

CURRICULUM
OF
FOOD SCIENCE AND
TECHNOLOGY

BS/B.Sc (Hons)
MS/M.Sc (Hons)

(Revised 2010)



HIGHER EDUCATION COMMISSION
ISLAMABAD

CURRICULUM DIVISION, HEC

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PREFACE

The curriculum of subject is described as a throbbing pulse of a nation. By viewing curriculum one can judge the stage of development and its pace of socio-economic development of a nation. With the advent of new technology, the world has turned into a global village. In view of tremendous research taking place world over new ideas and information pours in like of a stream of fresh water, making it imperative to update the curricula after regular intervals, for introducing latest development and innovation in the relevant field of knowledge.

In exercise of the powers conferred under Section 3 Sub-Section 2 (ii) of Act of Parliament No. X of 1976 titled “**Supervision of Curricula and Textbooks and Maintenance of Standard of Education**” the erstwhile University Grants Commission was designated as competent authority to develop review and revise curricula beyond Class-XII. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission under its Ordinance of 2002 Section 10 Sub-Section 1 (v).

In compliance with the above provisions, the HEC undertakes revamping and refurbishing of curricula after regular intervals in a democratic manner involving universities/DAIs, research and development institutions and local Chamber of Commerce and Industry. The intellectual inputs by expatriate Pakistanis working in universities and R&D institutions of technically advanced countries are also invited to contribute and their views are incorporated where considered appropriate by the National Curriculum Revision Committee (NCRC).

To bring international compatibility to qualifications held from Pakistani universities/DAIs for promotion of students mobility and job seekers around the globe, a Committee comprising of Conveners of the National Curriculum Revision Committee of HEC met in 2009 and developed a unified template for standardized 4-years/8-semester BS degree programmes. This unified template was aimed to inculcate broader base of knowledge in the subjects like English, Sociology, Philosophy, Economics etc in addition to major discipline of study. The Bachelor (BS) degree course requires to be completed in 4-years/8-semester, and shall require qualifying of 130-140 credit hours of which 77% of the curriculum will constitute discipline specific and remaining 23% will comprise compulsory and general courses.

In line with above, NCRC comprising senior university faculty and experts from various stakeholders and the respective accreditation councils has finalized the curriculum for BS and MS (Food Science and Technology). The same is being recommended for adoption by the universities/DAIs channelizing through relevant statutory bodies of the universities.

PROF. DR. ALTAF ALI G. SHAIKH
Member Academics

March 2010

CURRICULUM DEVELOPMENT

INTRODUCTION

The meetings of NCRC in Food Science and Technology were held on 19-21 October, 2009 and 12-14 April, 2010 at HEC Regional Centre, Karachi. The meeting was attended by the following members:

Sr.	Name	
1.	Prof. Dr Faqir Muhammad Anjum, Institute of Food Science and Technology, University of Agriculture, Faisalabad	Convener
2.	Prof. Tariq Maqsood Chairman Deptt of Food Science & Tech Arid Agriculture University Rawalpindi	Member
3.	Prof. Dr. Javeed Aziz Awan National Institute of Food Science & Technology University of Agriculture, Faisalabad	Member
4.	Dr. Alam Zeb Professor Deptt of Food Science & Tech KPK Agricultural University Peshawar	Member
5.	Dr. Saleem ur Rehman Professor National Institute of Food Science & Technology University of Agriculture Faisalabad	Member
6.	Prof. Dr. Abid Hussain Deptt of Food Science & Tech University of Karachi Karachi	Member
7.	Dr. Ikram ul Haq Director Institute of Industrial Biotechnology G.C. University Lahore.	Member
8.	Dr. Jehan Ara Professor Deptt of Food Science & Tech University of Karachi	Member

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| 9. | Dr. Habib Ahmad Rathore
Chairman
Deptt of Food Tech
Faculty of Agriculture
University of Azad Jammu & Kashmir
Rawalkot. AJK | Member |
| 10. | Dr. Habib ur Rehman
Assistant Professor
Department of Food Science &
Technology
Gomal University, D.I.Khan | Member |
| 11. | Dr. Sarfraz Hussain
Chairman
Department of Food Science &
Technology
University of Sargodha | Member |
| 12. | Dr. M.A.K. Malghani
Professor
Department of Food Science &
Technology
Balochistan University of Information
Technology,
Engineering Management Science,
Quetta | Member |
| 13. | Dr. Zulfqar Ali
Assistant Professor,
Department of Food Technology
Karakoram International University
Gilgat | Member |
| 14. | Dr. Saeed Akhtar
Assistant Professor
Department of Food & Horticultural
Science
University College of Agriculture
B.Z. University, Multan | Member |
| 15. | Dr. Samina Khalid
Food Quality & Nutrition Program
National Agriculture Research Centre
(NARC) Park Road
Islamabad. | Member |
| 16. | Dr. Ihsanullah
Head
Food Science Division
Nuclear Institute for Food &
Agriculture (NIFA) P.O. Box 446
Peshawar | Member |

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| 17. | Syed Shahzad Shah
Lecturer
Deptt of Home & Health Sciences
Allama Iqbal Open University
Islamabad | Member |
| 18. | Mr. Zahida Qadeer
Lecturer
Deptt of Food Science and Tech
Islamia University Bahawalpur
Bahawalpur | Member |
| 19. | Mr. Mahmood Azam
Lecturer
Deptt of Food Science & Tech
University of Karachi
Karachi | Member |
| 20. | Dr. Saghir Ahmed Sheikh
Professor
Institute of Food Sciences and
Technology
Sindh Agriculture University
Tandojam | Secretary |

The proceedings started with the recitation of Holy Verses from the Holy Quran. Prof. Dr. Altaf Ali G. Shaikh, Member Curriculum Development Program and Academics, HEC Islamabad welcomed the participants and briefed about the objectives of the meeting and the obligations of the Higher Education Commission for review, revision and development of curricula. He informed the participants that curriculum of B.Sc (Hons), M.Sc (Hons) and Ph.D degrees in Food Technology were previously revised in 2001 and 2004.

Dr. Shaikh informed the members that Government is striving hard to enhance the quality of education in public sector Universities/Institutions by developing curriculum and making it more compatible with international standards, job oriented and in line with the needs of the society. He distributed the template of the 4 years B.Sc Hons. in Agriculture disciplines among the members as a guideline for developing Food Science & Technology curriculum. He suggested that Internship of full semester be reduced to a four to six credit hours course and contact hours of practical be increased from 2 to 3 hours. The four years degree program comprises 130 to 140 credit hours.

He further informed the house that after developing the first draft of the curriculum, it will be sent abroad for review to meet the international standards. The comments on curriculum received from foreign experts

will be communicated and discussed in final meeting to be convened at appropriate time.

Prof. Dr. Faqir. Muhammad Anjum who was elected as convener of the committee welcomed all the members and Dr. Altaf Ali G. Shaikh and thanked the participants for attending the meeting. Dr Faqir M Anjum informed the members about various curricula being taught at different Universities. After through discussions and deliberations, it was decided to provide copies of syllabi being taught at various institutions for review. The syllabi of Undergraduate program B.Sc. Hons (4-years) of the following universities were given to each member for review.

1. University of Agriculture, Faisalabad.
2. Sindh Agriculture University, Tandojam.
3. Karachi University, Karachi.
4. The University of Sargodha, Sargodha.
5. Karakoram International University, Gilgat.

On the next day, every member participated in discussions and briefed the house about the deficiencies in the syllabi of various Universities and finally developed a template for B.Sc. Hons (4-Years) in Food Science and Technology containing compulsory courses, foundation courses, supporting courses and major courses.

The Curricula of postgraduate program was also discussed in length. Courses were distributed among the participants and finally a list of courses to be proposed was developed and revisions were suggested in the course contents.

In the end, Dr. M. Tahir Ali Shah, Deputy Director, Curriculum, HEC thanked all the members for attending the meeting and their contributions. The meeting ended with a vote of thanks.

Dr. Saghir A. Sheikh
Member/Secretary

Prof. Dr. Faqir Muhammad Anjum
Convener

Scheme of Studies Four years B.Sc. (Hons.) / B.S. Food Science & Technology/ Food Technology

S#	Course Code	Title	Cr. Hrs
1st Year: 1st Semester			
1.	Math Bio	Mathematics-I or Biology-I	3(3-0) 3(2-1)
2.	Stat	Statistics-I	3(3-0)
3.	CS	Introduction to Information Technology/ Computer	2(1-1)
4.	SSH	Pakistan Studies	2(2-0)
5.	Eng	English-I	3(3-0)
6.	Biochem	Biochemistry	3(3-0)
7.	FST	Introduction to Food Science and Technology	3(2-1)
Total			19
1st Year: 2nd Semester			
1.	Math Bio	Mathematics-II or Biology-II	3(3-0) 3(2-1)
2.	Stat	Statistics-II	3(2-1)
3.	IS SSH	Islamic Studies or Ethics (For Non-Muslim Students)	3 (3-0)
4.	Agron	Basic Agriculture	3(2-1)
5.	Hort	Horticulture	3(2-1)
6.	FST	General Microbiology	3(2-1)
7.	FST	Principles of Human Nutrition	3 (3-0)
Total			21
2nd Year: 3rd Semester			
1.	Ento	Entomology	3(2-1)
2.	PP	Plant Pathology	2(1-1)
3.	ENG	English-II	2(1-1)
4.	PHY	Physics	3 (2-1)
5.	FST	Food Processing & Preservation	3(2-1)
6.	FST	Food Chemistry	3(3-0)
Total			16
2nd Year: 4th Semester			
1.	MAB	Marketing and Agri. Business	3 (3-0)
2.	FST	Unit Operation in Food Processing	3(3-0)
3.	FST	Fluid Mechanics	3(2-1)
4.	FST	Food Plant Layout	2 (2-0)
5.	FST	Food Analysis	3(1-2)

6.	FST	Food Process Engineering-I	3 (2-1)
Total			17
3rd Year: 5th Semester			
1.	FST	Food Toxicology and Safety	3(3-0)
2.	FST	Fruit and Vegetable Processing	3(2-1)
3.	FST	Cereal Technology	3(2-1)
4.	FST	Sugar Technology	3(2-1)
5.	FST	Technology of Fats and Oils	3(2-1)
6.	FST	Instrumental Techniques in Food Analysis	3(1-2)
7.	FST	Food Process Engineering-II	3 (2-1)
Total			21
3rd Year: 6th Semester			
1.	FST	Community Nutrition and Dietetics	3(2-1)
2.	FST	Beverage Technology	3(2-1)
3.	FST	Confectionery and Snack Foods	3(2-1)
4.	FST	Bakery Products Technology	3(2-1)
5.	FST	Postharvest Technology	3(2-1)
6.	FST	Food Microbiology	3(2-1)
7.	FST	Food Product Development	3(1-2)
Total			24
4th Year: 7th Semester			
1.	FST	Meat Technology	3(2-1)
2.	FST	Dairy Technology	3(2-1)
3.	FST	Food Laws and Regulations	3(3-0)
4.	FST	Food Biotechnology	3(2-1)
5.	FST	Food Packaging	3(2-1)
6.	FST	Poultry and Egg Processing	3(2-1)
7.	FST	Research Projects and Scientific Writing	2(1-1)
Total			20
4th Year: 8th Semester			
1.	FST	Sensory Evaluation of Foods	3(2-1)
2.	FST	Sea Food Processing Technology	3(2-1)
3.	FST	Extrusion Technology	3(2-1)
4.	FST	Milk and Meat Hygiene and Public Health	3(2-1)
5.	FST	Food Quality Management	2(2-0)
6.	FST	Internship and Report Writing	4(0-4)
Total			18

Note:- Courses, codes, placement and number of courses may be adopted by the Universities as per their nomenclature and requirements.

Details of Courses for Bs/Bsc (Hons) in Food Science and Technology

FST- Introduction to Food Science and Technology 3(2-1)

Theory

Introduction: food science, food technology, relationship with other disciplines, career opportunities. Significance of food science and technology. Global and national food and nutrition situation. Food industry: history, developments, important food industries in Pakistan. Food sources: plants, animals, marine. Food constituents and their functions: water, carbohydrates, lipids, proteins, vitamins, minerals. Classification of foods: perishability, pH. Food spoilage agents: enzymes, microorganisms, pests, physical factors. Principles of food preservation: prevention or delay of autolysis, microorganisms, pests, physical defects.

Practical

Use of laboratory equipments. Estimation of moisture, fat, protein, carbohydrates, fiber and ash in food samples. Determination of soluble solids, total solids, pH, acidity, total sugars, specific gravity, refractive index and peroxide value.

Books Recommended

1. Potter, N.N. and Hotchkiss, J.H. 2007. Food science. The AVI Pub. Co. Inc., Westport, Connecticut, USA.
2. Awan, J.A. 2005. Food science and technology. Unitech Communications, Faisalabad- Pakistan.
3. Awan, J.A. and Rehman, S.U. 2003. Food analysis manual. Unitech Communications, Faisalabad.

FST- General Microbiology 3(2-1)

Theory

Microbiology: introduction, historical background, branches. Significance of microorganisms in food, water and environment. Microorganisms: cell structure, prokaryotes, eukaryotes. Characteristics of microorganisms: bacteria, yeasts, moulds, viruses. Growth requirements: cultural, physical, chemical, macro- and micro-nutrients. Culture media: types, applications. Microbial metabolism. Bacterial multiplication: growth curve, continuous culture. Microbial genetics: conjugation, transduction, transformation.

