SCHOOL OF CHEMICAL SCIENCES AND FOOD TECHNOLOGY

SCHOOL OF CHEMICAL SCIENCES AND FOOD TECHNOLOGY

Introduction

The School of Chemical Sciences and Food Technology offers graduate study programs by thesis and course work to train scientists to carry out fundamental and applied researches in the vision of strengthening and to strengthen UKM as a research university. The Master programs by thesis are supported by several courses that will provide the candidates with essential knowledge in carrying out research. The Master programs by course work require candidates to complete a short and focused research project. Postgraduate courses for Master and Doctor of Philosophy are implemented either on a full-time or part-time basis.

Research Areas and Degrees Offered

The School of Chemical Sciences and Food Technology offers researches which includes specialization in Chemistry and Food Science. The specializations or research offers in the field of chemistry includes natural products, analtical chemistry, Environmental chemistry, synthesis of inorganic compound, kinetics and catalysis as well as polymer and polymer composites. For the area of food science, it covers food chemistry and analysis, food additives, edible biopolymers, food acceptance, sensory evaluation, food safety and quality, food microbiology and fermentation, community nutrition, food processing, inorganic compound, liquid natural rubber, colloidal chemistry, catalysis, environment, natural product from plant, theory and simulation and oils and fats chemistry.

The degrees awarded are as follows:

- Doctor of Philosophy (Chemistry)
- Doctor of Philosophy (Nutrition)
- Doctor of Philosophy (Food Science)
- Master of Science (Chemistry)
- Master of Science (Nutrition)
- Master of Science (Food Science)

Entry Requirements

Candidates applying for the postgraduate programs must fulfill the following requirements:

Doctor of Philosophy Program

a) Master in Science degree from Universiti Kebangsaan Malaysia or any other universities approved by the Senate;
   or
b) Other qualifications of the same level as a Master of Science and other qualifications or experience approved by the Senate;
   or
c) Is currently following a Master of Science program in Universiti Kebangsaan Malaysia and is endorsed by the Graduate Studies Committee of the Faculty to change the status to a Doctor of Philosophy program;
   or
d) Degree in Science or other equivalent qualification with a Cumulative Grade Point Average (CGPA) of at least 3.67 from Universiti Kebangsaan Malaysia or any other universities approved by the Senate;

Master of Science Program

a) Bachelor of Science degree with a good Cumulative Grade Point Average (CGPA) from Universiti Kebangsaan Malaysia or any other universities approved by the Senate;
   or
b) Other equivalent qualification to a Bachelor's degree in Science or other qualification such as experiences approved by the Senate;
   or
c) Candidates who do not fulfill the minimum CGPA requirements may be considered on the basis of their experiences in research in related fields.

Program of Study

Doctor of Philosophy

Each candidates of this program is required to register and pass STPD6014 Research Methodology course and thesis every semester until completion of the academic program. Students are required to schedule meetings with their supervisor or postgradute committee for not less than 40 hours per semester for full-time students and 20 hours per semester for part-time students. The research output is written into a thesis.

Master of Science

Thesis

Each candidates in this program has to register and pass 8-14 credit hours and research findings should be written as a thesis.

The 8-14 credit hours consist of courses offered by the faculty and the school. Full-time students need to schedule discussion with their respective supervisor or Graduates Studies Committee for not less than 26 hours per semester whereas 13 hours per semester is required for part-time students.

Course work

Each candidate in these programs must successfully complete a minimum of 40 credit hours of course work. All the units taken are comprised of core courses and elective courses, as determined by the respective program.

DOCTOR OF PHILOSOPHY (CHEMISTRY)

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1: Competent with admirable personality and character that can uphold the vision of the faculty and the university as well as able to contribute an energy and expertise toward the current technology development and problem solving.

PEO2: Developing attitudes and awareness to identify, plan work activities, design of new and innovation research in the process and production related to chemistry.

PEO3: Provides in-depth knowledge and exploratory research guide in the field of chemicals that capable in addressing the issues of security, harmony and balance of nature.

PEO4: Provide in-depth knowledge, skills and networking knowledge sharing in the field of chemistry that contribute to the development of agriculture, health and manufacturing industries.

PROGRAM LEARNING OUTCOMES (PLO)

PLO1: Mastering the knowledge in advanced chemistry.
PLO2: Mastering technical skills in chemistry.
PLO3: Ability to identify, formulate and solve problems.
PLO4: Able to use scientific methods to design, manage experiments, analyze and interpret data.
PLO5: Able to appreciate the issues related to ethics, society and environment.
PLO6: Ability to communicate effectively.
PLO7: Able to play a role as an individual in a group as well as becoming an effective leader.
PLO8: Recognizing the need for lifelong learning and acquire skills to do it.
PLO9: Able to have entrepreneurial and management skills.

DOCTOR OF PHILOSOPHY (FOOD SCIENCE)

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1: Competent with admirable personality and character that can uphold the vision of the faculty and the university as well as able to contribute an energy and expertise toward the current technology development and problem solving.
PEO2: Developing attitudes and awareness to identify, plan work activities, design of new research and innovation in food industry.
PEO3: Provides advanced knowledge in the field of food science and technology and facilitate the current research exploration in the field.
PEO4: Developing and creating a knowledge sharing network to conduct research effectively and equitably to meet the challenges and fulfill the demands of the current food industry.

PROGRAM LEARNING OUTCOMES (PLO)

PLO1: Mastering basic and advanced knowledge to conduct research in food science and technology.
PLO2: Having in-depth technical competence in the field of food science and technology.
PLO3: Ability to identify and solve problems in food science and technology research.
PLO4: Ability to utilize scientific methods to design, conduct, analyze and interpret research data.
PLO5: Understanding of issues and needs related to ethics, society, culture and environment as a professional food scientist and technologist.
PLO6: Competent in both oral and written communications.
PLO7: Ability to function effectively as an individual and in a group with the capacity to be a leader as well as an effective team member.
PLO8: Ability to manage and gather the information for lifelong learning and the capacity to do so.

PLO9: Ability to acquire entrepreneurial and managerial skills to fulfill the needs of food industry.

DOCTOR OF PHILOSOPHY (NUTRITION)

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1: Competent with admirable personality and character that can uphold the vision of the faculty and the university as well as able to contribute an energy and expertise toward the current technology development and problem solving.
PEO2: Developing attitudes and awareness to identify, plan, develop and carry out research on the development of dietary habits on culture, the environment and changes in community attitudes.
PEO3: Provides advanced knowledge in the field of nutrition and health, and facilitate the exploration of current research in the field.
PEO4: Developing and creating a knowledge sharing network to conduct research effectively and equitably to meet the challenges and fulfill the demands of the current food and nutrition.

PROGRAM LEARNING OUTCOMES (PLO)

PLO1: Mastery basic and of advanced knowledge to conduct research in nutrition
PLO2: Having in-depth technical competence in the field of nutrition.
PLO3: Ability to identify and solve problems in nutritional research.
PLO4: Ability to utilize scientific methods to design, conduct, analyzes and interpret research data.
PLO5: Understanding of issues and needs related to ethics, society, culture and environment as a professional nutritionist.
PLO5: Competent in both oral and written communication.
PLO6: Ability to function effectively as an individual and in a group with the capacity to be a leader as well as an effective team member.
PLO7: Ability to manage and gather the information for lifelong learning and the capacity to do so.
PLO8: Ability to acquire entrepreneurial and managerial skills to fulfill the community needs.

MASTER OF SCIENCE (CHEMISTRY)

Introduction

The master program by thesis emphasizes research work to train scientists to be more capable to carry out fundamental and applied research and to support UKM as a Research University. Research or specialized areas offered by the Chemistry Program are Natural Products, Analytical Chemistry, Environmental Chemistry, Synthesis of Inorganic Compound, Catalysis, green polymers which include Thermoplastics, synthetic polymers and polymer composite.

The Master of Science (Chemistry) by course work offers a package of minimum two semesters for full-time students and four semesters for part-time students. This program is offered to qualified students from chemical industries, private colleges, research institutions, teachers and government sector which have limited time to further their studies. Graduates from this program are expected to contribute effectively to the development of science and technology.

Entry Requirements

Candidates applying for the graduate degree study should fulfill the following requirements:

a) Bachelor of Science degree with a good Cumulative Grade Point Average (CGPA) from Universiti Kebangsaan Malaysia or any other universities approved by the Senate;
   or
b) Other equivalent qualification to a Bachelor's degree in Science or other qualification such as experiences approved by the Senate;
   or
c) Candidates who do not fulfill the minimum CGPA requirements may be considered on the basis of their experience in research in related fields.

Type of Programs

The graduate programs offered are as follows:

- Thesis
- Course Work

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1: Competent with admirable personality and character that can uphold the vision of the faculty and the university as well as able to contribute an energy and expertise toward the current technology development and problem solving.

PEO2: Developing attitudes and awareness to identify, plan work activities, design of new and innovation research in the process and production related to chemistry.

