1.1.2 DESCRIPTION OF COURSES

CH90 CH9005 Chemical and Biomedical Engineering Research Seminar
Course type: compulsory for all SCBE research students
AUs: 2, Prerequisites: NIL
Scientific research is commonly multi-disciplinary and fast-paced. An active exchange of scientific knowledge between scientists is, therefore, essential in exposing one to a wide range of research areas and in keeping one updated of the development in the related fields. An open exchange of knowledge also helps in initiating new avenues for research and collaboration and in promoting good analytical skills. It is vital for a good scientist to develop the habit of open exchange of information with fellow scientists.

This weekly seminar series held within the department will help in promoting an active environment of information exchange and in culturing the habit of scientific discussion amongst graduate students who will be upcoming scientists. It will also serve as a good training ground for graduate students to develop adequate presentation and communication skills that will be essential in their career.

Division of Bioengineering (BIE)

BG9002 Molecular Biophysics
Course type: BIE Core
AUs: 3, Prerequisites: NIL
This is an advanced course in molecular biophysics. The objective of the course is to provide students with a foundation on the physics of biomolecules, starting from the forces between atoms and molecules. The topics covered in the course include: Structure and physics of biomolecules, polymer physics, entropic elasticity, fibrous proteins and molecular motors, protein thermodynamics, physics and mechanics of plasma membrane, and the mechanics of cell adhesion.

BG9004 Advanced Cell Biology
Course type: BIE Core
AUs: 3, Prerequisites: Molecular and cell biology and Biochemistry
This course is designed for graduate students who have successfully completed an undergraduate course in cell biology. Topics include the principles of cellular organization and function, regulation of the cell cycle, interactions between cells and cellular signaling pathways.

BG9005 Advanced Mathematics for Bioengineering
Course type: BIE Core
AUs: 3, Prerequisites: NIL
The aim of this course is to consolidate students' understanding on selected topics on applied mathematics and to expose them to advanced topics related to bioengineering/ biomedical research. The course will also serve to prepare the students in advanced research as well as providing further training in logical thinking.

BG9103 Bionanotechnology
Course type: BIE Core
AUs: 3, Prerequisites: Cell biology, chemistry, physics
This course aims to provide a deep understanding on the fundamental principles, the core technology and main applications of bionanotechnology for graduate students, and to build up their concepts in nano-scaled design and fabrication for bio-nano systems.

BG9101 Advanced Physical Characterization Methods
Course type: BIE Elective
AUs: 3, Prerequisites: Mainly physics-related subjects such as radiation, waves, quantum theory, optics, electromagnetism and mechanics
The aim of this course is to present the principles underlying physical characterization methods used in biomedical engineering research. At the end of this course, the student will have a basic knowledge in some of the most important physical characterization techniques currently available in bioengineering that enable them to apply in their research.

BG9102 Foundations of Biomechanics
Course type: BIE Elective

AUs: 3, Prerequisites: Undergraduate level Mechanics of Materials
This course provides students with a solid foundation on biomechanics. It will cover fundamental concepts in solid mechanics, including elasticity and viscoelasticity, with emphasis on applications to biological systems.

BG9104 Bioelectrochemistry
Course type: BIE Elective
AUs: 3, Prerequisites: Cell Biology, chemistry, physics
This course covers fundamentals and applications of bioelectrochemistry including electrochemistry basics, bioelectrochemical methods, the membrane electrochemistry chemistry, intra- and inter-cellular signal transduction in neurons, bioelectrochemistry of biomolecules, biosensing device and systems.

BG9105 Molecular Dynamics Modeling of Biological Systems
Course type: BIE Elective
AUs: 3, Prerequisites: NIL
The objective of this course is to introduce to students one of the most powerful methods in quantitatively analyzing biological systems at the molecular level: molecular dynamics simulation, and prepare them to be able to use this powerful tool for their research in bio- and nano-scaled science.

BG9107 Optics in Medical Imaging
Course type: BIE Elective
AUs: 3, Prerequisites: NIL
The objective of this course is to introduce optical imaging principles in comparisons with other already established medical imaging modalities such as X-ray CT and MRI. The students will learn how photon propagation is treated in tissue-like diffuse medium and how the 3D image reconstruction is done using model-based optimization.

BG9110 Systems Biology
Course type: BIE Elective
AUs: 3, Prerequisites: Molecular and cell biology
Systems biology is the coordinated study of biological systems by: investigating the components of cellular networks and their interactions; applying experimental high-throughput and whole-genome technique; and integrating computational methods with experimental efforts. The course is aiming at giving the students basic concepts in systems biology in terms of systems dynamics, system control methods, and system design methods in biological systems.