Practical

Safety in microbiological laboratory. Basic functions and handling of laboratory equipments. Use of microscope. Sterilization and disinfection

of glassware. Preparation of culture media. Staining of microorganisms and their structures. Bacterial cultivation, growth measurement. Characteristics of bacterial colonies. Bacterial and fungal morphology. Micrometry.

Books Recommended

1. Tortora, G.J., Funke, B.R. and Case, C.L. 2009. Microbiology: an introduction. The Benjamin/Cummings Pub. Co, Redwood City, California, USA.
2. Frazier, W.C. and Westhoff, D.C. 2008. Food microbiology. McGraw Hill Book Co, New York, USA.
3. Awan, J.A. and Rahman, S.U. 2005. Microbiology manual. Unitech Communications, Faisalabad, Pakistan.
4. Banwart, G.J. 2004. Basic food microbiology, 2nd ed. CBS Publishers and Distributors, New Delhi, India.

FST- Principles of Human Nutrition 3(3-0)

Theory

Introduction: definitions, food, nutrients, diet, balanced diet, food groups, food guide pyramid, meal planning. Eating food: smell, taste, satiety. Water: functions, sources, regulation in body, dietary requirements, content in food. Carbohydrates: types, role in body, dietary fiber, sweeteners, dietary requirements, content in food. Fats and oils: types, functions, dietary requirements, content in food, fat substitutes. Proteins: amino acids, protein synthesis, classification, functions, quality of proteins, dietary requirements, content in foods. Vitamins: classification, role in body, content in food. Mineral elements: types, requirements, sources, functions. Digestion: alimentary tract, digestive juices, secretions. Absorption and metabolism of nutrients: carbohydrates, protein, lipids. Nutrient and dietary deficiency disorders: malnutrition, obesity, coronary diseases, diabetes, lactose and gluten intolerance, dental caries – symptoms, causes, prevention.

Books Recommended

1. Geissler, C. and Powers, H. 2010. Human nutrition. Churchill Livingstone, London, UK.
2. Awan, J.A. 2007. Elements of food and nutrition. Unitech Communications, Faisalabad- Pakistan.
3. Bamji, M.S., Rao, N.P. and Reddy, V. 2004. Textbook of human nutrition. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India.
4. Eastwood, M. 2003. Principles of human nutrition. John Wiley & Sons, Inc., New York, USA.

5. Garrow, J.S., James, W.P.T. and Ralph, A. 2000. Human nutrition and dietetics. Churchill Livingstone, London, UK.

FST- Food Processing & Preservation 3(2-1)

Theory

Postharvest handling and preparation of foods for food processing: introduction, properties of raw materials, storage and transportation of raw materials. Preparatory operations: cleaning, sorting, grading, size reduction, blanching, sulphiting. Heat processing: methods – thermisation, pasteurization, HTST, commercial sterilization, UHT. Canning: unit operations. Retort operation: equipment. Effect of heat processing: nutrients, microorganisms. Low temperature preservation: refrigeration: methods and equipments. Cold storage: requirements, insulation, air circulation, humidity, refrigeration load, controlled atmospheric storage. Freezing: theory, equipment and changes in foods. Evaporation and dehydration: evaporation – concentration and condensation, principles, equipments, applications. Drying – principles, equipments, types of driers – cabinet (tray), kiln, tunnel, conveyer (belt), fluidized, pneumatic (flash), rotary. Dehydration: applications, dehydrated products – vegetables, fruits and milk. Use of chemical additives: contaminants, adulterants, additives. Food additives: classification, criteria for selection, GRAS additives, permissible limits, food safety, E-numbers. Preservation by fermentation technology: principles, objectives, types - alcoholic, acetic and lactic fermentations. Fermented foods: bread, wine, vinegar, yoghurt, sausages, pickles. Food irradiation: principles, applications, equipments, safety aspect, effect on food properties, detection methods.

Practical

Bottling/canning of selected fruits, vegetables. Cold storage of fruits and vegetables. Freezing of fruits and vegetables. Dehydration of fruits and vegetables. Use of chemicals in preservation of food products. Production of vinegar, yoghurt and pickles. Evaluation of bottled, frozen and dehydrated products. Visit to food industries.

Books Recommended

1. Awan, J.A. 2009. Food processing and preservation. Unitech Communications, Faisalabad, Pakistan.
2. Awan, J.A. and Rehman, S.U. 2009. Food preservation manual. Unitech Communications, Faisalabad, Pakistan.
3. Rahman, M.S. 2007. Handbook of food preservation. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.
4. Brennan, JG. 2006. Food processing handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.

5. Fellow, P.J. 2005. Food processing technology: principles and practices, 2nd ed. CRC Press, Taylor & Francis Group, Boca Raton, Florida.

FST- Food Chemistry 3(3-0)

Theory

Water: types, properties, structure, water activity, effect on shelf life of food. Carbohydrates: classification, structure, physical and chemical properties, caramelization, Maillard reaction, dietary fiber. Lipids: classification, structure, fatty acids, properties, rancidity, emulsifiers. Proteins: classification, structure, amino acids, chemical, physical and functional properties. Mineral elements: introduction, chemical and functional properties. Vitamins: classification, properties, structure, stability. Colours and pigments: functions, properties, stability. Flavours: characteristics – taste and other saporous substances, aromatic compounds. Enzymes: nature, functions, classification.

Books Recommended

1. Damodaran, S., Parkin, K.L. and Fennema, O.R. 2008. Fennema's food chemistry. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.
2. DeMan, J.M. 2007. Principles of food chemistry. Springer Verlag, Heidelberg, Germany.
3. Belitz, H.D, Groschm, W. and Schieberle, P. 2004. Food chemistry. Springer Verlag, Heidelberg, Germany.

FST- Unit Operations in Food Processing 3(3-0)

Theory

Introduction: units, dimensions, conversion. Energy and mass balance: heat transfer fundamentals – conduction, convection and radiation. Mass balance equations and Pearson's Law. Air-water mixture: psychrometric charts and their application. Rheology of food products: stress, deformation and other aspects. Transport of fluids through pipes: laminar and turbulent regimes. Circulation of fluid through porous beds. Darcy's law: permeability, porosity. Filtration: fundamentals, equipment, maintenance problems, prospects. Separation processes by membranes. Solid-liquid extraction.

Books Recommended

1. McCabe, W.L., Smith, J.C and Harriott, P. 2005. Unit operations of chemical engineering. McGraw Hill Inc., New York, USA.
2. Earle, R.L. and Earle, M. D. 2004. Unit operations in food processing (web edition). The New Zealand Institute of Food

Science and Technology. Available at:
<http://www.nzifst.org.nz/unitoperations/>.

3. Jeankopolis, C.J. 2004. Transport processes and separation process. Prentice Hall Professional Technical Reference, New Jersey, USA.
4. Gustavo, A and Barbosa-Canovas, V. 2002. Unit operations in food engineering. CRC Press, Taylor & Francis Group, Boca Raton, Florida.

FST- Fluid Mechanics 3(2-1)

Theory

Properties of fluids: density, viscosity, surface tension, specific gravity, specific weight, compressibility, fluid energy. Fluid pressure: definition, units, measuring devices, vacuum. Fluid static: derivations and problems. Fluid dynamics: mass and energy balance, steady flow head, Bernoulli's equation, Reynolds number and their practical applications. Energy losses in fluid flow. Newtonian and non-newtonian liquids: flow measurements and characteristics, examples in food. Venturi effect. Pumps: types, working principles, total dynamic head, hydraulic and energy gradelines, power consideration. Darcey-Weisbach equation: loss of head, types of impellers, solutions of flow problems. Diagnostic analysis and remedies. Handling systems.

Practical

Verification of Bernoulli's Theorem. Measurement of flow through venturimeter, orifice meter. Pipe flow and head loss relationship. Pipe head loss and pipe diameter relationship. Characteristic curves for pumps in parallel and series

Books Recommended

1. Hui, Y.H. 2006. Handbook of food science, technology and engineering, Vol-1. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.
2. McCabe, W.L., Smith, J.C. and Harriott, P. 2005. Unit operations of chemical engineering. McGraw Hill Inc., New York, USA.
3. Franzini, J.B. and Finnemore, E.J. 2001. Fluid mechanics with engineering applications. McGraw Hill Inc., New York, USA.
4. Streeter, V.L. 1988. Fluid mechanics. McGraw Hill Inc., New York, USA.

FST- Food Plant Layout 2(2-0)

Theory

Food processing industry: introduction, investment. Plant location and layout: significance, location analysis, selection criteria - freedom from

pollution, availability of potable water, raw material, labour and energy supply, communication facilities, facilities for waste disposal. Building design and construction: floors, drains, walls, doors, windows, ceiling, ventilation, lighting, auxiliary facilities. Food plant equipment: requirements, design, construction, choice of material, layout. Plant cleaning: soil types, methods, detergents, water conditioners. Sanitizing: chemical, heat, irradiation. Cleaning methods – CIP, dismantling cleaning. Pests: types, inspection, control. Waste management: fluid and solid wastes.

Books Recommended

1. Awan, J.A. and Rehman, SU. 2010. Food plant layout and sanitation. Unitech Communications, Faisalabad, Pakistan.
2. Arvanitoyannis, I.S. 2008. Waste management for the food industries. Elsevier Academic Press, New York, USA.
3. Leliveld, H.L.M., Mostert, MA and Holah, J. 2005. Handbook of hygiene control in food industry. Woodhead Publishing Ltd., Abington Hall, Abington, Cambridge, UK.
4. Farber, J.M. and Todd, E.C.D. 2000. Safe handling of foods. Marcel and Dekker, New York, USA.

FST- Food Analysis 3(1-2)

Theory

Food analysis: significance. Sampling: techniques, preparation, preservation. Physical properties and analysis of foods and food products: appearance, texture, specific gravity, refractive index, rheology. Chemical analysis: significance. Proximate analysis: moisture, ash, proteins, lipids, carbohydrates, fiber, NFE, acidity, pH, sugars, mineral elements, vitamins – significance, methods. Chromatography: paper, thin layer. Spectroscopy: atomic emission, atomic absorption. Sensory evaluation of foods: attributes, difference and preference tests, consumer acceptance. Analytical data: evaluation, interpretation, statistical applications.

Practical

Lab safety requirements. Preparation and standardization of laboratory solutions. Sampling. Determination of specific gravity, refractive index, moisture, ash, crude protein, crude fat, crude fiber, NFE, pH and acidity. Estimation of vitamin C. Determination of mineral elements through flame photometer and atomic absorption spectrophotometer. Paper and thin layer chromatography. Identification of toxins by TLC. Sensory evaluation of foods.

Books Recommended

1. AOAC. 2007. Official methods of analysis of AOAC. Association of Official Analytical Chemists, Arlington, USA.
2. Winton, A. and Winton, K.B. 2006. Techniques of food analysis. Agrobios Publishing Co., Jodhpur, India.
3. Awan, J.A. and Rehman, S.U. 2003. Food analysis manual. Unitech Communications, Faisalabad, Pakistan.
4. Pomeranz, Y. and Meloan, C.E. 2000. Food analysis: theory and practice. CBS Publishers, New Delhi.
5. Lawless, H.T. and Haymann, H. 1998. Sensory evaluation of food: principles and practices. Chapman and Hall, New York, USA.
6. Nielsen, S.S. 1994. Introduction to the chemical analysis of foods. Jones & Bartlett Publishers, London, UK.

FST- Food Process Engineering-I 3 (2-1)

Theory

Agricultural raw materials: physical, mechanical, biological, thermal and rheological properties. Engineering approach in materials handling: cleaning, sorting, grading, size reduction - equipments and their applications. Storage structures: refrigeration, air conditioning and freezing units. Mobile refrigeration units. Equipments used for packing of fruits, vegetables and their products. Extraction process for agricultural products: oil seeds, fruits. Cost analysis: engineering processes, finished products. Boilers, steam generators, retorts, fans, blowers: types, selection. Recycling engineering: fundamentals, applications.

Practical

Materials handling: cleaning, sorting, grading of raw materials. Determination of different types of storage environment conditions for agricultural raw materials. Maintenance and operation of equipment used for engineering processes – refrigerant units, heat exchangers. Visit to cold stores and freezing units.

Books Recommended

1. Keith, W. 2007. Handbook of waste management and co-product recovery in food processing, Vol. I. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.
2. Ramaswamy, H.S. and Marcotte, M. 2005. Food processing: principles and applications. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.
3. Smith, J.S. and Hui, Y.H. 2004. Food processing: principles and applications. Blackwell Pub. Co., Oxford, England.

FST- Food Toxicology and Safety 3(3-0)

Theory

Toxicology: definition, dose-response, absorption, translocation, storage excretion, food toxicology. Toxicity by naturally occurring food toxins: plant origin – accidental toxicity, haemagglutinins, goitrogens, cyanogens, lathyrogens, others; animal origin – honey, quail, eggs, milk, meat, fish. Toxicity by extraneous chemicals: agricultural chemicals, food processing, packaging, additives, adulterants. Toxicity from water. Microbial toxins: mycotoxins – moulds, mushrooms.; bacterial food intoxication; bacterial food infections. Food allergy and intolerance. Systems for food safety surveillance – GMP, TQM, HACCP and FSMS-ISO22000:2005.

