Master of Science (M.Sc.) Biomedical Sciences

(Four Semester Course)
Two Year Full Time Program & Examination

SYLLABUS
For the Semester Course Credit System

(CHOICE BASED CREDIT SYSTEM)

Department of Molecular Medicine
School of Interdisciplinary Sciences and Technology
JAMIA HAMDARD

Jamia Hamdard (University) Vision

To provide international quality higher education and undertake cutting-edge research in the fields of social, natural science and technology and particularly promote study of modern and traditional medicine systems, especially Unani-tibb, encompassing a holistic and integrative approach to healthcare and to meet societal education needs of underprivileged Indian communities.

Jamia Hamdard (University) Mission

- To promote and advance the cause of higher education through modern methods of teaching and advanced research in such branches of knowledge as the Jamia Hamdard may continue to develop core-competence for and as may be in consonance with the emerging needs of India in general and underprivileged communities in particular.
- To co-operate, collaborate and associate with national and international organizations and institutions in any part of the world having mission wholly or partly similar to those of Jamia Hamdard and as per the provision of the UGC regulations in place from time to time.
- To provide avenues for higher education leading to excellence and innovations in such Branches of knowledge as may be deemed fit primarily at under-graduate, post-graduate and doctoral levels, fully conforming to the concept and idea of the Jamia Hamdard.

Department of Molecular Medicine (DMM) Vision

To articulate and lead in the evolving areas combining ‘traditional and modern medicine’, to be a major center of discovery in biomedical research and develop into a world-class science and educational research entity within the JH fraternity. Jamia Hamdard-Institute of Molecular Medicine (JH-IMM) was established in Jamia Hamdard in the year of 2016 and the name has been changed into Department of Molecular Medicine (DMM) in the year 2020.

Department of Molecular Medicine (DMM) Mission

- To develop a multi-disciplinary approach via successful collaborations to bridge the gap between basic and clinical or translational sciences in India, since the multidisciplinary interphase research is an unexplored area in our country, with vast unmet demands relevant to the health needs of the population.
- To involve in scientific programs, which try to integrate laboratory and clinical research, with an aim to develop new and innovative therapeutic modalities with an active interest in disease intervention strategies and assay development for diagnostic and therapeutic purposes.
- To inculcate research interests also in traditional Indian medicines (Unani/Ayurvedic) along with marketed or phase III compounds to “repurpose or reposition” for various biological targets using proprietary assays and software.
- To pursue a major educational mission providing state-of-the-art meetings and courses in biomedical research.

COURSE CONTENT of M.Sc. Biomedical Sciences

Course Code	Course Name	Credits	Marks
Semester -I			
MFC 001	Foundation Course 1	4	100
MFC 002	Foundation Course 2	4	100
BMS 101	Biology of The Cell	4	100
BMS 102	Human Health and Pathology	4	100
BMS 103	Laboratory Practicals-1	6	200
		22	**600**
Semester -II			
BMS 201	Fundamentals in Microbial pathogenesis	4	100
BMS 202	Methods in Cell and Molecular Biology	4	100
BMS 203	Principles of Immunology	4	100
BMS 204	Student Seminars or MOOCs course at https://www.mooc.org	4	100
BMS 205	Laboratory Practicals-2	6	200
		22	**600**
Semester -III			

BMS 301	Principles of Human Disease	4	100
BMS 302	Diagnostics and Therapeutic concepts	4	100
BMS 303	Communication and analytical skills or MOOCs course at https://www.mooc.org	4	100
BMS 304	Biomedical Research and Development	4	100
BMS 305	Skill development: Essentials for Independent Researchers	6	200
		22	**600**

Semester – IV

BMS 401	Dissertation & Introduction to Research Project (Anyone from BMS 401A-E) 401A. Vaccinology – (Course Code: BMS 401A) 401B. Drug development – (Course code: BMS 401B) 401C. Diagnostics – (Course code BMS401C) 401D. Clinical research –(Course Code: BMS 401D) 401E. Neurological diseases - (Course Code: BMS 401E)		600
		24	**600**
	Total	**90**	**2400**

Program and courses in detail

THE PROGRAM: M.Sc. BIOMEDICL SCIENCES

Overall Learning Outcome of the Program (Program Outcome [PO]): MSc Biomedical Sciences

Department of Molecular Medicine' (DMM) of the School of Interdisciplinary Sciences and Technology of Jamia Hamdard in the year 2020 initiated a master's program, M.Sc., Biomedical Sciences. This 2-year course is expected to prepare students with multidisciplinary knowledge and hands-on skill sets encompassing basic, clinical and translational Biomedical sciences. This will allow the students to have wider career options in competing for professional opportunities in Biotech, Pharmaceutical and Education (academic) sectors in India and abroad.

The Program Specific Outcomes (PSO) of the program are detailed below

PSO1: Introduction to Biochemistry, Molecular Biology and Biophysics and infection biology with relevance to human diseases
PSO 2: Ability to comprehend the cell organelle, cell membrane, signal transduction, DNA replication and its implications, stem cell biology, cell cycle and its relevance
PSO 3: Introduction to human microbiome, comprehensive understanding of human physiological processes, and human pathology
PSO 4: Ability to understand the basics of techniques to study cells, basics of microscopy, Aseptic techniques and microbial culture methods
PSO 5: Ability to comprehend microbial diversity including Bacteria, viruses, parasites, emerging pathogens) and understanding the fundamentals in microbial pathogenesis
PSO 6: Comprehensive understanding of cell culture methods and techniques/tools involved in molecular biology, genomics, statistics and bioinformatics
PSO 7: Understanding the fundamental concepts and methods used in immunology
PSO 8: Develop skills for effective communication and manuscript preparation
PSO 9: Develop skills and ability to handle the equipment, Demonstrate skills to use modern techniques, tools/ software/ equipment's and analyze and solve problems in biochemistry and molecular biology. Gaining sufficient knowledge about the assays and analyzing data
PSO 10: Understanding of the fundamental concepts of Genetics in Human diseases, Understanding of cancer genetics and concepts in developmental biology
PSO 11: Ability to comprehend the Diagnostics and Therapeutic concepts in Clinical Biochemistry, Medicinal Chemistry, pharmacology and Vaccine Biology
PSO 12: knowledge and application of medical microbiology, and biotechnology, Understanding of safety evaluation and procedures, and statistical methods in biomedical research
PSO 13: Hands-on training and independent research experience
PSO 14: Freedom to choose an elective subject as per CBCS

Mapping of Program Specific Outcomes (PSOs) with the semester courses

Program Specific Outcomes [PSOs]														
Course Name	**PSO 01**	**PSO 02**	**PSO 03**	**PSO 04**	**PSO 05**	**PSO 06**	**PSO 07**	**PSO 08**	**PSO 09**	**PSO 10**	**PSO 11**	**PSO 12**	**PSO 13**	**PSO 14**
MFC 001	+++	++	+	++						+	+			
MFC 002	+++		++	++						+				
BMS 101	+++	+++	++	++						++				
BMS 102	+++		+++	++						+	+			
BMS 103	+++			+++									+++	
BMS 201	+++			++	+++									
BMS 202	+++			++		+++				++				
BMS 203	+++			++			+++			+				
BMS 204								+++						+++
BMS 205	+++			++					+++				+++	
BMS 301	+++			++						+++				
BMS 302	+++			++							+++			
BMS 303	+++			++				+++						+++
BMS 304												+++		
BMS 305	++			++				+++						
BMS 401	+++			++									+++	+++

+++ ‘High-level’ mapping
++ ‘Medium-level’ mapping
+ ‘Low-level’ mapping

Semester wise course outcomes:

Semester-1- [Max marks 600; 24 credits)

Foundation Course: Course Code MFC 001
Credit-4; Maximum Marks 100 [Internal 25 marks; End exam 75 marks]
Total Teaching hours: 60 **Class Type: L/T/P: L=4 credits**

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: Enable students to learn about the fundamentals of Biochemistry
CO2: Enhance basic knowledge on various cellular metabolism process
CO3: Enable to learn about fundamentals of Biotechnology and molecular biology
CO4: Enhance basic knowledge on the molecular biology tools will get towards genetic engineering
CO5: Inform about DNA, RNA and protein in vitro manipulations
CO6: Teach about gene cloning and DNA manipulations
CO7: Teach biosafety and ethics in DNA recombinant techniques
CO8: Educate about enzyme reactions and kinetics

Mapping of Course Outcomes (Cos) with Program Specific Outcomes (POSs)

Course Outcomes	Program Specific Outcomes													
	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05	PSO 06	PSO 07	PSO 08	PSO 09	PSO 010	PSO 011	PSO 012	PSO 013	PSO 014
CO1	+++	+	+								+			
CO2	++	++	+++							+				
CO3	+++	+				+++				++		+	++	
CO4	+++	++		++		++				+			++	
CO5	+++	++		++		++				+	+		++	
CO6	+++			++		++				+	+		++	
CO7	+								+		+	+++		
CO8	+++	+												

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Unit 1: Biochemistry: Macromolecules: Carbohydrates, amino acids, lipids and nucleic acids. Cell and its composition; Overview of Cell organelles and subcellular fractionation; Bioenergetics and Intermediary Metabolism: Glycolysis, TCA cycle, Oxidative

phosphorylation, ATP as energy currency; Intermediary metabolism. Central dogma of life. DNA as genetic material. DNA and RNA structures.

