

SCHEME & SYLLABUS

M. Sc.-Medical Microbiology

(Choice Based Credit System)

Program Code: PG032



**Department of Life Sciences and Allied
Health Sciences
UIS
SANT BABA BHAG SINGH UNIVERSITY
2021**

ABOUT THE DEPARTMENT

The department of Life Sciences formerly known as the Department of Natural Sciences was established in the year 2015 with only two UG programmes. Over the years this department has flourished and is offering various Programmes and courses at graduate, post-graduate and doctorate level in field of Botany, Zoology, Biotechnology, Biochemistry, Microbiology and Laboratory Sciences. The department is nurtured by the highly qualified and dedicated Faculty, honoured by various international and national awards. The department is blessed to have specialized faculties in various fields of Life Sciences viz. Plant physiology, Plant Biochemistry, Plant Microbe interaction, Stress Physiology, Chemical ecology, Microbial Physiology, Industrial Microbiology, Clinical microbiology, Microbial Biotechnology, Animal Biotechnology, Fisheries, Parasitology, Molecular biology, Entomology, Sericulture, Animal toxicology, Endocrinology, Biochemistry and Biodiversity

SALIENT FEATURES OF THE DEPARTMENT

- Research oriented curriculum designed to enable students to acquire all the skills needed to collect and analyze the data.
- The Institute drawing upon its strength of highly qualified well trained faculty, state of art infrastructure and innovative teaching methodology.
- Elective courses that brides the gap between industry requirements and academia.
- The department is disseminating various educational missions via e-learning platform in the form of SWAYAM, Virtual lab etc.
- The department is equipped with a number of instruments and facilities like, UV-Visible Spectrophotometer, High Speed Centrifuge, Deep Freezer, Laminar Air flow, Air Samplers, Autoclave, Incubator, Photo actometer, Air condition Labs, WiFi, Library etc.
- The department has organized a large number of conferences, seminars, symposia and workshops. National and International eminent scientists of the country have been associated with the Department as visiting and honorary professors.

M. Sc. Medical Microbiology

Scientific and technological advancements have created complexity in the diagnostic field necessitating advanced educational preparation. To keep pace with the tremendous progress in Medical Science and to meet changing health care needs specialization and research are essential in the field of Laboratory science. The specialties are provided by the university in M. Sc. Medical Microbiology, M. Sc. Medical Laboratory Science (Clinical Biochemistry) and M. Sc. Medical Laboratory Science (Clinical Microbiology).

VISION

To bridge the gap between demand and supply for Life Science and Allied Health Professionals with grooming young generations along with their moral and spiritual development.

MISSION

To radiate the knowledge of Life Science and Allied Health Science through quality education by using latest technology, modern infrastructure and the framework needed for the development of professionals.

ELIGIBILITY CRITERIA

B.Sc. MLT/MLS/ Applied Medical Science/ Bio- Science/ Medical Science/ Allied Medical Science/ Life Science/Microbiology/Biochemistry/ Biotechnology.

DURATION

2 Years

CAREER PATHWAYS

The program is designed to meet the growing requirement of qualified professionals in field of IT industry and education: The Medical Microbiologists/ technician may be assigned to a specialized area of work in a large medical labs/ research labs/ Intermediate reference labs. 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 officers.

PROGRAMME EDUCATIONAL OBJECTIVE (PEO)

PEO1. To educate graduates in basic and advanced areas of Medical microbiology and other related subjects along with sensitizing them to the scope for research.

PEO2. To empower the students with analytical and research skills.

PEO3. To foster entrepreneurial endeavors and to prepare a competent generation of microbiologist.

PEO4. To develop microbiologists with skills to pursue careers both in academia as well as in industry.

PROGRAMME OUTCOMES (PO)

PO1. Disciplinary Knowledge: The student has acquired in-depth knowledge of the various theoretical and practical concepts regarding the role of microbial infection in human health and its immune response.

PO2. Critical Thinking: Critical thinking as an attribute enables a student to identify, formulate and apply knowledge to develop critical thinking and practical understanding in the field of microbiology to find solutions for human benefits.

PO3. Problem Solving: gain hands on experience in state-of-the-art laboratory equipment that could enrich them to perform high through put research on microorganisms and execute diagnostic procedures in field of medical microbiology

PO4. Scientific /Analytical Reasoning: Students learn to investigate, experiments/ theoretical methods, relate information and interpretation of data based on scientific reasoning. The student will be able to draw logical conclusions based on a group of observations, mathematical techniques and measurements

PO5. Multicultural Competence: The ability to understand and constectively relate to uniqueness of each student in light of diverse cultrre that influence in multy prospectives

PO6. Environment & Sustainability: Student's ability to understand over all goal of conserving natural resourses and create and dvelop energy efficient projects and practice.

PO7. Research related skills & Ethics: develop the skill to think independently, plan research and execute it in different fields of Microbiology. The student is aware of what constitutes unethical behavior-- fabrication, plagiarism and misrepresentation or manipulation of data

PO8. Individual and Team Work: acquire the ability to function effectively on teams to accomplish a common goal. The student is capable of contributing meaningfully to team ethos and goals.

PO9. Communication Skills: Students are encouraged to communicate scientific concepts, experimental results and analytical arguments clearly and concisely, both verbally and in writing.

PO10. Life long Learning: students opt for higher studies, jobs in various sectors and entrepreneurship abilities in the field of microbiology

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1. Get equipped with a theoretical and practical knowledge of Medical microbiology.

PSO2. Explain about various applications of Microbiology such as Microbial Pathogenicity.

PSO3. Design and execute experiments related to Basic Microbiology, Immunology, Molecular Biology, Recombinant DNA Technology, and Microbial Genetics.

PSO4. Execute a short research project incorporating techniques of Basic and Advanced Microbiology under supervision.

PSO5. Take up a suitable position in academia or industry, and to pursue a career in research if so desired

Index

| S. No. | Subject Code | Subject | Semester | Page No. |
|--------|--------------|--|------------------|-------------|
| | | Course | 1-4 (ALL) | 7-11 |
| 1. | MMB501 | Basic Medical Microbiology | 1 | 13-14 |
| 2. | MMB505 | Systematic Bacteriology | 1 | 15-16 |
| 3. | MMB509 | Molecular Biology and Bioinformatics | 1 | 17 |
| 4. | MMB511 | Bioinstrumentation | 1 | 18-19 |
| 5. | MMB513 | Intellectual Property Right | 1 | 20 |
| 6. | MAT515 | Biostatistical Methods | 1 | 21 |
| 7. | MMB503 | Basic Medical Microbiology (Practical) | 1 | 22 |
| 8. | MMB507 | Systematic Bacteriology (Practical) | 1 | 23 |
| 9. | MMB502 | Applied Bacteriology | 2 | 25-26 |
| 10. | MMB506 | Medical Parasitology | 2 | 27-28 |
| 11. | MMB510 | Biochemistry and Metabolism | 2 | 29-30 |
| 12. | CSE554 | Introductory Concepts of Computer Technology | 2 | 31-32 |
| 13. | EVS003 | Natural Hazards & Disaster Management | 2 | 33 |
| 14. | MMB514 | Antimicrobial Agents and Chemotherapy | 2 | 34 |
| 15. | MMB504 | Applied Bacteriology (Practical) | 2 | 35-36 |
| 16. | MMB508 | Medical Parasitology (Practical) | 2 | 37 |
| 17. | MMB512 | Biochemistry and Metabolism (Practical) | 2 | 38 |
| 18. | CSE556 | Introductory Concepts of Computer Technology (Practical) | 2 | 39 |
| 19. | MMB601 | Medical Mycology | 3 | 41 |
| 20. | MMB605 | Medical Virology | 3 | 42 |
| 21. | MMB609 | Immunology | 3 | 43-44 |
| 22. | MMB613 | Recombinant DNA Technology (RDT) | 3 | 45 |
| 23. | MMB615 | Research Methodology | 3 | 46 |
| 24. | MMB603 | Medical Mycology (Practical) | 3 | 47 |
| 25. | MMB607 | Medical Virology (Practical) | 3 | 48 |
| 26. | MMB611 | Immunology (Practical) | 3 | 49 |
| 27. | MMB617 | Seminar | 3 | 50 |
| 28. | MMB602 | Dissertation/Project | 4 | 52 |

Course Scheme

M. Sc. Medical Microbiology (Semester-I-IV)

SEMESTER I

I. Theory Subjects

| S.No | Sub Code | Subject Name | Contact Hours (L:T:P) | Credits (L:T:P) | Total Contact Hours | Total Credits Hours | Course Type |
|------|----------|--------------------------------------|-----------------------|-----------------|---------------------|---------------------|-------------|
| 1 | MMB501 | Basic Medical Microbiology | 4:0:0 | 4:0:0 | 4 | 4 | CC |
| 2 | MMB505 | Systematic Bacteriology | 4:0:0 | 4:0:0 | 4 | 4 | CC |
| 3 | MMB509 | Molecular Biology and Bioinformatics | 3:1:0 | 4:0:0 | 4 | 4 | CC |
| 4 | MMB511 | Bioinstrumentation | 4:0:0 | 4:0:0 | 4 | 4 | CC |
| 5 | MMB513 | Intellectual Property Right | 2:0:0 | 2:0:0 | 2 | 2 | SECC |
| 5 | MAT515 | Biostatistical Methods | 3:0:0 | 3:0:0 | 3 | 3 | ID |