Books Recommended

1. Awan, J.A. and Anjum, F.M. 2010. Food toxicology. Unitech Communications, Faisalabad, Pakistan.
2. Shibamoto, T and Bjeldanes, L. 2009. Introduction to food toxicology, 2nd ed. Academic Press, London..
3. CAC (Codex Alimentarius Commission). 2007. Codex Alimentarius Commission – Procedural manual. Joint FAO/WHO Food Standards Programme. FAO, Rome, Italy.
4. ISO (International Standards Organization). 2005. Food safety management systems – requirements for an organization in the food chain. Case Postale, Geneva, Switzerland.

FST- Fruits and Vegetable Processing 3(2-1)

Theory

General properties of fruits and vegetables: chemical composition, nutritional aspects, structural features, choice of processing technologies. Maintaining post-harvest quality of fruits and vegetables: quality criteria, quality deterioration – measurement and maintenance. Spoilage factors (chemical, enzymatic, biological) and their control. General procedures for fruits and vegetables preservation: an overview. New technologies for processing of fruits and vegetables: minimal processing technology, modified atmosphere packaging, edible coatings and high pressure processing – introduction, applications, impact on bacteria, enzymes, product quality. Future trends in fruits and vegetables processing.

Practical

Preparation of fruits and vegetables products: dried, frozen and canned. Quality evaluation of the products during storage. Manufacturing of pickle, juice concentrate, ready to serve juices, squashes, syrups and

fruit candies. Use of edible coating for fruits and vegetables. Visit to fruit and vegetable processing units.

Books Recommended

1. Awan, J.A and Rehman, S.U. 2009. Food preservation manual. Unitech Communications, Faisalabad, Pakistan.
2. Jongen, W. (Ed). 2002. Fruit and vegetable processing – improving quality. Woodhead Publishing. Ltd., Abington, Cambridge, UK.
3. Sirivastava, R.P. and Sanjeev, K. 2002. Fruit and vegetable preservation: principles and practices. International Book Distributing Co., Lucknow, India.
4. Dauthy, M.E. 1995. Fruit and vegetable processing. FAO Agricultural Services Bulletin No. 119. Food and Agriculture Organization of the United Nations, Rome, Italy.

FST- Cereal Technology 3(2-1)

Theory

Cereal grains: importance, production, structure, composition, nutrition: Grain grades and grading. Storage: methods, types, role of temperature and moisture, safe storage methods. Dry milling process: cleaning, tempering, conditioning. Grinding process: types of grinding machines. Sieving process: principles, types of sifters. Flour treatment and quality assessment. Rheology of doughs and batters. Maize - wet milling: production of starch, oil, protein. Rice: Drying, milling, parboiling. Processing of rice and oats. Malting and brewing. Production of breakfast cereals and snack foods. Feed and industrial uses of cereals.

Practical

Grading of grains. Milling of cereal grain through different mills. Tests for flour quality assessment. Visit to wheat, maize and rice processing industries.

Books Recommended

1. Delcour, J.A. and Hosney, R.C. 2010. Principles of cereal science and technology. American Association of Cereal Chemists Inc, St. Paul, Minnesota, USA.
2. Karel, K. and Joseph, G.P. 2000. Handbook of cereal science and technology. Marcel Dekker, New York, USA.
3. Kent, N.L. and Evers, A.D. 1994. Kent's technology of cereals: an introduction for students of food science and agriculture. Pergamon Press, Oxford, England.

FST- Sugar Technology 3(2-1)

Theory

Sugar industry in Pakistan. Sugarcane and sugar beet: production, quality. Indigenous technology for small scale sugar production: *gur*, *khund*, *shakar*. Raw sugar manufacturing: unit operations - juice extraction, purification, heating, evaporation, crystallization, crystallization in motion. Refining: affination, clarification, decolorisation, crystallization, centrifugation, drying. Bagging, storage. Factors affecting sugar processing. Quality criteria: raw and refined sugar. Specialty sugar products: brown or soft sugar, liquid sugar. Sugar industry byproducts and their uses.

Practical

Analysis of sugar cane, sugar beet for TSS, pH, fiber, ash and polarization. Extraction and clarifications of raw juice. Analysis of sugar and its intermediate products. Inversion of sugar. Visit to sugar industries.

Books Recommended

1. Asadi, M. 2007. Beet sugar handbook. John Wiley & Sons, Inc., New York, USA.
2. Chen, J.C.P. 2007. Meade-Chen cane sugar handbook. John Wiley & Sons, Inc., New York, USA.
3. Chen, C.C. 2000. Handbook of sugar refining: a manual for the design and refining facilities. John Wiley & Sons, Inc., New York, USA.
4. Lionnet, G.R.E. 1999. Sugar technology for students. Lang Fred, Durban, South Africa.

FST- Technology of Oils and Fats 3(2-1)

Theory

Oils and fats: importance, sources, production, uses. Characteristics of oils and fats: physical, chemical. Oil bearing materials: pre-treatment, storage. Extraction methods: rendering, expression, solvent extraction. Processing: degumming, refining, bleaching, deodorization, fractionation, winterization, hydrogenation, interesterification, esterification, emulsification, stabilization. Spoilage: oxidative and hydrolytic rancidity – chemistry, prevention - use of antioxidants. Manufacture of frying oils, margarine, mayonnaise. Byproducts of fats and oils industry and their uses.

Practical

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

Books Recommended

1. AOCS. 2009. Official methods and recommended practices of AOCS. Am. Oil Chem. Soc., Illinois, USA.
2. Raie, M.Y. 2008. Oils, fats and waxes, National Book Foundation, Islamabad, Pakistan.
3. Akoh, C.C. and Min, D.B. 2008. Food lipids: chemistry, nutrition and biotechnology, 3rd ed. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.
4. Fereidoon S. 2005. Edible oil and fat products: application technology. John Wiley & Sons, Inc., New York, USA.
5. O'Brien, R.D. 2000. Fats and oils: formulating and processing for application. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.

FST- Instrumental Techniques in Food Analysis 3(2-1)

Theory

Introduction, significance. Instrumental techniques: principles, instrumentation, applications. Sample preparation. Supercritical fluid extraction. Chromatography: TLC, ion chromatography, GC, HPLC, LCMS, Spectroscopy: UV-VIS, atomic emission and absorption, Infrared - FTIR, NIR, NMR. Electrophoresis: types, principles, applications.

Practical

Estimation of food components using UV-VIS spectrophotometer. Mineral analysis by flame photometer and atomic absorption spectrophotometer. Determination of organic acids by chromatography. Determination of volatile compounds by gas chromatography, Identification of food components by FTIR. Protein characterization by electrophoresis.

Books Recommended

1. Oates, S. 2009. Handbook of food analysis instruments. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.
2. Nielson, S.S. 2003. Food analysis, Kluwer Academic/Plenum Pub., New York, USA.
3. Pomeranz, Y. and Meloan, C.E. 2000. Food analysis: theory and practice. CBS Publishers, New Delhi, India.

FST- Food Process Engineering-II 3(2-1)

Theory

Food engineering: trends. Properties of foods: physical, colligative, rheological, engineering. Microstructural and imaging analysis as related to food engineering. Heat transfer in food: heat measurement, transfer and control; steam and its use in industry. Applications of refrigeration and freezing: principles, insulation, cold storages - design, equipment, applications. Sterilization, evaporation, drying, pasteurizing. Engineering properties of packaging materials: diffusion through membrane, gas permeation mechanism. Materials handling: equipments. Energy for food engineering: steam, fuel utilization, electric power utilization, thermodynamic laws, energy balance for open systems, dynamic response of sensors.

Practical

Determination of depression in freezing point, surface tension and absolute viscosity of given fluids. Determination of freezing time for food products using Plank's equation. Verification of Stokes law. Selection of pumps and fans using characteristic curves. Determination of thermal conductivity of food materials. Determination of overall heat transfer coefficient of shell and tube heat exchangers. Calculation of thermal process time of foods packed in containers.

Books Recommended

1. Pandey, H., Sharma, H.K., Chauhan, R.C., Sarkar, B.C. and Bera, M.B. 2004. Experiments in food process engineering. CBS Publishers, New Delhi, India.
2. Sahay, K.K. and Singh, K.K. 2001. Unit operations of agricultural processing. Vikas Pub. House, New Delhi, India.
3. Barbosa-Canovas, G.V., Fito, P. and Ortega-Rodriguez, E. 1997. Food engineering 2000, Springer Verlag, Heidelberg, Germany.
4. Farrall, W. 1993. Engineering for dairy and food products. John Wiley & Sons Inc., New York, USA.

FST- Community Nutrition and Dietetics 3(2-1)

Theory

Community nutrition: foundation, status of Pakistani masses. Community nutrition programs: key features, benefits, planning, implementation, evaluation. Factors affecting: social, environmental. Nutritional status assessment: anthropometric measurements, dietary, biochemical, clinical. Nutritional requirements and recommendations: pre-school children, school children, adolescence, adults, pregnant and lactating women, geriatrics. Community nutrition and dietetics profession.

Dietetics: introduction, food composition tables, nutritional databases. Balanced diet: importance in disease prevention, immunonutrition, dietary counseling. Diet therapy: functional foods, glycemic index. Therapeutic diets: routine hospital diets, pre- and post-operative diets, special feeding methods. Diet designing: nutritional requirements, ideal calorie distribution, nutrient density, exchange diets, eating disorders. Diet for specific ailments: obesity, overweight, cardiovascular diseases, diabetes, stomach and liver diseases.

Practical

Dietary reference intakes. Interpretation of food guide pyramids. Nutritional requirements and basal metabolism. Food intake assessment. Major nutrients estimation in different diets. Diet planning for healthy and diseased people. Planning of exchange diets. Diet for school children, geriatric and healthcare centers.

Books Recommended

1. Singh J. 2008. Handbook of nutrition and dietetics. Lotus Press, Darya Ganj, New Delhi, India.
2. Boyle, M.A. 2008. Community nutrition in action: an entrepreneurial approach. Thomson Learning Wadsworth, New York, USA.
3. Mann, J. and Truswell, A.T. 2007. Essentials of human nutrition, 3rd ed. Oxford University Press, Oxford, England.
4. Whitney, E. and Rolfes, S.R. 2005. Understanding nutrition. Thomson Learning Inc., Belmont, U.S.A.
5. Sardesai, V.M. 2003. Introduction to clinical nutrition. Marcel Dekker, New York, USA.
6. Thomas, B. 2001. Manual of dietetic practice. Blackwell Pub. Co., Oxford, England.

FST- Beverage Technology 3(2-1)

Theory

Beverage industry in Pakistan. Beverages: classification – still, carbonated, alcoholic. Beverage ingredients: water, fruit components, sweeteners, flavorings, colorings, preservatives. Manufacture of soft drinks and fruit juices: mixing, pasteurization, homogenization, filling, packing and storage.

Carbonation: History, CO₂, gas volume. Soft drinks and fruit juices: ingredient specifications, manufacturing problems, changes in color, appearance, flavor. Packaging: types, interactions. Shelf life Issues: microbiological problems. Bottled water: legislation, water treatment, filling, quality issues. Fermented beverages: introduction, types, role of

microorganisms. Regulations and standards. Statuary requirement: labeling, nutrition claims.

Practical

Water treatment and analysis. Preparation and preservation of fruit pulps and juice concentrates. Formulation and preparation of carbonated beverages. Analysis of beverages: chemical, microbiological, sensory. Manufacture of fermented beverages and synthetic drinks. Visit to beverage industries

Books Recommended

1. Ashurst, P.R. and Hargitt, R. 2009. Soft drink and fruit juice problems solved. Woodhead Publishing. Ltd., Abington, Cambridge, UK.
2. Shachman, M. 2000. The soft drinks companions: A technical handbook for the beverage industry. CRC Press Taylor & Francis Group, Boca Raton, Florida, USA.
3. Varnam, H.A. and Sutherland, J.M. 1999. Beverages: technology, chemistry and microbiology. CRC Press Taylor & Francis Group, Boca Raton, Florida, USA.

FST- Confectionery and Snack Foods 3(2-1)

Theory

Confectionery: significance, classification, industries in Pakistan. Sugar confectionery: ingredients, manufacturing - high boiled sweets, caramel, toffee, fudge, gums. Sugar free confectionery: need, ingredients, manufacture. Chewing gum technology. Chocolate confectionery. Snack foods: history, status, manufacture - potato, nuts, cereal, meat and fish based. Puffed and baked snacks. Seasonings: ingredients, formulations, applications. Quality control. Packaging.

Practical

Preparation of candy, toffee, chocolates, and other sugar based confectionery. Manufacture of potato chips, fried legumes, nuts, nuggets, extruded snacks. Visit to confectionery and snack food industries.

Books Recommended

1. Panda, H. 2009. The complete technology on snack foods. National Institute of Industrial Research, New Delhi, India.
2. Lusas, W and Rooney, LW. 2001. Snack food processing. Technomic Pub. Co., Lancaster, UK
3. Edwards, WP. 2000. The science of sugar confectionery. Royal Society of Chemistry, Thomas Graham House, Science Park, Cambridge, UK

4. Jackson, E.B. 1995. Sugar confectionary manufactures. Blackie Academic & Professional, Glassgow, UK.

FST- Bakery Products Technology 3(2-1)

Theory

Science of bakery product: emulsions, oils & fats, proteins, starch, water. Raw materials: grains, milling; grades of flours; types of flours – Chorleywood bread flour, patent, soft, wholemeal, brown and low moisture flours; leavening agents; flour treatments; food starch excluding flour; fats; emulsifiers; colors; flavors; antioxidants; sugars; dairy ingredients; gums and gelling agents. Bread making: chemistry of dough development, making of bread, types of breads, variants of bread. Products other than bread: pastry, biscuits, wafers, cakes and other chemically leavened products. Dietetics bakery products. Quality control in bakery.

