

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

SCHEME OF TEACHING AND EXAMINATION (FIRST AND SECOND SEMESTER)

Theory	Subject	Teaching Hours per week				Exam Marks	Sessional Marks	Total Marks
		L	T	P	C			
First Semester								
1.1	Food Engineering	3	1	-	4	50	50	100
1.2	Biochemical Engineering	3	1	-	4	50	50	100
1.3	Food Safety and Quality Management	3	1	-	4	50	50	100
1.4	Selected Topics of Cereals, Oilseeds and Pulses	3	1	-	4	50	50	100
1.5	Functional Foods and Nutraceuticals	3	1	-	4	50	50	100
Practicals								
1.1.1	Biochemical Engineering-I	-	-	2	1		25	25
1.1.2	Food Process Engineering	-	-	2	1		25	25
Total		15	5	4	22	250	300	550

L: Lectures/week

T:Tutorial/Week

P: Practicals Hours/Week

C: Number of Credits

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

Theory	Subject	Teaching Hours per week				Exam Marks	Sessional Marks	Total Marks
		L	T	P	C			
Second Semester								
2.1	Food Packaging	3	1	-	4	50	50	100
2.2	Selected topics in Fruits and Vegetable Processing	3	1	-	4	50	50	100
2.3	Food Process Equipment Design	3	1	-	4	50	50	100
2.4	Research Methodology	3	1	-	4	50	50	100
2.5	Food Product Development	3	1	-	4	50	50	100
Practicals								
2.2.1	Food Processing and Analysis	-	-	2	1		25	25
Total		15	5	4	21	250	275	525

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

SCHEME OF TEACHING AND EXAMINATION(THIRD & FOURTH SEMESTER)

Theory	Subject	Teaching Hours per week				Exam Marks	Sessional Marks	Total Marks
		L	T	P	C			
Third Semester								
3.1	Analytical Techniques	3		-	3	40	35	75
3.2	Electives	4		-	4	50	50	100
3.3	Preliminary thesis			20	10	-	-	-
Total		7		20	17	90	85	175
Fourth Semester								
4.1	Thesis	-	-	30	15	-	-	-
Total				30	15	-	-	-

#: Preliminary thesis will be evaluated on the basis of seminar presentations and discussions and the candidate shall be awarded ‘S’ grade i.e. satisfactory for continuation or else ‘X’ grade i.e. unsatisfactory.

- List of Electives (FT 3.2) (Any one to be offered)
 1. Advanced Food Microbiology
 2. Advanced Food Biotechnology
 3. Food Rheology and Texture
 4. Thermal and Non Thermal Processing of Foods
 5. Industrial Pollution Control and Abatement

NOTE:

The student is required to make seminar presentation(s) of the results achieved before the submission of

the thesis.

1. The Post Graduate Student Research Committee (PGRC) of the Institute will evaluate the Thesis.

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

The constitution of the committee is as under:

a. Chairperson of the institute

b. Senior professor of the institute

c. Supervisor(s)

d. External examiner

2. The PGRC will evaluate the final thesis based on an open house presentation by the student, which will be attended by the faculty members, PG students and other research scholars of the institute.

3. No marks are assigned to Preliminary Thesis and Thesis evaluation work. On successful completion and presentation of Research Seminars, the candidate will be awarded 'S' grade i.e. satisfactory or else 'X' grade i.e. unsatisfactory.

4. Requirement for the award of M.E. in Food Technology degree is 75 credits with minimum CGPA of 6.0 and successful completion of thesis work.

SYLLABUS FORM. E. (FOOD TECHNOLOGY) **FIRST SEMESTER**

1.1 Food Engineering

Paper Code : 1.1; Max. Marks 50 ; Credits : 4; Time: 3 hours

Course Duration: 45 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B
Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set.
The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION A

Engineering Properties of foods, their significance and importance in equipment and process design. Steady state and unsteady state heat transfer. Numerical, graphical methods in the analysis of heat transfer. Solutions of unsteady state equations.

Kinetics of biological reactions, order of reaction, quality changes during storage of foods. Application of Arrhenius equations to biological reactions. Food quality analysis.

Principles of Refrigeration. Natural refrigeration, Vapour compression refrigeration. Mollier Chart, Rating of Systems, Compressors, evaporators, Condensers, Expansion valve. Heat Pump, Absorption refrigeration.

SECTION B

Freezing of foods, prediction of freezing time.

Thermal Processing of foods. Pasteurization and sterilization, D value, F value, Z value. Process time calculation. Cook value and quality retention. Microbial survival curve. Lethality, Ball method. Process calculation by graphical method.

