

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
2023

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 bridges 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 sciences, allied health sciences & agriculture professionals with grooming young generations, empowering them to become socially responsible leaders.

MISSION

To radiate the knowledge of life sciences, allied health science & agriculture sciences 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 Healthcare 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 students will acquire in-depth knowledge of the various theoretical and practical concepts such as microbial classification, using various microbial techniques, gain knowledge on microbial diversity in different environment and the role of microbial infection in human health and its immune response.

PO2. Critical Thinking: Critical thinking as an attribute will enable students 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: The students will gain hands on experience in state-of-the-art laboratory equipment that will enrich them to perform high throughput research on microorganisms and execute diagnostic procedures in field of medical microbiology.

PO4. Scientific /Analytical Reasoning: The students will be able to investigate and perform experiments related to microbial analysis based on scientific reasoning to draw logical conclusions.

PO5: Modern Tool Usage: Students will gain expertise in the usage of statistical tools for advanced molecular and microbial data analysis.

PO6: Multicultural Competence: Development of a set of competencies in order to enhance and promote the growth of multicultural sensitivity within the university to assess societal, health, safety, legal and cultural issues. Integrating multicultural awareness such as race, gender, physical ability, age, income and other social variables and by creating an environment that is welcoming for all students.

PO6. Environment & Sustainability: Students will understand the impact of scientific solutions in societal and environmental contexts and demonstrate the knowledge and need for sustainable development. And will be able to utilize the gained scientific knowledge to create eco-friendly environment.

PO7. Research Skills & Ethics: The students will develop the skill to think independently, plan research and execute it in the field of Medical Microbiology. The students will apply ethical principles and professional norms while following the scientific practices.

PO8. Individual and Teamwork: The students will acquire the ability to function effectively as teams to accomplish a common goal. The student will be capable of contributing meaningfully to team ethos and goals.

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

PO10. Lifelong Learning: Students will opt for higher studies, jobs in various sectors and entrepreneurshipabilities in the field of microbiology.

PROGRAMME SPECIFIC OUTCOMES (PSO)

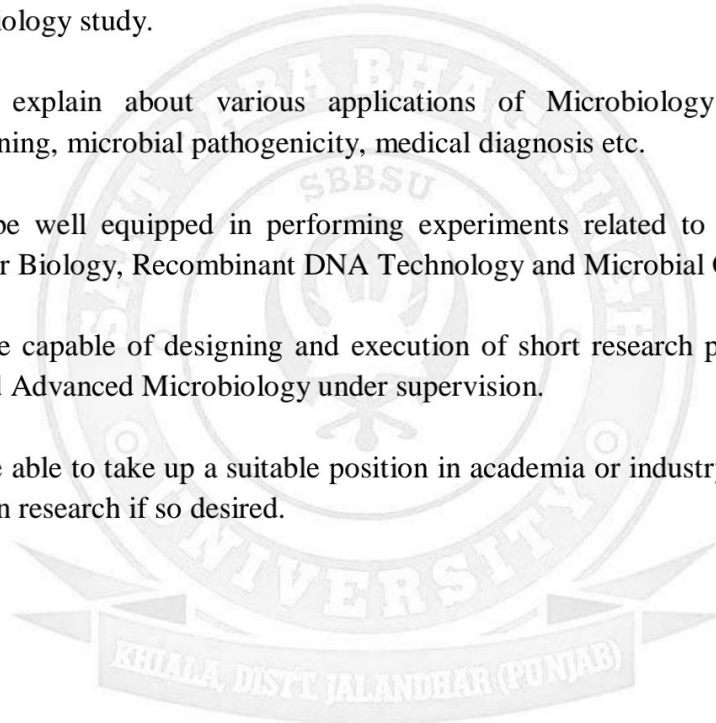
PSO1. Learners will be equipped with a theoretical and practical knowledge of Medical Microbiology along with molecular biology study.

PSO2. Learners will explain about various applications of Microbiology such as microbial identification and screening, microbial pathogenicity, medical diagnosis etc.

PSO3. Learners will be well equipped in performing experiments related to Basic Microbiology, Immunology, Molecular Biology, Recombinant DNA Technology and Microbial Genetics.

PSO4. Learners will be capable of designing and execution of short research projects incorporating techniques of Basic and Advanced Microbiology under supervision.

PSO5. Learners will be able to take up a suitable position in academia or industry or hospital settings, and to pursue a career in research if so desired.



