

Scheme of Teaching
&
Detailed Syllabus
For
Master of Science

M.Sc. (Biomedical Sciences)
(Two Year Program)
(w.e.f. Academic Session 2018–19)



School of Basic & Applied Sciences
Shobhit Institute of Engineering & Technology
(Deemed to-be University)
NH-58, Modipuram, Meerut (U.P.) – 250110

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Shobhit Institute of Engg. & Tech.
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NH-58, Modipuram, Meerut-250110

M.Sc. Biomedical

Overview: M.Sc. Biomedical Sciences concerns with the topics to understand the biological principles that govern the functioning of the human body, to discover the mechanisms of any disease and to find new and distinct ways to cure a disease by developing advanced diagnostic tools or new therapeutic strategies. The M.Sc. (Hons) Biomedical Science started as an interdisciplinary course at Shobhit University, Meerut. It is the applied domain of life and natural sciences, used for diagnosis, prevention and treatment of human diseases. This course is suited for those students who are desirous of teaching at the college level. Students should have skills like identifying blood groups, interpreting results and liaising with medical staff, maintaining records and writing medical reports to seek admission to M.Sc. Hons. (Biomedical Sciences).

Program Objectives:

1. Graduates will gain and integrate the key concepts of living systems such as cellular organization, transmission of biological information, and structure-function relationships.
2. Graduates will be able to apply fundamental concepts in the core areas of medical biochemistry, microbiology, and drug design to a succinct research problem in the chosen specialty area.
3. Graduates will be able to demonstrate knowledge of biomedical science arising from fundamental, translational, and clinical research.
4. Graduates will be able to apply fundamental concepts of the biomedical sciences to public health issues, in particular, prevention, diagnosis, and treatment of disease.
5. Graduates will be able to demonstrate a set of core laboratory skills, acquire, process and analyze biomedical data using appropriate mathematical and statistical techniques.
6. Graduates will be able to acquire and collate information from various sources that are relevant to a given biomedical question and objectively interpret them to draw an informed conclusion.
7. Graduates will develop critical thinking skills for applying scientific knowledge in research and problem-solving skills.
8. Graduates will be able to disseminate biomedical information in a variety of written and oral formats, using clear and coherent arguments, to scientific and non-scientific audiences.
9. Graduates will be able to evaluate recent advances in biomedical knowledge and recognize the limits of the scientific process.
10. Graduates will demonstrate competency in the ability to work well both independently and collaboratively and to conduct, analyze, report research findings.
11. Graduates will be able to evaluate and discuss contemporary social and ethical issues related to the biomedical sciences.
12. Graduates will exercise responsible and ethical conduct in scholarship and research demonstrating honesty, accuracy, efficiency, and objectivity while upholding the highest standards of integrity and professionalism.

Program Specific Outcomes (PSOs):

1. Apply knowledge of Medical Biochemistry, Microbiology, Immunology, Pharmacology, and related disciplines to solve problems in the chosen specialty area and public health issues.
2. Demonstrate the application of biomaterials and tissue engineering principles through development of innovative products that are of beneficial for the human welfare and the nation.
3. Exhibit skills for efficient hospital management and biomedical waste management in the healthcare set up.
4. Exhibit strong, independent learning, analytical and problem solving skills with special emphasis on design, communication, and ability to work in teams.
5. Pursue higher education and research in reputed institute at national and international level.

C. Course outcome (COs): MSc Biomedical Science

Course Code	Course name	Course outcomes	
Semester I			
BMMS-101	Medical Biochemistry	CO1	In-depth understanding of cell structure and functions, the fundamental unit of life and recent advancements.
		CO2	Understanding of biocatalysis and laboratory investigations related to bioreactions.
		CO3	To develop skills related to the clinical laboratory test useful for detecting health problems, determining prognosis and guiding the therapy of a patient.
		CO4	To gain a deeper understanding of aspects related to nutritional biochemistry and its clinical applications
		CO5	To develop an analytical mind to enhance the understanding of the biochemistry experiments and formulating reports.
BMMS-102	Pharmaceutical Chemistry	CO1	Understanding of key technologies involved in drug development from natural resources
		CO2	To know the concepts and applications of enzyme technology in clinical science
		CO3	Understanding the role of building blocks in disease cure and management along with their mechanism of action
		CO4	To understand the experimental process associated with the design and synthesis of biologically active molecules.
		CO5	Ability to design students research project and reports related to analytical method development and validation of APIs, herbal products, and phytochemistry

BMMS-103	Advanced Human Physiology	CO1	In-depth understanding for the anatomy and physiology of human body
		CO2	Ability to demonstrate the structural and functional aspects of major vital organs and systems like Central nervous system and plexuses, Respiratory system, and Cardiovascular/hematologic system
		CO3	Identify the musculoskeletal systems and their processes as they relate to each region of the body.
		CO4	To understand the impact of environmental on human physiology
		CO5	Skills to understand the advancements related to the human physiology
BMMS-104	Bioinstrumentation	CO1	To understand the principles of analytic instruments used for qualitative and quantitative detection of chemical and biological components
		CO2	To display the conceptual and practical skills related to the spectroscopic methods and its current applications.
		CO3	In-depth understanding of the working principles of mass spectrometry and identification of compatible technique
		CO4	Understanding the concepts related to the determination of quality control, purity and molecular structure of the sample through NMR
		CO5	Ability to develop logical lab reports and study designs using analytical techniques
BMMS-105	Forensic Sciences	CO1	Demonstrate competency in the collection, processing, analyses, and evaluation of evidence.
		CO2	Demonstrate competency in the principles of crime scene investigation, including the recognition, collection, identification, preservation, and documentation of physical evidence.
		CO3	Demonstrate an understanding of the scientific method and the use of problem-solving within the field of forensic science.
		CO4	Identify the role of the forensic scientist and physical evidence within the criminal justice system.
		CO5	Demonstrate the ability to document and orally describe crime scenes, physical evidence, and scientific processes.
BMMS-106	Fundamental of Bioinformatics	CO1	Skills development related to the acquisition, storage, analysis, and dissemination of biological data
		CO2	To develop practical skills related to the modeling of

			biological systems
		CO3	Ability to identify correlations between gene sequences and diseases,
		CO4	Ability to predict protein structures from amino acid sequences, to aid in the design of novel drugs
		CO5	Ability to understand new developments in genome bioinformatics and computational biology
BMMS-151	Medical Biochemistry Lab.	CO1	To develop essential research, diagnostic, and laboratory skills.
		CO2	To identify the structural elements of proteins, the basic features of enzyme catalysis and regulation, and the function of hemoglobin in oxygen binding and transport.
		CO3	Able to demonstrate skills related to the nucleic acids quantification
		CO4	Case studies related to nutritional deficiency
		CO5	To develop an analytical mind to enhance the understanding of the biochemistry experiments and formulating reports
BMMS-152	Pharmaceutical Chemistry Lab.	CO1	analytical method development and validation of APIs and formulations,
		CO2	standardization of herbal products using modern analytical techniques
		CO3	phytochemistry, natural product isolation from plants and their bioactivity,
		CO4	formulation development of phytochemicals
		CO5	Preparation of study reports and manuscripts
Semester II			
BMMS-201	Medical Microbiology & Immunology	CO1	Identification, classification, and characterization of bacterial species for the diagnosis of infectious diseases
		CO2	In-depth understanding of clinical aspects of pathogenic viruses.
		CO3	Enhanced understanding about the treatment of parasitic infection through advancing systems of their diagnoses.
		CO4	Understanding about the molecular and cellular basis of immune system.
		CO5	Understanding the processes that enable the immune systems to respond to evolving threats, and understand new, immunology-based disease treatments.

BMMS-202	Genome Biology	CO1	Enhanced understanding about the complexity of genetic inheritance in humans.
		CO2	Familiarity with the statistical tools used in genomic data analysis, linkage analysis by LOD score, association studies.
		CO3	Conceptual knowledge about the methods used for whole genome analysis and their applications..
		CO4	Theoretical skills related to the use of various databases containing annotation, experimental data from NGS, RNA seq and microarray and ENCODE.
		CO5	Ability to understand research advancements in the field of genomics
BMMS-203	Fundamentals of Cancer Biology	CO1	Understanding of tumor biology at cellular and molecular level
		CO2	Understanding of conventional cancer therapies and research advancements in cancer treatment
		CO3	Understanding of the cellular, genetic and epigenetic basis of cancer.
		CO4	Understanding the principles of in-vitro and in-vivo models of cancer
		CO5	Overall expansion of theoretical and practical aspects of oncology.
BMMS-204	Advanced Medicinal Chemistry	CO1	Knowing the structural activity relationship of different class of drugs.
		CO2	Understanding the importance of medicinal chemistry in drug discovery process
		CO3	Qualitative and quantitative applications of pharmacokinetics and pharmacodynamics principles
		CO4	Techniques for discovering molecules with desired biological activity
		CO5	Qualitative and quantitative applications of molecular modeling and computer aided drug design techniques
BTMS-203	Genetics	CO1	Understanding the principles of Classical Genetics.
		CO2	Solving hybrid cross genetic outcomes utilizing branch diagrams and/or Punnett squares. Using testcrosses to identify parental genotype and confirm the principle of segregation.
		CO3	Using the laws of probability to statistically analyze the outcomes of genetic crosses
		CO4	Understanding the importance of Drosophila in Genetics

		CO5	An overview of fundamental concepts behind the evolving fields of human genetics, genomics, and precision medicine.
BMMS-251	Medical Microbiology & Immunology Lab	CO1	Ability to conduct microbiology culture experiments
		CO2	Ability to carry out different types of microbial staining
		CO3	Ability to conduct antibiotic sensitivity profile and biochemical analysis of the given microbial culture
		CO4	Exposure to various immunological techniques including antigen-antibody interactions, quantization of antigens or antibody, ELISA, agglutination reactions
		CO5	Skills to prepare reports and short communications
BMMS-252	Genome Biology Lab	CO1	Ability to Construct Pedigree chart for family history.
		CO2	Basic understanding of experimental tools used in modern genomics
		CO3	Basic concepts related to DNA sequencing
		CO4	Practical skills related to the use of various databases containing annotation, experimental data from NGS, RNA seq and microarray and ENCODE.
		CO5	Understanding of next-generation sequencing experiments
Semester-III			
BMMS-301	Pharmacology & Toxicology	CO1	Advanced learning in molecular, cellular, neuro, receptor and organs systems pharmacology
		CO2	In-depth understanding of the drug properties, response, interactions
		CO3	Understanding for the molecular and cellular mechanisms of toxicity and to risk assessment.
		CO4	Advanced concepts in adverse effects of toxicology
		CO5	Ability to plan and conduct a pharmacology project and toxicological assays
BMMS-302	Biomedical Instrumentation	CO1	Explain basic electrophysiology mechanism involve in bio-potential generation
		CO2	Examine the bioelectrical and non-bioelectrical activities.
		CO3	Explain the working of patient monitoring system, diagnostic and therapeutic equipments
		CO4	Skills for data processing generated through biomedical instruments by softwares

		CO5	Overall understanding of the designing, manufacturing, maintenance, repair and operation of medical equipment.
BMMS-303	Biomaterials and Tissue Engineering	CO1	Conceptual knowledge about the principles of biomaterial.
		CO2	Understanding about the in-depth applications of biomaterials in clinical science
		CO3	Understanding of the methods used for biomaterials surface characterization and related properties
		CO4	Conceptual knowledge about the creation of artificial organs for transplantation through tissue engineering
		CO5	In-depth understanding of basic cell culture techniques, structure function relationships, cellular communication, natural and artificial biomaterials, and the basic equations governing cell survival and tissue organization.
BMMS-304	Biomedical Waste Management	CO1	Essential knowledge about the types of health care waste and its impact on health and environment
		CO2	Familiarity with the existing legislation, knowledge and practices regarding health care waste Management practices
		CO3	Conceptual skills to manage health care waste effectively and safely.
		CO4	Understanding of challenges related to safety issues for patients and medical staff.
		CO5	Case studies solution for Strategic planning and development and planning for Biomedical Waste Management
BMMS - 305	Hospital Management & Biosafety	CO1	Advanced understanding about the managerial and administrative roles at a hospital or a healthcare institute
		CO2	In-depth knowledge about the regulatory authorities related to hospital sector
		CO3	Case studies solution to demonstrate leadership skills, teamwork, analytical skills, interpersonal skills, problem solving skills
		CO4	Understanding the importance of patient-centred care with a continuous quality improvement orientation ensure smooth functioning of core process by forecasting, streamlining patient flow, staff scheduling, planning space/ facilities/ supplies, maintenance.
		CO5	In-depth understanding of bioethics in medical research
BMMS-351	Pharmacology & Toxicology Lab	CO1	Ability to conduct in-vitro pharmacology experiments
		CO2	Ability to conduct in-vivo pharmacology experiments

		CO3	Ability to conduct in-vitro toxicology experiments
		CO4	Ability to conduct in-vivo toxicology experiments
		CO5	Conceptual knowledge about regulatory requirements for safety studies
BMMS-352	Biomedical Instrumentation Lab.	CO1	Practical knowledge about the working of different Biomedical Instruments.
		CO2	Ability to troubleshoot different Bio Medical machine / Instruments
		CO3	Calibrate and handle the equipments related to the patient care and monitoring
		CO4	Ability to apply apply hypothetical math and material science ideas to fix the challenges related to electrical circuits in the biomedical field.
		CO5	Ability to process data through softwares
BTMS-311	Biostatistics	CO1	Ability to calculate summary statistics from biomedical data
		CO2	Ability to interpret written and visual presentations of statistical data
		CO3	Evaluate and interpret results of descriptive statistics and regression methods
		CO4	Ability to choose the most appropriate statistical method to answer your research question
		CO5	Statistical analysis through softwares
Semester-IV			
BMMS-481	Seminar	CO1	Comprehensive Literature review skills for the chosen topic
		CO2	Critical appraisal of the reported outcomes
		CO3	Skills for preparation of visually attractive and logical presentation and posters
		CO4	Skills for presenting the debate and open discussions
		CO5	Skills for team work and self reflection
BMMS-471	Project Work/Dissertation/ Industrial Training	CO1	Identification of research area and topic
		CO2	Skills to develop research design
		CO3	Skills for study planning, timelines and costings
		CO4	Skills to lead the experiment project

		CO5	Data interpretation, original dissertation report preparation, and manuscript
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Eligibility Criteria:

A candidate who has passed Bachelor's Degree in Biological Sciences (Microbiology, Biochemistry, Biotechnology, Genetics, Biomedical Science, Botany, Zoology, Bioinformatics, Marine Biology, Computational Biology, B. Pharm, B.Sc., Nursing (3or4years), Pharmacology) or any other Biological sciences degree with at least 50% of marks.

