

SCMM –M.Sc. Program

SCMM offers a highly sought after M.Sc. program in 'Molecular Medicine'. The goal of this program is to expose and train students in modern areas and techniques of cell and molecular biology in relation to human health and disease and the subsequent application of this training to find innovative targets for the diagnosis and therapy of different diseases. The completion of the Human Genome project and various other genomes including pathogenic organisms has opened new opportunities for the understanding of the molecular mechanisms of diseases both from the host as well as pathogen's perspectives.

Students will be trained to use the tools of modern biology including bioinformatics so as to understand, retrieve and exploit the wealth of information provided in the Genome projects to design modern and personalized medicines. The overall benefit of the M.Sc. course will be in retaining the trained post-graduate students for Ph. D, who are already experienced in this specific area of molecular medicine related to disease and drugs. This course will reduce the overall time taken for completion of a Ph. D program because it is expected that majority of them may extend their M. Sc. research project into the Ph. D. program.

1. Eligibility:

A minimum of 55% marks in Bachelor's degree in any branch of Basic or Applied Sciences (including MBBS and BVSc.) from recognized Universities and Institutes.

2.-Admission procedure:

Candidates will be selected through a combined JNU entrance examination followed by an interview of short listed candidates. The admission procedure will be as laid down by Academic Committee from time to time and the existing Special committee of SCMM will oversee the program.

3. Duration:

- i. The course work leading to the award of an M.Sc degree in Molecular Medicine shall be for a period of four semesters (two Monsoon Semesters and two Winter Semesters) with a compulsory requirement for submission of a research-based dissertation at the end of the Winter Semester. A student desirous of continuing to the Ph.D. program in Molecular Medicine will be eligible for enrolment for the Ph.D. program provided he/she has secured a minimum CGPA of 6.5 in M.Sc. (CGPA 6.0 in case of SC/ST candidates). These students will be offered provisional Ph. D. admission. They have to undergo compulsory noncredit courses during 5th semester for their confirmation of registration in the Ph. D. programme at the beginning of the 6th semester. The students will continue research work in the respective laboratories while doing the course work during 5th semester.

- ii. A Student, who successfully completes the first two years of the M.Sc.-Ph.D. integrated program (M.Sc. phase), would be allowed to leave with a M.Sc. degree if he/she wishes to do so.
- iii. The total duration of the M.Sc-Ph.D course will be 2+4 years (+1 year extension if required).

4. Credit Requirements:

A student will need to have a minimum of 65 credits including 10 credits for the dissertation at the end of two years in order to be eligible for the award of the M.Sc. degree.

A student who secures CGPA 4.0 and above (but below 6.5) will be allowed exit the programme with an M. Sc. degree in Molecular Medicine.

A student who secures a CGPA of 6.5 and above at the end of 4 semesters will be eligible to register for the Ph.D. program without fresh application through entrance test.

5. Credit Distribution:

First Semester: 19 Credits (including practical)

Second Semester: 19 Credits (including practical)

Third Semester: 12 Credits

Fourth Semester: 15 Credits

One credit = At least sixteen lectures per semester.

6. Intake:

Depending on the faculty strength, the intake will be up to a maximum of 10 students per year. At least one student will be assigned to each member of the core faculty of SCMM.

7. Fellowship:

At present, there is no provision for getting fellowship during M. Sc. They will be eligible for various fellowships offered by the university as availed by other students pursuing Master's degree. The centre will approach various funding agencies for the fellowship to make this programme more attractive. The students pursuing Ph. D. degree will be eligible for fellowships as per the rules of the Central Universities.