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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	MMB523	Immunology & Serology	4:0:0	4:0:0	4	4	CC
4	MMB519	Bioanalytical Techniques	3:0:0	3:0:0	3	3	CC
5	MMB521	Bioethics, Biosafety & Intellectual Property Right	3:0:0	3:0:0	3	3	SECC
6	EVS003	Natural Hazards & Disaster Management	3:0:0	3:0:0	3	3	AECC

II. Practical Subjects

1	MMB503	Basic Medical Microbiology (Practical)	0:0:4	0:0:2	4	2	CC
2	MMB507	Systematic Bacteriology (Practical)	0:0:4	0:0:2	4	2	CC
3	MMB525	Immunology & Serology (Practical)	0:0:3	0:0:1.5	3	1.5	CC
Total					32	26.5	

Total Contact hrs: 32
Total Credit Hours: 26.5

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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	3:0:0	3:0:0	3	3	CC
2	MMB520	Molecular Biology & Recombinant DNA Technology (RDT)	4:0:0	4:0:0	4	4	CC
3	MMB524	Microbial Physiology and Metabolism	4:0:0	4:0:0	4	4	CC
4	MMB528	Pharmaceutical Microbiology	3:0:0	3:0:0	3	3	DSE
5	MMB516	Laboratory Organization and Management					
6	MMB530	Anatomy & Physiology					
7	MAT515	Biostatistics	3:0:0	3:0:0	3	3	ID
8	CSE554	Introductory Concepts of Computer Technology	3:0:0	3:0:0	3	3	AECC

II. Practical Subjects

1	MMB504	Applied Bacteriology (Practical)	0:0:4	0:0:2	4	2	CC
2	MMB522	Molecular Biology & Recombinant DNA Technology (RDT) (Practical)	0:0:4	0:0:2	4	2	CC
3	MMB526	Microbial Physiology and Metabolism (Practical)	0:0:3	0:0:1.5	3	1.5	CC
4	CSE556	Introductory Concepts of Computer Technology (Practical)	0:0:2	0:0:1	2	1	ID
Total					33	26.5	

Total Contact hrs: 33
Total Credit Hours: 26.5

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	MMB627	Medical Parasitology & Entomology	4:0:0	4:0:0	4	4	CC
4	MMB631	Microbial Omics	3:0:0	3:0:0	3	3	DSE
5	MMB619	Applications of Microbiology					
6	MMB633	Epidemiology and Public Health					
7	MMB623	Bio-informatics	2:0:0	2:0:0	2	2	SECC
8	MMB635	Molecular Diagnostics					
9	MMB615	Research Methodology	3:0:0	3:0:0	3	3	AECC

II. Practical Subjects

1	MMB603	Medical Mycology (Practical)	0:0:4	0:0:2	4	2	CC
2	MMB607	Medical Virology (Practical)	0:0:2	0:0:1	2	1	CC
3	MMB629	Medical Parasitology & Entomology(Practical)	0:0:4	0:0:2	4	2	CC
4	MMB617	Seminar	0:0:2	0:0:1	2	1	AECC
Total					30	24	

Total Contact hrs: 30
Total Credit Hours: 24

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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	MMB602	Dissertation/Project	6 Months	0:0:26	512	26	CC

Contact Hours*: Submission within six months

Total Contact hrs: 512

Total Credit Hours: 26



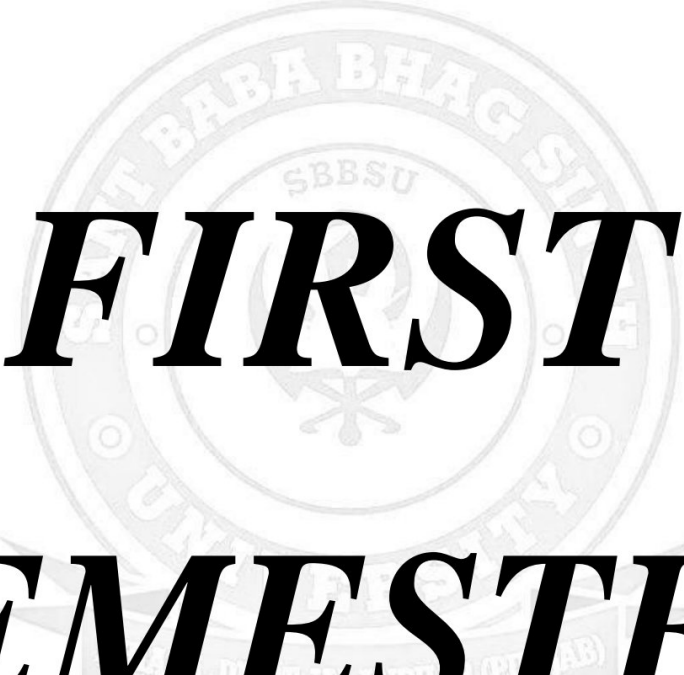
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FIRST SEMESTER

Basic Medical Microbiology

Course Code	MMB501
Course Title	Basic Medical Microbiology
Type of course	CC
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. Gain knowledge about the historical events and developments in Microbiology. 2. Be familiar with sterilization techniques and the use of standard safety measures while handling infectious materials. 3. Understand the process of cultivation through culture media and know about the nutritional requirements of microbes. 4. Apply the knowledge to identify the bacteria based on anatomical characterization and understand the method of replication. 5. Attain the knowledge of disposal of both infected & non-infected laboratory waste.

