SCHOOL OF BIOSCIENCES AND BIOTECHNOLOGY

SCHOOL OF BIOSCIENCES AND BIOTECHNOLOGY

Introduction

The postgraduate programmes offered are by thesis only. These programmes emphasize the exploration and appreciation of the living world based on the latest approach and focused on the national development of science, technology and industry. The programmes are supported by courses which give a strong foundation and perspective in bioscience.

Research Areas and Degrees Offered

Research conducted at the School of Biosciences and Biotechnology focused in priority areas of biosciences that include: Gene Structure and Function, Genomics and Bioinformatics, Biochemistry, Molecular Biology, Animal Science, Structural Biology, Environmental Biotechnology, Plant Biotechnology, Host-Microbe Interaction, Developmental Biology, Signal Transduction, Biology of Natural Products, Biology of Mammalian Cells and Fermentation Technology. Each field of research generates new knowledge and technology which are targeted towards the development of national biotechnology.

The degrees awarded are as follows:

- Doctor of Philosophy (Biochemistry)
- Doctor of Philosophy (Botany)
- Doctor of Philosophy (Genetics)
- Doctor of Philosophy (Microbiology)
- Doctor of Philosophy (Zoology)
- Master of Science (Biochemistry)
- Master of Science (Molecular Biology)
- Master of Science (Plant Biotechnology)
- Master of Science (Microbiology)
- Master of Science (Animal Science)
- Master of Science (Plant Science)

Entry Requirements

Candidates applying for the postgraduate programmes must have the following qualifications:

Doctor of Philosophy Programme

a) Master of Science degree from Universiti Kebangsaan Malaysia or any other universities approved by the Senate; or
b) Other qualifications equivalent to a Master of Science and qualifications or experience approved by the Senate; or
c) Currently following a Master of Science programme in Universiti Kebangsaan Malaysia and endorsed by the Faculty Graduate Student Studies Committee to change status to a Doctor of Philosophy programme; 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 Programme

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) Doctor of Medicine from Universiti Kebangsaan Malaysia or any other equivalent degree from any other universities approved by the Senate; or
c) Other qualifications equivalent to a Bachelor in Science and other qualifications or experience approved by the Senate.

Programme Structure

Doctor of Philosophy

All candidates are required to register for STPD6014 Research Methodology and Research Project in each semester. Students are required to schedule meetings with their supervisor or supervision committee for no less than 40 hours per semester for full time students and 20 hours per semester for part-time students. A thesis must be produced at the end of the programme.

Master of Science

Programmes offered by School of Biosciences and Biotechnology are by thesis only. All candidates required to register and pass 12 credit hours of courses. Candidates are required to register for Research Project in each academic semester and thesis will be produced at the end of the programme.

The required 12 credit hours units of courses should be made up of 8 credit hours of core courses and 4 credit hours of elective courses, respectively. The core courses include STPD6014 Research Methodology offered by the faculty and other courses offered by the school. Candidates can choose from any available elective courses offered by the school.

Candidates are required to schedule meetings with their supervisor or postgraduate committee for no less than 26 hours per semester for full-time students and 13 hours per semester for part-time candidates.

DOCTOR OF PHILOSOPHY (BIOCHEMISTRY)

PROGRAMME EDUCATIONAL OUTCOME (PEO)

PEO1: To produce graduates with intellectual aptitude and expertise in biochemistry.
PEO2: To inculcate the knowledge of biochemistry in career development.
PEO3: To apply knowledge in biochemistry to lead and contribute towards the progress of the fields that serves the needs and well-being of society.
PEO4: To develop the ability of creative and critical thinking for knowledge advancement.
PEO5: To strengthen the ability to integrate biochemistry in a broader knowledge framework.
PEO6: To strengthen effective communication skills of national and international standings.

PROGRAMME OUTCOME (PO)

PO1: Able to contribute key concepts in biochemistry, molecular biology and related areas in the development of society and industries.
PO2: Able to apply knowledge and expertise in decision making and problems solving.
PO3: Able to critically design experiments, analyse, interpret and integrate data.
PO4: Possess sound scientific communication skills and able to work as a team.
PO5: Able to source, retrieve and use scientific information related to the discipline and possess skills necessary for life-long learning.
PO6: Aware of ethical and contemporary issues in biochemistry and related areas.
PO7: Adequately informed and able to address issues pertaining to safety of products and procedures which could pose risks to public health and the environment.
PO8: Able and ready to disseminate knowledge and expertise.

