BYE LAWS & SYLLABUS FOR

M.SC. BIOMEDICAL SCIENCES

Choice Based Credit System (CBCS)

Approval Date: 28TH September 2021 (5TH BOARD OF STUDIES)

DMM

DEPARTMENT OF MOLECULAR MEDICINE
JAMIA HAMDARD

Deemed to be University
Accredited in 'A' Grade by NAAC
Declared to be designated as Institute of Eminence (lOE) by MHRD, GOI
New Delhi 110 062
www.jamiahamdard.edu

Master of Science (M.Sc.) Biomedical Sciences

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

SYLLABUS with LEARNING OUTCOMES
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 be a leading international research and teaching department imparting quality education and research training on biological, medical, chemical and computational approaches to biomedical research for investigating the molecular basis of human diseases and intervention, particularly catering India-specific needs and societal benefits.. 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

1. To educate, train and develop international standard manpower, skilled to handle newly evolving techniques in molecular medicine.

2. To mentor the next generation young minds by inculcating the spirit of innovation in the evolving area combining 'traditional and modern medicine'.

3. To provide cutting-edge research with state-of-the-art infrastructure in biomedical sciences to meet emerging challenges for unmet-medical needs in the country.

INDEX

1. **AFFILIATION**

The programs are governed by Department of Molecular Medicine (DMM), School of Interdisciplinary Sciences and Technology, Jamia Hamdard, Delhi-110 062.

2. **PROGRAMME STRUCTURE**

This is a CHOICE BASED CREDIT SYSTEM structured with Programme Outcome (PO) and Course Outcome (CO) parameters as adopted by Jamia Hamdard following UGC mandate. Each Course is mapped with PO and CO in accordance with NEP 2020.

Each M.Sc. Program is of two years duration. Each year will consist of two Semester as described below.

	Semester – Odd	**Semester-Even**
First Year	Semester – I	Semester – II
Second Year	Semester – III	Semester – IV

Each semester would consist of five papers including one practical through Semester I, II and semester III. Semester IV would comprise of Optional Research area, from which each student has to select one Dissertation work. Selection of labs in Semester IV would be completed by the end of semester II, based on lottery. It is mandatory for each student to complete a Mentored Dissertation, assigned at the end of II Semester and complete at the end of IV Semester. It would comprise of bench work, writing of thesis and presentation of work to an audience/expert committee. Dissertation can also be carried out optionally outside the institute in an industry, hospital or an institute as per student's interest with approval from the institute. The completed dissertation thesis must be submitted to the institute before end of the semester.

3. Duration: Two Years of Four semesters (two each year) designated as under:

1st Semester - July to December of 1st year
2nd Semester - January to May of 1st year
3rd Semester - July to December of 2nd year
4th Semester - January to May of 2nd year

Teaching days in each semester shall normally be **90 days**. Medium of instruction and examinations: **English**

4. **Eligibility of Admission:** All candidates (National, international or NRI candidates) seeking admission to the M.Sc. program must appear in the Entrance Test conducted by Jamia Hamdard. Also, the candidates should fulfill the following qualifications for admission: Must have passed B. Sc. from a recognized university under 10+2+3 system with one of the subjects in the area of life sciences and secured at least 55% marks in the aggregate. The Life Sciences courses include also Botany as major, if there are specific areas covered in their UG course, viz., Genetics/Molecular Biology/Genetic Engineering/Medicinal Chemistry/Microbiology or related areas to increase admission opportunity to those students. Admissions will be as per Jamia Hamdard guidelines.

Brief Overview of the Investigators:

JH-IMM Scientists, trained in reputed laboratories in the USA, are former faculties or employees of prestigious International organizations like FDA, NIH, Johns Hopkins, etc. After returning to India, they have established their labs in Delhi by securing generous funding from multiple government agencies (DBT, DST, DHR, SERB, BIRAC, ICMR, etc). They have proved their credentials to the government funding agencies and scientific organizations through their publications, collaborations, research presentation and grant evaluations.

