-8092.

## MFTT 414-EI: Entrepreneurship in Food Processing

### Course Objective: student will be able to

- 1.learn and understand the entrepreneurial skills.
- 2.impart knowledge about food business management.
- 3.characterize the different governmental policies and get knowledge about export business.
- 4.evaluate environmental factor, and business policies in food business.

<b>Credits = 4</b>	<b>SEMESTER I MFTT 414-EI: Entrepreneurship in Food Processing</b>	<b>No. of hours per unit</b>
<b>Credit I</b>	<b>UNIT I: Entrepreneurial Development</b>	<b>15</b>
	Case studies of successful entrepreneurs, Exercises on ways of sensing opportunities – sources of idea, creating efforts, Entrepreneurial skill assessment test, Techniques of development of entrepreneurial skills, positive self-image and locus of control, incubation and commercialization of business ideas Source of finance – Micro, Small, Medium entrepreneurship.	
<b>Credit I</b>	<b>UNIT II: Food Business Management</b>	<b>15</b>
	Case studies of Food Processing Business and its aspects, Business opportunity Identification and Assessment techniques, Business Idea Generation and evaluation exercise, Market Assessment study Analysis of competitive situation, SWOT Analysis for business and for competitors, Preparation of businessplan, Preparation of project report, Methods of Arrangement of inputs – finance and material	
<b>Credit I</b>	<b>UNIT III: Government Policies and Export Business.</b>	<b>15</b>
	Government schemes and incentives for promotion of entrepreneurship, Government policy on small and medium enterprises (SMEs)/SSIs, Export and import policies relevant to food processing sector, public-private partnerships, Characteristics of Indian food processing industries policy, programmes and agencies promoting entrepreneurship –KVIC, NABARD, NSIC, SIDBI, EDII, NIESBUD, DIC etc.	
<b>Credit I</b>	<b>UNIT IV: Environment and Business Policies.</b>	<b>15</b>
	Environmental factors affecting success of a new business; reasons for the failure and problems for new business. Legal issues, environmental clearance, quality	

	standards, government stores purchase schemes (e- tender process), exemption from income tax, industrial parks & food park.	
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**Course Outcomes: Student should be able to**

1. study the entrepreneurial skills.
2. illustrate to develop positive self-image and understand the business idea commercialization.
3. remember knowledge about food business management.
4. identify about venture capital, government business policies.

**References:**

1. D'Silva, Reema Jenifer, and Ganesh Bhat. "A systematic review on women entrepreneurship in food processing sector." *International Journal of Case Studies in Business, IT, and Education* 6, no. 2 (2022): 15-49.
2. Negi, Saurav. "Food processing entrepreneurship for rural development: drivers and challenges." *Sustainability Ethics* (2013): 117.
3. Singh, Sukhpal. "Aspects of entrepreneurship in primary food-processing industries in Punjab." *The Journal of Entrepreneurship* 6, no. 2 (1997): 223-231.
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7. Materia, Valentina C., Anita R. Linnemann, Eddy J. Smid, and Sijmen E. Schoustra. "Contribution of traditional fermented foods to food systems transformation: Value addition and inclusive entrepreneurship." *Food Security* 13, no. 5 (2021): 1163-1177.
8. Salem, U. I. "Rural women entrepreneurship in agro-food processing." *Asia Pacific Journal of Research ISSN (Print)* 1, no. XLVI (2016): 33-48.
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10. Bianchi, Tito. "With and without co-operation: two alternative strategies in the food-processing industry in the Italian South." *Entrepreneurship & Regional Development* 13, no. 2 (2001): 117-145.

## MFTT 414-EII: Marketing Management and International Trade

### Course Objective: student will be able to

1. learn and understand the management skills.
2. impart knowledge about food business management.
3. characterize the different international trade.
4. evaluate marketing management terms.