Practical

Preparation of breads, pastry, biscuits, wafers, cakes and chemically leavened products. Effect of different ingredients on bakery products. Visit to different baking plants.

Books Recommended

1. Edward, W.P. 2007. The science of bakery products. The Royal Society of Chemistry, Cambridge, UK. UK.
2. Hui, Y.H., Corke, H., Leyn, I.D. and Cross, N. 2006. Bakery product science and technology. Blackwell Pub. Co., London, UK.
3. Khetarpaul, N., Grewal, R.B. and Jood, S. 2005. Bakery science and cereal technology. Daya Pub. House, New Delhi, India.

FST- Postharvest Technology 3(2-1)

Theory

Postharvest technology: introduction, production, losses, causes, trade. Fruit ripening: changes during ripening, recommended conditions, commercial practices, water loss, respiration activity. Harvesting and handling methods. Maturity assessment of different fruits and vegetables. Ripening process: respiration, climacteric and non-climacteric patterns, pectic substances, ripening conditions. Postharvest physiology of fruits and vegetables. Postharvest treatments: coatings, curing, vapor heat treatment, hot water treatment, degreening. Storage: refrigerated, CA, hypobaric, MAS. Packaging: types, design, modified atmospheric packaging, recycling. Cold chain: packing house operations, transportation. Safety and quality of fruits and vegetables. Postharvest

technology of cereals: harvesting, threshing, drying, storage and handling. New developments in postharvest technology.

Practical

Determining harvest maturity of different fruits and vegetables. Grading and sorting. Applications of different postharvest techniques. Changes in physical and chemical quality parameters of fruits during storage - weight loss, acidity, TSS, vitamin C degradation, firmness, color changes. Effect of packaging materials on stored fruits and vegetables. Effect of different chemicals - anti-sprouting, anti-ripening.

Books Recommended

1. Chakraverty, A., Mujumdar, A.S., Raghavan, G.S.V., Ramaswamy, H.S. 2003. Handbook of postharvest technology: cereals, fruits, vegetables, tea, and spices, Marcel Dekker, Inc., New York, USA.
2. Thompson, A.K. 2003. Fruit and vegetables harvesting, handling and storage. Blackwell Science Pub., Cambridge, UK.
3. Wim, J. (ed.) 2002. Fruit and vegetable processing: Improving quality. Woodhead Publishing Ltd., Abington, Cambridge, UK.

FST- Food Microbiology 3(2-1)

Theory

Food microbiology: introduction and scope. Morphological, cultural and physiological characteristics: molds, yeasts and yeast like fungi, bacteria. Important microbial genera in foods: bacteria, moulds, yeasts, viruses - general, morphological, cultural and physiological characteristics. Factors affecting the growth and survival of microorganisms in food: intrinsic, extrinsic and implicit. Contamination and spoilage of perishable, semi perishable and stable foods: sources, transmission, microorganisms. Food microbiology and public health: food-borne infections: intoxications. Microbiological risk assessment. Microbiology in food sanitation: food sanitizers and pathogen reduction - a case study.

Practical

Isolation, identification and characterization of micro organisms: morphology, biochemical. Enumeration of microorganisms in food and water samples (total count, viable count, MPN). Examination of foods for pathogenic organisms (*Escherichia coli*, Coliform, *Salmonella* and *Listeria monocytogenes*).

Recommended Books

1. Frazier, W.C. and Westhoff, D.C. 2008. Food microbiology. McGraw Hill Book Co., New York, USA.

2. Adams, M.R. and Moss, M.O. 2006. Food microbiology. The Royal Society of Chemistry, Cambridge, UK.
3. Yousef, A. E. and Carlstrom, C. 2003. Food microbiology: a laboratory manual. John Wiley and Sons, New Jersey, USA.
4. Brown, M. and Stringer, M. 2002. Microbiological risk assessment in food processing. Woodhead Publishing Ltd. Cambridge, UK.
5. Spencer, J.F.T. and Ragout de Spencer, A.L. 2001. Food microbiology protocols. Humana Press, New Jersey, USA.

FST- Food Product Development 3(2-1)

Theory

Food product development: process, strategy, design, development, commercialization, evaluation. Key to new product success and failure. Consumer in food product development: consumer behavior, food choices, sensory needs, consumer role. Preference mapping and food product development: conducting trials, analyzing, recent developments. Case study of consumer-oriented food product development: reduced-calorie foods - Consumer trends and healthy eating, marketing and technological challenges, success factors. Case study: reduced-calorie on-the-go beverages. The ethics of food production and consumption.

Practical

Food product development projects - strategy, design, development, commercialization, launch and evaluation. Practical aspects and sensory evaluation techniques. Chemical and instrumental quality analysis.

Recommended Books

1. Earle, M., Earle, R. and Anderson, A. 2001. Food product development. Woodhead Publishing Ltd., Abington, Cambridge, UK.
2. Earle M. and Earle, R. 2007. Case studies in food product development. Woodhead Publishing Ltd., Abington, Cambridge, UK.
3. Frewer, L and Trijp, H. 2007. Understanding consumers of food products. Woodhead Publishing Ltd., Abington, Cambridge, UK.

FST- Meat Technology 3(2-1)

Theory

Meat animals: Status in Pakistan, factors influencing growth and development. Slaughtering process: pre-slaughtering care and handling of meat animals, stunning methods, bleeding methods – modern, Islamic, Kosher, Jhatka, others. Meat carcass: dressing, post-mortem

changes, carcass evaluation. Factors affecting quality of meat. Preservation of beef and lamb: chilling, freezing, canning, dehydration, curing, salting, smoking, irradiation. Properties of meat: physical, chemical, and microbiological. Nutritive value of raw and processed meat. Quality assurance and safety in meat industries.

Practical

Identification of meat cuts. Tests for freshness of meat. Meat grading and quality testing. Preservation of meat: freezing, canning, dehydration, smoking, curing. Preparation of meat products. Visit to abattoir and meat processing plants.

Books Recommended

1. Kerry, J., Kerry, J. and Ledward, D. 2007. Meat processing: improving quality. Woodhead Publishing Ltd., Abington, Cambridge, England.
2. NIIR Board of Consultants and Engineers. 2005. Preservation of meat and poultry products. Asia Pacific Business Press Inc., Kalma Nagar, Delhi.
3. Riaz, M.N. and Chaudry, M.M. 2003. Halal food production. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.
4. Pearson, A.M. and Gillett, T.A. 1997. Processed meats. Chapman & Hall, Inc., New York, USA.

FST- Dairy Technology 3(2-1)

Theory

Milk: production statistics, importance, standards, major constituents. Factors influencing raw milk quality. Milk handling: manual and machine milking, farm cooling, collection, reception, analyses at different levels, transportation. Unit operations in milk processing: cream separation, bacto-fugation, filtration, thermization, standardization, homogenization, pasteurization, sterilization, UHT, aseptic packaging, storage, distribution, effect on milk constituents. Technology, chemistry, microbiology of industrial products: evaporated, condensed and powder milks, butter, yogurt, cheese, ice cream, *khoa*, *gulabjamun*, *burfi*, *rabri*, *paneer*, *dahi*, *lassi*, *kheer*, *desi ghee*. Milk by-products: dried whey, casein.

Practical

Milk sampling methods. Reception tests: Sensory test, sedimentation, pH, acidity; lactometer reading, clot on boiling, alcohol precipitation test, standard plate count, reductase test. Physico-chemical and microbiological analysis of milk and milk products. Tests for adulterants. Visit to commercial dairy farms and milk processing plants.

Books Recommended

1. Chandan, R.C., Kilara, A. and Shah, N. 2008. Dairy processing and quality assurance, John Wiley & Sons Inc., New York, USA.
2. Walstra P., Wouters J.T.M. and Guerts T.J. 2006. Dairy science & technology. CRC Press Taylor & Francis Group, Boca Raton, Florida, USA.
3. Winton A.L. and Winton K.B. 2006. Milk and milk products. Agrobios, Agro House, New Delhi, India.
4. Alfa Laval/Tetra Pak. 2003. Dairy processing handbook. Tetra Pak Processing System, Lund, Sweden.
5. Smith, G (ed). 2000. Dairy processing: improving quality. CRC Press Taylor & Francis Group, Boca Raton, Florida, USA.

FST- Food Laws and Regulations 3(3-0)

Theory

Pakistan Standards and Quality Control Authority: functions, authorities, standards. Pure Food Rules - 2007: definitions, significant features, enforcement, amendments. Food inspector and public analyst: qualifications, duties, powers. Food adulteration: adulterants, health hazards, methods of detection. Food labelling: perspectives on nutrition labeling. Islamic food laws and regulations: sources, principles, lawful foods, unlawful foods. Consumer laws in Pakistan. International food laws: introduction. The World Trade Organization (WTO) - the agreement on the application of sanitary and phytosanitary measures. GATT. Codex Alimentarius: general, procedural manual, standards, codes, legal force.

Books Recommended

1. PSQCA (Pakistan Standards and Quality Control Authority). 2010. Standards for different food items. PSQCA, Karachi, Pakistan.
2. Meulen, B. and Velde, M. 2008. European food law handbook. Academic Publishers, Wageningen, The Netherlands.
3. Government of the Punjab. 2008. The Punjab Pure Food Rules – 2007. The Punjab Weekly Gazette. Government Printing Press, Lahore, Pakistan.
4. Riaz, M.N. and Chaudhary, M.M. 2004. Halal food production. CRC Press Taylor & Francis Group, Boca Raton, Florida, USA.
5. Khan, M.S. 1999. Consumer laws in Pakistan. Consumer Rights Commission of Pakistan, Islamabad, Pakistan.

FST- Food Biotechnology 3(2-1)

Theory

Biotechnology: introduction, history. Microbial metabolism. Developments in metabolic and biochemical engineering: metabolites, range of fermentation processes, components of fermentation

processes. Isolation and preservation of industrially important microorganisms. Industrial fermentations: media, design and types of fermentors, process variables in fermentation, recovery, purification of fermentation products. Production of organic acids, enzymes, amino acids, single cell proteins, carotenoids and fermented food products. Microbial genetics: conjugation, transduction, transformation. GMO in food biotechnology. Legal and social aspects of food biotechnology.

Practical

Isolation, purification and maintenance of yeast and bacterial cultures. Aerobic and anaerobic fermentation and production of various fermented food products.

Books Recommended

1. El-Mansi, F.M.T, Bryee, C.F.A, Demain, A.L. and Allman, A.R. 2007. Fermentation microbiology and biotechnology. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.
2. Shetty, K., Paliyath, G, Pometto, A. and Levin, RE. 2005. Food Biotechnology. Marcel Dekker Inc., New York, USA.
3. Borem, A., Santos, F.R. and Bowen, D.E. 2004. Understanding biotechnology. Pearson Education Inc., New Jersey, USA.

FST- Food Packaging 3(2-1)

Theory

Food packaging: introduction, needs, functions, systems, development. Packaging types: primary, secondary, tertiary. Packaging materials: rigid containers, flexible packaging. Properties of food packaging: physical, chemical. Packaging guidelines: retail containers, shipping containers. Factors influencing design and selection of packaging materials: product, distribution, marketing, packaging operation, cost. Printing processes: inks, adhesives. Filling and labeling. Safety and legislation. Novel food packaging techniques. Food labeling: importance, types, methods.

Practical

Identification of packaging materials used for various food products. Requirements of foods for specific packaging material. Canning in metal containers. Can testing. Determination of shelf-life in various packaging materials. Vapor permeability test. Determination of film thickness. Visit to packaging industries.

Books Recommended

1. Lee, D.S., Yam, K.M and Piergiovanni, L. 2008. Food packaging science and technology. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.

2. EIRI (Engineers India Research Institute). 2007. Handbook of packaging technology. Engineers India Research Institute, New Delhi, India.
3. Robertson, G.L. 2006. Food packaging: principles and practices. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.

FST- Poultry and Egg Processing 3(2-1)

Theory

Poultry industry in Pakistan. Factors affecting poultry quality: breed, age, sex, genotype, rearing conditions and practices. Bird selection: weight, quality. Primary poultry processing: live-bird supply, stunning, slaughtering, scalding, plucking, evisceration, giblet harvesting, whole-carcass and cuts packaging. Portioning and deboning operations. Preservation: freezing, canning, drying, chemical treatments, irradiation. Packaging: materials, selection. Quality assurance: parameters, drug and feed residues.

Eggs: identification, grading, composition, quality characteristics, handling, storage. Egg processing: drying, freezing - whole, white, yolk. Functional properties and applications in food processing. Quality control during processing.

Practical

Slaughtering and dressing of poultry. Poultry cuts. Tests for freshness of poultry and eggs. Grading of poultry meat and eggs. Preparation and preservation of poultry and egg products. Visit to poultry and egg processing plants.

Books Recommended

1. Mead, G.C. 2004. Poultry meat processing and quality. Woodhead Publishing Ltd., Abington, Cambridge, UK.
2. Sim, J.S., Nakai, S. and Guenter, W. 2000. Egg nutrition and biotechnology. CABI Publishing, New York, USA.
3. Pearson, A.M. and Gillett, T.A. 1996. Processed meats. Chapman & Hall, New York, USA.
4. Yamamoto, T. 1996. Hen eggs: basic and applied science. Woodhead Publishing Ltd., Abington, Cambridge, UK.

FST- Research Projects and Scientific Writing 2(1-1)

Theory

Types of scientific presentations. Collection of literature: printed and electronic sources. Managing literature. Initiating write up. Writing

scientific documents: synopsis, research proposal, articles, references, internship report. Oral presentations.