Credit Distribution:

Category	Courses	L	T	P	Credits
Core (BME)	15 T+ 6L		15	12	66
Open Elective	2	4	-	2	6
Skill Enhancement	2	2	-	2	4
Internship / Project	1	-	-	24	12
	Total				86

Semester I						
S.No.	Course Code	Course / Title	L	T	P	Credit
1.	BMMS-101	Medical Biochemistry	3	1	0	4
2.	BMMS-102	Pharmaceutical Chemistry	3	1	0	4
3.	BMMS-103	Advanced Human Physiology	3	1	0	4
4.	BMMS-104	Bioinstrumentation	3	1	0	4
5.	BMMS-105	Forensic Sciences	3	1	0	4
6.	BMMS-106	Fundamental of Bioinformatics	2	0	0	2
7.	BMMS-151	Medical Biochemistry Lab.	0	0	2	1
8.	BMMS-152	Pharmaceutical Chemistry Lab.	0	0	2	1
		Total	17	5	4	24

Semester II						
S.No.	Course Code	Course / Title	L	T	P	Credit
1.	BMMS-201	Medical Microbiology& Immunology	3	1	0	4
2.	BMMS-202	Genome Biology	3	1	0	4
3.	BMMS-203	Molecular Oncology	3	1	0	4
4.	BMMS-204	Advanced Medicinal Chemistry	3	1	0	4
5.	CSMS-209	Fundamental of Information Technology	2	0	0	2
6.	BTMS-203	Genetics	3	1	0	4
7.	BMMS-251	Medical Microbiology& Immunology Lab	0	0	2	1
8.	BMMS-252	Genome Biology Lab	0	0	2	1
		Total	17	5	4	24

Semester III						
S.No.	Course Code	Course / Title	L	T	P	Credit
1.	BMMS-301	Pharmacology & Toxicology	3	1	0	4
2.	BMMS-302	Biomedical Instrumentation	3	1	0	4
3.	BMMS-303	Biomaterials and Tissue Engineering	3	1	0	4
4.	BMMS-304	Biomedical Waste Management	3	1	0	4
5.	BMMS -305	Hospital Management & Biosafety	3	1	0	4
6.	BMMS-351	Pharmacology & Toxicology Lab	0	0	2	1
7.	BMMS-352	Biomedical Instrumentation Lab.	0	0	2	1
8.	BTMS-311	Biostatistics	0	0	4	2
		Total	15	5	4	24

Semester IV						
S.No.	Course Code	Course / Title	L	T	P	Credit
1.	BMMS-481	Seminar	0	0	4	2.0
2.	BMMS-491	Dissertation	0	0	12	12.0
		Total	0	0	16	14.0

Course code	BMMS-101				
Category	Core Biomedical				
Course title	Medical Biochemistry				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	Basic Knowledge of Biology				
Objectives	Biochemistry is a discipline, which aims at understanding the chemical properties of the biomolecules, their structural architecture and how they fold to their native, functional forms. This course includes metabolic pathways and their regulation, protein stability, folding and mis-folding, various analytical techniques used in characterization of the proteins and a detailed account of how enzymes function: their kinetics, regulation and inhibition.				
Outcomes	<p>Students would be able to:</p> <ul style="list-style-type: none"> • Demonstrate a broad knowledge of the fundamental introductory concepts of Chemistry, Biology and Physics. • Demonstrate a thorough knowledge of the intersection between the disciplines of Biology and Chemistry. • Demonstrate a proficiency in developing relevant biochemical questions, carrying out laboratory investigations to answer those questions, and critically analyzing, interpreting, and presenting in oral and written form the results of their experiments. • Locate, critically analyze, interpret and discuss data, hypotheses, results, theories, and explanations found in the primary literature, applying knowledge from Chemistry and Biology. • Appreciate the way in which practitioners in the disciplines of Biology and Chemistry intersect and bring their expertise to bear in solving complex problems involving living systems. <p>Understand the societal impacts, both positive and negative, of science and technology and the limitations of science.</p>				
Unit I	Cell and its functions: Structure & Function of Cell Membrane, Subcellular Organelles and their Functions. Carbohydrates- Definition, Classification & Biological importance of carbohydrates, Derivatives of Monosaccharides. Proteins- Definition & Classification of amino acids & Proteins, Biologically important peptides, Plasma proteins, Immunoglobulins. Lipids- Definition, Classification & Biological importance and Functions of Lipids. Structure and functions of Cholesterol, types and functions of Lipoproteins. Nucleotides- Structure and Functions of DNA & RNA. Biologically important nucleotides				08
Unit II	Enzymes: Definition and Classification. Factors affecting enzyme activity. Coenzymes and Cofactors. Enzyme inhibition & Regulation of enzyme activity. Acid Base balance- Acids, Bases & Body Buffers, Regulation of pH, Acid base disorders.				08
Unit III	Vitamins: Classification, Sources, RDA, Functions (in brief), deficiency manifestations and hypervitaminosis. Minerals- Classification, Sources, RDA, Functions (in Brief), deficiency manifestations of the following: calcium, phosphorous, iron, copper, iodine, zinc, fluoride, magnesium, selenium, sodium, potassium and chloride.				08
Unit IV	Nutrition: Nutrients, Calorific value of food, BMR, SDA, respiratory quotient and its applications, Balanced diet based on age, sex and activity, biological value of proteins, nitrogen balance, Protein energy malnutrition, Total parenteral nutrition, dietary fibers. Blood chemistry- Biochemical components & their reference ranges in normal & diseased states. Urine chemistry- Biochemical components & their reference ranges in normal & diseased states.				08

Unit V	Clinical Biochemistry: Specimen Collection- Blood, Urine and Body fluids. Preanalytical, analytical and postanalytical errors. Clinical Biochemistry-Parameters to diagnose Diabetes & Cardiovascular diseases. Diagnostic enzymology, Assessment of arterial Blood gas status and electrolyte balance, Point of Care Testing. Renal Function tests (in brief), Liver function tests(in brief), Biomedical Waste Management.	08
Course Title	Medical Biochemistry Lab.	CR
Course code	BMMS-151	1.0
<p>PRACTICALS : (Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)</p> <ol style="list-style-type: none"> 1. Salting in and salting out of proteins. 2. Desalting of proteins by dialysis and Sephadex G-25. 3. Protein estimation by Loorys& Bradford methods. 4. Ion-exchange chromatography. 5. Affinity chromatography for protein purification. 6. To check purity of protein & subunit structure by SDS page & silver staining. 7. Western blot analysis to check special proteins. 8. Isolation of genomic & plasmid DNA. 9. Protein & Nucleic Acid blasts, Clustal W and sequence alignment etc. 		
References	<ol style="list-style-type: none"> 1. Lehninger Principles of Biochemistry, 5th edition (2012), David L. Nelson and Michael M. Cox; W. H. Freeman, ISBN-13: 978-0716771081. 2. An Introduction to Practical Biochemistry, 3rd edition (1987), Plummer, McGraw-Hill College; ISBN-13: 978-0070841659. 3. Introduction to Protein Structure, 2nd edition (1999), Carl Branden and John Tooze; Garland Science, ISBN-13: 978-0815323051. 4. Principles and Techniques of Practical Biochemistry, 5th edition (2000), Keith Wilson and John Walker; Cambridge University Press, ISBN -13: 978-0521799652. 5. Protein Folding, 1st edition (1992), Thomas E. Creighton; W. H. Freeman Company, ISBN13: 978-0716770275. 6. Structure and Function of Intrinsically Disordered Proteins, 1st edition (2010), Peter Tompa; CRC Press, ISBN-13: 978-1420078923. 	

Course code	BMMS-102				
Category	Core Biomedical				
Course title	Pharmaceutical Chemistry				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	Basic Knowledge of chemistry and biological processes				
Objectives	The course highlights the importance of Medicinal Chemistry in all our lives and the fascination of working in a field that overlaps the disciplines of chemistry, biology, biochemistry, pharmacology etc. It gives brief understanding about drug-receptor interactions, lead discovery, drug design and molecular mechanism by which drug act in the body. The course emphasizes on various drug targets in the body and drug development strategies with mechanism of action of antibacterial agents and concept of drug resistance.				
Outcomes	completion of this course will be helpful in 1. Correlating between pharmacology of a disease and its mitigation or cure. 2. Understanding the drug metabolic pathways, adverse effect and therapeutic value of drugs 3. Knowing the structural activity relationship of different class of drugs. 4. Well acquainted with the synthesis of some important class of drugs. 5. Knowledge about the mechanism pathways of different class of medicinal compounds. 6. To understand the chemistry of drugs with respect to their pharmacological activity.				
Unit I	Introduction to pharmaceuticals –Pharmaceutical products from natural resources Extraction of active compounds – Identification of active compounds – Structural elucidation- Fractionation of active compounds by HPLC and GC – NMR techniques for structure determination – drug development for research on natural products.				08
Unit II	Enzymes – Detection of abnormal isozymes – Enzymes employed on a clinical basis – Plasmin – Blood clotting disease – Genetic defect – Liver disease - Bilirubin metabolisms – Jaundice.				08
Unit III	Amino acids – Amino end degradation – Carboxyl end degradation – Protein – Historic development of treatment for sickle cell disease – Hydroxyura treatment – Amyloid deposition in Alzheimer’s disease.				08
Unit IV	Alkaloids – Molecular structure and biological activity of alkaloids – Pyrrolidine alkaloids – Tropane alkaloids – Phenanthrene alkaloids – Role of alkaloids in pharmaceuticals – Terpenoids – Polynuclear Aromatic Hydrocarbons.				08
Unit V	Nucleotide metabolisms – Chemotherapy of breast cancer – Cyclophosphamide – Methotrexate – Fluorouracil – Hypothalamic neuropeptides – Hormones – Sex steroids – Infertile young woman and man – Sarcoidosis with Hypercalcemia – Medical need and pharmaceutical market.				08
Course Title	Pharmaceutical Chemistry Lab.				CR
Course code	BMMS-152				1.0
PRACTICALS : (Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)					
1. Preparation of Benzocaine.					
2. Preparation of Benzoquinone.					
3. Preparation of Aspirin and determination of partition coefficient in octanol-water system.					
4. Preparation of Paracetamol.					

	<ol style="list-style-type: none"> 5. Preparation of Phenacetin. 6. Preparation of Hippuric acid. 7. Preparation of s-benzyl thiuronium salt. 8. Extraction of caffeine from tea leaves and study its absorption properties. 9. Phytochemical screening and qualitative chemical examination of various plant constituents by Solvent extraction. (Detection of alkaloids, carbohydrates, glycosides, phytosterols, oils and fats, tannins, proteins, gums and mucilages).
References	<ol style="list-style-type: none"> 1. Introduction to Medicinal Chemistry, 4th edition (2009), Graham I. Patrick, Oxford University Press. ISBN-13: 978-0199234479. 2. The Organic Chemistry of Drug Design and Drug Action, 2nd edition (2004), Richard B. Silvermann, Elsevier, Academic Press. ISBN-13: 978-0126437324. 3. Medicinal Chemistry: A Molecular and Biochemical Approach, 3rd edition (2005), Thomas Nogrady and Donal F. Weaver, Oxford University Press. ISBN-13: 978-0195104561.