PEO3: Provides in-depth knowledge and exploratory research guide in the field of chemicals that capable in addressing the issues of security, harmony and balance of nature.

PEO4: Provides in-depth knowledge, skills and networking knowledge sharing in the field of chemistry that contribute to the development of agriculture, health and manufacturing industries.

PROGRAM LEARNING OUTCOMES (PLO)

PLO1: The ability to master knowledge in advanced chemistry.
PLO2: Having in-depth technical competence in chemistry.
PLO3: Able to undertake problem identification, formulation and solution.
PLO4: Able to utilize scientific method to design and conduct experiments as well as to analyze and interpret data.
PLO5: Able to appreciate issues related to ethics, society and environment.
PLO6 : Able to communicate effectively.
PLO7: Able to function effectively in a group as a team member as well as a leader.
PLO8: Recognizing the need for lifelong learning and acquiring the capacity to do so.
PLO9: Able to acquire entrepreneurial and managerial skills.

Program Structure

Thesis

Each candidate in this program must complete and pass 8 credit hours course as a fulfilment for the degree of Master of Science. The results of the research will be written out as a thesis.

The compulsory courses offered are as follows:

STPD6014 Research Methodology
STKK6014 Laboratory Research Skill

Course work

Each candidates in Master of Science (Chemistry) program by course work must register and successfully complete a minimum of 40 credit hours of course work throughout the studies. The following table listed the core courses and elective courses required to be taken by the candidates.

SEMESTER	CORE COURSES	ELECTIVE COURSES	TOTAL
I	STPD6014 Research Methodology STKK6113 Quantum Chemistry STKK6313 Inorganic Synthesis and Mechanism STKK6513 Organic Synthesis STKK6713 Principles of Analytical and Instrumentation Design Research STKK6972 Project I	STKK6142 Electrochemistry STKK6342 Physical Inorganic Chemistry STKK6542 Kinetics and Reaction Mechanism STKK6762 Surface Analysis STKK6942 Radiochemical Technique	
II	STKK6123 Advanced Polymer Chemistry STKK6323 Applied Inorganic Chemistry STKK6523 Spectroscopy in Chemistry STKK6723 Organic Chemical Management System STKK6986 Research Project II		
TOTAL	**36**	**4**	**40**

Courses Offered

STPD6014 Research Methodology
STKK6113 Quantum Chemistry
STKK6123 Advanced Polymer Chemistry
STKK6142 Electrochemistry

STKK6313	Inorganic Synthesis and Mechanism
STKK6323	Applied Inorganic Chemistry
STKK6342	Physical Inorganic Chemistry
STKK6513	Organic Synthesis
STKK6523	Spectroscopy in Organic Chemistry
STKK6542	Kinetics and Reaction Mechanisms
STKK6713	Principles of Analytical and Instrumentation Design
STKK6762	Surface Analysis
STKK6723	Chemical Management System
STKK6942	Radiochemical Techniques
STKK6972	Research Project I
STKK6986	Research Project II

Course Contents

STKK6014 Laboratory Research Skill

This course will expose the students to technical skills for laboratory work, which will help them to improve their skills in research work. The course will discuss the laboratory safety, labeling, chemical storage, chemical waste disposal, chemical safety acts, safety management and chemical safety database. Other laboratory techniques such as vacuum distillation system, cooling under zero temperature, precipitation process, handling of toxic and flammable chemicals, gas handling, dilution, glass tube will be covered. The syllabus will include trace analysis in chemistry and neutron activation analysis. Instrumentation and interpretation techniques from IR, UV, GCMS, AA, HPLC, NMR, TGA, DCS, X-ray Crystallography etc. QA/QC and GLP aspects will also be emphasized.

References

Braun, R.D. 1987. *Introduction to Instrumental Analysis*. New York: McGraw-Hill International Editions.

Bretherick, L. 1986. *Hazards in Chemical Laboratory*. Oxford: The Royal Society of Chemistry.

Crowl, C.A. & Louvar, J.F. 1990. *Chemical Process Safety: Fundamentals and Application*. New Jersey: Prentice-Hall.

Pipitone, D.A. 1991. *Safe storage of Laboratory Chemicals*. New York: John Wiley & Sons Inc.

Willard, H.H., Merritt, L.L. & Dean, J.A. 1994. *Instrumental Nethods of Analysis*. New York: Van Nostrand Reinhold.

STKK6113 Quantum Chemistry

This course introduces and discusses the basic principles in quantum theory; topics include wave-particle duality, Schrödinger equation, normalization and quantization, the Born interpretation of the wavefunction, operators, eigenvalues and eigenfunctions, probability and expectation values, and uncertainty principle. The application of wavefunction in solving the particle in a box and motion in two dimensions for translational motion; the energy levels and the wavefunctions for vibrational motion; and rotation in two and three dimensions, and spin for rotational motion will be included in discussion. Atomic and molecular orbitals, energy and orbitals, molecular orbital theory, and the Huckel approximation for polyatomic systems will also be discussed.

References

Atkin, P.W. 1994. *Physical Chemistry*. 5th Ed. London: Oxford University Press.

Griffiths, D.J. 1994. *Introduction to Quantum Mechanics*. New York: Prentice-Hall.
Simon, J. & Nichols, J. 1997. *Quantum Mechanics in Chemistry*. London: Oxford University Press.
Vincent, A. 2001. *Molecular Symmetry and Group Theory: A Programmed Introduction to Chemical Application*. New York: John Wiley & Sons.
Yates, K. 1978. *Huckel Molecular Orbital Theory*. New York: Academic Press.

STKK6123 Advanced Polymer Chemistry

This course focuses on three fundamental topics: thermodynamics of polymer mixture-entalphy, entropy and free energy; polymer blending-homogenity, compatibility, intermolecular interaction, curing, phase equilibrium, rheology and phase morphology, physical and mechanical properties of blends, solution blending and melting, and colloidal solution-solute, solvent and amphiphilic molecule clusterings/ surfactant, micelle structure and properties, stability, equilibrium and phase diagram, micro and macro emulsion.

References

Atkins, P. & de Paula, J. 2006. *Physical Chemistry*. 8th. Ed. Oxford UK: Oxford University.
Evans, D. F. & Wennerstrom, H. 1999. *The Colloidal Domain*. 2nd. Ed. New York: Wiley-VCH.
Shonaike, G. O. & Simon, G. P. 1999. *Polymer Blends and Alloys*. New York: CRC Press.
Utraki, L. A. 2002. *Polymer Blends Handbook.* Vol I & II, Netherlands:Kluwer Academic Pub.

STKK6142 Electrochemistry

Topics to be discussed includes general considerations; choice of solvent and electrolyte, cell design and electrodes, voltammetric techniques for synthetic reactions, electrochemical synthesis by controlled potential electrolysis, spectro-electrochemistry, electrochemical reactions in an aqueous medic and organic solvent. Application of electrochemistry in industrial including interface electrochemistry, bioelectrochemistry, electrochemistry for sensing, chlor-alkali industries, fuel cell, electroplating and application in environmental pollution control will be highlighted. Corrosions and stability of metals will also be discussed.

References

Bockris, J.O.M. & Reddy, A.K. 1998. *Modern Electrochemistry 1 & 2*. New York: Kluwer Academic Press.
Crow, D.R. 1994. *Principles and Applications of Electrochemistry*. 4th. Ed. Cambridge, UK.: Blackie.
Pletcher, D. & Walsh, F.C. 1990. *Industrial Electrochemistry*. Cambridge, U.K.: Chapman and Hall.
Sawyer, D.T., Sobkowiak, A. & Roberts, J.L. 1994. *Electrochemistry for Chemist*. New York: John Wiley & Son.
Schmickler, W. 1995. *Interfacial Electrochemistry*. Oxford: Oxford University Press.
W.E. Geiger & M.D. Hawley. 1986. *Physical Methods of Chemistry*. Vol. 2: Electrochemical Methods", ed. B.W. Rossiter, Wiley and Sons.

STKK6313 Inorganic Reaction Mechanism

This course involves the fundamentals, methodologies (experimental, computational and theoretical) and applications of inorganic reaction mechanisms, that is of the processes of bond formation and cleavage, electron transfer, the nature of intermediates, medium and other effects, in inorganic and organometallic redox and substitution reactions, including those which underlie important catalytic, environmental, biological and industrial processes. Examples on important inorganic and organometallic reactions will also be exposed to strengthen the understanding of the students in inorganic mechanism.

References

Atwood, J.D. 1997. *Inorganic and Organometallic Reaction Mechanisms*. 2nd. Ed. New York: John Wiley & Son.

Burgess, J. & Tobe, M.L. 2000. *Inorganic Reaction Mechanisms*. New York: Pearson Education Corp.

Cotton, F.A., Wilkinson, G., Murillo. C.A. & Bochmann, M. 1999. *Advanced Inorganic Chemistry*. 6th. Ed. New York: John Wiley & Son.

