

**THE GANDHIGRAM RURAL INSTITUTE - DEEMED TO BE UNIVERSITY
MINISTRY OF EDUCATION (SHIKSHA MANTRALAYA), GOI
ACCREDITED BY NAAC WITH 'A' GRADE (3rd Cycle) GANDHIGRAM - 624302,
DINDIGUL DISTRICT, TAMIL NADU**



**B.VOC FOOD TESTING AND QUALITY EVALUATION SYLLABUS
(With effect from September 2021) DDU – KAUSHAL
KENDRA GANDHIGRAM -624302**

Scheme of syllabus for DDU- KK UGC approved
B.Voc. Food Testing and Quality Evaluation Degree Programme
Semester I

Category	Course Code	Title of the Course	Contact Hours/ Week			Marks Distribution		
			Theory	Practical	total	CFA	ESE	Total
General Components (A)	21ENQU01F1	Foundational English I	3	-	3	40	60	100
		Yoga	-	1	1	50	-	50
	21FTQV0101	Laboratory Operation and Maintenance I	4	-	4	40	60	100
	21FTQV0102	Environmental science	4	-	4	40	60	100
		TOTAL	11	1	12	170	180	350
Skill Components (B)	21FTQV0103	Laboratory Techniques	4	-	4	40	60	100
	21FTQV0104	Food Science I	4	-	4	40	60	100
	21FTQV0105	Practical I – Laboratory techniques	-	4	4	60	40	100
	21FTQV0106	Practical II- Food Science- I	-	4	4	60	40	100
	21FTQV0107	Internship at Food Standards and Regulations/ Food Lab Equipment and its Handling	-	2	2	50	-	50
		TOTAL	08	10	18	250	200	450
		GRAND TOTAL (A+B)			30	420	380	750

NSQF LEVEL 4
Food lab worker

SEMESTER II

Category	Course Code	Title of the Course	Contact Hours/ Week			Marks Distribution			
			Theo Ry	Practi cal	Total	CFA	ESE	Total	
General Components (A)	21ENQU01F2	Foundational English II	3	-	3	40	60	100	NQS LEVEL 5 Food lab Assistant
	21CSAV0201		-	4	4	60	40	100	
	21FTQV0208	Food Adulteration	2	-	2	50	-	50	
	21FTQV0209	Laboratory Operation and Maintenance II	3	-	3	40	60	100	
		TOTAL	08	04	12	190	160	350	
Skill component (B)	21FTQV0210	Food Microbiology	3	-	3	40	60	100	
	21FTQV0211	Practical III Food Microbiology	-	2	2	50	-	50	
	21FTQV0212	Food chemistry	3	-	3	40	60	100	
	21FTQV0213	Food Science II	2	-	2	50	-	50	
	21FTQV0214	Practical IV- Food Adulteration	-	3	3	60	40	100	
	21FTQV0215	Practical V- Food Science- II	-	3	3	60	40	100	
On job Training(OJT)*	21FTQV0216	Training in FSSAI/ Quality Analysis for Foods	-	2	2	50	-	50	
		TOTAL	08	10	18	350	200	550	
		GRAND TOTAL (A+B)			30	540	360	900	

Semester III

Category	Course Code	Title of the Course	Theory	Practical	TOTAL Credit	CFA	ESE	Total
General Components (A)	21FTQV0317	Food Packaging	3	-	3	40	60	100
	21FTQV0318	Sensory evaluation	3	-	3	40	60	100
	21FTQV0319	Principles of Food Preservation	2	-	2	50	-	50
	21FTQV0320	Practical VI- Principles of Food Preservation	-	4	4	60	40	100
		TOTAL	08	04	12	190	160	350
Skill Components (B)	21FTQV0321	Techniques in food analysis	3	-	3	40	60	100
	21FTQV0322	Food analysis	2	-	2	50	-	50
	21FTQV0323	Food Safety System in Dairy Industries	3	-	3	40	60	100
	21FTQV0324	Practical VII- Food Analysis	-	4	4	60	40	100
	21FTQV0325	Practical VIII- Quality Evaluation of Milk and Milk Products	-	4	4	60	40	100
On Job Training (OJT)*	21FTQV0326	OJT	-	2	2	50	-	50
		TOTAL	08	10	18	300	200	500
		GRAND TOTAL (A+B)			30	490	360	850

Semester IV

Category	Course Code	Title of the Course	Theory	Practical	Credit	CFA	ESE	Total	
General Components (A)	21CSAV0402		-	4	4	60	40	100	NSQF LEVEL 6 FOOD QUALITY CONTROLLER
	21GSPSU001	Gandhi's Life, Thought and Work	2	-	2	20	30	50	
	21FTQV0427	Food Quality Assurance	4	-	4	40	60	100	
	21FTQV0428	Quality evaluation of packaging materials	2	-	2	50	-	50	
		TOTAL	8	-	12	170	130	300	
Skill Components (B)	21FTQV0429	Bakery and Confectionary	4	-	4	40	60	100	
	21FTQV0430	Quality Evaluation of Food Grains and its Products	4	-	4	40	60	100	
	21FTQV0431	Practical IX- Quality Evaluation of Food Grains and its Products	-	4	4	60	40	100	
	21FTQV0432	Practical X- Quality Evaluation of Bakery and Confectionery Products	-	4	4	60	40	100	
On Job Training (OJT)*	21FTQV0433	OJT	-	2	2	50	-	50	
		TOTAL	08	14	18	250	200	450	
		GRAND TOTAL(A+B)			30	420	330	750	

Semester V

Category	Course Code	Title of the Course	Theory	Practical	Credit	Marks Distribution		
						CFA	ESE	Total
General Components (A)	21FTQV0534	Financial management and entrepreneurship	4	-	4	40	60	100
	21FTQV0535	Food Hygiene and Sanitation	4	-	4	40	60	100
	21FTQV0536	Food safety	4	-	4	40	60	100
		TOTAL	12		12	120	180	300
Skill Components (B)	21FTQV0537	Processing of Beverages and Spices	3	-	3	40	60	100
	21FTQV0538	Processing of Fruits and Vegetables	3	-	3	40	60	100
	21FTQV0539	Practical XI- Quality Analysis of Beverages and Spices	--	3	3	60	40	100
	21FTQV0540	Practical XII- Quality Analysis of Fruits and Vegetables	-	4	4	60	40	100
	21FTQV05E1/E2/E3	ELECTIVE	3	-	3	40	60	100
On Job Training (OJT)*	21FTQV0541	OJT	-	2	2	50	-	50
		TOTAL	09	09	18	290	260	550
		GRAND TOTAL(A+B)			30	410	440	850

Semester VI

Category	Course Code	Title of the Course	Theory	Practical	Credit	Marks Distribution			
						CFA	ESE	Total	
General Components (A)	21FTQV0642	Design and Development of Food Testing Lab	4	-	4	40	60	100	(NSQF Level 7)/FOOD ANALYST
	21FTQV0643	FSSAI Regulations of Food Testing	4	-	4	40	60	100	
	21FTQV0644	Food Laws and Legislations	4	-	4	40	60	100	
Skill components (B)		TOTAL	12		12	120	180	300	
	21FTQV0645	Project Work	-	16	16	100	100 (75+25)	200	
	21FTQV0646	Internship	-	2	2	50	-	50	
		TOTAL	02	16	18	200	100	300	
		GRAND TOTAL(A+B)			30	320	280	600	

ELECTIVES

SL.No.	Course code	Course title	Credits
1.	21FTQV05E1	Product development, testing and marketing	3
2.	21FTQV05E2	By products and waste utilisation	3
3.	21FTQV05E3	Processing of Fish, Meat and Poultry products	3

Total credits:

General components (A) = $12+12+12+12+12+12 = 72$

Skill components (B) = $18+18+18+18+18+18 = 108$

TOTAL = 180

FIRST SEMESTER

FOUNDATIONAL COURSE I

Code: 21ENGU01F1

Credit: 3

Contact Hours/Week: 3

Marks:100

GRU-BVOC

LABORATORY OPERATIONS AND MAINTENANCE- I

Code: 21FTQV0101

Credits: 4

Hours/week:4

Marks: 100

Course Objectives

- To familiarize the students with laboratory organization
- To enable the students to use the theoretical knowledge in operation and maintenance of laboratories.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- design considerations that apply to the lab and to the areas that directly support its operation.
- importance of laboratory organization

UNIT I

Understanding on organization and design of laboratories: the essential requirements of a typical laboratory, space, designs of laboratories - fixed and flexible design laboratories, main laboratory in relation to other rooms, benching, surfaces, furniture and storage services, ventilation, lighting, heating and cooling, ventilation, lighting, heating and cooling, flooring and fume cupboards

UNIT II

Day-to-day management of the laboratories: day-to-day organization, day-to-day cleaning up, sterilization, disposal of wastes, routine inspection and maintenance of laboratory, maintenance of equipment, apparatus and furniture- prevention of dust, reduction of vibration, prevention of corrosion and rust prevention of equipment from excessive heat; correct usage of instruction manual; servicing of equipment.

UNIT III

Cleaning of laboratories and preparation rooms; colour coding of services, emergencies with services - emergency procedures for flooding and gas leaks; security and vandalism; storing of acids, alcohols and other toxic chemicals and their care; records; stock records, recording loans, recording stock used and misused, record of use of listed poisons, record of use of alcohol, record of breakages; information about equipment serial number, maintenance record, electrical checks and miscellaneous records; accident and incident record.

UNIT IV

Files: sources of information- classifying secondary and tertiary information sources, sources of information in the lab or preparation room, Filing systems- aims of filing systems, classification of files, filing methods, filing system for equipment, filing system for chemicals, filing of printed and written material work sheets/instruction for experiments- Demonstration. Procedure for reporting lab tests, documentation and record keeping, lab filing system.

UNIT V

Arranging stock, locating and referencing: shelf arrangement of stock by nomenclature, stock control- the two bin system, the constant cycle system; record keeping- bin cards, order books, inventory, service register; ordering procedure: preparation of list of requirements, inviting quotations, factors deciding purchases, role of purchase committee, purchase of alcohol, placing an order, tax and discounts; receipt of goods, taking delivery, processing of bills; accounting: records of expenditure controlling, budget, petty cash and impress money, GST tax and discounts, receipts of goods, taking delivery, processing of bills and accounting.

Related Experience

1. Study of design and features of a laboratory
2. Design and organization of laboratory store
3. Demonstration of sterilization, disposal of wastes, cleaning of equipments, using instruction manual for operating equipments
4. Demonstration of Gas Leaks, electrical checks, colour coding for services
5. Demonstration for stock records
6. Writing purchase order for chemical, alcohol etc
7. Recording of Cash transaction
8. Visit to different food testing laboratory

TEXT BOOKS

1. Rao B.V.S, (1963). Operation & Maintenance of Electrical Equipment - Volume I; Media Promoters and Pub Pvt Ltd.
2. Rao B.V.S, (1967). Operation & Maintenance of Electrical Equipment - Volume II; Media Promoters and Pub Pvt Ltd.

REFERENCE BOOKS

1. Rao S, (2010). Testing Commissioning Operation & Maintenance Of Electrical Equipments; Khanna Publishers.
2. National committee for Clinical laboratory standards. 1996. Clinical laboratory manuals, 3rd ed. approved guideline 3P2-3A. Villanova, Pa.

ENVIRONMENTAL SCIENCE

Code: 21FTQV0102

Credits: 4

Hours/week: 4

Marks: 100

Course Objectives:

- To impart the knowledge on environmental and natural resources.
- To study about the impact of pollution, social issues and disaster management.
- To obtain the brief knowledge on Eco system and its functions.

Specific Learning Outcome:

After learning this paper the students will gain knowledge in solid waste, waste water and disaster management and prevention techniques of deposition of hazardous materials on land.

Unit – I

Introduction - environmental ethics-assessment of socio - economic impact–environment audit-mitigation of adverse impact on environment - importance of pollution control-types of industries and industrial pollution.

Unit – II

Solid waste management-characteristics of industrial waste-methods of collection, transfer and disposal of solid wastes-converting waste to energy-hazardous waste management treatment technologies.

Unit – III

Waste water management-characteristics of industrial effluents-treatment and disposal methods-pollution of water sources and effects on human health.

Unit – IV

Air pollution management- sources and effects–dispersion of air pollutants-air pollution control methods-air quality management; noise pollution management–effects of noise on people, noise control methods. Ozone layer or ozone shield, importance of ozone layer, ozone layer depletion and causes; process of spring time ozone depletion and international protocols. Environmental policy debate, International agreements, Montreal protocol 1987; Kyoto Protocol 1997, Convention on Climate change, Carbon Credit and Carbon Trading; Clean development credit and carbon trading; Clean development mechanism.

Unit – V

Disaster management-meaning, concepts, causes and types, effects of disaster on community economy and environment, disaster management cycle, response rehabilitation, reconstruction, role of community in disaster. Activated Sludge Process – Trickling filters – oxidation ponds, fluidized bed reactors, membrane bioreactor, neutralization, regulatory framework for pollution monitoring and control; Ganga Action plan, Yamuna Action plan.

TEXT BOOKS

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad 380013, India, Email: mapin@icenet.net (R).

REFERENCE BOOKS

1. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.
2. Clerk B.S., Marine Pollution, Clarendon Press Oxford (TB).

WEBOGRAPHY

1. <https://vardhaman.org/wp-content/uploads/2019/10/ENVIRONMENTAL-SCIENCE-1.pdf>
2. <https://elaw.org/system/files/Chapter%208%20Disaster%20Management.pdf>
3. https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/WEDC/es/ES07CD.pdf
4. <http://rcueslucknow.org/publication/TrainingModules/Dr.A.K.Singh/HandBookDisasterManagement.pdf>
5. <https://www.iloencyclopaedia.org/part-vii-86401/environmental-pollution-control/item/507-air-pollution-management>

LABORATORY TECHNIQUES

Code: 21FTQV103

Credits: 4 Hours/week: 4

Marks: 100

Course Objectives

To enable the students to

- understand basics of laboratory procedures
- understand the use of various basic laboratory equipment's.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- know the basics of analysis.
- Know the use of basic laboratory equipment's.

UNIT I

Introduction to laboratory apparatus: introduction, identification of a apparatus, apparatus for heating: bunsen burner, air bath, water bath, oil bath, sand bath, hot plate heating, mantle heating and block immersion heater laboratory; glassware: jointed glassware, setting up demonstrations, selecting the apparatus, setting up the apparatus, laboratory centrifuge- use and description, rotor heads- advantages and disadvantages; laboratory glass: types of laboratory glass, characteristics of laboratory glass, laboratory glass components, glass rod and tubing demountable joints valves and stopcocks. Apparatus with interchangeable ground glass joints (Quickfit)

UNIT II

Measurement and measuring devices: introduction, mass and weight, balances: double-pan, analytical balance, single-pan, mechanical analytical balance, single-pan electronic analytical balance, digital balance, types of volume, measuring devices, approximate devices, accurate devices - burettes, pipettes and volumetric flasks; pH and conductivity: concept.

UNIT III

Solutions: introduction, water: chemical nature of water, water as a Solvent, types of water, water as a material for experiment; solutions, components of a solution, types of solution, solubility, concentration of solutions, percentage of molarity, molality and normality.