Protein structure and function: Secondary and tertiary structure of protein: a helix, ß sheets, examples of proteins. Types of bonding. Enzymes and Enzyme Kinetics: Substrate, active site, transition state, activation energy, equilibrium constant Km, Vmax, specificity, Michaelis-Menten equation. Reaction Mechanism: Acid-base catalysis and covalent catalysis. Regulation of enzyme activity: Reversible and irreversible inhibition (non-competitive, uncompetitive) and their effects on Km and Vmax, effect of pH, heat, PMSF and other inhibitors.

Unit 2: Basic Biotechnology: Basic concepts in recombinant DNA technology. Concepts of Promoters and replication origin. Mutation and mutagenesis. Genetic Engineering - Essentials of gene manipulation, vectors & enzymes used in recombinant technology. Primer design. Cloning and sub-cloning methods. cDNA and reverse transcription. Detection and identification of cloned DNA sequences. Application and principles of Polymerase Chain Reaction. Mutagenesis – different methods used to generate mutants.

Types of Restriction endonucleases; restriction maps. Enzymes used in genetic engineering such as T4 ligase, S1 nuclease, polynuceotide kinase, mung bean nuclease etc. Vectors - cloning and expression vectors, prokaryotic and eukaryotic cloning vectors, yeast vectors, shuttle vectors, YAC & BAC. Principles of selection of specific cloned DNA - blue white selection, insertional inactivation, antibiotic markers used in prokaryotic and eukaryotic cloning. Application of recombinant DNA technology: DNA fingerprinting, gene therapy, diagnostics. Bio-safety and ethics for recombinant DNA technology.

References

1. Harper's biochemistry by Robert K. Murray and Daryl K. Granner and Peter A. Mayes and Victor W. Rodwell; Ed. 25th; McGraw-Hill; 2000.
2. Biochemistry by Donald Voet and Judith G. Voet; Ed. 3rd; Wiley; 2008.
3. Lehninger principles of biochemistry by David L. Nelson and Michael M. Cox; Ed. 5th; W.H. Freeman, 2004.
4. Gene VIII by Benjamin Lewin Ed.7th; Oxford; 2008.
5. Molecular cell biology by Harvey Lodish and Arnold Berk, Chris A. Kaiser, and Monty Krieger; Ed.6th ; W H Freeman and Company; New York; 2008
6. Cell: a molecular approach by Geoffrey M. Cooper; Ed.3rd; ASM Press; 2004.

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of

Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

1. English shall be the medium of instruction and examination.
2. Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by the University.
3. Each course will carry 100 marks and will have two components: Internal assessment (25 marks) and end of semester examination (75 marks)
4. Internal Assessment 25 marks: a. Attendance = 5 marks; b. Test / Assignments 2x10 = 20 marks; c.
5. End of semester examination 75 marks.
6. During the pandemic year 2020, attendance of 5 marks has been included with the assignments.]

Foundation Course: Course Code MFC 002
Credit-4, Max Marks 100 [Internal 25 marks; End exam 75 marks]
Total teaching hours: 60 **Class Type: L/T/P: L=4 credits**

L/T/P: Lectures/tutorials/practical

The Course Outcomes

CO1: This will enable to learn about Infectious diseases
CO2: To educate on epidemics, pandemics of mainly viruses
CO3: Students will learn about Biophysical and Biochemical Techniques
CO4: Leaning on the preparation of related laboratory reagents
CO5: The knowledge on the equipment used in the biochemical and molecular tools
CO6: Educate on the equipment's operation and applications
CO7: Methods used to study molecular interactions will be learned

Mapping of Course Outcomes (Cos) with Program Specific Outcomes (PSOs)

Course Outcomes	Program Specific Outcomes													
	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05	PSO 06	PSO 07	PSO 08	PSO 09	PSO 010	PSO 011	PSO 012	PSO 013	PSO 014
CO1	+++		+++	+			++				++			
CO2	+++				+++		+				++			
CO3	+++					+++			++		+	+	+++	
CO4				++					+++			+	+++	
CO5						+			+++				+++	
CO6						+++			+++		+		+++	
CO7	+++	+++					+			+	+		++	

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Unit 1: An introduction: Infections, epidemics, pandemics and viruses

History and principles of virology, virus taxonomy, introduction to replication strategies. Virus structure and morphology. Viruses of veterinary importance and zoonotic viruses. Principles of bio-safety, containment facilities, maintenance and handling of laboratory animals and requirements of virological laboratory. Plant and animal viruses propagation.

Bacteriophages, bacteriophage propagation and viroids. Viral epidemics and pandemics. Challenges and solutions to pandemics.

Unit 2: Biophysical and Biochemical Techniques: Solution preparation and concentration calculations – molarity, moles and percentage. pH concepts, buffers, buffer index, and buffer capacity. Cell lysis and tissue homogenization processes – methods, Buffer composition and inhibitors. Extraction and isolation of macromolecules from cells and tissues. Principles of UV/VIS Spectroscopic techniques and applications. Quality check and quantification of biological macromolecules – DNA, RNA and Protein.

Principle of Chromatography, Classification of chromatographic techniques – Ion-exchange, gel filtration (molecular sieve), affinity chromatography, hydrophobic chromatography. HPLC and FPLC methods. Application of chromatography for Protein, and nucleic acid purification. Electrophoresis technique and applications. SDS-PAGE, PAGE, 2D electrophoresis and their applications. Isoelectric point determination.

Methods used to study protein-protein interactions (e.g. co-Immunoprecipitation) and protein-DNA interactions (EMSA and DNA foot-printing). Blotting techniques.

References

1. Medical Microbiology by Geo. Brooks and Karen C. Carroll and Janet Butel and Stephen Morse; Ed. 24th; McGraw-Hill Medical, 2007.

2. Topley and Wilson's Microbiology and Microbial Infections by Leslie Collier and Albert Balows and Max Sussman; Ed. 9th; 6-Volume Set; A Hodder Arnold Publication, 2000.
3. Introduction to Spectroscopy, Pavia DL. Lampson GM 2009.
4. Microscopic techniques in Biotechnology Hoppers M 2003.

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

1. English shall be the medium of instruction and examination.
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3. Each course will carry 100 marks and will have two components: Internal assessment (25 marks) and end of semester examination (75 marks)
4. Internal Assessment 25 marks: a. Attendance = 5 marks; b. Test / Assignments 2x10 = 20 marks; c.
5. End of semester examination 75 marks.
6. During the pandemic year 2020, attendance of 5 marks has been included with the assignments.]

Biology of the Cell: Course Code BMS 101
Credit-4, Max Marks 100 [Internal 25 marks; End exam 75 marks]
Total teaching hours: 60 **Class Type: L/T/P: L=4 credits**

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: This will enable students to learn about cell and its organelle structures
CO2: Students will learn about cellular processes
CO3: Learning process of structure and functions of RNA and DNA
CO4: Learning of gene structures, elements and functional aspects
CO5: Education of cell division and cycle process
CO6: This will enable postgraduate students to learn about signal transduction
CO7: Students will have the opportunity to learn about fundamentals of stem cell biology

Mapping of Course Outcomes (COs) with Program Specific Outcomes (PSOs)

Course Outcomes	Program Specific Outcomes													
	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05	PSO 06	PSO 07	PSO 08	PSO 09	PSO 010	PSO 011	PSO 012	PSO 013	PSO 014
CO1	+	+++		++	+	+			+		+			
CO2	++	+++		++	+	+				+	+			
CO3	+++	+				++				+	+			
CO4	+++	+			++				++					
CO5	++	+++				+++						++		
CO6		+++								+				
CO7		+++								+				

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Unit 1: Cell structure and function: Introduction to the cell: chemical composition, molecular organization, origin and evolution; Prokaryotic and eukaryotic cells; Cell theory and modern cell biology; Mammalian Cell organelles: Membrane biology- chemical composition and its structural plan; Membrane models; Structure of major sub-cellular organelles : endoplasmic reticulum, Golgi body, cytoskeleton, ribosome, mitochondria, and nucleus; Movement of ions and macromolecules across membrane; Protein Trafficking; Methods to study the cell: Visualization of cells, Principles of microscopy, and flow cytometry.