7. Courses Offered:

Total credits: 65 (for award of M.Sc. degree)

Semester I	Semester II
*Basic Biochemistry 3 Credits	*Molecular Biology 3 Credits
*General Microbiology 3 Credits	*Molecular Genetics 3 Credits
*Cell & Developmental Biology 3 Credits	*Nutrition in human health & disease 2 Credits
*Anatomy & Human Physiology of human Body 3 Credits	*Immunology 3 Credits
*Pathology 2 Credits	*Bioinformatics & Computational Biology 3 Credits
*Lab Practical (Biosafety, Biochemistry & Microbiology) 5 Credits	*Lab Practical (Molecular Biology & Cell Biology) 5 Credits
Total = 19 Credits	Total = 19 Credits
Semester III	Semester IV
Optional courses (any four):	
*Free Radicals & Metals in Biology & Diseases 3 Credits	* Pharmacology & Therapeutics 3 Credits
*Cell Adhesion & Signal Transduction 3 Credits	*Bioethics & IPR 2 Credits
*Molecular basis of Infectious Diseases 3 Credits	* Diseases of National Importance 2 Credits
*Molecular Endocrinology & Endocrinopathies 3 Credits	*Dissertation submission & Viva 8 Credits
*Host-Microbe relationships in health & disease 3 Credits	
*Proteomics & Metabolomics 3 Credits	
*Molecular basis of metabolic disorders 3 Credits	
Compulsory Course:	
* <i>Research based Dissertation (Starts)</i>	
Total = 12 Credits	Total =15 Credits
M.Sc Complete	Total Credits= 65
Semester V (PRE-Ph.D.) (Non-credit courses)	
* Advanced Instrumentation in Modern Biology including radiation safety and Bio safety	3 Credits
* Seminar (2)	2 Credits
* Term Paper (1)	2 Credits
* Research Proposal & Presentation	3 Credits
Note: Although the above courses are non-credit, the credits on the right indicate the weight age of each course.	

Course Contents:

Semester I:

Basic Biochemistry:

Credits: 03

Basic chemistry of biological materials, thermodynamics of biological systems; concept of free energy, entropy, enthalpy, free energy changes, high energy molecules; acids, bases, pH and buffers, biochemistry of macromolecules-carbohydrates, amino acids and lipids; Structure, constituents and function of biomembranes; Enzyme kinetics and mechanisms, coenzymes, cofactors, inhibitors, catalytic enzymes, ribozymes; Michaelis-Menten equation; Nucleic acids-classification, occurrence, nucleoside, nucleotides, structures of ribosyl and deoxyribosyl nucleotides & functions; glycolysis, anaerobic oxidation of glucose, citric acid cycle; mitochondrion and bioenergetics; lipid metabolism & diseases; metabolism of amino acids, anabolism and catabolism, urea cycle, biosynthesis of proteins, purine and pyrimidine metabolism. Introduction to clinical biochemistry of GI tract, liver, cardiovascular system, endocrine functions.

Recommended Reading Material:

1. Biochemistry Ed Lubert Stryer. W.H. Freeman and Company, New York.
2. Principles of Biochemistry. Ed Lehninger, Nelson and Cox. CBS publishers and distributors.
3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell. Appleton and Lange, Stamford, Connecticut.
4. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin. Wiley-Liss Publishers.
5. Biochemistry. Ed Donald Voet and Judith G. Voet. John Wiley & sons, Inc.
6. Methods in Enzymology

General Microbiology:

Credits: 03

Microbes, classification, evolution, diversity, (bacterial, fungal and viral structure), Bacterial physiology, genome, nutrients, microbes in oral cavity and guts, pathogenic bacteria, commercially exploitable bacteria (useful), un-culture-able bacteria, their usefulness and study, bacterial viruses (phages), virulent and temperate phages, classification of microbial biochemical pathways, plasmids, bacteria as biosensors, bioremediation, mechanism of bacterial pathogenesis, antibiotic producing microbes, mode of action of antibiotics, mechanism of antibiotic resistance, quorum sensing, biofilms, newly emerging infectious diseases, microscopy, classical and molecular identification, epidemiology, bio-safety, vaccines.