UNIT IV

Preparation of solutions: calculation of masses and volumes to prepare solutions- solids and liquids, more concentrated solutions, accuracy and precision of measurements of solutes; general guidelines for preparation of solutions; methods of preparing solutions, general methods of preparation, labelling, exceptions to the general method, notes on other solutions, bench reagents and standard solutions. Demonstration of preparative techniques- heating and agitation: heating, refluxing, controlled addition of a reagent, reflux heating with controlled addition, reflux heating with controlled addition and stirring. Sampling methods- sample preparation of analysis- statistical evaluation of analytical data – official methods of food analysis.

UNIT V

Glass Apparatus – Beaker, Test tube, boiling tube, funnel, separating funnel, filtration flask, round bottom flask, condenser, Liebig flask, watch glass, measuring conical flask or condenser, petri dish, desiccator.

Organizational norms and standards followed in work place; care and maintenance of glassware: cleaning methods, selecting the best cleaning method, handling glass apparatus assembly of glass apparatus, glass tubes in bungs, suck-back gas pressure in glass, storage of glassware, storage of glass apparatus, glassware breakage records. possible hazards from glass dangers -cut glass, heating glass; protective clothing, respiratory hazards and first aid in glass working.

TEXT BOOKS

1. Raghuramulu, N., Madhavan Nair, K., and Kalyanasundaram, S. 2003. A Manual of Laboratory Techniques. National Institute of Nutrition, ICMR, Hyderabad.
2. Maintenance Manual for laboratory Manual, 2008, 2nd Edition, WHO

REFERENCE BOOKS

1. Ranganna, S. 1986. Handbook of Analysis and Quality Control for Fruits and Vegetable Products. Tata McGraw Hill, New Delhi
2. Linden G. 1996. Analytical Techniques for Foods and Agricultural Products.
VCHBoundless. "Acid-Base Properties of Water." Boundless Chemistry.
3. <https://www.boundless.com/chemistry/textbooks/boundless-chemistry-textbook/acids-and-bases-15/acids-and-bases-107/acid-base-properties-of-water-451-10533/>

WEBOGRAPHY

1. <http://www.chem.uiuc.edu/clcwebsite/elec.html>

FOOD SCIENCE I

Code: 21FTQV0104

Credits: 4

Hours/week: 4

Marks: 100

Course Objectives:

To enable the students to

- describe the importance of various foods and their nutritive value and place in daily diet
- study the effects of processing conditions on nutritive value of the foods

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- explain the basic concepts of cooking - and processing- methods applied to various types of food
- describe the science behind the processing and preparation of food products
- find out the importance and role of each ingredients in food products

UNIT- I

Introduction to food science; basic four food group; food pyramid; balanced diet; weights and measures of the food ingredients, cooking- objective of cooking and different methods of cooking – Boiling, Steaming, Stewing, Frying, Baking, Roasting, Broiling, Pressure Cooking.

UNIT- II

Cereals: wheat- structure and composition; rice- composition of rice; gelatinization of starch, parboiling of rice- advantages and disadvantages; post harvest processing, quality characteristics of cereals: intrinsic and induced qualities of starch and protein; a brief description of foods from cereals-whole grain, milled, beverages, baked products and miscellaneous.

UNIT- III

Pulses: composition of pulses, processing of pulses- soaking, germination, decortications, cooking and fermentation; toxic constituents in pulses; quality characteristics of pulses; physical and functional qualities.

UNIT- IV

Fats and Oils: classification of fats and oils, sources, composition, oilseed processing- methods quality characteristics of fats and oils - physical and chemical properties, shortening effect of oil, smoking point of oil, factors affecting absorption of oil, Spoilage of fat.

Sugar Cookery - Stages of sugar cookery, Crystallization and factors affecting crystallization.

UNIT- V

Vegetables and Fruits: classification of vegetables and fruits, browning- enzymatic and non- enzymatic browning, pigments in vegetables and fruits; post-harvest changes in fruits and vegetables– climacteric and non-climacteric fruits, physical and chemical changes during the storage of fruits and vegetables; quality characteristics of vegetables and fruits: physical, chemical, microbiological and nutritional qualities.

TEXT BOOKS

1. Srilakshmi, B. (2008). Food Science. New Delhi: Chennai: New Age International Private Limited. Publishers.
2. Swaminathan, M. (1988). Food Science and Experimental Foods. Madras: Ganesh and Company.

REFERENCE BOOKS

1. Mudambi, R.S. and Rajagopal, M.Y. (1991). Fundamentals of Food and Nutrition. Newdelhi: Wiley Eastern Limited.
2. Mudambi, R.S. and Rao. S (1987). Food Science. New Delhi: Wiley Eastern Limited.
3. Potter, N.M. and Birch, G.G. (1986). Food Science, AVI, West Port, Conn.
4. Bennion, *et al.*, (1985). Introductory Foods. New York: Macmillan.
5. FAO ,AGRICULTURAL SERVICES BULLETIN No. 109 (1994) on Grain storage techniques Evolution and trends in developing countries.
6. Yeshajahn Pomeranz, Clifton E. Meloan. Chapman and Hall. 1994. Food Analysis, Theory and Practice, 3rd. Edition;

WEBOGRAPHY

1. <https://egyankosh.ac.in/bitstream/123456789/11694/1/Unit-1.pdf>
2. http://lib.rudn.ru/file/Food_Science_Nutrition_Catalogue_ebook.pdf
3. <https://www.slideshare.net/RoshinaRabail/introduction-to-food-science-and-technology-101>
4. <https://www.slideshare.net/partharoychaudhry/cereals-pulses-36867856>
5. <https://slideplayer.com/slide/14016092/>
6. <http://ecoursesonline.iasri.res.in/mod/resource/view.php?id=147675>

PRACTICAL I- LABORATORY TECHNIQUES

Code: 21FTQV0105

Credits: 4 Hours/week: 4 Marks: 100

1. Identification and understanding the use of various apparatus and glassware
2. Weighing of chemical using different types of balance
3. Measurement of colour and colourless solution using burette, pipette, volumetric flask
4. Measurement of pH
5. Separation of liquid using filtration and centrifugation techniques.
6. Preparation of solution by using various normality
7. Preparation of solution by using various molarity
8. Preparation of solution by using various molality
9. Preparation of standard volumetric solution
10. Preparation of solution by using different pH solution
11. Preparation of different buffer solution
12. Demonstration of glassware cleaning methods
13. Assembling and disassembling of glass apparatus
14. Sample of record for glassware breakage
15. Visit to food testing laboratory functioning inside the food industries

PRACTICAL II- FOOD SCIENCE I

Code: 21FTQV0106

Credits: 4 Hours/week: 4 Marks: 100

1. Display of basic four food groups
2. Measuring ingredients – methods of measuring different types of foods- grains, flours and liquids.
3. Cooking foods using different methods
4. Effect of cooking on cereal starch and protein,
5. Study of intrinsic quality of cereals,
6. Induced characteristics- colour, bulk density, odour, size, moisture, infested grain, broken grains and fall in number- comparison with international standards and
7. Study the gelatinization temperature and factors affecting gelatinization
8. Study on germination of pulse;
9. Study on fermentation of cereals and pulses
10. Study on intrinsic quality pulses
11. Induced characteristics- colour, bulk density, odour, size, moisture, infested grain, broken grains and fall in number- comparison with international standards
12. Study the physio chemical characteristics of oils and fats and spoilage of fat
13. Study on enzymatic and non enzymatic browning
14. Study on physical and chemical changes during storage of fruits;
15. Study on effect of cooking acid and alkali on pigments
16. Study on maturity index of fruits and vegetables- colour, flavor, texture, pH, moisture and pigments
17. Visit to cereals, pulses and oil seed processing industries

**II SEMESTER
FOUNDATIONAL ENGLISH II**

Code: 21ENGU01F2

Credit:3

Contact Hours/Week:3

Marks: 100

GRU-BVOC

COMPUTER FUNDAMENTALS AND OFFICE AUTOMATION

Code:

Credit:4

Contact Hours/Week: 4

Marks: 100

GRU-BVOC

FOOD ADULTERATION

Code: 21FTQV0208

Credits: T2 + P0

Hours/week: 2

Marks: 50

Course Objectives

To enable the student to

- educate about common food adulterants and their detection.
- impart knowledge in the legislative aspects of adulteration.
- educate about standards and composition of foods and role of consumer.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- gain the knowledge of food adulteration and influencing activity of food adulterants
- knowledge on regulatory laws and limitations for food adulteration.

UNIT I

Food adulteration – introduction of food adulteration, definition; new adulterants in foods, Historical food legislation in India, Central Food Laboratory, Municipal Laboratories.

UNIT II

Common adulterant in milk, oil and sugar and its identification

UNIT III

Common adulterants in spices, condiments and packed powders and its identification

UNIT IV

Common adulterants in beverages, fruit juices and food colours and its identification

UNIT V

Food Safety and Standards Act 2006; vertical standards Vs horizontal standards; food safety officer- powers, procedures, role of food analyst.

Consumer Education, Consumer problems rights and responsibilities, COPRA 2019 –

Offences and penalties – Procedure to Complain – Compensation to Victims.

TEXT BOOKS

1. Srilakshmi. B, (2008). Food Science, New Age International Pvt Limited Publishers, New Delhi.
2. Shakuntala Manay, N and Shadaksharaswamy ,(2008). Food Facts and Principles. New Age International Publisher, New Delhi.

REFERENCE BOOKS

1. Titus A. M. Msagati, (2012), “The Chemistry of Food Additives and Preservatives”, John Wiley & Sons Publishers.
2. Jim Smith, Lily Hong-Shum (2011), “Food Additives Data Book”, John Wiley & Sons Publishers.
3. Deshpande, S.S. (2002). “Handbook of Food Toxicology”, Marcel Dekker Publishers.
4. A first course in Food Analysis – A.Y. Sathe, New Age International (P) Ltd., 1999.
5. Food Safety, case studies – Ramesh. V. Bhat, NIN, 1992.
6. Food Analysis, 4th Edition. S. Suzanne Nielsen (ed.) 2010. Springer. 3rd Edition

LABORATORY OPERATION AND MAINTENANCE-II

Code:21FTQV0209

Credits: 3 Hours/week: 3

Marks: 100

Course Objectives

To enable the students to

- familiarize the students with laboratory organisation
- enable the students to use the theoretical knowledge in operation and maintenance of laboratories.
- familiarize the students with laboratory organisation
- enable the students to use the theoretical knowledge in operation and maintenance of laboratories.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- design considerations that apply to the lab and to the areas that directly support its operation.
- understand the calibration of equipment and maintain the files and records for stockverification

UNIT I

Calibration of equipments- preparation of standard solution for calibration of equipment's, method used in recording details of lab equipments for performance of falls, repairs and annual maintenance, understanding and working performance of all the equipments, apply industry standards such as GMP, GHP and HACCP.

UNIT II

Laws and regulations: regulations concerning safety and health of workers in industrial laboratories, regulations regarding electricity, fire, alcohol purchase and hazardous substances. Maintains records on sampling and analysis of raw materials, finished products, market sample, equipment calibration and regulatory requirements for different food lab activities.

UNIT III

Hazards in laboratory: Types of Hazards – Physical, Chemical and biological hazards and risk in a laboratory. Factors contributing to laboratory accidents and precaution. Electricity-wiring a plug selection of proper fuse selection of proper flex safe conduct earthing; other dangers associated with electrical equipment; gas: safe LPG connections in laboratory, high pressure gas hazards, detection and handling of gas leakage, low pressure gas hazards.

UNIT IV

Fire hazards in the laboratory: the fire triangle, causes of fires, classification of fires; precautions for fire prevention and use of fire extinguishers; chemical hazards: classification of hazardous chemicals, handling of chemicals and transfer from large container. First Aid: first aid box; what is first aid; placement of first aid box contents of first aid box; first aid treatment of localized injuries, burns, fractures and eye injuries.

UNIT V

Use of computers in laboratory organization and management: components of a computer central processing unit memory input and output devices, computerised systems, overall functions, data input, data processing, data output, application packages, database software spreadsheet, software communication programmes, word processing and software data output.

RELATED EXPERIENCE

1. Demonstration of Instrument calibration
2. Visit of industry that adopt HACCP
3. Demonstration of detection and handling hazards
4. Studying the use of fire extinguishers and demonstration of first aid
5. Generating stock of chemicals and glassware using MS- Excel
6. Visit to different food laboratory

TEXT BOOKS

1. Rao B.V.S, (1963). Operation & Maintenance of Electrical Equipment - Volume I; Media Promoters and Pub Pvt Ltd.
2. Rao B.V.S, (1967). Operation & Maintenance of Electrical Equipment - Volume II; Media Promoters and Pub Pvt Ltd.

REFERENCE BOOKS

1. Rao S, (2010). Testing Commissioning Operation & Maintenance Of Electrical Equipments; Khanna Publishers.
2. National committee for Clinical laboratory standards. 1996. Clinical laboratory manuals, 3rd ed. approved guideline 3P2-3A. Villanova, Pa.

FOOD MICROBIOLOGY

Code: 21FTQV0210

Credits: 3 Hours/week: 3

Marks: 100

Course Objectives

To enable the students to

- understand the role of microbes in food, health and disease.
- study the Microbes in relation to food spoilage, food borne diseases and food preservation.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- the factors influencing the growth of microorganisms in food
- the signs and symptoms of food spoilage and mode of prevention
- the importance of food safety

UNIT- I

Introduction of microbiology, Discovery, current status, classification of microorganism, nomenclature, morphology- yeast and moulds. concept and history of food microbiology; classification of microbes and structure of microbes; industrial application of microbes and their uses, Intrinsic, Extrinsic and Implicit Factors.

UNIT- II

Environmental microbiology: microbiology of air, soil and water, food contamination and its sources. Sanitation inside the food processing premises and outside the unit.

UNIT- III

Public health: food poisoning and food safety. Food borne diseases – bacterial food borne illnesses- staphylococcal food poisoning, bacillus cereus food poisoning, Botulism, Salmonellosis, Shigellosis. Risk Analysis and management.

Non- bacterial food borne diseases: Aflatoxicosis, Ergotism- investigation of food borne disease outbreaks and preventive measures.

UNIT- IV

Food microbiology and spoilage of cereals and cereal products; fruits and vegetable; milk and milk products; poultry, fish and other sea foods, Canned foods, Nuts and Oilseeds.

UNIT- V

Thermal inactivation of microbes: pasteurization, sterilization etc.; concept of TDT, F, Z and D values; factors affecting heat resistance; antimicrobial agents: mechanism and action.

General microbiological methods of enumeration and isolation of bacteria and fungi: Conventional (Serial dilution/ Pour plate technique) and modern methods (RIA).

