

West Bengal University of Health Sciences (WBUHS)



Under Graduate Syllabus
in
B.Sc. in Medical Microbiology
(BMM)
[w.e.f.: 2021-2022]

MISSION

The **B.Sc. in Medical Microbiology (BMM)** course is to train students in the field of Medical Microbiology. Theoretical as well as practical training is imparted to the candidates in the subspecialties viz. Bacteriology, Virology, Parasitology, Immunology and Mycology so that they can participate in good patient care and prevention of infectious diseases in the community. They are introduced to basic research methodology so that they can conduct fundamental and applied research. They are also imparted training in teaching methods in the subject which may enable them to take up teaching assignments in Medical Colleges/Institutes.

OBJECTIVES OF THE COURSE

As a nation we have gone ahead in many respects. But there are still areas, which demand attention, care and concern. The area identified by our think-tanks is “global standards in Paramedical education and training. This course will provide trained, qualified, technical personnel in the field of Paramedical Science to support the medical profession. At the end of the course the students should be able to: Establish good clinical microbiological services in a hospital and in the community in the fields of bacteriology, virology, parasitology, immunology and mycology. They will be able to plan, execute and evaluate teaching assignments and research work in medical microbiology and

ELIGIBILITY FOR ADMISSION

1. The students who have passed 10+2 in Science course (Physics + Chemistry + Biology) with 45% marks for general category and 40% marks for SC/ST category and should have valid JENAPS-UG examination rank.

JOB PROSPECTS

The B. Sc in Medical Microbiology (BMM) may be assigned to a specialized area of work in a large medical lab. In small labs, they may perform a variety of tests or all areas of lab work. They can also work as laboratory manager/ consultant/ supervisor, health care administrator, hospital outreach coordinator, laboratory information system analyst/ consultant, educational consultant/ coordinator/ director, health and safety officer etc.

MINIMUM ELIGIBILITY FOR APPEARANCE IN EXAMINATION

A Regular student i.e. a student who has undergone a regular course of study in a college for the period specified for that course of study by having been on the rolls of the college immediately preceding the examination and has his/her name submitted to the Controller of Examinations by the college Principal where he/she has pursued the course for the examination and has fulfilled the following conditions to be certified by the college Principal concerned:

- He/she has been a student of good conduct.
- He/she has attended not less than 75% of the lecture delivered including seminars, tutorials etc. in each course opted by him/her in that semester.
- He/she has passed in previous semester.
- In the case of laboratory course/practical, he/she has attended not less than 75% of the practical classes conducted (practical include field studies, workshop practice, surveying etc.).

- He/she has paid the prescribed fee.

SCHEME OF EXAMINATION

The evaluation of B.Sc. in Medical Microbiology course contains two parts: Internal Assessment (IA) and End-Semester Assessment (EA). The internal grade awarded to the students in the course in a semester shall be published on the notice board at least one week before the commencement of end semester examination. The responsibility of evaluating the internal assessment is vested on the teacher(s) who teaches the course. There will be University Examinations at the end of each semester for both Theory and Practical. Semester End Examinations for all theory papers shall be got set/prepared by the Controller of Examinations as per existing norms and evaluation of all theory papers courses shall be done by eligible faculty members set in the Board of Studies meeting held before the examination and under the supervision and coordination of the Controller of Examination. When there is a single college in a subject it has the liberty either to join the nearest cluster or form a new cluster with a similarly placed college.

The students will learn four theory papers (Full Marks 50) and two practical papers (Full Marks 50) in a semester (it may be changed as per the recommendation of Board of Studies members and approved by the Hon'ble Vice Chancellor). The details of the syllabus should be approved by the Board of Studies members and or syllabus committee made for the course. The evaluation of a candidate shall be awarded and record thereof maintained in accordance with the Regulations prescribed :

Paper	Internal Examination	End Semester Examination	Total Marks
Theory	10	40	50
Practical	00	50	50

The questions pattern of theory will be as follows:

Component	Course
04 Short Answer type Questions out of 06 Questions. Each carries 02 marks.	04×02=08
04 Medium Answer type Questions out of 06 Questions. Each carries 04 marks.	04×04=16
02 Long Answer type Questions out of 03 Questions. Each carries 08 marks.	02×08=16

It is not necessary that a medium answer type or long answer type question should contain only one question. The part marks questions are encouraged.

The questions pattern of practical will be as follows:

Component	Course
4 experimental question carries 10 marks each	10×04=40
Laboratory Note Book	05
Viva-voce	05

Internship: Internship will be done in a Government medical college or hospitals or research centre after completion of 6th semester.

PROMOTION TO NEXT SEMESTER

The students should secure 40% marks in each paper for qualifying the semester.