<b>Credits = 4</b>	<b>SEMESTER I</b> <b>MFTT 414-EII: Marketing Management and International Trade</b>	<b>No. of hours per unit</b>
<b>Credit I</b>	<b>UNIT I: Introduction to Marketing</b>	<b>15</b>
	Marketing: Concept, functions, scope and marketing management; Process: Concepts of marketing-mix, elements of marketing-mix; Market structure and consumer buying behavior; Marketing research and marketing information systems; market forecasting, market segmentation, targeting and positioning; Allocation and marketing resources; Marketing planning process;	
<b>Credit I</b>	<b>UNIT II: Product policy and planning</b>	<b>15</b>
	Product policy and planning: Product-mix, product line, product life cycle; New product development process; Product brand, packaging, services decisions; Marketing channel decisions; Retailing, wholesaling and distribution; Pricing decisions; Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry; Promotion-mix decisions;	
<b>Credit I</b>	<b>UNIT III: International Marketing</b>	<b>15</b>
	Salient features of international marketing, composition and direction of Indian exports, international marketing environment, deciding which and how to enter international market; Direct exports, indirect exports, licensing, joint ventures, direct investment and internationalization process, distribution channels;	
<b>Credit I</b>	<b>UNIT IV: International Trade</b>	<b>15</b>
	WTO and world trade agreements related to food business, export trends and prospects of food products in India; Government institutions related to international food trade: APEDA, Tea Board, Spice Board, MOFPI, etc.	

**Course Outcomes: Student should be able to**

1. study the Management skills.
2. illustrate to know marketing concept
3. remember knowledge about food business management.
4. apply the concept of International trade.

**References:**

1. Kottler, Philip, and Kevin Lane Keller. "Marketing management." *Jakarta: Erlangga* (2009).
2. Deepak, R. Kanthiah Alias, and S. Jeyakumar. *Marketing management*. Educreation Publishing, 2019.
3. Homburg, Christian, Sabine Kuester, and Harley Krohmer. *Marketing management*. McGraw-Hill Higher Education, 2009.
4. Leonidou, Constantinos N., and Leonidas C. Leonidou. "Research into environmental marketing/management: a bibliographic analysis." *European Journal of Marketing* 45, no. 1/2 (2011): 68-103.
5. Kotler, Philip. *A framework for marketing management*. Pearson Education India, 2003.
6. Leamer, Edward E., and James Levinsohn. "International trade theory: the evidence." *Handbook of international economics* 3 (1995): 1339-1394.
7. Krugman, Paul R. "Industrial organization and international trade." *Handbook of industrial organization* 2 (1989): 1179-1223.
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9. Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding, and Peter K. Schott. "Firms in international trade." *Journal of Economic perspectives* 21, no. 3 (2007): 105-130.
10. Milner, Helen V. "The political economy of international trade." *Annual review of political science* 2, no. 1 (1999): 91-114.

## MFTT 415: Research Methodology

### Course Objectives: Students will able be to

1. get basic knowledge on the fundamentals of research methodology.
2. learn how to present research in scientific manner.
3. know acquainted with different bio statistical tools in modern research.
4. understand the relationship between statistics and biological research.

Credits = 4	<b>SEMESTER I</b> <b>MFTT 415: Research Methodology</b>	<b>No. of hours per unit</b>
<b>Credit I</b>	<b>UNIT I: Introduction to Research Methodology I</b>	<b>15</b>
	<p>A)Research Methods vs. Methodology</p> <p>i) Introduction.</p> <p>ii) Types: Library research, field research, laboratory research.</p> <p>B)Defining a Research Problem</p> <p>i) Concept.</p> <p>ii) Selecting the research problem.</p> <p>iii) Techniques involved in defining problem.</p> <p>iv) Conclusion of the problem.</p> <p>C)Research Design</p> <p>i) Need for research design.</p> <p>ii) Concept in research design.</p> <p>iii) Types of research design.</p> <p>D)Developing a Research Plan</p> <p>i) Need.</p> <p>ii) Essential characteristics of research plan.</p>	
<b>Credit I</b>	<b>UNIT II: Introduction to Research Methodology II</b>	<b>15</b>
	<p>A)Reporting Practical and Project Work</p> <p>i) Structure of report</p> <p>ii)Title, authors and their institution,abstract, keywords, abbreviations.</p> <p>iii) IMRAD technique</p> <p>a) Introduction</p> <p>b) Material and methods</p> <p>c) Result discussion and conclusion</p> <p>d) Acknowledgements.</p> <p>B)Preparing a Grant Proposal for Research Project</p> <p>C)Manuscript Submission to Research Journals</p> <p>i) Statement of proposal.</p> <p>ii) Ethical considerations.</p> <p>iii) Publishing editorial issues.</p> <p>iv) Preparation and submission.</p>	
<b>Credit I</b>	<b>UNIT III: Descriptive Statistics</b>	<b>15</b>



