

**UNIVERSITY GRANTS COMMISSION
CURRICULUM AND TRAINING DIVISION
SECTOR H-9, ISLAMABAD**

**CURRICULUM REVISION COMMITTEE MEETING
IN
FOOD TECHNOLOGY**

A meeting of the National Curriculum Revision Committee to finalize the draft curriculum for Food Technology prepared in its preliminary meeting was held on May 3-5, 2001 at UGC, Regional Centre, Lahore. Following attended:

1. Prof. Dr. Faqir Muhammad Anjum, Convener
Chairman,
Department of Food Technology
University of Agriculture, Faisalabad.
2. Prof. Noor Muhammad Miano, Member
Chairman,
Department of Food Technology,
Sindh Agricultural University, Tandojam
3. Dr. Tariq Masud, Member
Associate Prof. & Chairman,
Department of Food Technology,
University of Arid Agriculture, Rawalpindi.
4. Dr. Muhammad Aslam Member
Principal,
University College of Agriculture, Multan.
5. Dr. Alam Zeb, Member
Associate Professor,
Department of Food Technology,
NWFP, Agricultural University, Peshawar.
6. Mr. Saifullah Khan, Member
Assistant Professor,
Department of Food Science and Technology
Faculty of Agriculture, Gomal University, D.I. Khan
7. Mr. Habib Ahmed Rathor, Member
Assistant Professor,
Department of Food Technology,
University College of Agriculture, Rawalakot.

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| 8. | Dr. Amjad Hussain,
PSO/Coordinator (Potato)
Director (Horticulture), NARC, Islamabad. | Member |
| 9. | Mr. Asif Mahmood Warraich
Production Executive,
Mitchells Fruit Farms Limited, Renala Khurd, Okara. | Member |
| 10. | Mr. Abid Hasnain,
Incharge,
Department of Food Technology,
University of Karachi. Karachi. | Member/Secretary |

The meeting started with recitation from the Holy Quran by Mr. Habib Ahmad Rathor.

Dr. Javed Ullah, Assistant Professor, NWFP Agricultural University, Peshawar was represented by Dr. Alam Zeb whereas Mr. Adil Anwar from Mitchells Fruit Farms Limited could not attend the meeting for his personal reasons and was represented by Mr. Asif Mahmood Warraich.

Mr. Muhammad Javed Khan, Director Curriculum, UGC, welcomed the participants and briefed them of the obligations of the Commission for review, revision and development of curricula as per provisions of the Act of Parliament, 1976. He informed the committee that the curriculum of B.Sc. (Hons.), M.Sc. (Hons.) and Ph. D. degrees in Food Technology prepared by the Committee in its meeting held in February, 2001 was circulated amongst members and the universities offering the subject. The members and institutions were requested to discuss the draft and submit their suggestions for improvement of the draft so that collective wisdom of experts can be incorporated in the text of the curriculum. The Director stated that though the revision and development of curricula is being undertaken by the commission as per provisions of its Act., but the whole exercise is being financed by Ministry of Science and Technology.

Dr. Altaf Ali G. Shaikh, Adviser (Curriculum and Training) in his opening remarks informed the members that the Government is striving hard to enhance quality of education in public sector universities/institutions by making curriculum more compatible with international standard, job oriented and to match the needs of society. He introduced the members of the committee of different Academic Programms of the commission aimed at facilitated the universities in execution of their programmes and as well as those launched by Ministry of Science and Technology including repair and maintenance of laboratories, provision of books for libraries, institution of indigenous Ph. D. scholarships, provision of computer and other modern tools like internet and e.mail etc.

The Committee unanimously appointed Prof. Dr. Faqir Muhammad Anjum as its convener and Mr. Abid Hasnain as Secretary. The committee, after discussing the 1st draft curriculum, comments for improvements and syllabi of national universities and some of the foreign universities/institutions at graduate/post graduate levels, benefiting from the presence of experts from Pakistan Agricultural Research Council and representatives of users industry agreed to the unified curriculum.

It was further noted that different universities follow different systems of teaching and examinations and was agreed that each university will offer minimum of 60 credit hours in semester/term systems and 40 credit hours in annual systems for B.Sc.(Hons) in Agricultur Majoring Food Technology. It was further agreed that each student admitted for M.Sc(Hons) and Ph.D. degrees in Food Technology will study courses on **Quality Assurance Management** and **Recent Advances in Food Science and Technology**, respectively. The universities will offer major courses out of the postgraduate courses recommended by the committee. However, the students of M.Sc. (Hons)/Ph.D. in Food Technology will take minor courses from appropriate departments related to food technology.

OBJECTIVES

- i. To provide graduate and post graduate level education for students interested in applying food science and technology to the theoretical and practical aspects of the entire food chain from production of the raw material to the utilization of the product by the consumer.
- ii. To provide a focus for graduate study and research in food science & technology.
- iii. To aid in promoting interactions with other disciplines which relate to the study of food science and technology.

**SCHEME OF STUDY
FOR
B.Sc. (Hons) Agriculture (Major in Food Technology)**

<u>S.No.</u>	<u>Title of Courses</u>	<u>Credit Hrs.</u>
1.	Introduction to Food Science	3(2-2)
2.	Food Processing and Preservation	3(2-2)
3.	Principles of Food Preservation	4(3-2)
4.	Fruits and Vegetable Processing	3(2-2)
5.	Oil and Fat Technology	3(2-2)
6.	Sugar Technology	3(2-2)
7.	Meat, Poultry and Fish Processing	3(2-2)
8.	Cereal Technology	3(2-2)
9.	Dairy Technology	3(2-2)
10.	Technology of Beverages	3(2-2)
11.	Food and Factory Laws	2(2-0)
12.	Food Microbiology	3(2-2)
13.	Food Chemistry	3(2-0)
14.	Nutrition and Dietetics	3(3-0)
15.	Food Analysis and Sensory Evaluation	4(3-4)
16.	Post Harvest Technology	2(2-0)
17.	Confectionery and Snack Foods	2(2-0)
18.	Internship in Food Industry	20(0-40)

DETAIL OF COURSES

INTRODUCTION TO FOOD SCIENCE

3(2-2)

Theory

Definitions: Food science, food technology, food processing. Sources of foods: plants – fruits, vegetables, cereals, legumes, oil seeds. Animal: meat, poultry, eggs, milk. Marine: fish, etc. Production statistics. Regulations of markets. Important food industries in Pakistan. Role of food science in national economy. Food Constituents: water, carbohydrates, proteins, lipids, vitamins, minerals and others. Classification of foods: pH and perishability basis. Food spoilage: mode, causes, spoilage agents.

Practical

Estimation of moisture, crude fat, crude protein, crude fibre and ash. Determination of specific gravity, soluble solids, pH and acidity.

Books Recommended

1. Awan, J.A. 1999. Elements of Food Science and Technology World Wide Publishers, Faisalabad.
2. Potter, N.N., 1995. Food Science,. The AVI Publishing Co. Inc., Westport, Connecticut.
3. Aurand, L.W., A.E. Woods and M.R. Wells. 1987. Food Composition and Analysis. AVI Book Publisher Van Nostrand Reinhold, New York.

