Curriculum for Integrated MSc – PhD program in Chemical and Molecular Biology

The first year laboratory courses are highlighted.

Semester 1:	Minimum Semester Credit Required : 24 Cumulative Semester Credit Required : 24			
Subject Type	**Subject No**	**Subject Name**	**L-T-P**	**Credit**
Depth	BS41003	BIOPHYSICAL AND BIOCHEMICAL METHODS	3-1-0	4
Depth	BS40005	CARBOHYDRATES AND LIPIDS: STRUCTURE AND FUNCTION	3-0-0	3
Depth	BS40003	NUCLEIC ACIDS: STRUCTURE AND FUNCTION	3-0-0	3
Depth	BS41001	CELL AND DEVELOPMENTAL BIOLOGY	3-1-0	4
Depth	BS41005	COMPUTATIONAL BIOLOGY AND BIOINFORMATICS	3-1-0	4
Depth	BS40009	MOLECULES OF LIFE AND THE FUNDAMENTALS OF LIVING SYSTEMS	2-0-0	2
Depth	BS49001	CHEMICAL BIOLOGY LABORATORY	0-0-6	4
Semester 2:	Minimum Semester Credit Required : 22 Cumulative Semester Credit Required : 46			
Subject Type	**Subject No**	**Subject Name**		**Credit**
Depth	BS41004	ADVANCES IN PROTEIN STRUCTURE AND FUNCTION	3-1-0	4
Depth	BS41002	STRUCTURE DETERMINATION OF BIOMOLECULES	3-1-0	4
Depth	BT60002	RECOMBINANT DNA TECHNOLOGY	3-1-0	4
Depth	BS40004	INFECTION AND IMMUNITY	3-0-0	3
Depth	BS40002	MOLECULAR MICROBIOLOGY	3-0-0	3
Depth	BS49002	CELL BIOLOGY LABORATORY	0-0-3	2
Depth	BT69016	RECOMBINANT DNA TECHNOLOGY LABORATORY	0-0-3	2
Semester 3:	Minimum Semester Credit Required : 21 Cumulative Semester Credit Required : 67			
Subject Type	**Subject No**	**Subject Name**		**Credit**
Depth	BS57001	PROJECT	0-0-18	12
Elective - I				
Elective - II				
Elective - III				
Semester 4:	Minimum Semester Credit Required : 23 Cumulative Semester Credit Required : 90			
Subject Type	**Subject No**	**Subject Name**		**Credit**
Depth	BS57002	PROJECT	0-0-24	16
Depth	BS58004	SEMINAR	0-0-3	2
Depth	BS58002	VIVA VOCE	0-0-0	2
Elective - IV				

List of Electives

List Of Available Subjects For Electives I, II and III			
Subject No	**Subject Name**	**L-T-P**	**Credit**
BS50001	FUNCTIONAL MATERIALS IN BIOLOGY	3-0-0	3
BS50003	PROTEOMICS	3-0-0	3
BS50005	BIOSYNTHESIS OF SECONDARY METABOLITES	3-0-0	3
BS50007	NANOSCALE ENGINEERING OF BIOLOGICAL SYSTEMS	3-0-0	3
BS60001	PHARMACOKINETICS AND PHARMACOGENOMICS	3-0-0	3
BT60003	IMMUNOTECHNOLOGY	3-0-0	3
CY60005	DRUG DESIGN AND DEVELOPMENT	3-0-0	3
CY60019	ELECTROANALYSIS AND SENSOR	3-0-0	3
CY60115	BIOTRANSFORMATION IN ORGANIC CHEMISTRY	3-0-0	3
CY71003	CHEMISTRY OF NATURAL PRODUCTS	3-0-1	4
MM61509	MEMS AND BIOSENSORS	3-0-1	4
MM61511	BIOSTAISTICS	3-0-1	4
AG60091	MODERN GENETICS	3-0-1	4
List Of Available Subjects For Electives IV			
Subject No	**Subject Name**	**L-T-P**	**Credit**
BS50002	DRUG DELIVERY AND GENE THERAPY	3-0-0	3
BS50004	BIOLOGICAL IMAGING: IN VIVO AND IN VITRO	3-0-0	3
BT41022	NEUROPHYSIOLOGY	3-0-1	4
MM60006	STEM CELL BIOLOGY AND THERAPY	3-0-0	3
MM61316	BIOMATERIALS	3-0-1	4
MM72335	CANCER BIOLOGY	3-0-1	4