DOCTOR OF PHILOSOPHY (BOTANY)

PROGRAMME EDUCATIONAL OUTCOME (PEO)

PEO1: To produce a graduate who has mastered the botany knowledge holistically.
PEO2: To produce a graduate who was competent in soft skills.
PEO3: To produce a graduate who has the awareness towards environment.
PEO4: To produce a graduate who was able to contribute to other disciplines in order to give impetus to the national and global development.
PEO5: To develop effective communication skills of national and international standings.

PROGRAMME OUTCOME (PO)

PO1: A solid foundation in botanical science which can contribute to other disciplines.
PO2: Have an in-depth knowledge in botanical science and be able to identify problems and formulate corrective action.
PO3: Be able to apply and disseminate knowledge in botanical science effectively.
PO4: Competent in conducting research and development in botanical science and possess creative and innovative skills.
PO5: Possess moral, ethical and professional values and show a concern for the environment.
PO6: Capable of interacting and communicating effectively.
PO7: Possess good entrepreneurship and leadership skills.
PO8: Willingness to explore and practice life-long learning.
PO9: Possess a high degree of confidence, self-esteem and open mindedness.

DOCTOR OF PHILOSOPHY (GENETICS)

PROGRAMME EDUCATIONAL OUTCOME (PEO)

PEO1: To produce graduates with intellectual aptitude and expertise in genetic.
PEO2: To inculcate the knowledge of genetic in career development.
PEO3: To apply knowledge in genetic to lead and contribute towards the progress of the field that serve the needs and well-being of society.
PEO4: To develop the ability of creative and critical thinking for knowledge advancement.
PEO5: To strengthen the ability to integrate genetic in a broader knowledge framework.
PEO6: To strengthen effective communication skills of national and international standings.

PROGRAMME OUTCOME (PO)

PO1: Able to contribute key concepts in genetic and related areas in the development of society and industries.
PO2: Able to apply knowledge and expertise in decision making and problems solving.
PO3: Able to critically design experiments, analyse, interpret and integrate data.
PO4: Possess sound scientific communication skills and able to work as a team.
PO5: Able to source, retrieve and use scientific information related to the discipline and possess skills necessary for life-long learning.
PO6: Aware of ethical and contemporary issues in genetic and related areas.
PO7: Adequately informed and able to address issues pertaining to safety of products and procedures which could pose risks to public health and the environment**.**
PO8: Able and ready to disseminate knowledge and expertise.

DOCTOR OF PHILOSOPHY (MICROBIOLOGY)

PROGRAMME EDUCATIONAL OUTCOME (PEO)

PEO1: To produce graduates with intellectual aptitude and expertise in microbiology.
PEO2: To inculcate the knowledge of microbiology in career development.
PEO3: To apply knowledge in microbiology to lead and contribute towards the progress of the fields that serves the needs and well-being of society.
PEO4: To develop the ability of creative and critical thinking for knowledge advancement.
PEO5: To strengthen the ability to integrate microbiology in a broader knowledge framework.
PEO6: To strengthen effective communication skills of national and international standings.

PROGRAMME OUTCOME (PO)

PO1: Able to contribute key concepts in microbiology, molecular biology and related areas in the development of society and industries.
PO2: Able to apply knowledge and expertise in decision making and problems solving.
PO3: Able to critically design experiments, analyse, interpret and integrate data.
PO4: Possess sound scientific communication skills and able to work as a team.
PO5: Able to source, retrieve and use scientific information related to the discipline and possess skills necessary for life-long learning.
PO6: Aware of ethical and contemporary issues in microbiology and related areas.
PO7: Adequately informed and able to address issues pertaining to safety of products and procedures which could pose risks to public health and the environment.
PO8: Able and ready to disseminate knowledge and expertise.

DOCTOR OF PHILOSOPHY (ZOOLOGY)

PROGRAMME EDUCATIONAL OUTCOME (PEO)

PEO1: To produce graduates with intellectual aptitude and expertise in zoology.
PEO2: To inculcate the knowledge of zoology in career development.
PEO3: To apply knowledge in zoology to lead and contribute towards the progress in the field that serves the needs and well-being of society.
PEO4: To develop the ability of creative and critical thinking for knowledge advancement.
PEO5: To strengthen the ability to integrate zoology in a broader knowledge framework.
PEO6: To strengthen effective communication skills of national and international standings.