	<p>A)Importance of statistics in Biology</p> <p>i) Samples and Population</p> <p>ii) Types of data, random sampling methods and sampling errors, scales and variables, accuracy and precision.</p> <p>B)Measures of Central Tendency</p> <p>i) Mean (arithmetic, geometric, harmonic), median, percentile and mode.</p> <p>ii) Measures of dispersion – mean deviation, standard deviation and variance.</p> <p>iii) Measures of a) Skewness b) Kurtosis.</p>	
<b>Credit I</b>	<b>UNIT IV: Hypothesis Testing</b>	<b>15</b>
	<p>A) Introduction to Hypothesis Testing</p> <p>i) Null hypothesis</p> <p>ii) Alternate hypothesis.</p> <p>B) Statistical Tools</p> <p>i) Significance level, type I and type II errors, p-value, one tailed and two tailed tests.</p> <p>ii) Distribution of sample means, standard error and confidence interval, Degrees of freedom</p> <p>iii) Equality of two population means, proportions: t-tests and z test</p> <p>iv) Chi-square test - test for goodness of fit, independence and homogeneity</p> <p>v) F test and ANOVA</p>	

**Course outcomes: Student will should be able to**

1. study the types of research.
2. identify research design.
3. remember the hypothesis testing.
4. apply the statistical tools

**References**

1. PANNEERSELVAM, Ramasamy. *Research methodology*. PHI Learning Pvt. Ltd., 2014.
2. *Research Methodology; Methods and Techniques* C. R. Kothari, 2nd Ed, (New Delhi, New Age International Publishers, 2004)
3. Snyder, Hannah. "Literature review as a research methodology: An overview and guidelines." *Journal of business research* 104 (2019): 333-339.
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6. Redmond, Elizabeth C., and Christopher J. Griffith. "A comparison and evaluation of research methods used in consumer food safety studies." *International Journal of Consumer Studies* 27, no. 1 (2003): 17-33.
7. Okumus, Bendegul. "Food tourism research: a perspective article." *Tourism Review* 76, no. 1 (2021): 38-42.
8. O'Connell, Rebecca. "The use of visual methods with children in a mixed methods study of family food practices." *International Journal of Social Research Methodology* 16, no. 1 (2013): 31-46.
9. Gimenez, Cristina. "Logistics integration processes in the food industry." *International Journal of Physical Distribution & Logistics Management* 36, no. 3 (2006): 231-249.
10. Taylor, Eunice. "A new method of HACCP for the catering and food service industry." *Food control* 19, no. 2 (2008): 126-134.

## MFTP 416: Practical I

### Course Objectives: Students will able be to

1. estimate shelf life of packaged fruits and vegetables.
2. know active modified atmosphere packaging.
3. understand the process of standardization of product.
4. determine Grammage , Bursting strength , Tearing strength of packaging material.

Credits = 2	<b>SEMESTER I MFTP 416: Practical I</b>	<b>No. of hours</b>
	<b>Practical's</b>	
	<ol style="list-style-type: none"> <li>1. Estimation of shelf life of packaged fruits and vegetable</li> <li>2. Non-enzymatic browning and estimation of polyphenol oxidase</li> <li>3. Active modified atmosphere packaging studies of fruits</li> <li>4. Determine of Water activity</li> <li>5. Artificial ripening for fruits</li> <li>6. Idea generation and selection of topic</li> <li>7. Cost analysis of product</li> <li>8. Standardization of product</li> <li>9. Development of new product</li> <li>10. Proximate Analysis of new products</li> <li>11. Sensory evaluation</li> <li>12. Marketing</li> <li>13. Visit to Startup Company</li> <li>14. Consumer feedback studies</li> <li>15. Determination of Grammage and thickness of paper, paperboard and plastic films.</li> <li>16. Determination of Cobb value of paper and board.</li> <li>17. Determination of Bursting strength and burst factor of paper and CFB.</li> <li>18. Determination of Tearing Strength of paper.</li> <li>19. Identification of flute types and dimensions of CFB.</li> </ol>	

**Course outcomes: Student should be able to**

1. estimate shelf life of packaged fruits and vegetables.
2. perform active modified atmosphere packaging.
3. standardize the product formulation.
4. define Grammage , Bursting strength , Tearing strength of packaging material.