Course title: Biophysical & Biochemical Methods

Syllabus:

Overview of modern biophysical and biochemical experimental techniques; Spectroscopy theory: Electromagnetic and quantum theory of radiation, wave particle duality, Light matter interaction, Transition dipole moment, Jablonsky diagram, Bear Lambert's Law. Spectroscopy - UV-visible, IR, fluorescence spectroscopy and circular dichroism (CD); Microscopy & Imaging - optical microscopy, confocal fluorescence microscopy, atomic force microscopy; Molecular interaction - fluorescence resonance energy transfer (FRET), surface plasmon resonance (SPR), isothermal titration calorimetry (ITC); Mass Spectrometry. Application in characterization of Bio molecules.

Analytical and preparative chromatographic separation techniques - general concepts, dynamics of zone migration, multi-component adsorption, chromatographic dispersion, linear and non-linear chromatography; liquid chromatographic techniques - size exclusion, ion exchange, affinity and reverse phase chromatography;

Textbooks:

1. Biophysical Techniques (2012) by Iain D. Campbell, Oxford University Press.
2. Interpretation of Mass Spectra (1993) edited by Fred McLafferty, University Science Books.

References:

1. Chromatographic methods (1996) by Braithwaite & Smith, Kluwer publisher

Course title: Carbohydrates & Lipids: Structure & Function

Syllabus:

Carbohydrate – Classification, structure, general properties and functions of polysaccharides and complex carbohydrates; amino sugars, proteoglycans and glycoproteins. Lipids –Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrocides, steroids, bile acids, prostaglandins, lipoamino acids, lipoproteins proteolipids, phosphatidopeptides, lipopolysaccharides.

Metabolism: Carbohydrates –Glycolysis, various forms of fermentations in micro-organisms, citric acid cycle,its function in energy generation and biosynthesis of energy rich bond, pentose phosphate pathway and its regulation. Gluconeogenesis, glycogenesis and glycogenolysis, glyoxylate and Gammaaminobutyrate shunt pathways, Cori cycle, anaplerotic reactions, Entner-Doudoroff pathway, glucuronate pathway. Metabolism of disaccharides. Hormonal regulation of carbohydrate metabolism Energetics of metabolic cycle. Lipids– Introduction, hydrolysis of tri-acylglycerols,α-,β-,ω- oxidation of fatty acids. Oxidation of odd numbered fatty acids – fate of propionate, role of carnitine, degradation of complex lipids. Fatty acid biosynthesis, AcetylCoA carboxylase, fatty acid synthase, ACP structure and function, Lipid biosynthesis, biosynthetic pathway for tri-acylglycerols, phosphoglycerides, sphingomyelin and prostaglandins. Metabolism of cholesterol and its regulation. Energetics of fatty acid cycle.

Textbooks:

1. Lehninger Principles of Biochemistry (2012) Sixth edition, By Nelson & Cox, W.H. Freeman publisher.

References:

1. Essentials of Glycobiology (2009) Second edition, Edited by Ajit Varki et. al., Cold Spring Harbor Laboratory Press.

Course title: Nucleic Acids: Structure And Function

Syllabus:

Historical overview; Structure and properties of RNA and DNA;DNA separation methods, chemical synthesis of DNA; the molecular basis of DNA replication, transcription and their regulation in prokaryotes and eukaryotes; Chromatin structure; DNA repair, excision repair, mismatch repair, post-replication repair, homologous recombination and non-homologous recombination; RNA structure and function; Ribozymes; experimental methods for studying DNA and RNA, recombinant DNA techniques, mutagenesis, protein-nucleic acids interaction.

Textbooks:

1. Lehninger Principles of Biochemistry (2012) Sixth edition, By Nelson & Cox, W.H. Freeman publisher.

References:

2. Nucleic Acids in Chemistry and Biology (2006) Third Edition, by G. Michael Blackburn, Royal Society of Chemistry Publishing.