Faculty:

Prof Farhan J Ahmad, PhD, Dean (SIST)

Dr. Farhan Jalees Ahmad, PhD, is currently a Professor, School of Pharmaceutical Education & Research and Jamia Hamdrd Institute of Molucular Medicine Jamia Hamdard, New Delhi, Having obtained his degree in M.Pharma and Ph.D (Pharmaceutics) from Jamia Hamdard, he continues to teach and leads a very productive research group which has been funded extensively by National and international funding agencies.

Dr. Ahmad has 27 years of rich experience in Research and Teaching. He has experience of industrial research through his fruitful association with Ranbaxy Research Laboratories for six long years as Scientist. His domain of research therein included development, scale-up, technology transfer and launching of pharmaceutical products, both for domestic and international markets.

He is working in the area of Nanomedicine for the last 18 years and has published a number of research papers on nanomedicine in peer reviewed journals. Two of his nanoproducts are approved by Drug Controller of India for Phase-III clinical studies.

He has two US patents, three PCT and 24 Indian patents to his name. He has published more than 350 research and review papers, 12 Book chapters, 9 books with a total citation of 13059, H-Index of 52 and i-10 index of 288 and attended many national and international conferences for presentation of research papers. He has guided around 35 M.Pharm students and about 33 PhD scholars. Besides this, he is offering consultancy to small pharmaceutical setups for pharmaceutical product development and scale-up, and troubleshooting specific problems.

Dr. Surajit Ganguly PhD (HOD DMM)

Dr. Surajit has a PhD degree in Biochemistry with over 22 years (post PhD) experience in Neurobiology Research. He specializes in Molecular Neuropharmacology, Neuroendocrinology and Cell Biology. He was trained in Neurosciences during his post-doctoral period at National Institute of Health (NIH), Bethesda, Maryland. He held various US Federal Government Scientific positions at NIH and subsequently, was a research faculty at Johns Hopkins Medical Center, Maryland before relocating to India. His works at NIH lead to the elucidation of circadian regulation of melatonin production in higher mammals including humans. His contribution in the research area was honored with Award of Merit from the US public health service at NIH. He is also recipient of Prof. B Uvnas Prize (Gold Medal) from the Indian Pharmacological Society and has authored over 30 research articles in reputed International journals. Currently, he is using animal models (Funded by DBT and DST) to identify metabolic supplements as a strategy for managing cognitive functions in neuropsychiatric disorder. He is also involved in developing stage–specific diagnostic marker panels for Head-Neck cancer (CSIR-NMTLI consortium).

Research objectives: Currently, the central thrust of his laboratory (Neurobiology and Drug discovery lab) at JH-IMM is to understand how pathogens via neuro-immune interactions modulate neuronal functions in brain, particularly in the hippocampus. To address this question, they have identified traditional commensals like S. aureus to play a direct role in driving epigenetic changes leading to suppression of Dopamine and Serotonin (5HT) synthesis in brain. They intend to expand our study using virus infections including Covid-19 in immediate future. The research program in his lab is guided by the following research topics with a central aim to understand how neurons responds to common environmental risk factors like infectious agents:

Acetyl histone map in the hippocampus linking cognitive function is modulated by pathogens in the peripheral system. Bacterial pathogens like Staphylococcus aureus, strains of pathogenic E. coli and alos some viral pathogens like SARS-CoV are mostly pathogens believed to prefer peripheral tissues. However, they have determined that low grade inflammation in response to these peripheral infections can induce dramatic changes in the epigenetic landscape in the brain tissues and that might lead to the premature of brain ageing accompanied by cognitive decline. Their hypothesis has proved an interesting lead and the preliminary data has been published recently. This project has generated one PhD submission and two papers and is funded by one grant from DHR. Studies to delineate the molecular nexus between systemic infection, neurotrannsmitter metabolism and neurocognitive decline using chronic infection model.

Dr. A. Selvapandiyan PhD

Dr. Selva has more than 32 years of experience working at International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi, Food and Drug Administration (FDA), USA, and Institute of Molecular Medicine, Delhi (IMM). He has contributed extensively in parasitic vaccine development and pathogen diagnostic areas. He was instrumental in the development of one live attenuated *Leishmania* vaccine candidate against the fatal 'visceral leishmaniasis' disease, which is currently in for a clinical trail after its successful efficacy studies as vaccine candidate in mice, hamster and dogs. In addition he has teaching and regulatory experiences at the above institutes. He has published over 65 refereed research papers; submitted 2 US patents; received several prestigious national and international awards. Selva is currently leading a number of large projects funded by Department of Biotechnology, Indian Council of Medical Research, DST-SERB, BIRAC, New Delhi and in collaboration with

number of national and international Institutes. He is also member of several national and international professional scientific organizations. He is currently the Head and Associate Professor of JHIMM.