FOOD PROCESSING AND PRESERVATION

3(2-2)

Theory

Principles of food preservation. Preservation by high temperature. Canning, can manufacture. Preservation by low temperature: cold storage and freezing.

Preservation by removal of moisture: sundrying, dehydration, freeze-drying, dehydrofreezing. Preservation by chemicals. Preservation by fermentation and irradiation.

Practical

Equipment and instruments used in food processing. Can manufacturing. Canning, freezing and dehydration of fruits and vegetables, Preservation of syrups, squashes, jams, jellies and pickles.

Books Recommended

1. Awan, J.A. 1999. Elements of Food Science and Technology. World Wide Publishers, Faisalabad.
2. Potter, N.N., 1995. Food Science,. The AVI Publishing Co. Inc., Westport, Connecticut.
3. Valentes, K.J., L. Levine and J.P. Clark. 1991. Food Processing Operation and Scale-up. Marcel Dekkar, New York.

PRINCIPLES OF FOOD PRESERVATION

3(2-2)

Theory

Preparatory operations. Browning – enzymatic and non-enzymatic. Preservation by canning; evaluation of caned foods, spoilage of canned foods. Preservation by low temperature: effect of temperature and relative humidity, cold storage temperature, effect of cold storage on food commodities and their packaging requirements. Defects in cold stored commodities. Calculation of refrigeration load. Preservation by freezing methods and equipments, packaging requirements, effects on foods, nutrient losses. Defects in frozen commodities. Use of chemical additives: non-preservative and preservative uses: application, properties, criteria for selection, mode of action, legitimate uses in food

processing. Synthetic and natural food additives: Preservation by drying and dehydration; types of dryers, dehydration ratio, drying times, drying / dehydration of selected food commodities, packaging requirements, rehydration capacity, osmotic dehydration. Preservation by irradiation; applications, types and properties of radiations, Effect of radiation on food components, microbes, enzymes. Packaging requirements. Health hazards. Food preservation by fermentation; alcoholic, acetic and lactic acid fermentation.

Practical

Canning, cold storage, dehydration of different foods. Use of chemicals in preservation of various food products. Production of vinegar, yoghurt and pickles. Evaluation of canned, dehydrated and frozen products. Visit to food industries.

Books Recommended

1. Kyzlink, V. 1990. Principles of Food Preservation. Elsevier Sci. Publ. Co. Inc., New York.
2. Desrosier, N.W. and J.N. Desrosier, 1987. The Technology of Food Preservation. AVI Publishing Co. Inc. Westport, Connecticut.
3. Brennan, J. G, J.R. Butters, N.D. Cowell and A.E.V. Lilly, 1976. Food Engineering Operations. Applied Science Publishers Ltd., London.

FRUIT & VEGETABLE PROCESSING

3(2-2)

Theory

Units operations; receiving, washing, grading, peeling, size reduction, blanching, sulphiting/sulphuring, syruring/brining, exhausting, processing and packaging. Processing technology of the manufacture of new products from fruits and vegetables: beverages, preserves, sauces, pickles, soups and others.

Preservation technologies: Packaging requirements. Spoilage of processed fruits, vegetables and their control. Nutritional evaluation of processed foods. Plant layout and hygiene: Fruit and vegetable plant layout, design, personal hygiene, plant sanitation and waste disposal. Quality control in fruits and vegetables processing industry.

Practical

Preparation of different fruit and vegetable products. Use of various ingredients in the fruit and vegetable processing. Visit to different fruits and vegetable processing industries.

Books Recommended

1. Micea, B.D. 1995. Fruit and Vegetable Processing. FAO Bulletin No.199. FAO, Rome.
2. Anonymous. 1993. Handbook for the Fruit Processing Industry. Copenhagen Pectin A/S, Lille Skensved.
3. Woodroof, J.G. and B.S. Luh. 1975. Commercial Fruit Processing. The AVI Publihers, Westport.
4. Bridget Jones (Editor). 1989. Home Preservation of Fruits and Vegetables. HMSO, London.

TECHNOLOGY OF OILS AND FATS

3(2-2)

Theory

Oils and fats: Importance, sources, food and non-food uses. Extraction methods. Processing: degumming, refining, bleaching, deodorization, fractionation, winterization, hydrogenation, interesterification, esterification and emulsification. Characteristics of oils and fats, physical chemical. Spoilage: oxidative and hydrolytic rancidity, polymerization.

Practical

Extraction of vegetable and animal oils and fats. Determination of physical and chemical constants: refractive index, colour, cold test, melting point, smoke point, acid value, specific gravity, peroxide value, iodine value, saponification value and solid fat index. Visit to oils and fats industries.

Books Recommended

1. AOAC. 1995. Official Methods of Analysis. Association of Official Analytical Chemists, Arlington.
2. Wan, P.J. 1991. Introduction to Fats and Oils Technology. Association of Official Analytical Chemists, Arlington.
3. Gunstone, F. D. and F.A., Norris. 1983. Lipids in Foods: Chemistry, Biochemistry and Technology. Pergamon Press, New York.

SUGAR TECHNOLOGY

3(2-2)

Theory

Sugar industry in Pakistan. Sources and chemical properties of sugar. Quality of sugarcane and sugarbeet. Raw sugar manufacturing: unit operations – juice extraction, purification, heating, evaporation, crystallization and crystallization in motion. Refining Affination, clarification, carbonation, sulphitation, phosphitation, crystallization, centrifugation: Factors affecting sugar processing. Packaging: Drying, bagging and storage, Quality criteria: Raw and refined sugar. Sugar by-products.

Practical

Analysis of raw sugar juice for TDS, pH, fiber and ash content. Clarification of raw juice by using chemical flocculants. Analysis of sugar crystals/solutions. Brown sugar crystallization. Inversion of sugar.

Books Recommended

1. Chen, J.C.P. 1985. Meade-Chen Cane Sugar Handbook. John Wiley and Sons, New York.
2. Jenkins, G.M. 1966. Introduction to Cane Sugar Technology. AVI Publishing Co. Inc. Westport, Connecticut.

MEAT, POULTRY AND FISH PROCESSING

3(2-2)

Theory

Mutton and Beef: slaughtering methods, dressing anti and post-mortem changes in carcass, composition and grading of meat. Various cuts in meat. Processing and preservation. Spoilage and its prevention.

Fish: Commercial catching methods, handling. Composition, classification and processing. Spoilage and its control. Criteria for freshness.

Poultry: Commercial methods of dressing, post-slaughter handling and storage of poultry meat, Classes of poultry meat. Spoilage and its control.

Eggs: Handling, grading, composition, storage. Spoilage and quality control.

Practical

Tests for freshness of meat, poultry, fish and eggs. Candling of eggs. Preparation of meat, poultry, fish and egg products. Preservation of meat, fish, poultry and eggs: canning, freezing, smoking and curing. Preparation of sausages. Salting and freezing of fish.

Books Recommended

1. Pearson, A.M. and T.A. Gillet. 1996. Processed Meat. Chapman and Hall, Washington.

2. Mountney, G.J. 1985. Poultry Products Technology. The AVI Publishing Co., Inc. Westport, Connecticut.
3. Govindon T.K. 1985. Fish Processing Technology. Oxford and IBH Publication Co. Pvt. Ltd., Calcutta.