Course code	BMMS-103				
Category	Core Biomedical				
Course title	Advance Human Physiology				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	Basic Knowledge of Biology				
Objectives	The prime concern of this syllabus is to integrate the individual functions of all the cells and tissues and organs into functional whole, the human body. Since function is dependent on a structure, the curriculum lays stress on functional anatomy of the organs. It attempts to highlight the necessary bodily balances and internal bodily control so called homeostasis as well as present their abnormal function in disease. It provides a link between basic sciences and Medicine.				
Outcomes	<p>Upon successful completion of the course, the student will be able to:</p> <p>Label the functions of the human anatomy and physiology from a regional perspective for the following regions and systems: a. Head and neck, thoracic, abdominopelvic, and upper and lower extremities.</p> <ol style="list-style-type: none"> 1. Major skeletal muscles, their actions, origins, insertions, and peripheral nerves. c. Central nervous system and plexuses d. Respiratory system e. Cardiovascular/hematologic system 2. Identify the major structures of the human anatomy for the following: a. Head and neck, thoracic, abdominopelvic, and upper and lower extremities. b. Major skeletal muscles, their actions, origins, insertions, and peripheral nerves. c. Central nervous system and plexuses d. Respiratory system e. Cardiovascular/hematologic system 3. Identify the major bones and their processes as they relate to each region of the body. 4. Tell briefly the basic components and functions of the gastrointestinal, renal/urinary, endocrine/metabolic, hepatic/biliary, genital/reproductive and immunologic, systems. 5. Identify the findings from a simulated healthcare record such as electrocardiogram data and pulmonary ventilation outcomes. 				
Unit I	<p>Sensory Physiology: Central nervous system synapses. Some special characteristics of synaptic transmission, Sensory receptors. Neuronal circuits for processing information. Somatic sensations: Tactile and position senses. Sensory pathways for transmission of somatic signals into the central nervous system. Transmission in dorsal column – medial lemniscal system. Pain, headache, and thermal sensations: Pain receptors and their stimulation, Dual transmission of pain signals into the central nervous system. Referred and visceral pain. Eye: Optics of vision, Receptor and neural function of retina, Photochemistry of vision, Color vision, Neural function of retina. Central neurophysiology of vision, Organization and function of visual cortex. Hearing: Tympanic membrane and ossicular system, Cochlea, Central auditory mechanisms, Vestibular sensations and maintenance of equilibrium. The chemical senses - taste and smell.</p>				08
Unit II	<p>Nervous system: motor and integrative neurophysiology: Motor functions of spinal cord. Spinal cord reflexes. Muscle sensory receptors - muscle spindles and Golgi tendon organs and their roles in muscle control, Flexor reflexes and withdrawal reflexes, Reflexes of posture and locomotion. Cortical and brain stem control of motor function: Motor cortex and corticospinal tract, Role of brain stem in controlling motor function. Cerebellum, basal ganglia and motor control. Integration of all parts of total motor control system. Cerebral Cortex: intellectual functions of brain, learning and memory. Physiologic anatomy of cerebral cortex. Functions of specific cortical areas, Association areas. Function of brain in communication - language input and output. Function of corpus callosum and anterior commissure. Thoughts, consciousness and memory. Behavioral and motivational mechanisms of brain. Limbic system and hypothalamus. Activating-driving systems of brain. Functional anatomy and functions of limbic system and</p>				08

	hypothalamus. States of brain activity. Sleep. Slow-wave sleep. REM sleep. Basic theories of sleep. Brain waves. Origin in brain of brain waves (EEG). Epilepsy, Psychotic behavior and dementia - roles of specific neurotransmitter systems.	
Unit III	Metabolism and Temperature Regulation: Metabolism of carbohydrates and formation of adenosine triphosphate. Lipid metabolism. Dietary balances, regulation of feeding, obesity and starvation. Vitamins and minerals. Energetics and metabolic rate. Body temperature, temperature regulation and fever.	08
Unit IV	Endocrine glands & Hormones: Endocrine glands & Hormones, Pituitary: Structure and function, Hypothalamic control of pituitary glands. Thyroid structure, function of parathyroid hormones. Adrenal Cortex, Structure and function of its hormones; Adrenal Medullary; function of its hormones. Pancreas: Function of its hormones.	08
Unit V	Environmental Physiology: High altitude, space and Deep Sea Diving Physiology: Effect of low oxygen pressure on the body, Effects of Acceleratory forces on the body in aviation and space physiology, Effect of High partial pressure of gases on the body.	08
References	<ol style="list-style-type: none"> 1. Guyton and Hall Textbook of Medical Physiology, 11th edition (2006), J. E. Hall; W B Saunders and Company, ISBN-13: 978-1416045748. 2. Human Physiology, 9th edition (2006), Stuart I. Fox; Tata McGraw Hill, ISBN-13: 978- 0077350062. 3. Lab Manual on Blood Analysis and Medical Diagnostics, 1st edition (2012), Dr. Gayatri Prakash; S. Chand, ISBN: 81-219-3967. 4. Manual of Practical Physiology, 4th edition (2012), A. K. Jain; Arya Publication, ISBN: 8178553155. 5. Principles of Anatomy and Physiology, 13th edition (2011), Gerard J. Tortora and Bryan H. Derrickson; Wiley and Sons, ISBN-13: 978-0470565100. 6. Ganong's Review of Medical physiology, 24th edition (2012), K. E. Barrett, S. M. Barman, S. Boitano and H. Brooks; Tata McGraw Hill, ISBN-13: 978-0071780032. 7. Textbook of Practical Physiology, 7th edition (2007), CL Ghai; Jaypee Publication, ISBN-13: 978-8184481419. 	

Course code	BMMS-104				
Category	Core Biomedical				
Course title	Bioinstrumentation				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	Basic Knowledge of physics and Electronics				
Objectives	Objective of this course is to acquaint the students with the recording methodology (placement of electrode or sensor, equipment, analysis and safety procedures) for electrical and non-electrical signals. It will also be helpful for them to understand the mechanism of signal origination and specified amplifier used for signal recording.				
Outcomes	After studying this course, students will able to: 1. Explain basic electrophysiology mechanism involve in bio-potential generation. 2. explain the working of patient monitoring system, diagnostic and therapeutic equipments 3. Examine the bioelectrical and non-bioelectrical activities. 4. Calibrate and handle the equipments related to the patient care and monitoring. 5. Students will know the definitions, basic principles and the applications of the available diagnostic and therapeutic devices.				
Unit I	Introduction: Principles of Instrumental Analysis, Types of Instrumental Methods to be covered in the course. Selecting an analytical method and developing a new Analytical Technique.				08
Unit II	Separation Methods: An introduction to chromatographic separation, Gas Chromatography, High Pressure Liquid Chromatography and FPLC, Supercritical fluid chromatography				08
Unit III	Mass Spectrometry: Explanation of mass Spectrometry. Forming charged particles: Electron impact (EI) and Chemical Ionization(CI), Fast Atom Bombardment (FAB), Field Desorption (FD), Electrospray Ionization, Matrix Assisted Laser Desorption Ionization (MALDI). Mass Analyzers: Magnetic sector mass spectrometers, Double focusing mass spectrometers, Quadrupole pole mass spectrometers, ion cyclotron resonance, Time of Flight mass analyzers. Combine the mass spectrometer with Gas Chromatography (GC/MS) and with liquid chromatography (LC/MS). Applications of mass spectrometry in Biomedical field.				08
Unit IV	Nuclear Magnetic Resonance Spectroscopy: Theory of NMR: Quantum description, Classical description – Processional motion, Larmour frequency, Relaxation processes, T1 and T2 and their measurement. Fourier Transform NMR: Pulsed excitation, FID, Types of NMR Spectra – Wild line and high resolution spectra. NMR Spectrometers: Instrumentation. Environmental Effects: Types, Chemical shift theory, Magnetic anisotropy, Spin–spin splitting, first order and second order spectra, Double Resonance Techniques, Proton on heteroatom. Application of proton NMR: Identification of compounds. ¹³ C NMR: Proton decoupling: Broad band, off-resonance, Pulsed decoupling, NOE, application to structure determination. Magnetic Resonance Imaging: The concept of MRI, Application in Muscle Physiology, functional mapping of brain. Other nuclei : ³¹ P, ¹⁹ F, ²³ Na, ¹⁵ N				08
Unit V	Miscellaneous Techniques in Biomedical Sciences: Ultraviolet / Visible molecular absorption spectroscopy, Fluorescence and Phosphorescence, Infrared, CD and ORD. Confocal Microscopy: Applications in Cell Biology, Electron				08

	Microscopy, Tracer Techniques in Biology: tumor diagnosis and imaging, infectious diseases such as tuberculosis, Flow Cytometry, Magnetic Assisted Cell Sorting	
References	<ol style="list-style-type: none"> 1. Waugh, A., & Grant, A. (2001). Ross and Wilson anatomy and physiology in health and illness. Churchill Livingstone. 2. Webster, J. (2010). Medical instrumentation: application and design, Fourth edition. In John Wiley and Sons, Inc. USA. 3. Khandpur, R. S. (1987). Handbook of biomedical instrumentation. McGraw-Hill Education. 4. Joseph, J. Carr, & Brown, J. M. (2001). Introduction to biomedical equipment technology. Prentice hall. 5. Clark, J. W., Neuman, M. R., Olson, W. H., Peura, R. A., Primiano, F. P., Siedband, M. P., & Wheeler, L. A. (1998). Medical instrumentation: application and design. Wiley. 	

Course code	BMMS-105				
Category	Core Biomedical				
Course title	Forensic Science				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	None				
Objectives	Forensic science is the application of scientific knowledge to questions of civil and criminal law. Interest in forensic science has grown considerably in recent years. Keeping this in view, the present forensic science course is designed for students to explore how forensic scientist's work, the tools and techniques they use and how they reach the conclusions they present in court. This engage students in using a creative, problem solving and inquiry based approach to investigate the crime scene. It also explains the characteristics of a fingerprint collect, process, and analyze fingerprint evidence and explain DNA analysis.				
Outcomes	At the completion of the Forensic Science Technology student will be able to: 1. Demonstrate competency in the collection, processing, analyses, and evaluation of evidence. 2. Demonstrate competency in the principles of crime scene investigation, including the recognition, collection, identification, preservation, and documentation of physical evidence. 3. Demonstrate an understanding of the scientific method and the use of problem-solving within the field of forensic science. 4. Identify the role of the forensic scientist and physical evidence within the criminal justice system. 5. Demonstrate the ability to document and orally describe crime scenes, physical evidence, and scientific processes. 6. Identify and examine current and emerging concepts and practices within the forensic science field.				
Unit I	Crime Scene Investigation : Introduction and principles of forensic science, Forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation				08
Unit II	Types of injuries and death : Classification of injuries and their medico-legal aspects, method of assessing various types of deaths, Case studies to depict different types of injuries and death.				08
Unit III	Forensic chemistry and Ballistics: Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives.				08
Unit IV	Forensic Graphology: General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples. Forensic Toxicology Role of the toxicologist, significance of toxicological findings				08
Unit V	Fingerprint analysis: Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification, Principle of DNA fingerprinting, application of DNA profiling in forensic medicine. Cyber Forensic Investigation				08
References	1. Forensic Science – An introduction to Scientific and Investigative Techniques, 3rd edition (2009), James SH, Nordby JJ and Bell S; CRC Press, ISBN-13: 978-1420064933. 2. Practical Forensic Microscopy: A laboratory manual, 1st edition (2008), Barbara Wheeler and Lori J Wilson; Bios Scientific Publisher, ISBN-13: 978-0470031766. 3. Forensic Handwriting Identification: Fundamentals, Concepts and Principals 1st edition				

<p>(2000) Ronald N. Morris, Academic press ISBN-13: 978-0125076401</p> <p>4. Handbook of Firearms and Ballistics: Examining Interpreting Forensic Science by Brian J Heard 2nd edition (2008), John Wiley and Sons ISBN-13: 978-0470694602.</p> <p>5. Principles of Forensic Medicine and Toxicology, 1st edition (2011) Rajesh Bardale; Jaypee Brothers Medical Pub, ISBN-13: 978-9350254936.</p> <p>6. Practical Crime Scene Processing and Investigation, 2nd edition (2011), Ross M Gardner, CRC press ISBN-13: 978-1439853023.</p> <p>7. Forensic Medicine and Toxicology: Oral, Practical And Mcq, 3rd edition (2006), Karmakar, Jaypee Brothers, ISBN-13:978-8171797350.</p> <p>8. Fundamentals of Forensic Science, 2nd edition (2010), Houck, M.M. and Siegel, JA; Academic Press, ISBN-13: 978-0123749895.</p> <p>9. Criminalistics- An Introduction of Forensic Science, 10th edition (2010), Prentice Hall Inc; ISBN-13: 978-0135045206.</p>