Research objectives: *Development of vaccines against leishmaniasis:*
Selva's laboratory works on developing live vaccines against parasitic infections, started at the Center for Biologics Evaluation and Research, Food and Drug Administration, USA, where Selva was involved in developing an attenuated vaccine candidate against the fatal Visceral Leishmaniasis (VL) diseases and cutaneous leishmanisis (CL) endemic to India and other neighbouring countries. *At SIST, Selva's group is attempting to carry out the preclinical toxicity of such parasite (with fund from BIRAC) in order to proceed to clinical evaluation.* In addition, characterising novel virulent genes in the VL causing parasite *Leishmania donovani* and CL causing parasite *L. mexicana*/*L. tropica* are some of the major aspects of this group by deleting such genes by conventional gene deletion procedures or by CRISPR Cas9 DiCre based modern approach (with fund from DBT, ICMR). *The gene deleted parasites would ultimately be tested for its attenuation in vitro and in vivo in the animals for its safety and protective efficacy.*

Development of diagnostics against infectious diseases:
Dr. Selva's laboratory has been also focusing on developing diagnostic procedures against several pathogens. Particularly against the parasitic disease leishmaniasis and typhoid. Leishmaniasis is a parasitic disease common in the Indian subcontinent. In India alone leishmaniasis causes both the fatal VL and CL. There is also a co-occurring parasite *Leptomonas* sp. in the leishmaniasis and *Selva's laboratory has been in forefront in developing diagnostic procedures against such co-prevailing parasite at SIST*. In addition, Selva's laboratory has been working on the *Salmonella typhi*, bacterium that is observed as both slow and quick responders to the drugs in the Delhi area. Antibiotic treatment of typhoid fever, a systemic infection caused by the bacterium *Salmonella typhi* has become very challenging, because of the emergence of resistant strains. *The prime objective of the study is to ascertain the genomic difference in the drug sensitive variants of S. typhi, and to determine how the variation could be targeted for therapeutic and diagnostic approach.*

Dr. Anuja Krishnan, PhD

Dr. Anuja has degree from National Institute of Immunology (NII) with over 12 years of experience (post PhD) in virology. During her post doc at Delhi University she worked on target-specific virosome based drug delivery vehicle. She was awarded the Indo US Science and Technology Forum (IUSSTF) visiting scientist award for which she worked at Albert Einstein College of Medicine, New York towards elucidating the intracellular receptor for Ebola virus which were published in high impact factor journal. Her current work involves uncovering the mechanisms by which Dengue viruses exploit their host cells to gain entry into the host cell. Apart from understanding the basic biology the long term goal is to identify critical host factor in Dengue virus infection which could provide the means for the rational design of novel intervention strategies. Her research interest also includes studying molecular epidemiology of Indian centric viruses (dengue, chickengunya, rotaviruses etc).

Research objectives: Covid 19 a pandemic caused by a new coronavirus, SARS CoV2, has resulted in global socioeconomic disruptions and disease burden to healthcare. At present there is no licensed vaccine or therapeutic drug available. Slight drop in pH in the endosome during virus entry and maturation is critical for generation of infectious virus particles. Therefore, it is a reasonable hypothesis that inhibiting the function of the endocytic and secretory pathways can directly or indirectly suppress viral infection. In this study, we propose to test FDA approved drugs with basic nature (renders alkaline pH) on SARS CoV2 entry using cell- cell fusion assay system which correlates with virus entry. Once established this assay system can be used in future for testing of

various other drugs, peptides and natural compounds for its anti-viral effect. Those drugs which show promising results will be again validated using pseudotype system for virus entry and finally on live SARS CoV2 in BSL3 facility. This will be a great starting point for screening of these compounds and development of therapeutic agent for SARS CoV2.

