### Kingdom of Saudi Arabia

**The National Commission for Academic Accreditation & Assessment**

## Course Specification

**BCH 452(474): Biomembrane and cell Signaling**

**Course Specification**

*For Guidance on the completion of this template, please refer to of Handbook 2 Internal Quality Assurance Arrangements*

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| Institution King Saud university |
| College/Department College of Science/Biochemistry Department |

A Course Identification and General Information

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| 1. Course title and code: Biomembrane and Cell Signaling, BCH 452 (474) |
| 2. Credit hours 2 (2 +0) |
| 3. Program(s) in which the course is offered.(If general elective available in many programs indicate this rather than list programs) Undergraduate and graduate in biochemistry |
| 4. Name of faculty member responsible for the course |
| 5. Level/year at which this course is offered seventh Level |
| 6. Pre-requisites for this course (if any)  BCH 302 |
| 7. Co-requisites for this course (if any) |
| 8. Location if not on main campus |

B Objectives

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| 1. Summary of the main learning outcomes for students enrolled in the course.     * To understand the general structure and functional properties of natural and synthetic membranes. * To be able to differentiate the basic constituents of the cell membrane with respect to their function. * To be able to critically evaluate the use of various scientific techniques in understanding of the basic membrane structure. * To learn about the various types of transport mechanisms such as energy dependent and energy independent phenomena operating across the membrane. * To be able to understand the basic function of cell membrane of nervous tissues in nerve impulse propagation. * To understand the role of cell membrane receptors molecules in signal transduction. * To relate the basic structure of mitochondrial membrane, endoplasmic reticulum membrane and bacterial membrane to their respective functions. * To understand the structure of cell membranes of rod and cone cells and know how does it help in prorogation of vision. |
| 2. Briefly describe any plans for developing and improving the course that are being implemented. (eg increased use of IT or web based reference material, changes in content as a result of new research in the field)  - Power point presentations are sometimes used specially to show models and mechanisms of transport in this course. |