Reference Books

1. Heldman and Singh. 1995. Introduction to Food Engineering. Academic Press.
2. McCabe WL, Smith JC and Harriott P. 1993. Unit operations of Chemical Engineering. McGraw Hills.

1.2 Biochemical Engineering

Paper Code : 1.2; Max. Marks 50 ; Credits : 4; Time: 3 hours

Course Duration: 45 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B
Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set.
The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION A

Fermentation processes: Biomass, enzymes and metabolites. Isolation and Utilization of Enzymes: Purification, immobilization, application of enzyme technology. Kinetics of Enzyme-Catalyzed Reactions: The substrate, enzyme kinetics, immobilizations, factors affecting enzymatic activity and enzymatic reactions in heterogeneous reactions.

Metabolic Pathways and Energetics of the Cell: The concept of energy coupling, aerobic and anaerobic metabolism, photosynthesis and biosynthesis, transport across cell membranes.

Cellular Genetics and Control: Growth and reproduction of a single cell, alteration of cellular DNA, commercial applications.

Kinetics of Substrate Utilization. Product Yield and Biomass Production: Growth cycle for batch cultivation and its mathematical modeling, products synthesis kinetics, thermal death kinetics of cells and spores.

SECTION B

Transport Phenomena in Microbial Systems: Gas-liquid mass transfer, determination of oxygen transfer rates, mass transfer, surface-area correlations for mechanically agitated vessels, scaling of mass transfer equipment, particulate mass transfer, heat transfer.

Design and Analysis of Biological Reactors: The ideal continuous-flow stirred-tank reactor (CSTR), residence time distribution, different types of reactors, relationship between batch and continuous biological reactors. Fermentation technology, product manufacture by fermentation, reactors for biomass production.

Downstream processing, primary, secondary and tertiary products.

Production of industrial products, case study of few products. Wastewater engineering. Genetically modified foods.

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

Reference Book

1. Biochemical Engineering Fundamentals by J. E. Bailey & D. F. Ollis, McGraw Hill Book Company, 1986.
2. Biochemical Engineering by H. W. Blanch & D. S. Clark, Marcel Dekker, Inc., 1997.
3. Bioprocess Engineering (Basic Concepts) by M. L. Shuler & F. Kargi, Prentice Hall of India, 2003.

1.3 Food Safety and Quality Management

Paper Code : 1.3; Max. Marks 50 ; Credits : 4; Time: 3 hours

Course Duration: 45 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION A

Concept of quality, quality attributes-physical, chemical, nutritional, microbial and sensory, their measurement and evaluation, sensory vis-à-vis instrumental methods for testing quality.

Concept of quality management, objectives, importance & functions of quality control, quality management systems in India, sampling procedures and plans, food safety & standard act 2006, domestic regulations, global food safety initiative, various organization dealing with inspection, FSSAI and its role. Traceability and authentication, certification & quality assurance (PFA, FPO, MMPO, MPO, AGMARK, BIS), labeling issues, international scenario, international food standards.

SECTION B

Quality assurance, total quality management, GMP/GHP, GLP, GAP, stationary & hygienic practices, HACCP, quality manuals, documentation & audit, Indian & international quality systems & standards like ISO, food CODEX, export import policy, export documentation, laboratory quality procedures and assessment of laboratory performance, applications in different food industries, food adulteration & food safety, IPR and patent. Role of FSSAI.

FAO/ WHO food standards, Food Additives, Contaminants, Pesticide Residues, Residues of Veterinary Drugs, Food Labeling, Organically Produced Food, Food Derived by application of Biotechnology.

Industry specific Issues: Fats and Oils, Marine Products, Dairy Products, Cereals and Cereal Products, Fruits and Vegetables, Meat and Meat Products, Fermented Foods, Mineral and

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

Packaged Drinking Water, Spices and Condiments, Street Food, Safety aspects of Nutrition and Food for Special Dietary Uses.

Application of Chromatographic methods: Gas chromatography and liquid chromatography.

Mass spectrometry, Immunological Assay (Elisa, PCR) in food analysis.

Reference Books :

1. Krammar and Twigg Quality Control for Food Industry, AVI Publishing, 1979.
2. Herschdoerfer, S.N. Quality Control in Food Industry, Academic Press, U.K.
3. Ranganna : Handbook of Analysis of Fruit and Vegetable Products, Tata McGraw Hill, New Delhi, 1986.
4. Nielsen, S.S, 2004, Introduction to chemical Analysis of foods, CBS Publishers, New Delhi.
5. Ranganna. S., 2001, Handbook of Analysis & Quality control for Fruit & Vegetable Products, Tata McGraw Hill, New Delhi.
6. Pomeranz.Y, Meloan.C.E, 1996, Food Analysis – Theory & Practice, CBS Publishers, New Delhi.
7. Jacobs.M.B., 1999, Chemical Analysis of Food & Food Products, CBS Publishers, New Delhi.
8. Jay.J.M, 1996, Modern Food Microbiology, CBS Publishers, New Delhi

1.4 Selected topics of Cereals, Oilseeds and Pulses

Paper Code : 1.4; Max. Marks 50 ; Credits : 4; Time: 3 hours

Course Duration: 45 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION A

World production and trade of grains. Status of cereal, pulses and oil seeds in Indian economy. General chemistry of starch. Degradation products and starch derivatives. Use of starch in food.

