

M.Sc.

Biomedical Sciences

SYLLABUS



**SHOBHIT INSTITUTE OF ENGINEERING & TECHNOLOGY, MEERUT
(Deemed to-be-University)**

**Approved and adopted in year 2018 (Board of Studies, August 3, 2018)
by 22nd Academic council (Agenda no-3.2 b)**

Index

S. No.	Subject Code	Subject Name	Page Number	% of Change
	BMMS-101	Medical Biochemistry		80%
	BMMS-105	Forensic Sciences		80%
	BMMS-203	Molecular Oncology changed to Fundamentals of Cancer Biology		100%
	BMMS-304	Biomedical Waste Management		100%

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 B.Sc. Hons. (Biomedical Sciences).

Program Outcome: The MSc in Biomedical Science programme's primary objective is to provide students with the underpinning knowledge and practical skills to pursue a successful career in biomedical science. The course is designed for those who wish to follow careers as Biomedical Scientists in research, the Health Service or in the wider context of biomedical science including Medical Technologies, Bio-pharmaceutical and other Healthcare industries. Using state of the art technologies and a range of skills from scientific, engineering and clinical disciplines to understand and investigate questions originating in biology and medicine. A major objective of the course is to introduce students to an interdisciplinary approach to Biomedical Science, which utilises technologies and skills from a wide spectrum of scientific, engineering and clinical disciplines.

PO1. This course forms the basis of science and comprises of the subjects like physics, chemistry, biology, zoology and mathematics.

PO2. It helps to develop scientific temper and thus can prove to be more beneficial for the society as the scientific developments can make a nation or society to grow at a rapid pace.

PO3. After the completion of this course students have the option to go for higher studies i.e. Ph.D. and then do some research for the welfare of mankind.

PO4. After higher studies students can join as scientist and can even look for professional job oriented courses.

PO5. This course also offers opportunities for serving in Indian Army, Indian Navy, Indian Air Force as officers.

PO6. Students after this course have the the option to join Indian Civil Services as IAS, IFS etc.

PO7. Science graduates can go to serve in industries or may opt for establishing their own industrial unit.

PO8. After the completion of the M.Sc. degree there are various other options available for the science students. Often, in some reputed universities or colleges in India and abroad the students are recruited directly by big MNC's after their completion of the course.

PO9. Apart from the research jobs, students can also work or get jobs in Marketing, Business & Other technical fields. Science graduates also recruited in the bank sector to work as customer service executives. Students can also find employment in government sectors.

Program Specific Outcome:

The Biomedical Sciences MSc provides opportunities for students to develop and broaden their knowledge and research skills and better prepare for future employment or specialist postgraduate research. Biomedical Sciences MSc graduates significantly enhance their employability by developing their subject-specific knowledge in the field of biomedical science and their analytical and research skills. Students gain an appreciation of how important biomedical science is to global healthcare and can approach international employers with confidence. In addition, the programme enhances student presentational and key skills enabling students to compete effectively in the job market.

PSO1. testing and screening for lifestyle diseases like diabetes, cancer or cardiovascular disease; and screening for infectious ones such as rubella, hepatitis or Ebola

PSO2. investigating and understanding the disease mechanisms, profile and progression

PSO3. finding new, effective and innovative ways to detect diseases as early as possible (e.g. discovery of new biomarkers or a new method of detecting a biomarker)

PSO4. working towards discovery and development of treatments, which could be preventive (vaccines) and/or therapeutic (drugs and medicines)

PSO5. In order to become a biomedical scientist a Bachelors degree is a must.

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:

S.No.	Criteria	I	II	III	IV	Total
1.	Core Biomedical (BBM)	24	18	22	14	78
2.	Generic Elective (GBT/GBM)		4	2	-	6
3.	Ability Enhancement (AEC)		2		-	2
	Total	24	24	24	14	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	Fundamentals of Cancer Biology	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-471	Project Work/Dissertation/ Industrial Training	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	General Biochemistry: Cell, cell membrane, and sub-cellular organelles structure and Functions; Transport through biological cell membrane; Chemistry & biological importance of carbohydrates, proteins & amino acids, lipids, nucleic acids, porphyrins glycosaminoglycans, glycoprotein's. Chemistry of blood & hemoglobin, plasma proteins, Blood coagulation.				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	Metabolism and Nutrition: Intermediary metabolism, metabolism of Carbohydrates, Lipids, Proteins, and Amino acids, Nucleic acids, Hemoglobin, metabolic control, energy production & regulation; Metabolic interrelationships & regulatory mechanism; Metabolic changes during starvation; Energy metabolism - Calorific value of food, BMR, SDA, respiratory quotient and its applications; Macro & micro – elements classification, sources, RDA, Functions, deficiency manifestations				08
Unit IV	Instrumentation: Principle, working & applications of Colorimetry, Spectrophotometry, Flame photometry, Flurometry, Atomic absorption spectrometry, Ultra centrifugation; Principle, types & applications of Electrophoresis, Chromatography; Auto analyzers, Blood gas analyzers; Automation in clinical chemistry; pH, electrodes & methods of pH determination; Basics of mass spectrometry; chemiluminescence and Electron - microscopy.				08
Unit V	Clinical Biochemistry: Specimen Collection- Blood, Urine and Body fluids. Organ function tests- Liver function tests, Kidney function tests, Thyroid function tests, Adrenal function tests, Pancreatic function tests, Gastric function tests; Biochemistry of Diabetes mellitus, Atherosclerosis, Fatty liver, and obesity; Radioisotopes & their clinical applications.				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"> Total Quality Management of Laboratory- a) Specimen collection, handling & storage of sample, b) Methods of standardization & calibration, Methods of quality control & assessment. . Fractionation & Identification of Amino acids, Sugar, Proteins, Lipoproteins by - <ol style="list-style-type: none"> Thin Layer Chromatography Paper chromatography (circular, Unidimensional & two dimensional Gel electrophoresis - agarose, starch & Polyacrylamide Gel Electrophoresis Paper electrophoresis & cellulose acetate paper electrophoresis. Estimation of total activity of following enzymes. i) LDH & separation of its isoenzymes by polyacryamide gel electrophoresis, Cellulose acetate electrophoresis & quantitation by densitometry. ii) AST (GOT) iii) ALT (GPT) iv) Alkaline phosphatase v) Acid phosphatase vi) Amylase vii) Creatine kinase its Isoenzymes Enzyme kinetic and Determination of Km value and effect of pH, substrate concentration & temperature on Enzyme activity. Estimation of serum lipid profile - i) Serum total cholesterol, ii) Serum HDL cholesterol, iii) Serum VLDL & LDL, iv) Serum Triglycerides, v) Serum Phospholipids Estimation of Fe & Total Iron Binding capacity & ferritin. Estimation of Glycosylated Hb. Estimation of Na, K & Lithium by Flame photometer. 		
References	<ol style="list-style-type: none"> Lehninger Principles of Biochemistry, 5th edition (2012), David L. Nelson and Michael M. Cox; W. H. Freeman, ISBN-13: 978-0716771081. An Introduction to Practical Biochemistry, 3rd edition (1987), Plummer, McGraw-Hill College; ISBN-13: 978-0070841659. Introduction to Protein Structure, 2nd edition (1999), Carl Branden and John Tooze; Garland Science, ISBN-13: 978-0815323051. Principles and Techniques of Practical Biochemistry, 5th edition (2000), Keith Wilson and John Walker; Cambridge University Press, ISBN -13: 978-0521799652. Protein Folding, 1st edition (1992), Thomas E. Creighton; W. H. Freeman Company, ISBN13: 978-0716770275. 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 *ct and therapeutic value of drugs 2. Knowing the structural activity relationship of different class of drugs. 3. Well acquainted with the synthesis of some important class of drugs. 4. 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. 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.
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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 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.</p>				08

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	<p>After studying this course, students will able to:</p> <ol style="list-style-type: none"> 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 – Procellional 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 Microscopy, Tracer Techniques in Biology: tumor diagnosis and imaging, infectious diseases such as tuberculosis, Flow Cytometry, Mangetic Assisted Cell Sorting				08
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 				