RELATED EXPERIENCE

1. Perform the sensitivity / threshold tests for four basic tastes.
2. Cleaning and sterilization of glassware
3. Preparation of nutrient broth, potato dextrose and nutrient agar media
4. Preparation of culture media and serial dilution
5. Gram staining and study of morphology of bacterial cell
6. Microbial examination of cereal and cereal products
7. Assessment of quality of raw milk by MBRT
8. Bacteriological analysis (*Coliform* count) of water by MPN method

TEXT BOOK

1. Frazier W.C and Westhoff D.C. (1992). Food Microbiology, Tata McGraw Hill Publishing Co., Ltd. New Delhi.

REFERENCE BOOKS

1. Annak.Joshua, (2001). Microbiology, Popular Book Depot. Chennai-18.
2. Ray, B. (2001) Fundamental Food Microbiology, 2nd Ed, CRC press, Boca raton FL

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3. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=5108>
4. <https://faculty.weber.edu/coberg/class/3853/3853%20historyoffood.htm>
5. https://www.researchgate.net/publication/334595896_History_and_Scope_of_Food_Microbiology
6. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7171901/>
7. <https://emedicine.medscape.com/article/175569-overview>
8. <https://food.unl.edu/food-poisoning-foodborne-illness>
9. <https://aggie-horticulture.tamu.edu/food-technology/bacterial-food-poisoning/>
10. https://www.researchgate.net/publication/260375689_Thermal_Inactivation_of_Microorganisms
11. <https://www.uoguelph.ca/foodscience/book-page/thermal-destruction-microorganisms>
12. [https://medcraveonline.com/JAPLR/antimicrobial-agents.html#:~:text=Antimicrobial%20agent%20is%20a%20general,growth%20of%20microbes%20\(microbiostatic\).](https://medcraveonline.com/JAPLR/antimicrobial-agents.html#:~:text=Antimicrobial%20agent%20is%20a%20general,growth%20of%20microbes%20(microbiostatic).)

FOOD MICROBIOLOGY PRACTICAL

Code:21FTQV0211

Credit: 2

Contact Hours/week:2

Marks: 50

Course Objectives:

- Food microbiology is the study of microorganisms that play major roles in food processing and preservation, general food quality, and may even occur naturally within certain food types.
- It is important to understand these microorganisms and their relation to the food industry in terms of food spoilage, food borne illness or food related intoxication.
- Identify factors essential for the growth of micro-organisms.
- Relate the requirements for bacterial growth to the definition of “Potentially hazardous food”.

Learning Outcomes:

- Students will be equipped with the knowledge to handle microbes and basic instrumentation used in microbiological laboratory.
- Students will be able to identify the various techniques to isolate, characterize the microbes morphologically

Practical Contents:

1. Study of microscope
2. Microbiological laboratory standards and safety protocols.
3. Staining (Simple and gram) of bacteria and morphological study
4. Spore staining of bacteria
5. Staining of molds & yeast and morphological study
6. To prepare nutrient broth and media with agar
7. Culture media preparation for molds and yeast
8. Preparation of slant, stab and plates using nutrient agar
9. Bacterial count with the help of Haemocytometer
10. To study the microflora of curd
11. Standard Plate count method
12. Isolation and identification of Lactobacillus
13. Isolation and identification of Acetobacter

REFERENCES

Adams M. R and Moss M.O. 2008. Food Microbiology. Royal Society of Chemistry.

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1. http://www.uwyo.edu/molb2210_lab/labmanual/lab_03.pdf
2. <http://ecoursesonline.iasri.res.in/mod/resource/view.php?id=101515>
3. <https://microbiologyinfo.com/nutrient-agar-composition-preparation-and-uses/>
4. <http://egyankosh.ac.in/bitstream/123456789/12432/1/Experiment-3.pdf>
5. <https://old.fssai.gov.in/Portals/0/Pdf/15Manuals/MICROBIOLOGY%20MANUAL.pdf>
6. <http://www.egyankosh.ac.in/bitstream/123456789/45805/1/Practical%20Manual.pdf>

FOOD CHEMISTRY

Code: 21FTQV0212

Credits: T3 + P0

Hours/week: 3

Marks: 100

Course Objectives:

To enable the students to

- Gain knowledge regarding the physical and chemical properties of the food constituents
- Understand the chemical and physical changes that occur food during processing

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- Name and describe the general chemical structure of major components of foods (water,carbohydrates, protein and lipids)
- Explain how changes in overall composition are likely to change the reactivity of foodcomponents.
- Predict how processing conditions are likely to change the reactivity of food components.

UNIT- I

Introduction to food chemistry, food constituents: proximate composition of foods, water in foods; water- structure of water and ice, physical constants of water, types of water, water activity.

UNIT- II

Carbohydrate: introduction, definition, classification; general properties of sugar (physical and chemical) identification of common monosaccharides- structure, disaccharides- structure and polysaccharides- structure, chemistry of starch, glycogen, cellulose, gums and crude fibre.

UNIT- III

Protein: physical and chemical properties of amino acids; classification of proteins, and amino acid, sequence in proteins, physical and chemical properties of proteins, molecular weight of proteins, protein denaturation.

UNIT- IV

Lipids: classification of lipids, structure, fatty acid, essential fatty acids, saponification number, acid numbers, iodine value, Changes in fats and oils - rancidity- oxidative and hydrolytic, Lipolysis, Auto-oxidation and preservation. Determination of refractive index and specific gravity of fats and oils.

UNIT-V

Enzymes-introduction, meaning and importance, classification of enzyme, enzyme kinetics, enzyme activity, Immobilised enzymes, factors affecting enzyme activity; pigments- meaning, classification, properties; chlorophyll, carotenoids, anthocyanins, anthoxanthins, flavonoids,tannins, natural flavour constituents , detection of plant pigments.

TEXT BOOKS

1. Potter, N.N. and Hotchkiss, J.H. (1996). Food Science, edition 5, CBS Publishers and Distributors, New Delhi.
2. Damodaran S, K.L. Parkin, and O. Fennema (Eds.), Marcel Dekker, NY, (2007). Fennema's Food Chemistry" 4th Edition. CRC press Taylor & Francis.

REFERENCE BOOKS

1. Seema Yadav, (1997). Food Chemistry, Anmol Publications Pvt.Ltd., New Delhi.
2. Meyer, (1991). Food Chemistry, AVI Publications, New York.
3. Ronsivalli, L.J. and Vieira, E.R. (1992). Elementary Food Science, 3rd Edition, Chapman and Hall, New York.
4. H.D. Belitz, W. Grosch and P. Schieberle, (2009). Food Chemistry 4th edition, Springer publications
5. Srinivasan Damodaran, Kirk L. Parkin and Owen R. Fennema. (2007). Food chemistry (4th edition) CRC Press.
6. John M. DeMan (1999). Principles of Food Chemistry, Springer publications.

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2. <http://154.68.126.6/library/Food%20Science%20books/batch1/Principles%20of%20Food%20Chemistry%203rd%20Edition.pdf>
3. https://edisciplinas.usp.br/pluginfile.php/4937824/mod_folder/content/0/Hans-Dieter%20Belitz%2C%20Werner%20Grosch%2C%20Peter%20Schieberle%20auth.%20Food%20Chemistry.pdf?forcedownload=1
4. <https://agrimoon.com/wp-content/uploads/Food-Chemistry.pdf>

FOOD SCIENCE II

Code: 21FTQV0213

Credits: T2 + P0 Hours/week: 2

Marks: 50

Course Objectives:

To enable the students to

- describe the importance of various foods and their nutritive value and place in daily diet
- study the effects of processing conditions on nutritive value of the foods

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- explain the basic concepts of cooking -and processing- methods applied to various types of food
- describe the science behind the processing and preparation of food products
- find out the importance and role of each ingredients in food products

UNIT- I

Fleshy Foods - meat, fish, poultry: Meat - composition of meat; ageing of meat and characteristics of meat-pH, tenderness, colour, water holding capacity and texture; Fish-composition of fish, organoleptic characteristics of fresh fish, spoilage of fish.

UNIT- II

Poultry – types, composition, nutritive value, selection, methods of cooking. Egg- structure of egg, composition and nutritive value egg, classification, characteristics of fresh egg, deterioration of egg quality, foam formation and factors affecting foam formation.

UNIT- III

Milk and Milk Products: composition of milk and its constituents, various steps in processing of milk; an overview types of market milk and milk products-cheese, paneer, ice cream, ghee, butter, flavoured milk.

UNIT- IV

Introduction to food additives: meaning, need of additives, classification -functions and uses of food additives; generally recognized as safe (GRAS), tolerance levels & toxic levels in foods, E- numbers of different food additives, detection of chemical preservatives in foods.

UNIT- V

Preservatives, antioxidants, colours and flavours (synthetic and natural- spices), sequestrants, humectants, hydrocolloids, sweeteners, buffering salts, anticaking agents – uses and functions in formulations; indirect food additives

TEXT BOOKS

1. Srilakshmi, B (2008). Food Science. New Delhi: Chennai: New Age International Private Limited. Publishers.
2. Swaminathan, M (1988). Food Science and Experimental Foods. Madras: Ganesh and Company.

REFERENCE BOOKS

1. Mudambi, R.S. and Rajagopal, M.Y. (1991). Fundamentals of Food and Nutrition. New Delhi: Wiley Eastern Limited.
2. Mudambi, R.S. and Rao. S (1987). Food Science. New Delhi: Wiley Eastern Limited.
3. Potter, N.M. and Birch, G.G. (1986). Food Science, AVI, West Port, Conn.
4. Bennion, *et al.*, (1985). Introductory Foods. New York: Macmillan.

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3. <https://www.slideshare.net/RoshinaRabail/introduction-to-food-science-and-technology-101>
4. <https://www.slideshare.net/partharoychaudhry/cereals-pulses-36867856>
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6. <http://ecoursesonline.iasri.res.in/mod/resource/view.php?id=147675>

PRACTICAL III- FOOD ADULTERATION

Code: 21FTQV0214

Credits: T0 + P3 Hours/week: 3

Marks: 100

1. Detection of adulterants in food grains and its identification
2. Detection of adulterant in milk and its identification
3. Detection of adulterant in oil and its identification
4. Detection of adulterants in sugar and its identification
5. Detection of adulterants in spices and its identification
6. Detection of adulterants in condiments and its identification
7. Detection of adulterants in packed powders and its identification
8. Detection of adulterants in beverages and its identification
9. Detection of adulterants in fruit juices and its identification
10. Detection of malachite green in green vegetables like bitter gourd, green chilli.
11. Detection of adulterants in food colours and its identification
12. Check list for the application of food laws
13. Visit to FSSAI

PRACTICAL IV- FOOD SCIENCE II

Code: 21FTQV0215

Credits: T0 + P3 Hours/week: 3

Marks: 100

1. Analysis of quality characteristics of meat
2. Study on tenderization of meat
3. Analysis of quality characteristics of fish
4. Analysis of egg quality
5. Analysis the quality of milk and milk products
6. Study on types of beverages
7. Study on quality characteristics of tea leaves and coffee seeds
8. Study on processing methods
9. Sensory Evaluation and preparation of score card.
10. Qualitative test for food additives
11. Testing of food additives in various food products
12. Visit to dairy and poultry industries

THIRD SEMESTER

FOOD PACKAGING

Code: 21FTQV0317 Credits: T3+P0 Hours/week: 3 Marks: 100

Course Objectives

To enable students to

- familiarize with different methods and materials used for packaging.
- understand the technology behind packaging.
- understand interaction of food with packaging & to do shelf life testing.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- the concepts and functions of food packaging
- know packaging of food products from primary to tertiary packaging materials and method .

UNIT I

Introduction to food packaging Definition, functions and requirements for effective packaging, packaging criteria Classification of packaging Primary, secondary and tertiary packaging. Flexible, rigid and Semi- rigid packaging, bulk level packaging, packaging machineries, data management packaging systems.

UNIT II

Materials for food packaging – types, various uses, merits & drawbacks. Paper, Glass, Tin, Aluminium: TFS, Polymer coated tin free steel cans, cellophane, plastics, LDPE, HDPE, LLDPE, HMHDPE, Polypropylene, polystyrene, polyamide, polyester, polyvinyl chloride

UNIT III

Different forms of food containers Boxes, jars, cans, bottle. Packaging requirements for various products-cereals, dairy, edible oil/fat fish, meat, spices, vegetables & fruits, canned foods, dehydrated foods

UNIT IV

Modern concepts of packaging technology. Aseptic packaging, Form-Fill-Seal packaging, Edible Films, Retort pouch packaging, Easy-Open-End, Boil-In-Bags, Closures, tetra-pack, vacuum-

packaging, MAP & CAP, Hyper baric storage, insect resistant packaging, intelligent packaging.
Edible Packaging, label designing, RIF Method, QR code.

UNIT V

Food packaging Laws & Specifications Food packaging Laws & Specifications Quality testing of packaging materials Paper & paper boards-thickness, bursting strength, breaking length, stiffness, folding endurance, ply bond test, surface oil absorption test, puncture resistance, Cobbs test, tearing resistance Flexible packaging materials (plastics)-yield, density, tensile strength, elongation, impact resistance, WVTR, GTR, Overall Migration Rate, seal strength. Transportation hazards and testing Oxygen interactions, moisture interchanges and aroma permeability.

TEXT BOOK

1. Potter, N. N., Hotchkiss, J. H. Food Science . CBS Publishers, New Delhi. 2000.
2. Robertson, G.L. (2006) “Food Packaging: Principles and Practice”. 2nd Edition. Taylor & Francis.

REFERENCE BOOKS

1. Sacharow, S., Griffin, R.C. (2000). Food Packaging. AVI Publishing Company, West Port, Connecticut.
2. Davis, E.G. (2004). Evaluation of tin & plastic containers for foods. CBS Publishers, New Delhi.
3. Cruess, W.V. (2003). Commercial Fruit & Vegetable Products. Allied Scientific Publishers, Delhi.
4. Raj, G .D. Encyclopaedia of Food Science, Vol 2. Anmol Publications PVT Ltd, New Delhi.
5. Ahvenainen, Raija. (2003). “Novel Food Packaging Techniques”. Wood Head Publishing.
6. Mathlouthi, M. (1999). “Food packaging and Preservation. Aspen Publications,
7. Paine, F.A. and Paine, H.Y. (1983). A Handbook of Food Packaging. Leonard Hill, Glasgow, UK.

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2. <https://www.emballagecartier.com/en/article/primary-secondary-and-tertiary-packaging-whats-the-difference/>

3. <https://www.eagri.org>
4. <https://icpe.in>
5. <https://www.dotugo.com/blog/92-packaging/283-different-types-of-packaging-materials.html>
6. <https://matmatch.com/learn/material/materials-used-in-food-packaging>
7. <https://content.ces.ncsu.edu/packaging-requirements-for-fresh-fruits-and-vegetables>
8. <https://archive.fssai.gov.in>

GRUB VOC

SENSORY EVALUATION

Code: 21FTQV0318

Credits: T3+P0

Hours/week: 3

Marks: 100

Course Objectives

To enable students to

- understand different aspects of sensory science and its application.
- use sensory evaluation as an analytical tool.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- understand importance of sensory perception to food quality
- know the scientific method used to evoke, measure, analyze and interpret those responses to products

UNIT I

Introduction, definition and importance of sensory evaluation in relation: to consumer acceptability and economic aspects; factors affecting food acceptance. Terminology related to sensory evaluation.

UNIT II

Principles of good practice: the sensory testing environment, test protocol considerations, Basic principles: Senses and sensory perception, Physiology of sensory organs, Classification of tastes and odours, threshold value factors affecting senses, visual, auditory, tactile and other responses.

UNIT III

Discrimination Tests, Procedure: Types of tests – difference tests\ (Paired comparison, due-trio, triangle) ranking, scoring, Hedonic scale and descriptive tests. Panel selection, screening and training of judges; Requirements of sensory evaluation, sampling procedures; Factors influencing sensory measurements.