Storage of cereal grain. Insect infestation control measures. Detection of insect and rodent infestation of cereals. Rice milling, rice products, rice based fermented products. Parboiling of paddy.

Wheat milling and cleaning equipment, bulgur wheat. Fermented and leavened products of wheat, macaroni. Fermented and leavened products from wheat. Dough rheology. Importance of glass transition temperatures in cereal.

Testing of mill stocks by suitable equipment like Amilograph, Extensograph, farinograph etc.

SECTION B

Corn milling, corn flour and other related products, breakfast cereal and sugar coating process.

Snacks corn chips, expanded snack products, extrusion cooking of cereal based products.

Milling of barley, oats, rye, sorghum, millets etc. National and international standards of quality of various cereal and cereal based products.

By-products utilization of cereal process industry. Cereal based animal feed, wheat germ, corn oil.

Advanced technology of Milling of pulses.

General chemistry and analytical methods of characterization of fats and oils. Quality standards of edible oils and fats, rancidity. Fats and oils in diet, nutrition and diseases. Detection of adulterations, trans fat. Chemical Adjuncts, lecithin, monoglycerides and derivatives, polypropylene glycol esters, poly glycol esters, shortening, manufacture and uses of shortening, types

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

of shortenings, Margarine manufacture process and its uses. Mayonnaise and salad dressings. Confectionary coatings. Peanut butter and vegetable ghee. Packaging and storage of fats and oils. Fat substitutes.

Reference Books:

1. Kent, N.L. Technology of Cereals, CBS Publisher.
2. Pomeranz, Y. : Wheat Chemistry and Technology, CHIPS Book, USA.
3. Tanley A. Watson & Paul E. Ramstad : Corn Chemistry and Technology, ADCC, USA.
4. Julliano, B.O. Rice Chemistry and Technology, AACC, USA.
5. Pandey, P.H. Post Harvest Technology.
6. Bailey : Fats and Oil, Wiley, USA.
7. Williards, P.N. & Devine, J. : The Chemistry & Technology of Edible Oils & Fats

1.5. Functional Foods and Nutraceuticals

Paper Code : 1.5; Max. Marks 50 ; Credits : 4; Time: 3 hours

Course Duration: 45 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B
Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set.
The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION A

Introduction to Nutraceuticals/ Functional foods: definitions, synonymous terms, basis for claims for a compound as a nutraceutical, regulatory issues for nutraceuticals including CODEX/FSSAI. Concept of angiogenesis and the role of health foods, Nutraceuticals for cardiac disease, cancer, diabetes, cholesterol management, obesity, joint pain, immune enhancement, age related macular degeneration, endurance performance and mood disorders-compounds and their mechanisms of action, dosage levels, and contradictions if any.

SECTION B

Manufacturing aspects of selected nutraceuticals such as lycopene, isoflavonoids, prebiotics and probiotic, glucosamine, phytosterols etc. Formulation of functional foods containing nutraceuticals-stability and analytical issues, labelling issues.

Chemical testing of nutraceuticals and health foods, interactions of prescription drugs and nutraceuticals, adverse effects and toxicity of nutraceuticals, Nutrigenomics-an introduction and its relation to nutraceuticals.

References Books

1. Robert EC. 2006. Handbook of Nutraceuticals and functional foods. Wildman.
2. Shi J. 2006 Functional food Ingredients and Nutraceuticals: Processing Technologies, CRC Press.
3. Webb GP. 2006. Dietary supplement and Functional Foods. Blackwell Publications.

Practical

1.1.1. Bio-Chemical Engineering-I

Fermenter design and optimization of environmental parameter of different biochemical processes.

References Books

1. Biochemical Engineering Fundamentals by J. E. Bailey & D. F. Ollis, McGraw Hill Book Company, 1986.
2. Biochemical Engineering by H. W. Blanch & D. S. Clark, Marcel Dekker, Inc., 1997.
3. Bioprocess Engineering (Basic Concepts) by M. L. Shuler & F. Kargi, Prentice Hall of India, 2003.