CEREAL TECHNOLOGY

3(2-2)

Theory

Cereal grains: importance, production, structure, composition. Grain grades and grading. Storage of cereals: basic types of storage, role of moisture, functional changes. Dry milling: milling process, milling products, flour treatment, quality. Wet milling: production of starch, oil and protein.

Rice: Milling, processing.

Production Technologies: Pasta, noodles and bakery products.

Practical

Grading of grains, Tempering and milling of wheat. Flour quality assessment. Rheological properties of dough. Preparation of vermicelli, bread, biscuits and cakes.

Books Recommended

1. AACC. 2000. Approved Methods of American Association of Cereal Chemists. American Association of Cereal Chemists Inc., St. Paul, Minnesota.
2. Hosney, R.C. 1994. Principles of Cereal Science and Technology. American Association Cereal Chemists Inc., St. Paul, Minnesota.
3. Kent. N.L. and A.D. Evers. 1994. Technology of Cereals. Pergamon Press, London.

DAIRY TECHNOLOGY

3(2-2)

Theory

Dairy industry in Pakistan. Production of milk in Pakistan. Milk: Sources, composition, methods of procurement, handling and distribution.

Milk processing: Pasteurised milk, UHT milk, concentrated milk, butter, ice cream, cheese, yoghurt and milk powder.

Milk by-products: dried whey and casein. Quality control of milk and milk products. Packaging of dairy products.

Plant layout: hygiene and sanitation

Practical

Fresh and processed milk testing: proximate analysis of milk and milk products, Microbiological examination of milk and milk products. Preparation of milk products such as 'khoa' yoghurt, cheese, butter and ice cream. Evaluation of milk and milk products.

Books Recommended

1. Skumer, De. 1980. Outline of Dairy Technology. Oxford University Press, New Delhi.
2. Vernam, A. H. and L.P. Sutherland. 1994. Milk and Milk Products – Technology, Chemistry and Microbiology. Chapman and Hall, New York.
3. Atherton, H.V. and J.A. Newlander. 1987. Chemistry and Testing of Dairy Products. CBS Publishers and Distributors, New Dalhi.

TECHNOLOGY OF BEVERAGES

3(2-2)

Theory

Beverages: Introduction, classification. Beverage industry in Pakistan. Traditional beverages.

Beverage ingredients: Water: sources, treatments and purification. Sweeteners, acids, colours. Flavours, additives, enzymes, carbon dioxide and carbonation, fruit pulps, juices, concentrates, and others.

Unit operations in beverage production: Beverage production - juice based, synthetic, dry mix formulations, fermented (tea and coffee). Carbonated and non-carbonated beverages. Bottled water. Quality control in beverage industry.

Practical

Preparation of different beverages, Effect of different ingredient on the quality of beverages. Water treatment. Preparation of syrups. Sensory evaluation of beverages. Chemical and microbiological analysis of different beverages.

Books Recommended

1. Mitchell, A.J. (Ed). 1990. Formulation and Production of Carbonated Soft Drinks. AVI Pub. Co. Westport, Connecticut.
2. Tressler, D.K. and M.A. Joslyn, 1971. Fruit and Vegetable Juice Processing Technology. The AVI Pub. Co. Inc. Westport, Connecticut.
3. Egan, H. 1987. Pearson's Chemical Analysis of Foods. 8th Edition. R.S. Kink and Longman Scientific and Technical, London.

FOOD AND FACTORY LAWS

2(2-0)

Theory

Food legislation: Concept and significance. Food legislation in Pakistan in relation to international laws. The Pure Food Rules 1965 – promulgation, enforcement, amendments. Food adulteration and health hazards. Sampling techniques for processed foods. Food standards and specifications for some selected foods. Approved food additives. Factory laws: requirements for food plants, conditions for product

manufacturing, quality, packaging, sanitation and hygienic conditions. Worker's safety.
Visit to various food plants.

Books Recommended

1. Mills, R. and J. Pedersen. 1991. A Flour Mill Sanitation Manual. Eagan Press,
2. Janjua, Z.I. 1987. Food Laws Manual. Law Times Pub., Lahore.

FOOD MICROBIOLOGY

3(2-2)

Theory

Food microbiology: Introduction, importance. Microorganisms in foods: role, sources of, contamination, characteristics of microorganisms, important in foods, relationship of microorganisms in their natural environment.

Control of microorganisms: physical and chemical.

Microbiology of fresh and processed foods: vegetables, cereals, legumes, dairy products, meat, poultry, fish. Microbiological spoilage of processed foods: canned, dehydrated, frozen, chemically preserved.

Fermented foods: microbiology of fermented fruit, vegetable, milk and meat products.
Food-borne diseases: food-borne intoxication's, food borne infections.

Practical

Basic techniques in microbiological laboratory, safety precautions, microscopy. Microbiological examination of foods. Detection of spoilage and pathogenic organisms. Identification of important bacteria, yeasts and moulds: morphological characteristics, staining, biochemical tests.

Books Recommended

1. Cappuccino, J.G. and N. Sherman. 1996. Microbiology – A Laboratory Manual. The Benjamin/Cummings Publishing Co. Inc., Menlo Park, California.
2. James, M. Jay, 1996. Modern Food Microbiology. CBS Publishers, New Delhi.
3. Tortora. G.J., B.R. Funke and C.L. Case. 1995. Microbiology – An Introduction. The Benjamin/Cummings Publishing Co., Inc. Menlo Park, California.
4. Frazier. W.C. and D.C. Westhoff. 1988. Food Microbiology. MacGraw Hill Book Co., New York.

FOOD CHEMISTRY

3(3-0)

Theory

Food components: water, carbohydrates, lipids, proteins, vitamins, mineral, flavour, colours and others – as functional components and in relation to food quality. Effect of handling and processing on food components.

Books Recommended

1. Coultate, T.P, 1996. Food; The Chemistry of its Components. The Royal Society of Chemistry, Cambridge.
2. Fennema, O.R. 1992. food Chemistry. Marcel Dekkar, Inc. USA.

NUTRITION AND DIETETICS

3(3-0)

Theory

Health and nutrition problems in Pakistan. Nutritional needs of vulnerable groups: infants, pregnant and lactating women, the aged. Dietary intolerance, disorders related to the affluent diet including coronary heart disease, dental caries, diabetes, hypertension and cancer. Problems of undernutrition including protein, energy, mineral and vitamin deficiencies. Physiological and nutritional aspects of dietary fibre, alcohol and food intolerance.

Food as a source of nutrients: functions of nutrients, recommended dietary allowances.

Diet, balanced diet, food groups (basic four, basic seven), food guide pyramid.

Digestion: the alimentary tract, digestive juices and secretions. Absorption and metabolism of nutrients.

Books Recommended

1. Awan, J.A. 2000. Elements of Food and Nutrition. Uni-Tech Communications, Faisalabad.
2. Bamji, M.S., N.P. Rao and V. Reddy (Eds.). 1996. Textbook of Human Nutrition. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Williams, S.R. 1991. Basic Nutrition and Diet Therapy. 10th Ed. Mosby Year Book Inc. New York.
4. Escott-Stum P,S. 1992. Nutrition and Diagnosis. Related Care, 3rd Ed. Lea and Febiger, London.
5. Harrison, G.A. and Waterlow, J.C. 1990. Diet and Disease in Traditional and developing societies. Cambridge University Press, New York.