Dr. Sonam Grover, PhD

Dr. Sonam Grover is a UGC-Assistant Professor at JH-Institute of Molecular Medicine, Jamia Hamdard, New Delhi. She completed her Ph.D. at JNU (2014) and joined Kusuma School of Biological Sciences, IIT Delhi as a Postdoctoral Fellow the same year. During this tenure, she received a Department of Health Research Women Scientist Grant. Her main areas of research include *Mycobacterium tuberculosis* host-pathogen interactions, drug repurposing and identifying novel drug targets against tuberculosis. She has published over 32 research papers in various international, peer-reviewed journals including *mBio* and *Molecular Neurobiology*. She has delivered talks and presented her work at several national and international conferences and symposia. She is PI/CoPI in research projects funded by agencies such as DBT and DHR. She was also awarded the prestigious 'ASCB Travel Award for graduate students' to present her research at international conferences.

Research objectives: Mycobacterium tuberculosis, (*M.tb*) the causative agent of tuberculosis, is a leading infectious disease organism, causing millions of deaths each year. This serious pathogen has been greatly spread worldwide and recent years have observed an increase in the number of multi-drug resistant and totally drug resistant M. tuberculosis strains (WHO report, 2014). The danger of tuberculosis becoming an incurable disease has emphasized the need for the discovery of a new generation of antimicrobial agents. The development of novel alternative medical strategies, new drugs and the search for optimal drug targets are top priority areas of tuberculosis research. In this study, FDA approved drugs are screened and validated against replication associated proteins that are critical for nucleotide synthesis, initiation, unwinding and elongation of the DNA during the replication process. As, these are pivotal processes required for successful multiplication of the bacterial cells and hence these will be investigated for the development of anti-tuberculosis drugs. Based on our understanding that we will develop during the course of this project, we will be able to address how these processes can be used as a drug target for FDA approved drugs.

Epigenetic mechanisms are pivotal in regulating gene expression during cellular response to extracellular stimuli. Bacterial infections have a profound effect on the host epigenome, which triggers susceptibility to diseases. Recent studies suggest that *M.tb* can modify the host epigenome to control the transcriptional machinery and plays a major role in immunomodulation of the host immune response. However, the mechanism of epigenetic alterations during *M.tb* infection has not yet been fully understood. Thus this project has been designed to elucidate the various epigenetic changes that *M.tb* is capable of bringing about in its host in order to enhance own survivability and pathogenesis.

Dr. Prem Prakash, PhD

Dr. Prem, did bachelor, master and Ph.D. in pharmacy. Joined Daiichi Sankyo India Pharma Pvt. Ltd. as a research scientist to execute my knowledge in advancing drug molecules from concept to clinic and market research industry. To get international exposure he pursued his postdoctoral research at the University of Iowa, USA with a group well known to study real-time vascular thrombosis in genetically engineered mice models. He has been awarded by prestigious DBT-Ramalingaswami, DST-Ramanujan Fellowship and got selected for UGC-Faculty

Recharge Programme to conduct high-quality cutting edge research in India. In a very short period as an independent researcher, he published various original research articles in high impact peer-reviewed journals and received research funding from various government body including Science and Engineering Research Board (SERB), UGC (University Grants Commission) and Department of Biotechnology (DBT) Government of India.

Research objectives: Patients diagnosed with cardiometabolic diseases may need medical attention for the rest of his or her life. However, such life-threatening diseases if get diagnosed at the premature stage then its progression can be slow down or prevented at its early stages of development. The strategy to curb such life-threatening diseases at its primitive phase will help patients to live normal or disease-free life and reduces the treatment cost significantly. Our lab research goal is to dissect the role of damage-associated molecular patterns (DAMPs) in the progression of cardiometabolic diseases. Similar to pathogen-associated molecular patterns DAMPs bind to Toll-like receptors and thus amplify the inflammatory response. We utilize state of the art high-end instruments such as intravital microscopy, cardiac pressure-volume loop analysis and various small animal diseases models such as ferric chloride injury-induced arterial thrombosis, arteriovenous shunt, deep vein thrombosis, myocardial ischemia-reperfusion injury, brain ischemic stroke, and transverse aortic constriction induced heart failure to unravel the mechanistic role of DAMPs in CVDs.