1.1.2. Food Process Engineering

1. Particle size reduction, Milling, Grinding, sieve analysis of cereal and wheat flour
2. Rheological Study and mixing index in a food mixture
3. Thermal processing, Kinetics and design of Retort processing & pasteurization of liquid food

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

4. Effect of processing conditions and product parameters on quality of fruit products
5. Effect of processing conditions and product parameters on baking of bread & biscuit
6. Effect of Processing conditions and product parameters on quality of dairy products
7. Effect of material and air properties on tray & spray drying of food materials
8. Effect of Non-thermal processing of food
9. Study of extraction of oleoresins from spices
10. isolation of microorganisms from different source and identification

References Books

1. Fuller, G.W. (2011). New Food Product Development: From Concept to Marketplace, 3rd ed, CRC Press, UK.
2. Barbosa-Cánovas, G. V., Ma, L., & Barletta, B. J. (1997). Food Engg Laboratory Manual. CRC Press. UK
3. Ibarz, A., & Barbosa-Canovas, G. V. (2002). Unit Operations in Food Engineering. CRC Press, UK

SYLLABUS FOR M. E. (FOOD TECHNOLOGY) SECOND SEMESTER

2.1 Food Packaging

Paper Code : 2.1; Max. Marks 50 ; Credits : 4; Time: 3 hours

Course Duration: 45 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B
Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set.
The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION A

Introduction to principals of Food Packaging, Types of packaging , Special packaging methods (vacuum, gas and shrink packaging), Function of a package, packaging materials, their structural qualities and performance including moisture and gas transmission, interaction of food and the packaging material. Rigid and flexible packaging materials.Types and roles of active and intelligent packaging.Oxygen, ethylene and other scavengers; antimicrobial food packaging; non-migratory bioactive polymers in food packaging; time-temperature indicators; freshness indicators.

SECTION B

Novel MAP applications for fresh-prepared produce, product safety and nutritional quality; reducing of pathogen risks in MAP-prepared produce, detecting leaks in modified atmosphere packaging, MAP with other preservation techniques. Novel packaging and particular products.Active packaging in practice meat, fish, fruits and vegetables, other fresh produce.Laminates, multilayer laminates, testing of packaging materials. Legislative issues relating to active and intelligent packaging, recycling packaging materials,green plastics for food packaging.

Packaging-flavour interactions; Food-packaging interactions; characteristics of food-grade packaging material.

Books Recommended:

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

1. Pines, F.A. : Fundamentals of Packaging, Cornhill Publication, London.
2. David, J.R. & David, D.R.D. Aseptic Processing and Packaging & Food, CRC Press.
3. Sacharow&Griffin : Food Packaging, AVI Publishing, Westport, Conn.
4. Brody, A.L. : Flexible Packaging of Foods, CRC Cleveland, Ohio Press.
5. Heiss, R. : Principle of Food Packaging, An International Guide United Nations Food & Agricultural Organization, Rome, Italy, 1970.

2.2 Selected Topics of Fruit and Vegetable Processing

Paper Code : 2.2; Max. Marks 50 ; Credits : 4; Time: 3 hours

Course Duration: 45 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION A

Importance of post harvest handling, Composition and nutritive value of fruits and vegetables. Fruit ripening, Spoilage of Fruits and vegetables, Indian environment for fruits and vegetable processing.

Application of recent advanced techniques of fruits and vegetables preservation. Low cost methods of preservation. Cold storage, Osmotic dehydration, Foam mat drying, Freeze drying, microwave heating applications, radiation preservation of fruits and vegetables, Irradiation sources, Spray drying of fruit and vegetable juices, concentrates & powder its sensory evaluation and packaging.

Use of additives in various fruits and vegetables product development. Application of enzymes in fruits and vegetables processing. Controlled ripening. Nutritional and biochemical changes during post harvest storage, processing and post process storage.

SECTION B

Metal contaminants and pick up in stored processed products. Use of pesticides in fields, its limit and identification. Processing equipment. Measurement of color and texture. Characterization, stimulation of fruit flavor, retention of flavor.

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

Legislation of processed fruit and vegetable products. Analysis and detection of contaminants and adulterants and quality control. Factory sanitation and hygiene.

Microbiology of fresh and processed products and its control.

Waste utilization and By-products of fruits and vegetable industry.

Reference Books

1. GiridhariLal : Preservation of Fruits & Vegetables, ICAR Publication, India.
2. Ranganna : Analysis of Fruits and Vegetables, Tata MacGraw Hill, India.
3. Luh&Woodroof : Commercial Vegetable Processing, AVI Publishing, USA.
4. Woodroof&Luh : Commercial Fruit Processing, AVI Publishing, USA

2.3 Food Process Equipment Design

Paper Code : 2.3; Max. Marks 50 ; Credits : 4; Time: 3 hours

Course Duration: 45 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B
Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set.
The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION A

Design considerations of agricultural and food Processing Equipments: factor of safety, theories of failure, allowable stresses, materials of Construction.