FOOD ANALYSIS AND SENSORY EVALUATION 4(2-4)

Theory

Physical analysis: Sample preparation, determination of physical properties of foods and food products – appearance, texture, specific gravity, refractive index, rheology.

Chemical analysis: Determination of chemical properties of foods and food products: acidity, pH, sugars, proteins, fats, mineral elements, vitamins.

Modern analytical techniques: Chromatography, spectrophotometry, Flame photometry, N.M.R., electrophoresis etc.

Official Methods: AOAC. AACC, AOCS. Sensory analysis: Determination of quality factors in foods – colour, flavour, texture, general acceptability. Sensory evaluation methods and attributes. Difference tests and preference tests. Food contaminants: Microbes, pesticides, veterinary drug residues, metals, radionuclids.

Statistical quality control: data analysis

Practical

Determination of proximate composition of foods: viscosity, specific gravity, refractive index, acidity, pH, sugars, proteins, minerals, vitamins. Sensory evaluation of foods. Detection of food contaminants.

Books Recommended

1. Lawless, H.T. and Heymann, H. 1998. Sensory Evaluation of Foods: Principles and Practices. Chapman and Hall. New York.
2. AOAC. 1995. Official Methods of Analysis. Association of Official Analytical Chemists, Arlington.
3. Nielson, S.S. 1994. Introduction to the Chemical Analysis of Foods. Jones and Bastlell Pub, London.
4. Piggott, J.R. 1988. Sensory Analysis of Foods. Elsevier Applied Science. London.
5. Egan, H. 1987. Pearson's Chemical Analysis of Foods. 8th Edition. R.S. Kink and Longman Scientific and Technical, London.

POST HARVEST TECHNOLOGY

2(2-0)

Theory

Structure and composition of fruits and vegetables, physiology and biochemistry, losses during harvesting, handling, transportation and storage. Harvesting methods. Water losses, respiration activity, mechanical injuries, storage methods and types.

Climacteric and non-climacteric.

Deterioration in stored grains: Causes, loss assessment, control. Mycotoxins. Commodity treatments and packaging: Storage atmosphere - role of temperature and humidity.

Books Recommended

1. Yamashita, R. 1993. New Technology in Grain Postharvesting. Farm Machinery Industrial Research Corp., Tokyo.
2. Christensen, C. M. and R. A. Meronuck. 1986. Quality Maintenance in Stored Grains Seeds. University of Minnesota Press.

3. Will, R.B.H., T.H. Lee, D. Graham, W.B. McGlasson and E.G. Hall. 1982. Post Harvest. The PVI Pub. Co. Inc. Westport. Conn.

CONFECTIONERY AND SNACK FOODS

2(2-0)

Theory

Confectionery: Ingredients, classification. Sugar and flour based confectionery: formulations, manufacture. Processing of cocabeans. Chocolate and cocoa products: formulations, manufacture. Recipe and processes for finished, fermented and sponged goods. Snack foods: ingredients, products and processes for potato, fruits, nuts, meat, dairy based snacks. Puffed and baked products. Extruded snacks.

Books Recommended

1. Booth, R. G (Ed.). 1997. Snack Foods. CBS Pub. Distributors, New Delhi.
2. Street, C.A. 1991. Flour Confectionery Manufacturing. Blackie and Sons, London.

INTERNSHIP IN FOOD INDUSTRY

20(0-40)

The student will go to the food industries for practical training in various food industries in the Country these students will be allocated by the department and they will submit heir final report in the department for evaluation and result

**SCHEME OF STUDIES
FOR
M.SC. (Hons.)/Ph. D. Food Technology**

Following courses are recommended to be essentially included in the Curriculum for M.Sc.(Hons.)/M.Sc./Ph.D. in Food Technology. A student pursuing M.Sc.(Hons.)/M.Sc./ Ph.D. is to select any of the following courses as per requirement in addition to Research Project and thesis.

S.No.	Title of Courses	Credit Hrs.
1.	Food Biotechnology	3(3-0)
2.	Food Additives	3(3-0)
3.	Food Enzymology	3(2-2)
4.	Plant Design and Layout of Food Factories	3(3-0)
5.	Food Toxicology	3(3-0)
6.	Milling of Cereals	3(2-2)
7.	Baking Science-I	3(2-2)
8.	Baking Science-II	3(2-2)
9.	Starch Chemistry and Technology	2(2-0)
10.	Processing of Non-Fermented Dairy Products	3(2-2)
11.	Processing of Fermented Dairy Products	3(2-2)
12.	Advanced Food Microbiology	3(2-2)
13.	Advanced Food Chemistry	3(2-2)
14.	Chemistry of edible Oils and Fats	3(2-2)
15.	Industrial Processing of edible Oils and Fats Products	3(2-2)
16.	Processing of Meat and Meat Products	3(2-2)
17.	Chemistry and Technology of Sugar Processing	3(2-2)
18.	Quality Assurance Management	3(3-0)
19.	Industrial Waste Management	3(3-0)
20.	Advances in Beverages	3(3-0)
21.	Post Harvest Management of Fruits and Vegetables	3(3-0)
22.	Food Packaging	3(2-2)
23.	Physical Properties of Food	3(2-2)

DETAIL OF COURSES

RECENT ADVANCES IN FOOD SCIENCES AND TECHNOLOGY 3(2-2)

FOOD BIOTECHNOLOGY 3(2-2)

Theory

Application of food biotechnology, benefits of microorganisms, microbial growth curve. Fermentation Technology, production of cultures for food fermentation, fungi based processes, bacteria based processes, production of enzymes, single cell protein, amino acids, vitamins, sweeteners and flavors. Cocoa, tea and coffee fermentation. Biosensors for biological monitoring of food.

Practical

Isolation, purification and identification of microorganisms for production of various food products by using biochemical techniques. Development of media for industrial fermentation. Production of microbial metabolites, enzymes preparation and purification.

Books Recommended

1. Lee, B.H. 1996. Fundamentals of Food Biotechnology. VCH Publishers, Inc. New York.
2. Frazier W.C. and D.C.Westhoff.1988. Food Microbiology. Tata McGraw Hill Publishing Company Limited, New Delhi.

3. Stanbury P. F. and W. Allan. 1984. Principles of Fermentation Technology. Pergaman Press, Oxford.
4. Glick, B. R. and J.J. Pasternak. 1998. Molecular Biotechnology. 2nd Ed. ASM Press Washington, D.C.

FOOD ADDITIVES

3(2-2)

GRAS and international regulatory status (FAO, WHO, WTO) of food additives, functions, types, modes of action, consequences of use, risks and benefits of foods additives. Nutritional additives, preservatives, anti-microbial agents, antioxidants. Emulsifiers, enzymes and acidulants. Flavoring agents and flavor enhancers. Sweeteners, natural and synthetic, coloring agents. Methods used for safety evaluation, food additives and hypersensitivity.