UNIT-I

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

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 thermos-labile equipments, Sporicidal agents, Mycobacterial disinfection, Quality control in sterilization

UNIT-III

Growth, survival of microorganisms: 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.

Isolation of microbes: Introduction, classification of culture media (solid media, liquid media, semisolid, Media, simple media, complex media, synthetic/defined media, routine culture media, basal media, enriched, enrichment, Selective, Indicator/differential media, sugar fermentation media, transport media, preservation media, aerobic media, and anaerobic media).

UNIT-IV

Morphology and Ultra-structure of Microbes: Anatomy of a bacterial cell including spores, flagella

and capsules.

Bacterial Genetics: Structure and replication of bacterial DNA plasmids, Variation- Mutation; Transfer of genetic material, Recombine DNA technology.

Collection and Transportation and disposal of Laboratory/ Hospital Waste: Non- Infectious Waste, Infected Sharp Waste Disposal, Infected Non- Sharp Waste Disposal.

Text & Reference Books:

S. No	Name/Title	Author	Publisher
1	Text book of Microbiology	Ananthnarayanan & Paniker	Universities press pvt. Ltd
2	Medical Microbiology	Satish Gupte	Jaypee Brothers Medical Publishers
3	Medical laboratory Technology	Mukherjee	McGraw Hill Co., New York.
4	Text book of Microbiology	Prescott	McGraw Hill Co., New York.
5	Practical Medical Microbiology	Mackie and Mac. Cartney	Mackie and Mac. Cartney
6	Textbook of Microbiology	C P Baveja	Arya Publication



Systematic Bacteriology

Course Code	MMB505
Course Title	Systematic Bacteriology
Type of course	CC
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: 1. Understand the role of instruments for culturing & isolation of bacteria. 2. Apply the knowledge to differentiate & identify bacteria on the basis of staining and biochemical characterization. 3. Differentiate a large number of common bacteria by their characteristics, features & classify bacteria into groups 4. Learn the morphology, cultural characteristics, biochemical characteristics & laboratory diagnosis of various bacteria.

UNIT- I

Culture Methods

- Instruments used to seed culture media
- Culture procedures – spread plate method, Pour plate method

Bacterial staining methods: Principal & procedure of simple, negative, differential & organelles stain and its significance.

UNIT- II

Biochemical identifications: Principle, procedures and interpretation of the following biochemical tests for the identification of bacteria (Catalase, Coagulase, Indole, Methyl Red, Voges Proskauer, Urease, Citrate, Oxidase, Nitrate reduction, Carbohydrate fermentation, H₂S production etc.)

UNIT- III

Various characterization (morphological, cultural and biochemical), pathogenesis and laboratory diagnosis of the different class of bacteria

Gram Positive Bacteria: *Staphylococcus*, *Streptococcus*, *Pneumococcus*, *Corynebacterium*, *Bacillus*, *Clostridium*

Gram Negative Bacteria: *Neisseria*, *Pseudomonas aeruginosa*, *Vibrio*, *Haemophilus influenzae*, *Campylobacter jejuni*

UNIT-IV

Various characteristics (morphological, cultural and biochemical), pathogenesis and laboratory diagnosis of the various bacteria.

Enterobacteriaceae: *E. coli*, *Klebsiella*, *Shigella*, *Salmonella*, *Proteus*, *Acinetobacter*, *Enterobacter*, *Citrobacter*

Miscellaneous bacteria: *Mycobacterium tuberculosis*, *Mycoplasma*, *Rickettsia*, *Chlamydiae*, *Actinomycetes* (*Actinomyces*, *Nocardia*), *Brucella*, *Bordetella pertusis*, *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.
4	Practical Medical Microbiology (Volume 1 & 2)	Mackie & McCartney	Churchill Living Stone
5	Bailey & Scott's Diagnostic Microbiology	Patricia M. Tille	15 th Edition, Elsevier



Immunology & Serology

Course Code	MMB523
Course Title	Immunology & Serology
Type of course	CC
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: <ol style="list-style-type: none"> 1. Learn the fundamental principles and components of eliciting immune response 2. Gain knowledge about the molecular mechanism of humoral and cell-mediated immunological response and the concept of vaccines. 3. Understand the role of MHC, complement system and cytokines in generating immune response. 4. Apply the knowledge to understand pathological conditions like Graft rejection, Auto immunity and antibody-based diagnosis.