Introduction to pumps and pipelines. Process plant piping, hygienic considerations and ease of cleaning for insulated as well as un-insulated pipes Introduction to boilers.

SECTION B

Psychrometry, Design of dryers: Introduction about drying, types of driers, design consideration of dryers. Design of plate heat Exchangers, evaporators.

Design of membrane separation unit (UF and RO), high pressure processing, pulse electric field processing.

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

Reference Books

- George D. Saravacos, A. E. Kostaropoulos., 2002. Handbook of food processing equipment. Springer.
- Mahajani, VV and Umarji, SB. 2004. Joshi's Process Equipment Design. Macmillan India.
- Peters, M.S. and Timmerhaus, K.D. 1980. Plant Design and Economics for Chemical Engineers, McGraw-Hill.
- Perry's Chemical Engineers' Handbook by Perry and Green, McGraw-Hill, New York.
- Jowitt, R. (1980). Hygienic Design and Operation of Food Plant. Ellis Horwood, Chichester, UK.
- B. C. Bhattacharyya. 2003. Introduction to Chemical Equipment Design, CBS Publishers & Distributors, New Delhi.

2.4 RESEARCH METHODOLOGY

Paper Code : 2.4; Max. Marks 50 ; Credits : 4; Time: 3 hours

Course Duration: 45 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

Introduction: Meaning, Features, Objectives/Motives & types of Research; Attributes of good Research, Research Methods and Research Methodology; Research Process, Significance of Research in Managerial decision making.

Research Design: Meaning, Characteristics and various concepts relating to research design and classification of research design, Importance.

Measurement and Scaling: Data Types Nominal, Ordinal and Ratio scale; scaling techniques.

Formulation of Hypothesis: Meaning, Characteristics and concepts relating to testing of Hypothesis (Parameter and statistic, Standard error, Level of significance, type-I and type-II errors, Critical region, one tail and two tail tests); Procedure of testing Hypothesis. Numerical problems based on chi-square test and F-test (variance ratio test only).

Data Collection: Sources of Data-Primary/Secondary Methods of collecting data; direct personal interview, indirect oral interview, information through local agencies, mailed questionnaire method, schedule sent through enumerators; questionnaire and its designing and characteristics of a good questionnaire.

Sampling Design: Meaning and need of Sampling, Probability and non-probability sampling design, simple random sampling, systematic sampling, stratified sampling, cluster sampling and convenience, judgement and quota sampling (non-probability), determination of sample size.

SECTION – B

Data Analysis & Interpretation: Introduction to Multivariate analysis- Multiple and partial correlation, multiple regression analysis (with two independent variables), specification of regression models and estimation of parameters, interpretation of results. Analysis of Variance (ANOVA)-One way and Two way ANOVA. Introduction to discriminant analysis and Factor Analysis

Design of Experiments:

Objectives, strategies, Factorial experimental design, Designing engineering experiments, basic principles-replication, randomization, blocking, Guidelines for design of experiments.

Single Factor Experiment: Hypothesis testing, Analysis of Variance components (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effects model, Estimation of variance components, Model adequacy checking.

Two factor Factorial Design, Basic definitions and principles, main effect and interaction, response surface and contour plots, General arrangement for a two - factor factorial design; Models-Effects, means and regression, Hypothesis testing

Report writing: Style/format, contents and essential steps for report writing.

Suggested Readings:

1. K.N. Krishna SwamyAppaLyer Siva KumarM.Mathirajan: Management Research Methodology,Pearson Education, 2009

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

2. RanjitKumar:Research Methodology, Pearson Education 2009-02-20
3. Donald R. Cooper Pamela S. Schindler: Business Research Methods, Tata McGraw Hill
4. Michael Riley et.al: Researching & Writing dissertation in Business & Management, ThomsonLearning.
5. R. Pannerselvam: Research Methodology, Parentice Hall of India Limited.
6. R. Nandagopalet.al.:Research Methods in Business, ExcelBooks.
7. William G.Zikmund :Business Research Methods, Thomson South Western Publication
8. C.R. Kothari:Research Methodology-Methods &Techniques.
9. K.V. Rao: Research Methodology in Commerce &Management.

2.5 Food Product Development

Paper Code : 2.5; Max. Marks 50 ; Credits : 4; Time: 3 hours

Course Duration: 45 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION A

Concepts of food product design, Product success and failure. Product Design Procedure, Categories of food product. Need for product development (Customer and societal needs), Customer preference.