If a student fail in 1 or 2 papers in an end semester examination, he/she get chance (five times) to clear those supplementary papers in the next year.

If a student fails in more than 2 papers in an end semester examination, he/ she has to repeat the semester.

The internal marks of a paper secured by a student will not be changed if he/ she fail in the respective paper in the end semester examination.

COURSE STRUCTURE
FOR
B.Sc. in Medical Microbiology (BMM)

FIRST SEMESTER

SL. NO	PAPER CODE	COURSE TITLE	CONDUCT HOURS PER WEEK				MARKS		
			L	T	P	CREDITS	Int. Asst.	End Sem.	Total
THEORY									
1	BMM-101	Cell Biology	3	1		4	20	80	50
2	BMM-102	Basics of Anatomy	3	1		4	10	40	50
3	BMM-103	Basics of Physiology	3	1		4	10	40	50
4	BMM-104	General Microbiology	3	1		4	10	40	50
Total Theory						16	200		
PRACTICAL									
5	BMM-195	Anatomy & Physiology (Lab)			4	4		50	50
6	BMM-196	Bacteriology (Lab)			4	4		50	50
Total Practical						8	100		
Total of Semester						24	300		

SECOND SEMESTER

SL. NO	PAPER CODE	COURSE TITLE	CONDUCT HOURS PER WEEK				MARKS		
			L	T	P	CREDITS	Int. Asst.	End Sem.	Total
THEORY									
1	BMM-201	Basics of Biochemistry	3	1		4	10	40	50
2	BMM-202	Metabolism	3	1		4	10	40	50
3	BMM-203	Instrumentation	3	1		4	10	40	50
4	BMM-204	Microbial Physiology	3	1		4	10	40	50
Total Theory						16	200		
PRACTICAL									
5	BMM-295	Analytical Biochemistry			4	4		100	50
6	BMM-296	Clinical Biochemistry			4	4		100	50
Total Practical						8	100		
Total of Semester						24	300		

THIRD SEMESTER

SL. NO	PAPER CODE	COURSE TITLE	CONDUCT HOURS PER WEEK				MARKS		
			L	T	P	CREDITS	Int Asst.	End Sem	Total
THEORY									
1	BMM-301	Laboratory TQM, Ethics, and Biosafety	3	1		4	10	40	50
2	BMM-302	Mycology	3	1		4	10	40	50
3	BMM-303	Virology	3	1		4	10	40	50
4	BMM-304	Parasitology	3	1		4	10	40	50
Total Theory						16	200		
PRACTICAL									
5	BMM-395A	Mycology and Virology			4	4		50	50
6	BMM-396A	Parasitology			4	4		50	50
Total Practical						8	100		
Total of Semester						24	300		

FOURTH SEMESTER

SL. NO	PAPER CODE	COURSE TITLE	CONDUCT HOURS PER WEEK				MARKS		
			L	T	P	CREDITS	Int Asst.	End Sem	Total
THEORY									
1	BMM-401	Entomology	3	1		4	10	40	50
2	BMM-402	Molecular Biology	3	1		4	10	40	50
3	BMM-403	Systematic Bacteriology	3	1		4	10	40	50
4	BMM-404	Immunology	3	1		4	10	40	50
Total Theory						16	200		
PRACTICAL									
4	BMM-495	Molecular Biology			4	4		50	50
5	BMM-496	Immunology & Haematology			4	4		50	50
Total Practical						12	100		
Total of Semester						24	300		

FIFTH SEMESTER

SL. NO	PAPER CODE	COURSE TITLE	CONDUCT HOURS PER WEEK				MARKS		
			L	T	P	CREDITS	Int Asst.	End Sem	Total
THEORY									
1	BMM-501	Computer Fundamentals	3	1		4	10	40	50
2	BMM-502	Bioinformatics	3	1		4	10	40	50
3	BMM-503	General Pathology	3	1		4	10	40	50
4	BMM-504	Biostatistics	3	1		4	10	40	50
Total Theory						12	200		
PRACTICAL									
4	BMM-595	Computer & Biostatistics			4	4		50	50
5	BMM-596	Review Work			4	4		50	50
Total Practical						12	100		
Total of Semester						24	300		

SIXTH SEMESTER

SL. NO	PAPER CODE	COURSE TITLE	CONDUCT HOURS PER WEEK				MARKS		
			L	T	P	CREDITS	Int Asst.	End Sem	Total
THEORY									
1	BMM-601	Diagnostic Microbiology	3	1		4	10	40	50
2	BMM-602	Applied Microbiology	3	1		4	10	40	50
3	BMM-603	Clinical Pathology	3	1		4	10	40	50
4	BMM-604	Systemic Pathology	3	1		4	10	40	50
Total Theory						12	150		
PRACTICAL									
4	BMM-695	Diagnostic Microbiology			4	4		50	50
5	BMM-696	Pathology			4	4		50	50
Total Practical						12	150		
Total of Semester						24	300		