Unit 2: Cellular processes: DNA Replication - replication in prokaryotes and eukaryotes: origin of replication, replication fork, replisome. Enzymes in DNA synthesis, structure, function and mechanisms of action. Transcription and RNA processing – splicing, capping and ploy A tail addition; Protein synthesis – ribosome assembly, t-RNA function, initiation, elongation and termination; Enzymes in post-translational modification; Chromosomes, Chromatin and the nucleosome - Packaging of eukaryotic DNA into chromosome; Nucleosome and Chromatin organization; epigenetic modifications; Gene-structure and Gene-expression; regulation concepts - promoters, enhancers, transcription factors; coding and non-coding genome; Mutation and polymorphism; Cell cycle and Cell division – Regulations and synchronization

Unit 3: Signal Transduction: Signal hypothesis; Cell responses to stimuli, Ligands; Receptor Biology – GPCRs, transporters, ion channels, Growth factors and receptor tyrosine kinases; Proteins and molecules involved in transduction of signal into the cell and from cytoplasm to nucleus; second messengers; soluble receptors; nuclear receptors; feedback loops, signaling cross-talks and converging pathways. Paracrine, autocrine and endocrine actions; Hormone mediated cellular responses.

Unit 4: Stem Cells biology: Stem cells overview – Cell potency and stemness; Stem cell types and precursors - Embryonic stem cells; pluripotent, multipotent and totipotent; Induced- stem cells, Adult stem cells and stem cell niches; Hematopoetic Stem Cells, Neural Stem cells, Muscle and Cardiac Stem Cells; Cell signaling in Cellular Differentiation, and regenerative processes; Differentiating media; growth factors in differentiation; Cell signaling in development; Role of transcription modules and tissue-specific regulations; Stem cells application and Ethics.

References

1. Molecular biology of the cell by Bruce, Alberts and Alexander Johnson and Julian Lewis, and Martin Raff; Ed. 5th Garland Science; 2008.
2. Molecular biology of the cell: the problem book by John Wilson and Tim Hunt; Ed. 5th; Garland Science; 2008.
3. Molecular cell biology by Harvey Lodish and Arnold Berk, Chris A. Kaiser, and Monty Krieger; Ed. 6th ; W H Freeman and Company; New York; 2008.
4. Cell: molecular approach by Geoffrey M. Cooper and Robert E. Hausman; Ed. 4th; ASM Press; 2007.
5. Cell biology by Thomas D. Pollard and William C. Earnshaw; Ed. 2nd; Saunders; 2008.

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

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3. Each course will carry 100 marks and will have two components: Internal assessment (25 marks) and end of semester examination (75 marks)
4. Internal Assessment 25 marks: a. Attendance = 5 marks; b. Test / Assignments 2x10 = 20 marks; c.
5. End of semester examination 75 marks.
6. During the pandemic year 2020, attendance of 5 marks has been included with the assignments.]

Human Health and Pathology: Course Code BMS 102
Credit-4, Max Marks 100 [Internal 25 marks; End exam 75 marks]
Total teaching hours: 60 **Class Type: L/T/P: L=4 credits**

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: This will enable students to have fundamental knowledge of Human Physiological processes
CO2: Learning of detail of nervous, hepatic and gastro-intestinal systems
CO3: Learning and detail of muscular, blood and cardio-vascular systems
CO4: This will enable students to have detailed knowledge of Human Physiological processes
CO5: Learning of Human Pathology
CO6: Learning of Cellular Adaptations, Cell Injury and Cell Death
CO7: Students will gain knowledge of Microbiome

Mapping of Course Outcomes (COs) with Program Specific Outcomes (PSOs)

Course Outcomes	Program Specific Outcomes													
	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05	PSO 06	PSO 07	PSO 08	PSO 09	PSO 010	PSO 011	PSO 012	PSO 013	PSO 014
CO1			+++		+									
CO2			+++	++	+									
CO3			+++	++										
CO4			+++		++									
CO5	++		+++				++				+			
CO6	++	++		+		++								
CO7			+++	++	++									

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Unit 1: Human Physiological process (I): Basic anatomic concepts and structures overview of integrative physiology. **Nervous system**: Overall anatomical features – central and peripheral ; Cellular features of neurons; concept of synapse; neurotransmission; role of non-neuronal cells –astrocytes, oligodendrocytes, glia, microglia, Schwann cells. **Nerve Physiology:** Origin of resting membrane potential and action potential, electrophysiology of ion channels. Structure and function of neuron, conduction of nerve impulse in a neuron, Synapse, its types and synaptic transmission , Neurotransmitters, types and functions **Gastro-**

intestinal (GI) system: General concept of digestive system. Structure and function of GI system. Mechanisms controlling GI system. Enteric Nervous System.

Unit 2: Human Physiological Process (II): Pulmonary system: Breathing and lung mechanics. Homeostasis and gas exchange. Regulation of blood pH. **Cardiovascular system**: Structure and function of heart, cardiac cycle, Basic concepts of electrocardiogram (ECG), circulatory system and hemodynamics, Lymph and lymphatic circulation, blood pressure(causes and factors effecting it). **Blood/lymphatic systems:** Blood components and their functions;Blood groups, ABO system, rhesus system; Overall design of circulatory system - pulmonary and systemic circulation. Clotting factors, extrinsic and intrinsic pathways; Composition and functions of lymph and lymphatic system; **Muscular system**: Types of muscles, Functional anatomy of muscular system, concepts of degeneration and regeneration of muscle, neuromuscular transmission, muscle excitation and contraction,types of contraction and its properties.

Unit 3: Human Pathology: Cellular Adaptations, Cell Injury and Cell Death: Causes and mechanisms of cell injury, reversible and irreversible injury, Necrosis, Apoptosis, subcellular and intracellular response, cellular ageing, cellular adaptations: Hyperplasia, Hypertrophy, Atrophy, Metaplasia. **Acute and Chronic Inflammation**: General features of inflammation: Acute Inflammation Vascular Changes, cellular events, chemical mediators of inflammation. termination of acute inflammation. Outcome and morphological effects of acute inflammation. Chronic Inflammation with examples, Systemic effects of Inflammation. **Tissue Renewal and Repair:** Regeneration and its mechanism. Role of Extracellular Matrix, repair and its types and mechanisms wound healing, healing-scar formation and fibrosis. **Applications of Pathology in understanding diseases:** Diabetes, Asthma, Jaundice. Schizophrenia, Parkinsons – Pathogenesis and Clinical symptoms

Unit -4 Introduction to Microbiome: Composition of the Human Microbiome; Site specific Microbiome classification; Sources of the organisms in humans; modifications of microbiome; Commensals and effect on human health: Role of microbiome in diseases; microbiome and host interactions; The dysbiosis concept of disease and strategies to shift a dysbiotic flora to one compatible with health. Probiotics and Designing an effective probiotic.

References

1. Textbook of medical physiology by Arthur C. Guyton and John E. Hall; Ed.11th; Saunders; 2005.
2. Review of medical physiology by William F. Ganong; Ed. 22nd; McGraw Hill; 2005.
3. Essential medical physiology by Leonard R. Johnson and Ed. 3rd; ELSEVIER; 2003.
4. Principles of anatomy and physiology by Gerard J. Tortora and Bryan Derrickson; Ed.1th; John Wiley; 2006. With (Brief atlas of the skeleton surface anatomy, and selected medical images)
5. Best and Taylor's physiological basis of medical practice by John B. West; 12th; B I Waverly Pvt Ltd.; New Delhi; 1990.
6. Medical Physiology: A cellular and molecular approach by Walter F. Boron and Emile L. Boulpaep; Saunders; 2003.
7. Physiology by Robert M. Berne and Matthew N. Levy; Mosby; 1998.

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

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2. Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by the University.
3. Each course will carry 100 marks and will have two components: Internal assessment (25 marks) and end of semester examination (75 marks)
4. Internal Assessment 25 marks: a. Attendance = 5 marks; b. Test / Assignments 2x10 = 20 marks; c.
5. End of semester examination 75 marks.
6. During the pandemic year 2020, attendance of 5 marks has been included with the assignments.]