Ideas and innovation in food product development.Life cycle analysis of food products, case studies.Product development process-product strategy, product design and process development, product commercialization, product launch and evaluation.

SECTION B

Product manufacturing, specifications, scale up/scale down, Economics, Specifications of food products. Microstructure of food products, case studies.

Sensory analysis.Sensory evaluation methods.Difference Testing, Descriptive analysis, Affective Testing.Analysis of sensory data in relation to instrumental analysis.Preference ans acceptance mapping.

Reference Books

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

1. Earle and Earle. 2001. Creating New Foods, Chadwick House Group.
Fuller 2004. New food Product development-from concept to market place, CRC.
2. Harry T Lawless and H Leymann. 2010. Sensory evaluation of foods: Principles and Practices. Springer, New York.
3. EL Cussler and GD Moggridge. 2012. Chemical Product Design. Cambridge University Press, UK.
4. Anita R Linneman, Catharina GPH Schroen and MAJS van Boekel. 2011. Food Product Design: An Integrated approach. Wageningen Academic Publishers, Netherland.

Practicals

2.2.1 Food Processing and Analysis

1. Proximate composition in food
2. Analysis of water
3. Analysis of wheat flour; Determination of damaged starch from whole wheat flour
4. Analysis of tea and coffee
5. Analysis of milk and dairy products & Detection of adulterants in milk (liquid)
6. Analysis of Food adulteration with respect to specific foods dairy, cereal, muscles food etc.
7. Microbial and Enzyme assay
8. Discriminative and Descriptive Sensory analysis of Foods
9. Estimation of phenolics, antioxidant activity, chlorophyll and Carotenoids
10. Demo of colorimeter, texture analyzer, DSC, HPLC, GC-MS etc.

Reference Books

1. AOAC International. 2003. Official methods of analysis of AOAC International. 17th Ed.
Gaithersburg, MD, USA, Association of Analytical Communities
2. Kirk, RS and Sawyer, R. 1991. Pearson's Chemical Analysis of Foods. 9th Ed. Harlow, UK, Longman Scientific and Technical.
3. Leo ML. 2004. Handbook of Food Analysis. 2nd Edition. Vol 1,2 and 3, Marcel Dekker.
4. Linden G. 1996. Analytical Techniques for Foods and Agricultural Products. VCH.

SYLLABUS OF M. E. (FOOD TECHNOLOGY) THIRD SEMESTER

3.1 Analytical Techniques

Paper Code : FT 3.1; Max. Marks 40 ; Credits : 3; Time: 3 hours

Course Duration: 42 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B
Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set.
The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION-A

Complexometric titrations: Complexes-formation constants; chelates – EDTA, Chelon Effect, EDTA equilibria, effect of pH on EDTA equilibria, EDTA titration curves, endpoint – detection and indicators; Importance of complexometric titrations.

Solvent Extraction: Distribution law, extraction process, factors effecting extraction, technique for extraction, quantitative treatment of solvent extraction equilibria, classification of solvent extraction systems. Advantages and applications of solvent extraction.

Chromatography: Introduction to chromatography, principles, classification of chromatographic techniques, thin layer and paper chromatography – principle and technique.

Column Chromatography – Factors affecting column efficiency and applications. Gas – liquid chromatography – theory, instrumentation and applications. HPLC – instrumentation, method, column efficiency and applications.

Thermoanalytical methods: Principle, classification of methods.

TGA – Instrumentation, factors affecting results and analysis of data. applications.

DTG – Instrumentation, analysis of data and applications.

DTA – Principle, Instrumentation and applications

SECTION-B

IR Spectroscopy: Origin, rigid rotor model, harmonic oscillator model, principle, modes of vibrations of atoms in polyatomic molecules, instrumentation, selection rules, identification of organic compounds on the basis of infrared spectra.

UV-Vis Spectroscopy: Introduction, laws of absorption, origin of spectra, types of transitions, selection rules, identification of organic compounds using UV-VIS spectroscopy.

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

NMR: Principle, chemical shift, spin-spin coupling shift reagents, instrumentation, spectra and molecular structure, identification of organic compounds on the basis of NMR.

Electron Microscopy: Introduction to Electron microscopy, classification of electron microscopy methods, Scanning electron microscopy, Instrumentation and applications. Scanning Tunnelling microscopy – Principle and comparison with SEM.