Course title: Cell and Developmental Biology

Syllabus:

Prokaryotic and eukaryotic cell organizations; intracellular compartments and transport: membrane bound organelles, protein sorting, and vesicular transport, secretory pathways, endocytosis pathways, phagocytosis and pinocytosis; cell communication: general principles of cell signaling, G-protein linked receptors and enzyme linked receptors; cytoskeleton: intermediate filaments, microtubules, and actin filaments, microtubule polymerization dynamics, dynamic instability and treadmilling, actin polymerization dynamics, cell crawling, contractile structures, actomyosin complex, muscle contraction, neurons, axons, dendrites, growth cone, inward transport and outward transport; motor proteins; the structure of eukaryotic chromosome; Overview of the cell cycle, mitosis, meiosis, and cytokinesis, animal cells and yeast cells division; cell cycle control: cell cycle check point, metaphase/anaphase transition, control of cell numbers in multi-cellular organisms and programmed cell death, cancer, anti-mitotic drugs; cytoskeletal diseases: microtubule dependent drugs and actin targeted drugs.

Life cycle, evolution of pattern formation; Embryonic development – fertilization, early development, genetics of axis specification in Drosophila; Later embryonic development – central nervous system, development of the tetrapod limb; Metamorphosis, regeneration and aging.

Textbooks:

1. Lodish et al., Molecular Cell Biology, W.H. Freeman & Company, New York, 2007, 6th edition.
2. Alberts et al., Molecular Biology of the Cell, Garland Publishing, Inc., 2002, 4th ed.

References:

1. Scott F Gilbert, Developmental Biology, Sinauer Associates, 10th ed.

CORE SUBJECTS

Course title: Computational Biology and Bioinformatics

Syllabus:

Vectors and Co-ordinate systems. Differentiation: Introduce change in concentration, length-scale etc. as derivatives. Relate slope and derivative. Integration: Integration as area under a curve. Integrating simple expressions. Use of Integration techniques in biology. Differential Equations: Ordinary/partial differential equations. Fourier transformation. Applications in biology. Stochasticity in biology: Introduction to probability and distribution functions, Gaussian and Poisson distribution, Examples from biology, Stochastic modeling of biopolymers, molecular motors. Descriptive statistics: Measurement scales, continuous and discrete data, Histograms, Mean, variance, standard deviation, Errors, fitting a function to experimental data, linear and non-linear fits.

Biological Databases: Organisation, searching and retrieval of information, accessing global bioinformatics resources using internet links. Introduction to Unix operating system and network communication. Nucleic acids sequence assembly, restriction mapping, finding simple sites and transcriptional signals, coding region identification, RNA secondary structure prediction. Similarity and Homology, dotmatrix methods, dynamic programming methods, scoring systems, multiple sequence alignments, evolutionary relationships, genome analysis. Protein physical properties, structural properties – secondary structure prediction, hydrophobicity patterns, detection of motifs, structural database (PDB). Genome databases, Cambridge structure database, data mining tools and techniques, Structural Bioinformatics, Topics from the current literature will be discussed.

Textbooks:

1. Mathematics for Biological Scientists, M. Aitken, B. Broadhursts, S. Haldky, Garland Science (2009)
2. Physical Biology of the Cell, R Phillips, J Kondev, J. Theriot, Garland Science (2009).
3. Bioinformatics: Tools and Applications by David Edwards, Jason Stajich and David Hansen

References:

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Andreas D. Baxevanis and B.F. Francis Ouellette.

Course title: Molecules of Life and the Fundamentals of Living Systems

Syllabus:

Structures and functions of DNA, RNA and proteins, and the relations between these molecules; DNA replication, transcription and translation; Enzymes; Carbohydrates and glycobiology; Lipids, biological membranes and transport; Principles of metabolic regulation, glycolysis and citric acid cycle. Introduction to cells and genomes; Internal organization of the cell, membrane structure, intracellular compartments and the cytoskeleton; Cell cycle and programmed cell death.

Textbooks:

1. The Molecules of Life (2013) First Edition, by Kuriyan et al., Garland Science publishers.
2. Lehninger Principles of Biochemistry (2012) Sixth edition, By Nelson & Cox, W.H. Freeman publisher

References:

1. Molecular Cell Biology (2013) Seventh Edition, by Lodish et al., Macmillan publishers.

Course title: Chemical Biology Lab

Syllabus:

Synthesis of peptides and assay molecules; Interaction of small molecules with macromolecules by fluorescence, CD, NMR, mass-spectrometry etc.; Small molecule-small molecule interactions; Protein conformation study by CD spectroscopy; Estimation of nucleic acids, amino acids and proteins; Chromatographic methods for protein purification; Liposomes and micelles as delivery vehicles; Synthesis and characterization of nanoparticles and their interaction with biomolecules.

