ADAMAS UNIVERSITY

SCHOOL OF LIFE SCIENCE AND BIOTECHNOLOGY

Department of Microbiology

Ph. D. (Microbiology)

(Program Code: MIB6305)

ADAMAS UNIVERSITY, KOLKATA

Department of Microbiology

Ph. D. (Microbiology) Course Structure Total Credit: 14								
SEMESTER - I								
Type of the Paper	**Paper Code**	**Theory / Practical**	**Brief Contents**	**Contact Hour Per Week**	**L**	**T**	**P**	**Credit**
Theory	**RES81101**	**Research Methodology** **Computer Application**		**4**	**4**	**0**	**0**	**4**
Theory	**RPS81101**	**Research and Publication Ethics**		**2**	**2**	**0**	**0**	**2**
Theory	**ECS81101**	**Computer Application**		**4**	**4**	**0**	**0**	**4**
Theory	**MIB31001/** **MIB31002/** **MIB31003/** **MIB31004**	**Principle and Application of Omics Biology/** **Nanobiotechnology/** **Genetics and Epigenetics/** **Antimicrobials and antimicrobial resistance**		**4**	**4**	**0**	**0**	**4**
TOTAL				**14**	**14**	**0**	**0**	**14**

MIB31001	PRINCIPLE AND APPLICATION OF OMICS BIOLOGY	L	T	P	C
Version 1.0	**Contact Hours - 60**	4	0	0	4

Unit I: Genomics and transcriptomics (20 h): Genome mapping- Genetic mapping, Physical mapping, Resolution of mapping. Strategies for Sequencing whole genome and sequence data analysis. Comparative Genomics and GWAS. Global expression profiling: whole genome analysis of mRNA and protein expression, RNA-seq analysis and their applications. Common strategies for functional genomics. Metagenomics: principle and strategies to analyse metagenomic data.

Unit II: Proteomics (15 h): Principle of mass spectroscopy (LC-MS/MS) and spectral processing for identification. IEF, 2D PAGE and DIGE. Analysing post translational modification. Database and search engines in proteomics. Mapping of protein interactions: two hybrid, IP, Pull-down. Data base mining: STRING.

Unit III: Metabolomics (10 h): Sample preparation for targeted and untargeted metabolomics. Data processing using univariate and multivariate statistical analysis. Annotation and confirmation of metabolites. Structural elucidation of new compounds. Inclusion of metabolites into biosynthetic pathways. Using stable isotopes for pathway determination

Unit IV: Applications of omics (15 h): Implementing omics to explore mechanism of pathogenesis, Drug discovery, Disease diagnosis, identification and characterization of novel proteins and deciphering drug resistance mechanisms.

Text/Reference Books:

1. Brown TA. Genomes, Willy
2. Twyman. Priciples of proteomics. Advanced text
3. Saraswathy and Ramalingam, Concepts and Techniques in Genomics and Proteomics, Elsevier
4. Steatehen and Reid. Human molecular genetics. Garland sciences
5. Lesk, Introduction to Genomics, OXFORD

MIB31002	NANOBIOTECHNOLOY	L	T	P	C
Version 1.0	Contact Hours - 60	4	0	0	4

Unit-I:

Introduction to Nanoscience and Nanotechnology (6 h): Overview of nanotechnology developments, different nanostructured materials and properties related to nano-structured surfaces, rules governing the health and safety standards related to use of chemicals and nanomaterials and the physical environment required for working with nanomaterials.

Unit-II:

Nanomaterials Synthesis and Characterization Techniques (22 h): Physical, chemical and mechanical methods of preparation, Microbial production of inorganic nanoparticles, physical characteristics of nano materials and nanostructured surfaces by X-ray diffraction, UV-Vis-NIR, Fourier transform infrared (FTIR) spectroscopy, Photoluminescence, Light Scattering methods, Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM) and Transmission Electron Microscopy (TEM).

Unit-III:

Nanostructured materials (10 h): Choice of nanomaterials in context of a bio nanostructured system for either development or production, Carbon nano tubes and nanowires, nano Silica, quantum dots, nanostructured thin films, composites, magnetic nano particles, DNA-based nanostructures, protein-based nanostructures, polymer nanocontainers, Dendritic nanostructures, gels and drug delivery systems.

Unit-IV:

Application of Nanotechnology (12 h): Nanotechnology for waste reduction and improved energy efficiency, nanotechnology-based water treatment strategies, Nanoporous polymers and their applications in water purification, Nanoparticles in agricultural and food diagnostics, Nanotechnology in food packaging, Nano drug carriers, characteristics, and evaluation of nano-drug carriers, cancer theragnostic with carbon- and silica-based nanoparticle platform, polymer- and protein-based nanotechnologies for cancer theranostics, nano biosensors, Nanotechnology in Tissue Engineering and Regenerative Medicine, nanomedicine patenting systems.

Unit-V:

Nanotoxicology and Biosafety (10 h): Nanoparticles interaction with the biological membrane, uptake and toxicological effects of different nanoparticles.

Mechanisms of nanomaterial toxicity: oxidative stress, hemolytic toxicity, mutagenicity and immunotoxicity.

Assessment of nanomaterial toxicity: *in vitro* and *in vivo* assessment of biocompatibility.