AFM/ Atomic Force microscopy – Principle instrumentation and its basic applications

Books Recommended:

1. Skoog, D. A. & West D. M. : Principles of Instrumental Analysis, 5th Edition, Saunders College Publishers, USA.
2. Skoog, D. A. & West D. M. : Fundamentals of Analytical Chemistry, 7th Edition, Saunders College Publishers, USA.
3. Willard, Meritt, Dean & Settle : Industrial Methods of Analysis, 7th Edition.
4. Galen W. Ewing. : Industrial Methods of Chemical Analysis, 5th Edition.
5. Silverstein R. M. & Webster F.X. : Spectrometric identification of Organic Compounds, 6th Edition, John Wiley and Sons, Inc., USA.

3.2 Electives:

Paper Title: Elective (Theory)

Paper Code : 3.2; Max. Marks 50 ; Credits : 3; Time: 3 hours

Course Duration: 42 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section

1. **Advanced Food Microbiology**

SECTION A

SYLLABI FOR MASTER IN (FOOD TECHNOLOGY)

Relevance of microbiology as a field of Food technology. Historical milestones in microbial food technology. Morphology and physiology of industrial microorganisms (Bacteria, yeasts, molds and actinomycetes). Isolation : identification and quantitative estimation of microorganisms, Microbiological assay in Microbial nutrition.

Unique pathways of microbial metabolism: ED, PK pathways, Respiration; Fermentations, Amphibolic pathways, Anaplerotic reactions.

Bacterial cell wall biosynthesis. Photoautotrophy, Chemolithotrophy, Methylophony, Calvin cycle.

SECTION B

Genetics of some industrial microorganisms, Microbiology of soil, Selection, development and maintenance of cultures.

Chemistry and biosynthesis of microbial products e.g. vitamins, amino acids, enzymes, steroids, antibiotics and polymers. Metabolic regulations in industrial fermentation.

Microbial transformation of alkanes, alkaloids, terpenes, aromatic compounds and naturally occurring polymers.

Microbial food production. Spoilage microorganisms in foods and their control. Applied microbiology in animal nutrition. Mycotoxins Microbial insecticides.

Reference Books:

1. Frazier W.C., Westhoff, D.C. (Ed). (1988). Food microbiology (McGraw-Hill).
2. Admas, M.R., Moss, M.O (2005). Food microbiology (Edition 3, Illustrated Publisher Royal Society of Chemistry).
3. SriLakshmi B. (2003) Food science (New Age International Publishers, India).
4. Jay J.M., M.J. Loessner, D.A. Golden. (2005). Modern food microbiology (Edition 7, Illustrated Publisher Springer).
5. B. Sivasankar (2004). Food processing and preservation (PHI Private Ltd, New Delhi).

6. Michael P. Doyle (1989). Food borne bacterial pathogens (Edition illustrated, Publisher Marcel Dekker).

2. Advanced Food Biotechnology

SECTION A

Introduction to food biotechnology, Application of genetic engineering in food production. Methods of molecular cloning. Advantages and disadvantages of genetically modified foods.

Technological aspects of industrial production of beer, wine, organic acids, amino acids, vitamins, antibiotics, baker's yeast, single cell protein. Production of bio- flavor, bio-color, bio-preservatives.

Classification of fermentation. Application of fermentation technology in food preservation. Fermented food origin, scope and development of sourkraut, yoghurt, cheese, miso, tempeh, idli, dosa. Organic foods basic concept, methodology and advantages. Regulatory and social aspects of biotechnology of foods.

SECTION B

Production of alcohol, lactic acid and acetic acid from various food materials. Bacteriocin production and its use in food preservation. Biotechnological processes of manufacture of functional foods, nutraceuticals and probiotics.

Biotechnological process for food fortification, prebiotics & oligosaccharides. Application of biotechnology in waste treatment of food industries. Improvement of quality of food by biotechnological processes. Biosensors.

Reference Books:

1. Daniel Charles. Lords of the Harvest: Biotech, Big Money, and the Future of Food (1st Edition). Perseus Books Group, 2001.
2. Adams, M.R. and M.O. Moss. Food Microbiology. Turpin Distribution Service Ltd., Blackhorse Road, Letchworth, Herts SG6 1HN, UK, 1995, 2nd edition.
3. GauriMittal. Food Biotechnology: Techniques and Applications. CRC Press, 1992.
4. Banwart, George J. Basic Food Microbiology, 2nd ed. AVI/ Van Nostrand

Reinhold Publishing Co, 1989.

5. Cliver, D.D. Foodborne Diseases. Academic Press, Inc, 1990.

6. Food and Drug Administration. Bacteriological Analytical Manual (BAM) (8th Edition).AOAC, Arlington, VA, 1995.

7. Debnath, 2005, Tools & Techniques of Biotechnology, Pointer Publishers, Jaipur.

3. Food Rheology & Texture

SECTION A

Introduction to rheology of foods: Definition of texture, rheology and psychophysics– their structural basis; physical considerations in study of foods; salient definitions –Stress tensor and different kinds of stresses.