Course code	BMMS-106				
Category	Skill Enhancement				
Course title	Fundamental of Bioinformatics				
Scheme and Credits	Credit	L	T	P	
	2	2	0	0	
Pre-requisites (if any)	Basic knowledge of Molecular Biology and Genetics				
Objectives	This course will introduce the discipline of computational biology and drug design. It has been designed to explain the different aspects of nucleotide and protein sequence analyses, sequence alignments and their applications in understanding biology. The course will also emphasize on the strategic issues in drug discovery and development, principles of computational methods involved in lead generation virtual screening, quantitative structureactivity relationship and molecular docking.				
Outcomes	Students would be able in Sequence alignment and visualization and Phylogenetic and microarray analysis				
Unit I	Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases - primary sequence databases, protein sequence and structure databases; Organism specific databases; Data – Access, Retrieval				08
Unit II	Submission: Standard search engines; Data retrieval tools – Entrez, DBGET and SRS; Submission of (new and revised) data; Sequence Similarity				08
Unit III	Searches: Local versus global. Distance metrics. Similarity and homology. Scoring matrices. Dynamic programming algorithms, Needleman-wunsch and Smith-waterman. Heuristic Methods of sequence alignment, FASTA, BLAST and PSI BLAST. Multiple Sequence Alignment and software tools for pairwise and multiple sequence alignment;				08
Unit IV	Genome Analysis: Whole genome analysis, existing software tools; Genome Annotation and Gene Prediction; ORF finding; Phylogenetic Analysis: Comparative genomics, orthologs, paralogs.				08
Unit V	Methods of phylogenetic analysis: UPGMA, WPGMA, neighbour joining method, Fitch/Margoliash method, Character Based Methods.				08
References	<ol style="list-style-type: none"> 1. Bioinformatics: Sequence and Genome analysis, 2nd edition (2004), David W. Mount, Cold Spring Harbour Laboratory Press. ISBN-13: 978-0879697129. 2. Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition (2004), Andreas D. Baxevanis and B.F. Francis Ouellette, John Wiley and Sons. ISBN-13: 978-0471478782. 3. Introduction to Medicinal Chemistry, 4th edition (2009), Graham I. Patrick, Oxford University Press. ISBN-13: 978-0199234479. 4. The Process of New Drug Discovery and Development, 2nd edition (2006), C.G. Smith and J.T. O'Donnell, Informa Healthcare, ISBN-13: 978-0849327797. 5. Cheminformatics (2003), J. Gasteiger, Thomas Engel; Wiley-VCH. ISBN: 9783527618279. 6. Molecular modeling - Principles and Applications, 2nd edition (2003), A. R. Leach, Pearson Education Limited, UK. ISBN 13: 9780582382107. 7. Cheminformatics in Drug Discovery (2006), edited by. T.I. Opera; Wiley Publishers, ISBN: 9783527604203. 8. Molecular dynamics simulation: elementary methods (1992), J. M. Haile, WileyInterscience, New York. ISBN-13: 978-0471184393. 				

Course code	BMMS-201				
Category	Core Biomedical				
Course title	Medical Microbiology & Immunology				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	Basic knowledge of cell and Biology.				
Objectives	The immune system distinguishes between self and foreign molecules and thus alerts and mediates protection against attack by potentially infectious organisms. Malfunctioning of the immune system leads to a number of disorders and diseases. Immunobiology is a comprehensive study of the organization and functioning of the immune system with its network of cells and molecules. Understanding the biology of the immune system is, therefore, key to developing strategies towards prevention and cure to a number of disorders and diseases that result due to interference in the functioning and regulation of the immune system. This paper covers the structure, organization, function and regulation of and by the immune system keeping the above aspects in mind.				
Outcomes	After going through this unit student shall be able to: 1. Trace the history and development of immunology. 2. Describe surface membrane barriers and their protective functions. 3. Explain the importance of phagocytosis and natural killer cells in innate body defense. 4. Describe the roles of different types of T cells, B cells and APCs. Compare and contrast the origin, maturation process, and general function of B and T lymphocytes.				
Unit I	Bacteriology: Introduction, Taxonomy, nomenclature and identification of bacteria, Reproduction and growth, Organization and ultrastructure of micro-organisms and various antibiotics, Antimicrobial used in clinical practical, Normal human flora, Pathogenesis and virulence factors of bacteria, Human diseases caused by bacteria in the following: Respiratory tract infections, Urinary tract infections, Genital tract infections, Gastrointestinal tract infections, Blood stream and CNS infections. Epidemiology of bacterial diseases.				08
Unit II	Clinical Virology: The structure, components and classification of viruses. Viral multiplication cycle, effect of virus infection on the host cell, cytopathic effects, inhibition of host cell cytopathic effects, inhibition of host macromolecular biosynthesis, changes in regulation of gene expression. Genetics of animal viruses. History, epidemiology, diagnosis, clinical features, treatment and prevention of small pox, herpes, adenoviruses, arboviruses, picornaviruses, myxoviruses.				08
Unit III	Parasitology and Mycology: Classification of parasitic protozoa. Cellular organization of parasitic protozoa. Epidemiology of parasitic infections. Immunology and immunopathology of parasitic infections, Control of parasites and parasitic infections. Common parasitic disease: Trypanosomiasis, Leishmaniasis, Malaria, Opportunistic parasitic infections, Helminths. Mycology: Classification, Cryptococcosis, Candidiasis, Blastomycosis, Histoplasmosis, Coccidiomycosis, Phycomycosis.				08
Unit IV	Immunoglobulins and MHC: Introduction, Overview of Immunoglobulin, V Gene Assembly and recombination, three Immunoglobulin gene Expression, Chromosomal Translocation involving Immunoglobulin loci. Major Histocompatibility Complex Detailed Structure and Molecular Interaction of MHC Molecules, Chemistry of peptide, Binding and Presentation, MHC and				08

	Transplantation, MHC and Diseases, Pathogen Interface with Antigen Presentation, TCR Genes, Chromosomal Translocations associated with Disease and Molecular Mechanism of T-Cell Activation.	
Unit V	Applied Immunobiology: Hybridoma Technology, Utilising Transgenic and Knockout Mice in understanding immune mechanisms, Mucosal Immunity, Aging and Immune Functions, Cytotoxic T-Lymphocytes, Inflammation, Systemic Autoimmunity, Pathogenesis of Allergic Diseases, Transplantation Immunology, Tumor Immunology, Immune Response to Infectious Disease-Viral, bacterial and Protozoans, Vaccines, immuno Deficiency Diseases, Immunotherapy, signal Transduction in Innate Immunity, Microbial evasion strategies.	08
Course code	BMMS-251	CR.
Course title	Medical Microbiology & Immunology Lab.	1.0
PRACTICALS : (Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)		
<ol style="list-style-type: none"> 1. Preparation and sterilization of different culture media (e.g. Blood agar, chocolate agar, nutrient agar, nutrient broth, Mac Conkey agar) and to obtain pure cultures. 2. To carry out different types of staining such as Gram staining, Acid fast staining, Spore staining, Albert's staining of the given bacterial culture. 3. To determine the antibiotic sensitivity profile of the given microbial culture using Kirby-Bauer method. 4. To carry out the following biochemical tests for given bacterial cultures: Catalase test, Urease set, Indole test, Methyl red test Voges-Prauskauer test, Citrate test, Lysine iron agar, Triple sugar iron, Sugar fermentation tests (glucose, maltose, sucrose). 5. To prepare temporary mounts from cultures/clinical specimens and observe permanent slides of the following: Rhizopus, Mucor, Aspergillus fumigatus, Aspergillus flavus, Candida albicans, Blastomyces dermatidis, Penicillium marneffei, Nocardia, Histoplasma capsulatum. 6. To demonstrate the presence of Candida albicans in the given clinical specimen using the germ tube test 7. Collection of blood: Retro-orbital bleeding, tail vein puncture 8. Separation and preservation of serum and plasma 9. Various routes of immunization: Intraperitoneal, Subcutaneous and Intra muscular 10. Immunization of animal (BALB/C) intraperitoneally with BSA 10% and adjuvant 11. Immunodiffusion techniques 12. Circulating Immune complex level estimation by PEG method 13. Separation of mononuclear cells from blood 		
References	<ol style="list-style-type: none"> 1. Immunology, 6th edition, (2006), J. Kuby et al, W.H. Freeman and Company, New York. ISBN-13: 978-1429202114. 2. Microbiology, 7th edition, (2008), Prescott, L., John Li Harley, Donald A. Klein, McGraw Hill. ISBN-13: 978-0071102315. 3. Roitt's Essential Immunology, 12th edition, (2011), Wiley-Blackwell Science. ISBN-13: 978-1405196833. 4. Immunology, 8th edition, (2012), Male, D., Brostoff, J., Roth, D.B. and Roitt, I., Elsevier-Saunders. ISBN-13: 978-0323080583. 5. An Introduction to Immunology, Immunochemistry and Immunobiology, 5th edition, (1988), Barrett, James T., Mosby Company, St. Louis. ISBN-13: 978-0801605307. 6. Immunology: An Introduction, 4th edition, (1994), Tizard, I.R., Saunders College Publishing, Philadelphia. ISBN-13: 978-0030041983. 	

Course code	BMMS-202				
Category	Core Biomedical				
Course title	Genome Biology				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	Basic knowledge of Biology				
Objectives	Genetics having its roots in mathematics thanks to Mendel, appeals to students as one of the analytical branches of biology even in senior school. Basic concepts that are essential to understand inheritance will be taught, starting from the abstract factors to physical basis of inheritance. The course aims to communicate the pivotal role of Mendelian concepts in the development of the science of genetics and also the fact that nature is full of examples that deviate from Mendelian laws starting from linkage groups. Introduction of models and the way they have contributed to our understanding of genetics will provide a perception of how forward genetics has been used to understand the basis of continuity of information transfer that is applicable to not only to the simple life forms but also to humans. Most of the topics will be at the introductory level, which would motivate the students to understand the molecular basis of <u>genotype to phenotype correlation</u> .				
Outcomes	<p>At the end of the course the students are expected to develop an appreciation for the groundwork carried out in genome research so far, relate to how it has been built on the numerous genetic studies carried out over decades on several model organisms that continue to contribute to the understanding of relationship between genotype and phenotype. The time is poised for understanding human as a model organism.</p> <ol style="list-style-type: none"> 1. The students will be able to understand the complexity of genetic inheritance in humans, beyond Mendelian genetics. 2. The dependence of human genetics on statistical analysis. They will be familiar with the statistical tools used in genomic data analysis, linkage analysis by LOD score, association studies. 3. They will know the methods used for whole genome analysis and their applications. They will be able to use various databases containing annotation, experimental data from NGS, RNA seq and microarray and ENCODE. 4. The students will be trained to read and critically evaluate research papers from journals. 				
Unit I	<p>Model organisms in genomic studies: E.coli: Mutation analysis through mutant selection and deciphering metabolic pathways. Saccharomyces cerevisiae: Tetrad analysis, isolation of mutants (e.g. cell cycle mutants) and their characterization. Caenorhabditis elegans: Discovery of RNAi/miRNA in developmental context. Drosophila melanogaster: from chromosomal basis of inheritance to sharing themes in developmental biology. (Note: students have studied this under Concepts in genetics (II semester), during these lectures the teacher is expected to reflect the integration of regulatory loops shared between Drosophila and humans, to show how this Cinderella of genetics remains relevant in the genomics era). Mus musculus: Generation of knockouts and transgenic for tissue expression analysis: Conventions of nomenclature of genes and gene products in different model systems (www.ncbi.nlm.nih.gov).</p>				08
Unit II	<p>Human and model organisms genome organization: History, organization and goals of human genome sequence. Tools (Vectors- BAC, PAC, YAC and sequencing techniques) and approaches (Hierarchical and shotgun sequencing used). Outcomes and ethical issues. Human Genome Project. Organization of the Human Genome. General features: Gene density, CpG islands, RNA-encoding genes. Gene clusters, Pseudogenes. Diversity in size and organization of genes. Types of repetitive DNA: LINES, SINES. Genetic markers and their applications. Overview of prokaryotic and eukaryotic genome organization and complexity: E.</p>				08