Laboratory Practicals-1: Course Code BMS 103
Credit-6, Max Marks 200 [Internal 50 marks; End exam 150 marks]
Total teaching hours: 90 **Class Type: L/T/P: P=6 credits**

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: Hands-on practice of aseptic techniques vis., Culture of parasites, bacteria and viruses and growth curve.
CO2: Learning of Cell viability studies viz., staining of cells with vital and non-vital stains
CO3: Microscopic observation of microbes
CO4: Counting of cells from culture by haemocytometer and cell counter
CO5: Hands-on isolation of DNA/RNA and protein
CO6: Learn to estimate macromolecules from tissues viz., Protein Estimation, DNA/RNA isolation
CO7: Learning of in vivo studies with animals and the route of drug Administration/injection
CO8: Learning of tissue processing, preparation of plasma and serum from blood
CO9: PBMC separation from blood
CO10: Hands-on learning of in silico protein analysis and homology modeling
CO11: Hands-on of 3D structure analysis of proteins and protein docking

Mapping of Course Outcomes (COs) with Program Specific Outcomes (PSOs)

Course Outcomes	Program Specific Outcomes													
	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05	PSO 06	PSO 07	PSO 08	PSO 09	PSO 010	PSO 011	PSO 012	PSO 013	PSO 014
CO1				++	+++									
CO2				+++										
CO3				++					++					
CO4						+++			+					
CO5									++				+++	
CO6	++								+++				+++	
CO7			+						+		+++			
CO8			+								+++	+++		
CO9											++	+++		
CO10						+++							++	
CO11						+++							+	

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Aseptic techniques Microorganism culture: Parasites, Bactria and Viruses and Growth curve, Cell viability studies: staining of cells with vital and non-vital stains; Microscopic observation of microbes; Counting cells by haemocytometer; cell counter; Estimation of macromolecules from tissues, Protein Estimation, DNA/RNA isolation and quantification.
Handling of animals, route of drug administration, tissue processing, preparation of plasma and serum from blood, PBMC separation, biochemical analysis of blood, Measurement of metabolites by TLC, HPLC

References

1. Cell: molecular approach by Geoffrey M. Cooper and Robert E. Hausman; Ed. 4th; ASM Press; 2007.
2. Medical microbiology: a guide to microbial infections: pathogenesis, immunity, laboratory diagnosis and control by David Greenwood and Richard C. B. Slack and John F. Peuthere, ed. 17th Ed. Churchill Livingstone; 2007.
3. Essentials of diagnostic microbiology by Lisa Anne Shimeld and Anne T. Rodgers; Delmar Publishers, 1999.
4. Microscopic techniques in Biotechnology Hoppers M 2003.
5. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology.

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

1. For the practical the End Semester Examination (Practical) 200 marks
2. The system of evaluation shall be as follows: Internal assessment will be broadly based on assignments and tests in the theory component (20 marks/100 marks). These criteria are tentative and could be modified by the faculty members associated with teaching of a paper based on guidelines approved by the academic council.

Semester-II [Max Marks 600; Credit- 24]

Paper 1

Fundamentals in Microbial pathogenesis: Course Code BMS 201
Credit-4, Max Marks 100 [Internal 25 marks; End exam 75 marks]
Total teaching hours: 60 **Class Type: L/T/P: L=4 credits**

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: Enable students to have detailed knowledge of prokaryotic system
CO2: Enable to learn viral pathogens
CO3: Enable to learn bacterial pathogens
CO4: Enable to learn parasitic pathogens
CO5: Students will learn about parasites and diseases
CO6: To facilitate students understand about emerging infectious diseases
CO7: Enable to learn on COVID-19 as a unique example of a pandemic

Mapping of Course Outcomes (COs) with Program Specific Outcomes (PSOs)

Course Outcomes	**Program Specific Outcomes**													
	PSO 01	**PSO 02**	**PSO 03**	**PSO 04**	**PSO 05**	**PSO 06**	**PSO 07**	**PSO 08**	**PSO 09**	**PSO 010**	**PSO 011**	**PSO 012**	**PSO 013**	**PSO 014**
CO1	+++		+++	++	+							+++		
CO2					+++							+++		
CO3			+++	++	+++							+++		
CO4					+++							+++		
CO5	+++				+++							+++		
CO6	++		++		+++							+++		
CO7	+		+++		+++						+	+++		

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Unit 1: Bacteriology: Structure-function relationships of macromolecular complexes and cellular ultrastructure's involved in fundamental microbial processes. Bacterial signaling and sensing: quorum sensing and two component regulatory systems, Bacterial pathogenicity: Mechanisms of bacterial pathogenesis including adherence, invasion, intracellular survival, toxins, host defenses and microbial evasion strategies, Virulence factors in specific infectious diseases. Key examples of infectious diseases relevant to the global population including

emerging diseases, and disease epidemiology. Antimicrobial mode of action and antimicrobial drug resistance, Biofilm initiation and development.

Unit 2: Virology Diversity of viruses and their structure. Molecular mechanisms of viral gene expression and regulation; Pathogenesis and replication of medically important viruses including the Virus dissemination & mechanism of virus transmission in vectors, natural cycle, maintenance of viruses in nature; Viruses and Cancer - mechanisms of virus transformation.

Unit 3: Parasitology: Parasites and pathogenicity, transmission and diversity; Malaria; Leishmaniasis; Amoebiasis; Babesiosis; African Sleeping sickness; Toxoplasmosis; Chagas disease; American trypanosomiasis; Filariasis; Tapeworm; Roundworms; Definitions on parasitic lifestyle. Investigations on worldwide parasitic outbreaks. Protozoa pathogenesis and defences. Host and parasite factors; Veterinary Parasitology; vectors and control; Diagnostics and Treatment; Drugs and Vaccine potentials.

Unit 4: Emerging Infectious diseases: Overview on the origins and pathogens causing emerging and re-emerging infectious diseases; Inter-species transmission; Vector borne infectious disease: dengue fever, Chikungunya, and Japanese Encephalitis. Pandemics - Drifts and shifts in Covid -19, Influenza and Avian flu; Animal to human transmissions (Covid-19, anthrax, brucellosis, bubonic plague, typhus etc) Impact of climate change. Neglected tropical diseases. Impact of corona infection in the population as an example – long term impact in the central nervous system and peripheral tissues. Anticipation and preparedness of a novel pathogen.

References

1. Microbiology by Lansing M. Prescott and John P. Harley and Donald Klein; Ed. 6th; McGraw-Hill Science, 2004.
2. Color ATLAS and textbook of diagnostic microbiology by Elmer W Koneman and Stephen D Allen and William M Janda and Paul C Schreckenberger and Washington C Winn; Ed. 6th; Lippincott Williams & Wilkins, 2005.
3. Medical microbiology: a guide to microbial infections: pathogenesis, immunity, laboratory diagnosis and control by David Greenwood and Richard C. B. Slack and John F. Peuthere, ed. 17th Ed. Churchill Livingstone; 2007.
4. Medical Microbiology by Geo. Brooks and Karen C. Carroll and Janet Butel and Stephen Morse; Ed. 24th; McGraw-Hill Medical, 2007.
5. Topley and Wilson's Microbiology and Microbial Infections by Leslie Collier and Albert Balows and Max Sussman; Ed. 9th; 6-Volume Set; A Hodder Arnold Publication, 2000.
6. Immuno Biology: the immune system in health and disease by Charles A. Janeway and Paul Travers and Mark Walport and Mark J. Shlomchik; 7th Ed; Garland Science;2008.

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of

Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

1. English shall be the medium of instruction and examination.
2. Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by the University.
3. Each course will carry 100 marks and will have two components: Internal assessment (25 marks) and end of semester examination (75 marks)
4. Internal Assessment 25 marks: a. Attendance = 5 marks; b. Test / Assignments 2x10 = 20 marks; c.
5. End of semester examination 75 marks.
6. During the pandemic year 2020, attendance of 5 marks has been included with the assignments.]