II. Practical Subjects

| | | | | | | | |
|--------------|--------|--|-------|---------|-----------|-----------|----|
| 1 | MMB503 | Basic Medical Microbiology (Practical) | 0:0:3 | 0:0:1.5 | 3 | 1.5 | CC |
| 2 | MMB507 | Systematic Bacteriology (Practical) | 0:0:3 | 0:0:1.5 | 3 | 1.5 | CC |
| Total | | | | | 27 | 24 | |

Total Contact hrs: 27
Total Credit Hours: 24

SEMESTER-II

I. Theory Subjects

| S.No | Sub Code | Subject Name | Contact Hours (L:T:P) | Credits (L:T:P) | Total Contact Hours | Total Credits Hours | Course Type |
|------|----------|--|-----------------------|-----------------|---------------------|---------------------|-------------|
| 1 | MMB502 | Applied Bacteriology | 4:0:0 | 4:0:0 | 4 | 4 | CC |
| 2 | MMB506 | Medical Parasitology | 4:0:0 | 4:0:0 | 4 | 4 | CC |
| 3 | MMB510 | Biochemistry and Metabolism | 3:1:0 | 3:1:0 | 4 | 4 | CC |
| 4 | CSE554 | Introductory Concepts of Computer Technology | 3:0:0 | 3:0:0 | 3 | 3 | ID |
| 5 | EVS003 | Natural Hazards & Disaster Management | 3:0:0 | 3:0:0 | 3 | 3 | AECC |
| 6 | MMB514 | Antimicrobial Agents and Chemotherapy | 2:0:0 | 2:0:0 | 2 | 2 | SECC |

II. Practical Subjects

| | | | | | | | |
|--------------|--------|--|-------|-------|-----------|-----------|----|
| 1 | MMB504 | Applied Bacteriology (Practical) | 0:0:3 | 0:0:2 | 3 | 2 | CC |
| 2 | MMB508 | Medical Parasitology (Practical) | 0:0:2 | 0:0:1 | 2 | 1 | CC |
| 3 | MMB512 | Biochemistry and Metabolism (Practical) | 0:0:3 | 0:0:2 | 3 | 2 | CC |
| 4 | CSE556 | Introductory Concepts of Computer Technology (Practical) | 0:0:2 | 0:0:1 | 2 | 1 | ID |
| Total | | | | | 29 | 25 | |

Total Contact hrs: 29
Total Credit Hours: 25

SEMESTER III

I. Theory Subjects

| S.No | Sub Code | Subject Name | Contact Hours (L:T:P) | Credits (L:T:P) | Total Contact Hours | Total Credits Hours | Course Type |
|------|----------|----------------------------------|-----------------------|-----------------|---------------------|---------------------|-------------|
| 1 | MMB601 | Medical Mycology | 3:0:0 | 3:0:0 | 3 | 3 | CC |
| 2 | MMB605 | Medical Virology | 3:0:0 | 3:0:0 | 3 | 3 | CC |
| 3 | MMB609 | Immunology | 4:0:0 | 4:0:0 | 4 | 4 | CC |
| 4 | MMB613 | Recombinant DNA Technology (RDT) | 3:0:0 | 3:0:0 | 3 | 3 | CC |
| 5 | MMB615 | Research Methodology | 2:0:0 | 2:0:0 | 2 | 2 | SECC |

II. Practical Subjects

| | | | | | | | |
|--------------|--------|------------------------------|-------|---------|-----------|-----------|------|
| 1 | MMB603 | Medical Mycology (Practical) | 0:0:3 | 0:0:1.5 | 3 | 1.5 | CC |
| 2 | MMB607 | Medical Virology (Practical) | 0:0:2 | 0:0:1 | 2 | 1 | CC |
| 3 | MMB611 | Immunology (Practical) | 0:0:3 | 0:0:1.5 | 3 | 1.5 | CC |
| 4 | MMB617 | Seminar | 0:0:2 | 0:0:1 | 2 | 1 | AECC |
| Total | | | | | 25 | 20 | |

Total Contact hrs: 25
Total Credit Hours: 20

SEMESTER-IV

Dissertation/Project

| S.No | Sub Code | Subject Name | Contact Hours (L:T:P) | Credits (L:T:P) | Total Contact Hours | Total Credits Hours | Course Type |
|------|----------|----------------------|-----------------------|-----------------|---------------------|---------------------|-------------|
| 1 | MMB 602 | Dissertation/Project | 5 Months | 0:0:26 | 512 | 26 | CC |

Contact Hours*: Submission within five months

Total Contact hrs: 512
Total Credit Hours: 26



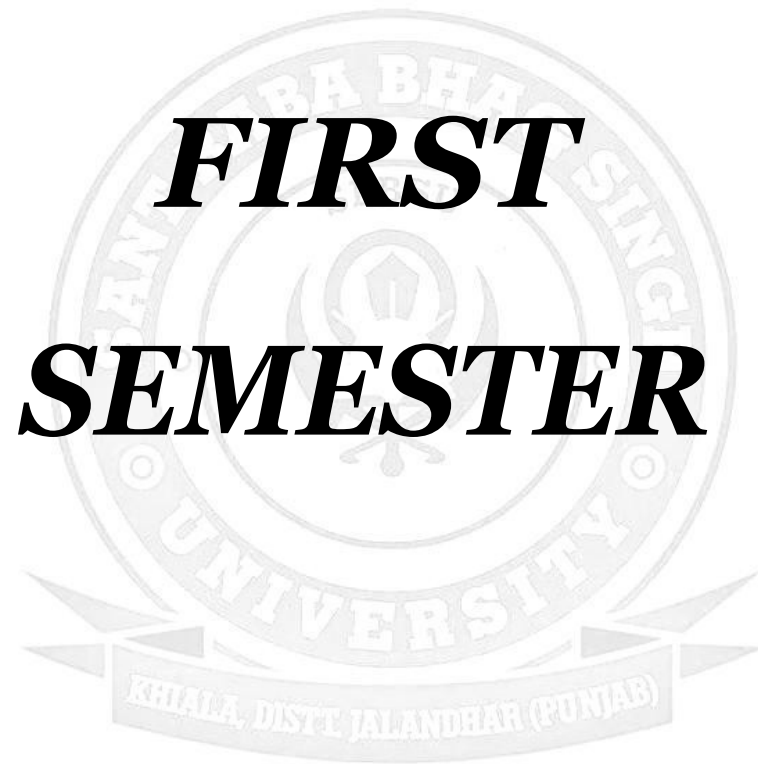
COURSE SCHEME SUMMARY

| Semester | L | T | P | Contact hrs/wk | Credits |
|--------------|-----------|----------|-----------|----------------|-----------|
| 1 | 20 | 1 | 6 | 27 | 24 |
| 2 | 19 | 1 | 10 | 29 | 25 |
| 3 | 15 | 0 | 10 | 25 | 20 |
| 4 | 0 | 0 | 26 | 26 | 26 |
| Total | 54 | 2 | 56 | 107 | 95 |

Note: Each student will submit Project report on any topic related to Medical Microbiology. Project report will be guided by subject teachers of the University and will be examined by external Examiner.

Total Contact hrs for I-III semester: 81
Total Credit Hours for I-III semester: 69

Total Contact hrs for IV semester: 512 (Five Months)
Total Credit Hours for IV semester: 26



Basic of Medical Microbiology

| | |
|----------------------------|---|
| Course Code | MMB501 |
| Course Title | Basic of Medical Microbiology |
| Type of course | Theory |
| L T P | 4 0 0 |
| Credits | 4 |
| Course prerequisite | B.Sc. MLS or B.Sc. (Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To make the students competent to isolate and identify the causative micro-organisms. |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Get about the historical events and developments in Microbiology. Theoretical & practical knowledge of Microbial world, Microscopy; their handling techniques and staining procedures 2. Familiarization with sterilization Techniques, Use of standard safety measures while handling infective materials. 3. Knowledge of Microbial cultivation various Chemotherapeutic agents & Nosocomial infection |

UNIT-I

Overview of microbial world: Historical background, Classification- Purpose, Basic principles and Classification systems, general characteristics of prokaryotes and eukaryotes, scope of medical microbiology.

Microscopy: Principle, methods of safe working, different parts, preparation of smears for examination, applications of following microscopes Bright field, dark ground, phase contrast, differential interference contrast, fluorescent, electron- scanning (SEM), transmission (TEM), polarizing, tunneling.

UNIT-II

Control of microorganisms: Sterilization and disinfection: Physical methods -Heat -Autoclaves, hot air oven, Filtration, Radiation, Chemical methods- Disinfectants, Antiseptics, Testing of disinfectants. Disinfection of thermo labile equipments Sporocidal agents Mycobacterial disinfection Quality control in sterilization

Principles in Clinical Microbiology: Collection, processing and handling of various samples, identification and characterization of micro organism, Laboratory safety, Quality control.