Jordan, R.B. 2007. *Reaction Mechanisms of Inorganic and Organometallic Systems*. 3rd. Ed. New York: Oxford University Press.

Wilkin, R.G. 1991. *Kinetics and Mechanisms Reactions of Transition Metal Complexes*. New York: John Wiley & Son.

STKK6323 Applied Inorganic Chemistry

Two important topics in inorganic chemistry relating to our daily life, firstly, the structural and functions of metal/metal ions in our life such as minerals, vitamin and coenzymes will be discussed. In addition, biochemistry reactions involving metal ions such as uptake, transport and storage of metal ion as exemplified by iron; copper-proteins, photosynthesis, coenzymes and catalytic enzyme reaction will also be included. Secondly, the important of inorganic compounds in industries as catalyst will be discussed. Mechanisms of homogeneous catalyst will be discussed in detailed and discussion on heterogenous system is concentrated on liquid and gas systems.

References

Bertini, I. & Gray, H.B. 1994. *Bioinorganic Chemistry*. Los Angeles: University Science Book.

Cowan, J.A. 1993. *Inorganic Biochemistry – An Introduction*. 2nd. Ed. London: VCH Publ. (UK) Ltd.

Jolly, W.L. 1991. *Modern Inorganic Chemistry*. 2nd. Ed. Singapore: McGraw-Hill International Edition.

Kaim, W. & Schwederski, B. (Ed.). 1994. *Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life: An Introduction and Guide*. New York: John Wiley & Son.

Parshall, G.W. & Ittel, S.D. 1992. *Homogeneous Catalysis: The Applications and Chemistry of Catalysis by Soluble Transition Metal Complexes*. 2nd. Ed. New York: John Wiley & Son.

STKK6342 Physical Inorganic Chemistry

Course involved in-depth study on the properties and reactions of inorganic compound. The main focus is on the substitution reaction of the octahedron complexes, tetrahedron and square planar. The concept of stable, labile and mechanism steps, stereochemistry, trans effect and experimental evidence of associations and exchange mechanism will be studied. Other than substitution reaction, redox reactions with internal and external spherical concept and also

reactions of in coordinated ligands are also investigated. Coordinated ligand reaction involved hydrolysis of ester amide and peptide, template and electrophilic. Reactions related to biochemical system will also be discussed.

References

Atwood, J.D. 1997. *Inorganic and Organometallic Reaction Mechanisms.* 2nd. Ed. New York: John Wiley & Son.

Burgess, J. & Tobe, M.L. 2000. *Inorganic Reaction Mechanisms*. New York: Pearson Education Corp.

Cotton, F.A., Wilkinson, G., Murillo, C.A. & Bochmann, M. 1999. *Advanced Inorganic Chemistry.* 6th. Ed. New York: John Wiley & Son.

Kettle, S.F.A. 2000. *Physical Inorganic Chemistry: A Coordination Chemistry Approach*. London: Oxford University Press.

Wright, J.R., Hendrickson, W.A. & Osaki, S. 1986. *Physical Methods for Inorganic Biochemistry. Biochemistry of The Elements.* Vol. 5. New York: Plenum Publ. Corp

STKK6513 Organic Synthesis

Reaction leading towards the formation of carbon-carbon bonds, summary of reactions especially involving functional group interconversions. Synthetic methods with emphasis on discovery, development and use of chemical reaction in synthesis; limitations and scope of the reactions in questions. Multi-step synthesis of natural products as templates for various synthetic approaches and strategies. Synthetic reagents using organometallic compound will also be discussed.

References

Carey, F.A. & Sunberg, R. J. 1994. *Advanced Organic Chemistry: Reactions and Synthesis.* Part B, 3rd. Ed. New York: Planum Press.

Nicolaou, K. C. & Sorensen, E.J. 1995. *Classic in Total Synthesis: Targets, Strategies, Methods*. New York: VCH Publ.

Norman, R.O.C. & Coxon, J.M. 1995. *Principles of Organic Synthesis*. 3rd Ed. New York: Blackie Academic Press.

Smith, M.B. 1994. *Organic Synthesis.* New York: McGraw-Hill Higher Education.

Wuts, P.G.M. & Greene, T.W. 1997. *Protective Groups in Organic Synthesis*. New York: John Wiley & Sons.

STKK6523 Spectroscopy in Organic Chemistry

This course introduced the structural determination and stereochemistry of organic compound. Theory and application of modern spectroscopic methods for this particular aim will be discussed including ultraviolet, infrared, one and two-dimensional NMR and mass spectroscopy. In addition, step by step approach in structural elucidation of organic compounds which involves abstraction and interpretation of ultraviolet, infrared, one and two-dimensional NMR and mass spectral data will be discussed in detail. Other than focusing on the structural elucidation exercises based on spectroscopic data, hands-on application of the instrument will also be done during one slot of practical work. The importance of spectroscopic and physical data in stereochemical determination of organic compound will also be covered.

References

Breitmaier, E. 2004. *Structure Elucidation by NMR in Organic Chemistry. A Practical Guide*. Sussex : John Wiley & Sons.

Claridge, T.G.W. 1999. *High Resolution NMR Techniques in Organic Chemistry*. New York: Pergamon Press.

Crews, P., Rodriguez, J. & Jaspars, M. 1998. *Organic Structure Analysis.* New York : Oxford University Press.

Pavia, D. L., Lampman, G. M. & Kriz, G. S. 2008. *Introduction to Spectroscopy*. Washington : Brooks & Cole.

Shriner, R.L., Christine, K.F., Morill, T.C., Curtin, D.Y. & Fuson, R.C. 1998. *The Systematic Identification of Organic Compounds.* 7th. Ed. New York: John Wiley & Son.

STKK6542 Reaction Kinetics and Mechanisms

This course explores on the details on method and data interpretations in parallel to the kinetic of an organic or inorganic reactions. Mathematical treatment of the proposed mechanisms which should be in agreement with the kinetic data obtained. The mechanism for several common reaction including substitution, redox, catalysis acid base, polimerisation and enzymatic reactions will be studied. Stopped flow and temperature jump technique will also be introduced. The linear free energy relationship, isotope effect and mathematical treatment of some complex reactions will be discussed.

References

Jencks, P. 1987. *Catalysis in Chemistry and Enzymology*. New York: Dover Publ.

Jones, R.A.Y. 1984. *Physical and Mechanistic Organic Chemistry*. 2nd. Ed. Cambridge: Cambridge University Press.

Lawry, T.H & Richardson, K.S. 1987. *Mechanism and Theory in Organic Chemistry*. 3rd. Ed. New York: Harper and Row.

Miller, B. 1997. *Advanced Organic Chemistry: Reactions and Mechanism*. London: Prentice-Hall.

Sykes, P. 1996. *A Guidebook to Mechanism in Organic Chemistry*. London: Prentice-Hall.

STKK6713 Principles of Analytical Instrumentation Design

Understanding on the chemical principle of qualitative and quantitative in designing analytical instrumentation is incorporated. System and component in the analytical instrumentation- light source, heater, optic, pump, motor, operational amplifier, electronic, central processing unit (CPU), vacuum, interfaces, volume and mass measurement, detector and others are discussed. Steps in designing analytical instrumentation system for specific purposes and example of automatic analyser and processing analyzer used in various field will also be introduced.

References

Clevert, K.J. 1984. *Handbook of Process Stream Analysis.* Chichester, UK: Ellis Horwood.

Johnson, K.J. 1992. *Automatic Process Control.* New York: McGraw-Hill.

Miller, J.T. 1994. *The Revised Course in Industrial Instrument Technology.* London: United Press London.

Peecok, R.L., Shields, L.D., Cairns, T. & McWilliam, L.G. 1996. *Modern Methods of Chemical Analysis.* New York: John Wiley & Sons.

Willard, H.H., Merrit, L.L. & Dean J.A. 1994. *Instrumental Methods of Analysis.* New York: Van Nostrand Reinhold.

STKK6723 Chemical Management System

Discussion on systematic chemical management system and related system as chemist in protecting the worker, public and environment: aspect and activities covering the whole life cycle of the chemicals. Role and responsibility of a chemist: Chemist Acts and role of Malaysia Chemistry Institute. Concept of Good Laboratory Practice (GLP) and laboratory accreditation under the Malaysia Laboratory Accreditation Scheme (SAMM) and ISO 17025. Environmental regulations, Good Manufacturing Practice (GMP), quality management (ISO9000 series) and environmental management system (ISO14000).

References

Bahu, R., Critenden, B. & O'Hara, J. 1997. *Management of Process Industry Waste: An Introduction.* Rigby: Institution of Chemical Engineers.

Huber, L. 1993. *Good Laboratory Practice – A Primer.* Germany: Hewlett Packard Co.

Lipton, S. & Lynch, J. 1994. *Handbook of Health Hazards Control in the Chemical Process Industry.* New York: John Wiley & Son.

Parkany, M. 1994. *Quality Assurance for Analytical Laboratories.* London: Royal Society of Chemistry.