Practical

Estimation of sorbates, benzoates and sulphur dioxide. Assesment of different antioxidants, emulsifiers, flavours and colours in different food commodities.

Books Recommended

1. Branen, A.L. and P. Michael. 1990. Food Additives. Davidson and Seppo Salminen. Marcel Dekker, Inc. Madison Avenue, New York.
2. Furia T.E. 1968. Handbook of Food Additives. The Chemical Rubber Co., Cleveland.

FOOD ENZYMOLOGY

3(3-0)

Theory

Enzymes, nature, classification and nomenclature. Enzyme kinetics and inhibition. Enzyme immobilization; methods and kinetics common enzyme reactions. Analysis of enzyme activity oxidases, separation, purification and assay of enzymes. Enzyme classes; proteases, amylases, cellulases, isomerases, lipases/phospholipase, redox enzymes. Application of enzymes in: baking, brewing, starch hydrolysis, dairy, fruit juice processing etc.

Practical

Extraction and purification of enzymes. Estimation of amylases, proteases and peroxidases. Effect of temperature and pH on enzyme stability and activity. Use of enzymes in bread, juice clarification, meat and tenderization.

Books Recommended

1. Mathewson, P.R. 1998. Enzymes. American Association of Cereal Chemists, Inc., St. Paul, Minnesota.
2. Boyce, C.O.L. 1986. NOVO'S Handbook of Practical Biotechnology. NOVO Industry A/S, Bagsvaerds, Denmark.
3. Kruger, J.E., D. Lineback, and C. E. Stanffar. 1987. Enzymes and their Role in Cereal Technology. American Association of Cereal Chemists, Inc., St. Paul, Minnesota.
4. Reed, G. and L.A. Undekoflar. 1975. Enzymes in Food Processing. Academic Press, New York.

PLANT DESIGN AND LAYOUT OF FOOD FACTORIES

3(3-0)

Theory

Plant design and layout: objectives and functions. Plant location, site selection, space requirements, process flow chart, building design, environmental impact, financial requirements, utilities and services. Support and services, use of computer for layout. Establishment of food factories winery utilities. Just in time manufacturing (JIT), potable water supply system and disposals planning, material handling and equipment. Recent developments in workers health check up system. Visit to food industries.

Books Recommended

1. Strom, D.R. 1996. Winery Utilities Planning Design and Operation. Chapman and Hall, International Thomson Publishing, New York.
2. Sheth, V.S. 1995. Facilities Planning and Materials Handling; Method and Requirements. Marcel Dekker Inc., New York.
3. Moore J.M. 1952. Plant Layout and Design. McMillan, New York.

FOOD TOXICOLOGY

3(3-0)

Theory

Food toxicology and related terms, naturally occurring toxicants in foods, toxicological aspects of food additives, microbial food toxicity; mycotoxins, aflatoxins, bacterial food intoxication, food infection. Intolerance and allergy to food. Toxicity due to metallic contamination. Toxicity due to recycling of animal /poultry parts. Detoxification mechanism. Toxicity of packaging material. Wholesomeness of irradiated food, genotoxicity, heat treatment and nutritional significance of maillard reaction products. Toxic factor induced by processing.

Books Recommended

1. Walker, R. and E. Quattrucci. 1988. Nutritional and Toxicological Aspects of Food processing. Taylor & Francis, London.
2. Luner, I. E.. 1986. Toxic Constituents of Plant Food Stuffs. Academic Press, New York.
3. Awan, J.A. and J.C. Okaka. 1983. Elements of Food Born Diseases. Pamco Nigeria Ltd., 81 Zik Avenue, Enugu, Nigeria.

MILLING OF CEREALS

3(2-2)

Theory

Experimental and laboratory milling; environmental conditions, wheat preparation, types of mills. Wheat handling, storage and blending. Wheat cleaning tempering and conditioning. Principles and methods of separating wheat impurities. Grinding process; types of grinding machines. Production of different extraction rates of flour. Operations of roller mill. Grinding systems (break, sizing, reduction and tailings). Sieving process; principles, various types of sifters. Purification process. Flour handling, storage & blending.

Quality control, air classification and fine grinding. Whole wheat products. Milling of soft & durum wheat. Milling of corn & rice. Recent developments in milling of cereal grains.

Practical

Moisture testing and equipment, test weight and kernel hardness measurement. Effect of tempering time and moisture percentage on flour yield. Experimental milling. Estimation of damaged starch. Flour mill stream analysis: colour, moisture, protein, ash and particle size. Measurement of amylase activity of flour.

Books Recommended

1. Posner, E.S. and A.N. Hibbs. 1997. Wheat Flour Milling. American Association of Cereal Chemists Inc. St. Paul. Minnesota.
2. AACC. 1998. Approved Methods of American Association of Cereal Chemists. American Association of Cereal Chemists Inc., St. Paul, Minnesota.

BAKING SCIENCE & TECHNOLOGY-I

3(2-2)

Theory

Bread types, quality assessment and formulations. Ingredients: wheat flour, components and functions; proteins, carbohydrates, lipids and enzymes. Miscellaneous flours (rye, triticale); Shortenings; functions, sources, types and mechanisms, Sweeteners; functions, types, Yeast; functions, types and factors influencing the fermentation. Minor ingredients; yeast foods, enzymatic supplements, oxidizing agents, salt, dairy and egg products, mold inhibitors, dough strengtheners/softeners and enrichment.

Bread making processes; straight dough, sponge and dough, rapid processing, mechanical dough development. Mixing and dough processing; functions of mixing, mixer types, fermentation, dough transfer systems, dough make up; dividing rounding and pre-moulding, first proving, moulding, panning and proving.

Proving processes; developments. Baking process, stages, baking reactions and bread cooling, thermal reactions keeping properties of bread and related products. Bread spoilage and staling, factors and control measures.

Practical

Bread baking; Effects of water absorption and dough mixing time, variations in fermentation and proofing time. Effect of shortening and surfactants, various oxidants, flour protein variation and chemical dough development. Effects of amylases, sweeteners and improvers on bread. Comparison of various dough procedures. Field trip.

Books Recommended

1. Cauvain, S.P. and Linda S. Y. 1998. Technology of Bread Making. Blackie Academic & Professional, London.
2. Matz, S.A. 1996. Bakery Technology and Engineering. 3rd Ed. CBS Pub. & Distributors, Daryaganj, New Delhi.
3. Pyler, E.J. 1988. Baking Science and Technology (Vol-I and II). 3rd Ed. Sosland Pub. Company, Kansas.
4. Pomeranz, Y. 1988. wheat Chemistry and Technology. Vol - I & II. 3rd Ed. American Association of Cereal Chemists Inc., St. Paul. Minnesota.

BAKING SCIENCE & TECHNOLOGY II

3(2-2)

Theory

Biscuits: biscuits, cookies, and crackers; ingredient and their functions, wheat flour, chlorine treatment of flour, granulation, shortening, sweeteners, chemical leaveners. Baking powder, function, composition, reactivity rates, neutralizing value. Preparation of biscuits doughs; mixing objectives, mixer types, formation of shaped dough pieces. Biscuit baking, heat transfer mechanism, changes during baking. Cooling, packaging and storage.