Practical

Exercises in collecting literature from different sources on assigned topics. Organizing and analysis of collected material. Writing synopsis/proposal, short communication, Delivering oral presentation.

Books Recommended

1. Awan, J.A. 2009. Scientific presentations. Unitech Communications, Faisalabad, Pakistan.
2. Khalil, S.K. and Shah, P. 2007. Scientific writing and presentation for crop sciences. Higher Education Commission, Islamabad, Pakistan.
3. Anderson, J., Durston, B.H. and Poole, M. 1992. Thesis and assignment writing. Wiley Eastern Ltd., New Delhi, India.

FST- Sensory Evaluation of Foods 3(2-1)

Theory

Introduction: overview, physiological and psychological foundations. General requirements for sensory testing. Organization and evaluation of sensory evaluation program. Measurement: difference, discrimination testing, scaling, threshold methods, descriptive analysis. Effective texture evaluation. Color and flavor evaluation. Special problems related to sensory science. Consumer field tests and questionnaire design. Statistical procedures.

Practical

Taste, odor identification, trigeminal sensations, taste modifiers. Use of sequential testing in selecting judges. Training of panelists by difference tests such as triangle test, paired comparison test, duo-trio test. Color, threshold determination, just noticeable difference. R-Index rating and ranking. Category scaling, determining an ideal level of an ingredient. Magnitude estimation. Descriptive analysis of different foods. Consumer test and analysis.

Books Recommended

1. Kemp, S.E., Hollywood, T and Hort, J. 2009. Sensory evaluation: a practical handbook. John Wiley & Sons Inc., New York, USA.
2. Chambers, E. and Wolf, M.B. 2005. Sensory testing methods. American Society for Testing and Materials, West Conshohocken, Pennsylvania, USA.
3. Stone, H. and Sidel, J.L. 2004. Sensory evaluation practices. Elsevier Academic Press, California, USA.

4. Carpenter, R.P., Hasdell, T.A. and Lyon, D.H. (Eds). 2000. Guidelines for sensory analysis in food product development and quality control. Aspen Publishers, Inc., Gaithersburg, Maryland, USA.
5. Lawless, H.T. and Heymann, H. 1998. Sensory evaluation of food: principles and practices. Kluwer Academic Publishers, Massachusetts, USA.

FST- Sea Food Processing Technology 3(2-1)

Theory

Fish and shell fish: overview, importance, handling, transportation. Reception, testing and storage of fish. Quality indicators: biochemical, microbiological. Fish preparation: heading, filleting, skinning. Standards for freshness of fish. Fish preservation: freezing, defrosting, canning, salt curing, smoking, drying. Processing of miscellaneous products. Quality control and factory sanitation.

Practical

Evaluation of freshness of fish. Quality evaluation of processed fish. Preservation of fish by salting, smoking, canning, freezing. Preparation of fish products. Visit to fish farm/ processing industry.

Recommended Books

1. Long, A. 2008. Fish processing technology. Cyber Tech. Publications. New Delhi, India.
2. Ninawe, A.S. and Rathnakumar, K. 2008. Fish processing technology and product development. Narendra Publishing House, New Delhi, India.
3. Bremner, H.A. 2005. Safety and quality issues in fish processing. Woodhead Publishing Ltd., Abington, Cambridge, UK.
4. Hall, G.M. 2001. Fish processing technology. Blackwell Pub Co., Cambridge, UK.

FST- Extrusion Technology 3(2-1)

Theory

Extrusion: introduction, importance, types, functions, applications. Dry extruders: principles, applications, advantages, disadvantages. Interrupted flight extruders/expanders: principles, applications, advantages, disadvantages. Single screw extruders: principles, applications, advantages, disadvantages. Twin screw extruders: principles, applications advantages. Preconditioners: characteristics, effect on extrusion. Changes in food during extrusion: effect on starch, proteins, fats, dietary fiber, vitamins. Applications in industry: textured

vegetable protein, breakfast cereals, direct expanded and third generation snacks.

Practical

Quality assessment of raw materials. Preparatory operations of raw material. Preparation of textured vegetable proteins, breakfast cereals, flavor coated snacks, third generation snacks. Effect of variation of ingredients, screw speed, temperature, etc. on the quality of end product.

Books Recommended

1. Riaz, M.N (ed). 2003. Extruders in food applications. Technomic Pub. Co. Inc., Lancaster, Pennsylvania, USA.
2. Guy, R. 2001. Extrusion cooking technology and applications. Woodhead Publishing Ltd., Abington, Cambridge, UK.

FST- Milk and Meat Hygiene and Public Health 3(2-1)

Theory

Milk hygiene: scope, importance. Hygienic milk production and handling practices. Preservation of milk: transportation, storage. Contamination: types, sources, effects. Milk defects: off flavors, milk-borne diseases. Adulteration in milk: current status, control methods. HACCP for hygienic milk production.

Meat hygiene: meat sanitation scope, importance. Abattoirs: pre-requisites. Anti-mortem inspection: disease symptoms. Slaughtering and meat handling: hygienic practices and principles, rules for meat industry, red meat hygiene. Waste management. Quality control. Meat-borne diseases. HACCP for hygienic meat production.

Practical

Sampling of milk. Physical examination of milk for general appearance, consistency, flavor and aroma. Testing of milk: clot on boiling, alcohol precipitate test, pH value, acidity and specific gravity. Total viable count in milk. Methylene blue reduction test. Somatic cell count. Detection of adulterants in milk. Detection of preservatives in milk. Visit to dairy plant/milk chilling plant.

Sampling of meat. Visual examination of carcass. Post-mortem examination. Microbiological examination of meat. Visit to slaughterhouse/ meat processing industries.

Books Recommended

1. Kurwijila, L.R. 2006. Hygienic milk handling, processing and marketing: reference guide for training and certification of small-scale milk traders in Eastern Africa. International Livestock Research Institute, Nairobi, Kenya.
2. MIF (Milk Industry Foundation of USA). 2005. Analysis of milk and its products: a lab manual. Biotech Books, New Delhi, India.
3. Spreer, E. 2005. Milk and dairy products technology. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.
4. Gracey, J.F., Collins, D.S. and Huey, R.J. 1999. Meat hygiene. Baillière Tindall, London, UK.

FST- Food Quality Management 2(2-0)

Theory

Food quality management: history, importance, systems. Good manufacturing practices (GMP): personal cleanliness, buildings and facilities, sanitary operations, sanitary facilities and controls, equipment and utensils, production and process control, warehousing and distribution, traceability and recall. Hazard analysis and critical control points (HACCP) system: history, prerequisites, preliminary steps, principles. Food Safety Management Systems (FSMS) – ISO22000:2005. Codex Alimentarius Commission (CAC) guidelines for food quality management.

Books Recommended

1. CAC (Codex Alimentarius Commission). 2007. Codex Alimentarius Commission – Procedural manual. Joint FAO/WHO Food Standards Programme. FAO, Rome, Italy.
2. ISO (International Standards Organization). 2005. Food safety management systems – requirements for an organization in the food chain. Case Postale, Geneva, Switzerland.
3. Lelieveld, H.L.M., Mostert M.A. and Holah, J. (Editor). 2005. Good manufacturing practices in the food industry. In: Handbook of hygiene control in the food industry. Woodhead Publishing Ltd., Abington, Cambridge, UK.
4. Blanchfield, J.R. 1998. Good manufacturing practices. Institute of Food Science and Technology, London, UK.

FST- Internship and Report Writing 4(0-4)

Every student will undertake practical training in an approved food industry or research organization. The student will maintain a daily diary duly signed by the industrial/research supervisor. At the end of the internship, the student will submit a written report. He/she will be

evaluated by a committee on the basis of his/her performance in the industry/research organization, final written report and oral presentation.

Scheme of Studies
MS/M.Sc. (Hons.)/ Ph.D Food Science & Technology

Course No.	Title of Course	Credit Hours
FST-	Food Biotechnology	3(2-1)
FST-	Food Additives	3(2-1)
FST-	Food Enzymology	3(2-1)
FST-	Food Toxicology	3(3-0)
FST-	Baking Science and Technology	3(2-1)
FST-	Starch Chemistry and Technology	2(2-0)
FST-	Dairy Processing-I	3(2-1)
FST-	Dairy Processing-II	3(2-1)
FST-	Advanced Food Microbiology	3(2-1)
FST-	Advanced Food Chemistry	3(2-1)
FST-	Chemistry of Edible Oils and Fats	3(2-1)
FST-	Ind. Processing Technol. of Edible Oils & Fats Products	3(2-1)
FST-	Meat Science	3(2-1)
FST-	Technology of Processed Meat	3(2-1)
FST-	Food Industrial Waste Management	3(3-0)
FST-	Post Harvest Management	3(3-0)
FST-	Food Packaging	3(2-1)
FST-	Physical Properties of Food	3(2-1)
FST-	Recent Advances in Food Science and Technology	3(2-2)
FST-	Milling of Cereals	3(2-1)
FST-	Advanced Beverage Technology	3(2-1)
FST-	Food Quality Assurance Management	3(3-0)
FST-	Seminar	1(1-0)
FST-	Special Problem	1(1-0)

Detail of courses for MS/M.Sc. (Hons.)/Ph.D in Food Science & Technology

Advanced Food Biotechnology 3(2-1)

Theory

Food Biotechnology: Introduction, importance, recent advances and trends, techniques and applications. Fermentation: Types, equipment, factors affecting the fermentation, and control of fermentation conditions. Fermentation kinetics, stoichiometry, bioreactors, solid state bioprocessing and transformation. Yeast based products: Alcoholic beverages, industrial alcohols, baker yeast, bread and related products. Bacteria based fermented products, dairy, meat and fish, vegetable, vinegar and organic acids, bacterial biomass. Mold based products. Other microbial based products: Enzymes, sweeteners, flavors, amino acids and vitamins. Food Safety: Safety evaluation of novel food products, genetically modified foods.

Practical

Isolation, purification and maintenance of yeast and bacterial cultures, aerobic and anaerobic fermentation and production of various fermented food products. Production of metabolites and enzymes, their purification.

Books Recommended

1. Capuccino, J.G. and N. Sherman. 1996. Microbiology and Laboratory Manual. The Benjamin Cummings Pub. Co., New York.
2. Lee. B.H. 1996. Fundamentals of food biotechnology. VCH Publishers, Inc, New York.
3. Mittal, G.S. 1992. Food Biotechnology: Techniques and applications. Technomic Pub Inc. Lancaster.
4. Shetty, K. (ed). 2005. Food Biotechnology, 2nd Ed. Marcel Dekker, Inc., New York, NY, USA.
5. Thomas and R.L Fuchs. 2002. Biotechnology and Safety Assessment. Taylor & Francis, Philadelphia, PA.

Food Additives 3(2-1)

Theory

Food additives: purpose of application in food, regulatory status, generally recognized as safe (GRAS), mode of action, stability & interaction with food components, metabolism & carcinogenic effect, recommended doses, application techniques in food, benefits & risks, precautionary instructions for safe use of food additives in food, hypersensitivity of food, consumers attitude towards food additives.

Types of food additives: antimicrobial agents, nutritional additives – vitamins and minerals, antibiotics, colors, flavoring & flavor enhancers, sugar and fat substitutes, sweeteners, acids, bases, humectants, thickening agents, gel builders, stabilizers, anticaking agents, emulsifiers, bleaching, glazing agents, sequestrant. Recommended analysis techniques of various food additives in food.

Practical

Estimation of food additives in different foods: antioxidants, enzymes, vitamins, minerals, anti-nutritional factors, colors, flavors, sweeteners, amino acids, sorbates, benzoates, emulsifiers.

Books Recommended

1. Branen, A.L., Davidson, R.M., Salminen, S. and Thorngate J.H. 2001. Food additives, 2nd ed. Marcel Dekker, Inc, Madison Avenue, New York.
2. Butt, M.S., Anjum, F.M. and Asghar, A. 2010. Food Additives: A comprehensive treatise. University of Agriculture Press, Faisalabad.
3. Wood, R., Foster, L., Damant, A. and Pauline, K. 2004. Analytical methods for food additives. CRC Press, Boca Raton, Florida.

Food Enzymology 3(2-1)

Theory

Enzymes: Nomenclature and classification. Enzyme classes: proteases, amylases, cellulases, transferases, hydrolases, isomerases, lipases, redox enzymes. Natural Sources of enzymes Enzyme kinetics and inhibition. Enzyme immobilization and methods, enzyme reactions. Analysis of enzyme activity. Separation, purification and assay of enzymes. Enzyme supplementations Regulation for enzyme supplementations therapeutic enzyme Application of enzymes: baking, brewing, starch hydrolysis, dairy, beverages, fruit juice processing, meat, fat and others.

Practical

Extraction and purification of enzymes. Estimation of amylases, proteases and peroxidases. Catalase enzyme activity test. Use of Natural enzymes in food products Effect of temperature and pH on enzyme stability and activity Application of enzyme (Rennet) in dairy. Use of enzymes in bread, juice clarification, meat tenderization and other food products.

Books Recommended

1. Mathewson, P.R. 1998. Enzymes. American Association of Cereal Chemists, Inc., St. Paul, Minnesota, USA
2. Whitaker, J.R., Voragen, A.G.J. and Wong, D.W.S. 2003. Handbook of Food Enzymology. Marcel Dekker, Inc., New York.
3. Whitehurst, J. and Law, B.A. 2002. Enzymes in Food Technology. CRC Press, Boca Raton, Florida, USA.
4. Wong, D.W.S. 1995. Food Enzymes. Chapman & Hall, New York.