Text Books:

Biophysical Techniques (2012) by Iain D. Campbell, Oxford University Press.

References:

Chromatographic methods (1996) by Braithwaite & Smith, Kluwer publisher.

Course title: Advances in Protein Structure & Function

Syllabus:

Primary, secondary, tertiary and quaternary structures; Motifs, super-secondary structures and fold types; forces that stabilize protein fold, folding pathways; Protein dynamics – timescales of motions, computation and experimental methods to study protein dynamics; intrinsically disordered proteins and their functions.

Directed protein evolution – phage display, cell surface display, cell free display systems; mutagenesis studies; Alternative scaffolds, combinatorial enzyme engineering; Protein engineering using non-canonical amino acids; Knowledge based protein design; Selected case studies.

Textbooks:

1. Introduction to Protein Science: Architecture, Function, and Genomics (2010) by Arthur M Lesk, Oxford University Press.

2. Introduction to Protein Structure (1998) by Branden & Tooze by Garland Publishing.

3. Protein Engineering Handbook. (2006) by Stefan Lutz and Uwe Bornscheuer, Wiley-VCH.

References:

4. Protein Engineering and Design (2010) by Sheldon Park and Jennifer Cochran, CRC Press.

Course title: Structure determination of Biomolecules

Syllabus:

Introduction to quantum spin states; Energy levels and transitions; Basic one-dimensional NMR experiment; Vector model; Product operators; Multi-dimensional NMR experiments; Relaxation; Fourier transformation and data processing; Spectrometer basics; Application to biological problems.

Diffraction theory - waves, interference and complex numbers; Atoms, crystals and reciprocal space; X-ray sources: from generators to synchrotrons; Crystallization, data collection, processing, complications; The phase problem: introduction to phasing methods; Introduction to fitting, refinement and validation.

Textbooks:

1. Understanding NMR Spectroscopy (2010) 2nd edition by James Keeler, Wiler Publishers.

2. Protein NMR Spectroscopy: Principles and Practice, 2nd edition. Cavanagh J, Fairbrother WJ, Palmer AG, Rance M and Skelton JJ ,New York: Academic Press.

3. Biomolecular Crystallography: Principles, Practice, and Application to Structural Biology (2009) by Bernhard Rupp 1st edition, Garland Science.

References:

1. Crystallography made crystal clear (2006) 3rd edition by Gale Rhodes, Elsevier Publishers.

Course title: Recombinant DNA Technology

Syllabus:

Tools of recombinant DNA: restriction endonucleases and other enzymes, plasmid, bacteriophage, cosmid and other vectors. c-DNA and genomic library, Gene isolation, cloning and expression, DNA sequencing, oligonucleotide synthesis, Southern and Northern hybridization, FISH, PCR, RAPD, RFLP, DNA fingerprinting and their applications for diagnosis of disease, site-directed mutagenesis, Gene silencing, Gene transfer technologies, Gene therapy; Molecular basis of genetic diseases, genetic counseling. Functional genomics: DNA chipsand microarray gene screen technology; transgenic animals and gene knockout techniques, cell culture based techniques. Practical: DNA isolation and purification, restriction enzyme analysis, southern hybridization, DNA sequencing, PCR, RAPD, gene cloning, identification of recombinant clone and expression of protein in bacteria and eukaryotic cells.

Course title: Infection & Immunity

Syllabus:

An overview of immune system; Infectious organisms: viruses, bacteria, fungi, protozoa, helminths, prion etc.; Virulence factors and host susceptibility, entry and exit of pathogens; How pathogens escape innate and adaptive immune systems; Control of infectious diseases: vaccination, chemotherapy and public health measures

Viral pathogenicity and antiviral agents; Case studies: HIV, influenza, swine flu etc., and recent viral outbreaks: Zika, Ebola, Chikungunya, bird flu etc.; bacterial diseases (Tuberculosis, Diphtheria, Staphylococcal infection etc) and immunity; Fungal (systemic and opportunistic infections) and protozoal (Malaria, Leishmaniasis etc.) diseases and immunity; Cancer immunology

Textbooks:

1. Janeway's Immunobiology, Author: Kenneth Murphy

2**. Infection and Immunity by John Playfair and Gregory Bancroft, 4th edition, Oxford University Press**

References:

1. Nigel Dimmock *et al*., Introduction to modern virology, John Wiley & Sons

Course title: Molecular Microbiology

Syllabus:

Introduction to molecular microbiology; Health/economic significance of microorganisms; vertical and horizontal transfer of genetic materials in microbes; Transformation, conjugation and transduction; Culture-based and culture-independent molecular detection of microorganisms. Morphology and cellular architectures of microorganisms; Molecular basis of bacterial growth and division; Solute transport in bacteria: ABC transporters, amino acid transport, drug export systems etc.; Microbial interactions: environmental and quorum sensing. Microbe-host interactions. Biofilm formation and its implication, bacterial adhesion to host and pathogenesis; targeting strategies against cell wall biosynthesis, and other fundamental processes of bacteria; Mechanism of antibiotic action and resistance; Multidrug resistance, progress and challenges; Structure, function and virulence of viruses, and others microorganisms including fungus, protozoa and parasites. Comparative and environmental genomics.

Textbooks:

1. Stanier, RY., et al., General Microbiology, 5th ed. Macmillan Press.

2. Atlas, RM., Principles of Microbiology, 2nd ed.,1997, McGraw-Hill

3. Prescott, LM., Microbiology, 6th ed. 2005, McGraw-Hill.

References:

1. Slonczewski JL and Foster JW, Microbiology: An Evolving Science, 3rd ed

Course title: Cell Biology Lab

Syllabus:

Visualization of plant and animal cells using Light microscopy, dehydration and fixation of tissues for microscopic analysis; Staining of Nucleus and visualization of mitotic chromosomes; Cell division and Cell-cell adhesion studies by microscopy and flow-cytometry; Mammalian cell culture techniques, Transfection and subsequent culture of mammalian and insect cells for heterologous expression of proteins

Media preparation and sterilization, Bacterial growth curve (using E. coli strain), Determination of antibiotic sensitivity of selected bacteria, Gram staining- Gram positive and negative staining procedures

Course title: Recombinant DNA Technology Lab

Syllabus:

Extraction and purification of genomic and Plasmic DNA. Restriction enzyme digestion of DNA and analysis by agarose gel electrophoresis. Elution of DNA from agarose gel. Labelling of DNA, Southern blotting. Extraction and analysis of total RNA.. Preparation and transformation of competent cells. Identification of recombinant clones. Polymerase chain reaction, DNA Sequencing.

ELECTIVES – I, II and III for 3rd Semester

Course title: Modern Genetics (AG60091)

Syllabus:

Genetics of inheritance: Mendelian principles and its modifications, genetic recombination. Transposable elements in plants. Outlines of DNA replication, damage and repair. Molecular genetics of gene expression: Plant nuclear genome structure. Outlines of transcription and translation mechanism in eukaryotes. Mechanisms of introns splicing, evolution of introns. RNA editing and guide RNA. Role of special transcription factors in gene expression. Histones and DNA methylation, genome imprinting. Riboswitch-dependent plant gene regulation. RNA interference: early history, cellular mechanism, difference in RNAi mechanisms in plants and animals. Genetic analysis of plant developmental processes.

Course title: Functional Materials in Biology (BS50001)

Syllabus:

Introduction to Biomaterials, Biomineralization, Molecular Self-assembly, Nanomaterials, Synthetic and naturally derived biomaterials, Organic and inorganic polymers, proteins, polysaccharydes, composite biomaterials, nanobiomaterials, Clinical applications, Decellularization, Hydrogels, Tissue engineering, Regenerative medicine, Biodegradable materials.

Textbooks:

1. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons. Biomaterials Science: An Introduction to Materials in Medicine, Academic Press, 2004, USA.

2. J.B. Park and J.D. Bronzino. Biomaterials: Principles and Applications. CRC Press. 2002. ISBN: 0849314917.

3. T. M. Wright, and S. B. Goodman. Implant Wear in Total Joint Replacement: Clinical and Biologic Issues, Material and Design Considerations. American Academy of Orthopaedic Surgeons, 2001.

References:

1. L Ambrosio. Biomedical composites, Woodhead Publishing Limited, UK, 2009

Course title: Proteomics (BS50003)

Syllabus:

Proteomics: a basic overview; Theory of mass spectrometry; Protein/peptide separation techniques; Protein mass spectrometry, Bioinformatics tools; Biological applications including quantitative proteomics; Protein post translational modification; Mapping Protein-protein Interaction; Topology and Network motifs; Hydrogen/deuterium exchange mass spectrometry for high throughput protein structure determination; Identification of protein targets and biomarkers; Protein arrays; Structural genomics and structural proteomics; Two-dimensional gel electrophoresis; Peptide structural characterization by tandem mass spectrometry; Protein identification using computational tools.