Text Books:

1. Introduction to Nanoscience and Nanotechnology, Gabor. L et al.
2. Fundamentals of Nanotechnology, Hornyak, G. Louis, Tibbals, H. F., Dutta, Joydeep, CRC Press, 2009.
3. Nanomaterials: An introduction to synthesis, properties and application, Dieter Vollath, Wiley-VCH, 2008.
4. The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C.N.R. Rao, A. Muller, A. K. Cheetham (Eds), Wiley-VCH Verlag (2004).
5. Handbook of Nanotoxicology, Nanomedicine and Stem Cell Use in Toxicology. Saura C Sahu, Daniel A Casciano.
6. Nanotoxicology - Interactions of Nanomaterials with Biological Systems. Yuliang Zhao and Hari Singh Nalwa.
7. Biointeractions of Nanomaterials. Vijaykumar B. Sutariya, Yashwant Pathak

MIB31003	GENETICS AND EPIGENETICS	L	T	P	C
Version 1.0	Contact hours-60	4	0	0	4

Unit I: Introduction to cancer biology

Cell cycle regulation, Apoptosis, Mutations in signal molecules, Modulation of cell cycle in carcinogenesis, Hallmarks of Cancer. Different forms of cancers.

Unit II: Mutations; Oncogenes and Tumor suppressor genes

Types of mutations: Nonsense, missense and point mutations; Intragenic and Intergenic suppression; Frameshift mutations; Physical, chemical and biological mutagens; Transposition - Transposable genetic elements in prokaryotes and eukaryotes; Mechanisms of transposition; Role of transposons in mutation; Viral and cellular oncogenes: definition, activation of oncogenes and dominant negative effect, oncogenes as transcriptional activators; Tumor suppressor genes from humans: definition, effector functions, Suppression of tumor suppressor genes in cancer.

Unit III: Principles of molecular cell biology of cancer

Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, detection of Oncogenes, Growth factor and Growth factor receptors that are Oncogenes. Oncogenes / Proto Oncogenes activity. Growth factors related to transformations.

Unit IV: Pathways regulating the process of carcinogenesis

Familial vs sporadic cancer, somatic mutation. Spontaneous mutation

DNA repair and cancer.- case study of colon cancer (HNPCC)/prostate cancer, UV light and xeroderma

Familial cancer- breast cancer case study

Genome stability and checkpoints- p53 as a tumor suppressor, E2F and the cell cycle

Other pathways in cancer- cell death, epigenetics, angiogenesis, telomeres

Multiple mutations and the evolution of metastases.-multiple mutations in cancer, metastasis, EMT pathway

Unit V: Modern study of cancer

Interrogation of carcinogenesis through genome analysis, kinase inhibitors, use of Hela cells, variants of unknown significance

Unit VI: Epigenetics and cancer

Epigenetics and control of gene expression control, Types of epigenetic modifications: DNA methylation, histone modification, acetylation, etc.

Epigenetic Modifications and Organisation of the Nucleus, Role of epigenetics on dosage compensation, gene silencing, Genome imprinting,

Gene silencing, RNA interference, microRNA mediated regulation of gene expression.

Text/Reference Books:

1. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics by Lauren Pecorino, 2016
2. The Biology of Cancer by Robert A. Weinberg, 2006
3. Introduction to the Cellular and Molecular Biology of Cancer by Margaret A. Knowles, 2005

MIB31004	Antimicrobials and Antimicrobial resistance	L	T	P	C
Version 1.0	Contact hours-60	4	0	0	4

Unit 1: Pathogens and microbial growth: in vitro and in vivo (15h)

Pathogens and opportunistic pathogens. Virulence determinants in Gram-negative and Gram-positive bacterial pathogens. Pathogenicity Islands. Bacterial growth in culture and tissues. Immune response against bacterial pathogens. Viral infection cycles. Parasitic protozoa: Plasmodium and Leishmania. Bacterial and fungal biofilms. Role of quorum sensing in pathogenicity. Persister cells and dormant life forms. Microbiome and disbiosys.

Unit 2: Antimicrobials and Antimicrobial Actions (15 h)

Physical and chemical control of microorganism. History of chemotherapy, antibiotics. Determining antimicrobial action (MIC, MBC, IC 50, IC 90 and time kill for antimicrobial), quorum quenchers. In vivo imaging for estimating antimicrobial potential. Measuring antibiofilm action. CLSI (The Clinical and Laboratory Standards Institute) guidelines.

Unit 3: Antimicrobial Resistant (15 h)

AMR, MDR, XDR. Modes of antibiotic resistance in bacteria. Antimicrobial resistance in fungal and parasitic protozoa. Developing resistant mutants in laboratory. Enumerating extent of resistant, different tools and techniques. Determining break points in clinical isolates. Precautions in handling resistant mutants. CR-CS Relationships between antimicrobials. AMR surveillance. Antimicrobial stewardship

Unit 4: Resistomics (15 h)

Genome wide analysis of resistant determinants. Functional genomic approach for associating SNV/ CNV/ Amplicons with AMR. RNAseq and its application in identifying resistant mechanisms. Application of proteomics and metabolomics in AMR research. Epigenomics of drug response. Use of metagenomics in AMR surveillance.

Reference books:

Antibiotics: Targets, Mechanisms and Resistance- Claudio O. Gualerzi, Letizia Brandi, Attilio Fabbretti, Cynthia L. Pon WILEY

Antimicrobial Stewardship Principles and Practice 2017 Edition by Kerry Laplante, Cheston Cunha, CABI