Turner, G.R. 1994. *Total Quality Management in the Chemical Industry – Strategies for Success.* London: Royal Society of Chemistry.

STKK6762 Surface Analysis

This course will discuss the importance of surface analysis, vacuum system, mean free path (MFP), photoelectron phenomenon and Aufer electron. The electron spectroscopy discussion will involve theory, instrumentation and data analysis for XPS, AES and UPS spectroscopy. Surface analysis for solid sample based on sample saturation/unsaturation involving N_2 gas, BET equation, surface area, pore size and distribution of pore. Selective saturation based on chemical saturation of the H_2 gas and other gases. The normal method used for surface analysis involve instrumental theory and the use of AFM, SEM and TEM instruments.

References

Niemantsverdriet, A. 1995. *Spectroscopy in Catalysis-An Introduction.* New York: VCH Publ.

Smith, G.C. 1994. *Surface Analysis By Electron Spectroscopy-Measurement And Interpretation*. New York: Pergamon Press.

Stohr, J. 1992. *NEXAFS Spectroscopy.* Heidelberg: Springer-Verlag.

Walls, J.M. & Smith R. 1994. *Surface Science Technique.* New York: Pergamon Press.

Walls, J.M. 1989. *Method of Surface Science Technique and Application*. Cambridge: Cambridge University Press.

STKK6942 Radiochemical Techniques

The course gives student the general theory, instrumentation and various methods and applications related to radioactive materials and ionizing radiation in chemistry. Emphasis will be given to the fields of radiochemical analysis and radiation techniques in polymeric systems. The topics of discussion include neutron activation analysis and nuclear reactions, isotope dilution analysis, radio-reagent methods, instrumental analysis based absorption and scattering. In the radiation techniques, discussion will include application of ionizing radiation in polymerization and modification of polymers. General radiation safety will also be given.

References

Choppin, G., Liljenzen, J. O & Rydberg. 1995. *Radiochemistry and Nuclear Chemistry*. 2nd. Ed. Oxford: Butterworth-Heinemann.

Ito & Tagawa, 1991. *Handbook of Radiation Chemistry.* USA: CRS Press.

Arnikar H. J. 1981. *Essential of Nuclear Chemistry.* India: Eastern Wiley.

Navaratil, O., Hala, J., Kopunec, R., Macasek, F., Mikulaj, V. & Leseticky, L.1992. *Nuclear Chemistry*. London: Ellias Horwood.Tabata

Tolgyessy, J. & Bujduso, E. 1991. *CRC Handbook of Radioanalytical Chemistry*. USA: CRC Press.

Vertes, A. & Kiss I 1987. *Nuclear Chemistry*. NewYork: Elsevier.

Vertes, A., Nagy, S. & Kelncsair, A. Z. (Editor) 2003. *Handbook of nuclear Chemisty.* Volume 1-5. Amsterdam: Kluwer Academic Publishers

Wood, R. J. & Pikev, A. R. 1993. *Applied Radiation Chemistry: Radiation Processing.* London: John Wiley & Sons

STKK6972 Research Project I

The objective of this course is to expose the students to the world of chemistry, which consists of organic, inorganic, analytical, physical and polymer chemistry. The research project will be carried out in two semesters consecutively and each student is expected to submit their report at the end of the second semester. The titles for the projects will be given by the respective lecturers who are responsible to guide the students during their studies. This project will be evaluated based on the written proposal, presentation and the progress of the project in the first semester.

STKK6988 Research Project II

Research project II is the continuation of Research Project I where the students in this semester are required to write a report in the form of a dissertation on the research findings. The evaluation will be carried out based on the dissertation and oral examination. The project must be written based on UKM's format stipulated in 'The UKM Style Guide'.

Reference

Pusat Siswazah. 2015. *Format Gaya UKM*. Bangi: Penerbit UKM.

MASTER OF SCIENCE (FOOD SCIENCE)

Introduction

The Food Science Program offers the Master of Science degree by thesis and course work. These fields of study are closely related to food production from the point of harvest or slaughter until it is marketed and reaches the consumer in conditions that satisfy the consumer's requirements in terms of food safety and taste.

The Master of Science program complements the Doctor of Philosophy program that comprises only research work. Graduates from this program will gain sound knowledge in the fields of Food Science and Nutrition. It is hoped that these graduates will apply the knowledge gained in the areas of research and production of nutritious foods, food safety and quality, food regulations as well as food and nutrition education programs.

Entry Requirements

Candidates applying for graduate degree study should possess the following qualifications:

a) Bachelor of Science degree (Food Science, Food Science and Nutrition, Food Technology) with a good Cummulative Grade Point Average from Universiti Kebangsaan Malaysia or any universities approved by the Senate;
   or
b) Other equivalent qualification to a Bachelor's degree in Science or other qualification such as experiences approved by the Senate;
   or
c) Candidates who do not fulfill the minimum CGPA requirements may be considered on the basis of their experience in research in related fields.

Type of Programs

Master of Science (Food Science) Program offers two types of study:

- Thesis
- Course work

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1: Competent with admirable personality and character that can uphold the vision of the faculty and the university as well as able to contribute an energy and expertise toward the current technology development and problem solving.

PEO2: Provides in-depth knowledge and guide exploratory research in the field of food science and technology that is able to address the issue of security, harmony and balance of nature.

PEO3: Developing attitudes and awareness to identify, plan work activities, design of new research and innovation to meet the challenges and fulfill the demand in the current food industry.

PEO4: Provides in-defth the knowledge, skills and networking knowledge sharing in the field of food science and technology that contribute to the development of agriculture, health and food industries.

PROGRAM LEARNING OUTCOMES (PLO)

PLO1: Mastery basic and of advanced knowledge to conduct research in food science and technology.

PLO2: Having in-depth technical competence in the field of food science and technology.

PLO3: Ability to identify and solve problems in food science and technology research.

PLO4: Ability to utilize scientific methods to design, conduct, analyse and interpret research data.

PLO5: Understanding of issues and needs related to ethics, society, culture and environment as a professional food scientist and technologist.

PLO6: Competent in both oral and written communication.

PLO7: Ability to function effectively as an individual in a group with the capacity to be a leader as well as an effective team member.

PLO8: Recognizing the need for lifelong learning and capacity to do so.

PLO9: Ability to acquire entrepreneurial and managerial skills to fulfill the needs of food industry.

Program Structure

Thesis

All candidates of this program have to register and pass 14 credit hours of courses to fulfill the requirement for graduation. From the 14 credit hours of courses, 4 credit hours core Faculty and 10 credit hours for core program. The list of the courses are:

STPD6014 Research Methodology

and select 10 credit hours courses from the following list:-

Semester I

STKM6033 Science of Fats and Oils
STKM6113 Advanced Food Microbiology
STKM6712 Food and Nutrition Toxicology

Semester II

STKM6043 Sugar & Chocolate Confection Technology
STKM6063 Food Additive Substance
STKM6123 Advanced Food Chemistry

Course work

All candidates of this programme have to register and pass 40 credit hours, of which 29 credit hours are from core courses and 11 credit hours from elective courses. Students may take any of the elective courses to fulfill the requirement.

SEMESTER	CORE COURSES	ELECTIVE COURSES	TOTAL
I	STPD6014 Research Methodology STKM6113 Advanced Food Microbiology STKM6122 Experimental Techniques in Food Science STKM6313 Food Quality STKM6712 Food and Nutritional Toxicology STKM6973 Research Project I	STKM6033 Science of Fats and Oils STKM6323 Food Processing Operations STKM6322 Current Techniques in Food Microbiology	**20**
II	STKM6023 Protein Product Technology STKM6123 Advanced Food Chemistry STKM6986 Research Project II	STKM6043 Sugar and Chocolate Confection Technology STKM6063 Food Additives STKM6243 Food Safety Management STKM6722 Food Packaging	**20**
TOTAL	**29**	**11**	**40**

Courses Offered

STPD6014 Research Methodology
STKM6023 Protein Product Technology

STKM6033	Science of Fats and Oils
STKM6043	Sugar and Chocolate Confection Technology
STKM6063	Food Additives
STKM6113	Advanced Food Microbiology
STKM6122	Experimental Technique in Food Science
STKM6123	Advanced Food Chemistry
STKM6243	Food Safety Management
STKM6313	Food Quality
STKM6322	Current Techniques in Food Microbiology
STKM6323	Food Processing Operations
STKM6712	Food and Nutrition Toxicology
STKM6722	Food Packaging
STKM6973	Research Project I
STKM6986	Research Project II

Course Contents

STKM6023 Protein Product Technology

This course discusses the scientific and technological aspects of plant and animal protein. Emphasis is based on animal protein technology especially meat, milk and eggs. The scientific aspects include microbial quality, chemical, biochemical and the physical properties of these proteins. Technological aspects include meat, milk and egg-based product processing technology. The production and usage of side products such as fats, leather, egg shells, whey and lactose will also be discussed.