	coli, Yeast, Drosophila, Mouse, M. tuberculosis and Plasmodium. Conservation and diversity of genomes	
Unit III	Techniques for Genomics: Cytogenetic techniques (Karyotyping and FISH). Polymorphism screening (Genotyping of SNPs and Microsatellite markers). Expression analysis and proteome analysis. Mapping strategies Physical Maps (Cytogenetic maps, Radiation hybrids). Genetic Maps (Marshfield and DeCode maps)	08
Unit IV	Identification of Genetic Basis of Disease Forward and Reverse Genetics; Top-down and Bottom- up approaches. Parametric and non-parametric approach, TDT, Polymorphism based analysis. Positional and Candidate Gene approaches, Positional- cloning approach [Examples like Huntington disease, Cystic fibrosis, but not restricted to these]. Genotypic and Allelic frequencies. Haplotype construction (using SNPs and/or microsatellites polymorphism data). Introduction to Copy number variation (to be covered through paper presentations)	08
Unit V	Implications of Genome Research: Diagnosis and screening of Genetic Disorders. Prenatal genotyping for mutations in β - globin gene and sickle cell anaemia. Applications in pharmacogenetics (Genetic polymorphism in drug metabolism genes and their effect on drug metabolism and drug response, toxicity) Website based analysis and seminars: www.ncbi.nlm.nih.gov , www.ensembl.org , HAPLORE for haplotype construction. Epigenome analysis [Concepts are taught in II semester]	08
Course code	BMMS-252	CR.
Course title	Genome Biology Lab.	1.0
PRACTICALS : (Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)		
<ol style="list-style-type: none"> 1. Studies of inversion polymorphism in Chironomous/mosquito polytene chromosomes. 2. Construction of Pedigree chart for family history. 3. Preparation of normal human karyotype and chromosomal diseases(Klinefelter syndrome, Down syndrome, Turner syndrome, etc). 4. Feulgen staining of DNA in Protozoa (Paramecium) 5. Chromosome staining and banding technique. 6. Structure and molecular organization of Chromosomes - Demo 7. Culture techniques Banding techniques Sex Chromatin bodies 8. Diagnosis of biochemical disorders (Phenylketonuria, Alkaptonuria, Survey of mucopolysaccharide disorders). 		
References	<ol style="list-style-type: none"> 1. Principles of Genetics, 6th edition (2011), Snustad DP and Simmons MJ, John Wiley and Sons, Inc; ISBN-13: 978-0470903599 2. Human Molecular Genetics, 3rd edition (2003) by Tom Strachan and Andrew Read; Garland Science Publishers, ISBN -13: 978-0815341826. 3. Concepts of Genetics, 10th edition, (2011). William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino; Pearson Education, ISBN-13: 978-0321724120. 4. Principles of Genetics, 8th edition (2005), Gardner EJ, Simmons MJ, Snustad DP. John Wiley and Sons, Inc. ; ISBN-13: 978-9971513467. 5. An introduction to Genetic Analysis, 10th edition (2010), Griffith AJF, Miller JH, Suzuki DT, Lewontin RC, Gelbert WM., W. H. Freeman and Co. New York. ISBN-13: 978-429229432. 6. Principles of Genetics, 6th edition (1998), Robert H. Tamarin Publisher: William C Brown Pub; ISBN-13: 978-0697354624. 	

Course code	BMMS-203				
Category	Generic Elective				
Course title	Molecular Oncology				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	Basic knowledge of Biology				
Objectives	With increase in incidence of cancer in our country, it is considered important to have a basic background of molecular basis of cancer. The students will be taught various risk factors and types of cancer. Basic concept of mechanism of carcinogenesis will be taught wherein important proteins and pathways will be taught. At the end of the course some of the research papers related to these topics will be presented and discussed in the class				
Outcomes	By the end of the course students will be familiar with common carcinogens and how life style can contribute to increase in cancer incident. They will also be aware of various steps and different mechanisms that form the basis of differences in cancer progression and drug response. A basic understanding of various techniques that can be used so as to do decipher these pathways and to identify the proteins involved in cancer will help them in pursuing research in this important area.				
Unit I	Mendelian genetics: Mendelian Laws of inheritance, its application in animal Genetics, analysis of results of Genetic crosses by various methods. Codominance, incomplete dominance, RFLP markers, gene interactions, multiple alleles. Genomic imprinting in mice, understanding molecular basis of epigenetic inheritance, human disorders related to imprinting, Prader Willi and Angelmen syndrome, Molecular basis of Epigenetic regulation in H19 and Igf2 region, histone modification marks, Position effect variegation. Linkage as a deviation from Mendelian Genetics Recombination, Gene mapping using Drosophila as an example, experiments demonstrating physical basis of recombination, crossing over. Gene mapping using special systems, yeast and Neurospora. Sex determination in Drosophila and humans Chromosomal basis to genetic basis, genetics of dosage compensation in Drosophila. X inactivation and its molecular basis in humans.				08
Unit II	Chromosomal and Extra chromosomal basis of inheritance inheritance: Chloroplast and mitochondrial inheritance, mitochondrial mutations in yeast, human genetic disorders related to mitochondrial inheritance. Sex chromosomes in grasshopper, maize and co-linearity of genes on chromosomes, Non-disjunction in Drosophila and its role in deciphering chromosomal basis of inheritance. Analysis of patterns of inheritance, Punnett square, statistical methods.				08
Unit III	Bacterial genetics Transformation, Conjugation, genetic map construction in E.coli. Phage genetics, fine structure of rII region, work of Seymour Benzer. Genetic control mechanisms and generation of cellular asymmetry The lambda phage control of lytic and lysogenic phase, molecular basis of regulatory mechanisms in phage lambda.				08
Unit IV	Population Genetics Definition, aim and scope of population genetics, population structure, factors maintaining population boundaries, effective breeding size, gene pool. The Hardy-Weinberg Law and its application, factors affecting the Hardy-Weinberg equilibrium. Human polymorphism (transient and balanced), relationship between sickle cell polymorphism and malaria, other				08

	<p>polymorphisms that may be an adaptation to malaria eg. G6PD deficiency. Duffy blood groups, thalassemia and haptoglobins. X linked polymorphism (G6PD and colour blindness). Incompatibility Selection. Non-random mating, inbreeding and its consequences. Migration and Genetics, types of migration, models to study genetic effects of migration, gene flow, effects of gene flow, admixture and natural selection, calculation of admixture.</p>	
Unit V	<p>Developmental genetics: Early embryonic development in Drosophila. Maternal inheritance, genetic basis of axis determination, regulatory cascade in development in Drosophila, Homeotic genes. Introduction to human Genetics Pedigree analysis and basic inheritance patterns in humans.</p>	08
References	<ol style="list-style-type: none"> 1. Molecular Biology of the Gene, 6th edition (2007), Watson, J. D., Baker T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R; Benjamin Cummings Publishers, ISBN-13: 978-0805395921. 2. Cell and Molecular Biology: Concepts and Experiments, 7th edition (2013), Gerald Karp. ; Wiley Publishers ISBN-13: 978-1118206737. 3. Molecular Cloning: A Laboratory Manual, 4th edition (2012), Michael R. Green and Joseph Sambrook; Cold Spring Harbor Laboratory Press, ISBN-13: 978-1936113422. 4. The World of the Cell, 7th edition (2008), Becker, Kleinsmith, Hardin and Bertoni. Benjamin Cummings, ISBN-13: 978-0805393934. 5. The Cell: A Molecular Approach, 6th edition (2013), Cooper and Hausman; Sinauer Associates, Inc. ISBN-13: 978-1605351551. 6. DNA Replication, 2nd edition (2005), Arthur Kornberg; University Science Books ISBN-13: 978-1891389443. 	

Course code	BMMS-204				
Category	Core Course				
Course title	Advance Medicinal Chemistry				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	None				
Objectives	The course highlights the importance of Medicinal Chemistry in all our lives and the fascination of working in a field that overlaps the disciplines of chemistry, biology, biochemistry, pharmacology etc. It gives brief understanding about drug-receptor interactions, lead discovery, drug design and molecular mechanism by which drug act in the body. The course emphasizes on various drug targets in the body and drug development strategies with mechanism of action of antibacterial agents and concept of drug resistance.				
Outcomes	completion of this course will be helpful in 1. Correlating between pharmacology of a disease and its mitigation or cure. 2. Understanding the drug metabolic pathways, adverse effect and therapeutic value of drugs 3. Knowing the structural activity relationship of different class of drugs. 4. Well acquainted with the synthesis of some important class of drugs. 5. Knowledge about the mechanism pathways of different class of medicinal compounds. 6. To understand the chemistry of drugs with respect to their pharmacological activity.				
Unit I	Drugs acting on Novel Targets: β -tubulin inhibitors and their mechanism. Kinase inhibitors e.g. AKT inhibitors, discovery of gleevac etc. HIV inhibitors: integrase inhibitors, CCR5 inhibitors etc. New drugs developed for tuberculosis and other infectious diseases. New drugs developed for cardiovascular disease Cholesterol, absorption inhibitors e. g. ezetimibe, glycoprotein inhibitor e.g. abciximab, Renin inhibitors e.g. aliskerin. Examples from past one decade				08
Unit II	Biotechnology and Drug Discovery: The impact of biotechnology on small-molecular drug discovery and development. Examples of approved biotechnology based drugs: Monoclonal antibodies, Interferon alpha, Interferon beta, Interferon gamma, Inter leukins, Growth hormones, Antisense nucleotides, Use of Transgenic animal models for drug evaluation				08
Unit III	Molecular Modelling and Computer Aided Design Basic elements contributing to 3D-structure, Macromolecular structure database: Its constitution and attributes, Sequence Homology and Homology based modeling, Modeling Ligand-Protein association: Docking methods, Molecular Mechanics, Molecular Dynamics.				08
Unit IV	Drug delivery Concepts in drug delivery systems, drug delivery devices: implants, minipumps, mechanism of controlled drug release, soluble delivery systems: micro and nano systems, routes of drug delivery systems .				08
Unit V	Receptor Chemistry and Biology: Chemistry of membrane and intracellular receptors; Isolation and characterization of receptors; Regulation of receptor number and affinity; Receptor cross-talk; Organ Receptors; Non-liganded and constitutive receptor activation; r-DNA receptor bioassays; Desensitization of receptors; Receptors as targets for vaccines and newer drug development.				08

References	<ol style="list-style-type: none"><li>1. Introduction to Medicinal Chemistry, 4th edition (2009), Graham I. Patrick, Oxford University Press. ISBN-13: 978-0199234479.<li>2. The Organic Chemistry of Drug Design and Drug Action, 2nd edition (2004), Richard B. Silvermann, Elsevier, Academic Press. ISBN-13: 978-0126437324.<li>3. Medicinal Chemistry: A Molecular and Biochemical Approach, 3rd edition (2005), Thomas Nogrady and Donal F. Weaver, Oxford University Press. ISBN-13: 978-0195104561.
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Course code	BTMS-203				
Category	Generic Elective				
Course title	Genetics				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	Basic knowledge of Biology				
Objectives	Genetics having its roots in mathematics thanks to Mendel, appeals to students as one of the analytical branches of biology even in senior school. Basic concepts that are essential to understand inheritance will be taught, starting from the abstract factors to physical basis of inheritance. The course aims to communicate the pivotal role of Mendelian concepts in the development of the science of genetics and also the fact that nature is full of examples that deviate from Mendelian laws starting from linkage groups. Introduction of models and the way they have contributed to our understanding of genetics will provide a perception of how forward genetics has been used to understand the basis of continuity of information transfer that is applicable to not only the simple life forms but also to humans. Most of the topics will be at the introductory level, which would motivate the students to understand the molecular basis of <u>genotype to phenotype correlation</u> .				
Outcomes	The student will demonstrate knowledge of the basics principles of Mendelian genetics by: 1. Discussing the progression of discovery from Classical to Modern Genetics. 2. Defining basic concepts of Classical Genetics. 3. Describing Mendel's experimental design. 4. Utilizing conventional Mendelian genetic terminology. 5. Explaining Mendel's principles of segregation, and independent assortment. 6. Solving monohybrid cross genetic outcomes utilizing branch diagrams and/or Punnett squares. 7. Using testcrosses to identify parental genotype and confirm the principle of segregation. 8. Solving dihybrid cross genetic outcomes utilizing branch diagrams and/or Punnett squares. 9. Analyzing the results of multihybrid crosses to confirm the principle of Independent Assortment. 10. Using the laws of probability to statistically analyze the outcomes of genetic crosses.				
Unit I	Mendelian genetics: Mendel's law of inheritance, Mendelian ratio, linkage, crossing over, chromosomal theory of inheritance. Chromosome mapping: linkage analysis, two point test cross, three point test cross, interference, coefficient of coincidence, chi-square analysis.				08
Unit II	Structural and numerical changes in chromosomes: Chromosomal aberration (deletion, duplication, translocation and inversion), euploidy and aneuploidy, aneuploidy in human. Mutations: Natural and induced mutations, physical and chemical mutagens, Ames test, uses of mutations in genetic studies, human health and crop improvement. Biochemical and microbial genetics: <i>Neurospora</i> as model system, one gene one enzyme hypothesis.				08
Unit III	Sex determination: Sex linked inheritance, determination of sex and dosage compensation. Chloroplast and mitochondrial genetics: Cytoplasmic inheritance, chloroplast inheritance in plants, mitochondrial genes in yeast.				08
Unit IV	Human genetics: Inborn errors of metabolism, Genetic diseases in human- Phenyl ketonuria, Alkaptonuria, Albinism, Lesch-Nyhan syndrome, Tay-Sachs disease, Cystic fibrosis, genetic counseling.				08
Unit V	Population and evolutionary genetics: Gene pool and gene frequencies, Hardy-Weinberg law, inbreeding, genetic equilibrium, genetic basis of evolution and speciation, molecular evolution, evolution of multigene families.				08