INTERNSHIP FOR 6 MONTHS

INTERNSHIP WILL BE DONE IN A MICROBIOLOGY LABORATORY OF MEDICAL COLLEGE OR RESEARCH CENTRE AFTER COMPLETION OF 6TH SEMESTER

FIRST SEMESTER

CELL BIOLOGY

Code: BMM 101

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Basics of Cell Biology (structure & function) – Discovery of cell and Cell Theory;
2. Comparison between plant and animal cells; cytosol, compartmentalization of eukaryotic cells, cell fractionation.
3. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.
4. Cell wall; Plasma membrane; Modification of plasma membrane and intracellular junctions.
5. Endoplasmic reticulum: Structure, function including role in protein segregation.
6. Golgi complex: Structure, biogenesis and functions including role in protein secretion.
7. Lysosomes: Vacuoles and micro bodies: Structure and functions
8. Ribosomes: Structures and function.
9. Mitochondria: Structure and function.
10. Nucleus: Structure and function, chromosomes and their structure.
11. Extracellular Matrix: Composition, macromolecules,

BASICS OF ANATOMY

Code: BMM 102

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Introduction: to the course and the subject of anatomy.
2. Orientation to: the systems of the body; anatomical terminologies; learning methodologies in anatomy; embryology.
3. Microscopic Anatomy: structure of cell, types of tissues, cell cycle and division, introduction to genetics.
4. Respiratory system: Gross and microscopic structures of the lungs.
5. Circulatory system: parts, microscopic anatomy of vessels, gross and microscopic structure of heart, blood vessels- both arteries and veins.
6. Digestive system: location, parts and functions of the system, gross and microscopic structure, location of digestive glands- gross and microscopic structure.
7. Urogenital system: a) Reproductive system: gross and microscopic parts of both male and female systems.
b) Urinary system: parts, kidney gross and microscopic structure, applied aspects.
8. Musculoskeletal systems: classification, location of the bones and muscles in the body.
9. Nervous systems: parts and division into central nervous system, gross and microscopy of brain and spinal cord, naming of cranial nerves, functions served by each of them.
10. Endocrinology: brief outline of location and function of the endocrine glands.
11. Brief outline of special senses: eye, ear, nose, tongue.

BASICS OF PHYSIOLOGY

Code: BMM 103

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Blood: Composition of blood and body fluid; Structure and function of RBC; WBC and platelets; lymphatic system. Haemoglobinopathis; Bleeding disorders.
2. Cardiovascular system: nerve supply to heart; Cardiac cycle and regulation of arterial blood pressure; cardiac output; heart rate.
3. Respiratory system: Physiological anatomy; pulmonary ventilation; mechanism of respiratory regulations; transport of blood gases; hypoxia; cyanosis; asphyxia; artificial respiration.
4. Digestive system: General structure of GI. Tract, Composition, regulation of secretion & functions of salivary juice; gastric juice; pancreatic juice. Motor functions of GIT. Peptic ulcer, gastritis.
5. Excretory system: Structure & functions of kidney; formation of urine; renal function test, mechanism of micturition & abnormalities.
6. Muscle: Structure of muscles; NMJ, Mechanism of skeletal muscle contraction and relaxation. Myasthenia gravis, muscular dystrophy, fatigue.
7. Nervous system: Structure of neurons; Neuronal organization at spinal cord level; Synapse; receptors, reflexes, sensations and tracts; Physiology of pain; functions of different parts of brain; autonomic nervous system; CSF.
8. Special senses: Fundamental knowledge of vision, hearing, taste and smell.
9. Endocrine system: Brief functions of pituitary, thyroid, adrenal glands; pancreatic hormones and disorders.
10. Reproductive system: Menstrual cycle, functions of ovarian hormones.. Spermatogenesis.
11. Skin and temperature: Body temperature regulation and function of skin.

GENERAL MICROBIOLOGY

Code: BMM 104

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. General characters and classification of Bacteria.
2. Characteristics of Bacteria, Morphology-structure of a typical bacterial cell- size, shape, arrangement ; ultra structures- flagella, pili, cell-wall, cytoplasmic membrane, spore, capsule, prokaryotic cellular reserve materials
3. Sterilization and Disinfection.
4. Physical agents- Sunlight, Temperature, steam at atmospheric pressure and steam under pressure, irradiation, filtration.
5. Chemical Agents- Alcohol, aldehyde, Dyes, Halogens, Phenols, Ethylene oxide.
6. Culture Media: Definition, uses, basic requirements, classification, Agar, Peptone, Transport Media, Anaerobic Media, Forms of Media
7. Staining Methods: Simple, Grams staining, Ziehl-Neelsen staining, Negative Staining
8. Collection and Transportation of Specimen: General Principles, Containers, Rejection, Samples- Urine, Faeces, Sputum, Pus, Body, fluids, Swab, Blood.