References

Damodaran, D. 1997. *Food Proteins and Their Applications.* New York: CRC.

Lawrie, R.A. 1998. *Meat Science.* 6th. Ed. Cambridge, England: Wrokhead Publ.

Nakai, S. (Ed.). 1996. *Food Proteins:Properties and Characterization.* New York: Wiley-VCH.

Thompson, A., Boland, M. & Singh, H. (Eds). 2008. *Milk Proteins: From Expression to Food.* New York: Academic Press.

Walstra, P., Noomen, T.J., Jelema, A. & van Boekel, MA.J.S. 1999. *Dairy Technology: Principles of Milk Properties and Processes.* New York: Marcel Dekker Inc.

William, J. Stadelman, W.J., Newkirk, D. & Newby, L. 1995. *Egg Science and Technology.* New York: CRC.

STKM6033 The Science of Fats and Oils

This course discusses fat and oil processing to produce value added products. These include fractionation, hydrogenation, transesterification and blending to produce emulsifiers (sugar esters, DAG, MAG) and specialty fats (structured lipids, confectionary fats, shortenings). In addition, polymorphic characteristics of fats and oils and their importance in fat migration, compatibility and formation of fat bloom will also be discussed. The physico-chemical changes in fats and oils during cooking will also be explained. The role of dietary fats and oils in health and diseases (coronary heart diseases, obesity) will be explained.

References

Akoh, C.C. & Min, D.B. 1998. *Food Lipids: Chemistry, Nutrition, and Biotechnology*. New York: Marcel Dekker, Inc.

Garti, N. & Sato, K. 1988. *Crystallization and Polimorphism of Fats and Fatty Acids.* New York: Marcel Dekker, Inc.

Gunstone, F.D. & Padley, F.B. 1997. *Lipid Technologies and Applications.* New York: Marcel Dekker, Inc.

Gunstone F.D., Harwood, J.L. & Padley, F.B. 1995. *The Lipid Handbook.* 2nd. Ed. London: Chapman & Hall.

Hamilton, R.J. 1995. *Developments in Oils and Fats.* London: Blakie Academic & Professional.

STKM6043 Sugar and Chocolate Confection Technology

This course will deliberate comprehensively and scientifically on technology of sugar and chocolate confection thoroughly in theory and practice. Course scope will deliberate on specification, raw material, processing, quality control, shelf life, product development and acceptance. Discussion will also focus on several physicochemical aspects of product such as carbohydrate, sweetener, emulsifier and fat. Raw material and confection product that will be discussed are jelly and gum, cocoa products, nuts, sweetener, fat, cocoa butter alternatives, replacement fat, sweet and caramel. Thorough discussions on product processing that will be covered are on crystallization aspect, thickness, blend impact, pH impact, boiling point, food additive and storage.

References

Beckett, S.T. 1994. *Industrial Chocolate Manufacture and Use.* 2nd. Ed. London: Chapman & Hall

Bernard, W.M. 1999. *Chocolate, Cocoa and Confectionary: Science and Technology.* 3rd update Ed. Maryland: Aspen Publ. Inc.

Lees, R. & Jackson, E.B. 1999. *Sugar Confectionery & Chocolate Manufacture.* London: Chapman & Hall.

Jackson, E.B. 1995. *Sugar Confectionery Manufacture.* 2nd. Ed. London: Chapman & Hall

Mathlouthi, M. & Reiser, P. 1994. *Sucrose: Properties and Applications.* London: Blackie Academic & Professional.

STKM6063 Food Additives

This course discusses the chemical reactions involve in natural food flavour formation from plants and animals as well as via food processing techniques. The method to isolate, separate and identify flavour compounds will also be discussed. Emphasis will be given on identification of off- flavours defects in foods and propose ways of preventing them. The synthetic and natural identical flavourings will be addressed in the course. Students will be given group assignment/project to apply flavourings to various formulated systems.

References

Bredie, W.L.P. & Petersen, M.A. 2006. *Flavour Science: Recent Advances and Trends*. Amsterdam: Elsevier.

Deibler, K.D. & van Ruth, S. 2005. *Simulation of mouth condition for flavor analysis*. Hoboken, N.J.:John Wiley & Sons.

Jelen, H. 2011. *Food Flavors: Chemical, Sensory and Technological Properties*. Boca Raton, Florida, USA: CRC Press.

Taylor, A.J. 2002. *Food Flavour Technology*. Sheffield: Sheffield Academic Press Ltd.

Taylor, A.J. & Hort, J. 2007. *Modifying Flavour in Food*. Cambridge: Woodhead Publishing Limited.

STKM6113 Advanced Food Microbiology

In this course, scientific aspect of microbial contamination in food are discussed, the physiology and biochemistry of microorganisms in contaminated food, and the survival aspects of vegetative cells and microbial spores due to exposure to various food preservation techniques. Toxin production mechanisms by bacteria and its action which causes food poisoning by infection and intoxication are also discussed. Molecular epidemiology, rapid methods of bacterial sub typing and data analysis, and food borne diseases emerging issues and international legislation related to food microbiology are taught. The principles and use of predictive microbiology during food preservation to control food pathogens are introduced besides other topic such as microbial risk assessment and microbiological criteria. Recent techniques based on immunology and genetic for detecting and determining of foodborne microorganisms in food particularly pathogens are also discussed.

References

Doyle, M.P., Beuchat, L.R. & Montville, T.J. 1997. *Food Microbilology: Fundamentals and Frontiers.* Washington DC: ASM Press.

Forsythe, S. J. 2002. *Microbiological Risk Assessment*. New York: Wiley-Blackwell.

Fratamico, P. M., Bhunia, A. K. & Smith, J. L. 2005. *Foodborne Pathogens: Microbiology and Molecular Biology.* New York: Caister Academic Press.

International Commission for the Microbiological Specifications of Foods (ICMSF). 2006. *Microorganisms in Foods 7: Microbiological Testing in Food Safety Management.* New York: Corr.

Palino, M. V. 2007. *Food Microbiology Research Trends.* New York: Nova Science Publishers.

International Commission on Microbiological Specifications for Foods (ICMSF). 2011. *Microorganisms in Foods 8: Use of Data for Assessing Process Control and Product Acceptance*. New York: Corr.

STKM6122 Experimental Technique in Food Science

This course will discuss the basic principles regarding the technique of conducting research in food science. Discussion will also include several methods in conducting experiments commonly practiced in the field of food science, data analysis and concluding experiment outputs along with the use of software to analyse data. This course will emphasize on hands-on practical aspects apart from the theory.

References

Cornell, J. 2002. *Experiments With Mixtures*. Florida: John Wiley & Sons. Inc.

Fellows, P. 2000. *Food Processing Technology*: *Principles & Practice*. England: Ellis-Harwood Ltd., Chichester.

Montgomery, D.C. 2005. *Design and Analysis of Experiments.* New York: John Wiley & Sons. Inc.

Myers, R.H. & Montgomery, D.C. 2002. *Response Surface Methodology*. Florida: John Wiley & Sons. Inc.

Paulson, D.S. 2003. *Applied Statistical Designs for the Researcher*. Marcel Dekker, Inc. New York.

STKM6123 Advanced Food Chemistry

This course will deliberate on the chemistry of protein, carbohydrate and lipid, pertaining to the chemistry and biochemistry, giving special emphasis on appropriate instrumental analytical techniques to monitor physicochemical properties related to quality. Protein chemistry will be discussed on interaction of protein-water, protein-protein, protein-starch and protein-metal and their

importance in food processing. Protein modification technology will also be discussed. Carbohydrate chemistry will cover detailed discussion on the structure-function relationship, modification and application in food industries. Lipid chemistry will cover topics such as the production of fats, classification of lipid, value added products, polymorphism, fat oxidation, structured lipid by interesterification and application of lipid in food systems. Techniques in fat and oils analysis will also be discussed.

References

Srinivasan Damodaran, Kirk L. Parkin, Owen R. Fennema. 2007. Fennema's Food Chemistry, Fourth Edition (Food Science and Technology). Springer

H.-D. Belitz , Werner Grosch, Peter Schieberle. 2009. Food Chemistry. Springer-Verlag Berlin Heidelberg.

Tom P. Coultate. 2009. Food: The Chemistry of Its Components. Royal Society of Chemistry, London

John M. deMan. 2013. Principles of Food Chemistry. Springer Science & Business, New York.

David E. Newton. 2009. Food Chemistry. Infobase Publishing, New York.

STKM6243 Food Safety Management

Food quality control, total quality management (TQM) and food safety management in food industry will be discussed. This course will also discuss the concept of food risk analysis and food traceability. Students will also be introduced to the development of food laws and standards and the salient features of the Food Act 1983 and Regulations 1985 as well as Malaysian Standards for various food products. The role of Codex Alimentarius Commision in the development of various standards and guidelines pertaining to food production will also be discussed. Students are also exposed to the elements of organization management which are required to develop and administer a product quality assurance system. An effective quality assurance system is required to produce a good and safe product which can meet national and international standards. Principle of food hygiene, Codes of practice, Good Manufacturing Practice, Halal food, Hazard Analysis and Critical Control Point (HACCP) and ISO9000 will be discussed. The development and administration of the regulations and rules pertaining to quality and safety systems will be covered in this course.