Paper 2

Methods in Cell and Molecular Biology: Course Code BMS 202
Credit-4, Max Marks 100 [Internal 25 marks; End exam 75 marks]
Total teaching hours: 60 **Class Type: L/T/P: L=4 credits**

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: Students will learn about Eukaryotic cell culture methods
CO2: Learning of host cell counting, imaging of cells
CO3: Learning of Fluorescence and confocal cell imaging of cells
CO4: Learning of DNA recombinant technology including cre-lox, CRISPR-Cas9, DiCre methods
CO5: Learning of gene expression editing steps, viz, siRNA, RNAi, microRNA.
CO6: Enable students to learn modern Genomic analysis tools including meta genomics
CO7: Learning sequencings of Proteins, RNA and DNA

Mapping of Course Outcomes (COs) with Program Specific Outcomes (PSOs)

Course Outcomes	Program Specific Outcomes													
	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05	PSO 06	PSO 07	PSO 08	PSO 09	PSO 010	PSO 011	PSO 012	PSO 013	PSO 014
CO1	+++	+		++		+++								
CO2	+++			++		+++								
CO3	+++			++		+++								
CO4	+++			++		+++			+++					
CO5	+++			++		+++			+++	+				
CO6	+++			++		+++			++					
CO7	+++			++		+++			+					

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Unit 1: Cell culture Methods: Prokaryotic and Eukaryotic cell culture methods; Types of Media, Composition and Nutrients; in vitro and ex vivo cell cultures; Tissue and primary cell cultures, preservation of cells, cell counting and viability, staining, mycoplasma: detection and control; Developing Cell-based assays and detection techniques; Microscopy and Image

analyses; Inverted, Fluorescence and confocal microscopy and imaging; cell cycle synchronization.

Unit 2: DNA recombinant technology and medical biotechnology: Cloning methods; Protein over-expression vectors - prokaryotic versus eukaryotic systems; Fusion protein expression strategies; Protein over-expression procedures and purification; Cloning strategies for promoter DNA; Concepts of reporter genes and vectors; Homologous, non-homologous, site specific and replicative recombination; Cre-Lox; CRISPR Cas9; DiCRE recombination; Types of gene transfections. Bacterial artificial chromosome engineering, selection genomic mutagenesis by gene-trapping. Tools for protein knock-down by gene-silencing – shRNA design tools, vectors, shRNA cloning and transfection techniques; evaluation of protein knock-down – advantages and disadvantages.

Unit 3: Genomic techniques: DNA, RNA and protein sequencings; shot-gun sequencing; High-throughput genomics techniques (NGS, metagenomics, whole genomics); PCR types: Real-time PCR; quantitative PCR; Multiplex PCR; Nested PCR; RNA inhibition: siRNA; RNAi and microRNA; siRNA versus shRNA; RFLP; RAPD; APPCR; SSR; EST, microarray; SNP genotyping, Chromatin Immunoprecipitation (CHIP) analysis.

Unit 4: Bioinformatics: Data-base search tools, Sequence analysis: pairwise and clustal W sequence alignment; dendrogram analysis; pathway analysis; Secondary structure prediction; homology modelling; protein-protein interaction simulation; plasmid design tools; Primer design tools. Genomics - informatics analysis of NGS and metagenomics data.

References

1. Color ATLAS and textbook of diagnostic microbiology by Elmer W Koneman and Stephen D Allen and William M Janda and Paul C Schreckenberger and Washington C Winn; Ed. 6th; Lippincott Williams & Wilkins, 2005.
2. Essentials of diagnostic microbiology by Lisa Anne Shimeld and Anne T. Rodgers; Delmar Publishers, 1999.
3. Topley and Wilson's Microbiology and Microbial Infections by Leslie Collier and Albert Balows and Max Sussman; Ed. 9th; 6-Volume Set; A Hodder Arnold Publication, 2000.
4. Introduction to Spectroscopy Pavia DL. Lampson GM 2009.
5. Wilson and Walker’s Principles and Techniques of Biochemistry and Molecular Biology.

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

1. English shall be the medium of instruction and examination.
2. Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by the University.
3. Each course will carry 100 marks and will have two components: Internal assessment (25 marks) and end of semester examination (75 marks)
4. Internal Assessment 25 marks: a. Attendance = 5 marks; b. Test / Assignments 2x10 = 20 marks; c.
5. End of semester examination 75 marks.
6. During the pandemic year 2020, attendance of 5 marks has been included with the assignments.]

Paper 3

Biomedical Research and Development: Course Code BMS 203
Credit-4, Max Marks 100 [Internal 25 marks; End exam 75 marks]
Total teaching hours: 60 **Class Type: L/T/P: L=4 credits**

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: Learning to exploit microbial metabolism for medical Biotechnology
CO2: Learning about Pre-clinical Research, Toxicity and safety evaluation
CO3: Knowing cellular responses to toxicants
CO4: To learn fundamentals in statistics
CO5: To apply statistical methods in Biomedical Research including, tests of significance; significance in ratios; analysis of variance; regression analysis etc.,
CO6: To learn about cGLP and cGMP products

Mapping of Course Outcomes (COs) with Program Specific Outcomes (PSOs)

Course Outcomes	Program Specific Outcomes													
	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05	PSO 06	PSO 07	PSO 08	PSO 09	PSO 010	PSO 011	PSO 012	PSO 013	PSO 014
CO1	+++				+++							+++		
CO2	+++											+++		
CO3	+++											+++		
CO4												+++		
CO5	+++								++			+++		
CO6												+++		

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Unit 1: Medical Microbiology and Biotechnology: Diversity and complexity of applications; Biodiversity of fermentations; Microbial metabolism and the assimilation of carbon, nitrogen, and sulphur; Inter-connections between catabolic and biosynthetic pathways; Selection, isolation and construction of useful organisms. Contemporary examples of industrial processes using microbes; Exploitation of microbial metabolism for medical biotechnology purposes.

Unit 2: Pre-clinical Research, Toxicity and safety evaluation: Research models in Biomedicine – Primates, rodents, zebra fish, drosophila and c. elegans; advantages and disadvantages; Pre-clinical models in Biomedical research - mammalian versus primates; Laboratory Animal usage ethics; Regulatory bodies for research using animal models; Alternative to animal models; Toxicity and Safety - Overview**;** Types of toxicants; Environmental toxicants – elemental and pathogenic source; Cellular responses to toxicants; Drug/NCE toxicity: Drug interactions, Drug/NCE Toxicity evaluation and safety assessment;

Unit 3: Statistical methods in Biomedical Research: Fundamental of Statistics - Arithmetic mean, median, mode: theory and simple numerical problem; Measures of variation: standard deviation, variance, coefficient of variation; Correlation, types and methods: simple, multiple, linear and nonlinear correlation, spearman's correlation, rank correlation; Regression: linear and curvilinear regression (for two variable X and Y only), Regression lines by least square method; regression equations of X on Y and Y on X only; Sample size; Power of study.

Tests of significance - Null hypothesis; Standard error; Level of significance; Degrees of freedom; Significance of mean for large samples; Significance in means for small samples (students t-test); Significance in ratio of two samples; F test (for difference between variance of two samples); Chi square test; Analysis of variance test (ANOVA) for one and two way classification; Signed rank test; Dunnet's test; Applications of various online tools: SPSS, Minitab, XLSTAT etc.

Unit 4: cGLP and cGMP products; Biosafety procedures; BSL laboratory types; Clinical trials, Intellectual property rights, Regulatory bodies and regulatory procedures; Major professional scientific organizations and research funding mechanisms; Ethics in research; Record keeping; SOPs; Major scientific journals and journal impact factors; Literature survey

References

1. Basic statistics by A. L. Nagar and R. K. Das; 2nd Ed.; Oxford; 2002.
2. Biostatistics: a manual of statistical methods for use in health, nutrition and anthropology by K. Visweswara Rao; Jaypee Borthers, 1996.
3. Introductory statistics by Prem S. Mann; 5th Ed.; John Wiley; 2003.
4. Biostatistics: a foundation for analysis in the health sciences by Wayne W. Daniel; 8th Ed.; John Wiley; 2005.
5. Cellular and molecular immunology by Abul K. Abbas and Andrew H. Lichtman and Shiv Pillai; Ed. 6th; Saunders, 2007.
6. Medical microbiology: a guide to microbial infections: pathogenesis, immunity, laboratory diagnosis and control by David Greenwood and Richard C. B. Slack and John F. Peuthere, ed. 17th Ed. Churchill Livingstone; 2007.
7. Medical Microbiology by Geo. Brooks and Karen C. Carroll and Janet Butel and Stephen Morse; Ed. 24th; McGraw-Hill Medical, 2007.