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1. Pereira, Ricardo N., and António A. Vicente. "Environmental impact of novel thermal and non-thermal technologies in food processing." *Food Research International* 43, no. 7 (2010): 1936-1943.
2. Lopez-Rubio, Amparo, Eva Almenar, Pilar Hernandez-Muñoz, Jose M. Lagarón, Ramón Catalá, and Rafael Gavara. "Overview of active polymer-based packaging technologies for food applications." *Food Reviews International* 20, no. 4 (2004): 357-387.
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5. Paltrinieri, Gaetano, and F. A. O. Staff. "Handling of fresh fruits, vegetables and root crops: A training manual for grenada." *Rome, Italy: Food and Agriculture Organization of the United Nations* (2014).
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9. Papermaking Science and Technology Gullichsen J. and Paulapuro H., , *Book 17: Pulp and Paper Testing* (Ed. Levlin J.-E. and Söderhjelm L.), (Finnish Paper Engineers' Association and TAPPI. 2012)
10. Handbook of Physical and Mechanical Testing of Paper and Paperboard, Mark R. E. (Vol. 1&2, Marcel Dekker. 2002)

## SEMESTER II

### MFTT 421: TECHNOLOGY OF CEREALS, LEGUMES AND OIL SEEDS

**Course Objectives:** Students will be able to

1. get basic knowledge of wheat processing
2. know basic knowledge of Riceprocessing.
3. Understand the processing of Corn, Barley and Oats.
4. evaluate the processing for production of edible oil

Credits = 4	<b>SEMESTER II</b> <b>MFTT 421: TECHNOLOGY OF CEREALS, LEGUMES AND OIL SEEDS</b>	No. of hours per unit
<b>Credit I</b>	<b>UNIT I Wheat Processing</b>	<b>15</b>
	Wheat: Types and physicochemical characteristics; wheat milling -products and byproducts; factors affecting quality parameters; physical, chemical and rheological tests on wheat flour; additives used in bakery products; flour improvers and bleaching agents; manufacture of bakery products, pasta products and various processed cereal-based foods; manufacture of whole wheat atta, blended flour and fortified flour. Production of starch and vital wheat gluten.	
<b>Credit I</b>	<b>UNIT II: Rice Processing</b>	<b>15</b>
	Rice: Classification, physicochemical characteristics; cooking quality; rice milling technology; by- products of rice milling and their utilization; Rice bran stabilization, oil extraction and refining, parboiling methods of rice criteria of quality of rice: aging of rice – quality changes; processed products based on rice	
<b>Credit I</b>	<b>UNIT III: Corn, Barley and Oats</b>	<b>15</b>
	Corn: Types and nutritive value; dry and wet milling, processing of corn in breakfast cereals, snacks, tortilla etc., production of glucose syrups, dextrose, high fructose corn syrups, modified starches. Barley: composition, milling, malting of barley, chemical and enzymatic changes during malting, uses of malt. Oat: composition, processing of oat, byproducts of oatmeal milling.	
<b>Credit I</b>	<b>UNIT IV: Legumes and oilseeds</b>	<b>15</b>
	Legumes and oilseeds: composition, anti-nutritional factors, processing and storage; processing for production of edible oil, meal, flour, protein concentrates and isolates; extrusion cooking technology; snack foods; development of low cost protein foods. Oil extraction process – mechanism, solvent, SCE, oil refining,	

**Course outcomes: Student will should be able to**

1. illustrate the need for wheat processing
2. study the manufacture of bakery products.
3. implement the need, safety and sanitation of fresh produce.
4. apply the special treatments after packaging