UNIT IV

Consumer Research – Affective Tests: Objectives. Methods, types or questionnaires, development of questionnaires, comparison of laboratory testing and Consumers studies, limitations. Data analysis- Concept of mean, mode, median and standard deviation.

UNIT V

Interrelationship between sensory properties of food products and various instrumental and physico-chemical tests; Quality Evaluations Application of sensory testing: sensory evaluation in food product development, sensory evaluation in quality control, scaling techniques and Experimental design.

TEXT BOOKS

1. Srilakshmi,B., (2008). Food Science, New Age International (P) Limited, New Delhi.
2. Manay,S., Shadaksharaswamy,M., (2008). Food Facts and Principles, New Age International (P) Limited., New Delhi.

REFERENCE BOOK

1. Amerine, M.A., Pangborn, R.M. and Rossles, E.B. 1965. Principles of Sensory Evaluation of Food. Academic Press, London.
2. Jellinek, G. 1985. Sensory Evaluation of Food - Theory and Practice. Ellis Horwood.
3. Lawless, H.T. and Klein, B.P. 1991. Sensory Science Theory and Applicatons in Foods. Marcel Dekker.
4. Piggot, J.R. 1984. Sensory Evaluation of Foods. Elbview Applied Science Publ.
5. Potter, N.N. and Hotchleiss, J.H. 1997. Food Science. 5th Ed. CBS Publishers, Delhi.
6. Rai, S.C. and Bhatia, V.K. 1988. Sensory Evaluation of Agricultural Products. Indian Agricultural Statistics Research Institute (ICAR), New Delhi.
7. Stone, H. and Sidel, J,L. 1985. Sensory Evaluation Practices. Academic Press.
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6. https://books.google.co.in/books/about/Sensory_Evaluation_of_Food.html?id=u-XpBwAAQBAJ&printsec=frontcover&source=kp_read_button&redir_esc=y
7. https://en.m.wikipedia.org/wiki/Sensory_threshold
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12. https://www.contractlaboratory.com/labclass/industries/consumer_products.cfm
13. <https://www.packworld.com/home/article/13364005/consumer-research-and-its-limitations#:~:text=Consumers%20don't%20understand%20their,way%20in%20the%20right%20context.>
14. https://www.contractlaboratory.com/labclass/industries/industry-details.cfm?consumer-products-testing&industry_id=18
15. <https://www.slideshare.net/mobile/Tamilselvan245/sensory-evaluation-and-quality-control>
16. <https://www.sciencedirect.com/science/article/abs/pii/095032939390314V>

PRINCIPLES OF FOOD PRESERVATION

Code: 21FTQV0319

Credits: T2+P0

Hours/week:2

Marks: 50

Course Objectives

To enable students to

- understand the types of spoilage occurring in foods
- gain knowledge and acquire skill on various methods of food preservation..

Specific Learning Outcomes:

On Successful Completion of this course, the students will be able to

- understand the concepts and principles of food preservation
- preserve food products from plant sources

UNIT I

Introduction to food processing: Basic principles, importance of food processing and preservation, classification of foods- Perishable, non- perishable and semi- perishable. Types of food spoilage, viz. microbiological, enzymatic, chemical and physical spoilages and their effects on food quality.

UNIT II

High temperature processing: Principles of thermal processing, Pasteurization and Sterilization, microbial destruction in batch and continuous sterilization, canning of foods, categories of foods for canning, heat penetration into food containers, calculating the process time for canned food, UHT processing, Irradiation and Microwave processing of foods.

UNIT III

Low temperature processing: Low temperature required for different foods, Refrigeration, chilling and Freezing of food, freezing principles, low and fast freezing, freezing process, determining freezing load, ammonia refrigeration systems, freezing rate, estimation of freezing time of foods, Types of freezers, thawing of frozen food.

UNIT IV

Processing by Moisture Removal: Evaporation, Concentration and Dehydration, Drying operation, Drying of solid and liquid foods, Types of dryers, their advantages and disadvantages, Concentration of liquid food by evaporators, Membrane processes for liquid food concentration. Water activity (aw) in foods: Role of water activity in food preservation. Microwave heating : Principles and application in food processing.

UNIT V

Use of preservatives: Sugar and salt preservation, use of chemical preservatives in food, types of fermentation of sugars, smoking, sulphating and pickling, purposes and advantages.

Recent advances in food preservation- Pulse electric field, use of technology for minimal processing for preservation of fresh foods, use of natural preservatives, preservatives on food labels.

TEXT BOOKS

1. Srilakshmi B (2008). Food Science, New Age Publisher Pvt Limited, New Delhi.
2. Subbulakshmi G and Shobha A. Udipi (2006). Food Processing and Preservation. New Age International Publishers.

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2. Girdharilal, G.S *et al.*, (1986). Preservation of Fruits and Vegetables. New Delhi: Publications and Information Division, ICAR.
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5. <http://www.uop.edu.pk/ocontents/Lecture%20no%202.pdf>
6. <https://www.slideshare.net/mohitjindal/principles-and-methods-for-food-preservation-149113723>
7. https://www.brainkart.com/article/Principles-and-Methods-of-Food-Preservation_2108/

PRACTICALS V- PRINCIPLES OF FOOD PRESERVATION

Code: 21FTQV0320 Credits: T0+P4 Hours/week:4 Marks: 100

1. Demonstration of various machineries used in food preservation.
2. Identification of class I & class II preservatives.
3. Demonstration on effect of blanching on quality of foods.
4. Demonstration on canning and bottling of fruits and vegetables.
5. Preservation of food by high concentration of sugar - preparation of squash
6. Preservation of food by using salt - Pickle
7. Preservation of food by using chemicals- jam
8. Drying of fruit slices in cabinet drier
9. Demonstration on drying of green leafy vegetables
10. Osmotic dehydration of foods e.g. candy
11. Drying of foods using freeze-drying & spray drying process.
12. Preservation of food by fermentation (idli, curd, dhokla etc.)
13. Visit to food preservation industries and small scale industries

REFERENCE BOOKS

1. Hersom AC & Hulland ED. 1980. Canned Foods. Chemical Publ. Co.
2. Larousse J & Brown BE. 1997. Food Canning Technology. Wiley VCH.
3. Stumbo. 1973. Thermo Bacteriology in Food Processing. CRC, Academic Press.
4. Thorne S. 1991. Food Irradiation. Elsevier.
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TECHNIQUES IN FOOD ANALYSIS

Code: 21FTQV0321

Credits: 3

Hours/week: 3

Marks: 100

Course Objectives:

- To provide students a conceptual introduction to the various instrumental techniques in food analysis
- To understand the applications, strengths and limitations of the methods in food analysis.

Specific Learning Outcomes:

On completion of the course the student will be able to:

- Demonstrate interaction of food by using different analytical techniques
- Assess physico-chemical properties of foods

UNIT I

Methods of analysis, introduction and scope of various analytical methods for food samples such as food color, pH value, turbidity, etc. Uses and roles of various grinding instruments/machines for preparation of samples for analysis.

UNIT II

Methods of moisture analysis in foods – drying methods, types of oven – Convection oven, Forced draft oven, Vacuum oven, Microwave oven, Infrared lamping, moisture analyser. NIR techniques, isothermic technique. Methods for separations- Decantation, Distillation, Centrifugation, identification and quantification of various food components

UNIT III

Separation methods – filtration, centrifugation, sedimentation, etc. Electrophoretic methods for protein: gel electrophoresis, continuous electrophoresis, paper electrophoresis, high voltage electrophoresis, starch gel electrophoresis, Agar and Agarose gel, PAGE, SLAB PAGE.

UNIT IV

Basic principles of spectroscopy instruments : UV, visible and fluorescence spectroscopy. Colorimetric methods of analysis for protein, amino acids, carbohydrates, sugars, vitamins, near infrared analytical techniques for moisture proteins, fats, fibers, vitamins, mineral etc Atomic absorption spectrophotometric method for minerals analysis.

UNIT V

Uses and basic instrument of HPLC – types of column and their applications, high pressure pumps, various type of detectors for HPLC methods. Uses and basic instrument of gas chromatograph and gas liquid chromatography (GLC) mass spectrophotometers and their applications in food analysis. Polarimetric and Refractometric techniques (refractive index) and instruments for various food.

TEXT BOOKS

1. Suzanne Nielson S (2003) Food analysis, Kluwer Academic Press, New York. Winton AL (1999) Techniques of food analysis, Allied Science, Official methods of analysis, Association
2. Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methods for Quality Assurance in Foods, MarcelDekker, Inc. New York

REFERENCES

1. James CS (1998). Analytical chemistry of foods, Blackic Acad, UK. Winton, AL (1999). Techniques of food analysis, Allied Science Publication, New Delhi.
2. Song, DWS (1996) Mechanism and theory in food chemistry Champasian and Hall Inc. New York..
3. DeMan, J.M., Voisey, P.W. Rasper, V.F. and Stanley, D.W. (1976): Rheology and Texture in Food Quality, the AVI Publishing Co. Inc, West Port.
4. Skoog, D.A., Holler, F.H. and Nieman (1998): Principles of Instrumental Analysis Saunders College Publishing, Philadelphia.
5. Gruenwedel, D.W.; Whitaker, J.R. (editors) (1984): Food Analysis Principles and techniques, Volumes 1 to 8, Marcel Dekker, Inc., New York.
6. Pare' J.R.J.,Belanger J.M.R.: Instrumental Methods in Food Analysis, Elsevier Publications
7. Herschdoerfer, S.M. (ed) (1968 – 1987): Quality Control in the Food Industry, Vols. 1 to 4, Academic Press, London.

WEBOGRAPHY

1. <https://www.labcompare.com/Food-Testing-Equipment/>
2. <https://www2.chemistry.msu.edu>
3. <https://www.khanacademy.org>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5206469/>

FOOD ANALYSIS

Code: 21FTQV0322

Credits: T2+P0

Hours/week: 2

Marks: 50

Course Objectives

To enable the students to

- Understand different sampling techniques employed in chemical analysis of foods.
- learn various chemical methods of food analysis and proximate analysis.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- Know the methods of sampling and handling equipments used for food analysis.
- Perform nutrient analysis of foods

UNIT I

Introduction to food analysis; Sampling, Population; Proximate Principles; Importance of sampling; Sampling technique; Types of sampling; Sampling Plan; Preparation of samples and Problems in sampling

UNIT II

Analysis of foods: Moisture analysis- Oven drying method, distillation method. Total carbohydrate analysis: Alkaline ferric cyanide method, Phenol-sulphuric acid method, starch analysis. Fibre Analysis, crude fibre analysis, dietary fibre analysis by AOAC method. Protein analysis: Kjeldahl method, Biuret method, Lowry method, BCA method, Barford's method, Ninhydrin method, Amino acid analysis.

UNIT III

Fat Analysis: Continuous solvent extraction method, Smoke point, Flash and Fire point, Iodine Value, Saponification Value, Acid Value, Peroxide Value. Estimation of Total fatty acids, characterization of fats- Melting point, Oxidation, determination of lipid composition: separation and analysis by chromatography, lipid fractions of TLC.

UNIT IV

Vitamins: Vitamin A by Carr-Price method, HPLC; Vitamin C- Ascorbic acid dichloroindophenol method; Vitamin D- Line test, Mineral- Calcium- Gravimetric, EDTA and redox titration; Iron – Redox titration; Phosphorous- colorimetry, atomic absorption spectroscopy.

UNIT V

Antinutritional and toxic constituents of foods, various types and chemical nature of antinutritional factors, their significance and methods of analysis. Various flavour components and additives of food and their chemical nature and analysis. Application of enzymes in food analysis.

TEXT BOOKS

1. Fennema, OR. Food Chemistry, McGraw Hill Publ. Belitz, HD and Grosch, W. Food Chemistry, Springer – Vantage Publ

REFERENCE

1. Kalia, M. Food Analysis and Quality Control. Kalyani Publishers, New Delhi. 2002.
2. Winton, A.L and Winton, K.B. Techniques of food analysis. Allied Scientific Publishers, New Delhi. 1999.
3. Nielsen, S.S. Introduction to the chemical analysis of foods. Jones and Bartlett Publishers, Boston, London. 2003.
4. Connell, J.J. Control of fish quality. Blackwell Scientific Publications, Cambridge

WEBOGRAPHY

<http://www.fao.org/3/Y5022E/y5022e03.htm>

<https://www.sciencedirect.com/topics/chemistry/food-analysis>

http://www.fsis.usda.gov/Science/Hazard_Analysis_%5C%26_Pathogen_Reduction/index.asp

FOOD SAFETY SYSTEMS IN DAIRY INDUSTRIES

Code: 21FTQV0323 Credits: T3+P0 Hours/week: 3 Marks: 100

Course Objectives

To enable student to

- provide exposure and awareness on food safety systems in dairy industries
- identify the sources for food standards, regulations and specifications prescribed by different certificate bodies
- implement strong control systems through different techniques

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- gain knowledge for identifying food safety problems
- build confidence among the students to handle the food safety projects in dairy industries.

UNIT I

Introduction: Current status of dairy industry-production-consumption-systems and structures-safety and quality problems in imports and exports, Food safety policies in dairy industry. Dairy development programme implemented in India.

UNIT II

Dairy Chemistry: Milk Composition – Physico Chemical properties of milk – Animal, Feed and Environmental factors influencing the composition of milk – Milk lipids, Proteins, Sugar and their biosynthesis, classes and significance – Minerals and Vitamins in Milk – Thermal stability of Milk – Freezing Point depression of Milk. UHT- Types, direct & indirect heating, advantages and disadvantages, changes in UHT milk during processing and storage.

UNIT III

Quality Analysis of Milk : Sensory analysis of Milk – Determination of Specific gravity, fat, SNF, TS, Acidity and pH in milk and their significance and interpretation – Determination and significance of MBR Test – SPC – Phosphatase activity in milk – Common adulterants in milk and their detection techniques – Advanced analytical techniques in milk and milk products

UNIT IV

Food Safety Processes in Dairy Industry: General practices- Reception- chilling- clarification- Pasteurization, sterilization- Ultra high temperature treatment- grading of raw milk prevention of nutritional losses- legal requirements of packaging materials and labeling. Food Safety Legislations and Enforcement Procedures: Prevention of food adulteration Milk and milk product order-agricultural produce act- export quality control and inspection act live stock importation ac

UNIT- V

Consumer Food Safety Management: Development and organization on training programmes for food handler's inspectors- analysts-food borne diseases due to milk contaminants ,adulterants and contaminants in milk and milk products. Certification Bodies: Implementation of hazard analysis critical control point in dairy industry, food quality and safety management system. Practices on controlling contaminants in milk-guidelines on good manufacturing practices, APEDA -Effluent treatment- international certification for dairy.

TEXT BOOK

1. Vijayendra, S. V. N. (2011) "*Food Safety Systems for Dairy Industries*". All India Seminar on Emerging Technologies in Dairy Industry. pp. 19-25.