Insulin resistance (IR) considered as an independent predictor of type-2 diabetes and cardiovascular diseases. Our data shows genetically modified mouse strain EDA-FN$^{fl/fl}$ on a chow diet, which constitutively expresses EDA-FN in plasma, displayed significantly impaired glucose and insulin tolerance. Moreover, we found a significant increase in plasma EDA-FN levels in wild-type (WT) mice fed on a high-fat diet (HFD) for 12 weeks compared to mouse on a chow diet. The EDA-FN$^{-/-}$ mice had markedly higher glucose tolerance and substantially more sensitive to insulin than the WT mice fed on HFD for 12 weeks. Furthermore, we found that TLR4 protein expression in adipocytes and proinflammatory cytokines such as tumour necrosis factor-alpha (TNFα) and interleukin 6 (IL6) level in blood plasma were significantly decreased in EDA-FN$^{-/-}$ mice compared to WT mice kept on HFD for 12 weeks.

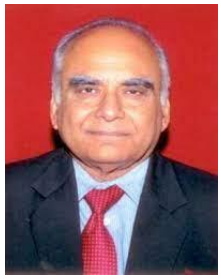
Dr. Nishi Raj Sharma, PhD

Dr Nishi Raj Sharma is an Assistant Professor at JH-IMM in Hamdard University (Jamia Hamdard) with over 9 years (post-PhD) of experience in the field of virus-host interactions including viral entry and post- entry steps in the process of viral replication. During his PhD research work with Prof. Debi P. Sarkar at Dept of Biochemistry, University of Delhi, he discovered the reciprocal regulation of membrane fusion step of an enveloped animal virus by host cell signaling (MAP kinase and AKT). His postdoctoral work at Emory University identified a priming event of Hepatitis C Virus by host's CD81 Protein for Low pH-dependent membrane fusion. His postdoctoral work at NIH with Dr. Zhi-Ming (Thomas) Zheng discovered for the first time the mechanistic regulation of mammalian cell RNA granules (stress granules and processing bodies) by an oncogenic DNA herpesvirus (KSHV). He was trained in molecular virology, biochemistry, Cell biology and RNA biology during his doctoral and post-doctoral period at National Institute of Health (NIH), Bethesda, Maryland. Before relocating to India, he also served as a scientist at Dept of Biochemistry, USUHS (a federal University in Bethesda, United states). He is a recipient of several awards including FARE (fellow award of research excellence sponsored by NIH) and DBT- Re-entry Ramalingaswami Fellowship.

Research objectives: His research aims to understand the roles of virus-host interactions in viral infection and pathogenesis. This program is combined with translational efforts to apply this

knowledge for the development of broad-spectrum host-centered antiviral approaches to combat emerging virus infections, including but not limited to Chandipura (CHPV), Chikungunya and SARS-CoV-2. One of our major goals is to understand role of host's RNA-granules and phospho-proteomic changes during CHPV/Chikungunya infection and pathogenesis. Another focus is on identifying the host's factors including receptor(s) for CHPV infection and to understand the mechanism of viral entry. We approach these problems using state-of-the-art techniques in cell and molecular biology, genetics and bioinformatics.

Adjunct Faculties:



Prof. Nirmal Kumar Ganguly: Former Director General (ICMR) Visiting Professor of Eminence, Policy Center for Biomedical Research, Translational Health Science & Technology Institute, Faridabad, India Honorary Senior Research Professor (Clinical Research) , Institute of Liver & Biliary Sciences, New Delhi, India & Professor (GRIPMER), The Ganga Ram Institute For Postgraduate Medical Education & Research, Sir Ganga Ram Hospital, New Delhi Address: National Institute of Immunology Aruna Asaf Ali Marg, J.N.U. Complex New Delhi – 110 067 (INDIA) Telefax : +91-11-2674-1501 e-mail : nkganguly@nii.ac.in Nirmal Kumar Ganguly, M.D was formerly a Distinguished Biotechnology Research Professor, Department of Biotechnology, Government of India.