References	<ol style="list-style-type: none">1. Principles of Genetics, 6th edition (2011), Snustad DP and Simmons MJ, John Wiley and Sons, Inc; ISBN-13: 978-04709035992. Human Molecular Genetics, 3rd edition (2003) by Tom Strachan and Andrew Read; Garland Science Publishers, ISBN -13: 978-0815341826.3. Concepts of Genetics, 10th edition, (2011). William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino; Pearson Education, ISBN-13: 978-0321724120.4. Principles of Genetics, 8th edition (2005), Gardner EJ, Simmons MJ, Snustad DP. John Wiley and Sons, Inc. ; ISBN-13: 978-9971513467.5. An introduction to Genetic Analysis, 10th edition (2010), Griffith AJF, Miller JH, Suzuki DT, Lewontin RC, Gelbert WM., W. H. Freeman and Co. New York. ISBN-13: 978-429229432.6. Principles of Genetics, 6th edition (1998), Robert H. Tamarin Publisher: William C Brown Pub; ISBN-13: 978-0697354624.
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Course code	CSMS-209				
Category	Skill Enhancement				
Course title	Fundamental of Information Technology				
Scheme and Credits	Credit	L	T	P	
	2	2	0	0	
Pre-requisites (if any)	Basic knowledge of Computers				
Objectives	Objective of this course to develop the computer skills in the students and make them technology friendly.				
Outcomes	Students would be aware with the basic use of the computers that would be helpful in report and project making and meet them with the demand of the industry.				
Unit I	Introduction to Computers: Basics of computer , Characteristics of computers, Limitations of computers, System Components, Input devices, Output devices, Computer Memory, Central Processing Unit, Mother Board, Computer Generations & Classifications: Evolution of computers, Classification of Computers, Types of Microcomputers Distributed Computer , Number Systems and Boolean algebra, Logical Circuits				08
Unit II	CPU Essentials, Modern CPU concepts- CISC vs. RISC CPUs, Circuit Size and Die Size, Processor Speed, Processor Cooling, System Clocks, CPU Overclocking, Computer Memory: Memory System, Memory Cells, Memory Arrays, Random Access Memory (RAM) Read Only Memory (ROM), Physical Devices Used to construct Memories, Buses Storage Devices, Input Output Devices				08
Unit III	Introduction to Computer Software: Computer Software, Overview of different operating systems, Overview of different application software, Overview of proprietary software, Overview of open source technology, Software Development, Design and Testing				08
Unit IV	Operating System Concepts: Operating System Concepts, Functions of Operating System, Development of Operating System, Operating system virtual memory, Operating System Components, Operating System Services, Operating System Security.				08
Unit V	Internet and Its Working: History of Internet , Web browsers, Web servers, Hypertext Transfer Protocol , Internet Protocols Addressing, Internet Connection Types, How Internet Works, Internet Security, Uses of Internet, Virus, Antivirus, Cloud System, Cloud Technologies, Cloud Architecture, Cloud Infrastructure, Cloud Deployment Models				08

Course code	BMMS-301				
Category	Core Biomedical				
Course title	Pharmacology & Toxicology				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	None				
Objectives	The course develops the understanding of theoretical and practical studies in the field of Pharmacology and Toxicology. The course involves the building up the knowledge of pharmacokinetic and pharmaco-dynamic profile of drug, pharmacological classification and principle of drug action and the types of toxicity assessments of various type toxicants of chemical and biological origin and environmental pollutants on organ system and drug disposition.				
Outcomes	After completing the course, students shall be able to: - <ol style="list-style-type: none"> 1. Describe the various steps involved in the interaction of a drug to its target, administer the drug through various routes to the rats or mice and do toxicity assays. 2. describe the pharmacokinetic and toxicokinetic profile of the drugs and chemicals respectively, - Describe the design of treatment strategy in animal group 3. plan and conduct a pharmacology project and toxicological assays 4. Independently acquire and critically assess Pharmacological and Toxicological information from databases 				
Unit I	Drugs acting on the central nervous system: General anesthetics, adjunction to anesthesia, intravenous anesthetics. Analgesic and non-steroidal anti-inflammatory drugs, narcotic analgesics, antirheumatic and antigout remedies, sedatives and hypnotics, pshycho pharmacological agents, anti-convulsants, analeptics. Centrally acting muscle relaxants and anti-parkinsonism agents, anti-Alzheimer's drugs. Local anesthetics.				08
Unit II	Overall Pharmacological agents Drugs acting onthe eye, mydriatics, drugs used in glaucoma. Drugs acting on the respiratory system- bronchodilators, expectorants and antitussive agents. Antacids, histamine and anti-histamines, prostaglandins. Cardiovascular drugs, cardiotonics, antianginal agents, antihypertensive agents, peripheral vasodilators and drugs used in atherosclerosis. Drugs acting on the blood and blood forming organs, haematinics, coagulants and anticoagulants, haemostatics, blood substitutes and plasma expanders. Drugs affecting renal function- diuretics and antidiuretics. Hormones and hormone antagonists- hypoglycemic agents, antithyroid drugs, sex hormones and oral contraceptives, corticosteroids. Drugs acting on the digestive system- carminatives, digestants, bitters, antacids and drugs used in peptic ulcer, purgatives and laxtives, antidiarrhoeals, emetics, antiemetics.				08
Unit III	Chemotherapeutic agents: Chemotherapy of microbial diseases, urinary antiseptics, sulfonamides, penicillins, streptomycin, tetracyclines and other antibiotics; antitubercular drugs, antifungal agents, antiviral drugs, antileprotic drugs. Chemotherapy of protozoal diseases , Drugs used in cancer, Disinfectants and antiseptics				08
Unit IV	Pesticides Brief classification with examples, residual and non-residual pesticides. Mode of entry and mode of action of pesticides in target and non-target organisms; metabolism of pesticides, phase I and phase II reaction, elimination. Ecotoxicology: Impact of pesticides residues on ecosystems, non-target organisms; Pesticide bioaccumulation, biomagnification through food				08

	chain. Environmental alteration of pesticides - microbial and solar, fate and dissipation of pesticides residue under tropical and temperature conditions.	
Unit V	Pesticide hazards to man Accidental and occupational exposure, entry through air, food and water, Main routes of entry and factors affecting intake, distribution, biotransformation and elimination dynamics. Residue levels in man: Indian experience Vs developed countries; Residues in tissues and organs – distribution and redistribution; Pregnancy and transfer to fetus. Health hazards: Non–fatal subtle levels, biochemical and physiological effects; Parameters used in carcinogenic risk assessment of pesticide residues; Animal experiments – carcinogenic, teratogenic and mutagenic tests; Organochlorine insecticide residues as carcinogens- parent status Carcinogens – phenoxyherbicides, arsenicals and HCB; Organochloro residue burden in newborn babies in developing countries and potential hazards.	08
Course code	BMMS-351	CR.
Course title	Pharmacology & Toxicology Lab.	2.0
<p>PRACTICALS (Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)</p> <ol style="list-style-type: none"> Animal handling and precautions, and study the routes of administration Topical application of Atropine and Pilocarpine on rabbit eye Analgesic effect of diclofenac on mice/rat Study the effects of acetylcholine (Ach) and plot the dose-response curve. Study the effect of general anaesthesia with ketamine To determine the effect of promethazine on phenobarbitone induced sleeping time in mice. To determine the acute toxicity of a given drug and calculate the LD50 value. Detection of organophosphorous pesticides in biological sample. To test the presence of paracetamol in the given biological sample. To study the effect of organophosphate Malathion on the specific activity of the enzyme acetylcholinestrase in rat brain homogenate. Determination of COD (chemical oxygen demand) of the given water sample. 		
References	<ol style="list-style-type: none"> Cassarett and Doull’s Toxicology “The Basic Science of The Poisons” 7th edition (2008), Curtis D. Klaassen Editor, McGrawHill Medical. ISBN: 9780071470513. Cassarett and Doull’s “Essentials of Toxicology” 2nd edition (2010), Klaassen and Whatkins, McGraw Hill Publisher. ISBN-13: 978-0071622400. Introduction to Toxicology, 3rd edition (2001), John Timbrell, Taylor and Francis Publishers. ISBN 13: 9780415247627. Principles of Toxicology, 2nd edition (2006), Stine Karen and Thomas M Brown, CRC press. ISBN-13: 978-0849328565. Lu’s basic toxicology: Fundamentals target organ and risk assessment, 5th edition (2009), Frank C Lu and Sam Kacow, Informa Health care. ISBN: 9781420093117. 	

Course code	BMMS-302				
Category	Core Biomedical				
Course title	Biomedical Instrumentation				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	Basic knowledge of Human Anatomy and Physiology				
Objectives	Objective of this course is to acquaint the students with the recording methodology (placement of electrode or sensor, equipment, analysis and safety procedures) for electrical and non-electrical signals. It will also be helpful for them to understand the mechanism of signal origination and specified amplifier used for signal recording.				
Outcomes	After studying this course, students will able to: 1. Explain basic electrophysiology mechanism involve in bio-potential generation. 2. explain the working of patient monitoring system, diagnostic and therapeutic equipments 3. Examine the bioelectrical and non-bioelectrical activities. 4. Calibrate and handle the equipments related to the patient care and monitoring. 5. Students will know the definitions, basic principles and the applications of the available diagnostic and therapeutic devices.				
Unit I	Biopotential Recorders: Resting and action potentials, propagation of action potential, Bioelectric signals (ECG, EMG, ECG, EOG & ERG) and their characteristics, effects of high contact Impedance, types of electrodes, electrodes for ECG, EEG and EMG.				08
Unit II	Patient Monitoring System: System concepts, Heart rate Meter & Alarm. Respiration rate meter, Blood pressure meter, temperature indicator. Foetal Mentoring System: Cardiotacography Method Foetal heart Rate (FHR) measurement.				08
Unit III	Diagnostic Equipments: Blood gas analyzer, Blood pH measurements, Measurement of Blood PCO ₂ & PO ₂ . Blood cell counters: Method of cell counting coulter counters, Differential counting cell. Impedance Plethysmography & Pulmonary Function Measurement, Spirometry, Pulmonary Function Analyzer, Respiratory Gas Analyzer				08
Unit IV	Therapeutic Equipments: Short wave diathermy machine microwave diathermy machine Ultrasonic therapy Unit. Pain relief through electrical stimulation. Pacemaker, Defibrillator and Incubator. Life Supporting Equipments: Life support systems: Heart Lung machine, Haemodialysers, Ventilators. .				08
Unit V	Safety and Precautions: Gross current, Micro Current shock, safety standards rays and considerations, safety testing instruments, biological effects of X-rays and precaution.				08
Course code	BMMS-352				CR
Course title	Biomedical Instrumentation Lab				2.0
PRACTICALS : (Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)					
1. Diagnosis of Electrical Activity of Heart					
2. Diagnosis of Electrical Activity of Brain/ Muscles					
3. Testing, Calibration, Maintenance and Working Principle of TENS					
4. Testing, Calibration, Maintenance and Working Principle of Ultrasound					

5. Testing, Calibration, Maintenance and Working Principle of Muscle Stimulator

6. Testing, Calibration, Maintenance and Working Principle of IFT

References

1. Waugh, A., & Grant, A. (2001). Ross and Wilson anatomy and physiology in health and illness. Churchill Livingstone.
2. Webster, J. (2010). Medical instrumentation: application and design, Fourth edition. In John Wiley and Sons, Inc. USA.
3. Khandpur, R. S. (1987). Handbook of biomedical instrumentation. McGraw-Hill Education.
4. Joseph, J. Carr, & Brown, J. M. (2001). Introduction to biomedical equipment technology. Prentice hall.
5. Clark, J. W., Neuman, M. R., Olson, W. H., Peura, R. A., Primiano, F. P., Siedband, M. P., & Wheeler, L. A. (1998). Medical instrumentation: application and design. Wiley.