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

1. English shall be the medium of instruction and examination.
2. Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by the University.
3. Each course will carry 100 marks and will have two components: Internal assessment (25 marks) and end of semester examination (75 marks)
4. Internal Assessment 25 marks: a. Attendance = 5 marks; b. Test / Assignments 2x10 = 20 marks; c.
5. End of semester examination 75 marks.
6. During the pandemic year 2020, attendance of 5 marks has been included with the assignments.]

Paper 4

Seminar presentation by students: Course Code BMS 204
Credit-4, Max Marks 100 [Internal 25 marks; End exam 75 marks]
Total teaching hours: 60 (CBCS) **Class Type: L/T/P: T=4 credits**

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: Enable students to develop skills for effective communication
CO2: Enable students to develop skills for data presentation
CO3: Enable students to develop skills for presenting journal articles
CO4: Enable students to get rid off-stage fear
CO5: Enable students to know effective preparation of powerpoint slides

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs)

Course Outcomes	Program Specific Outcomes													
	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05	PSO 06	PSO 07	PSO 08	PSO 09	PSO 010	PSO 011	PSO 012	PSO 013	PSO 014
CO1								+++						+
CO2								+++						+
CO3								+++						+
CO4								+++						+
CO5								+++						+

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

1. English shall be the medium of instruction and examination.

2. Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by the University.
3. Each course will carry 100 marks and will have two components: Internal assessment (25 marks) and end of semester examination (75 marks)
4. Internal Assessment 25 marks: a. Attendance = 5 marks; b. Test / Assignments 2x10 = 20 marks; c.
5. End of semester examination 75 marks.
6. During the pandemic year 2020, attendance of 5 marks has been included with the assignments.]

OR

A MOOC - Max Marks 100; Credits - 4

Any one online course at https://www.mooc.org/

Paper 5

Lab Practical -2: Course Code BMS 205
Credit-6, Max Marks 200 [Internal 50 marks; End exam 150 marks]
Total teaching hours: 90 **Class Type: L/T/P: P=6 credits**

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: Hands on trainings on DNA Cloning methods
CO2: Hands-on on transformation and Transfection techniques in prokaryotic/eukaryotic cells
CO3: Hands on trainings on genomic isolation, Northern blots, Southern blots
CO4: Hands-on on PCR, multiplex PCR, q-PCR and RT-PCR
CO5: Additional techniques to learn could be: clonal selection in microbes; ELISA.
CO6: Macrophage isolation; culture and pathogen infection
CO7: Gaining knowledge on good lab practices, Biosafety levels in cell culture
CO8: Gaining knowledge in fluorescence microscopy; confocal microscopy; flow cytometry

Mapping of Course Outcomes (COs) with Program Specific Outcomes (PSOs)

Course Outcomes	Program Specific Outcomes													
	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05	PSO 06	PSO 07	PSO 08	PSO 09	PSO 010	PSO 011	PSO 012	PSO 013	PSO 014
CO1	+++			++		+			+++					
CO2	+++			++		+			+++					
CO3	+++			++		+			+++					
CO4	+++			++		+			+++					
CO5	+++			++		+			+++					
CO6	+++			++		+			+++					
CO7	+++			++		+			+++					
CO8	+++			++		+			+++					

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

DNA Cloning strategy, transformation and Transfection techniques in mammalian cells, genomic isolation, northern blot, western Blot, PCR, multiplex PCR, nested PCR, Southern blot; q-PCR, realtime-PCR; DNA transfection and clonal selection in microbes; RFLP; RAPD; ELISA; Macrophage isolation; culture and pathogen infection.

Good lab practice, Biosafety levels in cell culture, mass spectroscopy, fluorescence microscopy, confocal microscope, flow cytometry, NMR, Nanoformulation preparation methodologies, Bioinformatics tools, Protein modelling,

References

1. Molecular biology of the cell by Bruce, Alberts and Alexander Johnson and Julian Lewis, and Martin Raff; Ed. 5th Garland Science; 2008.
2. Molecular cell biology by Harvey Lodish and Arnold Berk, Chris A. Kaiser, and Monty Krieger; Ed. 6th ; W H Freeman and Company; New York; 2008.
3. Cell: molecular approach by Geoffrey M. Cooper and Robert E. Hausman; Ed. 4th; ASM Press; 2007.
4. Microscopic techniques in Biotechnology Hoppers M 2003.

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

1. For the practical the End Semester Examination (Practical) 200 marks
2. The system of evaluation shall be as follows: Internal assessment will be broadly based on assignments and tests in the theory component (20 marks/100 marks). These criteria are tentative and could be modified by the faculty members associated with teaching of a paper based on guidelines approved by the academic council.

Semester-III [Max marks 600; 24 credits]

Paper 1

Principles of Human Disease: Course Code BMS 301
Credit-4, Max Marks 100 [Internal 25 marks; End exam 75 marks]
Total teaching hours: 60 **Class Type: L/T/P: L=4 credits**

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: Enable students to understand Concepts in genetics in human diseases
CO2: Learning on Impact of genetic variations in human diseases
CO3: Enable students to develop learn Developmental biology and disease
CO4: This will enable students to have knowledge in Cancer Genetics
CO5: This will enable students to learn medical genetics of non-communicable diseases

Mapping of Course Outcomes (COs) with Program Specific Outcomes (PSOs)

Course Outcomes	**Program Specific Outcomes**													
	PSO 01	**PSO 02**	**PSO 03**	**PSO 04**	**PSO 05**	**PSO 06**	**PSO 07**	**PSO 08**	**PSO 09**	**PSO 010**	**PSO 011**	**PSO 012**	**PSO 013**	**PSO 014**
CO1	+++					++				+++				
CO2	+++									+++				
CO3	+++									+++				
CO4										+++				
CO5										+++				

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Unit 1: Concepts in genetics: Mendelian principles, Inheritance patterns in Human (Sex-linked, Autosomal, Mitochondrial, Unifactorial, Multi-factorial), Linkage and Crossing over, Allelic variation and gene function, Non-Mendelian inheritance, Chromosomal variation in number and structure

Mechanisms of spontaneous and induced mutations; Role of numerical and structural changes of chromosomes, gene mutations, recombination and transposable elements in genetic variation.

Inheritance modes of genetic disorders - autosomal and sex-linked; non-Mendelian inheritance - multifactorial - continuous and discontinuous; twin concordance, family correlation studies. Somatic cell disorders; mitochondrial disorders.

Unit 2: Developmental biology and disease: Developmental Biology - Stages of early animal development. Cleavage: Mechanism, pattern and consequences; Morphogenesis. Axis formation; Cell specification and determination; Germ layer specification and patterning; Neural tube induction. Medical implications of Developmental Biology – Genetic errors of Human development, inborn errors of nuclear RNA processing & translation, identifying the genes for Human developmental anomalies, Teratogenesis – environmental assaults on Human development.

Unit 3: Cancer Genetics: Characteristics of normal cells, benign tumor cells, and malignant tumor cells, Oncogenes, activation of proto-oncogenes, Tumor suppressor genes, control of the cell cycle, control of the integrity of the genome, Tumor Suppressor pathways, mutations in oncogenes and suppressor genes, genetics of sporadic, familial, and hereditary cancers, Inherited Cancer syndromes, genetic testing for cancer syndromes, current and potential roles of gene therapy for cancer,

Unit 4: Medical genetics of non-communicable diseases: Respiratory and cardiovascular genetic diseases; Genetic disease of the immune system; Autoimmune disease; Nutritional and metabolic genetic diseases such as diabetes and obesity; Treatment of genetics diseases using novel therapies.

References

1. Genes by Benjamin Lewin Ed. 7th; Oxford; 2000.
2. Principles of Genetics by Eldon J. Gardner and Michael J. Simmons and D. Peter Snustad; Ed. 8th; John Wiley, 2005.
3. Molecular cell biology by Harvey Lodish and Arnold Berk, Chris A. Kaiser, and Monty Krieger; Ed. 6th; W H Freeman and Company; New York; 2008.
4. Principles of molecular oncology by Miguel H. Bronchud and Others; Humana Press; 2000.

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

1. English shall be the medium of instruction and examination.
2. Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by the University.
3. Each course will carry 100 marks and will have two components: Internal assessment (25 marks) and end of semester examination (75 marks)
4. Internal Assessment 25 marks: a. Attendance = 5 marks; b. Test / Assignments 2x10 = 20 marks; c.
5. End of semester examination 75 marks.
6. During the pandemic year 2020, attendance of 5 marks has been included with the assignments.]