Rheological classification of Fluid Foods : Shear-rate dependence and time dependence of the flow-curve; Non-Newtonian fluids; thixotropy; Mechanisms and relevant models for non-Newtonian flow; Effect of temperature; Compositional factors affecting flow behaviour; Viscosity of food dispersions – dilute and semi-dilute systems, concentration effects.

Comparative assessment of different types of Viscometers, and their Merits and Limitations: Co-axial cylinders, Spindle- or Impeller-type viscometers, Cone-plate viscometer, Capillary viscometers, Falling-sphere viscometer, Vibratory viscometers, Extrusion viscometer, Orifice viscometer.

SECTION B

Rheology of semi-solid and solid food ; Rheological characterization of foods in terms of stress-strain relationship; Viscoelasticity; Transient tests - Creep Compliance and Stress Relaxation; mechanical models for viscoelastic foods: Maxwell, Kelvin, Burgers and generalized models and their application; Dynamic measurement of viscoelasticity.

Large Deformations and failure in foods: Definitions of fracture, rupture and other related phenomena; Texture Profile Analysis; Instrumental measurements – Empirical and Fundamental methods; Rheometers and Texture Analyzers; Measurement of Extensional viscosity; Acoustic measurements on crunchy foods.

Rheological and textural properties of selected food products: Measurement modes and techniques; Effect of processing and additives (stabilizers and emulsifiers) on food product rheology; Relationship between instrumental and sensory data.

Reference Books

- Bourne, M. Food Viscosity and Texture, 2nd Edition, Academic Press, New York, 2002.
- Macosko, Ch.W. Rheology: Principles, Measurements, and Applications (Advances in Interfacial Engineering), Wiley-VCH, 1994.
- Morrison, Faith. Understanding Rheology, Oxford University Press, 2001.

- Phan-Thien, N. Understanding Viscoelasticity. Basics of Rheology. Springer, 2002.

4. Thermal and Non-thermal Processing of Foods

SECTION-A

Membrane Technology. Introduction to pressure activated membrane processes: micro filtration, UF, NF, RO and their industrial application. Supercritical fluid extraction. Concept and properties of super critical fluids.

Microwave and radio frequency processing. Definition, advantages, mechanism of heat generation. Microwave blanching. Hurdle technology-Types of preservation techniques and their principles, concept of hurdle technology and its application.

SECTION -B

High Pressure Processing. Concept, equipments for HPP treatment, mechanism for microbial inactivation and its application in food processing. Ultrasonic processing. Properties of ultrasonic, application of ultrasonic as processing techniques.

Innovative techniques in food processing. Application of technologies of high intensity light, pulsed electric field, ohmic heating, IR heating, inductive heating, X-Rays in food preservation. Nano technology: principle and application in foods.

References Books

Barbosa-Canovas. 2002. Novel Food Processing Technologies, CRC press.

MunirCheryan. 1986. Ultrafiltration handbook. Technomic publishing, Lancaster.

5. Industrial Pollution Control and Abatement

SECTION-A

Treatment Methods for water & waste :Sources and characterization of water pollution.

Primary Treatment: gravity separator, equalization tanks, Sedimentation, Flotation

Secondary Treatment – Design of :Upflow Anaerobic, Sludge Blanket (USAB) reactor, Activated Sludge process – Rotating Biological Contactors (RBC), Trickling Filters;

Natural Treatment - Wetland Systems, Waste Stabilization Ponds.

Tertiary Treatment systems: Disinfection etc.

Sludge and solid wastes treatment: Identification of hazardous wastes – disposal and waste minimization, waste management,

SECTION-B

Air Pollution Control : Air pollutants : Sources, effects, temperature inversions, plume behaviour, characterization, stack height, Gaussian Plume design model, Measurement and emission estimates, Isokinetic Sampling.

Control methods: Particulate emission control methods, gravitational settling chambers, cyclone separators, Scrubbers fabric filters, ESP, wet scrubbers, control of Volatile Organic Compounds (VOC's) Control of SO₂, NO_x,

Others: Motor Vehicle Air Pollution Control, Global Warming, Indoor Air Pollution

Books & References

1. Air Pollution by Perkins
2. Air Pollution by Rao & Rock
3. Industrial Pollution Control by S.P.Mahajan
4. Air Pollution Control Engg. by N.D.Nevers
5. Disposal of Wastes Water by Eddy Mt Calf
6. "Environment Engg. & Science" by Sincero&Sincero
7. Introduction to EnvironmentEngg. by – Davis and Cornwell