Cakes: cake varieties, ingredients and their functions, wheat flour, components ;shortening, eggs, baking powder, icings, confectionery coating, minor ingredients, formulations, formula balance, cake mixing objectives and methods. Batter specific gravity, temperature and pH, baking reactions.

Wafers: fermentation, ingredients and their function, flour, water, shortening, aerating agent and minor ingredients, mixing, storage and depositing of wafer butter, baking, cooling and conditioning of wafer sheets.

Miscellaneous products doughnut, pie, sweet yeast dough, pretzel and frozen dough products. Flat bread technology.

Practical

General procedures; formula calculation, titrable acidity and pH, baking quality of cake flour, use of layer cake measuring template, use of cake formula balance. Effect of sweeteners on cake quality. Use of baking response of cakes with different acidulants. Preparation of variety cakes. Preparation and evaluation of cookies. Pastry and cake icing.

Books Recommended

1. Wade, P. 1988. Biscuits Cookies and Crackers. Vol-I Elsevier Applied Science, New York.
2. Almond. 1988. Biscuits, Cookies and Crackers. Vol-II. Elsevier Applied Science, New York.

STARCH CHEMISTRY AND TECHNOLOGY

2(2-0)

Theory

Starch sources, composition and properties. Starch granules, structure composition and properties, organization and chemical composition. Amylose and amylopectin, swelling and gelatinization, starch pastes, retrogradation and starch films. Starch modifications: methods, applications, sauces, gravies, soups and dressing, baking products, snacks, cereals, confections and batters.

Books Recommended

1. Thomas, D.J. and Atwell, W.A. 1999. Starches. American Association of Cereal Chem. St. Inc., St. Paul. Minnesota.
2. Swinkels, I. J. J. M. Industrial Starch Chemistry. A VE BE ba. International Marketing and Sales, Foxhole, Holland.

PROCESSING OF NON FERMENTED DAIRY PRODUCTS

3(2-2)

Theory

Milk composition; (cow, goat, camel, sheep, human and buffalo milk). Milk bio-synthesis and production. Milk proteins; micelles and enzymes, milk lipids; free

fatty acid profile. Effects of short chain fatty acids on dairy products. Derivatives and lipolytic rancidity. Milk fat globule structure. Other constituents of milk: lactose, minerals, enzymes. Classification and composition of milk products. Milk microbiology; sources, contamination and control.

Fluid milk processing; dairy equipment, milk collection, tonning and standardization cream separation, pasteurization, homogenization, UHT treatment. Processing and manufacturing of cream, butter, dry milk condensed milk, Manufacture of ice cream. Quality tests, sensory and chemical standards of identity and quality. Sanitation of dairy plants.

Practical

Laboratory Procedures:

a) Analysis of milk composition;

1. Moisture & ash determinations.
2. Fat determination by Babcock/Gerber method
3. Protein determination
4. Titratable acidity determination
5. pH. Determination
6. Turbidity test
7. Phosphatase test
8. Estimation of total viable/coliform count.

i. Preparation and evaluation. Packaging and storage aspects, cost estimation and marketing acceptability of various non fermented dairy products i.e. UHT milk, cream, butter and ice cream etc.

Books Recommended

1. Wong, N.P. 1988. Fundamentals of Dairy Chemistry, 3rd Ed. Van Nostrand Reinhold Co., New York.

2. Marshall, R.T. and W.S. Arbuckle. 1996. Ice Cream. 5th Ed. Chapman and Hall, New York.
3. Atherton, H.V. and J.A. Newlander. 1977. Chemistry & Testing of Dairy Products. 4th Ed. The AVI Pub. Co., Westport, Connecticut.
4. Aurand, L.W., A.E. Woods and M.Q. Wells. 1987. Food Composition and Analysis. Van Nostrand Reinhold, New York.
5. Egan, H., S.K. Ronald and 1987. Pearson's Chemical Analysis of Foods. Longman London.

PROCESSING OF FERMENTED DAIRY PRODUCTS

3(2-2)

Theory

Fermentation, fermented milk. Yogurt, butter, butter milk, cheese etc. Role of microorganisms in their manufacture.

Yogurt: Processing technology of yogurt, butter, butter milk, and cheese etc. Major control points. Nutritional and therapeutic properties of fermented milks. Chemistry of flavour development . Physico-chemical changes in milk during the manufacture of different fermented dairy products. Microbiological hazards and patterns of spoilage.

Cheese Types of cheeses. Role of micro-organism in their manufacture. The importance of starter micro-organisms cultures. Technology of cheese making. Relationship between technology and the properties of the finished cheese. Chemical changes during making of cheese. Major control points. Chemistry of ripening. Microbiological hazards and pattern of spoilage.

Practical

Preparation and evaluation of fermented dairy products. Chemical microbial analysis of ingredients and products (yogurt, cheese) and other fermented dairy products. Microbial analysis of yogurt and cheese. Sensory evaluation of yogurt and cheese. Packaging and storage, cost estimation and market acceptability of dairy fermented products.

Books Recommended

1. Sukumar De. R. 1983. Outlines of Dairy Technology. Royal, Oxford University Press, Delhi.
2. Robinson R.K. 1994. Modern Dairy Technology. Vol.I. Chapman and Hall, London.
3. Varnam A. H. and Sutherland. 1994. Milk and Milk Products. Chapman & Hall, London.
4. Atherton, H.V. and J.A. New lander. 1977. Chemistry of Testing of Dairy Products. 4th Ed. The AVI Pub. Co., Westport, Connecticut.

ADVANCE FOOD MICROBIOLOGY

3(2-2)

Theory

Microorganisms and their products in the preservation of foods. Principles and application of predictive modeling of the effect of preservatives factors on microorganisms. Microbial ecology of different types of food. Meat and meat products, fish and fish products, milk and milk products, eggs and egg products, cereal and cereal products.

Assurance of the microbiological safety and quality of foods. GMP, HACCP and quality systems. Hygienic design of factories and equipment. Sampling for microbial analysis. Detection of microorganisms in foods. Principles and techniques. Principles of culture methods principles and application of genetic technology for detection, identification and sub-typing of food associated pathogenic microorganisms. Risk and microbiological criteria and standards. Food borne microbial diseases. Measurement of cleaning and sanitation effectiveness. Detection and enumeration of specific microorganisms using new technologies. Local and international approaches to obtaining safe food. An

advanced treatment of the pathogenically ecology, properties and control of pathogenic microorganisms in foods.

Theory/Practical

- Culture transfer techniques
- Isolation of pure cultures (techniques)
- Microscopy
- Biochemical activities of micro-organisms
- Cultivation of microorganisms
- Virus, fungi etc.
- Physical and chemical agents for the control of microbial growth
- Microbiology of food/water
- Immunology

Books Recommended

1. Jay, J.M. 1987. Modern Food Microbiology. 3rd Ed. CBS. Pub. & Distributor. Jain Bhawan, Bholu Nath Nagar, Delhi.
2. Wood, B.J.B. and W.H. Holzapeel. 1985. The General of Lactic Acid Bacteria. 2nd Vol. Blackie Academic and Professional. Chapman & Hall, London.
3. Frazier, W.C. and D.C. Westhoff. 1985. Food Microbiology. 3rd Ed. 7-Brothers Printing Press, 38-Urdu Bazar, Lahore.
4. Benson, H.J. 1998. Microbiological Applications. 7th Ed. Lab. Manual in General Microbiology. WCB McGraw Hill, New York.
5. Cappuccino, J.G. and N. Sherman. 1996. Microbiology. A Lab. Manual. 4th Ed. The Benjamin/Cummings Pub. Co., Inc. UK.
6. Barbara L., Parker. T.B. and Gould G. 1999. The Microbiological Safety and Quality of Foods. Vol. II Aspen Publishers, Inc.