**References**

1. Long, J. Hunter, Tarek N. Aziz, and Joel J. Ducoste. "Anaerobic co-digestion of fat, oil, and grease (FOG): A review of gas production and process limitations." *Process Safety and Environmental Protection* 90, no. 3 (2012): 231-245.
2. Terigar, B. G., S. Balasubramanian, C. M. Sabliov, M. Lima, and D. Boldor. "Soybean and rice bran oil extraction in a continuous microwave system: From laboratory-to pilot-scale." *Journal of Food Engineering* 104, no. 2 (2011): 208-217.
3. Dendy, D. A. V. "Composite and alternative flours." *Cereal Products*. Eds. Dendy DA & Dobraszczyk BJ Aspen Publisher Inc (2001): 263-275.
4. Hamilton, Richard John, and A. Bhati. "Fats and oils: chemistry and technology." (*No Title*) (1980).
5. Schober, Tilman J., Manuela Messerschmidt, Scott R. Bean, Seok-Ho Park, and Elke K. Arendt. "Gluten-free bread from sorghum: quality differences among hybrids." *Cereal chemistry* 82, no. 4 (2005): 394-404.
6. De Bondt, Yamina, Inge Liberloo, Chiara Roye, Peter Goos, and Christophe M. Courtin. "The impact of wheat (*Triticum aestivum* L.) bran on wheat starch gelatinization: A differential scanning calorimetry study." *Carbohydrate polymers* 241 (2020): 116262.
7. Buckley, Elyse. "Factors in hard winter wheat affecting water absorption tolerance." PhD diss., Kansas State University, 2013.
8. Liu, Xia, Shiqing Huang, Chen Chao, Jinglin Yu, Les Copeland, and Shujun Wang. "Changes of starch during thermal processing of foods: Current status and future directions." *Trends in Food Science & Technology* 119 (2022): 320-337.

## MFTT 422: FOOD PLANT ORGANIZATION AND LAYOUT

**Course Objectives: Students will be able to**

1. understand the food plant management.
2. know the structure and operations of food plant.
3. impart the classification of dairy and food plants.
4. learn the preparation of a plant layout.

<b>Credits = 4</b>	<b>SEMESTER II MFTT 422: FOOD PLANT ORGANIZATION AND LAYOUT</b>	<b>No. of hours per unit</b>
<b>Credit I</b>	<b>UNIT I: Introduction of Plant Organization.</b>	<b>15</b>
	Operation Research, definition and scope, techniques in operation research. Food plant management factors bearing on location and layout of food plants, Regulatory requirements of food industries.	
<b>Credit I</b>	<b>UNIT II: Structure and Operation of Food Plant.</b>	<b>15</b>
	Structure and operation of food plants, Executive design making in a food plant, Decision protocols, Evolution and role of management planning organizing and controlling, Decision processed for raising efficiency, productivity and quality in food plant operation, System analysis, its need and methodology.	
<b>Credit I</b>	<b>UNIT III: Design of Food Plant</b>	<b>15</b>
	Classification of Dairy and Food Plants, farm level collection and chilling center, space requirement. Overall design of an enterprise : Plant design, sales planning for plant design , Strength of material – engineering materials, material science, use of various metals, including plastic, glass, etc. in food industry,	
<b>Credit I</b>	<b>UNIT IV: Preparation of a Plant Layout</b>	<b>15</b>
	Plant Layout problem, importance, objectives, and classical types of layouts. Evaluation of Plant Layout. Advantages of good layout. Organizing for Plant Layout, Data forms, Common Problems in Plant Layout and Process scheduling, Sitting of Process sections, Equipment selection and capacity determination	

**Course outcomes: Student should be able to**

1. apply the executive design making in a food plan.
2. implement the productivity and quality in food plant operation
3. study the classification of dairy and food plants.
4. solve plant layout problem.

**References**

1. Balogun, O. S., E. T. Jolayemi, T. J. Akingbade, and H. G. Muazu. "Use of linear programming for optimal production in a production line in Coca-Cola bottling company, Ilorin." *International Journal of Engineering Research and Applications* 2, no. 5 (2012): 2004-2007.
2. Sharma, A. K., and B. K. Kumbhar. "Food Processing Plant and Design Layout." (2020).
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9. Svärdby, Rikard. "World Class Layouts. A study of packaging plants for liquid food." (2009).
10. Rosli, Nur Amira, Nor Ainy Mahyudin, Jinap Selamat, and Nor Khaizura Mahmud Ab Rashid. "Layout design for food safety improvement of frozen crispy chicken curry puff processing." *The Annals of the University Dunarea de Jos of Galati. Fascicle VI-Food Technology* 46, no. 1 (2022): 52-66.