9. Disposal of Laboratory/Hospital Waste: Non-infectious waste, Infected sharp waste disposal, infected non-sharp waste disposal.

PHYSIOLOGY & ANATOMY

Code: BMM 195

FULL MARKS-50

4P

CREDIT: 4

1. Identification of surface land marks of a human body.
2. Demonstration on muscles of trunk, lower and upper extremities and face.
3. Study on bone on human body with special reference to the origin and insertion of muscles and ligaments.
4. Study on gross anatomy of respiratory, digestive, endocrine, urinary and genital system on a dissected human body.
5. Demonstration on the anatomy of CNS and PNS.

BACTERIOLOGY

Code: BMM 196

FULL MARKS-50

4P

CREDIT: 4

1. Staining methods- simple staining, grams staining, capsule staining, spore staining, spirochete staining, Methods of motility testing: hanging drop preparation
2. Preparation of common culture media
3. Sterilization methods
4. Culture methods
5. Cultivation of bacteria and in laboratory
6. Biochemical test used for identification of bacteria
7. Anaerobic culture methods
8. Maintenance & preservation of bacterial cultures

SECOND SEMESTER

BASICS OF BIOCHEMISTRY

Code: BMM 201

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Carbohydrates: Classification, Chemistry, Properties of mono, di-and polysaccharides.
2. Proteins: Classification of proteins and amino acids, their properties, structure of proteins and amino acids, plasma proteins, general reactions of aminoacids.
3. Lipids: Classification of lipids, properties of fatty acids, phospholipids and sterols, lipoproteins- characterisation,classification
4. Enzymes: General properties andclassification.
5. Vitamins and minerals: Fat soluble and water soluble, chemistry, functions, dietary sources, daily requirements, deficiency manifestations, minerals and trace elements.
6. Nucleic acids: Chemistry of purines and pyrimidines, nucleosides, nucleotides, nucleic acids- DNA, RNA, difference between DNA and RNA types of RNA,DNA
7. Acids and bases: definition, ionization of acids, ionic product of water, H⁺ concentration, strong acids and bases, weak acids and bases, strength of acids, titration curves of acids and bases,
8. pH – definition, pH scale, calculation of pH, Hendreson- Hasselback equations, pH measurement
9. Buffers- definition, components, mechanism of action, buffer capacity, pK of buffers, preparation of buffers, buffers in biological system, commonly used buffers in lab.

METABOLISM

Code: BMM 202

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. β -oxidation of fatty acids.
2. Lipid Metabolism – Structures and roles of Fatty acids &Glycerols, beta oxidation of saturated fatty acids, oxidation of unsaturated fatty acids, oxidation of odd chain fatty acids, energy yield, Ketone bodies.
3. Amino acid Metabolism – Amino acid breakdown (amino acid deamination, Urea cycle, metabolic breakdown of individual amino acids – glucogenic& ketogenic amino acids), amino acids as biosynthetic precursors (haem biosynthesis & degradation, biosynthesis of epinephrine, dopamine, seretonin, GABA, histamin, glutathione); biosynthesis of essential & non-essential amino acids.
4. Nucleotide Metabolism – biosynthesis of purine & pyrimidine (de novo & salvage pathway); degradation of purine & pyrimidine.

INSTRUMENTATION

Code: BMM 203

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Study of common equipment used in microbiology lab: Incubators, Hot air oven, Autoclave, anaerobic cultivation apparatus, and Biological safety Cabinet.
2. Microscopy : Principle, resolving power, magnification, types of microscope, staining and specimen preparation for electron microscope
3. Centrifugation : Principle, RCF, RPM, types of centrifuges, applications of centrifugation
4. Chromatography : general principle, types of chromatography, HPLC
5. Electrophoresis: Theory, principle, gel electrophoresis- types of gels, tracking dyes, PAGE, applications of gel electrophoresis.
6. Colorimetry and spectrophotometry: Absorption and transmission of light, Principle of colorimetry, Beer- Lamberts law, selection of filters.
7. pH meters and pH measurements: parts , technique and application

MICROBIAL PHYSIOLOGY

Code: BMM 204

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Growth and cell division: Measurement of growth, cell division, growth yields, steady state growth, batch and continuous growth.
2. Cultivation of microbes: aerobic, anaerobic and facultative. Pure culture and its characteristics. Nutritional types, culture media. Measurement of growth (direct and indirect) and factors affecting growth.
3. Microbial stress responses: Osmotic stress and osmoregulation, Aerobic to anaerobic transitions, Oxidative stress, pH stress and acid tolerance, Thermal stress and heat shock response, Nutrient stress and starvation stress.
4. Intercellular signalling, concept of two component system. Quorum sensing in bacteria, sporulation in *Bacillus subtilis*, mechanism of bacterial competence.