ADVANCE FOOD CHEMISTRY

3(2-0)

CARBOHYDRATES

1. Nomenclature, classification and structure

2. **SUGARS**

Properties. Functions in food. Structural and functional changes during processing.

3. Polysaccharides

- a) Starch

Structure and properties. Gelatinization and Retrogradation

- b) Cellulose/Pectins/Gums
Structure and Properties. Pectin and ripening in fruits Industrial
uses of gums

Proteins

Amino acids the building blocks. Structure & classification. Classification of properties. Functional properties of proteins. Denaturation of proteins and the factors affecting denaturation.

Lipids

Classification. Reactions of industrial importance. Hydrogenation, halogenation, saponification & trans esterifications. Rancidity:- Oxidation & Hydrolytic. Refining of crude oil

Vitamins

Structure. Sources. Functions in food. Deficiency & excess. Functions in the body. Sensitivity to processing conditions

Flavors and aroma compounds

Individual aroma compounds, Carbonyl compounds, Phenols, Alcohol, Esters, Terpenes and their interactions with other food constituents, Synthetic and Natural Aroma Compounds

Books Recommended

1. O. R. Fennema. 1996. Food Chemistry 3rd Edition, 1996, Marcel Dekker, Inc., New York.

2. Food Chemistry by H-D Beltz and W. Grosch (1996), Pub. Springer Vertage.
3. Food Science by Norman N. Potter and Joseph H. Hotchkiss, 5th Ed., 1995 Chapman and Hall, 29 West 35th Street, New York.

CHEMISTRY OF EDIBLE OIL AND FATS

3(2-2)

Theory

Chemistry of natural oils, fats and waxes. Physical and chemical properties of fat, distribution of fatty acid in triglyride factors affecting physical characteristics of fats and oils. Fatty acid; Nomenclature, structure and occurrence, retrated acids, monoenoic acids, methylenic – inerupted polyonoic acid and others. Chemical reactions involved in oxidatin, epoxsitation and hydroxylation, etc. others reaction of double bounds; Hlogenation, metathesis, stereomutation, double bound migration, cyclisation, demerisation, etc. reaction of the carbonyl group; hydrolysis, estrification, alcobolysis, acidolysis, intrnesterification, nitrogen and sunfloe contating derivatives, alpha onion of carboxylic acids and peromy acids, etc.

Chemical aspects in therml degradation of fat and oil and deep fat frying –quality tests for fats and oils, animal fat tallow, butter and margarine.

Practical

Analysis of oils for various physical and chemical constants.

Books Recommended

1. AOAC. 1995. Official Methods of Analysis. Association of Official Analytical Chemists, Arlington.
2. Gunstone, F.D. and F.A. Norris. 1983. Lipids in Foods. Chemistry, Biochemistry and Technology. Pergaman Press, New York.

INDUSTRIAL PROCESSING OF EDIBLE OIL 3(2-2) AND FATS PRODUCTS

Theory

Natural sources of edible oils and fats, methods of extraction of oil from natural sources, rendering process, mechanical expression, solvent extraction. Production of vegetable ghee, refining, bleaching, deodorization and hydrogenation operations. Specification of vegetable ghee, production of salad and cooking oils, shortenings, hard butter (cocoa butter replacer, substitutes and extenders), margarine, butter, dressings of food (mayonnaise and salad dressing, pourable type dressing, reduced calories dressing), toppings, coffee whitener, confectioners coatings and other fermented foods. Production and characterization of specialty oils.

Practical

Oil extraction refining bleaching, deodorization and hydrogenation experiments. Production of oleo-oils and oil, etc visit to various oil processing plants and quality control laboratories.

Books Recommended

1. Lawson, H. 1995. Food Oils and Fats. Technology, Utilization and Nutrition. Chapman and Hall, Inc., New York.
2. Swen, D. 1980. Bailey's Industrial Oil and Fat Products. 4th Edition. Volume I and II. John Wiley & Sons Inc., New York.
4. Wan, P.J. 1991. Introduction to Fats and Oils Technology. Association of Official Analytical Chemists, Arlington.

PROCESSING OF MEAT & MEAT PRODUCTS

3(2-2)

Theory

Meat: muscle structure, function, slaughtering methods, chemical and biochemical factors in postmortem glycolysis. Chemical & biochemical constitution of muscle. Spoilage of meat, endogenous infections. Factors affecting the growth of meat spoilage microorganisms, prophylaxis. The storage and preservation of meat; storage above freezing and storage below freezing, dehydration of meat, freeze dehydration, curing. Use of chemical preservatives smoking, canning, pickling, sausages, packing requirements, sanitation, meat formulations & products. Recent developments in meat processing. Quality control measures.

Practical

Meat preservation, canning, cooking, freezing, sausage making, meat products preparation. Visit to meat processing industries.

Books Recommended

1. Larie, R.A. 1991. Meat Science. 5th Ed. Pergamon Press, Oxford.
2. Pearson, A.M. and T.A. Gillet. 1996. Processed meats. 3rd Ed. Chapman and Hall. New York.
3. Levie. A. _____. Meat Handbook. 4th Ed. AVI Publishing Company. Inc., Westport. Connecticut.

CHEMISTRY AND TECHNOLOGY OF SUGAR PROCESSING

3(2-2)

Theory

Sources of sugar its nature, composition and quality consideration from processors point of view. Basic concepts and terminologies used in sugar processing. Juice extraction from sugarcane and sugarbeet. Chemistry of mono- and disaccharide carbohydrates. Some important physical and chemical properties of invert sugars and sucrose. Sources of color and turbidity in raw and clarified juices. Clarification of raw juice. Action of lime and various physical and

chemical aspects involved in juice clarification, diffusion, objects and evaporation, heat transmission through evaporators and calculation of evaporator capacities. Principles of multiple effect evaporators.

Fundamental of crystallization, nucleation theory, seeding techniques, and various procedures of evapo-crystallization and crystallization in motion, centrifugation and drying operations. Recent advances in defecation processes with all its modifications and implementation practices.

Practical

Analysis of sucrose, juice, clarified juice, filtered massecuit, molasses, etc. Handling of processing equipments like juice extraction, clarifiers, filterpress, evaporator crystalizer and centrifugal machines. Visit to the sugar factories.

Books Recommendation

1. Chen, J.C.P. 1985. Meade – Chen Cane Sugar Handbook. A manual for cane sugar majufacturers and their chemists. Eleventh Edition. John Wiley and Sons, Inc. New York.
2. Lionnet, G.R.E. 1999. Sugar Technology for Students. This text forms part of a sugar echnology study programme. Printed by Lang Fred, Durban North, 4051 Rep. of Africa.