UNIT-III

Growth, survival of micro-Organisms: common nutrient requirements, nutritional types of microorganisms, growth curve, continuous culture and synchronous growth, influence of environmental factors on growth, culture media and its types aerobic & anaerobic cultures

Cultivation of microorganisms: bacteriological examination of air, water, food and milk

UNIT-IV

Chemotherapeutic agents: general characteristics of antimicrobial drugs, determining the level of antimicrobial activity, origin, mechanism and transmission of drug resistance

Nosocomial infections : Introduction and its types, sources and mode of transmission of nosocomial infection, laboratory diagnosis of nosocomial infection, hospital infection control committee and their roles, prevention and control of nosocomial infections

Text & Reference Books:

| S.No | Name/Title | Author | Publisher |
|-------------|--------------------------------|----------------------------|-----------------------------|
| 1 | Practical Medical Microbiology | Mackie and Mac. Cartney | Mackie and Mac. Cartney |
| 2 | Text book of Microbiology | Ananthanarayanan & Paniker | Universities press pvt. Ltd |
| 3 | Medical Microbiology | Satish Gupte | |
| 4 | Medical laboratory Technology | Mukherjee | McGraw Hill Co., New York. |
| 5 | Text book of Microbiology | Prescott | McGraw Hill Co., New York. |

Systemic Bacteriology

| | |
|----------------------------|---|
| Course Code | MMB505 |
| Course Title | Systemic Bacteriology |
| Type of course | Theory |
| L T P | 4 0 0 |
| Credits | 4 |
| Course prerequisite | B.Sc. MLS or B.Sc. (Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To enable the students about the different types of bacterial culture procedures, staining procedures and biochemical tests used for identification of bacteria. |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Understand the characteristics of bacterial cells, cell organelles, cell wall composition and various appendages like capsules, flagella or pili 2. Differentiate a large number of common bacteria by their characteristics features & classify bacteria into groups 3. Apply the knowledge to identify diseases, its diagnosis and predict the treatment plan. |

UNIT-I

Gram positive cocci: detailed account of cultural & morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of *Staphylococcus*, *Streptococcus*, *Pneumococcus*

Gram positive bacilli: detailed account of cultural & morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of *Corynebacterium*, *Bacillus*, *Clostridium* Acid fast bacteria

UNIT-II

Gram negative cocci : detailed account of cultural & morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of *Mycobacterium tuberculosis*, *Neisseria*

Gram negative bacilli: detailed account of cultural & morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of *Pseudomonas aeruginosa*, *Vibrio*, *Haemophilus influenzae*, *Campylobacter jejuni*

UNIT-III

Enterobacteriaceae-I: detailed account of cultural & morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of Enterobacteriaceae like *E. coli*, *Klebsiella*, *Shigella*, *Salmonella*

Enterobacteriaceae-II: detailed account of cultural & morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of Enterobacteriaceae like *Proteus*, *Acinetobacter*, *Enterobacter*, *Citrobacter*

UNIT-IV

Miscellaneous bacteria-I: detailed account of cultural & morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of *Mycoplasma*, *Rickettsia*, *Chlamydiae*, *Ehrlichia*

Miscellaneous bacteria-II: detailed account of cultural & morphological characteristics,

pathogenicity, clinical manifestations and laboratory diagnosis of *Actinomycetes* (*Actinomyces*, *Nocardia*), *Brucella*, *Listeria monocytogenes*, *Spirochaetes*

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|--------------|---------------------------|----------------------------|-----------------------------|
| 1 | Text book of Microbiology | Ananthanarayanan & Paniker | Universities press pvt. Ltd |
| 2 | Medical Microbiology | Panjarathinam R | New Age International |
| 3 | Text book of Microbiology | Prescott | McGraw Hill Co., New York. |

Molecular Biology and Bioinformatics

| | |
|----------------------------|--|
| Course Code | MMB509 |
| Course Title | Molecular Biology and Bioinformatics |
| Type of course | Theory |
| L T P | 3 1 0 |
| Credits | 4 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To aware the students about biological activity between biomolecules in the various systems of a cell, including the interactions between DNA, RNA and proteins and their biosynthesis, as well as the regulation of these interactions. |
| Course Outcomes | At the conclusion of the course, the students will <ol style="list-style-type: none"> 1. Acquire comprehensive knowledge about molecular events involved in the DNA replication, transcription and translation 2. Acquire basic knowledge regarding bioinformatics and its role in molecular data analysis 3. Acquire knowledge about sequence alignment and analysis. 4. Able to understand the principles and application of various molecular and data generation tools. |

UNIT-I

Introduction: Introduction to Bioinformatics and its relation with molecular biology. Examples of related tools (FASTA, BLAST, BLAT, RASMOL), databases (GENBANK, Pubmed, PDB) and software (PHYLIP).

Data generation; Gene Sequencing, Protein sequencing, 2 D Gel electrophoresis, Microarray.

UNIT-II

Sequence Alignments and Phylogeny: Introduction to Sequences, alignments and Dynamic Programming; Local alignment and Global alignment (algorithm and example), Pairwise alignment and multiple sequence alignment (Clustal W algorithm). Introduction to phylogenetics.

UNIT-III

Chemical composition of DNA, DNA replication, DNA damage and repair, PCR: Principle, Procedure, Types And Applications

UNIT-IV

Transcription and Translation: Mechanism of Transcription in prokaryotes & Eukaryotes; Processing of RNA:- m-RNA processing, 5' capping, 3' polyadenylation, Mechanism, of translation; Post translational modification of proteins.

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|-------|---|-----------------------------------|----------------------|
| 1 | Bioinformatics: Principles and Applications | Zhumur Ghosh , Bibekanand Mallick | oxford |
| 2. | Molecular Biology | Dr. P.S. Verma, Dr. V.K. Agarwal | S.Chand Publications |

Bioinstrumentation

| | |
|----------------------------|---|
| Course Code | MMB511 |
| Course Title | Bioinstrumentation |
| Type of course | Theory |
| L T P | 4 0 0 |
| Credits | 4 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To give students knowledge about the different Instruments used in biological sciences and prepare them for research work. |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Learn the principle, parts and application of Microscopic techniques. 2. Learn the principle and application of photometry. 3. Understand the working principle of separation techniques in biology like chromatography, electrophoresis, etc. |

UNIT-I

Microscopy, principle & applications of: Light microscope, phase contrast microscope and Fluorescence microscope; General principle and applications of Electron microscope (TEM & SEM); Principle and applications of confocal microscopy;

Cryotechniques: Cryopreservation of cells, tissues, organs and organisms, Freeze fracture & freeze drying

UNIT-II

Principles and applications of photometry: Beer & Lambert's law, Absorption spectrum & absorption maxima; Colorimeter & spectrophotometer; Flame photometer; Atomic absorption spectrophotometer

UNIT-III

Separation techniques: Chromatography: principle, types and applications; Electrophoresis, principle, types & applications; PAGE and agarose gel electrophoresis.

Radioisotopes in biology: Units of radioactivity, Radioactive counters, Autoradiography

UNIT-IV

Histological techniques: Principles of tissue fixation, Microtomy, cryotomy.

Immunological techniques: Immunodiffusion and Immunoelectrophoresis

Molecular cytological techniques: In situ hybridization (radiolabelled & non-radiolabelled methods), FISH, and Restriction banding.

Molecular biology techniques: Southern hybridization and Northern hybridization; DNA sequencing; Polymerase chain reaction (PCR).

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|-------|--|-------------------------------|---|
| 1 | Handbook of Microscopy | Locquin and Langeron | Butterwaths |
| 2 | Modern Experimental Biochemistry | Boyer | Benjamin |
| 3 | Practical Biochemistry | Wilson and Walker | Cambridge |
| 4 | Introduction to Instrumental analysis | Robert Braun | McGraw Hill Int. |
| 5 | Experimental Biochemistry | Clark & Switzer | Freeman Publ. |
| 6 | Bioinstrumentation | Veerakumari (2011) | MJP Publishers |
| 7 | Instrumental Methods of Analysis | Wliard, Merritt, Dean, Settle | Tata McGraw Hill Publishing Co. Ltd., New Delhi |
| 8 | Physical biochemistry: Principles and Applications | Sheehan, D. (2000) | John Wiley and Sons Ltd.,Chicester, England.. |



Intellectual Property Right

| | |
|----------------------------|---|
| Course Code | MMB513 |
| Course Title | Intellectual Property Right |
| Type of course | Theory |
| L T P | 2 0 0 |
| Credits | 2 |
| Course prerequisite | M. Sc. Medical Microbiology as Skill Enhancement Course |
| Course Objective | To inculcate the knowledge of intellectual property right to students and also aware them about Patents, trademark, copyright etc. |
| Course Outcomes | At the conclusion of the course the students will: <ol style="list-style-type: none"> 1. Understand the concept, scope and importance of IPR. 2. Know about patents, copyrights, trademarks and industrial designs. 3. Get awareness of acquiring the patent and copyright for the innovative works. |

UNIT I

Introduction to intellectual property right (IPR) : Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples. IPR and WTO (TRIPS, WIPO).

UNIT II

Patents : Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement.

Copyrights: Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement.

UNIT III

Trademarks: Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name.

Industrial Designs: Objectives, Rights, Assignments, Infringements, Defences of Design Infringement

UNIT IV

Biotechnology and Intellectual Property Rights: Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues in Patenting Biotechnological inventions.