Food Toxicology 3(3-0)

Theory

Food toxicology: Overview - intrinsic and extraneous toxins. Principles, types, branches. Toxicity: curve, factors influencing potency, margin of safety, factors influencing toxicity. Dose-response relationship, manifestation of organ toxicity. Measurement of toxicants and toxicity. Toxicokinetics: carcinogenesis, mutagenesis, teratogenesis. Chemical carcinogenesis: initiation, promotion, progression, angiogenesis. Manifestation of organ toxicity. Toxicants in the body: absorption, distribution, translocation, biotransformation, excretion. Detoxification mechanisms. Wholesomeness of processed foods: heat processed, irradiated, genetically modified foods.

Books Recommended

1. Awan, J.A. and Anjum, F.M. 2010. Food Toxicology. Unitech Communications, Faisalabad-Pakistan.
2. Helferich, W. and **Winter**, C.K. 2000. Food Toxicology. Woodhead Publishing Limited, Abington Hall, Abington, Cambridge.
3. LU, F.C. and Kacew S. 2002. Lu's Basic Toxicology, 4th ed. Taylor and Frances Inc., New York.
4. Sharma, P.D. 1997. Toxicology. Rastogi Pub. Co., Meerut, India.
5. Shibamoto, T., Taylor S. and Bjeldanes L. 1993. Introduction to food toxicology. Academic Press, London.

Baking Science & Technology

Theory

Bread types and Formulations. Wheat flour: components and functions. Shortenings: Types, functions, sources and mechanisms. Yeast: Types, functions, factors influencing fermentation and other minor ingredients. Bread making processes: Mixing and dough processing: Baking process: Stages, baking reactions, Bread packaging and storage. Bread spoilage

and staling, factors and control measures. Biscuits, cookies, and crackers: Ingredients and their functions, wheat flour, chlorine treatment of flour, granulation, shortening, sweeteners. Types of leavening agents. Preparation of biscuit doughs. Biscuit baking, heat transfer mechanism, changes during baking. Cooling, packaging and storage.

Cakes: Varieties, ingredients and functions. Wafers: Ingredients and functions: Miscellaneous products: Flat bread technology. Frozen dough products, pizza. Pastry, doughnut and Muffins.

Practical

Bread baking: effects of water absorption and dough mixing time, Variations in fermentation and proofing time. Effects of shortenings, emulsifier, amylases and sweeteners on bread. Comparison of various dough making procedures. Preparation and evaluation of flat breads i.e. chapattis and naans etc. Visit of processing plant. Biscuits and cakes: Preparation and sensory evaluation of variety breads, cakes, cookies and wafers, pastry and cake icing. Preparation of wafers, pizza and doughnuts. Baking powder preparation by using different ingredients.

Books Recommended

1. Almond, N. 1988. Biscuits, cookies and crackers. Vol-I & II. Elsevier Applied Science, New York, NY, USA.
2. Cauvain, S. and Young, L. 2006. baked products; technology and practice. Blackwell Pub., USA.
3. Cauvain, S.P. 2003. Bread making - improving quality. Woodhead Pub. Ltd., Cambridge, UK.
4. Edwards, W.P. 2007. The science of bakery products. Royal Soc. Chem., Cambridge, UK
5. Edwards, W.P. 2007. The science of bakery products. Royal Society of Chemistry, Cambridge, UK
6. Pylar, E.J. 1988. Baking science and technology. Vol-I & II. Sosland Pub. Co., Kansas, USA
7. Wade, P. 1988. Biscuits, cookies and crackers. Vol. I. Elsevier Applied Science, New York, NY, USA.

Starch Chemistry and Technology 2(2-0)

Theory

Starch: Structure & functionality. Sources: Cereal, root and tuber starches. Starch properties: Physical, functional & thermal properties, viscoamylography, gelatinization, starch swelling, starch pastes, retrogradation and starch films. Modification: Pregelatinization, acid modification, oxidation, cross linking, acetylation, esterification, multiple and genetic modifications. Applications; as an ingredient, in product

development. Starch and health; physical performance, nutritional fractions and resistant starches.

Books Recommended

1. Eliasson, A.C. 2004. Starch in food; structure, function and application. Woodhead Pub., Ltd., Cambridge, UK.
2. Geirwyr, S.J. 1995. Analytical chemistry of food. Chapman and Hall, Glasgow, UK.
3. Thomas, D.J. and Atwell, W.A. 1999. Starches. American Association of Cereal Chem. Inc., St. Paul, Minnesota, USA.

Dairy Processing-I 3(2-1)

Theory

Physical, chemical and functional properties of milk constituents: lactose, lipids, proteins, minerals, vitamins and enzymes. Milk microbiology: Sources of contamination, pathogens, spoilage organism and control. Classification and composition of non-fermented dairy products. Milk processing: Plant hygiene and cleaning, cream separation, standardization, bactofugation, membrane filtrations, homogenization, pasteurization, ultra pasteurization, UHT treatments, evaporation, drying, condensing, freezing and membrane fractionation. Heat induced changes in milk and milk products. Milk packaging: Types of packaging and their effect on milk quality.

Practical

Sampling techniques: Raw milk, processed milk. Production of pasteurized milk, ice-cream, dried milk powder and flavored milk. Quality assurance and safety tests: operational, laboratory equipment, raw material, control measures. Sensory and physio-chemical evaluation of pasteurized milk, UHT milk, condensed milk, dried milk powders and ice cream. Microbial examination of milk and milk products: Total viable count, yeast and mold, somatic cells, coliform, Escherichia coli, Salmonella.

Books Recommended

1. DeLaval/Tetra Pak. 2003. Dairy processing handbook. Tetra Pak Processing System, S-221 86, Lund, Sweden
2. Marshal, R.T. 1993. Standard Methods for the Examination of Dairy Products. American Public Health Association (APHA), Washing DC.
3. Robinson, R.K. 1996. Modern Dairy Technology. Vol.1. Advances in Milk Processing, 2nd ed. Chapman and Hall, London, UK.

4. Varnam, A.H. and Suthaland, J.P. 1994. Milk and Milk Products: Technology, Chemistry, and Microbiology. Chapman and Hall, London, UK.
5. Walstra, P., Wouters, J.T.M. and Guerts, T.J. 2006. Dairy Science & Technology, 2nd ed. CRC Press, Boca Raton, Florida, USA

Dairy Processing-II 3(2-1)

Theory

Fermented milk products: production and economic importance. Microbiology of raw and processed milk. Starter cultures and incubation temperatures, schematic ways of fabrications and processing technologies used for yoghurt, butter, kefir, acidophilus milk and cheese production. Compositional and physico-chemical changes occur in milk during manufacturing of fermented dairy products. Rheological parameters, Microstructural properties and organoleptic scores of products. Chemistry of fermentation and flavor development. Physical defects, causes and remedies in fermented products. Microbiological hazards and pattern of spoilage. Factors affecting shelf life of milk and milk products. Utilization of by products for standardisation: native casein micelles, whey and butter milk. Packaging of fermented products.

Practical

Preparation of fermented milk products: yoghurt, cheese, butter and therapeutic milk. Compositional, physico-chemical, microbial. Microstructural, rheological and sensory evaluation of fermented milk product. Identification of defects in cheese and yoghurt and their solutions like whey separation.

Books Recommended

1. Fox, P.F., Guinee, T.P., Cogon, T.M. and McSweeney, P.L.H. 2000. Fundamental of Cheese Science. Springer-Verlag, New York, NY, USA.
2. Marshal, R.T. 1993. Standard Methods for the Examination of Dairy Products. American Public Health Association (APHA), Washing DC
3. Robinson, R.K. 1994. Modern Dairy Technology. Vol. I. Chapman and Hall, London, UK.
4. Varnam, A.H. and Suthaland, J.P. 1994. Milk and Milk Products: Technology, Chemistry, and Microbiology. Chapman and Hall, London, UK.
5. Walstra, P., Wouters, J.T.M. and Guerts, T.J. 2006. Dairy Science and Technology, 2nd Ed. CRC Press, Boca Raton, Florida, USA.

Advanced Food Microbiology 3(2-1)

Theory

Food microbiology: Advances and trends. Physiology and biochemistry of food borne micro-organisms, microbial metabolism and genetics. Culture Types: Collection and maintenance. Detection of microorganisms in foods: Principles and techniques, rapid methods vs. conventional methods, estimation of microbial toxins, metabolites, inhibitory substances and pathogens. Differentiation of bacterial strains by electrophoretic protein profiles. Probiotic and proteolytic properties of different bacteria. Isolation and titration of bacteriophages. Traditional and current approaches to microbial food safety and quality. Genetically modified microorganisms.

Practical

Microbial techniques, detection of microorganism in food samples, detection of automated rapid and conventional methods for microbial toxins, metabolites, inhibitory substances, pathogens and bacteriophages through HPLC, GC and other techniques. Electrophoretic protein profiles of bacteria.

Books Recommended

1. Adams, M.R. and Moss. M.O. 2000. Food Microbiology. Royal Society of Chemistry, London, UK.
2. David, A.A., Janet, E.L., Corry, B.S. and Rosamund, M.B. 2005. Essentials of the Microbiology of Foods: A Textbook of Advanced Studies. John Wiley and Sons, New York.
3. Doyle, M.P., Beuchat L.R. and Montvile, T. 2001. Food Microbiology: Fundamentals and Frontiers. Centre for Food Safety, University of Georgia, Georgia, USA.
4. Jay, M.J. 1996. Modern Food Microbiology. CBS Publishers, New Delhi, India.
5. Spencer, J.F.T. and De Spancer, A.L.R.. 2001. Methods in Biotechnology Food Microbiology Protocols. Human Press, New Jersey, USA.
6. Thomas, A.M. 2003. Detecting pathogens in Food. CRC press, USA.

Advanced Food Chemistry 3(2-1)

Theory

Carbohydrates: Nomenclature, classification, structure. Sugars: properties, functions in food, structural and functional changes during processing. Polysaccharides: Starch - structure, properties, gelatinization, retrogradation. Cellulose/Pectins/Gums - structure,

properties, industrial uses. Proteins: Amino acids - structure, Classification and functional properties of proteins. Denaturation. Lipids: Classification, reactions of industrial importance, hydrogenation, halogenation, saponification, trans-esterifications. Rancidity: Oxidative and hydrolytic. Vitamins: Structure, sources, functions. Sensitivity to processing conditions. Flavors and aroma compounds: Carbonyl compounds, phenols, alcohol, esters, terpenes and their interactions with other food constituents, synthetic and natural aroma compounds. Food Contaminants: Toxic trace elements, Toxic compounds of microbial origin, Pesticides, Veterinary medicines and feed additives, Polychlorinated biphenyls (PCB,s).

Practical

Isolation and extraction of different food components. Titrametric determination of sugars, vitamin C, Iodine etc. Separation of natural food colors. Extraction of pectin from fruit waste. Estimation of starch, cholesterol, total dietary fiber, glucose, pigments etc.

Books Recommended

1. Belitz, H.D. and Grosch, W. 2004. Food Chemistry. Springer-Verlag, New York.
2. Tim, H. 2002. Food Chemical Composition: Dietary Significance in Food Manufacturing. Campden and Chorley Wood Research Association. Campden, UK.
3. Weaver, M.C. and Daniel, J.R. 2003. The Food Chemistry Laboratory: A Manual for Experimental Foods, Dietetics, and Food Scientists. Blackwell Pub. Co., Oxford

Chemistry of Edible Oils and Fats 3(2-1)

Theory

Introduction, history of triglyceride analysis, triglycerides types, nomenclature and possible applications. Extraction, isolation and fatty acid analysis (Methyl ester preparation, column, identification of peaks, quantization etc.). Preparation of chemical derivation reactions at double bond (hydrogenation, permanganate oxidation, ozonization, bromination, mercuration etc) reactions at ester linkages, hydroxy, epoxy and keto groups, silver ion adsorption chromatography, TLC, Column chromatography and application, GLC, Fractional crystallization. Distribution theories of fatty acid in natural triglyceride mixtures.

Practical

Extraction of lipids, isolation of triglycerides by column chromatography, Florisil/ salicylic acids, TLC. Fatty acid analysis by GLC, Methyl ester

preparation. Catalytic hydrogenation, permagnate oxidation, ozonization, epoxidation, bromination etc. Silver ion adsorption chromatography.

Books Recommended

1. Akoh, C.C. and Min, D.B. (Eds). 2008. Food Lipids; Chemistry, Nutrition and Biotechnology. CRC Press, New York.
2. AOCS. 1998. Official methods and recommended practices of AOCS, 5th ed. Am. Oil Chem. Soc. Illinions, USA.
3. NIIR BOARD. Modern Technology of Oil, Fats and its derivatives. Asia Pacific Business Press Inc., India.
4. Nilelsen, S.S. 1994. Introduction to the Chemical Analysis of Foods. Jones and Bartlett Pub. Inc., London.
5. Perkins, E.G. 1993. Analysis of Fats, Oils and Derivatives. AOCS Press, Champaign.

Industrial Processing Technology of Edible Oils & Fats Products 3(2-1)

Theory

Edible oils and fats, natural sources. Oil extraction: Rendering process, mechanical expression, solvent extraction. Production of hydrogenated oils: Refining, bleaching hydrogenation and deodorization operations. Specifications of vegetable ghee. Production of salad and cooking oils, margarine, butter, food dressings, toppings, coatings and shortenings. Production and characterization of specialty oils, quality control in oils and fats processing.