Paper 2

Diagnostics and Therapeutic concepts: Course Code BMS 302
Credit-4, Max Marks 100 [Internal 25 marks; End exam 75 marks]
Total teaching hours: 60 Class Type: L/T/P: L=4 credits

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: This will enable students to understand Clinical Biochemistry and Diagnostics
CO2: Learning on factors influencing diagnostic methods
CO3: This will enable students to learn Vaccine Biology
CO4: This will enable students to have knowledge in Medicinal Chemistry
CO5: This will enable students to learn Systemic Pharmacology
CO6: Learning on novel drug delivery systems

Mapping of Course Outcomes (COs) with Program Specific Outcomes (PSOs)

Course Outcomes	Program Specific Outcomes													
	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05	PSO 06	PSO 07	PSO 08	PSO 09	PSO 010	PSO 011	PSO 012	PSO 013	PSO 014
CO1	+++										+++			
CO2	+++										+++			
CO3	+++										+++			
CO4	+++										+++			
CO5	+++										+++			
CO6	+++										+++			

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Unit 1: Clinical Biochemistry and Diagnostics: Clinical chemistry/biochemistry - concept, definition and scope; Biological samples - types, collection, processing, stability and storage; Serum and serum separator devices; Chemical composition of biological fluids: blood, urine and cerebrospinal fluid; Reference range; Quality assurance; Accuracy and precision; Factors influencing the accuracy of results; Levy-Jennings's chart; Reliability of laboratory methods; Interferents; Biochemical tests in clinical practice: uses of a chemical/biochemical analysis; Criteria for selecting a method for biochemical analysis; Enzymes as diagnostic tool; Advantages and disadvantages of enzyme assays; Isoenzymes and their diagnostic importance; Methods for the detection of isoenzymes; Organ function tests: clinical presentation and diagnosis of the diseases of the liver and kidney; Bilirubin metabolism and hyperbilirubinaemia; Acid base disorders.

Unit 2: Vaccine Biology: history; Vaccine development; Types of vaccines - DNA/RNA, subunit and whole organism vaccines; Killed and live attenuated vaccines; Therapeutic and prolylactic types; Vaccines in current use; Passive and active immunity; childhood vaccines; immunization schedules; vaccines against bioterrorism; Viral vaccines; Bacterial Vaccines; Parasitic vaccines; Cancer vaccines; personalised vaccines; cold- chain management; vaccine administration.

Unit 3: Medicinal Chemistry: Drug design and targeting - Discovery of lead compound, lead modification, conventional drug screening, structural modification, bioisosteres, structure activity relationship, Quantitative structure activity relationships, introduction to molecular modelling and molecular graphics, pharmacophore descriptors

Receptors - Chemical nature of receptors, Neurotransmitters and their receptors, Receptor modulation and mimics, Receptor sites, Drug receptor interactions, active transport, affinity and efficacy, antagonism, partial antagonism, inverse agonism, allosteric binding sites Chirality and receptor binding.

Drug Metabolism - Biotransformations and their mechanisms, Phase I and Phase II metabolism, Oxidation, Reduction, Hydrolysis, Deamination and Conjugation (GSH, Sulfate, Glucuronide and Amino acids), Role of non-specific enzymes: Oxidases, Mono-oxygenases, Di-oxygenases and Peroxidases: Biotransformations illustrated by suitable examples of commonly used drugs, Chirality and drug metabolism. Enzyme Inhibition concepts.

Reversible and irreversible, Adverse drug reactions, Drugs acting on cell wall, Fungal membrane and Nuclear membrane, Drugs inhibiting protein synthesis. Structure-based drug design; rules and strategies, NCEs versus repurpose; analytical tools; Concept & Models for Novel Drug-delivery systems (NDDS): Classification of rate controlled drug delivery systems (DDS), rate programmed release, activation modulated &feedback regulated DDS, effect of system parameters in controlled drug delivery, computation of desired release rate and dose for controlled release DDS, pharmacokinetic design for DDS – intermittent, zero order & first order release.

Unit 4: Systemic Pharmacology: Study of consolidation parameters; Diffusion parameters, Dissolution parameters and Pharmacokinetic parameters; Drug Absorption from the Gastrointestinal Tract: Gastrointestinal tract, Mechanism of drug absorption, Factors affecting drug absorption, pH–partition theory of drug absorption.

Drug interactions: introduction, the effect of protein binding interactions, the effect of tissue-binding interactions, cytochrome p450-based drug interactions, drug interactions linked to transporters.

Application of Pharmacokinetics: Modified-Release Drug Products; Targeted Drug Delivery Systems and Biotechnological Products. Nano Particles & Liposomes: Types, preparation and evaluation the various approaches for development of novel drug delivery systems;

References

1. Biochemistry by Christopher K. Mathews and Kensal E. van Holde and Kevin G. Ahern; Ed. 3rd; Prentice Hall, 1999.
2. Textbook of biochemistry with clinical correlations by Thomas M. Devlin; Ed.6th; Wiley-Liss; 2005.
3. Biochemistry by Jeremy M. Berg and John L. Tymoczko and Lubert-Stryer; Ed. 6th ; W.H. Freeman,

4. Medicinal chemistry: principles and practice by Frank D. King; Ed. 2nd; The Royal Society of Chemistry; 2002.
5. Introduction to medicinal chemistry by Graham L. Patrick; Ed. 3rd; Oxford; 2006.
6. Essentials of diagnostic microbiology by Lisa Anne Shimeld and Anne T. Rodgers; Delmar Publishers, 1999.

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

1. English shall be the medium of instruction and examination.
2. Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by the University.
3. Each course will carry 100 marks and will have two components: Internal assessment (25 marks) and end of semester examination (75 marks)
4. Internal Assessment 25 marks: a. Attendance = 5 marks; b. Test / Assignments 2x10 = 20 marks; c.
5. End of semester examination 75 marks.
6. During the pandemic year 2020, attendance of 5 marks has been included with the assignments.]

Paper 3

Principles of Immunology: Course Code BMS 303
Credit-4, Max Marks 100 [Internal 25 marks; End exam 75 marks]
Total teaching hours: 60 **Class Type: L/T/P: L=4 credits**

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: To learn on Introduction to immune system
CO2: Learning all about T cells, B cells, NK cells
CO3: Learning types of antigens and antibodies
CO4: To learn on Immune defense mechanisms
CO5: To learn about Products and factors produced by immune system
CO6: Leaning of various methods in Immunology

Mapping of Course Outcomes (COs) with Program Specific Outcomes (PSOs)

Course Outcomes	**Program Specific Outcomes**													
	PSO 01	**PSO 02**	**PSO 03**	**PSO 04**	**PSO 05**	**PSO 06**	**PSO 07**	**PSO 08**	**PSO 09**	**PSO 010**	**PSO 011**	**PSO 012**	**PSO 013**	**PSO 014**
CO1	+++						+++							
CO2	+++						+++							
CO3	++						+++							
CO4	++						+++							
CO5	++						+++							
CO6	++						+++							

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Unit 1: Introduction to immune system – Various immune cells; specificity, diversity, innate and acquired immunity; self-versus non-self. Humoral and cell mediated processes; T-Cells: Helper T cells; cytotoxic T cells; memory T cells; regulatory cells; NK cells; Th1; Th2; Th17; ThFH cells; T cell activation; B-cells; T cell dependent; T cell independent; B cell maturation; B cells types: regulatory B cells; memory B cells; Antigens /antibody.

Unit 2:Immune defense; Immune responses to bacteria, virus and parasites; immunotherapy; allergy, Immunodeficiency; Tolerance, autoimmunity and inflammation. Immune booster response Transplantation immunology; tumor immunology; tumor surveillance; immunomodulators and as drugs.

Unit 3: Products and factors produced by immune system; cytokines and chemokines; antibody engineering. Plantibodies; bispecific antibodies; immunity generated against antigens/vaccines; recall response; Th1 and Th2 polarity; Th1 and Th2 balance; central memory and effector memory; T cell memory response; B cell memory response.

Unit4: Methods in Immunology: Immunoprecipitation; Agglutination; Immunofluoresecence; Immunoelectrophoresis; RIA; ELISA: Indirect and Sandwish; ELISPOT assay; Cytotoxicity assay; MTT assay; MLR; Hemolytic plaque assay; Flow Cytometry; Cell sorting; MHC inbred, nude, congenic, syngenic, knockout mice and utility; Hybridoma Technology.