REFERENCE BOOKS

1. Food safety and standards authority of India expert group milk and milk products (2010) NDDDB publication (Edition I)
2. Early R.(1995)."*Guide to Quality Management Systems for Food Industries*". Blackie Academic.
3. Krammer A & Twigg BA.(1973). "*Quality Control in Food Industry*". Vol. I, II. AVI Publication.
4. Dairy Science: Petersen (W.E.) Publisher – Lippincott & Company 2. Outlines of Dairy Technology – Sukumar (De) – Oxford University press 3. Indian Dairy Products – Rangappa (K.S.) & Acharya (KT) – Asia Publishing House.
5. The technology of milk Processing – Ananthakrishnan, C.P., Khan, A.Q. and Padmanabhan, P.N. – Shri Lakshmi Publications.

WEBOGRAPHY

<http://www.fsis.usda.gov/>

<http://www.cfsan.fda>

https://www.fao.org/infoods/index_en.stm).

<https://www.onlinebiologynotes.com>

PRACTICALS VI- FOOD ANALYSIS

Code: 21FTQV0324

Credits: T0+P4

Hours/week:4

Marks: 100

1. Estimation of Moisture
2. Estimation of Ash
3. Estimation of Crude fibre
4. Estimation of sugar by Phenol Sulphuric acid method
5. Estimation of sugar by Alkaline ferric cyanide method
6. Estimation of carbohydrate by anthrone method.
7. Estimation of Protein by Lowry's method and Kjeldahl Method
8. Saponification Value of oils/fats
9. Acid value of oils/fats
10. Estimation of ascorbic acid, beta carotene, and B vitamins using spectroscopic methods
11. Estimation of calcium, Phosphorus and Iron using spectroscopic methods
12. Analysis of Phytochemicals and antioxidants
13. Visit to food analysis laboratories –National and Regional

REFERENCE BOOKS

1. Lab Manual for analysis of foods:, FSSAI 2015

WEBOGRAPHY

1. <https://gpadampur.files.wordpress.com/2011/11/6-2-faqc-practicals-08022014.pdf>

PRACTICAL VII- QUALITY EVALUATION OF MILK AND MILK PRODUCTS

Code: 21FTQV0325 Credits: T0+P4 Hours/week: 4 Marks: 100

1. Determination of Acidity (Titrable Acidity) of Milk.
2. Determination of fat and SNF content in milk.
3. Determination of total solids (Gravimetric method).
4. Clot on boiling test for milk.
5. Determination of specific gravity of milk.
6. Detection of Addition of Starch, glucose, water, sodium chloride, urea, cellulose and nitrates in Milk
7. Pasteurization test
8. Test for syneresis in yoghurt and curd
9. Test for Adulterants in milk, ghee and butter 9. Preparation of flavoured milk and quality analysis
10. Visit to milk processing unit .

REFERENCE BOOKS

Lab Manual for analysis of foods: Milk and Milk products ,FSSAI 2015

WEBOGRAPHY

1. Online Fssai lab manual 1: manual of methods of analysis of foods milk and milk products.
2. <http://www.fao.org/dairy-production-products/products/quality-and-testing/en/#:~:text=Good%2Dquality%20raw%20milk%20has,the%20quality%20of%20milk%20products.>
3. <http://www.fao.org/ag/againfo/resources/documents/mpguide/mpguide2.htm>
4. <https://agriquora.com/blog-details/milk-quality-tests>
5. [https://old.fssai.gov.in/Portals/0/Pdf/Draft Manuals/MILK AND MILK PRODUCTS.pdf](https://old.fssai.gov.in/Portals/0/Pdf/Draft%20Manuals/MILK%20AND%20MILK%20PRODUCTS.pdf)
6. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=6180>

SEMESTER
INTERNET AND WEB TECHNOLOGY

Code: **Credit:4** **Contact Hours/week:4** **Marks:100**

(Course will be offered by the Department of Computer Science Applications, GRI)

GRI-BVOC

GANDHI'S LIFE, THOUGHT, WORK

Code: 21GSPSU001

Credit: 2

ContactHours/week:2

Marks:50

(Course will be offered by the Department of Gandhian Thought and social work, GRI)

GRI-BVOC

FOOD QUALITY ASSURANCE

Code: 21FTQV0427 Credits: T4+P0 Hours/week: 4 Marks: 100

Course Objectives

To enable students to

- acquaint with food quality parameters and control systems, food standards, regulations, specifications.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- understand the principles and framework of food safety.
- apply preventive measures and control methods to minimize microbiological hazards and maintain quality of foods.
- identify the wide variety of parameters affecting food quality.

UNIT I

Concept of quality: Quality attributes- Intrinsic and Extrinsic factors, physical, chemical, nutritional, microbial, and sensory; their measurement and evaluation; Sensory *vis-à-vis* instrumental methods for testing quality.

UNIT II

Concepts of quality management: Objectives, importance and functions of quality control, Quality management systems in India, Sampling procedures and plans, Food Safety and Standards Act, 2006, Domestic regulations, Global Food safety Initiative, Various organizations dealing with inspection, traceability and authentication, certification and quality assurance –PFA, FPO, MMPO, MPO, AGMARK, BIS; Labeling issues, international food standards.

UNIT III

HACCP system: Hazard analysis Critical Control Point: Definition, principles, Guidelines for the application of HACCP system. Biosafety concept, principles and safety levels; EMS/ laboratory Management System – ISO 17025; NABL Accreditation of Food laboratory, Statistical Quality Control.

UNIT IV

Food Quality Laws and Regulations: Quality assurance, Total Quality Management, GMP/GHP, GLP, GAP, Sanitary and hygienic practices, HACCP, Quality manuals, documentation and audits; Indian & International quality systems and standards like ISO and Food Codex, Export import policy, export documentation, Laboratory quality procedures and assessment of laboratory performance, Applications in different food industries, Food adulteration and food safety.

UNIT V

Quality Improvement Techniques: Quality Improvement Plans (QIP); Quality Control Circles (QCC) and Total quality management (TQM) – seven tools of TQM, implementation of TQM, Bench marking approach and process, PDCA cycle.

TEXT BOOKS

1. Bhatia,R. and Ichhpujan,R.L. (2004) Quality assurance in Microbiology. CBS Publishers and Distributors, New Delhi. .
2. Kher, C.P. (2000) Quality control for the food industry. ITC Publishers, Geneva. .
3. Philip,A.C. Reconceptualizing quality(2001)New Age International Publishers, Bangalore.

REFERENCE BOOKS

1. Yong-Jin Cho, Sukwon Kang.(2011), “Emerging Technologies for Food Quality and Food Safety Evaluation” ,CRC Press.
2. Alli Inteaz, (2003), “Food Quality Assurance: Principles and Practices”, CRC Press.
3. Vasconcellos J. Andres, (2003), “Quality Assurance for the Food Industry: A Practical Approach”,CRC Press.

WEBOGRAPHY

1. https://en.wikipedia.org/wiki/Quality_assurance<https://www.omicsonline.org/scholarly/food-quality-assurance-journals-articles-ppts-list.php><http://www.fao.org/3/v5380e/V5380E05.htm>
2. <https://www.aaps.ca/principles-of-qaqc-in-the-food-industry.php>
3. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1019>
4. <http://egyankosh.ac.in/bitstream/123456789/11486/5/Unit-1.pdf>
5. https://www.researchgate.net/publication/304351925_Relationship_between_sensory_and_instrumental_measurement_of_texture

6. https://www.dlg.org/fileadmin/downloads/lebensmittel/themen/publikationen/expertenwissen/lebensmittelsensorik/e_2015_2_Expertenwissen_Electronic_Noses.pdf
7. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/food_technology/food_analysis_and_quality_control/08.sensory_analysis_of_foods/et/2613_et_m8.pdf
8. <https://www.yourarticlelibrary.com/production-management/quality-control-meaning-importance-definition-and-objectives/26174>
9. <http://www.fao.org/3/i1379e/i1379e05.pdf>
10. https://www.indiacode.nic.in/bitstream/123456789/7800/1/200634_food_safety_and_standards_act%2C_2006.pdf
11. https://ourworldisnotforsale.net/2017/Domestic_Regulation.pdf
12. <https://www.grains.k-state.edu/spirel/docs/conferences/mb-alternatives/presentation/m%20olewnik.pdf>
13. https://en.wikipedia.org/wiki/Global_Food_Safety_Initiative
14. <https://www.fda.gov/food/hazard-analysis-critical-control-point-haccp/haccp-principles-application-guidelines>
15. [http://elearning.nokomis.in/uploaddocuments/Quality%20Management%20in%20Health%20care/chp%204%20Quality%20Control%20Circle%20\(QCC\)/Summary/Chapter%204.pdf](http://elearning.nokomis.in/uploaddocuments/Quality%20Management%20in%20Health%20care/chp%204%20Quality%20Control%20Circle%20(QCC)/Summary/Chapter%204.pdf)

QUALITY EVALUATION OF PACKAGING MATERIALS

Code: 21FTQV0428

Credit:2

Contact Hours/Week: 2

Marks: 50

Course Objectives

- To be familiar with various methods of packaging techniques
- To understand the technology behind packaging materials

UNIT I Introduction of Food packaging

Need of food packaging, Role of packaging in extending shelf life of foods. Designing of package materials. Testing of package materials. Testing of package performance. Principles in the development of safe and protective packing, Safety assessment of food packaging materials.

UNIT II Packaging of different food products

Packaging of spices, pickles, garam masala & condiments. Packaging of edible oil, fats & vanaspati. Packaging of milk & dairy products, Indian sweetmeats, confectionaries. Packaging of biscuits & bakery products. Packaging of fresh fruits & vegetables.

UNIT III Testing and Quality control of Packaging Material

Testing of paper and paper board. Testing of adhesives. Testing of flexible laminates and rigid containers. Testing of oxygen and moisture vapor transmission rates of films and packages. Migration of components from packaging materials, ASLT, sensory evaluation, BIS specifications and standards. Packaging machinery sealers and filling lines.

UNIT IV Quality Evaluation of Packaging Material

Important quality evaluation methods, Identification of packaging materials, Quality evaluation of fabricated Packaging. Evaluation of glass bottles- dimensional measurements, pressure test, thermal shock test, impact test.

Current trends in packaging technologies- Aseptic filling/ processing, Ohmic/ Induction heating, Sous vide Cooking, Steam/ Vacuum cooking.

UNIT V Regulations on packaging materials

Packaging materials and Environmental impact and management. Packaging laws, standards of weights and measures act 1976 and SWMA 1977, PFA 1954, Feeding bottles and infant foods act 1992, FPO, Jute control order, HACCP, Regulations and Standards, FSSAI (India), IMDG and UN Protocol. Sustainability concepts in Packaging Industry Inter material and Interpolymer Competition in

Packaging end-use applications.

BOOK REFERENCE:

1. Anon (1992)Advisory Committee on the microbiological safety of the food. Report on vacuum packaging and associated processes, HMSO, LONDON, ISBN 0-11-321558-4.
2. Anon (1999) MSI Data Report: Modified Atmosphere Packaging: UK MSI.
3. Gill, C.O (1990) Controlled atmosphere packaging of Chilled meat. Food Control, 1, 74- 79.
4. King, A. D and Nagel, C.W (1975) Influence of Carbon dioxide up on the metabolism of Pseudomonas aeruginosa J. Food science., 40, 362.
5. Valley, G. And Rettger, L. F. (1927) The Influence of carbon dioxide on bacteria, J. Bacteriol., 14, 101-113.

WEBOGRAPHY

https://moodle.isekifood.net/pluginfile.php/2417/mod_data/content/3667/Food%20Packaging.pdf

<https://www.yorksaw.com/types-of-food-packaging/>

<https://matmatch.com/learn/material/materials-used-in-food-packaging>

https://www.newworldencyclopedia.org/entry/Food_packaging

<https://gcwgandhinagar.com/econtent/document/1586855195EvaluationOfPackagingMaterials.pdf>

<https://foodsafetyhelpline.com/fssai-notifies-the-new-packaging-regulation-2018/>

BAKERY AND CONFECTIONARY

Code: 21FTQV0429

Credits: 4

Hours/week: 4

Marks: 100

Course Objectives

To enable students to

- impart basic and applied technology of baking and confectionary and acquaint with the manufacturing technology of bakery and confectionary products.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- highlight the processing methods used in baking and confectionery industries.
- know about the various types of food products made using baking technology.
- able to start a small scale bakery and confectionery unit

UNIT I

Bakery products: Scope of bakery & confectionery, organization chart for bakery, Types, specifications, compositions, ingredients Cereals and millets, formulations, processing, equipment, packaging, storage and quality testing.

UNIT II

Confectionery and chocolate products: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing, fundamentals of science of chocolate, equipments used in chocolate candy making.

UNIT III

Bread making: Methods, : Different types of bread and preparation of bread using different methods, quality evaluation of bread, staling of bread, variation of bread, factors affecting the quality of bread.

UNIT IV

Different types of biscuits and preparation of biscuits using different methods, quality evaluation of biscuits, Preparation of other bakery products: bun, rusks, crackers, muffins and pizza quality evaluation.

UNIT V

Packaging and Regulation for bakery products: Packaging, storage and distribution- Food regulations and standards-National and International level, conduct manual/automatic packaging/labelling operation of finished baked products.

REFERENCE BOOKS:

1. NIIR Board of Consultants & Engineers. 2014. The Complete Technology Book on Bakery Products (Baking Science with Formulation & Production), 3rd Ed. NIIR, New Delhi.
2. Peter P. Grewling. 2013. Chocolates & Confections, 2nd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. E.J. Pyler and L.A. Gorton. 2009. Baking Science & Technology, Vol. II: Formulation & Production, 4th Ed. Sosland Publishing Company, Kansas City, MO, USA.
4. John J. Kingslee. 2006. A Professional Text to Bakery and Confectionery. New Age International, New Delhi.
5. Harold Corke, Ingrid De Leyn, Nanna A. Cross, Wai-Kit Nip, Y.H. Hui. 2006. Bakery Products: Science and Technology. Blackwell Publishing Ltd., Oxford, UK.
6. E.B. Jackson. 1995. Sugar Confectionery Manufacture, 2nd Ed. Springer-Verlag, US.
7. Zhou. W, Hui Y,H; (2014), "Bakery Products Science and Technology", 2nd Edition, Wiley Blackwell Publishers,
8. Stanley P. Cauvain, Linda S. Young, (2008), "Baked Products: Science Technology and Practice". John Wiley & Sons Publishers.
9. Practice". John Wiley & Sons Publishers.
10. Ouaouich and Peter Fellows. 2004. Cereal Milling and Bakery Products. Production Methods, Equipment and Quality Assurance Practices. FAO Publications, Rome.
11. Fellows, P.J., Axtell, B. and Dillon, M. 1995. Quality Assurance for Small Scale Rural Food Industries, FAO Agricultural Services Bulletin # 117, FAO Publications Assuring food safety and quality.2003.FAO Food and Nutrition Manual., FAO Publications, Rome.