Course code	BMMS-303				
Category	Core Biomedical				
Course title	Biomaterials and Tissue Engineering				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	Basic knowledge of Human Anatomy and Physiology				
Objectives	Objective of this course is to acquaint the students with the different types of the materials those are biocompatible, nontoxic and not hazardous to the body. Those can be use for bio-implantation.				
Outcomes	After studying this course, students will able to: 1. Explain basic characteristics of biomaterials 2. Evaluate the biocompatibility of materials 3. Material tissue interaction mechanism.				
Unit I	Introduction: Types of biomaterials, advantages and disadvantages, Bio ceramics for implant coating, calcium phosphates, hydroxy epilates Ti6Al4V and other biomedical alloys, implant and tissue interaction.				08
Unit II	Medical Implants: Advantages of Nanomaterials use as implants, biological response of implanted materials, desirable and undesirable reactions of the body with implanted materials, Materials used for orthopaedicimplants ,bioceramics, modes of failure, Materials used for dental, modes of dental implant failure, wear debris, materials used for cartilage and vascular, bladder, modes of cartilage implant, vascular implant, implant failure study, modes of bladder implant failure				08
Unit III	Implant – Cellular Interaction: Protein interactions with implanted materials, cellular recognition of Proteins adsorbed on material surfaces, adhesion, migration, differentiation, Cellular Extra cellular Matrix deposition leading to tissue regeneration, foreign-body response, inflammatory response				08
Unit IV	Tissue engineering: Introduction, Stem cells, Morphogenesis, Generation of tissue in the embryo, Tissue homeostasis, Cellular signaling, Extracellular matrix as a biologic scaffold for tissue engineering, Scaffold fabrication, bioactive scaffold, Natural polymers in tissue engineering applications, Degradable polymers for tissue engineering.				08
Unit V	Artificial Organs: Design of artificial organs-substitutive medicine, Biomaterial Concentration, Outlook for Organ Replacement, Design Consideration, Evaluation of Artificial Organs.Artificial heart and circulatory assist devices, Artificial lungs and blood gas exchange devices, Artificial kidney and artificial pancreas, Artificial blood and artificial liver				08
References	1. William A. Goddard, Sergey Edward Lyshevski, Donald W. Brenner (Ed) Handbook of Nanoscience, Engineering and Technology CRC press 2003 2. Mark A. Ratner, Daniel Ratner (Ed) Nanotechnology; a gentle introduction to the next big idea; Prentice Hall PTR; 2003 3. ‘Tissue Engineering and Artificial Organs’ By Joseph D.Bronzino 4. ‘Biomaterials, Artificial Organs and Tissue Engineering’ by Larry L.Hench and Julian R.Jones.				

Course code	BMMS-304				
Category	Core Biomedical				
Course title	Biomedical Waste Management				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	None				
Objectives	Medical facilities generate waste hazardous chemicals and radioactive materials and if not disposed can produce detrimental effect over environment, surrounding microbiota and human health. Study of Biomedical waste management is an over aging technology with great career option.				
Outcomes	<ol style="list-style-type: none"> 1. To Gain in-depth knowledge on Biomedical Waste Management and Infection Control, Challenges in implementation and compliance and Strategies to overcome 2. To Grab an opportunity to meet and interact with Sector Experts 3. To Get a practical exposure through field visits to health care facility / biomedical treatment facility 4. To Get hands-on learning experience 5. To Obtain technical know-how on BMW management technologies 				
Course Content					
<ul style="list-style-type: none"> • Biomedical Waste Storage & Handling – Intermediate and Final storage area • Sharps Management • Liquid Waste Management from the laboratories • Linen Management • Infection Control • Biomedical Waste Treatment Technologies 					
Methodology					
<ul style="list-style-type: none"> • The course adopts an interactive approach, with a blend of lectures, simulation/ group exercises, exchange of experiences and practical exposure through field visits • National and International cases, good practices and recent developments will be shared and analysed • Each of the participant will be given an opportunity to interact with sector experts to gain more insights on the related topics and also share best practices, if any. 					
References	<ol style="list-style-type: none"> 6. William A. Goddard, Sergey Edward Lyshevski, Donald W. Brenner (Ed) Handbook of Nanoscience, Engineering and Technology CRC press 2003 2. Mark A. Ratner, Daniel Ratner (Ed) Nanotechnology; a gentle introduction to the next big idea; Prentice Hall PTR; 2003 3. 'Tissue Engineering and Artificial Organs' By Joseph D.Bronzino 4. 'Biomaterials, Artificial Organs and Tissue Engineering' by Larry L.Hench and Julian R.Jones. 				

Course code	BMMS-305				
Category	Core Biomedical				
Course title	Hospital Management & Biosafety				
Scheme and Credits	Credit	L	T	P	
	4	3	1	0	
Pre-requisites (if any)	None				
Objectives	The main focus of this programme is to promote professional management practices that are necessary for effective healthcare ensuring continuous quality improvement, labour relations, financial sustainability, awareness creation, demand generation, optimum utilization of limited available resources and strategic approach towards inflation, rapid advancement in medical technology, increased expectations of staff and patients.				
Outcomes	<p>In the end of this course students would be able to:</p> <ol style="list-style-type: none"> 1. Understand the need and importance of cost effective sustainable healthcare through demand generation and enhanced quality care 2. Develop and apply various employee friendly systems for effective functioning of different administrative activities and support services of hospital 3. Promote patient centred care with a continuous quality improvement orientation ensure smooth functioning of core process by forecasting, streamlining patient flow, staff scheduling, planning space/ facilities/ supplies, maintenance, etc. 4. Ensure optimum tilization of available limited resources. 5. Sharpen managerial skills. 6. Have an appreciation on the use of information technology in the hospital 				
Unit I	Introduction to Management, evolution of Management, Definition and importance of Management, Different bodies of Management thought- overall support and utility services management, Medical record maintenance and computer applications.				08
Unit II	Epidemiological basis for healthcare management, Management development-towards development of professional management of Indian Hospitals, Management of Indian Hospitals, challenges ,strategies, Modern Techniques of hospital management, Operation concept- use of models, Health services research & formalized managerial methods.				08
Unit III	Hospital Planning, Guiding principles in planning hospital facilities, services, Planning the hospital building, Finance, Need assessment survey of community, factors determining site, legal requirements, design consideration, Project management & implementation, Planning the operational units, engineering, lighting etc.				08
Unit IV	Organization of the hospital, Management structure, Types of hospitals, Governing body, Hospital committee and hospital functionaries, Duties and responsibilities of various positions Hospital Operational management, Management of Quality Assured services of professional service units of hospital.				08
Unit V	Waste disposal management, Hospital waste management, Biosafety- regulatory frame work for GMOs, bioethics and its socio economic impact.				08
References	<ol style="list-style-type: none"> 1. Webster J.C. and Albert M.Cook, “<i>Clinical Engineering Principle and practice</i>”, Prentice Hall Inc., Englewood Cliffs, New Jersey, 1979. 2. Goyal R.C., “<i>Handbook of hospital personal management</i>”, Prentice Hall of India, 1996. 3. Kunders GD, Gopinath S and Katakam Asoka ,” <i>Hospitals Planning , Design and Management</i>” Tata McGraw Hill Publishing Company Limited New Delhi. 				

Course code	BTMS-311				
Category	Generic Elective				
Course title	Biostatistics				
Scheme and Credits	Credit	L	T	P	
	2	2	0	0	
Pre-requisites (if any)	None				
Objectives	In public health work, one may be concerned with planning of experiments and the analysis of their results. Therefore, one has to deal with statistical data analyses that come from no deliberate experiment but that arise because of the data collected from the population in the course of public health study and survey. This course therefore provides training to the students on how to conduct epidemiological surveys, design questionnaire and analyze the data. The students will get hands-on-training on 'R', a free software environment for statistical computing and graphics.				
Outcomes	After the completion of this course students would be able to: 1. use and interpret results of, descriptive statistical methods effectively. 2. Explain the principal methods of statistical inference and design. 3. Read and learn new statistical procedures independently.				
Unit I	Descriptive Statistics Biostatistical Concepts Scope of Biostatistics, Samples & population & Sampling techniques, Kinds of variable, Graphical & diagrammatic representation Theory of errors, measure of precision, Probable errors of function, rejection of observation Mean (Arithmetic, Harmonic, & Geometric), Median & Mode.				08
Unit II	Measures of Dispersion: Range, standard deviation, coefficient of variance and covariance. Measure of dispersion, standard deviation & standard errors Moments: Raw and central moments and their relationships. Measures of Skewness: Pearson's and Bowley's coefficients of skewness, Measures of Kurtosis.				08
Unit III	Correlation Analysis: Pearson's and Spearman's coefficients of correlation, coefficient of determination, standard and probable errors.				08
Unit IV	Regression Analysis: Method of least squares, equations of lines of regression and their applications in biostatistics. Linear, Bivariate & Polynomial regression analysis Level of significance: F test, T test, chi square & goodness of fit, ANOVA				08
Unit V	Probability and Probability Distributions Probability: Basic concepts, addition and multiplication rules of probability, conditional probability, Bayes' theorem and its applications in biostatistics. Binomial, Poisson & normal distribution				08
References	<ol style="list-style-type: none"> 1. Cassarett and Doull's Toxicology "The Basic Science of The Poisons" 7th edition (2008), Curtis D. Klaassen Editor, McGrawHill Medical. ISBN: 9780071470513. 2. Cassarett and Doull's "Essentials of Toxicology" 2nd edition (2010), Klaassen and Whatkins, McGraw Hill Publisher. ISBN-13: 978-0071622400. 3. Introduction to Toxicology, 3rd edition (2001), John Timbrell, Taylor and Francis Publishers. ISBN 13: 9780415247627. 1. Principles of Toxicology, 2nd edition (2006), Stine Karen and Thomas M Brown, CRC press. ISBN-13: 978-0849328565. 2. Lu's basic toxicology: Fundamentals target organ and risk assessment, 5th edition (2009), Frank C Lu and Sam Kacow, Informa Health care. ISBN: 9781420093117. 				

M.Sc Biomedical(2018-19)

COs Mapping with POs & PSOs

(Three Level : 3-Strongly Related , 2-Moderate, 1-Slightly)

Medical Biochemistry: BMMS-101

Course Outcomes

CO1:Demonstrate a broad knowledge of the fundamental introductory concepts of Chemistry, Biology and Physics.

CO2:Demonstrate a thorough knowledge of the intersection between the disciplines of Biology and Chemistry.

CO3:Demonstrate a proficiency in developing relevant biochemical questions, carrying out laboratory investigations to answer those questions, and critically analyzing, interpreting, and presenting in oral and written form the results of their experiments.

CO4:Locate, critically analyze, interpret and discuss data, hypotheses, results, theories, and explanations found in the primary literature, applying knowledge from Chemistry and Biology.

CO5:Appreciate the way in which practitioners in the disciplines of Biology and Chemistry intersect and bring their expertise to bear in solving complex problems involving living systems.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	1	2	1	1	1	2	1	2	2	1	1	1	1
CO 2	2	1	1	2	2	1	2	1	2	2	1	2	1
CO 3	2	2	3	2	2	3	2	3	2	2	2	2	1
CO 4	1	2	1	1	2	1	1	1	1	2	2	2	1
CO 5	2	2	3	3	2	2	3	2	3	2	2	2	1
Average	1.6	1.8	1.8	1.8	1.8	1.8	1.8	1.8	2	1.8	1.6	1.8	1

Pharmaceutical Chemistry BMMS-102

Course Outcomes

CO1:Correlating between pharmacology of a disease and its mitigation or cure.

CO2:Understanding the drug metabolic pathways, adverse effect and therapeutic value of drugs

CO3:Knowing the structural activity relationship of different class of drugs.

CO4:Well acquainted with the synthesis of some important class of drugs.

CO5:Knowledge about the mechanism pathways of different class of medicinal compounds.

CO6:To understand the chemistry of drugs with respect to their pharmacological activity.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	1	1	2	1	3	2	1	1	1	1	1	1	1
CO 2	1	1	2	2	2	2	2	2	2	2	1	1	1
CO 3	2	3	2	1	2	1	2	3	3	3	3	2	1
CO 4	2	1	1	2	2	1	1	1	1	1	2	2	1
CO 5	1	2	2	2	2	2	3	2	3	2	2	3	1
CO 6	1	2	1	2	2	2	1	2	1	1	1	1	1
Average	1.3	1.6	1.6	1.6	2	1.6	1.6	1.8	1.8	1.6	1.6	1.6	1

Advance Human Physiology BMMS-103

CourseOutcomes

CO1:Major skeletal muscles, their actions, origins, insertions, and peripheral nerves. c. Central nervous system and plexuses d. Respiratory system e. Cardiovascular/hematologic system

CO2:Identify the major structures of the human anatomy for the following: a. Head and neck, thoracic, abdominopelvic, and upper and lower extremities. b. Major skeletal muscles, their actions, origins, insertions, and peripheral nerves. c. Central nervous system and plexuses d. Respiratory system e. Cardiovascular/hematologic system

CO3:Identify the major bones and their processes as they relate to each region of the body.

CO4:Tell briefly the basic components and functions of the gastrointestinal, renal/urinary, endocrine/metabolic, hepatic/biliary, genital/reproductive and immunologic, systems. Identify the findings from a simulated healthcare record such as electrocardiogram data and pulmonary ventilation outcomes.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	1	1	2	2	1	1	1	1	1	1	1	1
CO 2	1	1	2	1	2	1	2	1	2	1	1	2	2
CO 3	1	2	2	3	2	1	3	3	2	2	2	2	3
CO 4	2	2	1	1	2	1	1	1	1	2	2	2	1
Average	1.5	1.5	1.5	1.7	2	1	1.7	1.5	1.5	1.5	1.5	1.7	1.7

Bioinstrumentation BMMS-104

CourseOutcomes

CO1:Explain basic electrophysiology mechanism involve in bio-potential generation.