UNIT-I

History of immunology, Immune response: mechanism of innate and adaptive immune response. Structure, composition and types of cells involved in the 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.

Development of humoral immunity, Cell mediated immunity and its mechanism

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

UNIT-III

Major Histocompatibility complex: Organization of MHC genes, types and function of MHC molecules, antigen presentation.

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

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

UNIT-IV

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

Autoimmunity: Organ-specific 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	Immunology, 5 th Edition	Janis Kuby	W.H. Freeman & Co Ltd
2.	Essential Immunology, 9 th Edn.	Ivan M. Roitt	Blackwell Science, Inc.
3.	Handbook of Human Immunology	Mary S. Leffell & Noel R. Rose,	CRC press
4.	Fundamentals of Immunology	Paul, W.	L. Williams & Wilkins
5.	Janeway's Immunobiology, 6 th Edition	Charles Janeway	Garland Science



Bio-analytical Techniques

Course Code	MMB519
Course Title	Bio-analytical Techniques
Type of course	CC
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 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 principles, components and applications of advanced microscopic and cryo-techniques used in medical laboratories. 2. Familiarize with the principles, working and applications of various types of spectrophotometers. 3. Understand the working principle of separation techniques in biology like electrophoresis, centrifugation & chromatography. 4. Gain theoretical knowledge about the radioisotopes used in medical diagnosis, their measurements, dosage and safety guidelines

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

Cryo-techniques: Cryopreservation of cells, tissues, organs and organisms, Freeze fracture & freeze drying. Principles of tissue fixation, Microtomy, cryotomy.

UNIT-II

Principles and applications of photometry: Absorption of light, Transmittance, Absorbance (Optical density), Lambert-beer law, Method of determining Absorption spectrum of copper sulphate by spectrophotometer, Colorimeter & spectrophotometer; Flame photometer; Atomic absorption spectrophotometer.

UNIT-III

Separation Techniques: Basic principle of sedimentation, Relative centrifugal force (RCF), Sedimentation rate, sedimentation coefficient, Isopycnic (equilibrium) sedimentation and Theory of ultracentrifugation.

Electrophoresis: Principle, Types & Applications- PAGE and Agarose Gel Electrophoresis.

UNIT-IV

Chromatography: Principle, types and applications of Paper, TLC and column chromatography, Gas Chromatography, Ion exchange and Affinity chromatography and HPLC.

Radioisotopes in biology: Radioactive decay and units of radioactivity, Different types of radioisotopes used in diagnosis. Principles of Radioactive counters (GM and Scintillation counters), Autoradiography, Radiation dosimetry and safety guidelines.

Text & Reference Books:

S. No.	Name/Title	Author	Publisher
1	Handbook of Microscopy	Locquin and Langeron	Butter waths
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	Bio-instrumentation	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..



Bioethics, Bio-safety & Intellectual Property Right

Course Code	MMB521
Course Title	Bioethics, Bio-safety & Intellectual Property Right
Type of course	SECC
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 inculcate the knowledge of intellectual property rights to students and aware them about Patents, trademarks, copyright etc.
Course Outcomes	At the conclusion of the course the students will: <ol style="list-style-type: none"> 1. Understand the ethical principles & practices and national & international biosafety guidelines. 2. Understand the concept, scope and importance of IPR. 3. Know about patents, copyrights, trademarks and industrial designs. 4. Get awareness of acquiring the patent and copyright for innovative works.

UNIT I

Ethics: Benefits of Ethics, ELSI of Bioscience, recombinant therapeutic products for human health care, genetic modifications and food consumption, release of genetically engineered organisms, applications of human genetic rDNA research, human embryonic stem cell research.

Biosafety regulation of products microbial products and bioseptic concerns individual society National and international bio safety regulations in Laboratories handling of Recombinant products.

UNIT II

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).

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. Bio-safety and its implementation,

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



Natural Hazards and Disaster Management

Course Code	EVS003
Course Title	Natural Hazards and Disaster Management
Type of course	AECC
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: 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, Zlatanova 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

Basic Medical Microbiology Practical

Course Code	MMB503
Course Title	Basic Medical Microbiology Practical
Type of course	CC
L T P	0 0 4
Credits	2
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	This course aims to impart practical knowledge of different procedures for the cultivation and identification of various types of microorganisms.
Course Outcomes	At the conclusion of the course, the students will: 1) Be able to identify bacteria based on morphological characteristics. 2) Prepare different types of media for the cultivation of microorganisms. 3) Know the effect of nutritional & environmental factors on microbial growth

LIST OF PRACTICALS

1. To demonstrate the morphology of different types of bacteria.

2. To demonstrate the methods of sterilization and preparation of culture media

- To study the method of sterilization by autoclave & hot air oven
- To prepare nutrient agar media for the isolation of bacteria
- To prepare working dilution of commonly used disinfectants.