Recommended Reading Material:

1. General Microbiology by Stainer R. V., Adelberg, E. A., and Ingrahm J. L. Macmillan Press, 5th ED.
2. Microbiology by Westriech, G. A., and Lechmann, M. D. Macmillan Press, 5th ED.
3. Medical Microbiology, 4th ED. Edited by Samuel Baron. University of Texas Medical branch at Galveston, Texas, ISBN-10: 0-9631172-1-1

Cell and Developmental Biology:

Credits:

03

Cell Biology: Basic structure of cells in prokaryotes & eukaryotes, structure and function of cellular organelles, genome organization of different organisms, transcription & translation, interactions between nucleus and cytoplasm, basic concepts of cell specialization in complex organisms, organization of the cytoskeleton and its cellular function in cell polarity, shape and motility, cellular structure of actin, actin-based motors, microtubules and motor proteins, intermediate filaments, membrane structure, transport & trafficking, mechanisms of protein sorting and targeting, intercellular communication and associated signaling pathways. Diseases associated with disruption of cytoskeleton, cellular communication and protein sorting/targeting, cell death pathways.

Developmental Biology: introduction to cell fate and early embryonic patterning in different organisms (*Drosophila*, *Xenopus*, *C. elegans*, mouse); development of cell lineage and segment formation in *Drosophila* and the regulatory genes, specification of the dorsal-ventral axis in *Drosophila*, structure and function of Hox genes; principles of vertebrate development, *xenopus* animal-vegetal axis determination, generation of embryonic asymmetry, mesodermal patterning, gastrulation, somite formation, neural induction, neural organizers, establishment of the anterior-posterior axis, dorsal-ventral patterning, progenitor cells, tissue stem cells and embryonic stem cells.

Recommended Reading Material:

1. Molecular Biology of The Cell (Fifth edition), 2007 by Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Publisher: Garland Publications
2. Molecular Cell Biology (sixth edition), 2008 by Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh, Paul Matsudaira. Publisher: W H Freeman & Company
3. Essential Cell Biology (Third Edition), 2009 by Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Publisher: Garland Science
4. Developmental Biology (Ninth Edition), 2010 by Scott F. Gilbert. Publisher: Sinauer Associates, Inc., Publishers
5. Principles of Development (Fourth Edition) 2010 by Lewis Wolpert and Cheryll Tickle. Publisher: Oxford University Press

7. Essential Developmental Biology(Third Edition), 2012 by Jonathan M. W. Slack. Publisher: John Wiley & Sons

Anatomy & Physiology of Human Body Credits 03

Introduction to General Physiology & Anatoly, Nervous System, Musculo-Skeletal System, Cardiovascular System, Gastro-Intestinal System, Genito-Urinary System, Endocrine System, Reproductive System, Blood & its constituents, plasma proteins.

Recommended Reading Material:

1. Best and Taylor's Physiological Basis of Medical Practice.
2. Guyton-Hall-Textbook-Medical-Physiology.
3. Ganong's Review of Medical Physiology, 24th Edition (LANGE Basic Science)
4. Harper's Illustrated Biochemistry, 29e, Robert K. Murray, David A. Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil.

Pathology Credits 02

Basic Concepts in Pathology, Cellular Injury, Inflammation and Healing, Cardiovascular Pathology, Respiratory Pathology, Gastro-intestinal Pathology, Hepato-biliary Pathology, Renal & Genitourinary Pathology, Neuro and Endocrine Pathology, Pathology of bone and muscle, Haematologic disorders, Pathology of Infections (Bacterial, Fungal and Viral etc.)

Recommended Reading Material:

1. Pathology by Alan Stevens and James Lowe, Elsvier Publication
2. Pathology by Arthur S. Schneider, Lippincott Williams & Wilkins Publications
3. General and systemic Pathology by James C Underwood. Churchill Livingstone, Elsevier Limited publication.

Biosafety: Basic training in biosafety & occupational hazards

Biochemistry: weighing and solution preparation; estimation of protein, DNA, RNA; principles of spectrophotometer and uses; different chromatographic methods: principles and uses; Thin layer chromatography: separation of ATP, ADP and Pi using ATPase; gel filtration chromatography: separation low and high molecular mass containing proteins; Ion exchange chromatography; Ultracentrifugation: principles and uses; subcellular fractionation of organelles using ultracentrifugation; Enzyme kinetics and purification: alkaline phosphatase.