References

Foster, S.T. 2004. *Managing Quality: An Integrative approach*. Upper Saddle River, New Jersey: Prentice Hall.

Hoyle, D.2005. *ISO9000 Quality Systems Handbook.* 5th. Ed. Butterworth Heinemann. Publication.

ICMSF. 1988. *HACCP In Microbiological Safety and Quality*. Oxford: Blackwell Scientific.

Kementerian Kesihatan Malaysia. 2006. S*kim Pensijilan Amalan Pengilangan Yang Baik.* Kuala Lumpur: Publication of the Ministry of Health, Malaysia

Ministry of Health Malaysia. 2001. Malaysian Certification for HACCP, Guideline for HACCP Certification, Guidelines for HACCP Surveillance Audit, Guidelines for HACCP Compliance Audit, Publication of the Ministry of Health, Malaysia.

Moretimore, S. & Wellace, C. 1998. *HACCP: A Practical Approach*. 2nd. Ed. Maryland : Aspen Publication.

STKM6313 Food Quality

This course will discuss in depth the aspects of quality control in several types of food, with emphasis on foods for both local consumption as well as for export. This course will introduce candidates to the methods of drawing up specifications, standards as well as techniques for measurement of quality characteristics in various types of food, including determination of halal food. The quality and physiological changes relating to ripening and shelf life of tropical fruits will be discussed. Sensory evaluation techniques such as descriptive and quantitative analyses as well as flavor and texture profiling will also be discussed.

References

Aminah Abdullah. 2000. *Prinsip Penilaian Sensori.* Bangi: Penerbit Universiti Kebangsaan Malaysia.

International Trade Centre. 1991. *Quality Control for the Food Industry: An Introductory Handbook Geneva.* UNCTAD/GATT.

Lawless, H.T. & Heyman, H. 1998. *Sensory Evaluation of Food: Principles and Practices.* New York: Chapman & Hall.

Maskowitz, H.R. 1985. *New Directions for Product Testing and Sensory Analysis of Foods.* Wesport, Conn, USA: Food & Nutrition Press, Inc.

Marsili, R. 1996. *Techniques for Analyzing Food Aroma.* New York: Marcel Dekker. Inc.

STKM6322 Current Techniques in Food Microbiology

In this course, current techniques in food microbiology are exposed to the graduate student. It includes the detection, identification and characterization of different techniques in food microbiology such as nucleic acid-based diagnostic and ELISA. Students are thought the common microbial contaminant in food and risk material of Bovine Spongiform Encephalopathy (BSE). They are also exposed to data analysis and molecular epidemiology study from DNA finger printing obtained and explained current developments in nucleic acid-based diagnostic for determination of food contents from aspects of religious (Halal issues), safety, legislation and declaration. Besides that, explanation and problem solving method in issue related to microorganism will be exposed to the students.

References

John R. Crowther. 2008. *Elisa: Theory and Practice (Methods in Molecular Biology*. 2nd. Ed. USA: Springer Protocol.

Conrad Sachse. 2002. *PCR Detection of Microbial Pathogens (Methods in Molecular Biology).* First Edition. USA: Humana Press.

Ron Fridell. 2001. *DNA Fingerprinting: The Ultimate Identity.* USA: Childrens Press.

STKM6323 Food Processing Operation

Food processing operation involves a series of unit operations which bring about changes in the raw materials. In an effort to produce food products which are safe, nutritious and stable, knowledge of the food product as well as the combination of the processing operation units are of utmost importance. This course discusses the physical and chemical properties of food and the operation units involved in raw material preparation, size reduction, mixing, forming, thickening, heating processes, frying, micro waving, filtration and extraction. This course will also cover the use of pulsed electric field, high pressure processing and ohmic heating in food processing.

References

Brennan, J.G., J.R. Butters, N.D. Cowell & A.W. Lilly. 1993. *Food Engineering Operations.* London: Applied Science Publ. Ltd.

Erickson, D.R. 1990. *Edible Fats and Oils Processing: Basic Principles and Modern Practices.* Illinois: AOCS.

Fellows, P. 2000. *Food Processing Technology: Principles & Practice.* Chichester, England: Ellis-Harwood Ltd.

Fennema, O.R. 1996. *Food Chemistry*. 2nd. Ed. New York.Marcel-Dekker Publ. Inc.,

Singh, R.P. 1998. *Introduction To Food Engineering.* New York: Academic Press.

Whitaker, J. R., Voragen, A. G. J. & Wong, W. S. 2002. *Handbook of Food Enzymology.* Boca Raton: CRS Press.

STKM6712 Food and Nutritional Toxicology

This course discusses the basic and applied concepts of food and nutritional toxicology. Emphasis will be given on the absorption, distribution, metabolism (biotransformation) and excretion of food toxicants. Several natural and environmental toxicants will also be introduced. Emphasis will be placed on the mechanism, control and elimination of food toxicity.

References

Barceloux, D.G. 2008. *Medical Toxicology of Natural Substances: Foods, Fungi, Medicinal Herbs, Plants, and Venomous Animals*. New Jersey, USA: John Wiley and Sons Inc.

Dong, M.H. 2014. *An Introduction to Environmental Toxicology Third Edition*. South Carolina, USA: CreateSpace Publishing.

Frank, P. and Ottoboni, M.A. 2011. *The Dose Makes the Poison: A Plain-Language Guide to Toxicology, 3rd Edition*. New Jersey, USA: John Wiley and Sons Inc.

Klaassen, C.D. 2013. *Casarett & Doull's Toxicology: The Basic Science of Poisons, 8th Edition*. Boston: McGraw-Hill Professional Publishing.

Shibamoto, T and Bieldanes, L.F. 2009. *Introduction to Food Toxicology, 2nd Edition*. London, UK: Elsevier Inc.

STKM6722 Food Packaging

This course will cover the basic aspects of food packaging. Emphasis will be placed on the types of packaging materials available, their properties such as absorbency, tensile strength and the interaction between the food product and its packaging material. Methods of packaging, the role of packaging during transportation of foods and labeling will be discussed. The importance of packaging in food preservation and protection of food from spoilage and contamination during storage and transportation will be covered too. The properties of packaging materials which come into direct contact with food, controlled or modified atmosphere packaging and water, oxygen and carbon dioxide absorption materials will also be discussed.

References

Robertson, G.L. 1992. Food Packaging – Principles and Practice. Marcell Dekker Inc. New York.
Brody, A.L. & Marsh, K.S. 1997. The Wiley Encyclopedia of Packaging Technology. John Wiley & Sons. New York.
Mathlouthi, M. 1994. Food Packaging and Preservation – Theory and Practice. Elsevier Applied Sci. Publ. London.
David, J.R.D., Graves, R.H. and Carlson, V.R. 1996. Aseptic Processing and packaging of Food – A Food Industry Perspective.CRC Press, Boca Raton.
Piringer, O.G. and Baner, A.L. 2000. Food Packaging Materials : Barrier Function, Mass Transport, Quality Assurance and Legislation. Wiley-VCH.

STKM6973 Research Project I

Students are required to conduct a research project related to food science. This project will be conducted in two consecutive semesters. Title of the project will be provided by appointed supervisor. Evaluation of research project I is based on written proposal, presentation and progress throughout the semester.

Reference

Pusat Siswazah. 2015. *Format Gaya UKM*. Bangi: Penerbit UKM.

STKM6986 Research Project II

Research Project II is the continuation of Research Project I. Upon completion of the project, the students will prepare a dissertation and defend its content during result presentation and oral examination. Regulation on preparations of the dissertation are stipulated in "The UKM Style Guide".

Reference

Pusat Siswazah. 2015. *Format Gaya UKM*. Bangi: Penerbit UKM.

MASTER OF SCIENCE (NUTRITION)

Introduction

The Nutrition program offers a Master of Science degree by thesis and course work. The candidates in this field of specialization will be trained on the importance of nutrition in health and the complexity of nutritional problems. Nutrition is also closely linked to food production and safety.

The Master of Science (Nutrition) Program complements the Doctor of Philosophy program that comprises only research work. Graduates from this program will possess sound knowledge in the field of Nutrition. It is hoped that these graduates will apply the gained knowledge in areas of research and production of nutritious foods, food safety and quality, food regulations as well as food and nutrition educational programs.

Entry Requirements

Candidates applying for graduate degree study should possess the following qualifications:

a) Bachelor of Science degree (Food Science and Nutrition, Nutrition or Dietetics) with a good Cumulative Grade Point Average (CGPA) from Universiti Kebangsaan Malaysia or any universities approved by the Senate, or
b) Other equivalent qualification to a Bachelor's degree in Science or other qualification such as experiences approved by the Senate;
or

c) Candidates who do not fulfill the minimum CGPA requirements may be considered on the basis of their experience in research in related fields.