Practical

Oil extraction, refining, bleaching, hydrogenation and deodorization. Preparation of different fat products: butter, margarine, dressings, toppings etc. Visits to various oil processing plants and quality control laboratories.

Books Recommended

1. Fereidoon, S (Ed). 2005. Edible Oil and Fat Products: Application Technology, Vol. 4. John Wiley and Sons, London.
2. Hamm, W. and Hamilton, R.J. 2000. Edible Oil Processing. CRC Press, Boca Raton, Florida.
3. Lawson, H. 1995. Food Oils and Fats: Technology, Utilization and Nutrition. Chapman and Hall, New York.
4. O'Brein, R.D. 2004. Fats and Oils. Formulating and Processing for Applications, 2nd ed. CRC Press, London.

Meat Science 3(2-1)

Theory

Meat: Types, chemical and biochemical aspects Muscle: Muscle proteins, intramuscular fat, muscle function in vivo, post-mortem glycolysis, onset of rigor mortis. Factors reflected in specialized muscle function and constitution: Species, breed, sex, age, anatomical location of muscles and myofibrils. Conversion of muscle to meat: pre-slaughtering handling, moisture loss, glycogen loss, stunning and bleeding, dressing and cutting. Ageing of meat: Protein denaturation, proteolysis and other chemical changes. Meat spoilage: Endogenous and exogenous infections. Factors affecting the growth of meat spoilage microorganisms. Use of Bacteriocins against meat borne pathogens. Propleylaxis: Hygiene, biological control, antibiotics, ionizing radiations.

Practical

Determination of chemical composition of red meat. Protein profile of various meats. Determination of minerals, vitamins, fatty acids and toxins.

Books Recommended

1. Lawrie, R.A. 1998. Lawrie's Meat Science, 6th Ed. Woodhead Pub. Ltd. Cambridge.
2. Nollet, L.M.L. and Toldra, F. 2006. Advanced Technologies for Meat Processing. CRC, Taylor and Francis, New York.
3. Aushurst, P.R. and Dennis, M.J. 1996. Food Authentication. Blackie Academic & Profession, London.
4. Marwaha, K. 2007. Meat Hygiene. Gene-Tech Books, 4762-63/2. Ansarri road, Daya. Ganj. New Delhi-110002.

Technology of Processed Meat 3(2-1)

Theory

Meat: Handling, transportation and storage. Curing of meat: Curing ingredients and curing methods. Meat smoking: Purpose, production, deposition of smoke on meats, methods of smoking, liquid smoke preparation and its application. Meat cookery & cooked meat products. Meat cooking: Sausages, classification, fermented meat products, sausage formulations, casings, extruders & additives. Herbs, spices & condiments in processed meats. Types of cured & smoked meats. Reduced & low fat meat products. Canned meat formulations, restructured meat products, procedures, raw materials & formulations. Development of functional meat products. Cold storage, food freezing of meat. Quality control and sanitation. Sensory analysis of meat, New developments in decontaminating raw meat. Visits to the meat industries.

Practical

Local meat products and cookery: Beef stews, chili, sausages, meat balls with gravy, sliced dried beef, potted meat, smoked meat & other meat products, restructured meat products.

Books Recommended

1. Footitt, R.J. and Lewis, A.S. 1995. The Canning of Fish & Meat, 1st Ed. Blackie Academic & Professional, London.
2. Karry, J., Karry, J. and Ledward, D. 2007. Meat Processing: Improving quality. Woodhead Publishing Ltd. Cambridge. England.
3. Lawrie, RA. 1998. Lawrie's Meat Science. 6th Ed. Woodhead Pub. Ltd., Cambridge.
4. Nollet, L.M.L. and Toldra, F. 2006. Advanced technologies for Meat Processing, CRC, Taylor and Francis, New York
5. Pearson, A.M. and Gillett, T.A. 1996. Processed Meats, 3rd Ed. Chapman and Hall, New York.
6. Von Lovesick, H.W. 2001. Outlines of Food Technology, 2nd Ed. Agro House, Chopasani Road, Jodhpur, India.

Food Industrial Waste Management 3(3-0)

Theory

Food industrial wastes: types; sources and characteristics of food processing wastes. Waste disposal and physical, chemical and biological treatments. BOD, COD, Bio processing in food waste treatment. Management of waste by products: sugar, fruits and vegetable, meat, fish, oil and fat, dairy and cereals. Recovery of materials from effluents by different systems. Utilization of food industry wastes.

Books Recommended

1. Arvanitoyannis, L.S. 2008. Waste management for the food industries. Elsevier Academic Press, Oxford.
2. Lawrence, K.W. and Wang, M.U.S. 1992. Hand Book of Industrial Waste Treatment. Harcep Dekker, Inc., New York.
3. Lee, B.H. 1996. Fundamentals of food biotechnology. VCH Pub. Inc., New York.
4. Waldron, K. 2008. Handbook of waste management and co-product recovery in food processing. CRC press, New York.

Post Harvest Management 3(3-0)

Theory

Fruits and vegetables: Structure, composition, physiology and biochemistry methods of harvesting, losses during harvesting, handling, transportation, packaging and storage. Water losses, respiration activity,

mechanical injuries. Storage methods and types. Grains and legumes: Harvesting, threshing and grading systems. Deterioration during storage causes, loss assessment, control, mycotoxins. Commodity treatments and packaging. Storage atmosphere role of temperate and humidity. Different storage methods controlled atmosphere (CA) and modified atmosphere (MA). Modified atmosphere packaging (MAP). Role of temperature and humidity in storage, methods of packaging and types of packaging.

Books Recommended

1. Christensen, C.M. and Meronuck, RA. 1986. Quality Maintenance in Stored Grains Seed. University of Minnesota Press, Minnesota.
2. Wim, J. 2002. Fruits and vegetable processing - improving quality. CRC Press, Boca Raton, Florida.
3. Yamashita, R. 1993. New technology in grain post-harvesting. Farm Machinery Industrial Research Corp., Tokyo.

Food Packaging 3(2-1)

Theory

Introduction to Food Packaging, Types of packaging materials. Shelf life of foods. Aseptic Packaging of foods. Packaging of microwaveable foods. Active and Intelligent Packaging. Modified atmosphere packaging. Packaging of flesh foods. Packaging of horticultural products. Packaging of dairy products. Packaging of cereals, snack foods and confectionary. Packaging of beverages. Packaging of ready to eat foods. Labels and labeling. Test Procedures for packaging materials and packaged products. Safety and legislative aspects of food Packaging.

Practical

Selection of packaging material for specific foods, study of shelf life of different foods in various packaging materials, comparison of different packaging. Materials for quality, migration of hazardous chemicals from packaging material to foods. Package integrity checks. Testing of packaging materials and packages.

Books Recommended

1. Ahvenainen, R. 2003. Novel Food Packaging Techniques. Woodhead Pub. Ltd., Cambridge.
2. Blakistone, B.A. 1998. Principles and applications of modified atmosphere packaging of foods, 2nd ed. Blackie Academic & Professional. New York.
3. Fellows, P. and Axtell, B. 1993. Appropriate Food Packaging. Tool Publications, Amsterdam. Netherlands.

4. Lee, D.S., Yam, K.M and Piergiovanni L. 2008. Food Packaging Science and Technology. CRC Taylor & Francis, London, UK.
5. Robertson, G.L. 2006. Food packaging: Principles and practices. CRC Taylor & Francis, London, UK.

Physical Properties of Food 3(2-1)

Theory

Physical properties of foods: Relation to other food properties: optical, thermal, electrical, mechanical Physical properties and texture of muscle foods, measurement of physical properties of muscle foods, horticultural products, baked foods. Rheology of emulsions and dispersions: behavior of colloids, evaluation of rheological properties. Rheological properties of cereals, proteins and carbohydrates. Application in cereal industry. Electron microscopy: Principles, scanning, transition. Calorimetry: Physical properties of colors, physiological basis of colors, tristimulus Calorimetry.

Practical

Determination of viscosities, Specific gravity of oils, organic solvents and solutions. Determination of conductivities of different foods. Use of colorimeters and spectrophotometers for determination of optical properties of foods. Measurement of food textures and rheological properties.

Books Recommended

1. Faridi, H. and Faubion, J.M. 1997. Dough rheology and baked products texture. CBS Pub. & Dis., New Dehli.
2. Rahman, M.S. 1995. Food properties handbook. CRC Press, Boca Raton, Florida.
3. Rao, M.A. and Rizvi, S.S.H. 1995. Engineering properties of foods, 2nd ed. Marcel Dekker, Inc. New York.
4. Walstra, P. 2003. Physical chemistry of foods. Marcel Dekkar Inc., New York.

Recent Advances in Food Science and Technology 3(2-2)

Theory

Functional foods, genetically modified foods, organic foods: Safety, nutrition, legislation. Emerging technologies: Fats and oils, cereals, dairy, beverage, fruits and vegetables and meat industry. Emerging food safety issues. Supercritical fluid extraction, Biofortification, Nanotechnology: concept and applications, Novel ideas in food packaging, High pressure processing, Ohmic heating, Membrane processing. Extrusion

technology. Modern quality standards like ISO-22000. New tools in food analysis: HPLC, electrophoresis, FTIR, Mass spectrometry and coupling techniques like GC-MS, LC-MS. Recent news in food science and technology.

Books Recommended

1. Buttriss, J. and Saltmarsh, S. 2000. Functional foods. Royal Society of Chemistry, Cambridge.
2. Nielsen SS. 2003. Food Analysis. Kluwer Academic Pub., New York.
3. Otlés, S. 2009. Handbook of food analysis instruments. CRC Press, New York.
4. Sun, D.W. 2005. Emerging technologies for food processing. Elsevier Academic Press, CA, US.

Milling of Cereals 3(2-1)

Theory

Wheat milling: Types of mills, handling, storage, blending, cleaning, tempering and conditioning. Wheat impurities separation: Principles, methods and equipment. Grinding process: Types of grinding machines, different extraction rates of flour. Operations of roller mill. Grinding systems: Break, reduction and tailings. Sieving process: Principles and types of sifters. Purification process. Flour handling and storage. Mill's wheat-cleaning system. Air classification and fine grinding. Whole wheat products. Milling of soft and durum wheats. Wet milling of corn: Production of starch, oil, gluten. Milling of rice. Recent developments in commercial milling.

Practical

Test weight and kernel hardness measurement. Effect of tempering time and moisture content on flour yield. Experimental milling. Flour mill stream analysis: color, moisture, protein, ash, pH and particle size. Flour performance test; farinograph, mixograph and amylograph. Gluten washing tests, alkaline water retention capacity, pelshenke value and SDS sedimentation test.

Books Recommended

1. Atwell, W.A. 2001. Wheat flour. Eagan Press, U.S.A.
2. Khan, K. and Shewry, P.R. 2009. Wheat: chemistry and technology. American Association of Cereal Chemists Inc., St. Paul., Minnesota, U.S.A.
3. Owens G. 2001. Cereals processing technology. Woodhead Pub. Ltd. Cambridge, U.K.

4. Posner, E.S. and Hibbs, A.N. 1997. Wheat flour milling. American Association of Cereal Chemists Inc., St. Paul., Minnesota, U.S.A.

Advanced Beverage Technology 3(2-1)

Theory

Overview of beverage industry. Water treatment plants: To study the water purification systems. Bottle washing plants: Operations and inspection, detergents used in bottle washing. Plant sanitation: CIP systems for beverage plants, cleaning and disinfection: Packaging materials: (glass bottles, pet bottles, metal cans, tetra-pack, plastic containers; container closures (plastic, aluminum and metal closures). Raw material handling and storage: Syrup room operation, pasteurization, sterilization, stabilizers and emulsifiers.

Filling systems: Premix, post mix, three stage processes. Composition and formulation of carbonated and non-carbonated beverages: Carbon dioxide and carbonation. Trouble shooting in beverage industry: spoilage detection and control, physical, chemical and microbiological spoilage. Shelf life of beverages: factors affecting shelf life.

Practical

Production and sensory evaluation of different instant and powdered mixes/drinks, fermented, still, carbonated and non- carbonated beverages. Storage study of such prepared products under different conditions through taking laboratory tests (physical, chemical, sensory and microbiological examination) during whole storage life.

Books Recommended

1. Ashurst, P.R. 2005. Chemistry and Technology of Soft drinks and Fruit Juices. Blackwell Pub. Co., Oxford.
2. Shachman, M. 2004. The Soft Drinks Companion: A Technical Handbook for the Beverage Industry. CRC Press, Boca Raton, Florida.
3. Steen, D.P. 2006. Carbonated soft drinks - formulation and manufacture. Blackwell Publishers, Oxford, UK.

Food Quality Assurance Management 3(3-0)

Theory

Codex Alimentarius: Format of commodity standards. Quality assurance: theoretical and practical considerations, description of different systems: GMP, TQM, HACCP, ISO – 9000, 9001 and 22000 series. Verification, certification and validation. WHIMS. Biosecurity programs. Philosophical approaches to quality assurance: Deming's,

Juran's Corsby's etc. Statistical quality control techniques. Sanitation and hygiene in quality assurance. Quality Assurance tools, instrument calibration, production line check record, laboratory analysis record. Incoming material inspections, certificate of analysis, training manuals and programmes, Internal and external audits.