Microbiology: Basic bacterial culture and growth curve, cell number counting, growth of λ phage, plaque counting, testing of temperature sensitive bacterial and phage strains, Gram staining, microscopy, site directed mutagenesis, making of genomic library, testing of auxotrophs, isolation of bacterial genomic DNA, plasmid DNA, short and long term storage of bacterial, fungal and phage stocks.

Recommended Reading Material:

1. Principles and techniques of practical biochemistry. Ed Keith Wilson and John Walker. Cambridge; University Press.
2. Molecular Cloning- A Laboratory Manual. J. Sambrook, E.F.Fritsch and T.Maniatis. Cold Spring Harbor Laboratory Press.

Semester II:

Molecular Biology: Credits

03

DNA structure & function; Different topological forms of DNA and their separation; DNA denaturation and renaturation curves; DNA sequencing methods from chemical sequencing to next generation sequencing; Different types of RNA: structure and function; Mechanisms of DNA replication: prokaryotes vs eukaryotes, Initiators, polymerases and other accessory factors, control of DNA replication and inhibitors; DNA Repair and recombination; Transcription, mechanism and regulation: Prokaryotes vs eukaryotes; initiation, elongation and termination. Post transcriptional processing of different RNAs; Components and mechanism of Translation; Molecular Biology of diseases: Genetic, infectious and indeterminate.

Recommended Reading Material:

1. Genes IX. Ed Benjamin Lewin. Oxford University Press.
2. Molecular Cell Biology, H. Lodish, A. Berk, S.L.Zipursky, P. Matsudaira, D. Baltimore, J. Darnell. W. H. Freeman and Company, New York.
3. Cell and Molecular Biology. DeRobertis EDP and DeRobertis EMF Jr. Lippincott Williams and Wilkins, Philadelphia, USA.

4. Molecular Biology of the Cell. Bruce Alberts, Alexander Johnson, Lewis J, Raff M, Roberts and Walter P. 5th Edition. Garland Science, Taylor and Francis Group, USA.

Books covered under Biochemistry may also be consulted for Molecular Biology course.

Molecular Genetics: Credits

03

Genetic notations, conventions and terminology, internet based genetic data search, mutants and mutations, analysis of mutants (recombination, mapping, linkage, recombination frequency, deletion and complementation), nucleic acid hybridization, sequencing and mutagenesis; chromosome structure and function, mitosis and meiosis, chromosome banding and nomenclature, physical mapping, chromosome abnormalities, Mendelian genetics, bacterial chromosome, , bacterial conjugation, transposons, phage λ genetics – DNA, gene organization, life cycle, lysogeny, transduction, construction of bacterial strains, human genome and its organization, instability of human genome (mutation, polymorphism and DNA repair), genome projects, identification of human disease genes, molecular pathology, genetic testing, DNA fingerprinting.

Recommended Reading Material:

1. Molecular Genetics by Stanley R. Maloy, John E. Cronan, and David Freifelder. 1994
2. Human Molecular Genetics, 2nd ED. By Tom Strachan and Andrew Reed. ISBN-10: 1-85996-202-5.

Nutrition in human health & disease

Credits 02

Nutritional Biochemis try: Basic concepts, essential and non-essential nutrients, proteins, carbohydrates, lipids, vitamins and minerals, measurement of the calorie values of foods, recommended dietary allowances, basal metabolic rate (BMR), Measurement of energy requirements, malnutrition, malabsorption and interventional strategies, role of diet and nutrition in the prevention and treatment of diseases, atherosclerosis, liver disease and rheumatic disorder, inherited metabolic disorders. phenylketonuria, gout, and diabetic mellitus.