ANALYTICAL BIOCHEMISTRY

Code: BMM 295

FULL MARKS-50

4P

CREDIT: 4

1. Demonstration of analytical instruments (principles and applications) available in the Department.
2. Estimation of total protein, DNA and RNA of a bacterial cell.
3. Determination of activity of enzyme. Effect of pH, temperature on enzyme activity.
4. Purification of protein (demonstration only).
5. Determination of MW of protein by PAGE.
6. Study of enzyme by native gel electrophoresis (zymogram).

CLINICAL BIOCHEMISTRY

Code: BMM 296

FULL MARKS-50

4P

CREDIT: 4

1. Biochemistry Laboratory instruments: (Photometry, Centrifuge, Water bath). Medical laboratory professional - professionalism in biochemistry laboratory. Calibration of pipettes and other volumetric apparatus. General approach to specimen collection, transport and disposal. Anticoagulants
2. Biochemical Estimation: Estimation of blood sugar, Glucose tolerance tests (GTT), Glycosylated haemoglobin (HbA1C). Lipid determination of serum lipids – cholesterol, triglycerides and lipoprotein fractionation
3. Liver Function Tests: Estimation of Total Protein, Albumin & A/G ratio, Estimation of Bilirubin – total and conjugated. Renal function test: Estimation of NPN substances a) Blood Urea, b) Serum Creatinine. c) Serum Uric acid
4. Enzymes: Determination of Alkaline Phosphates, Acid phosphates, SGOT, SGPT, salivary Amylase.

THIRD SEMESTER

LABORATORY TQM, ETHICS, AND BIOSAFETY

Code: BMM 301

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Quality control of product, chemical reagents, good reliable and authentic report, total quality management framework of laboratory.
2. Essential elements in quality assurance programme, internal quality control, control of preanalytical variable, laboratory precision, accuracy and sensitivity validation method.
3. Quality control chart, Culsum chart
4. Internal and External factors for quality control
5. Co-operation and working relationship with other health professionals
6. Dignity and privacy of patient
7. Institutional ethical committee and its role
8. Laboratory ethics of Bio-Safety.
9. Code of good and safe laboratory practice for support staff and responsibilities of the workers regarding Biosafety.
10. ISO rules for laboratory.
11. Laboratory Biosafety Level Criteria (BSL-1-4).
12. Handling, transfer and shipment of specimen. Decontamination and disposal. Treatment and disposal technologies for health- care waste.
13. Chemical, electrical, fire and radiation safety. Safety organization.
14. Laboratory first-aid measures and kit.
15. Safety equipment, Safety signs.

MYCOLOGY

Code: BMM 302

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Morphology & reproduction of fungi
2. Isolation & identification of fungi
3. Medical importance of *Candida*, *Cryptococcus*, *Malassezia*, *Trichosporon*, *Saccharomyces*.
4. Medical importance of *Aspergillus*, *Zygomycetes*, *Pseudoallescheria*, *Fusarium*, *Piedra*.
5. Dimorphic fungi
6. Dermatophytes
7. Fungi causing mycetoma, keratomycosis & otomycosis.

VIROLOGY

Code: BMM 303

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. General properties of viruses, Classification of viruses, Morphology: Virus structure.
2. Viroids, virusoids, prions, satellite viruses.
3. Principal events involved in viral maturation, Host response to viral infection.
4. Details on important viruses namely Herpesvirus, Poliovirus, SV40 and Adeno Virus, Poxviruses, Hepatitis viruses, A, B, C, D, E; coronaviruses, Retroviruses.
5. Orthomyxo and paramyxo viral diseases (Influenza, Mumps, Measles) including vaccines.
6. Retrovirus -HIV infection & AIDS
7. Oncoviruses -examples & properties
8. Bacteriophage