Type of Programs

The Master of Science (Nutrition) degree offers two types of study program:

- Thesis
- Course work

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1: Competent with admirable personality and character that can uphold the vision of the faculty and the university as well as able to contribute an energy and expertise toward the current technology development and problem solving.

PEO2: Provides in-depth knowledge and guide current exploratory research on the development of dietary habits on culture, the environment and changes in community attitudes.

PEO3: Developing attitudes and awareness to identify, plan work activities, design of new research and innovation to meet the challenges and demands in the current field of nutrition.

PEO4: Developing and creating a knowledge sharing network to conduct research effectively and equitably to meet the challenges of food and nutrition industry demand.

PROGRAM LEARNING OUTCOMES (PLO)

PLO1: Mastery of advanced knowledge to conduct research in nutrition.

PLO2: Having in-depth technical competence in the field of nutrition.

PLO3: Ability to identify and solve problems in nutritional research.

PLO4: Ability to utilize scientific methods to design, conduct, analyze and interpret research data.

PLO5: Understanding of issues and needs related to ethics, society, culture and environment as a professional nutritionist.

PLO6: Competent in both oral and written communication.

PLO7: Ability to function effectively as an individual and in a group with the capacity to be a leader as well as an effective team member.

PLO8: Recognizing the need for lifelong learning and possessing the capacity to do so.

PLO9: Ability to acquire entrepreneurial and managerial skills to fulfill the community needs.

Program Structure

Thesis

All candidates of this program have to register and pass 14 credit hours of courses to fulfill the requirement for graduation. From the 14 credit hours of courses, 4 credit hours core Faculty and 10 credit hours for core program. The list of the courses are:

STPD6014 Research Methodology

and select 10 credit hours from the list:-

Semester I

STKM6033 Science of Fats and Oils
STKM6122 Experiment Techniques in Food Science
STKM6223 Research Techniques in Nutrition
STKM6313 Food Quality
STKM6413 Nutrition and Aging
STKM6712 Food and Nutrition Toxicology

Semester II

STKM6063 Food Additive Substance
STKM6213 Applied Nutrition
STKM6222 Nutrient and Drug Interactions
STKM6243 Food Safety Management
STKM6333 Diet Therapy Advanced

Course work

All candidates of this program have to register and pass 40 credit hours, of which 29 credit hours are from core courses and 11 credit hours from elective courses. Students may take any of the elective courses to fulfill the requirement.

SEMESTER	CORE COURSES	ELECTIVE COURSES	TOTAL
I	STPD6014 Research Methodology STKM6223 Research Techniques in Nutrition STKM6313 Food Quality STKM6712 Food and Nutrition Toxicology STKM6973 Research Project I	STKM6033 Science of Fat and Oil STKM6122 Experimental Techniques in Food Science STKM6413 Nutrition and Aging	**20**
II	STKM6213 Applied Nutrition STKM6222 Nutrient and Drug Interactions STKM6333 Diet Therapy STKM6986 Research Project II	STKM6063 Food Additives STKM6243 Food Safety Management	**20**
TOTAL	**29**	**11**	**40**

Courses Offered

STPD6014 Research Methodology
STKM6033 Science of Fats and Oils
STKM6063 Food Additives
STKM6122 Experimental Techniques in Food Science
STKM6213 Applied Nutrition
STKM6222 Nutrient and Drug Interactions
STKM6223 Research Techniques in Nutrition
STKM6243 Food Safety Management
STKM6313 Food Quality

STKM6333	Diet Therapy
STKM6413	Nutrition and Aging
STKM6712	Food and Nutritional Toxicology
STKM6923	Developmental Nutrition
STKM6973	Research Project I
STKM6986	Research Project II

Course Contents

STKM6033 Science of Fats and Oils

This course discusses fat and oil processing to produce value added products. These include fractionation, hydrogenation, transesterification and blending to produce emulsifiers (sugar esters, DAG, MAG) and specialty fats (structured lipids, confectionary fats, shortenings). In addition, polymorphic characteristics of fats and oils and their importance in fat migration, compatibility and formation of fat bloom will also be discussed. The physico-chemical changes in fats and oils during cooking will also be explained. The role of dietary fats and oils in health and diseases (coronary heart diseases, obesity) will be explained.

References

Akoh, C.C. & Min, D.B. 1998. *Food Lipids: Chemistry, Nutrition, and Biotechnology*. New York: Marcel Dekker, Inc.

Garti, N. & Sato, K. 1988. *Crystallization and Polimorphism of Fats and Fatty Acids.* New York: Marcel Dekker, Inc.

Gunstone, F.D. & Padley, F.B. 1997. *Lipid Technologies and Applications.* New York: Marcel Dekker, Inc.

Gunstone F.D., Harwood, J.L. & Padley, F.B. 1995. *The Lipid Handbook.* Ed. ke-2. London: Chapman & Hall.

Hamilton, R.J. 1995. *Developments in Oils and Fats.* London: Blakie Academic & Professional.

STKM6063 Food Additives

This course discusses the chemical reactions involve in natural food flavour formation from plants and animals as well as via food processing techniques. The method to isolate, separate and identify flavour compounds will also be discussed. Emphasis will be given on identification of off- flavours defects in foods and propose ways of preventing them. The synthetic and natural identical flavourings will be addressed in the course. Students will be given group assignment/project to apply flavourings to various formulated systems.

References

Bredie, W.L.P. & Petersen, M.A. 2006. *Flavour Science: Recent Advances and Trends*. Amsterdam: Elsevier.

Deibler, K.D. & van Ruth, S. 2005. *Simulation of mouth condition for flavor analysis*. Hoboken, N.J.:John Wiley & Sons.

Jelen, H. 2011. *Food Flavors: Chemical, Sensory and Technological Properties*. Boca Raton, Florida, USA: CRC Press.

Taylor, A.J. 2002. *Food Flavour Technology*. Sheffield: Sheffield Academic Press Ltd.

Taylor, A.J. & Hort, J. 2007. *Modifying Flavour in Food.* Cambridge: Woodhead Publishing Limited.

STKM6122 Experimental Techniques in Food Science

This course will discuss the basic principles regarding the technique of conducting research in food science. Discussion will also include several methods in conducting experiments commonly practiced in the field of food science, data analysis and concluding experiment outputs along with the use of software to analyse data. This course will emphasize on hands-on practical aspects apart from the theory.

References

Cornell, J. 2002. *Experiments With Mixtures*. Florida: John Wiley & Sons. Inc.

Fellows, P. 2000. *Food Processing Technology*: *Principles & Practice*. England: Ellis-Harwood Ltd., Chichester.

Montgomery, D.C. 2005. *Design and Analysis of Experiments.* New York: John Wiley & Sons. Inc.

Myers, R.H. & Montgomery, D.C. 2002. *Response Surface Methodology*. Florida: John Wiley & Sons. Inc.

Paulson, D.S. 2003. *Applied Statistical Designs for the Researcher*. Marcel Dekker, Inc. New York.

STKM6213 Applied Nutrition

This course discussed the food habit of ethnic groups in Malaysia. Several nutrition related programs in Malaysia will also be discussed. The students will be exposed to field work in relation to nutrition where the students will be involved in planning, implementing, teaching and evaluating of project conducted.

References

Bauer, K.D, Liou, D. and Sokolik, C.A. 2012. *Nutrition Counseling and Education Skill Development*. Belmont CA: Wadsworth/Cengage Learning.

Frank, G. 2008. *Community Nutrition: Applying Epidemiology to Contemporary Practice, 2nd Edition.* Sudbury, MA: Jones and Bartlett Publisher.

Mahan, L.K., Stump, S.E & Raymond, J.L. 2012. *Krause's food and the nutrition care process, 13th Edition*. Missouri: Elsevier Saunders.

Nix, S. 2013. *William's Basic Nutrition and Diet Therapy, 14th Edition*. Missouri: Elsevier Mosby.

Nnakwe, N.E. 2009. *Community Nutrition: Planning Health Promotion and Disease Prevention, 2nd Edition.* Sudbury, MA: Jones and Bartlett Publisher.

STKM6222 Nutrient and Drug Interactions

This course discusses the effects of nutrient on the efficacy and toxicity of drugs. Students will be exposed to the influence of drugs on the absorption, distribution and metabolism of nutrients. Emphasis will be given on the influence of drugs such as alcohol and food. The interactive effects of food additives and supplements with drugs on certain diseases will also be addressed.

References

Boullata, J.I. & Armenti, V. T. (eds.). 2000. *Handbook of Drug-Nutrient Interactions.* New York: Springer-Verlag.

Lininger, S. W. 1999. *A-Z Guide To Drug-Herb and Vitamin Interaction.* New York: Prima Communications, Inc.