C. Course Description (Note: General description in the form to be used for the Bulletin or Handbook should be attached)

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| 1 Topics to be Covered | | |
| Topic | No of  Weeks | Contact hours |
| Definition of Membrnology. Composition of biomembranes: Lipids, proteins and carbohydrates. General functions of biomembranes. | 1 | 2 |
| Micelles, liposomes and vesicles, their preparation and applications in drug delivery. Membrane solubilisation with detergents. Visualization of membrane proteins with SDS-PAGE... | .5 | 1 |
| Visualization of membrane proteins with freeze fracture and freeze-etching electron microscopy. Structural and functional asymmetry of membranes with respect to carbohydrates, lipids and proteins. Factors affecting fluidity of membranes.  Diffusion coefficient. Fluid mosaic model. | 1 | 2 |
| Role of cell surface carbohydrates in recognise ion, as receptor of antigens, hormones, toxins, viruses and bacteria. Their role in histocompatability and cell-cell adhecion.Visualization of membrane carbohydrates. | .5 | 1 |
| Diffusion across biomembranes. ficks law. Structural types of channels (pores):a-type, B-barrel,pore forming toxins,ionophores.Functional types of channels(pores):voltage-gated channels e.g.sodium channels,ligand-gated channels e.g.acetylcholine receptor (nicotinic-acetylcholine channel ),c-AMP regulated. | .5 | 1 |
| Gap junctions and nuclear pores.  Transport systems: Energetics of transport systems, G calculation in each type .Passive Transport (facilitated diffusion). | .5 | 1 |
| Kinetic properties.  Examples on passive transport : Glucose transporters (GLUT 1to5),C1-HCO Exchanger(anion exchanger protein)in erythrocyte membrane .. | .5 | 1 |
| .Active transport : Kinetic properties.  Types of active transport :Primary ATPases (Primary active transporters):P transporters (e.g.Na,K-ATPacr) | .5 | 1 |
| ATP binding cassettes (ABC transports) (e.g. cystsis fibrosis transmembrane conductance regulator-chloride transport). Multidrug resistance protein transporter. transporters F transporters. Secondary active transporters (e.g.Na -dependent transport of glucose and amino acids ).To be covered under intestinal brush border. | .5 | 1 |
| Transport of large molecules(Macromolecules)  Types : Exocytosis Endocytosis-pinocytosis and phagocytosis  Types of pinocytosis : Absorptive pinocytosis, characteristics and examples .Fluid phasepinocytosis, charactristics and examples . | .5 | 1 |
| SPECIALIZED MEMBRANES:  Erythrocyte membrane. Isolation.Types and functions of membrane proteins.Cytos;eletal system of the erythrocyte membrane.Microfilaments of the membrane .Transprot of glucose, anions, cations. | .5 | 1 |
| Intestinal brush border membrane. Types and functions of membrane proteins. Transport of glucose with sodium as an example on secondary active transport. Transport of a. acid, transport of bile acids Na+/ K+ antiport. | .5 | 1 |
| Renal Tubular membrane;: membrane s of proximal and distal renal tubules and the functions of each. Reabsorption processes NaCl, H2O, glucose, HCO3- and a. acids. Secretion of H+. Transport of a. acid by γ- glutamyl cycle. | .5 | 1 |
| Membrane of muscle cells: Sarcolemma and sarcoplasmic reticulum and the function of each Ca2+ -ATPase in each. | .5 | 1 |
| Mitochondrial membranes: Outer and inner membranes. The interrelationship among; phosphate transporter (Pi/H+), adenine nucleotide transporter (ADP/ATP), dicarboxylate transporter (Pi/malate) and OH-/ Pi antiporter. The interrelationship among: Ca2+/Na+ antiporter. The interrelationship among : Tricaboxylate transporter (Malate/Citrate); Dicarboxylate transporter (Pi/ malate), malate α-ketoglutarate transporter. The interrelationship among: Monocaboxylate transporter (pyruvate/ OH-) and OH-/Pi antiporter. | .5 | 1 |
| Membranes of nerve tissue: A brief review of CNS anatomy and types , functions of nerve cells. Myellin membrane-structure and function and composition-multiple sclerosis. | 1 | 2 |
| The structure of retina in brief. Red and cone cells. Detailed formation of 11-cis-retinal and rhodopsin from β-carotene. Conformational changes that rhodopsin undergoes after photoactivtion that leads metarhodopsin II (active rhodopsin). Detailed cascade of biochemical reactionms involved in the visual cycle. | 1 | 2 |
| Nerve impulse generation (Action potential generation along an axon). Neurotransmitters. Neurotransmitter-gated ion channel receptors as major signal transduction elememts at neural synapses. | 1 | 2 |
| Model of the mechanism of regulation of synaptic vesicles function by calcium ions and calmodulin kinaseII. Myasthenia gravis. Nerve gases. | .5 | 1 |
| Signal transduction: types (modes) of intrercellular signal transduction. Basic elements of signal transduction pathway at the cellular level. Basic properties of intercellular receptors versus cell surface receptors | 1 | 2 |
| Major classes of cell surface receptors for secreted signalling molecules. Receptor tyrosine kinase in detail. Types and structures of second messenger molecules. | 1 | 2 |
| Bacterial plasma membrane: phosphoenol pyruvate-dependent phosphotransferase system (PTS). Lactose permease (galactoside permease). The interrelationship between the two systems. | .5 | 1 |
| Biosynthesis and assembly of membrane: The synthesis and assembly of lipid components. The ribosomal synthesismembrane insertion, and initial glycosylation of integral membrane proteins via the secretory pathway. Posttranslation processing of proteins (insertion into the plasma membrane, transport to lysozomes or secretion). | .5 | 1 |

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| 2 Course components (total contact hours per semester): | | | | |
| Lecture: 30 | Tutorial: | Practical/Fieldwork/Internship: | Other: | |
| 3. Additional private study/learning hours expected for students per week. (This should be an average: for the semester not a specific requirement in each week)  - At least four to five hours self study per semester. | | | |