Recommended Reading Material:

1. Modern Nutrition In Health And Disease By Maurice Edward Shils (50th Anniversary Edition) Comments: Freely available in Internet
2. Nutritional Biochemistry, By Tom Brody, From Academic Press
3. Advanced Nutrition and Human Metabolism; Fifth edition, By Sareen S. Gropper, Jack L. Smith, James L. Groff From Cengage Learning (Comments: Freely available in Internet)

The concept of self vs. non-self; innate Immunity – determinants, cellular and molecular mediators and signaling pathways; Adaptive Immunity – Cellular Determinants, Antigens and Antibodies, Mechanisms of receptor and antibody diversity and signaling pathways; Innate and Adaptive Immune Cross-talk and antigen presentation; Immune Memory and regulation; Immune dysregulation and pathobiology of diseases.

Recommended Reading Material:

1. Janeway's Immunobiology (Immunobiology: The Immune System (Janeway)) [Paperback] Kenneth Murphy (Author) Publisher: Garland Science; 8 edition (July 25, 2011)
2. Case Studies in Immunology: A Clinical Companion by Raif Geha and Luigi Notarangelo. Publisher: Garland Science; 6 edition (October 18, 2011)

Bioinformatics & Computational Biology Credits**03**

Background and major developments in Bioinformatics and Computational Biology; different biological databases and their usage; Analysis of Nucleic acid sequences and protein sequences; alignment, similarity and pattern searches; secondary structure; motifs; functional homologs & orthologs; meta-analysis and functional assignment of unknown open reading frames particularly for pathogens; RNA sequence analysis, secondary structure, small non-coding RNAs, siRNA, miRNA, design and application; PHYLP and tree construction for evolutionary analysis.

Introduction to Biostatistics, Sampling – Random and non-random sampling methods, Data analyses – measures of averages and dispersion, Data Presentation techniques – Graphical and tabular, Normal distribution – properties and applications, Standard error, Confidence interval and sampling distribution – definition, computation, interpretation and applications, Basic principles of testing of hypothesis, Test of significance - t-test, Chi square and Non parametric methods; anova, sample size in health science research – Basic principles and computations, Correlation and Regression, data storage and management.

Recommended Reading Material:

1. Bioinformatics for Dummies by Jean-Michel Claverie and Cedric Notredame 2nd Edition, Wiley Publishing Inc.
2. An introduction to Bioinformatics algorithms. Neil C. Jones and Pavel A. Pevzner. MIT Press
3. Introduction to Bioinformatics. Arthur M Lesk. Oxford Press
4. Fundamentals Of Biostatistics (6th Edition), 2006, Author: Bernard A. Rosner, Publisher: Thomson, Brooks/Cole
5. Biostatistics: The Bare Essentials (Third Edition), 2008, Author: Geoffrey R. Norman and David L. Streiner, Publisher: People's Medical Publishing House
6. Principles of Biostatistics, 2000, Authors: Marcello Pagano, Kimberlee Gauvreau

Publisher: Duxbury,

7. The analysis of biological data, 2009, Author: Michael Whitlock, Dolph Schluter, Publisher: Roberts and Co.

Lab Practical (Molecular Biology & Cell Biology) Credits 05

Molecular Biology: Isolation and characterization of plasmid DNA and genomic DNA from *E.coli*; RNA preparation and analysis, Agarose gel electrophoresis; restriction enzyme activity, digestion of DNA and analysis; concept of primer designing for PCR, Setting of PCR reaction, analysis of amplification product; ligation, cloning; transformation of *E. coli*, evaluation of transformants and preparation of glycerol stocks; transfection of DNA; recombinant protein expression in *E. coli*, SDS-PAGE analysis of protein expression, western blotting.

Cell Bio logy: Introduction to mammalian cell culture, types of cultures, primary and immortalized cells, Introduction to contamination and Biosafety; Preparation of complete growth media (cell culture media, medium additives, animal sera); principles of cell culture devices and surfaces; cell growth and propagation, principles of cell imaging, microscopic examination of cultures, subculture of cells (monolayer and suspension cells), passage number and cell counting and viability; cryopreservation: freeze medium, equipment, procedure and revival.