QUALITY ASSURANCE MANAGEMENT

3(3-0)

Theoretical and practical consideration of the qualify assurance. Description of different quality control systems: GMP, TQM, and series of ISO – 9000, HACCP. Philosophical approaches to quality control. Cleaning and sanitation, local and international approaches to obtain safe foods. Statistical quality control techniques.

Books Recommended

1. ISO9000, Quality Management System by Kamran Moosa and Imranullah Shariff, Pub. Ibrahim Publisher, Lahore, Pakistan.
2. Dean J. W. J. and R. R. Evans. 1994. Total Quality: Management, Organization and Strategy. West Port Publ. Co. New York.
3. Gould, W.A. and R.W. Could. 1993. Total Quality Assurance. CTI Pub. Inc. Baltimore.

INDUSTRIAL WASTE MANAGEMENT

3(3-0)

Theory

By products, waste, BOD, COD, types of wastes and their sources, Waste treatments and their disposal, physical, chemical and biological. The economics of effluent treatment. Management of waste by products of different industries, sugar industry by products, recovery of fruits and vegetables waste, citrus waste. Meat, fish and animal by products, oil and fat by products, treatment of dairy waste. By products from cereal industry. Recovery of materials from effluents by membrane system. Advances in the utilization of food industry wastes.

Books Recommended

1. Herzaka A. and R. G. 1981. Food Industry Wastes. Disposal and Recovery. Book. Applied Science Pub. London.
2. Birch, G.G., K.J. Parker and J.T. Worgan. 1976. Food from Wastes. Applied Science Pub. Ltd., London.
3. Webb, B. 1970. By Products from Mills. AVI Pub. Co., USA.

BEVERAGE TECHNOLOGY

3(2-2)

Theory

Comparative studies on water treatment plants. Bottle washing plants, bottle washing and inspection, detergents used in bottle washing.

Packaging materials: glass bottles, pet bottles, metal cans, tetra pack, plastic containers.

Containers and closures; plastic, aluminum and metal closures.

Plant sanitation; C.I.P. systems for beverage plants, cleaning and disinfection, composition and formulation of beverages, carbonated and non carbonated beverages, syrup room operations.

Filling systems; premix, post mix, three-stage process. Processing operations; filtration, homogenization, raw material handling and storage, pasteurization, carbonation and sterilization, bodying agents, stabilizers, emulsifiers.

Refrigeration systems, problems in beverage industry. Spoilage detection and control; physical, chemical and microbial spoilage. Shelf life of beverages; factors affecting shelf life. Plant layout and design.

Practical

Visit to beverage plants. Production of beverages of various kinds.

Books Recommended

1. Woodroof, J.G. and G.F. Phillips, 1974. Beverages; Carbonated and non-carbonated. AVI Pub. Co. Westport, Connecticut.
2. Mitchell, A.J. (Edit). 1990. Formulation and Production of Carbonated Soft Dinks. AVI Pub. Co. New York.
3. Charles r.C. 1969. Operation and Control of Water Treatment Processes. 3rd Ed. World Health Organization, Geneva.
4. Green, L.F. 1978. Developments in Soft Drinks Technology-I, applied Sci. Pub.Ltd., London.

POST HARVEST MANAGEMENT OF FRUITS AND VEGETABLES 3(2-2)

Biochemistry and physiology of metabolism in fresh fruit and vegetables, respiration measurements as an index of metabolism, maturation and senescence, physiological and metabolic changes occurring during ripening and

storage. Effect of temperature on metabolism, constraints of high and low temperatures, role of humidity control and water loss in quality maintenance, use of atmosphere control to delay senescence and ripening. Physiological disorders of stored produce, microorganisms of importance to postharvest tissue, physical and chemical methods of control, postharvest disinfestations and quarantine measures. Examination of current commercial storage and marketing operations.

Practical

Sorting and grading techniques, measurement of ethylene, effect of ripening agents. Physico chemical analysis of fruits and vegetables, ripening techniques. Visits to cold storages.

FOOD PACKAGING

3(2-2)

Theory

Chemical and physical properties of package materials, interaction between package and food, selection and evaluation of packaging materials and systems, package design criteria, printing, computers in packaging, modified atmospheres. Corrosion, scale-up, waste engineering, CIP systems.

Practical

Estimation of shelf life of fresh and preserved food using various packages such as a metal container, glass container and flexible packages. Determination of permeability of different plastic films. Estimation of protection against microorganisms in various food packages. Identification of plastic films. Visit to Packages Limited, Lahore

Books Recommended

1. Heid J.L. and M.A. Joslyn. 1981. Fundamentals of Food Processing Operations, Ingredients, methods and Packaging. AVI, Publishing Co. Inc. USA.
2. Heid J.L. and M.A. Joslyn. Food Processing Operation. Vol-I. AVI, Publishing Co. Inc. USA.

Physical Properties of Foods and their Relation to other Food Properties:

Geometrical Properties. Optical Properties. Thermal Properties. Electrical Properties. Mechanical Properties

Relation of Structure to Physical Properties of Foods:

Physical properties and texture of Muscle foods, Measurement of Physical properties of Muscle foods

Physical properties and structure of horticultural products, their classification and structure

Structural and textural characteristics of baked foods, Physical characteristics of food powder, particles and bulk properties.

Rheology of Emulsions & Dispersions: Rheology behaviour of colloids, evaluation of rheological properties

Electron Microscopy of Foods: Principles of Electron Microscope, Scanning Electron Microscopy, Transition Electron Microscopy

Colorimetry of Foods: Physical properties of color, Physiological basis of colour, Tristimulus colorimetry

Practical

- Determination of viscosities of oils, organic solvents and solutions.
- Determination of conductivities of different foods
- Use of colorimeters and spectrophotometers for determination of optical properties of foods.

Books Recommended

1. Micha Peleg & Edward B. Bagely, (Editors) (1983). Physical Properties of Foods. The Avi Pub. Co. Inc. Westport, Connecticut, U.S.A.
2. M.A. Rao & S.S.H.Rizvi (Editors), 1986. Engineering Properties of Foods. Marcel Dekker, Inc. New York.

RECOMMENDATIONS

1. The Departments of Food Science and Technology in different universities must be strengthened by adding faculty members, laboratory and library facilities and modern laboratory equipments. Provision of funds for purchase of chemicals and related material for carrying out research and practical be ensured to meet the requirements of public and private sectors according to the scenario of WTO.
2. Food Technologists must be provided job opportunities in provincial food department, PASSCO and Export Promotion Bureau. Food Technologists be given proper place in Pakistan Standards and Quality Control Authority/Public analyst.
3. Food Industries must ensure the employment of qualified food technologists by the Ministry of Industries.
4. Special funds and facilities for out reach activities/internship of students and teachers must be provided by UGC.
5. UGC should organize In-service Teachers Training Courses in different themes of Food Technology.
6. Provision of funds for visiting faculty for different universities of Pakistan be arranged under UGC programmes short courses by subject experts.
7. The UGC is urged to approach Ministry of Industries, Ministry of Food and Agriculture and other relevant agencies with a request to direct public and private sector food industries and related research institutions to facilitate the internship of students of Food Technology.