Division of Chemical and Biomolecular Engineering (CBE)

CH9001 Advanced Transport Phenomena
Course type: CBE core
AUs: 3, Prerequisites: Basic knowledge of fluid mechanics, heat & mass transfer, vector analysis, and differential equations
The objectives of this course are to enhance students' knowledge and understanding of fundamental transport phenomena-fluid mechanics, heat and mass transfer, and to prepare students for future research or project work in this field.

CH9002 Advanced Mathematics in Chemical & Biological Engineering
Course type: CBE core
AUs: 3, Prerequisites: Undergraduate level background knowledge in analytical methods and numerical analysis preferred.
This course is targeted at postgraduate students, who are interested in process modeling and simulation for various chemical and engineering processes. The course covers both analytical and numerical techniques in solving the associated algebraic as well as differential equations. Analytical methods such as eigenvalue-eigenvector and Green's function method, and numerical methods such as finite difference, collocation and finite element methods are discussed. All fundamental concepts are introduced with applications related to chemical and biological engineering using modern software tools.

CH9003 Advanced Reaction Engineering
Course type: CBE core

AUs: 3, Prerequisites: NIL
The objective of this course is to impart and to continue the rigorous study of reaction engineering. In this course, particular emphasis will be given to chemical kinetics and transport systems, design of fluid-fluid and fluid-solid reactors, scale-up and stability of chemical reactors and residence time analysis of heterogeneous chemical reactors.

CH9004 Advanced Chemical Engineering Thermodynamics
Course type: CBE core
AUs: 3, Prerequisites: Undergraduate level background knowledge in fundamental thermodynamics preferred
This course is targeted at students who are interested in Fundamentals of thermodynamics; Review of basic laws on thermodynamics; Thermodynamic properties of fluids and fluid mixtures from equations of state and corresponding state correlations; Molecular thermodynamics: intermolecular forces and potential functions; internal energy and entropy from microscopic viewpoint; Theories of solutions based on excess Gibbs energy; Topics in phase equilibra.

CH9101 Nanotechnology & its Applications
Course type: CBE elective
AUs: 3, Prerequisites: Some background in basic algebra, knowledge of light, heat and force, and molecular structures.
The emergence of nanoscience portends a revolution in technology that will soon impact virtually every faucet of our technological lives. This course lays the ground for students who are interested in the field and sparks their imaginations and challenges them to participate in the advances that will bring nanotechnology's potential to fruition.

CH9102 Cell Therapeutics Engineering
Course type: CBE elective
AUs: 3, Prerequisites: Basic knowledge of molecular and cell biology, algebra
This course introduces students to Tissue Engineering, and covers topics on Tissue Engineering fundamentals, practical Tissue Engineering and case studies. It also provides a forum for discussion on papers in literature and current issues in Tissue Engineering. The objective of this course is to provide students with a good foundation upon which cell and tissue-based therapy can be explored.

CH9103 Downstream Processing in Pharmaceutical Engineering
Course type: CBE elective
AUs: 3, Prerequisites: Mathematics, physics, chemistry or equivalent subjects
The course aims to develop a thorough understanding of the principles and design of key separation processes applied in the pharmaceutical industry, including adsorption and chromatography separations, crystallization and membranes.

CH9104 Formulation & Quality Aspects of Active Pharmaceutical Ingredients Dosage Forms
Course type: CBE elective
AUs: 3, Prerequisites: Mathematics, physics, chemistry or equivalent subjects
The objective of this course is to give an insight in drug formulation and the setting of quality specifications. Thus, this course is devoted to the objectives involved in bringing an active pharmaceutical ingredient into an effective and safe dosage form.

CH9105 Nanotechnology & its Applications in Pharmaceutical Engineering
Course type: CBE elective
AUs: 3, Prerequisites: Mathematics, physics, chemistry or equivalent subjects
This course will provide a comprehensive overview of applications of nanotechnology in pharmaceutical industry. After a basic introduction to the field of nanoscience and nanotechnology, various topics that include synthesis methods for production of nanomaterials and their superstructures; properties nanomaterials; drug delivery by nanoparticles; nanosupport materials for heterogeneous catalysis and advanced separation techniques using technology. This course also presents a comprehensive review of the scientific literatures with shining examples which help students understand the nanotechnology's potential to pharmaceutical engineering.