He was formerly President of the Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), as well as that of the Asian Institute of Public Health, Bhubaneswar, Odisha. He is the former Director General, Indian Council of Medical Research (ICMR), New Delhi; former Director, PGIMER (Chandigarh); and former Director, National Institute of Biologicals (Noida). Prof. Ganguly has published more than 775 research papers and has supervised 130 PhD theses as Supervisor/Co-Supervisor. Prof. Ganguly is Fellow, Imperial College Faculty of Medicine, London; Royal College of Pathologists, London; International Academy of Cardiovascular Sciences, Canada; Third World Academy of Sciences, Italy; and International Medical Sciences Academy, New Delhi. He is also Fellow, National Academy of Medical Sciences, New Delhi; Indian National Science Academy, New Delhi; National Academy of Sciences, Allahabad; and the Indian Academy of Sciences, Bangalore. He is Member of the Advisory Group, Cholera Vaccine Investment Case Preparation, International Vaccine Institute, Seoul, South Korea. He is also Member, Global Access Advisory Committee, University of Western Ontario, Canada; Worldwide Anti-malarial Resistance Network (WWARN), Centre for Tropical Medicine, University of Oxford, U.K., and Asian AIDS Vaccine Network Task Force, WHO, Geneva, Switzerland. He is Member, Editorial Board of Molecular and Cellular Biochemistry, Institute of Cardiovascular Sciences, University of Manitoba, Canada. He is Advisory Board Member, Grand Challenges (Canada). He is also advisor to Regional Director SEARO and is a member of Regional Task Force on Diseases Targeted for Elimination. He has been appointed as a member of Global Work Group of the Advisory Committee to the Director (ACD) of Center for Disease Control (CDC), Atlanta, USA. He is also selected as Global Infectious Disease External Advisory Board, Sanofi Pasteur, June 2015. In 2015 he has been selected for the award of Helmholtz International Fellow by Helmholtz Center for Infection Research, Germany for significant contribution to the field of infectious diseases.

Dr. Hira L. Nakhasi, PhD, FASTMH

He is the Director of the Division of Emerging and Transfusion Transmitted Diseases in the Office of Blood Research and Review (OBRR) at the Centre for Biologics Evaluation and Research (CBER) of FDA. He received his Master's and

Ph.D. in biochemistry from the M.S. University in Baroda, India and post-doctoral training at the National Institutes of Health in Bethesda, MD, USA and Columbia University in NY. Before his current position, he was also the acting associate director for Research in OBRR/CBER and Chief of Laboratory of Parasitic Biology and Biochemistry in the Division of Allergenic and Parasitic Products, in the Office of Vaccines Research and Review at CBER.

His main research focus is on the development of *Leishmania donovani* vaccine and diagnosis. His laboratory is also developing diagnostic reagents for blood-borne parasitic pathogens to ensure the safety of our nation's blood supply.

His scientific expertise in molecular virology, parasitology, immunology and vaccinology is reflected in over 130 publications, including reviews and book chapters and membership of the review committees of several high impact journals, reviewer of grants, and invited talks at national and international forums. His research on Leishmania vaccine is partially funded by research grants from various sources. He was also a member of several scientific organizations, including the American Association of Immunologists, American Society of Microbiologists, American Society of Tropical Medicine and Hygiene, and a Fellow of the American Society of Tropical Medicine and Hygiene (FASTMH). He has also received numerous awards, including the US Department of Human and Health Services Distinguished Service Award.

Prof. S.K. Sharma, MD

Dr. S.K. Sharma retired from AIIMS, New Delhi in January 2017. He was head of a department of Internal medicine for over a decade.

He has been awarded more than 10 awards nationally and internationally while having more than 250 publications in national and international journals. He has written three books and has contributed chapters in several prestigious titles read by doctors worldwide. He was recently awarded the American Thoracic Society's World Lung Award (2017).

He is an internal medicine specialist, providing world-class expertise for heart patients, diabetics, endocrinological disorders (thyroid etc.), infectious diseases including malaria, dengue and chikungunya, sleep disorders, rheumatic diseases, renal disorders, gastric diseases and pulmonary diseases. He has been associated to JH-Institute of Molecular Medicine since 2016 and has been a guiding principle to the departmental research in various aspects of infectious diseases including COVID-19, the current pandemic.

Prof. Nadira Karunaweera, MBBS, Ph.D.