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|-------|--|---|---------------------------------|
| 1 | Textbook on intellectual property rights | N.K. Acharya | Asia Law House (2001). |
| 2 | Understanding Trips: Managing Knowledge in Developing Countries | Manjula Guru & M.B. Rao | Sage Publications (2003). |
| 3 | Intellectual Property Rights: Unleashing the Knowledge Economy, | P. Ganguli, | Tata McGraw-Hill (2001). |
| 4 | Intellectual Property: Patents, Trademarks and Copyright in a Nutshell | Arthur Raphael Miller, Micheal H. Davis | West Group Publishers (2000). |
| 5 | Intellectual property rights in the WTO and developing countries, | Jayashree Watal | Oxford University Press, Oxford |

Biostatistical Methods

| | |
|----------------------------|---|
| Course Code | MAT515 |
| Course Title | Biostatistical Methods |
| Type of course | Theory |
| L T P | 3 0 0 |
| Credits | 3 |
| Course prerequisite | B.Sc. MLS or B.Sc. (Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To give the knowledge of statistical techniques used in life sciences for simplification of complex things, so that they can be easily understood. |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Able to calculate and apply measures of location and measures of dispersion -- grouped and ungrouped data cases 2. Learn to apply discrete and continuous probability distributions to various business problems. 3. Implement knowledge to compute and interpret the results of Bivariate and Multivariate Regression and Correlation Analysis, for forecasting and also perform ANOVA and F-test |

UNIT-I

Data collection, tabulation, Frequency distribution and its graphical representation;

Measures of Central tendency: mean, mode, median;

Measures of Dispersion: range, variance, Standard deviation and Standard error

UNIT II

Probability: Mathematical definition of a probability event; Conditional probability; Additive and Multiple law of Probability;

Theoretical Distributions: Binomial, Poisson and Normal

UNIT III

Null Hypothesis and Level of Significance; Confidence limit and confidence interval; Skewness and Kurtosis moments; Student's t- test (Paired and Unpaired); Chi Square test

UNIT-IV

Correlation: Covariance, Karl pearson's correlation coefficient and Spearmans rank correlation coefficient;

Regression: Least square technique for regression lines, regression coefficient; Relation between Correlation and Regression;

Analysis of variance (one way and two way ANOVA)

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|-------|---|--------------------|----------------------------|
| 1 | Introduction to Mathematics for Life Scientists | Batschelet, E | Springer-Verlag, Berlin |
| 2 | Mathematical Biology | Murray, J.D. | Springer-Verlag, Berlin |
| 3 | Statistical Methods | Snedecor & Cochran | Affiliated East-West Press |
| 4 | Biostatistics | P. Ramakrishnan | Saras Publications |
| 5 | Biostatistics: Basic Concepts and Methodology for the Health Sciences | Wayne W. Daniel | Wiley Publication |

Basic of Medical Microbiology - Practical

| | |
|----------------------------|---|
| Course Code | MMB503 |
| Course Title | Basic of Medical Microbiology – Practical |
| Type of course | Practical |
| L T P | 0 0 3 |
| Credits | 1.5 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To inculcate the knowledge of different processing and identification of various pathogens like bacteria, parasites, viruses using different techniques. |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none">1. Demonstrate different staining (Simple, differential & special) techniques.2. Able to prepare different type of media & perform biochemical tests of bacteria3. Know the effect of of nutritional & environmental factors on microbial growth. |

LIST OF PRACTICALS

Simple and Gram staining of bacteria

- To perform simple staining and Gram staining of bacterial cultures

Special stain

- To perform endospore staining and Albert's staining of bacterial culture

Physiological tests of bacteria

- To perform IMViC test
- To perform Urease, Oxidase and Catalase test

Effect of nutritional factors on growth

- To study the effect of different carbon & nitrogen sources on the growth of microorganisms

Effect of environmental factors on growth

- To study the effect of pH on the growth of microorganisms
- To study the effects of UV radiation on growth of microorganisms

Microbes in hospital environment

- To isolate and identify the bacteria and fungi from hospital environment

Systematic Bacteriology – Practical

| | |
|----------------------------|---|
| Course Code | MMB507 |
| Course Title | Systematic Bacteriology – Practical |
| Type of course | Practical |
| L T P | 0 0 3 |
| Credits | 1.5 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To enable the students about the different types of bacterial culture procedures, staining procedures and biochemical tests used for identification of bacteria. |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none">1. Understand the basic laboratory practices in the field of bacteriology2. Apply this knowledge to isolate the pathogens from different types of samples such as blood, urine, Sputum and Pus3. Perform antibiotic sensitivity test and other serological test for the detection of pathogens. |

LIST OF PRACTICALS

1. **Skin/pus pathogens:** Isolation and identification of Microbes from skin/pus
2. **Blood pathogens:** Isolation and identification of microorganisms from blood sample
3. **Pathogens in urine:** Isolation and identification of microorganisms from urine sample
4. **Upper respiratory tract:** Isolation and identification of microorganisms from throat
5. **Lower respiratory tract :** Isolation and identification of microorganisms from sputum sample
6. **Air-borne pathogens:** Bacteriological examination of pathogens present in air
7. **Wound pathogens :** To isolate and identify microorganisms of the wounds Microbial
8. **Flora of the mouth :** To isolate and identify microbial flora of mouth teeth crevices
9. Isolation and identification of *Escherichia coli*
10. Isolation and identification of *Salmonella*



***SECOND
SEMESTER***

Applied Bacteriology

| | |
|----------------------------|---|
| Course Code | MMB502 |
| Course Title | Applied Bacteriology |
| Type of course | Theory |
| L T P | 4 0 0 |
| Credits | 4 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To enable the students about the different types of diagnosis of bacterial pathogen in laboratory. |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Explain about applications of Microbiology such as Microbial Pathogenicity & Laboratory diagnosis of various infective syndromes 2. Demonstrate Antibiotic susceptibility testing in bacteriology. 3. Know the collection, transportation and processing of Bacteriological examination of water, milk, food, air samples & methods to preservation of microbes. |

UNIT I

Laboratory strategy in the diagnosis of various Infective syndromes: Samples of choice, Collection, transportation and processing of samples for laboratory diagnosis of the following complications:

Urinary tract infections, Septicemia and bacteremia, Upper Respiratory tract infections, Lower Respiratory tract infections, Wound, skin, and deep sepsis, Enteric fever, Pyrexia of unknown origin, Genital Tract infections, Meningitis, Gastro intestinal infections, Tuberculosis (Pulmonary and Extra-pulmonary)

UNIT II

Antibiotic susceptibility testing in bacteriology: Definition of antibiotics, Culture medium used for Antibiotic susceptibility testing, Preparation and standardization of inoculums, Control bacterial strains, Choice of antibiotics, MIC and MBC: Concepts and methods for determination, Various methods of Antibiotic susceptibility testing with special reference to Stokes method and Kirby-Bauer method, Tests for production of β -lactamase

UNIT III

Bacteriological examination of water, milk, food and air:

Examination of water: Collection and transportation of water sample, Presumptive coliform count Eijkman test, Introduction and importance of other bacteria considered as indicators of fecal contamination, Membrane filtration tests, Interpretation of results

Examination of Milk and milk products: Basic Concepts regarding gradation of milk, Various tests for Bacteriological examination

Examination of food articles: Basic Concepts regarding classification of food like frozen food, canned food, raw food, cooked food etc., Various tests for Bacteriological examination with special reference to food poisoning bacteria

Examination of Air: Significance of air bacteriology in healthcare facilities, Settle plate method,

Types of air sampling instrument, Collection processing and reporting of an air sample

UNIT IV

Sterility testing of I/v fluids: Collection, transportation and processing of I/v fluids for bacterial contamination, Recording the result and interpretation

Preservation of microbes and Lyophilisation methods

Epidemiological markers: Serotyping, Phage typing, Bacteriocin typing.

Text & Reference Books:

| S. No. | Author(s) | Title | Publisher |
|---------------|---|---|--------------------|
| 1 | Ananthanarayan and Paniker | Text book of Microbiology | Universities Press |
| 2 | Michael J. Pelczar, JR. E.C.S Chan & Noel R. Krieg | Text book of Microbiology | Tata McGraw Hill |
| 3 | D.R Arora& B. Arora | Text book of Microbiology | CBS Publisher |
| 4 | KL Mukherjee | Medical laboratory Technology Volume-II(2 nd Ed.) | Tata McGraw Hill |

Medical Parasitology

| | |
|----------------------------|--|
| Course Code | MMB506 |
| Course Title | Medical Parasitology |
| Type of course | Theory |
| L T P | 4 0 0 |
| Credits | 4 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To enable the students about the different types of Parasites & their diagnosis in laboratory. |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Identify parasitism, parasites and their examples 2. Comprehend the techniques for diagnosis of parasites 3. Know the role of vector in spreading the parasitic diseases. |

UNIT-I

Introduction to Medical Parasitology : Classification of parasites, host-parasite relationships, parasitism, routes of infection, organs and tissues affected, host response to parasite infections, zoonoses.

Diagnostic Procedures: Collection, Transport, processing and preservation of samples for routine parasitological investigations, Stool examination (Gross examination of stool, microscopic examination, concentration methods), Examination of blood for parasites.