3. Effect of various nutritional factors on growth of bacteria.

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

4. 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

Systematic Bacteriology Practical

Course Code	MMB507
Course Title	Systematic Bacteriology Practical
Type of course	CC
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. MLS or B.Sc. (Applied Medical Science/Bio-sciences/ Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	This course aims to impart hands-on practice on culturing, staining procedures, biochemical tests used for bacterial identification
Course Outcomes	At the conclusion of the course, the students will: 1) Understand the basic laboratory practices in the field of bacteriology 2) Be able to identify the isolated bacteria through staining methods. 3) Apply this knowledge to identify the bacteria from different types of samples through morphological and biochemical characterization.

LIST OF PRACTICALS

1. To demonstrate the instruments used to seed culture media
2. To learn techniques for Inoculation of bacteria on culture media
3. To isolate specific bacteria from a mixture of organisms.
4. To demonstrate simple staining (Methylene blue)
5. To prepare India ink preparation to demonstrate negative staining.
6. Bacterial identification: To demonstrate reagent preparation and procedure for:
 - a. Gram stain
 - b. Albert stain
 - c. Neisser's staining
 - d. Z-N staining
 - e. Capsule staining
 - f. Demonstration of flagella by staining methods
 - g. Spore staining
7. Physiological tests of bacteria
8. To perform IMViC test
9. To perform Urease, Oxidase, Catalase and Coagulase test

Immunology & serology Practical

Course Code	MMB525
Course Title	Immunology & Serology Practical
Type of course	CC
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Bio-sciences/ Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	This course aims to develop insights 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. Learn the basic laboratory practices in the field of immunology including serum & plasma separation. 2. Be able to determine the TLC, DLC, ABO & Rh factor from blood sample 3. Be able to demonstrate antigen/antibody interactions by various immunological techniques. 4. Be able to perform various types of serological tests for the diagnosis of bacterial infection.

LIST OF PRACTICALS

1. Collection, separation and preservation of serum and plasma from blood.
2. To determine Blood group and Rh factor by slide agglutination test
3. To determine Total Leukocyte Count (TLC) for a given blood sample
4. To determine Differential Leukocyte Count (DLC) for given blood sample using the Leishman stain
5. To precipitate immunoglobulins by ammonium sulphate.
6. To determine total immunoglobulin contents.
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, CCIEP, ELISA.
10. Performance of Serological tests:
 - Widal (Slide and rapid IgG/ IgM)
 - VDRL
 - ASO (Anti-Streptolysin _O)
 - C-Reactive Protein
 - Rheumatoid factor (RF)

Text & Reference Books:

S. No.	Author(s)	Title	Publisher
1	Frances Fischbach	A Manual of Laboratory & Diagnostic Tests	Lippin Cott wiliam & wilkins



SECOND SEMESTER

Applied Bacteriology

Course Code	MMB502
Course Title	Applied Bacteriology
Type of course	CC
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 enable the students about the different types of diagnosis of bacterial pathogens in the laboratory.
Course Outcomes	At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Acquire knowledge about microbial pathogenicity & laboratory diagnosis of various infective syndromes. 2. Demonstrate antibiotic susceptibility testing in bacteriology. 3. Apply the learned concept for bacteriological examination of water, milk, food and air. 4. Elaborate the various techniques of microbial preservation, typing methods & nosocomial infection.

UNIT I

Laboratory strategy in the diagnosis of various Infective diseases: 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, Gastrointestinal 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 items: Basic Concepts regarding the 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

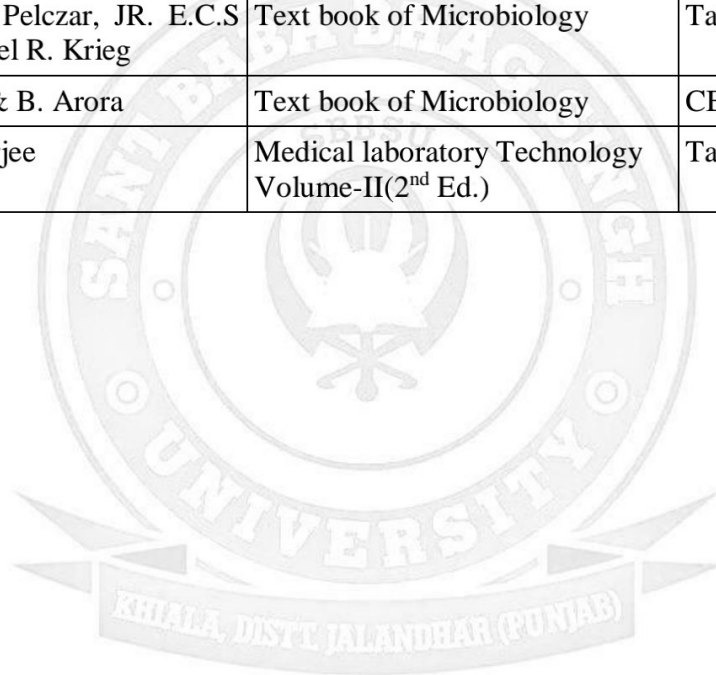
Preservation of microbes and Lyophilisation methods