PARASITOLOGY

Code: BMM 304

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. An elementary study of types of animal associations- types of parasites, classification of protozoa and helminthes
2. An elementary knowledge of the structure , life history of parasites belonging to the following genera with reference to forms seen in human pathological material, and the methods used to identify them
3. Protozoa: Entamoeba, Dientamoeba, Iodamoeba, Acaanthamoeba and Naegleria
4. Flagellates- Giardia, Trichomonas, Chilomastix, Enteromonas, Trypanosome, Leishmania
5. Sporozoa- Plasmodium, Isospora, Eimeria, Balantidium,
6. Collection and preservation of specimens for parasitological examinations, preservation of specimens of parasitic egg and embryos, preserving fluids, transport of specimen
7. Detection of intestinal parasites- detection and identification of amoeba and other intestinal protozoans and parasites
8. Examination of blood parasites: thick and thin smear preparations for malaria and filarial, other parasites and concentration methods
9. Examination of biopsy material and other body fluids: brief account of spleen puncture for diagnosis of kala azar and skin biopsy, for parasites, examination of vaginal swabs

MYCOLOGY & VIROLOGY

Code: BMM 395

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Collection and transport of specimens
2. Processing of samples for microscopy and culture
3. Direct examination of specimens by KOH, Giemsa, Lactophenol cotton blue

4. Examination of histopathology slides for fungal infections.
5. Isolation and identification of medically important fungi & common laboratory contaminants
6. Demonstration of animal cell cultures, Media, sterilization, demonstration of cell line.
7. Detection of Measles Virus by ELISA.
8. Detection of Dengue Virus by ELISA.
9. Detection of HIV by ELISA.

PARASITOLOGY

Code: BMM 396

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Identification of different disease causing Arthropods (Housefly, Mosquito etc.)
2. Identification of different disease causing Helminth and Protozoan parasites.
3. Identification of different phases of life cycle of arthropods protozoa, helminth, having medical importance for causing disease.
4. Slide identification of microfilaria, Taenia solium, ascaris, and deferent stages of malaria.
5. Examination of stool for OPV (Ova parasite Cyst).

FOURTH SEMESTER

ENTOMOLOGY

Code: BMM 401

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Introduction: classification of arthropods of public health importance
2. Role of arthropods in the transmission of diseases
3. Mosquito: morphology, life cycle, binomics and public health importance of anopheles, culex, aedes, and mansonina
4. Insecticides used for the control of arthropods of public health importance
5. Mosquito borne diseases and their control
6. Phebotomus (sand fly)- morphology, life history, public health importance and control
7. House fly: morphology, life history, disease relationship, public health importance and control
8. Fleas- morphology, life cycle, disease transmitted and control

MOLECULAR BIOLOGY

Code: BMM 402

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. DNA replication, transcription and translation. Post transcriptional (capping, polyadenylation, splicing, intron and exons) and post translational modification.
2. Transcriptional regulation in prokaryotes, Operon concept – lac, trp operons.
3. DNA damage and repair: photoreactivation, excision – BER and NER, recombination. SOS repair, mismatch, Methyl-directed mismatch repair, very short patch repair, rDNA methylation, transposition. Site directed mutagenesis.
4. Mechanism of genetic exchange: Plasmid and bacterial sex, Types of plasmids (F Plasmid : a Conjugate plasmid', Mobilization of Non-conjugative plasmid, R plasmid, Col plasmid, Copy number and incompatibility), Episomes.
5. Transduction (Generalized transduction, Specialized Transduction)- gene mapping

SYSTEMATIC BACTERIOLOGY

Code: BMM 403

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Gram positive cocci of medical importance including *Staphylococcus*, *Pnemococcus*, *Streptococcus*.
2. Gram negative cocci of medical importance including *Neisseria*, *Haemophilus*
3. Gram positive bacilli of medical importance including *Clostridium*, *Bacillus*, *Corneybacterium*.
4. Gram negative bacilli of medical importance including *Vibrios*, *Brucella*, *Pseudomonas*, *Bacteroides*.
5. Enterobacteriaceae

6. *Mycobacterium*
7. *Spirochaetes*
8. *Chlamydiae*
9. *Mycoplasma*
10. *Rickettsiae*

The study of the above mentioned bacteria should be focused on morphology, antigenic structure, pathophysiology, and laboratory diagnostics.

IMMUNOLOGY

Code: BMM 404

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Introduction to immunology, Infection: definition, classification, sources, methods of transmission, factors predisposing to microbial pathogenicity, types of infectious diseases
2. Immunity : Mechanisms of innate immunity, acquired immunity, Measurement of immunity, Herd immunity
3. Antigens : Determinants of antigenicity, biological classes
4. Antibodies : Structure, classes, abnormal immunoglobulins, immunoglobulin specificities
5. Antigen- Antibody reaction: General features, measurement, serological reactions
6. Complement system: General properties, components, complement activation; classical, alternative and lectin pathways;
7. Structure and functions of the immune system: Central and peripheral lymphoid organs, Cells of the lympho reticular system, T and B cell maturation, Null cells, MHC and MHC restriction
8. Immune response : Humoral immune response, production of antibody, Monoclonal antibodies, Cellular immune response, Cytokines
9. Autoimmunity : Mechanism, classification and pathogenesis of autoimmune diseases