	<p>Education.</p> <p>4. Joseph, J. Carr, & Brown, J. M. (2001). Introduction to biomedical equipment technology. Prentice hall.</p> <p>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.</p>	
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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	<p>At the completion of the Forensic Science Technology student will be able to:</p> <ol style="list-style-type: none"> 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	<p>Introduction: Definition, History & Development, Scope, Ethics in Forensic Science; Physical Evidence: Nature, Types, Search methods, Collection, Preservation, Packing & Forwarding of Physical & Trace evidence for forensic analyses, Chain of Custody; Crime Scene: Nature, Types, Preservation of Scene of Crime; Criminal Investigations: Unnatural deaths, Criminal assaults, Sexual offences, Poisoning, Vehicular accidents; Courts: Types, powers and jurisdiction, Admissibility of evidence in Courts, Definition of Experts, Provisions in Cr.P.C.,1973 & Indian Evidence Act relating to experts & their reports; Court Procedures pertaining to Expert Testimony & Witness; Organization of Forensic Science Laboratories of Centre and State, NCRB and NICFS; Fundamental Rights: Right of Equality (Articles 14 to 18) and Right of Freedom (Articles 19 to 22) as per Constitution of India; Criminal Profiling: Profile of victim and culprit, its role in crime investigation, Lie detection (Polygraphy), Narco analysis, Brain mapping, scope and limitations; Concept of quality control management in Forensic institutions</p>				08

Unit II	Detection and Identification of Blood stains; Determination of Species of Origin; Blood Group Systems; Techniques of Determination of Blood groups of Blood Stains; Detection of Seminal and other body fluids and their Blood Grouping, Red cells Enzymes, Serum Proteins of forensic significance; Disputed Paternity & Maternity; DNA Extraction and Profiling Techniques; DNA Phenotyping and RNA Profiling & their applications	08
Unit III	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; 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 IV	Fire arms and Ballistics: Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Forensic examination of Firearms, Ammunition, Firearms projectiles (Bullets, Shots, Slug etc.), Shell case; Gunshot residues analysis; Concept of Velocity, Penetration, Dispersion, Ricochet, Accidental Discharge, Determination of Range in firearm cases; Examination of Country made firearms; Basics of Internal, External and Terminal Ballistics; Tool marks: Meaning, Types and Examination; Restoration of Erased Markings on Metal Surfaces; Fire and Arson: Analyses of Petroleum Products and other incendiary materials; Explosives: Definition, Types and Analyses; Bombs: Country made bombs, Improvised Explosive Devices (IEDs) and their examination; Investigation in Explosion and Arson related cases.	08
Unit V	Fingerprints: History, Characteristics, Types, Classification, Preservation, Development, Lifting and Comparison, Examination of Chance Prints, Computerization of Fingerprints, AFIS; Track Marks: Foot Prints, Shoe Prints, Tire Marks, Their Preservation & Casting, Comparison, Skid marks. Gait pattern; Biometric Systems of Identification and its relevance; Voice Analysis: Introduction, Significance, Structure of Human Voice apparatus, Voice spectrography, Voice analysis, Legal aspects and limitations	08
References	<ol style="list-style-type: none"> 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 (2000) Ronald N. Morris, Academic press ISBN-13: 978-0125076401 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. 5. Principles of Forensic Medicine and Toxicology, 1st edition (2011) Rajesh Bardale; Jaypee Brothers Medical Pub, ISBN-13: 978-9350254936. 6. Practical Crime Scene Processing and Investigation, 2nd edition (2011), Ross M Gardner, CRC press ISBN-13: 978-1439853023. 7. Forensic Medicine and Toxicology: Oral, Practical And Mcq, 3rd edition (2006), Karmakar, Jaypee Brothers, ISBN-13: 978-8171797350. 8. Fundamentals of Forensic Science, 2nd edition (2010), Houck, M.M. and Siegel, JA; Academic Press, ISBN-13: 978-0123749895. 9. Criminalistics- An Introduction of Forensic Science, 10th edition (2010), Prentice Hall Inc; ISBN-13: 978-0135045206. 	

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	<p>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.</p>				
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 Transplantation, MHC and Diseases, Pathogen Interface with Antigen Presentation, TCR Genes, Chromosomal Translocations associated with Disease and Molecular Mechanism of T-Cell Activation.				08
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				08

	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.	
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 Ii 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 genotype to phenotype correlation.				
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	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).				08
Unit II	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. coli, Yeast, Drosophila, Mouse, M. tuberculosis and Plasmodium. Conservation and diversity of genomes				08