UNIT-II

Protozoan Parasites-I: Morphology, life cycle, pathogenesis and lab diagnosis of *Entamoeba histolytica*, *Giardia lamblia*, *Trichomonas vaginalis*, *Trypanosoma brucei gambiense*, *Leishmania donovani*

Protozoan Parasites-II: Morphology, life cycle, pathogenesis and lab diagnosis of *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae*, *Plasmodium ovale*, *Toxoplasma gondii*, *Cryptosporidium parvum*

UNIT-III

Cestodes: Morphology, life cycle, pathogenesis and laboratory diagnosis of *Taenia solium*, *Taenia saginata*, *Echinococcus granulosus*, *Hymenolepis nana*

Trematodes: Morphology, life cycle, pathogenesis and laboratory diagnosis of *Schistosoma mansoni*, *Schistosoma haematobium*, *Paragonimus westermanni*, *Fasciola hepatica*

UNIT-IV

Nematode-I: Morphology, life cycle, pathogenesis and lab diagnosis of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Trichinella spiralis*

Nematode-II: Morphology, life cycle, pathogenesis and lab diagnosis of *Enterobius vermicularis*, *Wuchereria bancrofti*, *Brugia malayi*, *Strongyloides stercoralis*

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|--------------|-------------------------------------|--|---|
| 1 | Protozoology and helminthology. Ltd | Chatterjee KD | CBS publishers & distributors pvt. Ltd |
| 2 | Medical parasitology | Arora BB | CBS publishers & distributors pvt. Ltd. |
| 3 | Essentials of medical parasitology | Apurba sankar sastry and sandhya bhat | Jaypee brothers medical publishers pvt. Ltd. |

Biochemistry and Metabolism

| | |
|------------------------------|--|
| Course Code | MMB 510 |
| Course Title | Biochemistry and Metabolism |
| Type of course | Theory |
| L T P | 3 1 0 |
| Credits | 4 |
| Course prerequisite | B.Sc. MLS or B.Sc. (Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective (CO) | The students will have knowledge regarding the analysis of biological fluids for its chemical constituents & correlating the same in health & disease. |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. To describe the basic structure and chemical properties of biomolecules involved in microbial science: carbohydrates, proteins, amino acids, nucleic acids 2. Able to illustrate the metabolism of carbohydrates, lipids and amino acids 3. Able to describe nomenclature, classification of enzymes and identify the enzyme action and kinetics 4. Able to apply the knowledge acquired above to the microbial systems. |

UNIT-I

Carbohydrates: structure of sugars, classification, properties, chemical reactions, stereoisomerism and optical isomers of sugars. Structure properties and functions of disaccharides, oligosaccharides, and polysaccharides, carbohydrate derivatives; peptidoglycan, glycoproteins and glycolipids.

Lipids: classification, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, sterols and terpenes

UNIT-II

Amino acids: structure classification, properties and functions.

Proteins: structural and functional proteins, synthesis of peptide bonds. Primary, secondary, tertiary and quaternary structure of proteins. Protein disorders.

Nucleic acids : structure and properties of purines and pyrimidine bases, nucleosides and nucleotides, Basic structure and types of DNA and RNA

UNIT-III

Enzymes: basic concept as a biocatalyst, specificity, active sites, activity unit and iso-enzymes, enzyme classification.

Enzyme kinetics: Michaelis-Menton equation for simple enzymes, determination of kinetic parameters

Enzyme inhibition: competitive, noncompetitive and uncompetitive inhibition, allosteric enzymes.

Carbohydrate metabolism: glycolysis and its regulation, TCA, Glycogenesis, Glycogenolysis and regulation, Gluconeogenesis, Pentose phosphate pathway

ATP synthesis: Substrate level and oxidative phosphorylation.

UNIT-IV

Lipid Metabolism: Degradation of Lipids, oxidation of unsaturated, saturated, even and odd chain fatty acids, ketone bodies.

Amino acid metabolism

Catabolism of amino acids: Breakdown of amino acids into six common intermediates and urea cycle

Nucleotide metabolism: Biosynthesis of purines and pyrimidine nucleotides by de-novo and salvage pathways.

Nucleic acid catabolism

Text & Reference Books

| S. No | Name | Author(S) | Publisher |
|--------------|--------------------------------------|------------------------------------|--|
| 1. | Lehninger Principles of Biochemistry | David L. Nelson and Michael M. Cox | W.H. Freeman and Company;2008 , 5 th edition |
| 2 | Biochemistry | Geoffrey L. Zubay | Adison-Wesley educational publishers Inc.,2008 , 4 th edition |
| 3 | Practical Clinical Biochemistry | Harold Varley | CBS Publishers & Distributers |
| 4 | Text book of Medical Biochemistry | M N Chaterjee and R. Shinde | Jaypee Brothers Medical Publishers(P) Ltd. |

Introductory Concepts of Computer Technology

| | |
|----------------------------|---|
| Course Code | CSE554 |
| Course Title | Introductory Concepts of Computer Technology |
| Type of course | Theory |
| L T P | 3 0 0 |
| Credits | 3 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To aware students about the basic fundamentals of computer and its use in day today life. |
| Course Outcomes | At the conclusion of the course, the students will: 1. Understand Basics of computer and its operating system 2. Distinguish the types of Software 3. Learn the MS-Windows basics and applications |

UNIT-I

Evolution of computers; Basics of computer and its operation: Functional Components and their inter-connections, concept of Booting, Use of Operating System for directory listing, hierarchical directory structure, renaming, deleting files/folders, formatting floppy, copying files, concepts of path and pathname, switching between tasks, installation/removal of applications

UNIT-II

Computers and their applications in biology

Operating systems: Need for operating system, Functions of operating system (Processor Management, Memory Management, File Management and Device Management);

Types of operating system - Interactive (GUI based), Timesharing, Real Time and Distributed

Types of Software: System Software, Utility Software and Application Software

UNIT-III

Computer fundamentals, Introduction to digital computers, Organization; Number system, I/O devices, Storage devices; Introduction to internet and its applications – www, email

UNIT-IV

MS-Windows basics

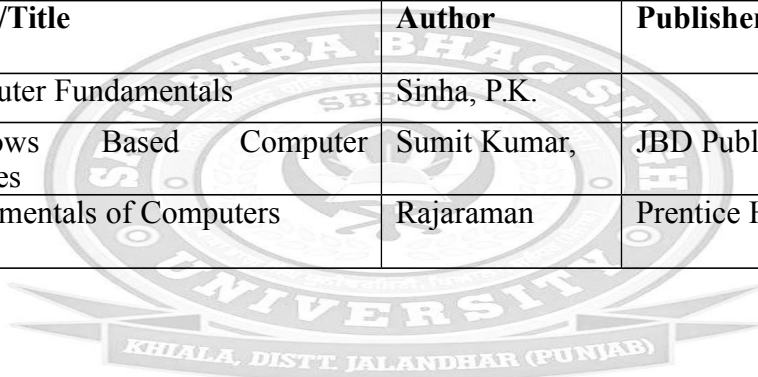
MS-Word: Meaning of Word-Processing, Creating, Saving, Printing documents, Formatting, Spell-Check, Adding page numbers, Header and Footer, Macros, Creating tables, Converting table to text and vice-versa, Mail Merge;

MS-Excel: Spreadsheets, Using different types of formulae, Creating graphs and charts, Exporting charts to MS-Word

MS-PowerPoint: Creating presentations, Formatting, Adding effects and timings.

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|--------------|--------------------------------|---------------|------------------------|
| 1 | Computer Fundamentals | Sinha, P.K. | |
| 2 | Windows Based Computer Courses | Sumit Kumar, | JBD Publishers |
| 3 | Fundamentals of Computers | Rajaraman | Prentice Hall of India |



Natural Hazards and Disaster Management

| | |
|----------------------------|---|
| Course Code | EVS003 |
| Course Title | Natural Hazards and Disaster Management |
| Type of course | Theory Course |
| L T P | 3 0 0 |
| Credits | 3 |
| Course prerequisite | Graduation |
| Course Objective | To learn about natural hazards, risk assessment and disaster management |
| Course Outcomes | At the conclusion of the course the students will: <ol style="list-style-type: none"> 1. Learn the concept of natural hazards 2. Understand the role of Disaster management system |

UNIT I

Overview of natural hazards; Introduction to natural hazards, impact and mitigation in Global and Indian context; causes and consequences of geological hazards, flood, drought and climate change issues, forest hazard, tsunami and coastal hazards, cyclone hazards, snow avalanche, GLOF and glacier related hazards, extreme weather events, urban and industrial hazards.

UNIT II

Introduction to vulnerability and risk assessment, socio-economic and physical aspects of vulnerability and elements of risk mapping, assessment, and reduction strategies.

UNIT III

Earth observation: Data availability and key operational issues for DM: EO systems for natural hazards study: present (operational) and future systems; multi-temporal data sources, multi-temporal database organization: Key operational issues, utilization of geo-information products for disaster management (available through International cooperation e.g. International Charter etc.)

UNIT IV

Disaster management framework of India and recent initiatives by Govt. of India with special emphasis on DRR HFA 2005-2015, MDG and SAARC comprehensive framework for DRR Disaster Management Support (DMS): Status in India for use of space inputs Mainstreaming DRR in Development Planning Sustainable development in the context of Climate Change Disaster Recovery-Strategy and case examples.

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|-------|---|--|----------------------------|
| 1 | Environmental Hazards : Assessing Risk and Reducing Disaster | Keith Smith and Petley David, 2008. | Routledge |
| 2 | Geo-information for Disaster Management | van Oosterom Peter, Zlatanov Siyka and Fendel Elfriede, 2005 | Springer-Verlag |
| 3 | Geospatial Techniques in Urban Hazards and Disaster Analysis | Showalter, Pamela S. and Lu, Yongmei, 2010. | John Wiley and Sons. |
| 4 | An International Perspective on Natural Disaster: Occurrence, Mitigation and Consequences | Stoltman JP, Lidstone J and Dechano LM., 2004. | Kluwer Academic Publishers |

Antimicrobial Agents and Chemotherapy

| | |
|----------------------------|--|
| Course Code | MMB 514 |
| Course Title | Antimicrobial Agents and Chemotherapy |
| Type of course | M.Sc Medical Microbiology as Skill Enhancement Course |
| L T P | 2 0 0 |
| Credits | 2 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To provide knowledge about antimicrobial agents and their mode of actions. |
| Course Outcome | At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Able to acquire conceptual knowledge of antimicrobial agents 2. Able to provide an overview of the mode of action of antibiotics 3. Able to understand the mechanism involved of the chemotherapeutic agents in subsiding the microbial activities. |

UNIT I

History of chemotherapy. Types of antimicrobial agents, Paul Ehrlich and his contributions to chemotherapy. Chemical non-medicinal antimicrobials- sanitizers, disinfectants, antiseptics.