Epidemiological markers: Serotyping, Phage typing, Bacteriocin typing.

Nosocomial Infections: Introduction, sources and types of nosocomial infections. Bacteriological surveillance of hospital environment. Role of microbiology laboratory in control of nosocomial infections

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



Molecular Biology & Recombinant DNA Technology (RDT)

Course Code	MMB520
Course Title	Molecular Biology & Recombinant DNA Technology (RDT)
Type of course	CC
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/ Bio-sciences/ Medical Science & Allied Medical/ Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	The course aims to Provide Insights to the central dogma of life, genetic engineering and their applications in the field of molecular diagnosis and therapeutics.
Course Outcomes	At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Learn about basic structure of nucleic acids and the mechanism of replication of DNA and DNA Repair. 2. Understand the molecular mechanism of transcription and translation in pro & Eukaryotes and the significance of RNA processing, splicing and other post-translational modifications. 3. Understand the basics of recombinant DNA technology and identify the different DNA modifying enzymes and understand their roles. 4. Able to acquire knowledge of different cloning vectors; 5. Recognize different cloning techniques and familiarize with the applications of RDT in medicine and microbial diagnostics.

UNIT-I

Introduction: History of molecular biology, Importance of Molecular Biology, Central dogma of Molecular Biology, Model organisms for studying Molecular Biology.

DNA Replication: Proof of semi-conservative nature of DNA replication, DNA polymerases, Mechanism of bidirectional DNA replication in pro & eukaryotes, Causes and type of DNA damage and repair mechanisms.

UNIT –II

Transcription in prokaryotes and eukaryotes: RNA structure and types of RNA, RNA polymerase, Initiation, elongation and termination of RNA chains, Processing of RNA: mRNA capping and polyadenylation, RNA splicing

Translation in prokaryotes and eukaryotes: Components of translational machinery (mRNA, tRNA, ribosomes and aminoacyl tRNA synthetases), Mechanism of translation: Initiation, elongation and termination, Post translational modifications of proteins.

UNIT-III

Enzymes used in DNA technology: Restriction Endonucleases, DNA modifying enzymes- Nuclease, Polymerase, Enzymes that modify the ends of DNA molecules. DNA ligase-joining DNA Molecules, Use of adaptors, Linkers, Homopolymer tailing.

Gene cloning vectors: Plasmids, Cosmids, Bacteriophage (bacteriophage lambda and M13 based vectors), Phagemids, BAC, YAC, Shuttle vectors.

UNIT-IV

Cloning techniques: Transformation methods (chemical methods, Electroporation and microinjection)

Cloning Strategies: Construction of Genomic libraries, cDNA libraries, Preparation of DNA fragments for cloning: Positional cloning, chromosome walking

Nucleic Acid based selection and screening of Recombinants, Applications of Recombinant DNA Technology in Medicine, Molecular diagnostics.

Text & Reference Books:

S. No.	Name/Title	Author	Publisher
1	Molecular Biology, 2 nd edition (2004)	David Freifelder	Narosa Publishing House
2.	Molecular Biology	Dr. P.S. Verma, Dr. V.K. Agarwal	S.Chand Publications
3.	Molecular Biology of the Gene (6 th Edition)	Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008)	Cold Spring Harbour Laboratory Press, Pearson Publication.
4.	Cell and Molecular Biology: Concepts and Experiments. 6th edition.	Karp, G.	John Wiley & Sons. Inc.
5.	Molecular Cell Biology 6th edition.	Lodish, H., Berk,	W. H. Freeman
6	Gene Cloning and DNA Analysis	T A Brown	Blackwell
7	From genes to clones introduction to gene technology	by Ernst L. Winnacker	John Wiley

Microbial Physiology and Metabolism

Course Code	MMB524
Course Title	Microbial Physiology and Metabolism
Type of course	CC
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 (CO)	The students will learn the analysis of biological fluids for their chemical constituents & their correlation with health & disease.
Course Outcomes	At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Understand and apply methods and principles of growth and control of microbes and their relationship with environmental factors. 2. Understand and apply the knowledge of mechanism involved in nutrient uptake and transport across microbial cell membrane to analyze microbial growth in different nutritional environments. 3. Understand major differences between various groups of microbes, i.e., bacteria, algae, protozoa, and fungi and their metabolic pathways 4. Gain a thorough understanding of biochemical pathways involved in aerobic and anaerobic respiration in microorganisms and their implications for various ecological and industrial processes. 5. Able to learn the metabolism of Chemoheterotrophic, Chemolithotrophic and Phototrophic bacteria.