MOLECULAR BIOLOGY

Code: BMM 495

FULL MARKS-50

4P

CREDIT: 4

1. Isolation of mutant (UV/ NTG / HNO₂/ Dyes).
2. DNA isolation (plasmid & chromosomal).
3. Agarose gel electrophoresis for DNA.
4. Amplification of DNA / RNA by PCR.
5. Restriction analysis of bacterial DNA.
6. Demonstration of transformation and transduction process.
7. Induction of β -galactosidase in *E. coli*.

IMMUNOLOGY & HAEMATOLOGY

Code: BMM 496

FULL MARKS-50

4P

CREDIT: 4

1. Collection of blood by venepuncture, separation of serum and preservation of serum for short and long periods.
2. Performance of serological tests viz. Widal, VDRL, ASO, Enzyme linked immunosorbent assay
3. Latex agglutination tests
4. Separation of lymphocytes by centrifugation etc.
5. Separation and characterization of blood cell.
6. Estimation of TC & DC.
7. Separation of macrophage.
8. Ouchterlony double diffusion technique
9. Detection of immunoglobulins by ELISA.
10. Precipitation techniques: immunodiffusion, immuno electrophoretic method

FIFTH SEMESTER

COMPUTER FUNDAMENTALS

Code: BMM 501

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Basic concept of Computer System: Introduction, Characteristics of Computer, Components of Computer, Basic organization of Computer System (I/P, O/P, Memory & CPU units).
2. Generation of Computer: 1st to 4th generations with characteristics.
3. Operating System: Introduction; Operations of OS. Evolution of OS – Batch processing, Multiprogramming.
4. Process Management: Process concept, Process States, Process control block (PCB)
5. Process Synchronization: Cooperating process, Critical-Section problem and solution, Semaphores (Binary & counting).
6. Software's-use of MS word, MS EXCEL-Bar diagram, Pie diagram and line diagram MS power point.

BIOINFORMATICS

Code: BMM 502

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Introduction to bioinformatics.
2. Data Generation and Data Retrieval: Sequence submission tools (BankIt, Sequin); Sequence fileformat (flat file, FASTA, Genbank, Genpept, EMBL, Swiss-Prot); Data retrieval systems (NCBI Entrez).
3. Sequence Alignment and Pattern recognition: Sequence similarity searching; Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA algorithm); Local and global alignment, pairwise and multiple sequence alignments (without algorithm); Concept of identity and homology of sequences.
4. Ligand-protein interaction.

GENERAL PATHOLOGY

Code: BMM 503

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Aims and objectives of the study of pathology. Meaning of terms, etiology, pathogenesis and lesions.
2. Causes of disease and cell injury – features of cell injury, mechanism of cell injury – hypoxia, free radical injury. Necrosis and gangrene.
3. Inflammation- definition, events of acute inflammation, chemical mediator of inflammation, morphological types of acute inflammation, chronic inflammation, difference between acute and chronic inflammation
4. Repair –primary healing, secondary healing, factors affecting healing and repair healing of skin, muscle and bone.

5. Fluid and hemodynamic derangements – oedema, hyperemia, Haemorrhage, shock, embolism, thrombosis, infarction.
6. Neoplasia: characteristic of benign and malignant tumors, grading and staging of malignant tumors, a brief outline of the carcinogenic agents and methods of diagnosis of malignancy and general effects of malignancy on the host.
7. Nutritional disorders: deficiency disorders (protein deficiency, vitamin deficiency (A, B, C, D, E) causes, features, a brief outline of the methods of diagnosis.

BIO-STATISTICS

Code: BMM 504

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Introduction to Biostatistics: Definition, role of statistics in health science
2. Sampling: Population, sample, sampling, reasons for sampling, probability and non-probability sampling, Methods of probability sampling-simple random.
3. Measures of location: Arithmetic mean, median, mode, quartiles and percentiles – definition.
4. Measures of variation: Range, inter-quartile range, variance, standard deviation, coefficient of variation- definition.
5. Tests of significance: Basic of testing of hypothesis - Null and alternate hypothesis, one way analysis of variance (ANOVA).
6. Correlation and Regression: Concept and properties of correlation coefficient, Testing the significance of correlation coefficient. Linear and multiple regressions.
7. Application of Statistics: Application of SPSS, Origin lab, Software, Use of software for pathological data analysis

COMPUTER & BIOSTATISTICS

Code: BMM 595

FULL MARKS-50

4P

CREDIT: 4

1. Operation of personal computer.
2. Data storage, reporting, data presentation in computer.
3. Application of MS-office in pathological laboratories.
4. Problem solving on mean, median, SEM, SD.
5. Problem solving on 't' test: match group, single group study, population mean study.