References

1. Kuby Immunology by Thomas Kindt and Richard A. Goldsby and Barbara A. Osborne; Ed. 6th; W.H. Freeman and Company, New York; 2007.
2. Cellular and molecular immunology by Abul K. Abbas and Andrew H. Lichtman and Shiv Pillai; Ed. 6th; Saunders, 2007.
3. Immunology; Ed.7th by David Male and Jonathan Brastoff and David B. Both and Ivan Roitt; Mosby Elsevier; 2006.
4. Immuno biology: the immune system in health and disease by Charles A. Janeway and Paul Travers and Mark Walport and Mark J. Shlomchik; 7th Ed; Garland Science; 2008.
5. Immunology of infection diseases by Stefan H. E. Kaufmann and Alan Sher and Rafi Ahmed; ASM Press, Washington; 2002.
6 Essentials of immunology & serology by Jacqueline H. Stanley; DELMAR; Australia; 2002.

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

1. English shall be the medium of instruction and examination.
2. Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by the University.
3. Each course will carry 100 marks and will have two components: Internal assessment (25 marks) and end of semester examination (75 marks)
4. Internal Assessment 25 marks: a. Attendance = 5 marks; b. Test / Assignments 2x10 = 20 marks; c.
5. End of semester examination 75 marks.
6. During the pandemic year 2020, attendance of 5 marks has been included with the assignments.]

Paper 4

Communication and Manuscript Preparation: Course Code BMS 304
Credit-4, Max Marks 100 [Internal 25 marks; End exam 75 marks]
Total teaching hours: 60 (CBCS) Class Type: L/T/P: T=4 credits

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: Students will learn through SEMINARS (by Students/ Internal faculties/visiting faculties)
CO2: Students will learn through their Journal Article presentation
CO3: Stimulation of critical data evaluation skills
CO4: Students will learn about Manuscript Preparation
CO5: Aspiring young minds towards choice based credit system

Mapping of Course Outcomes (COs) with Program Specific Outcomes (PSOs)

Course Outcomes	Program Specific Outcomes													
	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05	PSO 06	PSO 07	PSO 08	PSO 09	PSO 010	PSO 011	PSO 012	PSO 013	PSO 014
CO1								+++						
CO2								+++						
CO3								+++	++					
CO4								+++						
CO5														+++

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Unit -1: SEMINARS (Students/Internal faculties/visiting faculties);

Unit 2: Journal Article presentation – critical data evaluation skills.

Unit 3: Manuscript Preparation

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of

Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

1. English shall be the medium of instruction and examination.
2. Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by the University.
3. Each course will carry 100 marks and will have two components: Internal assessment (25 marks) and end of semester examination (75 marks)
4. Internal Assessment 25 marks: a. Attendance = 5 marks; b. Test / Assignments 2x10 = 20 marks; c.
5. End of semester examination 75 marks.
6. During the pandemic year 2020, attendance of 5 marks has been included with the assignments.]

OR

A MOOC - Max Marks 100; Credits - 4

Any one online course at https://www.mooc.org/

References

Paper 5

Essentials for Independent Researchers: Course Code BMS 305	
Credit-6, Max Marks 200 [Internal 50 marks; End exam 150 marks]	
Total teaching hours: 90	**Class Type: L/T/P: P :6 credits**

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: Master students in proposal writing: Research Objective ideating skills, work plan organization and Literature survey;
CO2: Engage students in group discussions and scientific debates; poster preparations; teaching skills; Lab organization and Specific assignments/teamwork skills
CO3: Teachings will be on data search online; data submission online (eg., DNA/protein sequence submission); patents and its submissions
CO4: Students will be taught submissions related to FDA, FSSAI, CDSCO, RCGM, IBSC, IEC

Mapping of Course Outcomes (COs) with Program Specific Outcomes (PSOs)

Course Outcomes	**Program Specific Outcomes**													
	PSO 01	**PSO 02**	**PSO 03**	**PSO 04**	**PSO 05**	**PSO 06**	**PSO 07**	**PSO 08**	**PSO 09**	**PSO 010**	**PSO 011**	**PSO 012**	**PSO 013**	**PSO 014**
CO1	++							+++	++				++	
CO2	++							+++	++				++	
CO3	++							+++	+++				+	
CO4	++										+	+++		

+++ 'High-level' mapping
++ 'Medium-level' mapping
+ 'Low-level' mapping

Detailed Syllabus

Proposal Writing: Research Objective ideating skills, work plan organization and Literature survey; Group discussions and Scientific debates; Poster preparations; Teaching skills; Lab organization and Specific assignments/team work skills. ; data search online; data submission online (eg., DNA/protein sequence submission); patents and its submissions; submissions related to FDA, FSSAI, CDSCO, RCGM, IBSC, IEC

References

Notes and SOPs distributed by the teachers.

Teaching-Learning Strategies in brief

The teaching learning strategies, followed are board and chalk teaching, Learning through discussion among the peer group, classroom interaction, discussion of research papers of Journal related to topics, power point presentation, Q & A session and reflective learning, remedial classes, group discussions, assignments students seminars etc

Assessment methods and weightages in brief

1. For the practical the End Semester Examination (Practical) 200 marks
2. The system of evaluation shall be as follows: Internal assessment will be broadly based on assignments and tests in the theory component (20 marks/100 marks). These criteria are tentative and could be modified by the faculty members associated with teaching of a paper based on guidelines approved by the academic council.

Semester – 4 [Max Marks 600; credits 24]

Elective: Dissertation in any one from the options below –Course code BMS 401
Credits – 24 Max Marks 600 [Internal 150 marks; End exam 450 marks]
Total teaching hours- 360 (CBCS) **Class Type: L/T/P: P=24 credits**

L/T/P: Lectures/tutorial/practical

The Course Outcomes

CO1: Hands on training of instruments and techniques in Biomedical Sciences
CO2: Inculcating students to choose dissertation areas in line with their future job aspirations
CO3: Encouraging the students to come up with their own ides in research
CO4: Bringing students in team-based research in laboratories
CO5: Training students to build and maintain laboratory infrastructure
CO6: Training students in their own data presentations

Mapping of Course Outcomes (COs) with Program Specific Outcomes (PSOs)

Course Outcomes	Program Specific Outcomes													
	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05	PSO 06	PSO 07	PSO 08	PSO 09	PSO 010	PSO 011	PSO 012	PSO 013	PSO 014
CO1	+++								+++				+++	
CO2	+												+++	+++
CO3	+													+++
CO4	++ +												+++	
CO5	+												+++	
CO6	+	+	+	+				+++					+	

+++ ‘High-level’ mapping
++ ‘Medium-level’ mapping
+ ‘Low-level’ mapping

Detailed Syllabus

Research projects (Dissertation):

BMS 401A: Vaccinology – Design and development of concept vaccine/vaccines (protein, live, DNA, RNA, antigen, antibody etc based) against infectious diseases; immune prediction due to vaccine administration; experimental, preclinical or clinical aspects in vaccine study; comparisons in vaccines, safety and efficacy (Course Code: BMS 401A)

BMS 401B: Drug development – Design and development of drugs; drug target determination; safety and efficacy studies in vitro, ex vivo and or in vivo studies; drug encapsulations (Course code: BMS 401B)

BMS 401C: Diagnostics – Design and development of diagnostic tools; in vitro and/or clinical validations of drugs; point of care developments; comparison of diagnostic tools (Course code BMS 401C)

BMS 401D: Clinical research – studies on infectious diseases; emerging diseases including COVID-19; Vector research; disease epidemiology; Differentiation and Basis of metastasis (Course Code: BMS 401D)

BMS 401E: Neurological diseases - Neuroprotection& Neurotoxicity, assay development, in vivo and in vitro models; (Course Code: BMS 401E)

References

1. Project related research and review peer reviewed journal articles
2. Laboratory publications and protocols/SOPs
3. References on methods studied in earlier semesters

Teaching-Learning Strategies in brief

For project work the topics shall be given in advance, however, the credits assigned for the project work shall be awarded at the end of fourth semester. For project work, the Head of the Department shall call a meeting of all the teachers of the Department and assign appropriate number of students to each teacher to act as the supervisor for project work. The student in consultation with the supervisor shall select a topic for the project work and inform the Head of the Department.

Assessment methods and weightages in brief

Dissertation will formally begin from end of Semester II and will consist of bench work. Dissertation work will consist of internal evaluation by the concerned Mentor/Supervisor based on general performance, participation in daily activities in the lab, instrument handling, concept development / ability to develop hypothesis/ method protocols through published literature, and student seminar. Research complexity of the dissertation/writing skills (100 marks), Project work (500 marks), presentation and viva-voce (100 marks) - the last two being evaluated by a board comprising of all teachers in the Department and /or external experts.

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