PROGRAMME OUTCOME (PO)

PO1: Able to contribute key concepts in zoology, molecular biology and related areas in the development of society and industries.
PO2: Able to apply knowledge and expertise in decision making and problems solving.
PO3: Able to critically design experiments, analyse, interpret and integrate data.
PO4: Possess sound scientific communication skills and able to work as a team.
PO5: Able to source, retrieve and use scientific information related to the discipline and possess skills necessary for life-long learning.
PO6: Aware of ethical and contemporary issues in zoology and related areas.
PO7: Adequately informed and able to address issues pertaining to safety of products and procedures which could pose risks to public health and the environment.
PO8: Able and ready to disseminate knowledge and expertise.

MASTER OF SCIENCE (BIOCHEMISTRY)

PROGRAMME EDUCATIONAL OUTCOME (PEO)

PEO1: To inculcate knowledge and understanding of biochemistry at master level and their effect towards life.
PEO2: To inculcate the knowledge of biochemistry in career development.
PEO3: To apply knowledge in biochemistry for research, conservation of environment and societal development.
PEO4: To develop the ability of creative and critical thinking for knowledge advancement.
PEO5: To strengthen the ability to integrate biochemistry in a broader knowledge framework.
PEO6: To develop effective communication skills of national and international standings.

PROGRAMME OUTCOME (PO)

PO1: Able to understand advanced concepts in biochemistry, molecular biology and related areas in molecular biosciences.
PO2: Able to apply practical skills in biochemistry, molecular biology and related areas in molecular biosciences.
PO3: Able to design experiments, to analyse and interpret data critically.
PO4: Possess sound scientific communication skills and able to work as a team.
PO5: Able to continuously acquire related scientific knowledge necessary for life-long learning.
PO6: Possess the awareness of ethical and contemporary issues in related fields.
PO7: Adequately informed and able to address issues pertaining to safety of products and procedures which could pose risks to public health and the environment.
PO8: Possess entrepreneurial and managerial skills in related fields.

MASTER OF SCIENCE (MOLECULAR BIOLOGY)

PROGRAMME EDUCATIONAL OUTCOME (PEO)

PEO1: To inculcate knowledge and understanding of molecular biology at master's level and effects towards life.
PEO2: To inculcate the knowledge of molecular biology in career development.
PEO3: To apply knowledge in molecular biology for research, conservation of environment and societal development.
PEO4: To develop the ability of creative and critical thinking for knowledge advancement.
PEO5: To strengthen the ability to integrate molecular biology in a broader knowledge framework.

PEO6: To develop effective communication skills of national and international standing.

PROGRAMME OUTCOME (PO)

PO1: Able to understand advanced concepts in modern biotechnology, molecular biology and related areas in molecular biosciences.
PO2: Able to apply practical skills in modern biotechnology, molecular biology and related areas in molecular biosciences.
PO3: Able to design experiments, to analyse and interpret data critically.
PO4: Possess sound scientific communication skills and able to work as a team.
PO5: Able to continuously acquire related scientific knowledge necessary for life-long learning.
PO6: Possess the awareness of ethical and contemporary issues in related fields.
PO7: Adequately informed and able to address issues pertaining to safety of products and procedures which could pose risks to public health and the environment.
PO8: Possess entrepreneurial and managerial skills in related fields.

MASTER OF SCIENCE (PLANT BIOTECHNOLOGY)

PROGRAMME EDUCATIONAL OUTCOME (PEO)

PEO1: To inculcate knowledge and understanding of plant biotechnology at master level and their efforts towards life.
PEO2: To inculcate the knowledge of plant biotechnology in career development.
PEO3: To apply knowledge in plant biotechnology for research, conservation of environment and societal development.
PEO4: To develop the ability of creative and critical thinking for knowledge advancement.
PEO5: To strengthen the ability to integrate plant biotechnology in a broader knowledge framework.
PEO6: To develop effective communication skills of national and international standings.