Antibiotics – Definition of antibiotics, types (chemical) of antibiotics, cell wall inhibitors, membrane inhibitors, inhibitors of macro-molecular synthesis, anti metabolites.

UNIT II

Bactericidal and bacteriostatic agents: Factors affecting static and cidal activity, phenols and phenolic compounds, alcohols, halogens, heavy metals, dyes, detergents, aldehydes. Non-medical uses of antibiotics.

UNIT III

Antiviral agents: Biological antiviral agents- interferon and its action, chemical antiviral agents. Phenomenon of drug resistance, basis of drug resistance, biochemistry of drug resistance, genetics of drug resistance. Control of drug resistant bacteria

Unit IV

Mode of action of important drugs – Cell wall inhibitors (betalactam drugs), membrane inhibitors (polymyxin), Ribosomal inhibitors (aminoglycosides – streptomycin), folic acid inhibitors (sulfa drugs), antifungal drugs (nystatin)

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|-------|--------------------------------------|--------------------------|-----------|
| 1 | Pharmaceutical microbiology | Hugo Russell | |
| 2 | Biochemistry of antimicrobial action | Franklin, TJ and Snow, L | |
| 3 | Antibiotics and chemotherapy | Gerrod et al | |

Applied Bacteriology (Practical)

| | |
|----------------------------|---|
| Course Code | MMB504 |
| Course Title | Applied Bacteriology (Practical) |
| Type of course | Practical |
| L T P | 0 0 3 |
| Credits | 1.5 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To provide students' knowledge of the laboratory strategy in the diagnosis of various infective syndromes i.e. choice of samples, collection and transportation and processing of samples for isolation of bacterial pathogens and then to put antibiotic susceptibility testing. |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none">1. Understand the basic laboratory practices in the field of bacteriology2. To perform antibiotic susceptibility testing of clinical isolates by using standard method.3. Collection, transportation and processing of various clinical samples & preservation of isolates. |

LIST OF PRACTICALS

1. Inoculation of different culture media
2. Isolation of pure cultures
3. Processing of following clinical samples for culture and identification of pathogens:
 1. Blood
 2. Throat swab
 3. Sputum
 4. Pus
 5. Urine
 6. Stool for *Salmonella*, *Shigella* and *Vibrio cholera*
 7. C.S.F. and other body fluids
4. Antimicrobial susceptibility testing
 1. Introduction and terms used
 2. Preparation and standardization of inoculum
 3. To demonstrate reference bacterial strains
 4. Choice of antibiotics
 5. To determine MIC and MBC a known bacteria against a known antibiotic
5. To perform antibiotic susceptibility testing of clinical isolates by using
 1. Stokes method and
 2. Kirby-Bauer method

6. Collection, transportation and processing of following articles for bacteriological examination:

1. water,
2. milk
3. food and
4. air samples

7. To demonstrate sterility testing of intravenous fluid with positive and negative controls

8. Demonstration of serotyping and bacteriocin typing

9. Demonstration of lyophilization

10. To learn 'How to dispose of bacterial cultures'

Text & Reference Books:

| S. No. | Author(s) | Title | Publisher |
|---------------|----------------------|--|--|
| 1. | Mackie & Mac Cartney | Practical Medical Microbiology Volume 1 and Volume 2 | Churchill Living Stone |
| 2. | D.R Arora & B. Arora | Text book of Microbiology | CBS Publishers |
| 3 | KL Mukherjee | Medical laboratory Technology Volume-II | Tata McGraw Hill (2 nd Ed.) |

Medical Parasitology (Practical)

| | |
|----------------------------|--|
| Course Code | MMB508 |
| Course Title | Medical Parasitology (Practical) |
| Type of course | Practical |
| L T P | 0 0 2 |
| Credits | 1 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To aware the students about Understand the general characteristics and the disease caused by various protozoans and helminths. |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Perform the examination of stool, blood and sputum samples for diagnosis of disease. 2. Demonstrate various staining techniques. 3. Comprehend the techniques for diagnosis of parasites. |

LIST OF PRACTICALS

1. Stool and sputum examination

- Routine examination of stool and sputum for parasitic infections by physical and chemical method
- Routine examination of stool and sputum for parasitic infections by microscopic examination
- Preparation of permanently stained smear of the stool sample

2. Giemsa stain

- To prepare and perform the Giemsa stain for the identification of malarial parasite from blood sample

3. Stool concentration methods

- To perform the saturated salt flotation method for stool concentration
- To perform the zinc sulfate centrifugal flotation method for stool concentration
- To perform the formol-ether sedimentation method for stool concentration

4. Leishman stain

- To prepare and perform the Leishman stain for the identification of malarial parasite from blood sample

5. Field stain

- To prepare and perform the Field stain for the identification of malarial parasite from blood sample

6. Jaswant Singh Bhattacharjee stain

- To prepare and perform the Jaswant Singh Bhattacharjee stain for the identification of malaria parasite from blood sample

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|-------|----------------------|-----------------------|-------------------------|
| 1 | Medical parasitology | V. Baveja, C.P. Bavej | 4 th edition |
| 2. | Medical parasitology | D.R. Arora | 5 th edition |

Biochemistry and Metabolism Lab

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|----------------------------|--|
| Course Code | MMB 512 |
| Course Title | Biochemistry and Metabolism(Practical) |
| Type of course | Practical |
| L T P | 0 0 3 |
| Credits | 1.5 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | At the conclusion of the course, the students will: 1. Able to identify and perform various biochemical tests 2. Able to apply various tests in diagnosis and characterisation of microbes |

LIST OF PRACTICALS

1. To detect the presence of carbohydrate in the given sample by Molish test
2. To detect the presence of reducing sugar in the given sample by Fehling's test
3. To detect the presence of pentose sugar in the given sample by Bial's test
4. To determine the presence of monosaccharide using Anthrone test
5. To detect presence of reducing sugar using Benedict's test.
6. To determine the presence of monosaccharide using Barfoed's reagent
7. To determine the presence of starch in given sample by using iodine solution (starch-iodine test).
8. To determine the presence of ketose sugar by Seliwanof's reagent in given sample.
9. To determine the presence of protein by Biuret method.
10. To determine the presence of protein by Xanthoprotic test
11. Quantification of protein contents in given sample by Folin's- Lowry method
12. To determine Saponification value of given fat sample

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|-------|---------------------------------|------------------------|-------------------|
| 1 | Biochemistry | Voet, D. and J.G. Voet | Freeman & Co |
| 2 | Textbook Biochemistry | Lehninger | |
| 3 | Essentials of Molecular Biology | Freifelder, D | Freeman & Co |
| 4 | Biochemical Calculations | Segal, I.H | J. Wiley and Sons |

Introductory Concepts of Computer Technology Practical

| | |
|----------------------------|--|
| Course Code | CSE556 |
| Course Title | Introductory Concepts of Computer Technology Practical |
| Type of course | Practical |
| L T P | 0 0 2 |
| Credits | 1 |
| Course prerequisite | B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject |
| Course Objective | To aware students about the basic fundamentals of computer and its use in day today life. |
| Course Outcomes | At the conclusion of the course, the students will: 1. Learn the basics of computer and its operating system 2. Understand the working of different softwares 3. Learn the basics of MS-Word, MS-Excel, MS-PowerPoint |

I. Word Processor software

Word

To familiarize with parts of Word window, To create and save a document, page settings, create headers and footers, To edit a document and resave it, To use copy, cut and paste features. To create a table with specified rows and columns, To create a table with specified rows and columns, To select a table, a row, a column or a cell ,To insert new row and/or a column, To delete a row and/or a column

Excel

To familiarize with parts of Excel window, To create and save a workbook with single and/or multiple worksheets, To edit and format text as well numbers, To insert new row and/or column in a worksheet, To delete a row and/or column in a worksheet.

Power point

To familiarize with parts of PowerPoint, window create and save a new presentation, To apply design templates to a presentation insert, edit and delete a slide, To use different views of slides . To use slide show from beginning or from the current slide and To preview and print a presentation.

To check spellings in a presentation, To add clip art and pictures in a slide, To add chart, diagram and table in a slide, To set animation for a selected slide and/or for entire presentation.

II. Exploring the Internet:

To understand the working of the internet web browsers, create email-account, sending mails, receiving mails, sending files as attachments, etc. To login to a remote computer, To search information using search engines.

Text and Reference Books:

| S.No. | Name/Title | Author | Publisher |
|-------|-------------------------------------|---------------|--------------|
| 1 | Computer Organization fifth edition | Carl hamacher | Mc Graw Hill |



***THIRD
SEMESTER***

Medical Mycology

| | |
|----------------------------|--|
| Course Code | MMB601 |
| Course Title | Medical Mycology |
| Type of course | Theory |
| L T P | 3 0 0 |
| Credits | 3 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To give practical demonstration to the students to develop insight into pathogenicity, diagnosis and prophylaxis of fungal infections. |
| Course Outcomes | At the conclusion of the course, the students will: 1. Explain classification, morphology and laboratory diagnosis and prevention measures of fungi 2. Differentiate between superficial, subcutaneous, systemic and opportunistic mycosis. 3. Identification and description of mycosis. |

UNIT-I

Introduction to medical mycology: Taxonomy, classification and general characteristics of various medically important fungi, Normal fungal flora, Morphological, cultural characteristics of common fungal laboratory contaminants

UNIT- II

Laboratory diagnosis: Direct microscopy in Medical mycology laboratory, Culture media used in mycology chemotherapeutic agents for fungi, mechanism of resistance of chemotherapeutic agents,
Molecular techniques: Recent molecular techniques used for the diagnosis of fungal infection.