Nadira Karunaweera is the Chair and Senior Professor of Parasitology at the Faculty of Medicine, University of Colombo, Sri Lanka and an honorary Visiting Fellow at the School of Public Health, Harvard University, USA. Trained as a Medical Parasitologist she has extensive teaching, training and research experience in tropical diseases, with special emphases on vector-borne diseases.

She is an elected Fellow of the National Academy of Sciences of Sri Lanka (NASSL), elected Fellow of The World Academy of Sciences (TWAS) for the advancement of science in developing countries, the first Sri Lankan elected as an honorary member of the American Academy of Arts and Sciences and the first Sri Lankan elected as a Distinguished International Fellow of the American Society of Tropical Medicine and Hygiene.

She is the Chair of the Research Arm of the National Science Foundation, Sri Lanka and remains as a board member of several policy making bodies that includes the Inter-Academy Partnership of The World Academy of Sciences, Governance Council of the Genomic Epidemiology of Malaria network, University of Oxford, United Kingdom and has served as a Consultant/advisor to the Strategic Research Steering Committee on Pathogenesis and Functional Genomics, World Health Organization, Geneva for over a decade.

She is considered as an authority in malaria research that encompasses wide ranging fields including pathogenesis, epidemiology, immunity and genetic diversity and has been instrumental in generating novel information, to aid the process of policy making during malaria control, elimination and post-elimination phases in Sri Lanka. She continues to function as a team leader in multidisciplinary research studies in human parasitic infections and is responsible for pioneering work in the field of leishmaniasis, a newly established disease in Sri Lanka, with setting up of the first leishmaniasis diagnostic, training and research laboratory in the country. The studies led by her and the findings of her team continue to influence national health policy that includes recognition of leishmaniasis as a public health problem in Sri Lanka, leading to its inclusion as a 'notifiable disease' in the health sector (first step towards its control through use of systematic methods), recognition of new treatment options for leishmaniasis to improve efficacy and patient safety and recognition of insecticide resistance in sand flies as a challenge for the control program.

Dr. Akhil Varshney, PhD. He is a Ramanujan Fellow and Assistant Professor at Jamia Hamdard Institute of Molecular Medicine. His comprehensive molecular and cell biology background began when he was working on his Ph.D. at the Jawaharlal Nehru University, India. There his roots and desire to understand molecular and cellular events developed, as he explored the function of telomerase in cancer cell proliferation and survival. This research then led him to a DBT-Research Associate (national fellowship from Govt of India) at National Institute of Immunology, New Delhi, India. Much of his work was focused on developing a novel real time PCR based method for studying the role of miRNA in DNA damage and signaling. Then, he ventured to the University of Kentucky where he was a Postdoctoral Fellow in Ophthalmology and subsequently moved with group to University of Virginia, where he was Postdoctoral Research Associate, his work focused on investigating role of retrotransposon in a healthy versus diseased eye. He worked closely with Human and Mouse Retinal Pigment Epithelial to identify the effects of LINE-1 and Alu retrotransposon on Retinal Pigment Epithelial behavior, by looking at the biochemical outcomes of these events.

Research objectives: Dr Varshney has more than 8 years (post-PhD) of research experience in the field of molecular biology, oncology and retinal disease. In collaboration with Dr Sandeep Saxena at National Institute of Immunology (NII), he discovered a new tumor suppressor miRNA- miR874 which is down regulated in aggressive osteosarcoma. Subsequently, in collaboration with Prof. J. Ambati at University of Virginia USA, he discovered the novel mechanism of Alu complementary DNA formation and its cytotoxic effect on Retinal Pigmented Epithelial (RPE) cells in advanced form of age related macular degeneration (AMD) which is a leading cause of blindness in elderly people and re-purposed Nucleoside reverse transcriptase inhibitor (NRTIs), frontline anti-HIV drug for the treatment of AMD using in vivo mouse model. He is a recipient of prestigious Ramanujan Fellowship from DST, Govt of India and DBT-RA fellowship from DBT, Govt of India. He has authored about 14 research articles in high impact journals. Currently, the central thrust of his laboratory at JH-IMM is to understand the novel molecular mechanism that contributes to intraocular and metastatic extraocular retinoblastoma by investigating the retro transposable element LINE-1. His previous work identified evidence of LINE-1 expression and activity in retinal tissue on pathogenesis of age related macular degeneration (AMD).