CO2:explain the working of patient monitoring system, diagnostic and therapeutic equipment's

CO3:Examine the bioelectrical and non-bioelectrical activities.

CO4:Calibrate and handle the equipment's related to the patient care and monitoring.

Students will know the definitions, basic principles and the applications of the available diagnostic and therapeutic devices.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	1	1	1	2	1	1	1	1	3	2	1	2
CO 2	1	1	3	2	2	1	2	2	2	2	1	2	2
CO 3	1	2	2	2	3	3	2	2	2	2	2	1	2
CO 4	2	2	1	1	1	1	2	1	1	1	2	2	1
Average	1.5	1.5	1.7	1.5	2	1.5	1.7	1.5	1.5	2	1.7	1.5	1.7

Forensic Science BMMS-105

Course Outcomes

CO1:Demonstrate competency in the collection, processing, analyses, and evaluation of evidence.

CO2:Demonstrate competency in the principles of crime scene investigation, including the recognition, collection, identification, preservation, and documentation of physical evidence.

CO3:Demonstrate an understanding of the scientific method and the use of problem-solving within the field of forensic science.

CO4:Identify the role of the forensic scientist and physical evidence within the criminal justice system.

CO5:Demonstrate the ability to document and orally describe crime scenes, physical evidence, and scientific processes.

CO6:Identify and examine current and emerging concepts and practices within the forensic science field.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	1	1	1	2	2	1	1	1	1	2	1	1
CO 2	1	1	2	1	3	1	2	3	3	2	1	2	2
CO 3	1	3	3	3	2	3	3	3	3	2	2	2	3
CO 4	2	2	1	2	2	2	2	1	1	1	2	3	1

CO 5	3	2	2	3	2	1	2	2	3	2	2	2	2
CO 6	2	1	2	2	1	1	1	1	1	2	2	1	1
Average	1.8	1.6	1.8	1.8	2	1.6	1.8	1.8	2	1.6	1.8	1.8	1.6

Fundamental of Bioinformatics BMMS-106

CourseOutcomes

CO1:Students would be able in Sequence alignment and visualization and Phylogenetic and microarray analysis

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	1	1	1	2	1	2	2	1	1	1	1	1
Average	2	1	1	1	2	1	2	2	1	1	1	1	1

Medical Microbiology & Immunology BMMS-201

CourseOutcomes

CO1:Trace the history and development of immunology.

CO2:Describe surface membrane barriers and their protective functions.

CO3:Explain the importance of phagocytosis and natural killer cells in innate body defense.

CO4:Describe the roles of different types of T cells, B cells and APCs. Compare and contrast the origin, maturation process, and general function of B and T lymphocytes.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	1	1	1	1	2	1	1	1	2	1	2	1	1
CO 2	1	1	2	2	2	1	2	2	2	2	1	2	2
CO 3	2	2	3	2	2	2	3	3	3	3	2	2	2
CO 4	2	2	1	1	2	2	2	1	1	1	1	2	1
Average	1.5	1.5	1.7	1.5	2.0	1.5	2.0	1.7	2.0	1.7	1.5	1.7	1.5

Genome Biology BMMS-202

CourseOutcomes

CO1:The students will be able to understand the complexity of genetic inheritance in humans, beyond Mendelian genetics.

CO2:The dependence of human genetics on statistical analysis. They will be familiar with the statistical tools used in genomic data analysis, linkage analysis by LOD score, association studies.

CO3:They will know the methods used for whole genome analysis and their applications The will be able to use various databases containing annotation, experimental data from NGS, RNA seq and microarray and ENCODE.

CO4:The students will be trained to read and critically evaluate research papers from journals.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	1	1	1	1	2	1	2	1	1	1	1	1	1
CO 2	1	3	3	3	2	1	2	2	2	3	1	1	3
CO 3	2	2	2	2	2	2	3	2	2	2	2	2	2
CO 4	2	2	1	1	2	2	2	1	1	1	2	2	1
Average	1.5	2	1.7	1.7	2	1.5	2	1.5	1.5	1.7	1.5	1.5	1.7

Molecular Oncology BMMS-203

Course Outcomes

CO1:Students will be familiar with common carcinogens and how life style can contribute to increase in cancer incident.

CO2:Students will be aware of various steps and different mechanisms that form the basis of differences in cancer progression and drug response.

CO3:Students will have understanding of various techniques that can be used so as to do decipher these pathways.

CO4:Students will be identify the proteins involved in cancer will help them in pursuing research in this important area.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	1	1	1	1	2	1	1	1	1	1	1	1	1
CO 2	1	1	3	2	2	1	2	2	3	2	1	2	2
CO 3	2	3	3	3	2	2	2	3	3	3	2	2	3
CO 4	2	2	1	1	2	1	2	1	1	1	2	2	1
Average	1.5	1.7	2.0	1.7	2.0	1.2	1.7	1.7	2.0	1.7	1.5	1.7	1.7

Advance Medicinal Chemistry BMMS-204

Course Outcomes

CO1: Correlating between pharmacology of a disease and its mitigation or cure.

CO2: Understanding the drug metabolic pathways, adverse effect and therapeutic value of drugs

CO3: Knowing the structural activity relationship of different class of drugs.

CO4: Well acquainted with the synthesis of some important class of drugs.

CO5: Knowledge about the mechanism pathways of different class of medicinal compounds.

CO6: To understand the chemistry of drugs with respect to their pharmacological activity.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	1	1	2	2	1	1	1	2	1	1	2	1
CO 2	1	1	2	2	2	2	2	3	2	2	2	2	2
CO 3	2	2	2	3	3	2	3	3	2	2	2	2	3
CO 4	2	2	2	1	1	1	2	1	1	1	2	3	1
CO 5	2	2	3	3	2	1	2	3	2	1	2	2	2
CO 6	1	1	2	1	2	1	2	1	1	1	2	1	2
Average	1.6	1.5	2.0	2.0	2.0	1.3	2.0	2	1.6	1.3	1.8	2	1.8

Genetics BTMS-203

Course Outcomes

CO1: Discussing the progression of discovery from Classical to Modern Genetics.

CO2: Defining basic concepts of Classical Genetics.

CO3: Describing Mendel's experimental design.

CO4: Utilizing conventional Mendelian genetic terminology.

CO5: Explaining Mendel's principles of segregation, and independent assortment.

CO6: Solving monohybrid-cross genetic outcomes utilizing branch diagrams and/or Punnett squares.

CO7: Using testcrosses to identify parental genotype and confirm the principle of segregation.

CO8: Solving dihybrid cross genetic outcomes utilizing branch diagrams and/or Punnett squares.

CO9: Analyzing the results of multihybrid crosses to confirm the principle of Independent Assortment.

CO10: Using the laws of probability to statistically analyze the outcomes of genetic crosses

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	1	1	2	1	1	1	1	1	1	1	1	1
CO 2	1	1	3	2	2	1	2	2	3	2	1	2	2
CO 3	2	3	3	3	2	2	3	3	3	3	2	2	3
CO 4	2	2	1	1	3	1	1	1	1	1	2	2	1
CO 5	2	2	3	3	2	1	2	3	3	2	2	2	2
CO 6	1	1	1	2	2	1	1	1	1	1	2	1	1
CO 7	2	1	1	1	2	1	1	1	1	1	1	1	1
CO 8	1	1	3	2	2	1	2	2	3	2	1	2	2
CO 9	2	3	3	3	2	2	3	2	3	3	2	2	3
CO 10	2	2	1	1	2	1	1	1	1	1	2	2	1
Average	1.7	1.7	2.0	2.0	2.0	1.2	1.7	1.7	2.0	1.7	1.7	1.7	1.7

Fundamental of Information Technology CSMS-209

CourseOutcomes

CO1:Students would be aware with the basic use of the computers that would be helpful in report and project making and meet them with the demand of the industry.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	1	2	1	2	1	1	1	2	1	2	1	1
Average	2	1	2	1	2	1	1	1	2	1	2	1	1

Pharmacology & Toxicology BMMS-301

CourseOutcomes

CO1:Describe the various steps involved in the interaction of a drug to its target, administer the drug through various routes to the rats or mice and do toxicity assays.

CO2:describe the pharmacokinetic and toxicokinetic profile of the drugs and chemicals respectively, - Describe the design of treatment strategy in animal group

CO3:plan and conduct a pharmacology project and toxicological assays

Independently acquire and critically assess Pharmacological and Toxicological information from databases.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	2	2	2	2	2	2	1	2	1	2	1	1
CO 2	1	1	2	3	2	1	3	2	1	1	1	2	2
CO 3	2	2	2	1	2	2	1	3	3	3	2	2	2
Average	1.6	1.6	2.0	2.0	2.0	1.6	2.0	2	2.0	1.6	1.6	1.6	1.7

Biomedical Instrumentation BMMS-302

CourseOutcomes

CO1:Explain basic electrophysiology mechanism involve in bio-potential generation.

CO1:Explain the working of patient monitoring system, diagnostic and therapeutic equipments

CO1:Examine the bioelectrical and non-bioelectrical activities.

CO1:Calibrate and handle the equipments related to the patient care and monitoring.

CO1:Students will know the definitions, basic principles and the applications of the available diagnostic and therapeutic devices.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	1	1	2	1	2	1	2	2	1	2	1	2
CO 2	1	2	2	2	2	2	2	2	3	2	1	2	2
CO 3	2	3	2	3	3	2	3	2	2	3	2	2	3
CO 4	2	2	1	2	3	1	2	1	1	1	2	2	1
CO 5	2	2	3	1	1	1	2	3	1	2	2	2	2
Average	1.8	2.0	1.8	2.0	2.0	1.6	2.0	2.0	1.8	1.8	1.8	1.8	2.0

Biomaterials and Tissue Engineering BMMS-303

CourseOutcomes

CO1: Explain basic characteristics of biomaterials

CO2: Evaluate the biocompatibility of materials

CO3: Material tissue interaction mechanism.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	2	2	1	2	2	2	1	2	1	2	1	1
CO 2	1	1	1	2	2	1	3	2	1	1	1	2	1
CO 3	2	2	3	3	2	2	1	3	2	3	2	2	3
Average	2	1.6	2.0	2.0	2.0	1.6	2.0	2.0	1.6	1.6	1.6	1.6	1.6

Biomedical Waste Management BMMS-304

CourseOutcomes

CO1: To Gain in-depth knowledge on Biomedical Waste Management and Infection Control, Challenges in implementation and compliance and Strategies to overcome

CO2: To Grab an opportunity to meet and interact with Sector Experts

CO3: To Get a practical exposure through field visits to health care facility / biomedical treatment facility

CO4: To Get hands-on learning experience

CO5: To Obtain technical know-how on BMW management technologies.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	1	1	2	2	2	1	1	2	1	1	2	1
CO 2	1	2	2	2	2	1	2	1	3	2	2	1	2
CO 3	1	3	2	2	2	2	3	2	3	2	2	2	3
CO 4	3	2	1	1	3	2	2	2	1	1	2	3	1
CO 5	2	2	3	3	1	1	2	2	1	2	2	1	2
Average	1.8	2.0	1.8	2.0	2.0	1.6	2.0	1.6	2.0	1.6	1.8	1.8	1.8

Hospital Management & Biosafety BMMS-305

CourseOutcomes

CO1:Understand the need and importance of cost effective sustainable healthcare through demand generation and enhanced quality care

CO2:Develop and apply various employee friendly systems for effective functioning of different administrative activities and support services of hospital

CO3:Promote patient centred care with a continuous quality improvement orientation ensure smooth functioning of core process by forecasting, streamlining patient flow, staff scheduling, planning space/ facilities/ supplies, maintenance, etc.

CO4:Ensure optimum tilization of available limited resources.

CO5:Sharpen managerial skills.

CO6:Have an appreciation on the use of information technology in the hospital

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	1	2	1	2	2	1	1	2	2	1	1	2
CO 2	1	1	3	3	2	1	2	3	3	2	2	2	2
CO 3	2	2	2	3	2	2	2	3	3	3	2	2	3
CO 4	3	2	1	1	2	2	1	1	1	2	2	2	1
CO 5	2	2	2	3	2	2	2	3	2	2	3	2	1
CO 6	1	1	1	1	1	1	2	1	1	1	2	1	1
Average	1.8	1.5	1.8	2.0	1.8	1.6	1.8	2.0	2.0	2.0	2.0	1.6	1.6

Biostatistics BTMS-311

CourseOutcomes

CO1:Use and interpret results of, descriptive statistical methods effectively.

CO2:Explain the principal methods of statistical inference and design.

CO3:Read and learn new statistical procedures independently.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	2	2	1	2	2	2	1	2	1	3	2	2
CO 2	1	1	1	2	2	1	3	2	1	1	1	1	1
CO 3	2	2	3	3	2	2	1	3	2	3	2	2	3

Average	2	1.6	2.0	2.0	2.0	1.6	2.0	2.0	1.6	1.6	2	1.6	2.0
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