REVIEW WORK

Code: BMM 596

FULL MARKS-50

4P

CREDIT: 4

Students have to submit (bounded copy) and present (power point presentation) a review work in front of the examiners.

SIXTH SEMESTER

DIAGNOSTIC MICROBIOLOGY

Code: BMM 601

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Vaccine, Disease control by vaccination, national vaccination schedules. Types of vaccine: live microorganism, attenuated organism, genetically modified organism, protein, edible, synthetic, naked DNA, recombinant and anti-idiotypic vaccine. Hazards of immunization.
2. Epitope design and its application in immunodiagnosis tests. Immunotechniques – agglutination, precipitation, immunofluorescence, ELISA
3. Western blot, FACS. Immunohistochemical methods.
4. Epidemiology, symptomatology. General description of microbial pathogens, diagnosis, prevention and therapy of - meningitis, tuberculosis, leprosy, urinary tract infection, cholera, ring-worm, syphilis, diphtheria, malarial parasite, *Giardia* and *Leishmania*.

APPLIED MICROBIOLOGY

Code: BMM 602

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Normal microbial flora of the human body.
2. Epidemiology of communicable diseases: host, reservoir, carrier, vector; Infective agents- modes and routes of infection, pathogenesis and symptoms, control and eradications of infectious diseases
3. Hospital acquired infections
4. Detailed procedure in sample collection, transportation and laboratory diagnosis of diseases of
 - i. Upper and Lower respiratory tract infection
 - ii. Genital tract infection
 - iii. Infections of the eye and ear
 - iv. Skin and soft tissue infection
 - v. Pyogenic infection
5. Laboratory procedures in the diagnosis of viral infections
6. Laboratory diagnosis of fungal infections
7. Quality control in microbiology laboratory
8. Sterility test
9. Automation in microbiology

CLINICAL PATHOLOGY

Code: BMM 603

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Collection of urine and stool specimen, types of urine and stool specimen and preservation of urine and stool.
2. Routine examination of urine – physical and Microscopic examination.
3. Chemical test of urine for glucose, protein, Ketone bodies, bilirubin, urobilinogen & blood.
4. Laboratory investigation, Serous fluid and Gastric juice.
5. Collection and processing of CSF and its laboratory investigation.
6. Routine test for stool and occult blood test.
7. Examination of Sputum – routine and special test.
8. Semen Examination – routine and special test.
9. Various methods of detecting HCG level.

SYSTEMIC PATHOLOGY

Code: BMM 604

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Blood Vessels: Atherosclerosis, thromboangitisobliterance, varicose vein, DVT, thrombophlebitis, lymphoedema
2. Disease of Heart: Congestive cardiac failure, ischemic heart disease, rheumatic heart disease, infective heart disease (pericarditis, myocarditis, endocarditis)
3. Respiratory System: Pneumonias, Bronchiactesis, Emphysema, Chronic bronchitis, Asthma, Tuberculosis etc.
4. Joints Disorders: Arthritis- types and their features.
5. Bone Disorders: Osteoporosis, Paget's disease, Osteogenesis Imperfecta, Osteomyelitis, tumors–Osteosarcoma, Chonrosarcoma, Ewings sarcoma, Multiple myeloma (a brief outline only)
6. Muscles: Muscular dystrophy, Myasthenia gravis
7. Nervous System: Meningitis, encephalitis, vascular diseases of brain, poliomyelitis, nerve injuries.

DIAGNOSTIC MICROBIOLOGY

Code: BMM 695

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Antimicrobial susceptibility testing, MIC
2. Identification of *E. coli*, *P. aeruginosa*, *S. aureus*, *Salmonella* sp. by biochemical tests (IMVIC Test).

3. Disposal of contaminated materials like cultures
4. Disposal of infectious waste
5. Bacteriological tests for water and milk
6. Grouping of Streptococci by latex agglutination test.

CLINICAL PATHOLOGY

Code: BMM 696

FULL MARKS-50

3L+1T=4

CREDIT: 4

1. Physical examination of urine.
2. Microscopic examination of urine sediment.
3. Laboratory testing of serous fluid.
4. Laboratory testing of synovial fluid, gastric juice and pleural fluid.
5. Routine examination of sputum.
6. Routine test for stool and occult blood test.

INTERNSHIP

Code: BMM 701

FULL MARKS-200

30P

CREDIT: 4

Internship for 6 months

Internship will be done in a Government Medical College or Hospitals or Research Centre after completion of 6th semester.