Recommended Reading Material:

1. Molecular Cloning- A Laboratory Manual. J. Sambrook, E.F.Fritsch and T.Maniatis. Cold Spring Harbor Laboratory Press.

Semester III:

Free radicals and metals in biology and diseases: Credit 03

Chemistry and biology of Reactive Oxygen Species (ROS); Reactive nitrogen species (RON) including H₂S, their roles in physiology and innate immunity and detection in vivo and in vitro; transition metals in oxidative processes; mechanisms of lipid, protein and DNA oxidation; antioxidants- small molecules (like thiols) and enzymes; involvement of oxidative processes in ageing, cancer and atherosclerosis and infectious diseases; metal ions in gene regulation, Iron in human diseases-anaemia, thalassemia, primary and secondary hemochromatosis, hemophilia; metals in immunity; Menkes' and Wilson's disease: Genetic disorders of copper transport; metals and free radicals in Parkinson's, Alzheimer's and other neurodegenerative diseases.

Recommended Reading Material:

1. Selected topics from methods in enzymology
2. Selected reviews in Biochemistry, Pharmacology (Annual reviews) as recommended by the course co-ordinator.

Introduction to cell adhesion; cell-cell interactions; cell-extracellular matrix interactions; cell-ligand interactions; molecules involved in cell adhesion- ICAM, NCAM, VCAM, PECAM, laminin, fibronectin, collagen; integrins, cadherins, catenins, α -actinin, selectins, cartilage-link proteins; junctional adhesion complexes- structure, composition and functions; introduction to tight junctions, adherens junctions, desmosomes and gap junctions; overview of adhesion mediated signaling pathways- MAP kinase, JNK, ERK, PI3K, and TGF- β pathways and associated diseases.

Recommended Reading Material:

1. Cell Adhesion (Frontiers in Molecular Biology) 2002, Edited: Mary C Beckerle Publisher: Oxford University Press
2. New Cell Adhesion Research, 2010, Edited :Patrick Nott, Matthew Temple Publisher: Nova Biomedical
3. Adhesion Molecules, 2010, Author: Victor R. Preedy, Publisher: Science Publishers

Principles of Infectious Diseases: general principles of microbial interactions with humans that result in infection and diseases; examples of bacterial, viral, fungal and parasitological pathogens with special emphasis in developing countries; molecular basis of bacterial pathogenesis: Role of virulence factors, adhesins, pathogenicity island, protein and DNA secreting systems in pathogenicity and disease; modulation of host signaling system in response to infection; molecular and cellular basis of viral infections: key examples of RNA and DNA viruses of humans causing diseases; molecular biology of tumor viruses; mechanisms of viral carcinogenesis; molecular parasitology: The molecular aspects of parasite biology, genetics and biochemistry; mechanisms of pathogenesis, parasite adaptations for survival within the host; grand challenges for drug and vaccine development and disease control in infectious diseases.

Recommended Reading Material:

1. Bacterial Pathogenesis: A Molecular Approach: 3rd Edition. Abigail A Salyers. ASM Press.
2. Emerging infectious Diseases. Vol. 14. CDC Press
3. Molecular Diagnostics of Infectious Diseases. By Harald H. Kessler.
4. Medical Microbiology: An Introduction to Infectious Diseases. By John C. Sherris, Kenneth J Ryan et al. Elsevier publication.

Molecular Endocrinology & Endocrinopathies

Credits

03

Introduction to basic endocrinology, endocrine system and recent advances in molecular endocrinology. Hormones and cell signalling. Extracellular and intracellular receptors, receptor-ligand interactions, co-activators and co-repressors. Receptor regulation and degradation. Nuclear receptor superfamily and classification. Steroid hormone receptors in health and diseases. Molecular basis of endocrinopathies. Ligand-independent transcriptional activation of steroid hormone receptors. Endocrine-related cancers and metabolic disorders, Prostate and breast cancers. Selective steroid receptor modulators and endocrine disruptors.