PROGRAMME OUTCOME (PO)

PO1: Ability to understand advanced concepts in plant science and its improtance in the plant based products.
PO2: Ability to transfer principles and results from basic and applied sciences of plant biotechnology field to the development of ideas.
PO3: Ability to design experiments, to analyse and interpret data critically.
PO4: Ability to communicate scientifically and able to work as a team.
PO5: Ability to analyse and comprehend existing knowledge and to transfer knowledge to develop hypotheses and evaluate their usefulness in the context of a given problem.

PO6: Ability to understand the awareness of ethical and contemporary issues in the field of plant biotechnology.
PO7: Ability to create awareness towards safety of products and procedures which could pose risks to public health and the environment.
PO8: Ability to understand the entrepreneurial and managerial skills in plant biotechnology.

MASTER OF SCIENCE (MICROBIOLOGY)

PROGRAMME EDUCATIONAL OBJECTIVE (PEO)

PEO1: To inculcate knowledge and understanding of microbiology at the master's level and their effects towards life.
PEO2: To inculcate the knowledge of microbiology in career development
PEO3: To apply knowledge in microbiology for research, conservation of environment and societal development.
PEO4: To develop the ability of creative and critical thinking for knowledge advancement.
PEO5: To strengthen the ability to integrate microbiology in a broader knowledge framework.
PEO6: To strengthen effective communication skills of national and international standings.

PROGRAMME OUTCOME (PO)

PO1: Able to understand advanced concepts in microbiology, molecular biology and related areas in molecular biosciences.
PO2: Able to apply practical skills in microbiology, molecular biology and related areas in molecular biosciences.
PO3: Able to design experiments, to analyse and interpret data critically.
PO4: Possess sound scientific communication skills and able to work as a team.
PO5: Able to continuously acquire related scientific knowledge necessary for life-long learning.
PO6: Possess the awareness of ethical and contemporary issues in related fields.
PO7: Adequately informed and able to address issues pertaining to safety of products and procedures which could pose risks to public health and the environment.
PO8: Possess entrepreneurial and managerial skills in related fields.

MASTER OF SCIENCE (ANIMAL SCIENCE)

PROGRAMME EDUCATIONAL OBJECTIVE (PEO)

PEO1: To inculcate knowledge and understanding of animal science at the master's level and their effects towards life.
PEO2: To inculcate the knowledge related to animal sciences in career development.
PEO3: To apply knowledge in animal sciences for research, conservation of environment and societal development.

PEO4: To develop the ability of creative and critical thinking for knowledge advancement.
PEO5: To strengthen the ability to integrate animal sciences in a broader knowledge framework.
PEO6: To strengthen effective communication skills of national and international standings.

PROGRAMME OUTCOME (PO)

PO1: Able to understand advanced concepts in animal sciences, molecular biology and related areas in molecular biosciences.
PO2: Able to apply practical skills in animal sciences, molecular biology and related areas in molecular biosciences.
PO3: Able to design experiments, to analyse and interpret data critically.
PO4: Possess sound scientific communication skills and able to work as a team.
PO5: Able to continuously acquire related scientific knowledge necessary for life-long learning.
PO6: Possess the awareness of ethical and contemporary issues in related fields.
PO7: Adequately informed and able to address issues pertaining to safety of products and procedures which could pose risks to public health and the environment.
PO8: Possess entrepreneurial and managerial skills in related fields.

MASTER OF SCIENCE (PLANT SCIENCE)

PROGRAMME EDUCATIONAL OBJECTIVE (PEO)

PEO1: To impart knowledge and critical understanding in plant sciences at the master's level and their effects towards life.
PEO2: To inculcate the knowledge of plant sciences in career development.
PEO3: To apply knowledge in plant sciences for research, conservation of environment and societal development.
PEO4: To develop the ability of creative and critical thinking for knowledge advancement.
PEO5: To strengthen the ability to integrate plant sciences in a broader knowledge framework.
PEO6: To strengthen effective communication skills of national and international standings.

PROGRAMME OUTCOME (PO)

PO1: Able to understand advanced concepts in plant sciences and related areas in molecular biosciences.
PO2: Able to apply practical skills in plant sciences and related areas in molecular biosciences.
PO3: Able to design experiments, to analyse and interpret data critically.
PO4: Possess sound scientific communication skills and able to work as a team.