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	Fundamentals of Cancer Biology			
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	Molecular basis of carcinogenesis: Multistep process of carcinogenesis; Hallmarks of cancer; Oncogenes: growth factors, growth factor receptors, G protein/signal transduction, tyrosine and serine/ - threonine kinases and transcription factors; tumor suppressor genes: p53, RB, BRCA1, BRCA2, APC and WT1; their normal cellular function, mutagenesis, interactions and consequences of their mutant state in cancer.	08
Unit II	Cell cycle and apoptosis: cell cycle checkpoints, G1/S checkpoint, G2/M checkpoint, cyclins and cyclin dependent kinases, CDK inhibitors - p16, p21 and p27; Molecular mechanism of apoptosis, p53 and apoptosis, apoptotic pathways and cancer therapy; Autophagy; Necrosis	
Unit III	Cell immortalization, tumorigenesis, and Genetic instability : mutation, deletion, insertion, aneuploidy, chromosome translocation and Gene amplification;; Mismatch repair, Telomerase, DNA methylation, Protein phosphorylation/ dephosphorylation and degradation events; Transformation by RNA and DNA tumor viruses: Adenovirus, Simian Virus 40 and Human papilloma virus	
Unit IV	Cancer diagnosis and treatment: Diagnostic methods and Molecular tumor pathology. The major treatment principles of cancer (surgery, radiotherapy, hormonal treatment, and biological therapy). Novel and developing treatment strategies. Ethics. Palliative treatment.	08
Unit V	Cancer cell line culture and animal models: growth environment and culture requirement. Primary culture, subculture, cell line, cell strain, cell clone. Importance of serum and serum-free media, culturing and sub-culturing of cancer cell lines, cell-based assays, cell differentiation and movement, animal cell culture facility. Primary cell culture, tissue culture, organ culture, cell line immortalization, cell line preservation & characterization, karyotype analysis, cellular markers, commercial cell lines, and insect cell culture; Rodent and murine models in scientific research associated with cancer	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	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	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 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 genotype to phenotype correlation.				
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
	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 Angelman 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.				
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 dosages 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: 978-0470903599 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	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 on the 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 laxatives, 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 chain. Environmental alteration of pesticides - microbial and solar, fate and dissipation of pesticides residue under tropical and temperature conditions.				08
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				08

	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.	
Course code	BMMS-351	CR.
Course title	Pharmacology & Toxicology 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.)		
<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: <ol style="list-style-type: none"> Explain basic electrophysiology mechanism involve in bio-potential generation. explain the working of patient monitoring system, diagnostic and therapeutic equipments Examine the bioelectrical and non-bioelectrical activities. Calibrate and handle the equipments related to the patient care and monitoring. 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.)		
<ol style="list-style-type: none"> 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	<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-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 epitates 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	<p>In the end of this course students would be able to:</p> <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 				
Unit I	Definition and description of Medical Waste, Classification of hazardous medical waste, Characterization of health-care waste, Medical Waste Risks and Impact on Health and the Environment, Overview of Hazards, Public sensitivity, Public Health impact				08
Unit II	Fundamental Principles of a Waste Management Programme Responsibilities & duties of hospital project manager, Water and habitat engineer, local waste manager, Hospital administrator, head nurse, chief pharmacist, head of laboratory, Preparing the waste management plan, Estimating costs, Implementing the waste management plan				08
Unit III	Recycling Process, Waste minimization, Recycling symbols for plastics, Recycling and recovery, Environmental management systems, Minimum approach to waste minimization, Sorting principles, Handling of bags, Hazardous waste handling rules				08
Unit IV	Collection, Storage and Transport System, Various methods, Precautions during collection, Storage & Transportation of Hospital Waste, Treatment and disposal methods, Incineration, Chemical disinfection, Needle extraction or destruction, Encapsulation.				08
Unit V	Staff Protection Measures, Personal protective equipment, Personal hygiene, Emergency measures, Training, Policy Aspects: Legislative, Regulatory and Policy aspects of Health-care waste				08
References	<ol style="list-style-type: none"> 1. Hospital Waste Management: A Guide for Self-Assessment and Review By: Shishir Basarkar Pub.: Jaypee Brothers, Medical Publishers Pvt. Limited 2. Evaluation of Biomedical Waste Management System By: Khalid Maryam Pub.: LAP Lambert Academic Publishing 3. Infectious and Medical Waste Management By: Peter A. Reinhardt Pub.: CRC Press 4. Environmental Waste Management By: Ram Chandra Pub.: CRC Press 				

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 utilization 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. 				