Recommended Reading Material:

1. Endocrinology: An Integrated Approach, By Stephen Nussey and Saffron Whitehead. Oxford: BIOS Scientific Publishers; 2001, ISBN-10: 1-85996-252-1
Freely available at NCBI bookshelf
2. Molecular Endocrinology, By Franklyn F. Bolander Academic Press, 2004
3. Nuclear Receptors: Current Concepts and Future Challenges, By CM Bunce MJ Campbell, Springer Science (2010)
4. Nuclear Receptors as Drug Targets, Eckhard Ottow, Hilmar Weinmann, Raimund Mannhold - 2008
5. Nuclear Receptors in Drug Metabolism, Wen Xie (Editor), Publisher: Wiley (2008)
6. Williams Textbook of Endocrinology By Shlomo Melmed , Kenneth S. Polonsky MD, P. Reed MD Larsen, Henry M. Kronenberg, Publisher: Saunders; 12 edition (May 27, 2011)
7. The Nuclear Receptor Superfamily: Methods and Protocols (Methods in Molecular Biology) By Iain J. McEwan Publisher: Humana Press (Nov 19, 2010)

Host - Microbe Relationships

Credits

03

Symbiotic relationships: mutualism, commensalism and parasitism. Microbial Colonization of Epithelial Surfaces; bacterial biofilms and Quorum Sensing in health and disease; the microbiome and human health; epithelial host defense: sensors of extracellular colonization by bacteria, intracellular invasion; signaling pathways and effectors of innate immune system, mechanisms of immune tolerance and its relationships with host commensals; case studies: Host-microbe relationships in inflammatory Bowel Disease, obesity and others.

Reading Material:

1. Bacteriology of Humans: An Ecological Perspective by Michael Wilson. Publisher: Wiley-Blackwell; 1 edition (May 6, 2008)

Proteomics and Metabolomics**Credits****03**

Kinds of omics studies; introduction to Mass Spectrometry – Mass Analyzers , Detectors and mechanisms of ionizations; proteomics – Proteins, Peptides, Amino acids and Post-translational Modifications. Types of Proteomics; Separation Techniques in Proteomics; Metabolomics; Omics in wet lab – Sample Preparation and SOPs; Data Analysis and Interpretation in Proteomics and Metabolomics; case studies in proteomics; human protein atlas, annotation and data analysis.

Reading Material:

1. Metagenomics of the Human Body. Editor: Karen E. Nelson. Publisher: Springer; 1st Edition. Edition (November 17, 2010)
2. Mass Spectrometry: Principles and Applications by Edmond de Hoffmann, Vincent Stroobant. Publisher: Wiley-Interscience; 3 edition (November 20, 2007)

Molecular basis of metabolic disorders**Credits****03**

Introduction to metabolic disorders and metabolic profiling. Obesity, Cardiovascular diseases. Disorders in hormonal action. Insulin dependent and independent diabetes. Genetics and epigenetics in metabolic disorders. Diagnosis of metabolic disorders and therapy.

Recommended Reading material:

1. Selected topics from Annual Reviews, Nature Reviews, New England Journal of Medicine, Lancet

Research based Dissertation

It will start during third semester based on the mutual interests of the students and the faculties. At least one student will go to the each laboratory.

Semester IV:**Pharmacology & Therapeutics****Credits****03**

Therapeutics: i) Molecular basis of biological therapeutics; ii) Molecular Targets of therapeutics: Microbial targets, Signal Transduction Pathways, Autoimmune Disease Targets, Cancer Targets, Epigenetic modifications and Emerging Targets; iii) Biomarkers; iv) Chemical and Synthetic therapeutics drugs and classes; v) Peptide Therapeutics: Monoclonal Antibodies; Pharmacodynamics: i) definition, general mechanisms; ii) receptors and specificity; iii) agonists and antagonists; iv) pharmacodynamics of individual classes of drugs; v) site (or sites) of drug action (ex: narcotic analgesics); vi) specific mechanism of drug action: (a) therapeutic and side