PO5: Able to continuously acquire related scientific knowledge necessary for life-long learning.
PO6: Possess the awareness of ethical and contemporary issues in related fields.
PO7: Adequately informed and able to address issues pertaining to safety of products and procedures which could pose risks to public health and the environment.
PO8: Possess entrepreneurial and managerial skills in related fields.

Candidates are required to register for the following courses:

CORE COURSES	ELECTIVE COURSES	TOTAL
STPD6014 Research Methodology STBP6244 Current Developments in Molecular and Cellular Biology ***or*** STBP6254 Biotechnology Management	STBP6262 Bioinformatics STBP6342 Bioprocess Technology STBP6352 Molecular Phylogeny STBP6362 Signalling and Regulation of Cellular Development STBP6442 Cancer Cell Biology STBP6452 Molecular Mechanism of Pathogenicity STBP6662 Current Topics and Innovation in Plant Science	
8	**4**	**12**

Courses Offered

STPD6014 Research Methodology
STBP6244 Current Developments in Molecular and Cellular Biology
STBP6254 Biotechnology Management
STBP6262 Bioinformatics
STBP6342 Bioprocess Technology
STBP6352 Molecular Phylogeny
STBP6362 Signalling and Regulation of Cellular Development
STBP6442 Cancer Cell Biology
STBP6452 Molecular Mechanism of Pathogenicity
STBP6662 Current Topics and Innovation in Plant Science

Course Contents

STBP6244 Current Developments in Molecular and Cellular Biology

Cell and molecular biology is a subject emphasizing the study of cell function at the cellular and molecular levels, and how the cells control gene expression. This course is designed to provide a forum to discuss current issues and technology developments in the field of cell and molecular biology. Exciting applications on how we use these technologies to understand the development of fight diseases, how molecular system influence cellular behaviour, interactions and production of therapeutics products will be discussed. Selected topics will include the human genome and proteome project, new approaches in biomarker discovery, and

therapeutics using selected disease models. Scientific progress which impacted on social and economy of mankind and its environment will also be emphasized.

References

Bernot, A. 2007. *Genome, Transcriptome and Proteome Analysis*. Chichester: John Wiley & Sons

Gellissen, G. (Ed.) 2005. *Production of Recombinant Proteins: Novel Microbial and Eukaryotic Expression Systems.* Weinheim: Wiley-VCH

Holland, S., Lebacqz, K. & Zoloth, L. 2001. *The Human Embryonic Stem Cell Debate: Science, Ethic and Public Policy.* Massachussetts: MIT Press.

Janitz, M. (Ed.). 2008. *Next-generation Genome Sequencing: Towards Personalized Medicine.* Weinheim: Wiley-VCH

Pennington, S. & Dunn, M.J. (Ed.). 2001. *Proteomics: From Protein Sequence to Function.* Amsterdam: Springer Verlag.

STBP6254 Biotechnology Management

This course discusses important topics on biotechnology industry. Initially, students will be exposed to concepts and policies of the national biotechnology for the economy growth. The organization structure and mechanisms for the biotechnology development will be discussed at length in this course. In addition, the business aspects and management of biotechnology organizations will also be discussed. Students will also be exposed on the intellectual property and technology management for manufacturing biotechnology products. The application of good manufacturing practice for biotechnology and pharmaceutical products will be discussed. Methods of starting, managing, and strengthening biotechnology companies will be discussed according to the business development, entrepreneurship, careers, investing, science, patents and regulations. Matters on joint cooperation, legal aspects and corporate policy on product development and finance as well as the corporate culture, marketing and entrepreneurship are also discussed.

References

Austin, M. 2008. *Business Development For The Biotechnology and Pharmaceutical Industry.* London: Gower Publishing Limited.

Chiesa, V. & Chiaroni, D. 2005. *Industrial Clusters in Biotechnology: Driving Forces, Development Processes and Management Practices.* London: Imperial College Press.

Cohen, J.I. 2000. *Managing Agricultural Biotechnology: Addressing Research Program Needs and Policy Implications (Biotechnology in Agricultural Series, No.23).* New York: CAB International.

Friedman, Y. 2006. *Building Biotechnology: Starting, Managing, and Understanding Biotechnology Companies - Business Development, Entrepreneurship, Careers, Investing, Science, Patents and Regulations.* Washington: Logos Press.