UNIT-I

Microbial Growth and Effect of Environment on Microbial Growth

Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve Microbial growth in response to environment -Temperature, pH, solute and water activity, Oxygen.

Microbial growth in response to nutrition and energy.

UNIT-II

Nutrient uptake and Transport

Passive and facilitated diffusion Primary and secondary active transport, concept of uniport, symport and antiport Group translocation Iron uptake

Nutritional classification of microorganisms, Energy generation in cyanobacteria, green bacteria, purple sulphur bacteria and chemolithotrops.

UNIT-III

Chemoheterotrophic Metabolism

Aerobic Respiration: Concept of aerobic respiration, anaerobic respiration and fermentation Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway TCA cycle Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport

phosphorylation, uncouplers and inhibitors

Anaerobic respiration: Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction)

Fermentation: Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways

UNIT-IV

Chemolithotrophic and Phototrophic Metabolism: Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction).

Introduction to phototrophic metabolism- groups of phototrophic microorganisms, anoxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria.

Nitrogen Metabolism: An overview, Introduction to biological nitrogen fixation, Ammonia assimilation, Assimilatory nitrate reduction, dissimilatory nitrate reduction & denitrification

Text & Reference Books

S. No	Name	Author(S)	Publisher
1	Microbiology: An Introduction	Tortora, Funke and Case	Pearson Education
2	Microbial Physiology	Albert G. Moat and John W. Foster.	John Wiley and Sons
3	Microbial Physiology	Moat AG and Foster JW.	John Wiley & Sons
4	Microbial Physiology	Reddy SR and Reddy SM.	Scientific Publishers India
5	Bacterial Metabolism	Gottschalk G.	Springer Verlag
6	General Microbiology	Stanier RY, Ingrahm JI, Wheelis ML and Painter PR	McMillan Press
7	Biochemistry by Voet & Voet	Voet & Voet	

Pharmaceutical Microbiology

Course Code	MMB528
Course Title	Pharmaceutical Microbiology
Type of course	DSE
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 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 chemotherapy and antimicrobial agents. 2. Able to provide an overview of the factors affecting action of antimicrobials. 3. Understand the principles of drug resistance and its control. 4. Able to understand the mechanism involved of the chemotherapeutic agents in subsiding the microbial activities. 5. Apply the knowledge to prevent the pharma products from Microbial spoilage

UNIT I

Introduction to Chemotherapeutic Agents: History and development of chemotherapeutic agent, Properties of antimicrobial agents, Types of chemotherapeutic agents – Synthetic, Semi-synthetic, Natural.

Antibiotics: Types of antibiotics with their mode of action; antibacterial, antifungal, antiviral, antiprotozoal

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.

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 III

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)

Role of microbial genetics in vaccine designing: Microbial genetics and design of vaccines. Design of vaccines for BCG, TB and Leprosy. DNA vaccines, design and advantages.

Unit IV

Microbial spoilage of Pharma products and diseases: Contamination, spoilage and preservation of different pharmaceutical products.

Text & Reference Books:

S. No.	Name/Title	Author	Publisher
1	Pharmaceutical microbiology, 6 th edition	W.B.Hugo & A.D.Russell	Blackwell scientific Publications
2	Biochemistry of antimicrobial action	Franklin, TJ and Snow, L	
3	Antibiotics and chemotherapy	Gerrod et al	

Laboratory Organization and Management

Course Code	MMB516
Course Title	Laboratory Organization and Management
Type of course	DSE
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	The students will be made aware of the basic ethics, good lab practices including awareness/ safety in a clinical lab. In addition they will understand sample accountability, quality management system, calibration and validation of clinical laboratory instruments
Course Outcomes	At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Understand the ethical and clinical responsibilities towards the patient, colleagues and society 2. Know the importance of GLP and merits of GLP 3. Learn the methods of precautions from the pre- post exposure of immuno-compromised diseases. 4. Understand the importance of quality and quality parameters.