effects. Posology: i) definition; ii) dose - response relationship; iii) potency and ED 50 (effective dose 50); minimal effective concentration; iv) efficacy: time - response graph; onset of action; duration of action; termination of action Toxicology and Applied Pharmacology: i) Mechanisms of toxicity; ii) Therapeutic Index (TI), Lethal dose 50 (LD 50); iii) Dose response complexities and adverse drug effects v) Mechanisms of Detoxification and Testing. Pharmacokinetics: i) importance of pharmacokinetics, pharmacodynamics, and pharmacometrics in the understanding of drug action, therapy, design, development, and evaluation; ii) definition and factors determining the active concentration of drug; iii) Mechanisms of drug absorption: Dissolution, epithelial barriers, active, passive transport and diffusion, Bioavailability; iv) Clinical Trials. Medicinal Plants: i) Fundamentals of Phytotherapy; ii) Classes of Medicinal Plants; iii) Chemistry and mechanisms of medicinal plant products.

Recommended Reading material:

1. Basic Concepts in Pharmacology, Publisher: McGraw-Hill Professional; 3 edition (September 26, 2005), ISBN-10: 0071458182, ISBN-13: 978-0071458184
2. Basic and Clinical Pharmacology, 11th Edition, Publisher: McGraw-Hill Medical; 11 edition (July 1, 2009), ISBN-10: 0071604057, ISBN-13: 978-0071604055

Bioethics & IPR

Credits 02

Safe laboratory practices, animal ethics, human subjects research ethics and regulations; concept of intellectual property, patents, innovation and regulations.

Laboratory equipment, Chemical, fire and electrical safety, Disinfection and sterilization, Basic laboratories, The definitions of Biosafety Levels 1-5, Microbiological risk assessment, Biosafety and recombinant DNA technology, Laboratory animal facilities

Ethical Use of laboratory Animals, Ethical Use of Human Subjects, Biosafety guidelines: WHO and Government of India, Introduction to the JNU IERB

Recommended Reading:

Biethics: Basic Laboratory Methods for Biotechnology (2nd Edition). Publisher: Benjamin Cummings; 2 edition (November 8, 2008)

IPR: MANUALS OF PATENT OFFICE PRACTICE AND PROCEDURE

Diseases of National Importance

Credit

03

Seminar series by medical and clinical specialists on selected topics including Diabetes, Goitre, hypertension, Ischemic heart disease, bronchial asthma, epilepsy, prostate cancer, cervical cancer, breast cancer, lung cancer, gastric and diarrheal diseases, malaria, Tuberculosis.

Dissertation submission & Viva

Credits

10

M.Sc Complete

Semester V (Pre-Ph.D.):

Advanced instrumentation in Modern Biology including Radiation safety Credits 03

Principles of Fluorescent cell sorting and analysis; electron microscopy, confocal microscopy and live cell imaging; RT-PCR- theory and practical; NMR, Laser and other tissue/cell dissection methods in cell biology; Mass Spectrometry and Separation Platforms.

Characteristics of alpha particle, beta particle and gamma rays and their usage. Different types of radioactive elements and their usage in Biological research. Strong and weak beta emissions. Measurements of radioactivity, half life. Safety measures and precautions while handling radioactive elements. Alternatives to use of radioactive elements.

Recommended Reading Material:

Biology in the Laboratory: An Introduction to Methodologies and Instrumentation in the Modern Biology Laboratory by Jeffrey A. Hughes. Publisher: Jones & Bartlett Pub

Seminars (2)

Credits 02

Term Paper (1)

Credits

02

The students have to give two seminars and write a term paper in the areas of Molecular Medicine/respective fields of research interest.

Research proposal and presentation

Credits

03

It will be based on actual research problem that the candidate is going to undertake as Ph. D. topic. It will be an extension of M. Sc project wherever possible with the inclusion of preliminary data.