WEBOGRAPHY

<https://en.wikipedia.org/wiki/Confectionery>

<https://www.bakingmad.com/recipes/confectionery>

<https://archive.lib.msu.edu/MMM/JA/11/b/JA11b019.pdf>

QUALITY EVALUATION OF FOOD GRAINS AND ITS PRODUCTS

Code: 21FTQV0430

Credits: T4+P0

Hours/week: 4

Marks: 100

Course Objectives

To enable students to

- acquaint with production and consumption trends, structure, composition, quality evaluation, and processing technologies for product development and value addition of various cereals.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- create awareness about the processing of major cereals like paddy, maize
- study the storage and handling techniques of cereals
- gain knowledge on processing and milling of cereals

UNIT I

Introduction, Grain structure-wheat, rice and millets, Grain Quality Parameters, Length and Width, Aspect Ratio, Texture, Chalkiness, Whiteness, Damaged / discolored grains, Breakage and cracking, Immature, Yellowing, Adulteration, Yield, Technical Terms

UNIT II

Manual Techniques for Grain Analysis, Grain analysis methods, Approximately circular seed, Grain size analysis, Sieving Method, Manual and mechanical sieving: Single sieve and sieve set sieving: Conventional Image Based Grain Analysis Techniques, Automatic grain quality inspection

UNIT III

Grain Analysis Standards, Importance of standards, Rice standard organizations, Bureau of Indian Standards (BIS), Directorate of Marketing & Inspection (DMI), Department of Food & Public Distribution (DFPD), CODEX Standards, The African Organisation for Standardisation Standards (ARSO : ARS 464 (English) : Milled Rice Specification 2012), Cambodia milled rice standards(CS053:2014-Rev.1)(International Financial Corporation 2014), United States standards for rice by USDA, Food and Agriculture Organisation of United Nations

UNIT IV

Biodeterioration: Principles, types of biodeterioration, Moulds and mycotoxins, The significance of mycotoxins. The interaction mycotoxins, The control of mycotoxins, Sampling and analysis. Biocides, Rodent and insect control on storage of grains, controlling food biodeterioration.

UNIT V

Quality evaluation of grain products: Intrinsic Qualities – Colour, Composition, bulk density, odour, aroma. Induced Qualities-age, broken grain, chalky or immature grain, foreign matter, moisture content. Microscopic structure of grain starches, Physico chemical properties of flours, shelf life analysis of grain flours, determination of intentional and unintentional adulterants in grain flours and its products.

TEXT BOOKS

1. Boxall, R.A. and Gough, M.C. (1992a) Investigation of technical problems associated with the distribution of food grain from temperate to tropical regions. NRI Report 4: A study of a shipment of food-aid maize to Angola. Chatham, UK: Natural Resources Institute. 71pp

REFERENCE BOOKS

1. Boxall, R.A. and Gough, M.C. (1992b) Investigation of technical problems associated with the distribution of food grain from temperate to tropical regions. NRI Report 5: A study of a second shipment of food-aid maize to Angola. Chatham, UK: Natural Resources Institute. 40pp.
2. Conway, J.A., Daplyn, P.F., Clarke, P.A. and Twiddy, D.R. (1992) A study in the determination of quality/value relationships in rice. NRI Bulletin 55: Chatham, UK: Natural Resources Institute. 45pp.
3. Foster, G.H. (1982) Drying Cereal Grains. In Storage of Cereal Grains and Their Products. C M Christensen, Ed. St Paul: American Association of Cereal Chemists Inc. 79116.
4. Jewers, K., Coker, R.D., Jones, B.D., Cornelius, J., Nagler, M.J., Bradburn, N., Tomlins, K., Medlock, V., Dell, P., Blunden, G., Roch, O.G. and Sharkey, A. (1989) Methodological developments in the sampling of foods and feeds for mycotoxin analysis. Journal of Applied Bacteriology Symposium Supplement: 105S-116S.

WEBOGRAPHY

1. <https://pdfs.semanticscholar.org/94e1/4d258349e588ff4cbe7f89a445c419467581.pdf>
2. <https://www.sciencedirect.com/topics/food-science/grain-quality>
3. <https://www.sciencedirect.com/science/article/abs/pii/S0956713517301329>
4. <http://www.fao.org/3/x5036e/x5036E17.htm>
5. <http://ecoursesonline.iasri.res.in/mod/resource/view.php?id=147675>
6. <http://www.fao.org/3/t0567e/T0567E0a.htm>
7. <http://www.goenfoods.com/wheat-grain-structure/>
8. https://www.researchgate.net/figure/General-structure-of-millet-grain_fig1_318921493

PRACTICAL VIII- QUALITY EVALUATION OF FOOD GRAINS AND ITS PRODUCTS

Code: 21FTQV0431 Credits: T0+P4 Hours/week: 4 Marks: 100

1. Determination of refractions in grain: Filth, karnal bunt and ergot
2. Determination of functional properties of the various grain flours.
3. Microscopic structure of grains
4. Evaluation grain quality parameters: Length, width, and aspect ratio, texture, chalkiness, whiteness, damaged and discolored grains, immature and yellowing.
5. Grain analysis: Shape, Sieving,
6. Estimation of Gluten Content of flour.
7. Estimation of moisture in grains
8. Determination of sedimentation power of flour
9. Determination of adulterants in flour
10. Study of physico-chemical properties of flours
11. Nutrient quality of grain flours-protein, fat, carbohydrate, fiber, ash and vitamins 11. Visit to rice and millet processing units and regional institutes

REFERENCE:

1. Manual of methods of analysis of foods, cereals and cereal products, FSSAI, 2016

WEBOGRAPHY

1. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=90220>
2. <https://rfssh.wordpress.com/2014/09/25/estimation-of-crude-fibre/>
3. <https://discoverfoodtech.com/soxhlet-extraction-method/>
4. <https://discoverfoodtech.com/protein-estimation-by-kjeldahl-method/>
5. <https://cwsimons.com/determination-of-ash-content/#:~:text=Ash%20content%20represents%20the%20inorganic,at%20500%20%E2%80%93%20600%20oC.&text=Ash%20content%20determination%20is%20widely,quality%20measure%20for%20flour%20extraction.>
6. <http://egyankosh.ac.in/bitstream/123456789/33675/1/Practical%208.pdf>

PRACTICAL IX- QUALITY EVALUATION OF BAKERY AND CONFECTIONERY PRODUCTS

Code:21FTQV0432 Credits: T0+P4 Hours/week: 4 Marks: 100

1. Introduction to Bakery and Confectionery Equipments
2. Quality evaluation of raw ingredients: Flour, egg, milk, yeast, fat, sugar and other ingredients
3. Determination of Gluten content in the flour and its suitability for bakery products
4. Determination of reducing and non reducing sugar in chocolates Test for the chocolate components of filled chocolate.
5. Assessment of quality of the prepared bakery and confectionery products: Physical, nutritional, functional and microbial:
6. Bread , Pizza base and Buns
7. Butter cake and Sponge cake. Cookies and biscuits
8. Chocolates- Hard and soft Fudge, toffee
9. Preparation of different types of pastry and evaluation of its quality.
10. Visit to bakeries and confectioneries unit

REFERENCES BOOKS

1. Lab manual for Beverages. Sugar and Confectionery ,FSSAI 2015
2. Dubey, S.C. (2007). Basic Baking 5th Ed. Chanakya Mudrak Pvt. Ltd.
3. Raina et.al. (2003). Basic Food Preparation-A complete Manual. 3rd Ed. Orient Longman Pvt. Ltd.
4. Manay, S. & Shadaksharaswami, M. (2004). Foods: Facts and Principles, New Age Publishers.
5. Barndt R. L. (1993). Fat & Calorie – Modified Bakery Products, Springer US.
6. Samuel A. Matz (1999). Bakery Technology and Engineering, PAN-TECH International Incorporated.
7. Faridi Faubion (1997). Dough Rheology and Baked Product Texture, CBS Publications.
8. Samuel A. Matz (1992). Cookies & Cracker Technology, Van Nostrand Reinhold

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2. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0101-20612015000200215
3. <https://www.slideshare.net/mobile/vlaparna/bakery-and-confectionery-final>
4. <https://www.slideshare.net/mobile/divyapanneer7/bakery-ppt>
5. <https://www.slideshare.net/mobile/AnuragMundaje/bakery-products>
6. <https://www.slideshare.net/mobile/cris-marz/baking-tools-and-equipments-65274399>
7. https://slideplayer-com.cdn.ampproject.org/v/s/slideplayer.com/amp/14118468/?amp_js_v=a6&_gsa=1&usqp=mq331AQHKAFQArABIA%3D%3D#aoh=16176350926198&referrer=https%3A%2F%2Fwww.google.com&_tf=From%20%251%24s&share=https%3A%2F%2Fslideplayer.com%2Fslide%2F14118468%2F
8. <https://www.slideshare.net/mobile/mrs0ft059/yahayay>
9. <https://www.slideshare.net/mobile/pratikguptateddy/chocolate-27455478>
10. <https://www.slideshare.net/faizanmehtab90/fudge-41120031>
11. <https://www.slideshare.net/faizanmehtab90/toffees>
12. <https://bakerpedia.com/processes/bread-evaluation/>

SEMESTER- V

FINANCIAL MANAGEMENT AND ENTREPRENEURSHIP

Code: 21FTQV0534

Credits: 4

Hours/week: 4

Marks: 100

Course Objective:

- To acquaint the students with the accounting and balance sheet preparation
- To develop the skill to perform at different enterprises related to the accounting and transactions.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- Maintain records in a food testing laboratory
- Gain knowledge on financial management

UNIT I Principles of Accounting

Principles of accounting-Definition, investors, creditors, regulators, suppliers. Standard rules and guideline, GAPP- accounting concepts and accounting conventions, five important principles of modern accounting- revenue principle, expense principle, matching, cost and objectivity.

UNIT II Sources of Finance

Sources of company finance – Internal and External sources, long term and short term finance. Kinds of shares and debentures, ploughing back of profits, role of banks and other financial institutions – procedure for financial assistance Budget planning, loans from commercial banks, trade credit, discounting of bill of exchange.

Unit III Book keeping and Final Accounting

Book keeping, journal and ledger, balancing – trial balance preparation of cash book, petty cash book, digital cash transaction and digital books.

Profit and loss account, balance sheet – simple adjustments, computers in accounting - excel worksheets in journalizing, posting. VAT, GST. Use of software's in accounting procedures and basics of its applications. Steps in NABL lab accreditation and Charging Procedures.

UNIT IV Entrepreneurship Development

Need and scope of entrepreneurship types of entrepreneurs, qualities of entrepreneurs Entrepreneurship development programs, procedure to start small scale food outlets, incentives and subsidies, exports and imports. Industrial estates – objectives – advantages. Funding agencies and proposal writing for funding agencies.

UNIT V Business Startups and Funding Sources

Documents required to start the food business, Market Analysis, Organizational Management, Marketing and sales Management, Funding sources – Grand, Venture Capital, Private investor, Fellowship. Business scalability, validation and stabilization of business.

TEXT BOOKS

1. Gupta.K.Sharma and R.K.Sharma ,“Financial management”- Kalyani publishers. 2. Prasanna Chandra “ Financial management”-Tata McGraw Hill.
2. Madhavi P., Satyanarayana G.(2018),Entrepreneurship, Make in India and Jobs Creation, New Century Publications, New Delhi,.
3. Vinayakam, N., Mani, P, Land Nagarajan, K,LI. (2015),Principles of Accounting, Himalaya Publications, New Delhi, Reddy, T, S., Murthy, A., (2014),Financial Accounting, Margham publications, Chennai,
4. Jain, S, P and Narang,M., (2013), Financial Accounting, Kalyani Publishers, Ludhiana 6. Jain, S, P., Narang, K, (2013) Cost Accounting, Kalyani publishers, Ludhiana,
5. Reddy, P, N Gulshan, (2013),Principles of Business Organisation and Management, Eurasia publishing house, New Delhi,.
6. Bhusan, Y, K.,(2013), Fundamentals of Business Organisation and Management, Sultan Chand and Sons, New Delhi,
7. Shankar, Raj.,(2013), Essentials of Entrepreneurship, Vijay Nicole, Imprints Private Limited, Chennai,.
8. Chole, R.R., Kapse, P.S., and Deshmukh, P.R.,(2012),Entrepreneurship Development & Communication skills, Scientific Publication, Jodhpur,.
9. Khanka S.S.,(2010), Entrepreneurial Development, S. Chand & Company Ltd, New Delhi,.

JOURNAL:

- The journal of entrepreneurship
- International journal of entrepreneurship
- International journal of entrepreneurship and small business.
- The Journal of Hospitality Financial Management

REFERENCE BOOK:

- Pandey .I.M. (2009) “Financial Mnagement”, 9 th edition , Vikas Publications,
- Jain. S.P. and Narang , K.L. (2005) “Cost Accounting” ,Kalyan Publishers, New Delhi.

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<https://www.accountingcoach.com/bookkeeping/explanation>

<https://en.wikipedia.org/wiki/Bookkeeping>

www.ehospitalitytimes.c

www.ediindia.org

GRLEB V OC

FOOD HYGIENE AND SANITATION

Code: 21FTQV0535

Credits: 4

Hours/week: 4

Marks: 100

Course Objectives

To enable students to

- understand and impart knowledge of importance of food hygiene, sanitation, and safety during food processing unit.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- know the principles and applications of sanitation in food industry.
- know about the various types of Sanitation techniques applicable in the food industry
- gain an understanding of food hygiene, sanitation and safety during food processing unit operations.

UNIT I

Sanitation and Health: Definition, importance of sanitation, application of sanitation to food industry and food service establishments; Microorganisms control of and microbial growth in food.

Food Safety : Factors affecting food safety, contamination- types of contamination in food.

UNIT II

Hygiene and Food Handling: Purchasing and receiving safe food, food storage, sanitary procedures in food preparation, serving and displaying of food, special food operations.

UNIT III

Environmental Sanitation: Location and layout of premises, constructional details, sanitary requirements for equipments, guidelines for cleaning equipments, cleaning procedures, pest control, water supply, storage and waste disposal, environmental pollution.

UNIT IV

Hygiene Practices in Food Industry: Introduction, necessity, personnel hygiene, sanitary practices, management and sanitation, safety at work place, planning and implementation of training programme.

UNIT V

Sanitation regulations and Standards: Introduction, regulatory agencies, control of food quality, local health authority. Food sanitation check lists given by FSSAI, Special responsibilities of food safety, Sanitation Risk Management.

TEXT BOOKS

1. Marriott, Norman (2013), “Principles of Food Sanitation”, Springer Science & Business Media Publishing

REFERENCE BOOKS

1. Roday S, (2011) (2002), “Food Hygiene and Sanitation”, McGraw Hill Publishing Company Limited.
2. Lelieveld, John Holah, David Napper, (2014), “Hygiene in Food Processing: Principles and Practice”, Elsevier Publications.

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[hygienehttp://www.open.edu/openlearncreate/mod/oucontent/view.php?id=193&printable=1](https://www.open.edu/openlearncreate/mod/oucontent/view.php?id=193&printable=1)

[https://www.who.int/foodsafety/areas_work/food-](https://www.who.int/foodsafety/areas_work/food-hygiene/en)

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[compliance/compliance-guides-index/sanitation-performance-standards/sanitation-](https://www.fsis.usda.gov/wps/portal/fsis/topics/regulatory-compliance/compliance-guides-index/sanitation-performance-standards/sanitation-compliance-guide)

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FOOD SAFETY

Code: 21FTQV0536

Credits: T4+P0

Hours/week: 4

Marks: 100

Course Objectives

To enable students to

- provide a basic understanding of food safety.
- provide approaches to remove the hazards
- provide a basic acquaintance with standards and specifications

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- gain the concepts of food safety and quality assurance
- know the quality improvement techniques, external quality control activities and also various agencies involved in food safety.