Friedman, Y. 2008. *Best Practices in Biotechnology Business Development: Valuation, Licensing, Cash Flow, Pharmacoeconomics, Market Selection, Communication, and Intellectual Property.* Washington: Logos Press.

STBP6262 Bioinformatics

This course is aimed to introduce students on how to access the data archives of genomes and proteins, the tools that have been developed to work with these archives, and the questions that these data and tools can answer. The students are

required to have knowledge in molecular biology and able to use a computer. This course will train students to conduct bioinformatics analysis.

References

Baxevanis, A.D. & Ouellette, B.F.F. 2005. *Bioinformatics: A Practical Guide To The Analysis of Genes and Proteins.* New Jersey: John Wiley & Sons, Inc., Hoboken,

Brown, T.A. 2002. *Genomes*. 2nd. Ed. USA: John Wiley & Sons, Inc. www.ncbi.nlm.nih.gov/books.

Higgs, P.G. & Attwood, T.K. 2005. *Bioinformatics and Molecular Evolution*. Oxford: Blackwell Science.

Lesk, A.M. 2008. *Introduction to Bioinformatics.* New York: Oxford University Press Inc.

Nei, M. & Kumar, S. 2000. *Molecular Evolution and Phylogenetics*. Oxford: Oxford University Press.

STBP6342 Bioprocess Technology

This course discusses the culturing of microbes to produce biotechnology related products. It combines elements from microbiology, biochemistry and process engineering. This course covers upstream, production and downstream aspects and their impact on the environment. This will involve development assessment and the efficiency of inoculums cells, medium formulation, bioreactor design and operating system, control systems, kinetics and quantitative analysis of growth, scale-up, design of processing plant, bio separation, waste and water treatment and process economics. It also emphasizes new approaches and technologies such as high density culture, production of products and recombinant proteins.

References

El-Mansi, E.M.T., Bryce, C.F.A., Demain, A.L. & Allman, A.R. 2011. *Fermentation Microbiology and Biotechnology*. Florida: CRC Press.

Harrison, R.G., Todd, P.W., Rudge, S.R., & Petridges, D. 2003. Bioseparations Science and engineering. New York: Oxford University Press

McNeil, B. & Harvey, L. 2008. *Practical Fermentation Technology*. Chichester: John Wiley & Sons Ltd.

Mitchell, D.A., Krieger, N. & Berovic, M. 2006. *Solid-state Fermentation Bioreactors: Fundamentals of Design and Operation.* Berlin: Springer-Verlag.

Seader, J.D. & Henley, E.J. 2011. *Separation Process Principles*. 2nd. Ed. New York: John Wiley.

STBP6352 Molecular Phylogeny

The course will discuss concepts in phylogeny analysis based on molecular data with reference to certain examples and comparison to earlier approach. Emphasis will be given to recent molecular methods. Students also have a chance to use several software for analysis.

References

Baxevanis, A. D. & Ouellette, B. F. F. 2005. *Bioinformatics: A Practical Guide To The Analysis of Genes and Proteins.* 3rd Ed. Hoboken, New Jersey: John Wiley & Sons, Inc.

Higgs, P. G. & Attwood, T. K. 2005. *Bioinformatics and Molecular Evolution.* Oxford: Blackwell Science.

Keller, E. F. 2002. *The Century of the Gene*. Cambridge: Harvard University Press.

Lesk, A. M. 2008. *Introduction to Genomics*. Oxford: Oxford University Press.
Nei, M. & Kumar, S. 2000. *Molecular Evolution and Phylogenetics*. Oxford: Oxford University Press.

STBP6362 Signalling and Regulation of Cellular Development

This course discusses cell signaling and its functions in a biological system. Pathways in cell signaling will be discussed. Among the signaling processes which will be covered are the involvements of G-proteins as information transferring proteins, receptors as information receivers and as secondary messengers. Signaling pathways involved in the process of cell development will also be discussed. Growth factors, regulation of gene transcription and their involvement in the cell cycle will also be covered.