UNIT-III

Superficial mycoses- Pathogenicity, clinical features and laboratory diagnosis of *Dermatophytoses*, *Piedra*, *Tinea nigra*, *Tinea versicolor*.

Subcutaneous mycoses- Pathogenicity, clinical features and laboratory diagnosis of *mycetoma*, *chromoblastomycosis*, *sporotrichosis* and *rhinosporidiosis*

UNIT -IV

Superficial mycoses- Pathogenicity, clinical features and laboratory diagnosis of *Paracoccidioidomycosis*, *coccidioidomycosis*, *histoplasmosis*, *blastomycosis*.

Opportunistic mycoses- Pathogenicity, clinical features and laboratory diagnosis of *cryptococcosis*, *candidiasis*, *aspergillosis*, *penicillosis*, *zygomycosis*.

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|-------|---|---------------------|-----------------|
| 1 | A guide to study of basic medical mycology | Kee Peng Ng et al. | Kindle Edition |
| 2 | Medical Mycology: A self instructional text | Kathleen S. Blevins | |
| 3 | Fundamental Medical Mycology | Errol Reiss et al. | Wiley-Blackwell |

Medical Virology

| | |
|----------------------------|---|
| Course Code | MMB605 |
| Course Title | Medical virology |
| Type of course | Theory |
| L T P | 3 0 0 |
| Credits | 3 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | Develop insight into pathogenicity, diagnosis and prophylaxis of viral infections |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Explain classification, nomenclature, structure and properties of viruses 2. Apply this knowledge to understand the cultivation, isolation, transmission, mode of infection of various viruses 3. Analyze the role of molecular techniques to identify diseases and laboratory diagnosis and prophylaxis |

UNIT- I

General Properties of Viruses: Origin of virology, properties of viruses, classification and nomenclature of viruses, structure of viruses, capsid symmetry and architecture.

UNIT- II

DNA & RNA viruses: Transmission of viruses, epidemiology of viral infection, prevention and control measures of viral infection, molecular techniques for clinical diagnosis of viral diseases.

UNIT- III

Cultivation and Purification of Viruses : Cultivation, isolation, purification and virus assays, virus receptors, interaction with host cell, attachment and penetration, uncoating and replication, lysogenic and lytic bacteriophages, lysogeny with special reference to lambda and mu phages

UNIT- IV

Pathogenicity, clinical features, laboratory diagnosis, immunoprophylaxis and prophylaxis: Dengue , Yellow fever, Influenza virus (H5N1 & H1N1), Rubella virus, Hepatitis, HIV, Ebola, Nipah

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|-------|--|-----------------------------|-------------------------|
| 1 | Medical Virology | D.E White & Frank J. Fenner | Elsevier |
| 2 | Principles of virology | F.J Flint et al. | |
| 3 | Medical Virology: A practical Approach | U. Desselberger | Oxford University Press |

Immunology

| | |
|----------------------------|--|
| Course Code | MMB609 |
| Course Title | Immunology |
| Type of course | Theory |
| L T P | 4 0 0 |
| Credits | 4 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | The student will learn the basics of immunology including structural components, their functions and underlying mechanisms. |
| Course Outcomes | At the conclusion of the course students will: 1. To provide students a conceptual knowledge of immunological processes. 2. To understand the mechanism of how the immune system works. 3. Be able to provide an overview of the interaction between the immune system and pathogens. |

UNIT-I

History of immunology, Immune response: mechanism of innate and adaptive immune response. Structure, composition and types of cells involve in immune response: mononuclear cells, granulocytes, antigen presenting cells, lymphoid cells. Mediators and process of inflammation.

Structure and function of immune system: primary and secondary lymphoid organs Antigens-structure and properties, factors affecting the immunogenicity, haptens, superantigen, adjuvants

UNIT-II

Antibody: structure, properties, types and function of antibodies, antigenic determinants on immunoglobulin; isotypes, allotypes, and idiotypes.

Structure and development of T-cell receptor, Structure of CD4 and CD8, Cell mediated immunity and its mechanism

Vaccines: Active and passive immunization, vaccine schedule, whole organism vaccine, sub unit vaccine, DNA vaccine, recombinant vaccine and applications, subunit vaccines and anti-idio type vaccine .

UNIT-III

Major histocompatibility complex: organization of MHC genes, types and function of MHC molecules, antigen presentation. MHC polymorphism.

Complement system: components, activation pathways, regulation of activation pathways and role of complement system in immune response.

Cytokines: types, structure and functions, cytokines receptors, cytokine regulation of immunoreceptors.

UNIT-IV

Hypersensitivity: type I, II, III and types IV hypersensitivity. Immunodeficiency diseases: primary and secondary immunodeficiency.

Autoimmunity: organ specific autoimmune diseases, mechanism of autoimmune diseases

Transplantation immunology: immunologic basis of graft rejection, clinical manifestation of graft rejection and clinical transplantation.

Text & Reference Book:

| S. No | Name | Author(S) | Publisher |
|-------|---------------------------------------|------------------------------------|---|
| 1 | th Immunology, 5 Edition | Janis Kuby, | W.H.Freeman & Co Ltd; 3rd Revised edition edition (16 April 1997) |
| 2. | th Essential Immunology, 9 Edn. | Ivan M. Roitt | Blackwell Science, Inc. |
| 3. | Handbook of Human Immunology, | Mary S. Leffell,& Noel R. Rose, | CRC press |



Recombinant DNA Technology (RDT)

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|----------------------------|---|
| Course Code | MMB613 |
| Course Title | Recombinant DNA Technology (RDT) |
| Type of course | Theory |
| L T P | 3 0 0 |
| Credits | 3 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To sentient students about the different new techniques and terminology related to molecular biology and recombinant DNA technology . |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. The students will be able to understand the basics of recombinant DNA technology 2. Able to identify the different DNA modifying enzymes and understand their roles in microbial technology 3. Able to acquire knowledge of different cloning vectors; cloning techniques and utilize them to produce pharmaceutical products for treatment of microbial infections. |

UNIT-I

Enzymes used in DNA technology: Restriction Endonuclease and Restriction mapping DNA modifying enzymes:- Nuclease, Polymerase, Enzymes that modify the ends of DNA molecules. DNA ligase- joining DNA Molecules; Adaptors, Linkers, Homopolymer tailing

UNIT -II

Gene cloning vectors: Plasmids, Cosmids, Bacteriophage; Phagemids, BAC, YAC; Shuttle vector.
Cloning Strategies: Genomic libraries, Preparation of DNA fragments for cloning; Positional cloning, chromosome walking

UNIT-III

Cloning techniques: DNA isolation (Bacteria, Fungi, Plant and animal), Insert preparation, Ligation, Transformation methods (chemical methods, Electroporation and microinjection), Transfection

UNIT -IV

Applications of Recombinant DNA Technology in Medicine, Molecular diagnostics, recombinant and DNA vaccines. Gene therapy: somatic and germ line gene therapy.

Text & Reference Books:

| S.No. | Name/Title | Author | Publisher |
|-------|---|---|------------|
| 1 | Gene Cloning and DNA Analysis | T A Brown | Blackwell |
| 2 | From Genes to Genomes: Concepts and Applications of DNA Technology, 3rd Edition | Jeremy W. Dale, Malcolm von Schantz, Nicholas Plant | Wiley |
| 3 | From genes to clones introduction to gene technology | by Ernst L. Winnacker | John Wiley |

Research Methodology

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|-------------------------------|---|
| Course Code | MMB615 |
| Course Title | Research Methodology |
| Type of Course | AECC |
| L T P | 2 0 0 |
| Credits | 2 |
| Course Prerequisites | M.Sc. Medical Microbiology as Ability Enhancement course |
| Course Objectives (CO) | The objective of this module is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings. |
| Course Outcomes | At the conclusion of the course students will: 1. The students will be able to learn how to collect, read and manage research information. 2. Able to plan experiments, conduct and observe results. 3. Able to write and publish results effectively. |

UNIT I

Objectives and Types of Research: Motivation and objectives – research methods vs. Methodology. Types of research – Descriptive vs. Analytical, applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical

UNIT II

Research Formulation: Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review– Primary and secondary sources

UNIT III

Research Design and Methods: Research design, Basic Principles, Need of research design, Observation and Facts.

UNIT IV

Reporting and Thesis Writing – Structure and components of scientific reports ,Types of report, Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Illustrations and tables - Bibliography, referencing and footnotes

Text & Reference Books:

| S. No | Name | Author(S) | Publisher |
|-------|--|--|-----------------------|
| 1 | An introduction to Research Methodology | Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K. | RBSA Publishers |
| 2 | Research Methodology: Methods & Techniques | Kothari.C.R | New Age International |

Medical Mycology Practical

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|----------------------------|--|
| Course Code | MMB603 |
| Course Title | Medical Mycology (Practical) |
| Type of course | Practical |
| L T P | 0 0 3 |
| Credits | 1.5 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | To give practical demonstration to the students to develop insight into pathogenicity, diagnosis and prophylaxis of fungal infections. |
| Course Outcomes | At the conclusion of the course students will: <ol style="list-style-type: none"> 1. Collect clinical specimen of fungal infection 2. Perform laboratory investigations for the diagnosis of infectious diseases caused by fungi 3. Maintain stock cultures |

LIST OF PRACTICALS

1. Collection of specimens for mycology.
2. Direct examination of specimens by KOH, Gram, Kinyoun's, Giemsa, Lactophenol cotton blue stains.
3. Isolation and identification of pathogenic yeasts and moulds and recognition of common laboratory contaminants.
4. Special techniques like Wood's lamp examination, hair baiting, hair perforation, paraffin baiting and slide culture.
5. Maintenance of stock cultures.