UNIT 1

Introduction to Food Safety: Definition, Types of hazards, biological, chemical, physical hazards

Factors affecting Food Safety, Importance of Safe Foods, food contamination and spoilage, food borne disease.

UNIT II

Food Hazards of Physical and Chemical Origin, Introduction , Physical Hazards with common examples ,Chemical Hazards(naturally occurring ,environmental and intentionally added, Packaging material as a threat, Impact on health, Control measures

UNIT III

Food Hazards of Biological Origin: Introduction, Indicator Organisms, Food borne pathogens: bacteria, viruses and eukaryotes, Seafood and Shell fish poisoning, Mycotoxins

Management of hazards : Need , Control of parameters , Temperature control , Food storage. Risk analysis and management

UNIT IV

Hygiene and Sanitation in Food labs and industries: Introduction, sources of contamination, Control methods using physical and chemical agents, Waste Disposal, Pest and Rodent Control, Personnel Hygiene. Need for food safety protocols during during pandemic situations and FSSAI guidelines and regulations for FBO, Food industries and Food testing labs.

UNIT V

External Quality Control Activities: Inspection- pre shipment inspection and inspection at the port of destination and Certification and quality marks. Sanitation regulations and standards- Introduction, regulatory agencies, control of food quality, Food Sanitation checklist,

Food Regulatory Agencies: National and International Standard Bodies, Various organizations dealing with inspection and Testing Laboratories. Food safety inspection services (FSIS) and FSSAI and their utilization.

TEXT BOOK

1. Bhatia,R. and Ichhpujan,R.L. Quality assurance in Microbiology. CBS Publishers and Distributors, New Delhi. 2004.

REFERENCE BOOKS

1. Philip,A.C. (2001). Reconceptualizing quality. New Age International Publishers,Banglore.
2. Kher, C.P. (2000). Quality control for the food industry. ITC Publishers, Geneva.

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1. <http://www.open.edu/openlearncreate/mod/oucontent/view.php?id=196&printable=1>
2. <https://www.fssai.gov.in/home>
3. <https://www.who.int/news-room/fact-sheets/detail/food-safety>
4. <http://www.cfsan.fda.gov/> <http://www.cfsan.fda.gov/~lrd/haccp.html>

PROCESSING OF BEVERAGES AND SPICES

Code: 21FTQV0537 Credits: T3+P0 Hours/week: 3 Marks: 100

Course Objectives

To enable students to

- knowledge of beverage and spices, types of manufacturing process involved in different manufacturing industries.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- study about the various beverages and spices and their products
- provide a technical view of beverages and spice processing.

UNIT I

Introduction: History, importance of beverages and status of beverage industry. Types of beverages and their importance, status of beverage industry in India, Manufacturing technology for juice-based beverages, synthetic beverages; technology of still, carbonated, low-calorie and dry beverages, isotonic and sports drinks; role of various ingredients of soft drinks, carbonation of soft drinks.

UNIT- II

Manufacturing process of beverages: Beverages based on tea, coffee, cocoa, spices, plant extracts, herbs, nuts, Dairy-based beverages. Sweeteners, colorants, acidulants, clouding, clarifying and flavouring agents for beverages

UNIT- III

Types of coffee and tea: Chemical composition and processing of tea and coffee and their quality assessment. Types of tea: black tea, green tea, oolong tea. Types of coffee: Vacuum coffee, drip coffee, iced coffee. Espresso coffee, instant coffee. Decaffeination of Coffee types of decaffeination

UNIT IV

Introduction, classification, composition and functions; Major international quality specifications of spices; Spice processing, spice reconditioning, spice grinding, post processing treatments of major spices: Pepper, cardamom, ginger, clove, nutmeg, vanilla, cinnamon, chilli and turmeric and Minor spices- cloves, leafy spices, bay leaf, oregano.

UNIT V

Spice extractives: Value added spice products: Spice volatile oils, spice blends, spice oleoresins, Use of spice extractives, replacement of spices with oils and oleoresins, alternative products, essential and encapsulated oils, salad dressings and seasonings. Preparation of Indian Masala for different foods Packaging of spices and spice products.

TEXT BOOKS

1. Manay, N.S, Shandaksharaswamy, M., (2004), "Foods- Facts and Principles", New Age International Publishers, New Delhi,
2. Potter, N.N, Hotchkiss, J.H.(2000), "Food Science". CBS Publishers, New Delhi.
3. Srilakshmi, B. Food Science (3rd Edition) (2003), New Age International (p) Limited Publishers, New Delhi

REFERENCE BOOKS

1. Nicholas Dege. (2011), "Technology of Bottled water". Blackwell publishing Ltd, UK.
2. J.S.Purthi, (2003) (2001), "Minor Spices and Condiments: Crop Management and Post Harvest Technology", ICAR publication, 1st Edition
3. Handbook of Fruit Science and Technology: Production, Composition, Storage, and Processing. D. K. Salunkhe, S. S. Kadam, CRC Press, 1st Edition, 1995.
4. N.K.Jain,(1989), "Global Advances in Tea Science", Aravali Books International, 1st Edition

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1. <https://www.foodsafetymagazine.com/magazine-archive1/octobernovember2012/category-dry-ingredients-quality-assurance-and-food-safety-of-powderedingredients/>
2. [https://old.fssai.gov.in/Portals/0/Pdf/Draft Manuals/SPICES AND CONDIMENTS.pdf](https://old.fssai.gov.in/Portals/0/Pdf/Draft_Manuals/SPICES_AND_CONDIMENTS.pdf)[https://www.starwest-botanicals.com/content/quality assurance.html](https://www.starwest-botanicals.com/content/quality_assurance.html)
3. <http://jnkvv.org/PDF/05042020135315spices.pdf>
4. [https://www.rvskvv.net/images/Lec1 PHM-323 16.04.2020.pdf](https://www.rvskvv.net/images/Lec1_PHM-323_16.04.2020.pdf)
5. <https://ccsuniversity.ac.in/bridge-library/pdf/FST-Paper-%20II%20Food%20Beverages-%20IV-Semester.pdf>
6. <https://ncert.nic.in/textbook/pdf/lehe105.pdf>
7. <http://www.fao.org/3/ad420e/ad420e.pdf>
8. <https://www.slideshare.net/assenzio1732/spices-sensory-and-functional-aspects-in-food-processing>
9. <https://www.slideserve.com/cade/role-of-spices-in-processed-foods>

PROCESSING OF FRUITS AND VEGETABLES

Code: 21FTQV0538

Credits: T3+P0

Hours/week: 3

Marks: 100

Course Objectives

To enable students to

- proper post-harvest handling technologies of fruits and vegetables
- know the process of development of fruit and vegetable processing products.

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- know about the status of fruit and vegetable production in India with importance to losses.
- study the processing of fruits and vegetables.
- impart knowledge about the various products and study the various methods of processing fruits and vegetables

UNIT I

Introduction; Composition and nutritive value of fruits and vegetable; Factors affecting composition and quality of fruits and vegetables; Quality requirements of raw materials for processing; sourcing and receiving at processing plants, primary processing: grading, sorting, cleaning, washing, peeling, slicing and blanching

UNIT II

Spoilage of fruits and vegetables: Different types of spoilage in fruits and vegetables. Spoilage during storage of fruits and vegetables and their prevention; General methods of preservation of whole fruits/vegetables and processed fruits and vegetables; Spoilage of pickles; Methods of preparation, curing techniques, defects, and remedies. Types of preservatives commonly used in Fruits and vegetables processing industry, permissible limits of usage of preservatives.

UNIT III

Processing of fruits and vegetables: Dehydration of fruits and vegetables using various drying technologies like sun drying, solar drying (natural and forced convection), osmotic, tunnel drying, fluidized bed drying, freeze drying, convectional and adiabatic drying; applications to raisins, dried figs, vegetables, intermediate moisture fruits and vegetables; Fruit powders using spray drying; Technology of extraction of juices from different types of fruits.

UNIT IV

Manufacture of Fruit products: Manufacturing process of juice, soup, puree, and paste. Jams, Jellies, and marmalades: selection, preparation, production; Difference between jam and jelly; Theory of gel formation, failure, and remedies in jam and jelly making. General principles and manufacturing processes of preserves, candied fruits, glazed fruits, crystallized fruits, cordial, syrup, fruit juice concentrates.

UNIT V

Manufacture of vegetable products: Manufacturing process of sauce, ketchup, vegetable juices, and concentrated products. Application of ionizing radiation in preservation of fruit and vegetables. Advantages and limitations. By-products of fruit and vegetables industries and their utilization. Recent development in fruits and vegetables processing

TEXT BOOKS

1. Manay, N.S, Shandaksharaswamy, M., (2004), "Foods- Facts and Principles", New Age International Publishers, New Delhi, 2. Potter, N.N, Hotchkiss, J.H.(2000), "Food Science". CBS Publishers, New Delhi.
3. Srilakshmi, B. Food Science (5rd Edition) (2015), New Age International (p) Limited Publishers, New Delhi,

REFERENCE BOOKS

1. Nirmal Sinha, Y. H. Hui, et al; (2010), "Handbook of Vegetables and Vegetable Processing", John Wiley & Sons.
2. Olga Martin-Belloso, Robert Soliva Fortuny, (2010), "Advances in Fresh-Cut Fruits and Vegetables Processing". CRC Press.
3. Jongen (2002), "Fruit and Vegetable Processing: Improving Quality", Elsevier Publications.

WEBOGRAPHY

<http://www.fruitandvegetable.ucdavis.edu/files/217117.pdf>

http://www.actahort.org/books/379/379_70.htm

<https://pubag.nal.usda.gov/download/26087/PDF>

GRUB-VOC

PRACTICAL X- QUALITY ANALYSIS OF BEVERAGES AND SPICES

Code: 21FTQV0539 Credits: 3 Hours/week: 3 Marks: 100

1. To study the morphological identification and description of spices and condiments.
2. Preparation of sample for analysis
3. Determination of Extraneous Matter and other Refractive Indices in Whole spices
4. Determination of Moisture (Dean and Stark Toluene Distillation Method), (Karl Fischer Method)
5. Preparation of extracts using different solvents to study its secondary metabolites
6. Determination of phytochemicals in spice extracts-curcumin, Piperine
7. Detection of mineral oil in pepper, Argemone seeds in Mustard
8. Preparation of coffee and tea samples for analysis
9. Determination of colour soluble and insoluble ash, alkalinity in coffee and tea, coco powder
10. Determination of caffeine content in coffee and Test for solubility in hot water-instant coffee
11. Test for colouring substance and microscopic examination

REFERENCE BOOK

1. Lab manual for spices and condiments.FSSAI 2015
2. Lab manual for Beverages. Sugar and Confectionery ,FSSAI 2015

WEBOGRAPHY

1. <https://www.fssai.gov.in/home/food-testing/food-testing-manual.html>

PRACTICAL-XI QUALITY ANALYSIS OF FRUITS AND VEGETABLES

Code: 21FTQV0540

Credits: T4+P0

Hours/week: 4

Marks: 100

1. Thermally processed fruits and vegetables (Canned/Bottled/ Flexibly Packaged):
Physical examination, can condition, drained weight, determination of soluble solids,
2. Test for brix using refractometer for fruit and vegetable jams, jellies, squash and syrups
3. Test for insoluble solids-marmalades, syrups
4. Determination of pH, total sugars and titrable acidity in processed fruits and vegetable products
5. Determination of Vitamin C in citric processed fruits
6. Determination of mineral impurities in processed vegetables and fruits
7. Determination of Total soluble solids free of added salt (in Vegetable juices and Tomato juice), soup powders, pulp
8. Determination of moisture content in Vegetable juices and Tomato juice), soup powders, pulp
9. Microbiological analysis of thermally processed fruits and vegetables
10. Check physical quality parameters in frozen market samples of frozen fruits and vegetables.
11. Visit to fruit and vegetable processing unit

REFERENCE BOOKS

Lab manual for fruits and vegetables, FSSAI, 2016

WEBOGRAPHY

<https://www.fssai.gov.in/home/food-testing/food-testing-manual.html>

SEMESTER- VI

DESIGN AND DEVELOPMENT OF FOOD TESTING LAB

Code: 21FTQV0642

Credits: T4+P0

Hours/week: 4

Marks: 100

Course Objectives

- To design and develop labs for food testing operations

Specific Learning Objectives

- Use details of space, equipments and cost to design a lab that meets quality standards
- Design labs with all facilities to enable for accreditation from national bodies.

UNIT I

Types of Laboratory, Main Laboratory, Multi- location laboratory- Multi- location, Satellite laboratory, Field laboratory, Mobile laboratory, Food Laboratory, Setting up a Regulatory Food Analysis Laboratory

UNIT II

Designing Food lab, Layout of different food laboratory, space, materials, cupboard, shelves, waterlines, lighting, ventilation adopted in different units of food testing lab. Overall Space Utilization. Guidelines , Security Laboratory Signage's ,Corridors and aisles ,Exits/Doors and Windows , Flooring , Walls and ceiling, Sinks Storage , Chemical Storage in the Laboratory/Bulk storage , Gas Cylinder Storage and Gas Lines

UNIT III

Location of storage equipment and spacing, Planning storage spaces, Safety and security of stores, Work simplification, working heights in relation to equipment, Laboratory signages

UNIT IV

Laboratory Building Requirements and Design - General requirements -Laboratory Layout, Microbiology Laboratory, Microbiology Lab Layout, Microbiology Lab equipment, Administration or office area Infrastructure of the food testing lab. Guidelines and regulation in designing food testing lab by FSSAI.

UNIT V

Laboratory and Personnel Safety , Safety Equipment , Safety design in labs , Electrical Services and Safety , Lab Furniture, Work Tables , Waste Disposal : Chemical Waste, Biological Waste, LIMS.

TEXT BOOKS

1. Peters Max. S., Timmerhaus Klaus D. and Ronald E West., Plant Design and Economics for Chemical Engineers, V Edition McGraw Hill. 2003
2. Coulson, J. M. and Richardson J. F., Chemical Engineering, Pergamon Press, vol. 61989.

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1. Evans, F. L., "Equipment Design Handbook", Gulf Publishing Company, 2nd Edition 1979.
2. Perry, R.H and Chilton, Perry's Chemical Engineers Handbook, McGraw Hill, New York, 7th Edition, 1997

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[https://old.fssai.gov.in/Portals/0/Pdf/GFLP Document 06 09 2016.pdf](https://old.fssai.gov.in/Portals/0/Pdf/GFLP_Document_06_09_2016.pdf)

<https://www.fddiindia.com/Services-new/food-testing-noida.php>

<https://www.manufacturing.net/article/2015/05/importance-laboratory-testing-food-production>

FSSAI REGULATIONS ON FOOD TESTING

Code: 21FTQV0643

Credits: T4+P0

Hours/week: 4

Marks: 100

Course Objectives

To enable students to

- Know the latest regulations laid by FSSAI
- Apply the practical experience to check the quality of the products as per the regulations laid by FSSAI

Specific Learning Outcomes

On Successful Completion of this course, the students will be able to

- To identify foods of good quality.
- To explore the lab standards and apply the same in interpretation of result

UNIT I

Role of FSSAI in standardising the proper quality standards – food regulations – standards – quality standards – improving quality- structure of food lab ecosystem by FSSAI- new regulations of FSSAI 2018- Procedure for getting FSSAI certification –licensing – HACCP. Benefits of obtaining FSSAI food license, authority and stakeholders involved in the enforcement of the FSSAI.