## MFTT 423: Packaging Laws and Regulation

### Course Objectives: Students will be able to

1. understand the Indian regulatory system.
2. learn the International laws CE Marking.
3. know the Sustainable development and processes.
4. evaluate the labeling regulations

<b>Credits = 4</b>	<b>SEMESTER II MFTT 423: Packaging Laws and Regulation</b>	<b>No. of hours per unit</b>
<b>Credit I</b>	<b>UNIT I: Indian Regulatory System</b>	<b>15</b>
	<p>Indian Regulatory System Introduction, Laws and regulations- Need/Importance – Bureau of Indian Standards The Standards of weights and Measures Act (SWMA), Standard Units, Laws, Regulations and Ministries involved, Essential Commodities Act, Agricultural Produce ( Grading and Marketing ) Act, Prevention of Food Adulteration Act, Codex Standard Act, Export ( Quality Control and Inspection) Act, Declarations on Packaged Commodities - Declarations for Interstate Trade and Commerce, Standard Packages, Maximum Permissible Error, Label Declarations, Standard Quantity specifications for various products, Symbols and Units used.</p>	
<b>Credit I</b>	<b>UNIT II: International Laws CE Marking</b>	<b>15</b>
	<p>International Laws CE Marking, EU-REACH Regulations in packaging, RoHS (Restriction on Hazardous Substances), Uniform Weights and Measures Law, Details of Violations, offences, Penalties under various sections, ISO 14000 Environment Management System, IMDG (International Maritime for Dangerous Goods), EU Directives, Various storage requirements of Products, Specifications of Raw Materials used, IS Specifications with respect to packaging and Packaging Materials</p>	
<b>Credit I</b>	<b>UNIT III: Sustainable Development &amp; Processes</b>	<b>15</b>
	<p>Introduction to Sustainability, Sustainable Development &amp; Processes, Need Today, Three Pillars of Sustainability &amp; their effects on sustainable growth – Relation with environment waste management, Relevance of Sustainable Development in Packaging Sector – Traditional Packaging vs. Sustainable Packaging.</p>	



<b>Credit I</b>	<b>UNIT IV: Labeling regulations</b>	<b>15</b>
	Labeling regulations, Due diligence, Grouping information on the label, Nutritional labelling, Making a claim about vitamins and minerals, Date marking, Allergens declaration, Print size and clarity, Net quantity, Quantitative ingredient declaration/calculation (QUID), Use of symbols or icons, Specific labelling requirement	

**Course outcomes: Student should be able to**

1. implement the Indian regulatory system.
2. apply the symbols and units used in packaging.
3. illustrate the International laws CE marking.
4. study the IS specifications with respect to packaging and packaging materials.

**References**

1. Handbook of Analysis and Quality control for fruits and vegetable products S.Ranganna (McGraw Hill Education(India) PVT.LTD, Chennai, 2<sup>nd</sup> edition, 2008)
2. Food Packaging Technology Richard coles, Derek Mc Dowelland Mork J Kirwan (Blackwell publishing CRC Press, 2003)
3. Novel Food Packaging Techniques Raija Ahvenainen, (Woodhead Publishing Limited, 2003)
4. TAPPI Standards: Regulations and Guidelines. Revision of T4 111om-97.

## MFTT 424-EI: Instrumentation and Process Control

### Course Objectives: Students will be able to

1. Understand the measurement of temperature, pressure, humidity.
2. know programmable logic controller.
3. learn applications of laplace transforms.
4. impart signal flow graph reduction technique.