Text & Reference Books:

| S. No | Name | Author(S) | Publisher |
|-------|---------------------------|--|--------------------|
| 1. | Text book of Microbiology | Michael J. Pelczar, JR. E.C.S Chan & Noel R. Krieg | Tata McGraw Hill |
| 2 | Text book of Microbiology | Ananthanereyan And Paniker's Text Book of Microbiology | Universities Press |
| 3. | Medical Microbiology | Paniker & Satish Gupte | Universities Press |

Medical Virology Practical

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|----------------------------|--|
| Course Code | MMB607 |
| Course Title | Medical Virology (Practical) |
| Type of course | Practical |
| L T P | 0 0 2 |
| Credits | 1 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | Develop insight into pathogenicity, diagnosis and prophylaxis of viral infections. |
| Course Outcomes | At the conclusion of the course , the students will: <ol style="list-style-type: none"> 1. Perform blood samples for the diagnosis of viruses through serological tests. 2. Preparation of different type of media for the cultivation of viruses 3. Demonstrate handling of animals for pathogenicity tests. |

LIST OF PRACTICALS

1. Preparation of glassware for tissue culture (washing, sterilization)
2. Preparation of media like Hanks, MEM.
3. Preparation of clinical specimens for isolation of viruses.
4. Serological tests
 - ELISA and rapid tests for HIV
 - RPHA for HbsAg
 - Haemagglutination inhibition for influenza
 - AGD and counterimmunoelectrophoresis for detection of viral antigens or antiviral antibodies.
5. Handling of mice, rats, guinea pigs, rabbits for collection of blood, pathogenicity test etc.

| S. No | Name | Author(S) | Publisher |
|-------|---------------------------|--|--------------------|
| 1. | Text book of Microbiology | Michael J. Pelczar, JR. E.C.S Chan & Noel R. Krieg | Tata McGraw Hill |
| 2 | Text book of Microbiology | Ananthanarayan And Paniker's Text Book of Microbiology | Universities Press |
| 3. | Medical Microbiology | Paniker & Satish Gupte | Universities Press |

Immunology Practical

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|----------------------------|--|
| Course Code | MMB611 |
| Course Title | Immunology Practical |
| Type of course | Practical |
| L T P | 0 0 3 |
| Credits | 1.5 |
| Course prerequisite | B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent. |
| Course Objective | Develop insight into pathogenicity, diagnosis and prophylaxis of viral infections. |
| Course Outcomes | At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Able to understand the basic laboratory practices in the field of immunology 2. Determination of TLC, DLC, ABO & Rh factor from blood sample 3. Demonstration of antigen / antibody determination by various techniques |

LIST OF PRACTICALS

1. To prepare serum and plasma from blood.
2. To precipitate immunoglobulins by ammonium sulphate and to determine total protein contents.
3. To determine Blood group and Rh factor by slide agglutination test
4. To determine Total Leukocyte Count (TLC) for given blood sample
5. To determine Differential Leukocyte Count (DLC) for given blood sample using Leishman stain.
6. To perform Widal agglutination test (slide and tube) for diagnosis of typhoid.
7. To perform Ouchterlony double diffusion test for detection of antigen and antibody reaction and to demonstrate relationship between antigens.
8. To perform Radial immuno-diffusion test for detection of antigen and antibody reaction and for quantification of antigens.
9. Demonstration of antigen / antibody determination by Immunofluorescence, Immunodiffusion, CIEP, ELISA, SDS-PAGE and western blotting.

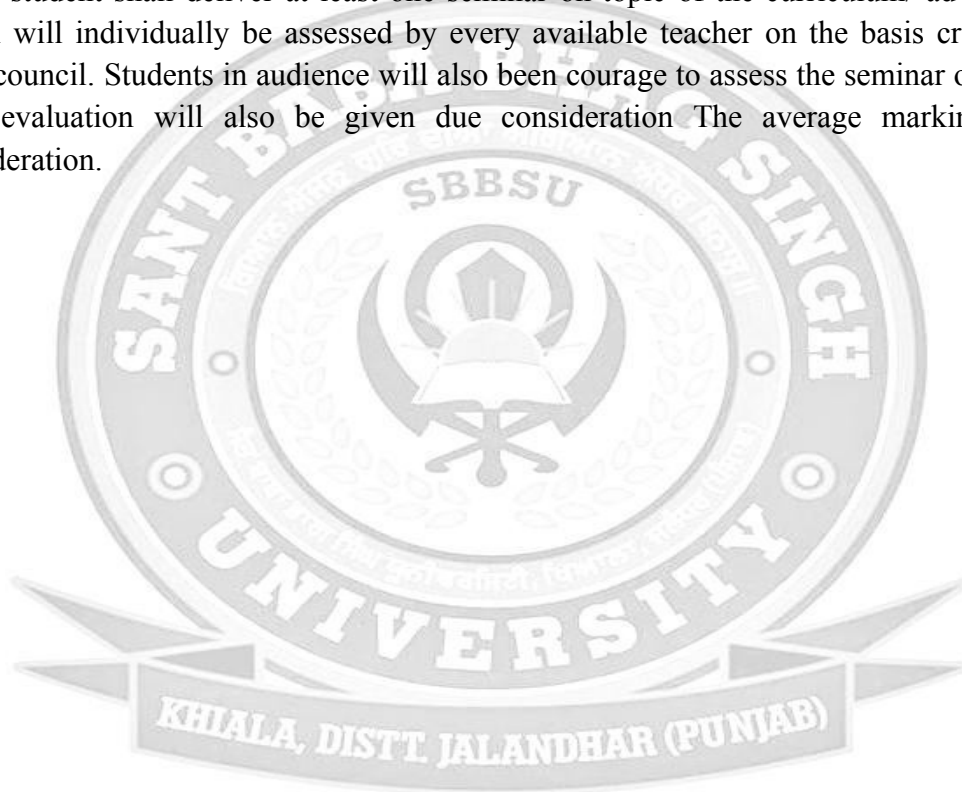
Text & Reference Books:

| S. No. | Author(s) | Title | Publisher |
|--------|-------------------|---|-------------------------------|
| 1 | Frances Fischbach | A Manual of Laboratory & Diagnostic Tests | Lippincott Williams & Wilkins |

Seminar

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|------------------------------|--|
| Course Code | MMB617 |
| Course Title | Seminar |
| Type of course | Practical |
| L T P | 0 0 2 |
| Credits | 1 |
| Course prerequisite | M.Sc Medical Microbiology as Skill Enhancement Course |
| Course Objective (CO) | The students will prepared presentation to impart skills or knowledge. |
| Course Outcome | At the conclusion of the course students will: 1. Understand the application of computer. 2. Develop Critical Thinking, Interdisciplinary Inquiry 3. Develop Presentation Skills. communication skill |

Every student shall deliver at least one seminar on topic of the curriculum/ advances in Microbiology which will individually be assessed by every available teacher on the basis criteria laid down by the Staff council. Students in audience will also been courage to assess the seminar on the given criteria and their evaluation will also be given due consideration The average marking will be taken into consideration.





FOURTH SEMESTER

Dissertation/Project

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|------------------------------|--|
| Course Code | MMB602 |
| Course Title | Dissertation/Project |
| Type of course | Practical |
| L T P | 0 0 26 |
| Credits | 26 |
| Course prerequisite | B.Sc MLT/MLS/ Medicine/ Applied Medical Science/ Bio- Science/ Medical Science Allied Medical Science/ Life Science/Microbiology/Biochemistry. |
| Course Objective (CO) | The students will undergo 5 months training to learn about latest techniques used in research |
| Course Outcome | At the conclusion of the course students will: <ol style="list-style-type: none"> 1. Understand the research methodology and techniques of experimental work. 2. Develop skill of Scientific writing. 3. Impart proficiency of designing scientific experiments and carry out those experiments |

GUIDELINE TO CARRY OUT PROJECT WORK

1. Purpose of Project Work: The main purpose of Project Work is to make the students familiar with Research Methodology i.e. reference work, experimental work, statistical analysis of experimental data, interpretation of results obtained, writing of dissertation and power point presentation of Project work. This will not only help train the inquisitive minds of the students, but also inspire them to take up research- oriented higher studies and career.

2. Duration of Project work:-

Development on the nature of the research problem and the infrastructure available in the Respective Biotechnology/Biochemistry/Microbiology Departments or Research Institutes or Industries, the recommended duration of Project Work is 05 months which includes 4 months of training and 2 months for dissertation compilation.

3. Nature of Research Project:-

The following will be considered as the Research Project.

- a. Experimental based involving laboratory analytical work, or
- b. Survey based Field work with statistical analysis of data collected, or
- c. Industrial training based provided that the candidate has undergone actual hands on training in instrumental analytical techniques.

4. Submission of project Work:-

- a. After completion of Project each student should prepare a PowerPoint presentation to be delivered to the respective department committee.
- b. The committee should conduct comprehensive viva-voce of the students.
- c. The final copy of the dissertation will have to submit to the respective department.