Textbooks:

- Proteomics, C. David O'Connor, B. David Hames
- Principles of Proteomics, Richard Twyman
- Proteomics, Timothy Palzkill

References:

- Proteomics: from protein sequence to function, Stephen R. Pennington, M. J. Dunn

Course title: Biosynthesis Of Secondary Metabolites (BS50005)

Syllabus:

Biosynthesis of antibiotics: erythromycin and other polyketides, streptomycin, puromycin, penicillins, cephalosporins, clavulanic acid and tetracycline; biosynthesis of alkaloids, terpenes, flavonoids and lignin.

Textbooks:

- Natural Product Reports 2013, 21-107
- The Chemistry of β-Lactams by Michael I. Page

References:

- Chemical Review, 1997, Issue 7

Course title: Nanoscale Engineering of Biological Systems (BS50007)

Syllabus:

Introduction to Nanotechnology; Nanoparticles and Colloids; Materials Science aspects of nanoparticles and their properties (optical, electronic, etc.); Nanomaterials fabrication and characterization; Classification of nanodevices; Carbon nanotubes: types, properties and synthesis by arc discharge, laser ablation, chemical vapor deposition techniques. MEMS & NEMS: MEMS fabrication and limitations, Introduction to NEMS-fabrication processes and applications. Nanomedicine: Medical use of Nanomaterials; Targeted drug delivery systems; Cancer treatment; Applications of Nanomaterials in Medical imaging. Bio molecular nanotechnology: Nanorobots and their application; Nano-bio sensors (including DNA and protein sensors; glucose sensors); Nanoparticles for gene delivery systems; Optical biosensors and their application.

Textbooks:

1. N. Malsch, Biomedical nanotechnology, CRC press

References:

1. R. A. Freitas Jr., Nanotechnology: Science, Innovation, and Opportunity, Nanomedicine: Basic Capabilities, Vol. 1, American Scientific Publishers, 1999.

Course title: Pharmacokinetics And Pharmacogenomics (BS60001)

Syllabus:

Course title: Immunotechnology (BT60003)

Syllabus:

Characteristics of animal cells and their implication on process design Nutritional requirements and serum free culture of mammalian cells Kinetics of growth and product formation. Reactor systems for large-scale production using animal cells. Production of Polyclonal antibodies with different types of antigens: antigen preparation and modification, adjuvants does and rute of antigen administration, collection of sera, purification of antibodies. Hybridoma technology – production and applications of monoclonal antibodies for diagnosis and therapy. Production of virus vaccines, specific vaccines. Production of cellular chemicals like Interferons, Interleukin etc. Immunoassay procedures.

Course title: Drug Design and Development (CY60005)

Syllabus:

Approaches to Drug Design: Enzyme Inhibition, Molecular Recognition, Receptor Based Molecular Modelling, QSAR, Agonist and Antagonist. Examples of Designed Drugs: Antihypertensive, Antiviral, Anticancer and Antibiotic. Combinatorial Library and Highthrouput Screening.

Course title: Electroanalysis and Sensor (CY60019)

Syllabus:

Approaches to Drug Design: Enzyme Inhibition, Molecular Recognition, Receptor Based Molecular Modelling, QSAR, Agonist and Antagonist. Examples of Designed Drugs: Antihypertensive, Antiviral, Anticancer and Antibiotic. Combinatorial Library and Highthrouput Screening.

Course title: Biotransformation In Organic Chemistry (CY60115)

Syllabus:

Prerequisite : CY30103General methods for new biocatalyst discovery; Screening and assay methods; Isolation, purification and immobilization techniques; Classification and nomenclature (IUBMB); Catalytic role of enzymes (enzyme kinetics and various kinds of inhibition); Potentials and limitations; Enzymes in functional

group transformation; White biotechnology; Few industrial process using enzymes for production of drugs, fine chemicals and chiral intermediates; Combinatorial biocatalysis; Bio-mimetic catalysts (catalytic antibodies, artificial enzymes, molecular imprinted polymeric catalyst) and their applications; DNA and RNA based catalysis; Recombinant DNA technology in enzyme engineering.Books: Enzyme catalysis in organic synthesis (Vol I-III); Eds by K. Drauz and H. Waldmann. Willey-VCH; Biotransformations in organic chemistry. K. Faber . Springer.