<b>Credits = 4</b>	<b>SEMESTER II MFTT 424-EI: Instrumentation and Process Control</b>	<b>No. of hours per unit</b>
<b>Credit I</b>	<b>UNIT I: Measurement of various parameters</b>	<b>15</b>
	Transducers: Measurement of temperature, flow, pressure, humidity, Gas concentration, Specific gravity, Concept of bio-sensors. Introduction to Fuzzy logic& neural networks.	
<b>Credit I</b>	<b>UNIT II: Data and Monitoring system</b>	<b>15</b>
	Programmable logic controller, Data loggers, Data Acquisition Systems (DAS). Introduction to Direct Digital Control (DDC), Supervisory Control and Data Acquisition Systems (SCADA), Monitoring of plant parameters through Internet with SAP integration.	
<b>Credit I</b>	<b>UNIT III: Concept of Laplace Transform, Poles and zeros</b>	<b>15</b>
	Review of Laplace Transforms, concept of poles and zeroes, open and closed loop systems, transfer function, block diagram reduction technique.	
<b>Credit I</b>	<b>UNIT IV: Signal flow , Stability concepts</b>	<b>15</b>
	Signal flow graph reduction technique, Stability general concepts, absolute and relative stability, Routh stability criterion, Bode Plots.	

**Course outcomes: Student should be able to**

1. measure temperature, pressure, humidity.
2. analyze Gas concentration, Specific gravity.
3. make of plant parameters through Internet with SAP integration.
4. describe the Routh stability criterion, Bode Plots.

**References**

1. Measurement System - Application and Design Doebelin EO,. (McGraw Hill.Ernest O Doebelin.1995).
2. Experimental Methods for Engineers Nachtigal CL,. (McGraw Hill. 1990).
3. Instrumentation and Control Fundamentals and Application John Wiley & Sons,.
4. Measurement and Control Basics Thomas A.Hughes ( ISA Press).
5. Control systems Engineering I.J Nagrath ,M.Gopal,(New Age International).
6. Mechanical Measurements BeckwithTG,(Addison-Wesley 1996)

## MFTT 424-EII: Fluid Mechanics and Hydraulics

### Course Objectives: Students will be able to

1. understand the property of fluids.
2. know the flow concepts.
3. learn functions of hydraulics in food processing
4. impart the applications of turbines and pumps

<b>Credits = 4</b>	<b>SEMESTER II MFTT 424-EII: Fluid Mechanics and Hydraulics</b>	<b>No. of hours per unit</b>
<b>Credit I</b>	<b>UNIT I: Introduction to fluids</b>	<b>15</b>
	Properties of fluids; Static pressure of liquids: Hydraulic pressure, absolute and gauge pressure. Pressure head of a liquid; Pressure on vertical rectangular surfaces. Compressible and non-compressible fluids; Surface tension, capillarity	
<b>Credit I</b>	<b>UNIT II: Flow Concept</b>	<b>15</b>
	Fluid flow: Classification, steady, uniform and non-uniform, laminar and turbulent, continuity equation Pressure measuring devices: Simple, differential, micro-, inclined manometer.	
<b>Credit I</b>	<b>UNIT III: Concept of Mechanics</b>	<b>15</b>
	Bernoulli's theorem and its applications; Flow through pipes: Loss of head; Flow through orifices, mouthpieces, notches and weirs; Vena contracta, hydraulic coefficients, discharge losses; Time for emptying a tank; Loss of head due to contraction, enlargement at entrance and exit of pipe	
<b>Credit I</b>	<b>UNIT IV: Applications of turbines and pumps</b>	<b>15</b>
	Types of notches, rectangular and triangular notches, rectangular weirs; Venturimeters, pitot tube, rotameter Turbines and pumps: classification, centrifugal pumps, reciprocating pumps, positive displacement pump; Centrifugal pumps: operating characteristics of centrifugal pumps	

**Course outcomes: Student should be able to**

1. illustrate the property of fluids.
2. study the Compressible and non-compressible fluids
3. describe the flow concepts.
4. implement the laminar and turbulent flow.