Books Recommended

1. Blanchfield, J.R. 1998. Good manufacturing practice. Institute of Food Science and Technology, London.
2. Clute, M. 2008. Food industry quality control systems. Culinary and Hospitality Industry Publication Services, USA.
3. Evans, J.R. 2005. Total quality: management, organization and strategy. Westport Pub. Co., New York.
4. Hoyle, D. 2001. ISO 9000: Quality system handbook, 4th ed. Butterworth-Heinemann, Oxford.
5. McDonald, D.J. and Engel, D. 1996. A guide to HACCP. Highfield Pub. Sprotborough, UK.

Special Problem 1 (1-0) Seminar 1 (1-0)

**DETAILS OF COMPULSORY COURSES
COMPULSORY COURSES IN ENGLISH FOR
Undergraduate Level**

English I (Functional English)

Credit Hrs. 3

Objectives: Enhance language skills and develop critical thinking.

Course Contents

Basics of Grammar
Parts of speech and use of articles
Sentence structure, active and passive voice
Practice in unified sentence
Analysis of phrase, clause and sentence structure
Transitive and intransitive verbs
Punctuation and spelling

Comprehension

Answers to questions on a given text

Discussion

General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening

To be improved by showing documentaries/films carefully selected by subject teachers

Translation skills

Urdu to English

Paragraph writing

Topics to be chosen at the discretion of the teacher

Presentation skills

Introduction

Note: Extensive reading is required for vocabulary building

Recommended books:

1. **Functional English**
 - a) Grammar
 1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
 2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506
 - b) Writing
 1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
 - c) Reading/Comprehension
 1. Reading. Upper Intermediate. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.
 - d) Speaking

English II (Communication Skills)

Credit Hrs. 3

Objectives: Enable the students to meet their real life communication needs.

Course Contents

Paragraph writing

Practice in writing a good, unified and coherent paragraph

Essay writing

Introduction

CV and job application

Translation skills

Urdu to English

Study skills

Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic skills

Letter/memo writing, minutes of meetings, use of library and internet

Presentation skills

Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review

Recommended books:

Communication Skills

- a) Grammar
 - 1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

- b) Writing
 - 1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
 - 2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

- c) Reading
 - 1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
 - 2. Reading and Study Skills by John Langan
 - 3. Study Skills by Richard Yorky.

English III (Technical Writing and Presentation Skills)

Credit Hrh. 3

Objectives: Enhance language skills and develop critical thinking

Course Contents

Presentation skills

Essay writing

Descriptive, narrative, discursive, argumentative

Academic writing

How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building

Recommended books:

Technical Writing and Presentation Skills

- a) Essay Writing and Academic Writing
 1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
 2. College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.
 3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.
- b) Presentation Skills
- c) Reading

The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

ISLAMIC STUDIES (Compulsory)

Objectives:

This course is aimed at:

- 1 To provide Basic information about Islamic Studies
- 2 To enhance understanding of the students regarding Islamic Civilization
- 3 To improve Students skill to perform prayers and other worships
- 4 To enhance the skill of the students for understanding of issues related to faith and religious life.

Detail of Courses

Introduction to Quranic Studies

- 1) Basic Concepts of Quran
- 2) History of Quran
- 3) Uloom-ul -Quran

Study of Selected Text of Holly Quran

- 1) Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
- 2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
- 3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
- 4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- 5) Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)

Study of Selected Text of Holly Quran

- 1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
- 2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
- 3) Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

Seerat of Holy Prophet (S.A.W) I

- 1) Life of Muhammad Bin Abdullah (Before Prophet Hood)
- 2) Life of Holy Prophet (S.A.W) in Makkah

- 3) Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II

- 1) Life of Holy Prophet (S.A.W) in Madina
- 2) Important Events of Life Holy Prophet in Madina
- 3) Important Lessons Derived from the life of Holy Prophet in Madina

Introduction To Sunnah

- 1) Basic Concepts of Hadith
- 2) History of Hadith
- 3) Kinds of Hadith
- 4) Uloom –ul-Hadith
- 5) Sunnah & Hadith
- 6) Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction To Islamic Law & Jurisprudence

- 1) Basic Concepts of Islamic Law & Jurisprudence
- 2) History & Importance of Islamic Law & Jurisprudence
- 3) Sources of Islamic Law & Jurisprudence
- 4) Nature of Differences in Islamic Law
- 5) Islam and Sectarianism

Islamic Culture & Civilization

- 1) Basic Concepts of Islamic Culture & Civilization
- 2) Historical Development of Islamic Culture & Civilization
- 3) Characteristics of Islamic Culture & Civilization
- 4) Islamic Culture & Civilization and Contemporary Issues

Islam & Science

- 1) Basic Concepts of Islam & Science
- 2) Contributions of Muslims in the Development of Science
- 3) Quranic & Science

Islamic Economic System

- 1) Basic Concepts of Islamic Economic System
- 2) Means of Distribution of wealth in Islamic Economics
- 3) Islamic Concept of Riba
- 4) Islamic Ways of Trade & Commerce

Political System of Islam

- 1) Basic Concepts of Islamic Political System
- 2) Islamic Concept of Sovereignty

3) Basic Institutions of Govt. in Islam

Islamic History

- 1) Period of Khlaft-E-Rashida
- 2) Period of Ummayyads
- 3) Period of Abbasids

Social System of Islam

- 1) Basic Concepts of Social System of Islam
- 2) Elements of Family
- 3) Ethical Values of Islam

Reference Books:

- 1) Hameed ullah Muhammad, "Emergence of Islam", IRI, Islamabad
- 2) Hameed ullah Muhammad, "Muslim Conduct of State"
- 3) Hameed ullah Muhammad, "Introduction to Islam"
- 4) Mulana Muhammad Yousaf Islahi,"
- 5) Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.
- 6) Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)
- 7) Mir Waliullah, "Muslim Jrisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)
- 8) H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)
- 9) Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)

Pakistan Studies (Compulsory)

Introduction/Objectives

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline

1. Historical Perspective

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land
 - i. Indus Civilization
 - ii. Muslim advent
 - iii. Location and geo-physical features.

2. Government and Politics in Pakistan

Political and constitutional phases:

- a. 1947-58
- b. 1958-71
- c. 1971-77
- d. 1977-88
- e. 1988-99
- f. 1999 onward

3. Contemporary Pakistan

- a. Economic institutions and issues
- b. Society and social structure
- c. Ethnicity
- d. Foreign policy of Pakistan and challenges
- e. Futuristic outlook of Pakistan

Books Recommended

1. Burki, Shahid Javed. *State & Society in Pakistan*, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.

3. S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.
5. Wilcox, Wayne. *The Emergence of Banglades.*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development*. Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh*. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan*. Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective*. Islamabad: National Commission on Historical and Cultural Research, 1993.

COMPULSORY MATHEMATICS COURSES FOR B.Sc (Hons) AGRICULTURE

1. MATHEMATICS I (ALGEBRA)

Prerequisite(s): Mathematics at secondary level
Credit Hours: 3 + 0

Specific Objectives of the Course: To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions.

Matrices: Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.

Quadratic Equations: Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.

Sequences and Series: Arithmetic progression, geometric progression, harmonic progression.

Binomial Theorem: Introduction to mathematical induction, binomial theorem with rational and irrational indices.

Trigonometry: Fundamentals of trigonometry, trigonometric identities.

Recommended Books:

Dolciani MP, Wooton W, Beckenback EF, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin,

Boston (suggested text)

Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston

2. MATHEMATICS II (CALCULUS)

Prerequisite(s): Mathematics I (Algebra)

Credit Hours: 3 + 0

Specific Objectives of the Course: To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Preliminaries: Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities.

Limits and Continuity: Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

Derivatives and their Applications: Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.

Integration and Definite Integrals: Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

Recommended Books:

Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8th edition), 2005, John Wiley, New York

Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text)

Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston

Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading, Ma, USA

3. MATHEMATICS III (GEOMETRY)

Prerequisite(s): Mathematics II (Calculus)

Credit Hours: 3 + 0

Specific Objectives of the Course: To prepare the students, not majoring in mathematics, with the essential tools of geometry to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Geometry in Two Dimensions: Cartesian-coördinate mesh, slope of a line, equation of a line, parallel and perpendicular lines, various forms of

equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line.

Circle: Equation of a circle, circles determined by various conditions, intersection of lines and circles, locus of a point in various conditions.

Conic Sections: Parabola, ellipse, hyperbola, the general-second-degree equation

Recommended Books:

Abraham S, *Analytic Geometry*, Scott, Freshman and Company, 1969

Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston

Note:

- 1. Two courses will be selected from the following three courses of Mathematics.**
- 2. Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.**

Statistics-I

Credit 3 (2-1)

Definition and importance of Statistics in Agriculture, Data Different types of data and variables

Classification and Tabulation of data, Frequency distribution, stem-and-Leaf diagram, Graphical representation of data Histogram, frequency polygon, frequency curve.

Measure of Central tendency, Definition and calculation of Arithmetic mean, Geometric mean, Harmonic mean, Median quantiles and Mode in grouped and ungrouped data.

Measure of Dispersion, Definition and Calculation of Range, quartile deviation, Mean deviation, Standard deviation and variance, coefficient of variation.

Practicals

- a. Frequency Distribution
- b. Stem-and-Leaf diagram
- c. Various types of Graphs
- d. Mean, Geometric mean Harmonic Mean,
- e. Median, Quartiles Deviation, mean Deviation.
- f. Standard Deviation, Variance, Coefficient of variation,
- g. Skewness and kurtosis

Book Recommended

1. Introduction to Statistical Theory Part- I by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. A Concise Course in A. Level Statistic with world examples by J. Crawshaw and J. Chambers (1994)
4. Basic Statistics an Inferential Approach 2nd Ed. (1986) Fran II. Dietrich-II and Thomas J. Keans

Statistics-II

Credit 3 (2-1)

Sampling Probability and non-Probability Sampling, Simple random sampling stratified random sampling Systematic sampling error, Sampling distribution of mean and difference between two means. Interference Theory: Estimation and testing of hypothesis, Type—I and type-II error, Testing of hypothesis about mean and difference between two means using Z-test and t-test, Paired t-test, Test of association of attributes using χ^2 (chi-square) Testing hypothesis about variance.

Practicals

- a. Sampling random sampling
- b. Stratified random sampling.
- c. Sampling distribution of mean
- d. Testing of hypotheses regarding population mean
- e. Testing of hypotheses about the difference between population means
- f. Chi-square test
- g. Testing of Correlation Coefficient
- h. Fitting of simple linear regression
- i. One-way ANOVA
- j. Two-way ANOVA

Book Recommended

1. Introduction to Statistical Theory Part-II by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. Principles and Procedures of Statistics A Bio-meterial approach, 2nd Edition, 1980 by R.G.D Steal and James H. Tarric
4. Statistical Procedures for Agricultural Research 2nd Edition (1980) by K.A. Gomez and A.A. Gomez

Note: *Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.*

Course Name: **Introduction to Information and Communication Technologies**

Course Structure: Lectures: 2 Labs: 1 **Credit Hours: 3**

Pre-requisite: None **Semester: 1**

Course Description:

This is an introductory course on Information and Communication Technologies. Topics include ICT terminologies, hardware and software components, the internet and world wide web, and ICT based applications.

After completing this course, a student will be able to:

- Understand different terms associated with ICT
- Identify various components of a computer system
- Identify the various categories of software and their usage
- Define the basic terms associated with communications and networking
- Understand different terms associated with the Internet and World Wide Web.
- Use various web tools including Web Browsers, E-mail clients and search utilities.
- Use text processing, spreadsheets and presentation tools
- Understand the enabling/pervasive features of ICT

Course Contents:

- : Basic Definitions & Concepts
- : Hardware: Computer Systems & Components
- : Storage Devices, Number Systems
- : Software: Operating Systems, Programming and Application Software
- : Introduction to Programming, Databases and Information Systems
- : Networks
- : Data Communication
- : The Internet, Browsers and Search Engines
- : The Internet: Email, Collaborative Computing and Social Networking
- : The Internet: E-Commerce
- : IT Security and other issues
- : Project Week
- : Review Week

Text Books/Reference Books:

Introduction to Computers by Peter Norton, 6th International Edition
(McGraw HILL)

Using Information Technology: A Practical Introduction to Computer &
Communications by Williams Sawyer, 6th Edition (McGraw HILL)

Computers, Communications & information: A user's introduction by
Sarah E. Hutchinson, Stacey C. Swayer

Fundamentals of Information Technology by Alexis Leon, Mathewsleon
Leon Press.

Functional Biology-I

Credit Hours 3+0

Biological Methods

Principles of Cellular Life
Chemical Basis
Structure and Function
Principles of Metabolism
Energy Acquisition

Principles of Inheritance

Mitosis and Meiosis
Chromosomes
Observable Inheritance Patterns
DNA Structure and Function
RNA and Proteins
Genes
Genetic Engineering and Biotechnology

Biodiversity

Fundamental Concept of Biodiversity
One or two examples of each of the following from commonly found organism
Prions
Viruses
Bacteria
Protistans
Algae
Fungi
Plants
Crops
Animals
Invertebrates
Vertebrates

Reading

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

Functional Biology-II

Credit Hours 3+0

Myths and Realities of Evolution
Microevolution
Speciation
Macroevolution
Level of Organization
Plants
Tissues
Nutrition and Transport
Reproduction
Growth and Development
Animals
Tissue, Organ System and Homeostasis
Information Flow and Neuron
Nervous System
Circulation and Immunity
Nutrition and Respiration
Reproduction and Development
Ecology and Behavior
Ecosystems
Biosphere
Social Interactions
Community Interactions
Human Impact on Biosphere
Environment Conservation

Reading

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

Note: *Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.*