Mahan, L. K. & Escott-Stump, S. 2008. *Krause's Food & Nutrition Therapy.* Missouri: Saunders Elsevier, Pub.

McCabe, B. J., Wolfe, J. J. & Frankel, E. H. 2003. *Handbook of Food-Drug Interactions*. Florida: CRC Boca Raton.

Meckling, K. A. 2007. *Nutrient-Drug Interactions.* Florida: CRC/Taylor & Francis.

Pronsky, Z. M. et al. 1995. *Food-Medication Interactions.* Pottstown, PN: Food Medication Interactions Pub.

STKM6223 Research Techniques in Nutrition

This course discusses the techniques commonly used in biological assay of food proteins and nutritional evaluation using small animals and *in vitro* studies. The principals of research technique in nutrition is introduced whereby students will be able to carry out experiments using animals to conduct bioassays, PER and digestibility studies. Students will be exposed to the research ethics, management of the laboratory for animal studies, appreciate the handling of small animals and work in group to achieve results. Research techniques involving surveys and clinical studies will also be covered in this course.

References

Akins, C. K., Panicker S. & Cunningham, C. L. (eds.) 2004. *Laboratory Animals In Research And Teaching: Ethics, Care, And Methods.* Washington, D.C.: APA

Choo, S.C. & Liu, J.P. 1998. *Design and Analysis of Clinical Trials: Concept and Methodologies.* New York: John Wiley & Sons.

FAO/WHO. 1985. *Energy and Protein Requirements.* Tech. Rep. Ser. No. 724. Geneva:WHO.

James, W.P.T. & Schofield E.C. 1990. *Human Energy Requirements. A Manual for Planners and Nutritionists.* Oxford: Oxford Medical Public.

Langley, G. 1989. *Animal Experimentation: The Consensus Changes.* Hamsphire: the Macmillan Press.

STKM6243 Food Safety Management

Food quality control, total quality management (TQM) and food safety management in food industry will be discussed. This course will also discuss the concept of food risk analysis and food traceability. Students will also be introduced to the development of food laws and standards and the salient features of the Food Act 1983 and Regulations 1985 as well as Malaysian Standards for various food products. The role of Codex Alimentations Commission in the development of various standards and guidelines pertaining to food production will also be discussed. Students are also exposed to the elements of organization management which are required to develop and administer a product quality assurance system. An effective quality assurance system is required to produce a good and safe product which can meet national and international standards. Principle of food hygiene, Codes of practice, Good Manufacturing Practice, Halal food, Hazard Analysis and Critical Control Point (HACCP) and ISO9000 will be discussed. The development and administration of the regulations and rules pertaining to quality and safety systems will be covered in this course.

References

Foster, S.T. 2004. *Managing Quality: An Integrative Approach*. Upper Saddle River, New Jersey: Prentice Hall

Hoyle, D. 2005. I*SO9000 Quality Systems Handbook.* 5th. Ed. Butterworth Heinemann. Publication

ICMSF. 1988. *HACCP in Microbiological Safety and Quality*. Oxford: Blackwell Scientific

Kementerian Kesihatan Malaysia. 2006. S*kim Pensijilan Amalan Pengilangan Yang Baik*. Kuala Lumpur: Publication of the Ministry of Health, Malaysia

Ministry of Health Malaysia. 2001. Malaysian Certification for HACCP, Guideline for HACCP Certification, Guidelines for HACCP Surveillance Audit, Guidelines for HACCP Compliance Audit, Publication of the Ministry of Health, Malaysia.

Moretimore, S. & Wellace, C. 1998. *HACCP: A Practical Approach*. 2nd. Ed. Maryland : Aspen Publication

STKM6313 Food Quality

This course will discuss in depth the aspects of quality control in several types of food, with emphasis on foods for both local consumption as well as for export. This course will introduce candidates to the methods of drawing up specifications, standards as well as techniques for measurement of quality characteristics in various types of food, including determination of halal food. The quality and physiological changes relating to ripening and shelf life of tropical fruits will be discussed. Sensory evaluation techniques such as descriptive and quantitative analyses as well as flavor and texture profiling will also be discussed.

References

Aminah Abdullah. 2000. *Prinsip Penilaian Sensori.* Bangi: Penerbit Universiti Kebangsaan Malaysia

International Trade Centre. 1991. *Quality Control for the Food Industry: An Introductory handbook Geneva.* UNCTAD/GATT.

Lawless, H.T. & Heyman, H. 1998. *Sensory Evaluation of Food: Principles and Practices.* New York: Chapman & Hall.

Maskowitz, H.R. 1985. *New Directions for Product Testing and Sensory Analysis of Foods.* Wesport, Conn, USA: Food & Nutrition Press, Inc.

Marsili, R. 1996. *Techniques for Analyzing Food Aroma.* New York: Marcel Dekker. Inc.

STKM6333 Diet Therapy

This course covers the aspects of nutrition which are the foundations for treatment of certain pathological conditions. Good nutrition can assist the recovery of patients suffering from acute and chronic diseases by alleviating problems such as stress, trauma, infection, metabolic changes and the after effects of surgery. Students will be exposed to the physiology of diseases and various aspects of nutrition such as enteral and parenteral nutrition as well as nutrition for diseases of the intestines, liver and kidneys. Nutrition for conditions such as cancer, diabetes mellitus, cardiovascular diseases, food allergy and others will also be covered in this course.

References

Aminah Abdullah. 2000. *Prinsip Penilaian Sensori.* Bangi: Penerbit Universiti Kebangsaan Malaysia

International Trade Centre. 1991. *Quality Control for the Food Industry: An Introductory handbook Geneva.* UNCTAD/GATT.

Lawless, H.T. & Heyman, H. 1998. *Sensory Evaluation of Food: Principles and Practices.* New York: Chapman & Hall.
Maskowitz, H.R. 1985. *New Directions for Product Testing and Sensory Analysis of Foods.* Wesport, Conn, USA: Food & Nutrition Press, Inc.
Marsili, R. 1996. *Techniques for Analyzing Food Aroma.* New York: Marcel Dekker. Inc.

STKM6413 Nutrition and Aging

This course discusses the elderly demographic pattern, theories related to ageing process and factors influencing ageing process such as environment, social, psychology, biology and physiology. Malnutrition problems faced by elderly, nutritional need and dietary managements well as functional and quality of life will also be discussed. Students will be exposed to the various facilities and institution available for the elderly in Malaysia.

References

Mahan, L.K. & Stump, S.E. 2008. *Krause's Food & Nutrition Therapy.* 11th. Ed. Canada: Saunders Elsevier.
Morley, J.E. & Thomas, D.R. 2007. *Geriatric Nutrition.* New York: CRC Press.
Perlmutter, M & Hall, E. 1992. *Adult Development and Aging.* 2nd. Ed. New York: John Wiley & Sons, Inc.
Roe, D. A. 1987. *Geriatric NUTRITION*. 2nd. Ed. New Jersey: Prentice-Hall, Inc.
Suriah Abdul Rahman. 2001. *Pemakanan Wargatua.* Kuala Lumpur: Dewan Bahasa & Pustaka.

STKM6712 Food and Nutritional Toxicology

This course discusses the basic and applied concepts of food and nutritional toxicology. Emphasis will be given on the absorption, distribution, metabolism (biotransformation) and excretion of food toxicants. Several natural and environmental toxicants will also be introduced. Emphasis will be placed on the mechanism, control and elimination of food toxicity.

References

Barceloux, D.G. 2008. *Medical Toxicology of Natural Substances: Foods, Fungi, Medicinal Herbs, Plants, and Venomous Animals*. New Jersey, USA: John Wiley and Sons Inc.
Dong, M.H. 2014. *An Introduction to Environmental Toxicology Third Edition*. South Carolina, USA: CreateSpace Publishing.
Frank, P. and Ottoboni, M.A. 2011. *The Dose Makes the Poison: A Plain-Language Guide to Toxicology, 3rd Edition*. New Jersey, USA: John Wiley and Sons Inc.
Klaassen, C.D. 2013. *Casarett & Doull's Toxicology: The Basic Science of Poisons, 8th Edition.* Boston: McGraw-Hill Professional Publishing.
Shibamoto, T and Bieldanes, L.F. 2009. *Introduction to Food Toxicology, 2nd Edition*. London, UK: Elsevier Inc.

STKM6973 Research Project I

Students are required to conduct a research project related to nutrition. This project will be conducted in two consecutive semesters. Title of the project will be provided by appointed supervisor. Evaluation of research project I is based on written proposal, proposal presentation and progress throughout the semester.

Reference

Pusat Siswazah. 2015. *Format Gaya UKM*. Bangi: Penerbit UKM.

STKM6988 Research Project II

Research Project II is the continuation of Research Project I. Upon completion of the project, the students will prepare a dissertation and defend its content during result presentation and oral examination. Regulation on preparations of the dissertation are stipulated in "The UKM Style Guide".

Reference

Pusat Siswazah. 2015. *Format Gaya UKM*. Bangi: Penerbit UKM.