References

Alberts B., Johnson, A., Lewis, J., Raff, M., Roberts, K. & Walter, P. 2007. *Molecular Biology of the Cell.* 5h. Ed. New York: Garland Science, Taylor & Francis Group.
Carraway, K.L. & Carraway, C.A.C. (Ed.) 2000. *Cytoskeleton: Signaling and Cell Regulation: Practical Approach.* Oxford: Oxford University Press.
Karp, G. 2009. *Cell and Molecular Biology: Concepts And Experiments.* 6th Ed. New Jersey: John Wiley & Sons.
Krauss G. 2013. *Biochemistry of Signal Transduction & Regulation*. 5th. Ed. Weinheim: Wiley-VCH.
Lewin, B., Krebs J.E., Kilpatrick, S.T. & Goldstein, E.S. 2011. *Lewin's Gene X*. Massachusetts: Jones and Bartlett.

STBP6442 Cancer Cell Biology

This course discusses the fundamentals of cell cycle control and the molecular biology of structure and intracellular function will be covered in the introduction. Discussions will focus on genetic roles, cytogenetic, immunology and hormone induction, environment of carcinogenesis, infection agents and disturbance in signal transduction that cause transformation from normal to cancer cells. Ontogenesis, anti-oncogenes and tumor suppressor genes will also be covered in this course. Malignancy through various molecular metastasis and angiogenesis mechanisms and mode of action for several anticancer agents will be discussed.

References

Baider, L., Cooper, C. L. & De-Nour, A.P. 2000. *Cancer and the Family.* 2nd. Ed. Chichester: John Wiley & Sons.
King, R. J. B. & Mike, W. 2006. *Cancer Biology.* 3rd. Ed. Harlow: Pearson/Prentice Hall.
Mendelsohn, J., Howley, P.M, Israel, M.A, Gray J.W. & Thompson, C.B. 2015. *The Molecular Basis of Cancer*. 4th Ed. Philadelphia: W. B.
Metcalf, T. & Metcalf, G. 2008. *Cancer and Nutrition: Prevention and Treatment*. Detroit: Thomson / Gale.
Missailidis, S. 2007. *The Cancer Clock.* Chichester : John Wiley & Sons.

STBP6452 Molecular Mechanism of Pathogenicity

This course discusses pathogenic mechanisms that fulfill the microbial needs to cause disease. Among these needs were the adherence to the host surface, invasion into tissue, multiplication within host cells, disruption of the host cell defenses and damage to the host. The pathogenicity mechanisms of pathogens such as viruses, bacteria, protozoa or fungi will be illustrated by examples on virulence factors

mode of action. Discussions will also covers on how these factors acted upon disease pathogenesis.

References

Acheson, A.H. 2011. *Fundamentals of Molecular Virology*. New Jersey: John Wiley & Sons.

Brogden, K.A., Roth, J.A. & Stanton, T.B. 2000. *Virulence Mechanisms of Bacterial Pathogens*. Washington D.C: ASM Press.

Groisman, E. 2001. *Principles of Bacterial Pathogenesis*. London: Academic Press.

Heitman, J., Filler, S.C., Edwards, J.E. & Mitchell, A.P. 2006. *Molecular Principles of Fungal Pathogenesis.* Washington: ASM Press.

Mims, C.A., Nash, A. & Stephen, J. 2001. *Mims' Pathogenesis of Infectious Disease*. 5th Ed. London: Academic Press.

STBP6662 Current Topics and Innovation in Plant Science

This course discusses recent and selected topics in plant science. Emphasize will be given on development, genome organization and processes involved at the cellular level such as signal transduction, senescence and response towards biotic and biotic stress. Discussion also covers several important technologies employed in plant science research. Several important aspects of bio safety and bioethics in plant research will be discussed.

References

Bassett, C.L. 2007. *Regulation of Gene Expression in Plants: The Role of Transcript Structure and Processing.* New York: Springer.

Buchanan, B. B., Gruissem, W. & Jones R.L. 2000. *Biochemistry and Molecular Biology of Plant.* Maryland: American Society of Plant Physiologist.

Inze, D. 2007. *Cell Cycle Control and Plant Development (Annual Plant Reviews).* London: Blackwell Publishing Limited.

Trigiano, R.N. & Gray, D.J. 2007. *Plant Development and Biotechnology*. Florida: CRC Press LLC

Varshney, R.K & Koebner, R.M.D. 2007. *Model Plants and Crops Improvement*. Florida: CRC Press LLC.