**References**

1. Fluid Mechanics, Frank M. White, 7<sup>th</sup> Ed. McGraw-Hill Book Co., Inc.,
2. Fluid Mechanics: Fundamentals and Applications. Yunus A. Çengel and John M. Cimbala.
3. Fluid Mechanics with Engineering Applications, E. John Finnemore and Joseph B. Franzini, 10<sup>th</sup> Ed. McGraw-Hill, Inc., New York, USA. 2002
4. A Textbook of Fluid Mechanics and Hydraulics, Bansal RK, Firewell Media, 2005

**MFTP 425: Research Project**

<b>Credits 4</b>	<b>MFTP 425: Research Project</b>	<b>No. of hours- 60</b>
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## MFTP 426: Practical II

### Course Objectives: Students will be able to

1. know determination of gluten content of wheat flour and conditioning of wheat.
2. evaluate Malting, puffing and popping of grains.
3. understand designing of layout of cold storage, pre-processing house, fruits and vegetable processing plants.
4. determine of gas transmission rate, water vapor permeability of packaging material.

<b>Credits = 2</b>	<b>SEMESTER II MFTP 426: Practical II</b>	<b>No. of hours per unit</b>
	<b>Practical's</b>	<b>8</b>
	<ol style="list-style-type: none"> <li>1. Physical-tests of wheat and rice</li> <li>2. Determination of gluten content in wheat flour.</li> <li>3. Conditioning of wheat; Milling of wheat and rice by laboratory mill;</li> <li>4. Parboiling of rice.</li> <li>5. Amylose content determination in rice.</li> <li>6. Malting, puffing and popping of grains.</li> <li>7. Preparation of protein concentrates and isolates and their evaluation for protein content and solubility;</li> <li>8. Layout of Food storage wares and go-downs</li> <li>9. Layout and design of cold storage.</li> <li>10. Layout of pre-processing house</li> <li>11. Design and layout of low shelf life product plant</li> <li>12. Design and layout of fruits processing plants</li> <li>13. Design and layout of vegetable processing plants</li> <li>14. Designing of ETP layout</li> <li>15. Identification of different packaging instruments.</li> <li>16. Identification of plastic Films</li> </ol>	

	17. Determination of water vapor permeability of packaging material. 18. Determination of the static and dynamic tensile strength of paper 19. Measurement of resistance of a paper board and corrugated board to puncture. 20. Measurement of bursting strength of paper.	
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**Course outcomes: Student should be able to :**

1. determine gluten content of wheat flour and conditioning of wheat.
2. perform malting, puffing and popping of grains.
3. design of layout of cold storage, pre-processing house, fruits and vegetable processing plants.
4. describe the gas transmission rate, water vapor permeability of packaging material.

**References**

1. Aleena, K. S., M. P. Divya, A. K. Beena, C. R. Rachana, and K. B. Divya. "Oxidative stability of sunflower oil on high temperature cooking." *Oxidative Stab. Sunflower Oil High Temp. Cook* 9 (2020): 552-554.
2. Dendy, D. A. V. "Composite and alternative flours." *Cereal Products. Eds. Dendy DA & Dobraszczyk BJ Aspen Publisher Inc* (2001): 263-275.
3. Hamilton, Richard John, and A. Bhati. "Fats and oils: chemistry and technology." (*No Title*) (1980).
4. Jayaram, Vinay B., Sven Cuyvers, Kevin J. Verstrepen, Jan A. Delcour, and Christophe M. Courtin. "Succinic acid in levels produced by yeast (*Saccharomyces cerevisiae*) during fermentation strongly impacts wheat bread dough properties." *Food chemistry* 151 (2014): 421-428.
5. Kay, D. E. "Food legumes. The Tropical Products Institute. London." *UK. Crop and Product Digest* 3 (1979): 435.8. Kent, Norman Leslie. *Kent's Technology of Cereals: An introduction for students of food science and agriculture.* elsevier, 1994.
6. Balogun, O. S., E. T. Jolayemi, T. J. Akingbade, and H. G. Muazu. "Use of linear programming for optimal production in a production line in Coca-Cola bottling company, Ilorin." *International Journal of Engineering Research and Applications* 2, no. 5 (2012): 2004-2007.
7. Managerial Economics- Analysis, Problems and cases. Metha, P.L. 2003., Sultan Chand and Sons, New Delhi.(Unit-I,II)
8. VIHAR, JYOTI. "M. Tech. in Food Science & Technology." *Food Engineering* 1: 04.
9. Moore, James M. "Computer aided facilities design: an international survey." *International Journal of Production Research* 12, no. 1 (1974): 21-44.