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	Biomedical Research and Development	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	Principles of Immunology	4	100
BMS 304	Communication and analytical skills or MOOCs course at https://www.mooc.org	4	100
BMS 305	Practical 3: 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 following Program Outcomes:

PO1: Students will gain multidisciplinary knowledge in biomedical field.
PO2: Students will gain hands-on skill sets encompassing basic, clinical and translational Biomedical sciences.
PO3: The program will train to improve students in their personalities in facing interview, present their scientific work in public/to scientific communities
PO3: The program 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 (POs) with the program specific outcomes (PSOs)

Program Specific Outcomes [PSOs]													
Program outcomes	**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**
PO1	+++	+++	+++	+	+++	+++	+++	+	+	+++	+++	+++	+	+
PO2	++	+	+	+++	+	+	++	++	+++	+	+	+	++	+++
PO3	+	+	++	+	+	+	+	+++	+	+	+	+	+++	+++
PO4	+	+	+	+++	+	+	+	+	+++	+	+	+	+++	+++

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 (40 marks) and end of semester examination (60 marks)
4. Internal Assessment 40 marks: a. Attendance = 10 marks; b. Test / Assignments 3x10 = 30 marks.
5. End of semester examination 60 marks.

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.
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 (40 marks) and end of semester examination (60 marks)
4. Internal Assessment 40 marks: a. Attendance = 10 marks; b. Test / Assignments 3x10 = 30 marks.
5. End of semester examination 60 marks.

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; Hematopoietic 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

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 (40 marks) and end of semester examination (60 marks)
4. Internal Assessment 40 marks: a. Attendance = 10 marks; b. Test / Assignments 3x10 = 30 marks.
5. End of semester examination 60 marks.

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

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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 (40 marks) and end of semester examination (60 marks)
4. Internal Assessment 40 marks: a. Attendance = 10 marks; b. Test / Assignments 3x10 = 30 marks.
5. End of semester examination 60 marks.

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 (80 marks) and with the final semester practical exam including viva (120 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 (40 marks) and end of semester examination (60 marks)
4. Internal Assessment 40 marks: a. Attendance = 10 marks; b. Test / Assignments 3x10 = 30 marks.
5. End of semester examination 60 marks.

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 (40 marks) and end of semester examination (60 marks)
4. Internal Assessment 40 marks: a. Attendance = 10 marks; b. Test / Assignments 3x10 = 30 marks.
5. End of semester examination 60 marks.

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 (40 marks) and end of semester examination (60 marks)
4. Internal Assessment 40 marks: a. Attendance = 10 marks; b. Test / Assignments 3x10 = 30 marks.
5. End of semester examination 60 marks.

Paper 4

Seminar presentation by students/MOOCS course: 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 (40 marks) and end of semester examination (60 marks)
4. Internal Assessment 40 marks: a. Attendance = 10 marks; b. Test / Assignments 3x10 = 30 marks.
5. End of semester examination 60 marks.

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 (80 marks) and with the final semester practical exam including viva (120 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 (40 marks) and end of semester examination (60 marks)
4. Internal Assessment 40 marks: a. Attendance = 10 marks; b. Test / Assignments 3x10 = 30 marks.
5. End of semester examination 60 marks.

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 (40 marks) and end of semester examination (60 marks)
4. Internal Assessment 40 marks: a. Attendance = 10 marks; b. Test / Assignments 3x10 = 30 marks.
5. End of semester examination 60 marks.

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 (40 marks) and end of semester examination (60 marks)
4. Internal Assessment 40 marks: a. Attendance = 10 marks; b. Test / Assignments 3x10 = 30 marks.
5. End of semester examination 60 marks.

Paper 4

Communication and Manuscript Preparation/MOOCS course: 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 (40 marks) and end of semester examination (60 marks)
4. Internal Assessment 40 marks: a. Attendance = 10 marks; b. Test / Assignments 3x10 = 30 marks.
5. End of semester examination 60 marks.

OR

A MOOC - Max Marks 100; Credits - 4

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

Paper 5

Practical 3: 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 (80 marks) and with the final semester practical exam including viva (120 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	+	+	+	+	+	+	+	+++	+	+	+	+	+	+

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++ '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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