Course title: Chemistry of Natural Products (CY71003)

Syllabus:

Course title: Mems and Biosensors (MM61509)

Syllabus:

Fundamental of MEMS: Introduction to MEMS principles and fabrication technologies, fundamental of MEMS structures, MEMS materials, MEMS design, fabrication, packaging, Fundamental mechanical, electrical, optical, biochemical and fluidic characteristics of the basic microstructures. Bio-MEMS for clinical detection: Fundamentals of micro and nano fabrication of biochips and lab-on-a-chips, molecular recognition and bio-immobilization principles and procedures, on-chip biochemical detection methods, introduction to micro/nano fluidics, basic components of lab-on-a-chips and its integration. Biosensors and Biochips: Fundamentals of biosensors, fundamentals of electrochemistry and electrochemical biosensors, micro-fluidic devices and systems, MEMS sensors and actuators for medical instrumentation and fundamental of bioelectronics for bio-signal conditioning and processing.

Course title: Biostatistics (MM61511)

Syllabus:

Measurements and descriptive statistics in medical research and practice: Data types and scales of measurement: continuous vs. enumeration data, Sampling distributions - normal distribution (continuous data), binomial distribution (proportions, based on enumeration data), Measures of central tendency-mean, median, mode Measures of variability-standard deviation and standard error, Probability and odds Confidence limits on the mean Disease incidence and prevalence, Sensitivity, specificity, positive and negative predictive values Risk measures-relative risk, attributable risk, odds ratios, risk factors, Survival curves. Sampling : Concept of a source population, Random sampling, Estimation of population statistics, Standard error of a sample mean and of a proportion, and their differences, Confidence intervals Regression and Correlation: Simple, Partial and Multiple Correlation, Simple Linear / Nonlinear Regression, Logistic Regression for dichotomous variable.Statistical Inference and Hypothesis Testing: Hypothesis generation, Null hypothesis, Type I and II errors, Statistical Power, Interpretation of P-values and confidence intervals, Statistical and clinical significance. Comparing 2 or more groups: Comparing means of two populations with the t-test (continuous data), Comparing proportions of responders in two populations (enumeration data), Chi square with corrections (goodness of fit, test of independence). One - Way ANOVA: Ftest,Treatments and Factors.

ELECTIVE – IV for 4th Semester

Course title: Drug Delivery and Gene Therapy (BS50002)

Syllabus:

Introduction to drug delivery; Drug delivery: the basic concepts/principles; Polymers in controlled drug delivery; Controlled drug delivery systems; Traditional oral drug delivery; Nanotechnology in drug delivery; Implant drug delivery; Transdermal drug delivery; Nasal and pulmonary drug delivery.

Human Disease Targeted for Gene therapy, Antigene and Antisense Therapy, Vector and other Delivery Systems for Gene therapy, Viruses as vector, on viral DNA Delivery systems, Synthetic particles and nanotechnology for drug Targeting and Gene therapy, *Ex vivo* vs *In vivo* Gene Therapy. Genetically modified stem cells in experimental gene therapy.

Textbooks:

1. Drug Delivery Systems by Vasant V. Ranade; John B. Cannon CRC Press.
2. Molecular Biotechnology: Principles and Applications of Recombinant DNA: Bernard R Glick & Jack Pasternak

References:

1. Controlled Drug Delivery: Fundamentals and Applications, Joseph Robinson, Vincent H. L. Lee Taylor & Francis

Course title: Biological Imaging: In Vivo and In Vitro (BS50004)

Syllabus:

Introduction to biological imaging: Biostructures of interest in Biological Imaging (BI): Cells and Tissues, Information molecules and other biomolecules of interest in BI, Implication of molecular imaging in structural and functional characterization of biological object.
Imaging techniques: Fundamentals of macro and micro imaging, Optical properties of cell, tissues and molecules, Interference, diffraction, polarization, birefringence phenomena, Luminescence, Basics of fluorescence and their labeling procedure to acquire biological signals, fluorophores, chromophores, Molecular probes, contrast agents in molecular imaging.
Macro-imaging: Basics and techniques of X-ray, CT, USG, PET, MRI, X-ray fluoroscopy, digital X-ray, Micro-bubble enhanced USG, Plasmon Resonance Spectroscopy, PET-CT, basic biological properties of fMRI signal, Applications of molecular imaging in Biomedical and Biomaterial Sciences.
Micro-imaging: Basics of light microscopy (compound microscope, polarization, DIC & Phase contrast) imaging systems and its applications in biology, Auto-fluorescence Imaging, Detector of flurescence microscopy, Cellular Response to Laser Radiation in Fluorescence Microscopes, IR- Thermography, Optical Coherence Tomography (OCT), Laser scanning Confocal Microscopy and its applications to living cells and tissues, Atomic Force Microscopy and its use for elastography, ESEM and EDAX,

Introduction Raman spectroscopy, Fusion imaging techniques: Raman-OCT, Raman-confocal, Laser Doppler imaging.

Textbooks:

1. Bioimaging, Authors: Douglas E Chandler and Robert W Roberson, Publisher: Jones and Bartlett
2. PET: Molecular imaging and its biological applications, Author: Michael E. Phelps, Publisher: Springer.
3. Functional Magnetic Resonance Imaging, Authors: Scott A. Huettel, Allen W. Song, Gregory Mccarthy, Publisher: Sinauer Associates Inc

References:

1. Methods in cellular imaging, Author: Periasamy Ammasi

Course title: Neurophysiology (BT41022)

Syllabus:

Nerve-Muscle Physiology: Neuron structure and function; Regeneration of nerve;;Axoplasmic flow and transport mechanism in the axons; Nature of nerve fibre excitation and interpretation of action potential; Significance of different nerve fibre types. Structural architecture of Neuro-Muscular Junction (NMJ); Neuro-muscular transmission - Electrical and Biochemical events; Drugs acting at NMJ. Protein components and contraction mechanism of muscles. B. Nervous System: Interpretative function of cerebral cortex. Aging and its effect on brain, Regulatory function of cerebellum and structure activity relationship (neural circuitory) of cerebellum, Vestibular apparatus, hypothalamus and its functions, basal ganglia, thalamo cortical projections. Non-specific sensory mechanism- Sleep and wakefulness. Behavioral functions of the brain - emotion, memory, learning and consciousness, Pharmacology and chemical transmission autonomic nervous system. C. Special Sense: Sensory modalities, Sensory receptors, Sensory circuits, and Sensory perception. Taste system, Olfactory system, Visual Sense and Auditory Senses.

Course title: Stem Cell Biology and Therapy (MM60006)

Syllabus:

Course title: Biomaterials (MM61316)

Syllabus:

Introduction to Materials, General structure and properties. Classification of common materials and applications. Chemical Bonding, Crystalline, Amorphous. Melting, Solidification, Nucleation, Phase diagrams. Metal and alloys in Medical application: Stainless steel, cobalt based alloys, titanium based alloys (including

shape memory alloys). Ceramics and glasses-bioceramics: Type of Ceramics and their classification, Calcinations, Annealing, Sintering, Nearly inert ceramics, bio-reactive glasses and glass ceramics, Calcium phosphate ceramics. Introductions to polymers: Definition, classification, Polymerization. Rubber, plastics, fibers and resins and structure-properties relationship. Biodegradable polymers; Natural polymers, Composites, Pyrolitic carbon, Carbon nano tubes. Bulk Proper, Surface properties and modification of surface properties. Basic principles of engineering manufacturing, methods and applications of common manufacturing processes, milling, grinding, finishing, rolling, forging, Concept of biomimetic synthesis, Preparation of fiber and wire, Fabrication of Porous Materials, Direct moulding Technique, Different advanced fabrication technique.

Course title: Cancer Biology (MM72335)

Syllabus:

Oncogenes and cancer, tumor suppressor genes, growth factors and signal transduction, signal transduction mechanism, cell cycle and apoptosis, angiogenesis, different important bio-markers and targets for targeting cancer e.g.: epidermal growth factors and its receptors, vascular epidermal growth factor and its receptors, PI3-K and AKT and others, different compounds for cancer therapy, monoclonal antibodies, small tyrosine kinase inhibitors and others. Combination therapy with antibody or small tyrosine kinase inhibitors in combination with chemotherapeutics drugs alone or with radiation. Ionizing radiation: a genetic switch for cancer therapy.