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| 4. Development of Learning Outcomes in Domains of Learning  For each of the domains of learning shown below indicate:   * A brief summary of the knowledge or skill the course is intended to develop; * A description of the teaching strategies to be used in the course to develop that knowledge or skill; * The methods of student assessment to be used in the course to evaluate learning outcomes in the domain concerned. |
| a. Knowledge |
| (i) Description of the knowledge to be acquired  - The students should have a sound knowledge of basic structure and function of Biomembrane. Basically this course emphasise the use of various techniques which helped the scientist to elucidate the detailed structure of the membrane the knowledge of fluid mosaic model. In this course it would be emphasised that different types of membrane has different constituents and composition depending on their function. The types of transport mechanisms operating across the membrane will be discussed in detail. The functional; role of different types of membrane such as mitochondrial membrane, ER membrane, bacterial membrane, neuron cell membrane and Rod and Cone cell membrane would be explained in detail. The students must know how the cell membrane is essential for signal transduction through a cascade of events. |
| (ii) Teaching strategies to be used to develop that knowledge  - Lectures with the help of power point and animation for the better understanding of the underlying concepts   * Homework assignments. * Class quizzes to know the learning outcome   .   * Class discussion about the students weaker areas and how to improve their learning     . |
| (iii) Methods of assessment of knowledge acquired   * Two continuous assessment exams. * Class quizzes * Major final exam. * Homework assignments on the selected topics to encourage independent learning skills. |
| b. Cognitive Skills |
| 1. Cognitive skills to be developed  * Identify general structural properties of biomembranes. * Identify functions of membrane lipids, proteins, and carbohydrates. * Identify Passive and active transport of molecules across biomembranes. * Identify flow of information across biomembrans. * Identify Biosynthesis and assembly of membranes and the diseases that could be associated with it. |
| (ii) Teaching strategies to be used to develop these cognitive skills   * Homework assignments. * Discussion in classes. * Seminars and essays about some course topics. * Class quizzes |
| 1. Methods of assessment of students cognitive skills  * Two continuous assessment exams. * Class Quizzes * Home work assignments * final exam. |
| c. Interpersonal Skills and Responsibility |
| (i) Description of the interpersonal skills and capacity to carry responsibility to be developed  - Work independently and as part of a team.   * To submit home work on time and to know how to meet the deadlines for submission of home work assignment * To know time management skills. * To develop self study and research skills on the selected topics related to the course. * Writing skills, how to write a scientific documents with the proper usage of scientific references.   - Mange resources & time. |
| (ii) Teaching strategies to be used to develop these skills and abilities  - Solving doubts in office hours. |
| (iii) Methods of assessment of students interpersonal skills and capacity to carry responsibility  - Checking their homework assignment. |
| d. Communication, Information Technology and Numerical Skills |
| (i) Description of the skills to be developed in this domain. |
| (ii) Teaching strategies to be used to develop these skills |
| (iii) Methods of assessment of students numerical and communication skills |
| e. Psychomotor Skills (if applicable) |
| (i) Description of the psychomotor skills to be developed and the level of performance required  - Not applicable. |
| (ii) Teaching strategies to be used to develop these skills  - Not applicable. |
| (iii) Methods of assessment of students psychomotor skills  - Not applicable. |

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| 5. Schedule of Assessment Tasks for Students During the Semester | | | |
| Assessment | Assessment task (eg. essay, test, group project, examination etc.) | Week due | Proportion of Final Assessment |
| 1 | First continuous assessment exam + home work assighnment |  | 15+ 5 |
| 2 | Second continuous assessment exam + home work assighnment |  | 15+ 5 |
| 3 | Quizzes |  | 10 |
| 4 | Final Exam |  | 50 |
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D. Student Support

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| 1. Arrangements for availability of faculty for individual student consultations and academic advice. (include amount of time faculty are available each week)   * Office hours 6 hours / week. |

##### E Learning Resources

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| 1. Required Text(s)   Harrison. R & Lunt G.G.: Biological Membrances, their structure & function, Halasted, New York, (Latest edition). |
| 2. Essential References  Weissman, G. & R. Claiborne (eds.): Cell membranes: Biochemistry, Cell biology, & Pathology, H.P. Publishing Co., New York, (Latest ed.). |
| 3- Recommended Books and Reference Material (Journals, Reports, etc) (Attach List) |
| 4-.Electronic Materials, Web Sites etc   * Websites on the internet that is relevant to the topics of the course. |
| 5- Other learning material such as computer-based programs/CD, professional standards/regulations     * Multimedia associated with the text book and the relevant |

F. Facilities Required

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| Indicate requirements for the course including size of classrooms and laboratories (ie number of seats in classrooms and laboratories, extent of computer access etc.) |
| 1. Accommodation (Lecture rooms, laboratories, etc.)   * Auditorium of a capacity with 70-80 seats for the lecture format classes. |
| 2. Computing resources   * Computer lab. |
| 3. Other resources (specify --eg. If specific laboratory equipment is required, list requirements or attach list) |

G Course Evaluation and Improvement Processes

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| 1 Strategies for Obtaining Student Feedback on Effectiveness of Teaching   * Course evaluation by student. |
| 2 Other Strategies for Evaluation of Teaching by the Instructor or by the Department   * Peer consultation on teaching. * Departmental council discussion. |
| 3 Processes for Improvement of Teaching   * Conducting workshops given by experts on the teaching and learning methodologies. * Periodical departmental revisions of its method of teaching. |
| 4. Processes for Verifying Standards of Student Achievement (eg. check marking by an independent faculty member of a sample of student work, periodic exchange and remarking of a sample of assignments with a faculty member in another institution)   * Providing samples of all kind of assessment in the departmental course portfolio of each course. * Conducting standard exams. |
| 5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.   * The course material and learning outcomes are periodically reviewed and the changes to be taken are approved in departmental and higher councils. * The head of department and faculty take the responsibility of implanting the proposed changes. |