UNIT II

Regulations laid for drinking water: Microbiological requirement, organoleptic and physical properties ,general parameters concerning substances undesirable in excessive amount, parameters concerning toxic substances, parameters concerning radio- active residues, pesticide residues.

UNIT III

Regulations laid for dairy products and perishable food items: Specifications for milk, derivatives of milk, condensed milk, infant milk products, milk derivatives processed butter and cheese., online FSSAI license for milk products. Quality standards for meat and meat products, fish, poultry.

UNIT IV

Regulations laid for cereals and bakery products: standards laid down for cereal and cereal products, maida, rice, drum wheat maida, starches, dried fruits, infant foods, instant noodles, fortified atta, Establishment of a bakery, location and surroundings, design and facilities, control of operation, food traceability, quality control, product information labelling, consumer awareness.

UNIT V

Regulations laid for vegetables and fruits: Food safety- pesticide residue levels, artificial ripening, quality standards for exports, Harvesting techniques. FSSAI regulation, standards, analysis methods. Guidelines for importing and exporting food. Penalties and offences for violating the act and the remedies available for consumers. Impact of the FSSAI act.

WEBOGRAPHY

1. [https://old.fssai.gov.in/Portals/0/pdf/FSSAI SoPs_for_Imports.pdf](https://old.fssai.gov.in/Portals/0/pdf/FSSAI_SoPs_for_Imports.pdf)
2. www.fssai.org Lab Manuals of FSSAI -2015-2018
3. [https://foodsafetyhelpline.com/fssai-drafts-standards-for-fruits-and-vegetables-including-additional-new-products/#:~:text=Extra%20light%20sweetened%3A%20\(name\(,more%20than%2021.9%C2%B0%20Brix](https://foodsafetyhelpline.com/fssai-drafts-standards-for-fruits-and-vegetables-including-additional-new-products/#:~:text=Extra%20light%20sweetened%3A%20(name(,more%20than%2021.9%C2%B0%20Brix)
4. <https://foodsafetyhelpline.com/fssai-guidance-note-on-artificial-ripening-of-fruits/>
5. <https://foodsafetyhelpline.com/fssai-notifies-final-vertical-standards-fish-fisheries-products/>
6. <https://foodsafetyhelpline.com/fssai-notifies-revised-general-standards-milk-milk-products/>
7. <https://www.element.com/more-sectors/environmental-testing/water-testing/physical-chemical-properties-of-water>
8. <https://foodsafetyhelpline.com/fssai-makes-amendments-standards-related-packaged-drinking-water>

FOOD LAWS AND LEGISLATIONS

Code:18FTQV0644 Credits: T4+P0 Hours/Weeks:4 Marks:100

Course Objectives

- To provide an opportunity to learn food safety and management systems
- To learn food law and quality standards.

UNIT I Introduction

Food safety and quality -Definition, Principles of Food safety and quality - Quality attributes (product and service quality), quality control principles in food industry, Good Hygienic Practices, purchasing practices, Good Manufacturing Practices, Good Laboratory Practices. Role of Health Inspector, Total quality management in foodservice

UNIT II Food Safety Regulation Acts

Food laws- Objectives and regulations at National and Regional Level, Laws and Regulations to Prevent Adulteration Cross Contamination, Food Additives, Regulations of food additive:, INS number: food colors, antioxidants, sweeteners, preservatives, processing aids. Food processing aids. Food Laws on Food Sanitation and Hygienic Practices,

UNIT III National Food Standards

Contamination- Cross Contamination, Microbial Contamination, Chemical and Environmental Contamination Food Safety and Standard Authority of India regulations – Agricultural (cereals, pulses, fruits and vegetables milk ,meat and meat product) and Processed food (ready to eat , and ready to cook foods), Export Development Authority - Marine Product, Export Inspection council and Export Inspection Agency, Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP)

UNIT IV International standards

International standards -International Standardization Organization (ISO), Joint FAO/WHO Food Standards Program. Codex Alimentarius Commission (CAC), Other International Organizations Active in Food Standard Harmonization. Advantages of Utilizing International Standards. Rapid Alert system..FDA, EPA, EU, ASEAN, EFSA (European Food Safety Authority)

UNIT V

American National Standard Institute (ANSI), ASEAN Consultative Committee for Standards and Quality (ACCSQ), Arab Industrial Development and Mining Organization (AIDMO), African Regional Organization for Standardization), European Committee for Standardization (CEN) Pacific Area Standards Congress (PASC), Scientific and Other Regional Organizations Interested in Agricultural and Future Trends.

REFERENCE BOOKS

1. Renuka. G., Food hygiene and sanitation. Paradise press, New Delhi, 2018.
2. Puja Dudeja, Amarjeet Singh, SukhpalKaur., Food Safety implementation, CBS publishers and distributors Pvt Ltd., Mumbai, 2016
3. Jennifer L. Pomeranz., Food Law for Public Health, Oxford University Press 2016
4. Norman .N. Potter.,Joseph .H. Hotchkiss.,Food Science, Indian binding House, Noida, 8thEdition, 2015.
5. Mahindru. S.N., Food safety concept and reality, APH publishing corporation, New Delhi, 2014.
6. ShyamKarthick Mishra., BabitaAgarwal., Food security in India (Policies and challenges), New century publications, 2013.
7. Ruth. S., Food storage and preservation, Navyug books- International, New Delhi, 2012.
8. Biswajit .Chatterjee, Asim.k.Karmakar, Food security in India, Regal publications, New Delhi, 2012.
9. Devendra Kumar Bhatt, PriyankaTowar., An introduction to food science technology and Quality management, Kalyani publishers, New Delhi, 2011.
10. Prem .Kumar Jaiswal., Food Quality and Safety, CBS publishers and distributors Pvt Ltd., Chennai, 2011.

JOURNALS

1. Food and Drug Law Journal
2. Journal of Food Law and Policy
3. Journal of Food , Microbiology, Safety and Hygiene
4. International Journal of health services
5. Journal of public health policy

WEBOGRAPHY

1. www.foodstandards.gov.au_ safety standards
2. www.usda.gov_ health-and-safety
3. www.fssai.gov.in
4. www.mpi.govt.nz_ law-and-policy_ requirements
5. Foodregulation.gov.au
6. www.fda.gov

ELECTIVES

ELECTIVE 1

PRODUCT DEVELOPMENT, TESTING AND MARKETING

Elective: 21FTQV05E1 Credits: T3+P0 Hours/week:3 Marks: 100

Course Objectives:

- To understand various aspects of development of a food product
- To acquire knowledge on the importance of Consumer Research, Finance and Communication

Specific Objectives of Learning:

on successful completion of these units, students are expected:

- To appraise the main features and trends of a specific food product within an appropriate market setting
- To understand the development cycle of the food product.
- To develop and justify technical specifications for the new product

UNIT I

New Food Products development: Definition, classification, characterization, factors influencing new product development – social concerns, health concerns, impact of technology and market place influence. Product life cycle – growth, maturity and decline stages of PLC.

UNIT II

Generation of New Product Ideas: Internal sources of idea, External sources of ideas and market place analysis. Porters five forces models. Screening of the ideas: Team approach and involvement of various departments, objectives of screening, criteria for screening ideas.

UNIT III

Phases in Food Product Development-prototype, standardization, Sensory Evaluation: Descriptive, labelling and acceptance test. Shelf life testing- types of shelf life testing mode of food deterioration. Technical development – recipe development and scale up. Food safety and food Spoilage .

UNIT IV

Newer food stabilizing systems : Thermal processing, ohmic heating, stabilizing with high pressure, other non-thermal stabilizing systems, controlled / modified atmosphere packaging, irradiation, hurdle technology, low temperature stabilization -Use of various new ingredients to suit product functions.

UNIT V

Packaging- types, new trends in packaging materials and methods suitable for various products. Graphic designing and nutritional labelling.

Test Marketing: Consumer goods and Business goods of test marketing. Evaluating results and analyzing. Costing of the products, methods of pricing

REFERENCES:

1. Fuller G W (1994) New Food Product Development : From Concept to Market place CRC Press, New York
2. Man C M D and James A A (1994) Shelf life Evaluation of Foods. Blackie Academic and Professional, London
3. Olickle, J K (1990) New Product Development and value added. Food Development Division, Agriculture, Canada
4. Graf E and Saguy I S (1991), Food Product Development : From concept to the Market Place, Van Nostrand Reinhold New York

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1. <https://www.destechpub.com/wp-content/uploads/2015/01/Methods-for-Developing-New-Food-Products-preview.pdf>
2. <https://nzfst.org.nz/resources/foodproductdevelopment/Chapter-3-1-2.htm>
3. <https://discoverfoodtech.com/food-product-development-process/>
4. <https://krishi.icar.gov.in/jspui/bitstream/123456789/20380/1/An%20overview%20of%20non%20thermal%20preservation.pdf>
5. <https://www.basu.org.in/wp-content/uploads/2020/04/10th-PPT-of-Foods-and-Industrial-MicrobiologyCourse-No.-DTM-321.pdf>

ELECTIVE 2
BY PRODUCTS AND WASTE UTILISATION

Elective: 21FTQV05E2 Credits: T3+P0 Hours/week: 3 Marks: 100

. Course Objectives:

- To develop an understanding among the students on a. Origin and type of waste and by products, waste identification, classification and composition.
- Need for treatment and utilization.
- Impact of waste disposal on environment.

Specific Objectives of Learning:

on successful completion of these units, students are expected:

- To utilize waste from food industries and develop novel products
- Align with the Legal and statutory requirements for food waste handling, treatment and disposal

UNIT I

Introduction to by-products and waste generation in agricultural production and processing. Types and formation of by-products and waste; Magnitude of waste generation in different food processing industries; Uses of different agricultural by-products from rice mill, sugarcane industry, oil mill etc., and fishery by – products from fish processing industry.

UNIT II

Concept, scope and maintenance of waste management and effluent treatment, Temperature, pH, Oxygen demands (BOD, COD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues.

UNIT III

Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette, generation of electricity using surplus biomass, producer gas generation and utilization; Waste utilization from fish Processing Industry – Bio fuel, dietic products, Pigments, Packaging application, Cosmetics, Therapeutic products etc.

UNIT IV

Waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermin-composting, Pre treatment of waste: sedimentation, coagulation, flocculation and floatation, Secondary treatments: Biological and chemical oxygen demand for different food plant waste–trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons, Tertiary treatments: Advanced waste water treatment process–sand, coal and activated carbon filters, phosphorous, sulphur, nitrogen and heavy metals removal, Assessment.

UNIT V

Solid waste disposal method and management – Landfills, incineration, recycling and composting, hazards waste treatment, Treatment and disposal of solid waste; and biogas generation, Effluent treatment plants, Environmental performance of food industry to comply with ISO-14001 standards.

TEXT BOOKS

1. Shewfelt, R.L. and Prussi, S.E. 1992. Post-Harvest Handling – A Systems approach, Academic Press Inc.
2. USDA. 1992. Agricultural Waste Management Field Hand book. USDA, Washington DC..
3. V.K. Joshi & S.K. Sharma. Food Processing Waste Management: Treatment & Utilization. New India Publishing Agency

REFERENCE BOOKS

1. Markel, I.A. 1981. Managing Livestock Waste, AVI Publishing Co.
2. Pantastico, ECB. 1975. Post Harvest Physiology, Handling and utilization of Tropical and Subtropical fruits and vegetables, AVI Pub. Co..
3. Vasso Oreopoulou and Winfried Russ (Edited). 2007. Utilization of By-products and Treatment of waste in the Food Industry. Springer Science & Business media, LLC 233 New York.
4. Weichmann J. 1987. Post Harvest Physiology of vegetables, Marcel and Dekker Verlag

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1. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=126248>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3614052/>
3. https://www.eai.in/ref/ae/wte/typ/clas/india_industrial_wastes.html
4. <https://p2infohouse.org/ref/31/30495.pdf>

ELECTIVE 3

PROCESSING OF FISH , MEAT AND POULTRY PRODUCTS

Code: 21FTQV05E3

Credits: T0+P43

Hours/week: 3

Marks: 100

Course Objectives:

- To provide an extensive description of meat, fish and poultry processing
- To introduce the latest technologies, manufacturing processes and tools for effective control of safety and quality during processing

Specific Objectives of Learning:

on successful completion of these units, students are expected:

- To understand the processing techniques involved in fish, meat and poultry products.
- To develop safe and quality fleshy food products

UNIT I

Sources and importance of fish, meat and poultry; Status of fish, Meat and poultry industry in India; Pre-slaughter operations and slaughtering operations for animals, fish and poultry; Evaluation of animal carcasses; Factors affecting post-mortem changes, properties and shelf life of meat;

UNIT II

Mechanical deboning, grading and aging; Eating and cooking quality of meat; Preservation of meat by chilling, freezing, pickling, curing, cooking and smoking, dehydration, radiation, chemical and biological preservatives.

UNIT III

Meat tenderization; Meat emulsions; Meat cutting and handling; Preparation, preservation and equipment for manufacture of smoked meat and its quality evaluation; Preparation, packaging and equipment for manufacture of dehydrated meat products and their quality evaluation.

UNIT IV

Ante-mortem examination, slaughtering and post-mortem examination of meat and poultry. Postmortem carcass evaluation and storage. Postmortem physical and biochemical changes in meat. Preparation, preservation and equipment for manufacture of meat sausages and their quality evaluation; Abattoir design and layout; Eggs: Structure, composition, quality characteristics, processing, preservation of eggs;

UNIT V

Processing and preservation of fish meat, poultry meat and chicken patties; Meat plant sanitation and safety; By-products of meat, poultry and eggs and their utilization; Safety standards in meat industry: HACCP/ISO/MFPO/FSSAI/Kosher/Halal. Need and various aspects of food testing and notified NABL, referral and reference labs.

PRACTICALS

1. Pre-slaughter operations of fish meat, animals and poultry birds;
2. Slaughtering and dressing of meat animals;
3. Study of post-mortem changes; Meat cutting and handling; Preservation of meat by freezing;
4. Preservation of meat by curing and pickling; Preservation of meat by dehydration;
5. Evaluation of quality and grading of eggs;
6. Preservation of shell eggs;
7. Preparation of value added poultry meat products;
8. Value added egg products;
9. Visit to abattoir.

TEXT BOOKS

1. Vikas Nanda. 2014. Meat, Egg and Poultry Science & Technology. I.K. International Publishing House Pvt. Ltd., New Delhi.
2. B.D. Sharma and Kinshuki Sharma. 2011. Outlines of Meat Science and Technology. Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.
3. B.D. Sharma. 2003. Modern Abattoir Practices and Animal Byproducts Technology. Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.

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1. B.D. Sharma. 1999. Meat and Meat Products Technology Including Poultry Products Technology. Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi.
2. Alan H. Varnam and Jane P. Sutherland. 1995. Meat and Meat Products: Technology, Chemistry and Microbiology. Chapman & Hall, London.
3. William J. Stadelman and Owen J. Cotterill. 1995. Egg Science and Technology, 4th Ed. Food Products Press, NY, USA.
4. R.A. Lawrie. 1985. Meat Science, 4th Ed. Pergamon Press, Oxford, UK.

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3. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000015FT/P000076/M000257/ET/1500357969M-09.pdf
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