UNIT I

Ethical Principles and standards for a clinical laboratory professional:

Duty to the patient, Duty to colleagues and other professionals, Duty to the society

Good Laboratory Practice (GLP) Regulations and Accreditation:

Introduction to Basics of GLP and Accreditation, Aims of GLP and Accreditation, Advantages of Accreditation, Brief knowledge about National and International Agencies for clinical laboratory accreditation

UNIT II

Awareness / Safety in a clinical laboratory: General safety precautions, pre- and post-exposure guidelines for HIV and Hepatitis B & C, Drug Resistant Tuberculosis

Patient management for clinical samples collection, transportation and preservation

UNIT III

Sample accountability: Purpose of accountability, Methods of accountability

Sample analysis: Introduction, Factors affecting sample analysis

Reporting results: Basic format of a test report, Reported reference range, Clinical Alerts, Abnormal results, Turnaround time, Results from referral laboratories, Release of examination results, Alteration in reports

Quality Management system: Introduction, Quality assurance, Quality control system, Internal and External quality control, Introduction and importance of calibration and Validation of Clinical Laboratory instruments

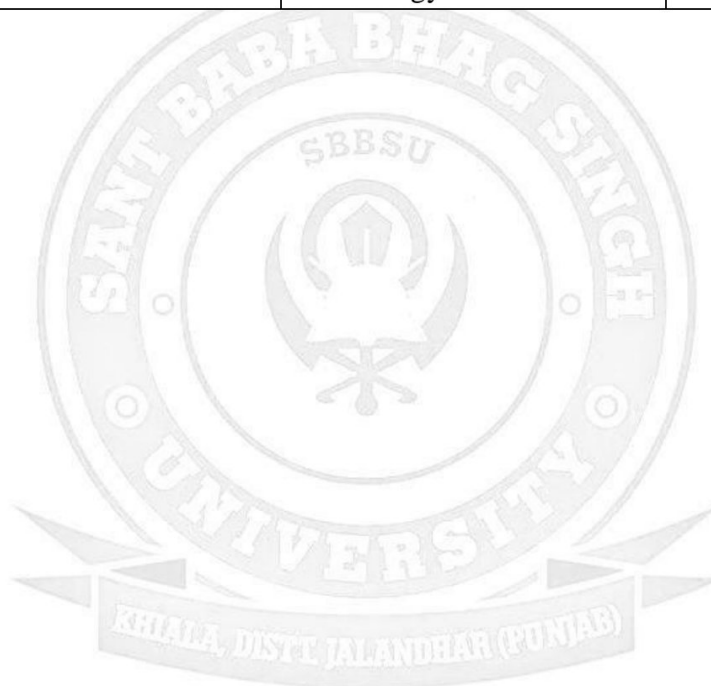
UNIT IV

Laboratory Information system (LIS), Hospital Information system (HIS) and financial Management: Introduction, Functions of a laboratory management system, Standards for

laboratory management system, Introduction and awareness of financial management in a clinical laboratory

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Sangeeta Sharma, Rachna Agarwal, Sujata Chaturvedi and Rajiv Thakur	Medical Laboratories Management- Cost effective methods	Viva Books Originals
2	K.L. Mukherjee	Medical Laboratory Technology	Jaypee Brothers Medical Publishers(P) Ltd.



Anatomy & Physiology

Course Code	MMB530
Course Title	Anatomy & Physiology
Type of course	DSE
L T P	3 0 0
Credits	3
Course prerequisite	10+2 Medical/ Dip in MLT/ Non-Med with 50% marks.
Course Objective	The course aims to identify and relate basic concepts of the structure and function of cells, tissues and organs and to understand the human body's anatomical organization, coordination and integrated functions.
Course Outcomes	At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Be familiar with anatomical terminology, planes, clinical positions and movement terms. 2. Be able to demonstrate knowledge of cell physiology including membrane transport, bio-membrane potentials, and cellular composition. 3. Identify and describe the musculoskeletal and nervous systems' structure, function, and classification, including their components and functions. 4. Students will apply concepts and knowledge of terminology related to the cardiovascular, Lymphatic, Reproductive and Excretory system.

UNIT-I

General anatomy: Anatomical terminology, Anatomical planes, Anatomical positions, Clinical positions, Terms related to movements

Basics of cytology: Structure of cell membrane, Cell organelles, Junctional complexes

Cell Physiology: Membrane transport, Bio-membrane potentials, Nernst equation, Composition of ECF and ICF, Goldmann equation.

UNIT-II

Musculoskeletal system: Bones & their classification, Morphology, ossification, blood supply

Nervous system: Central Nervous system & Peripheral Nervous system, Gross basic Anatomy, Cranial nerves, Spinal nerves, Functions of nerves, Autonomic nervous system

Nerve Muscle: Neuron (structure, functions and classification) and neuroglia, Action potential, neuromuscular junction, Skeletal muscle (structure, mechanism of contraction), Smooth muscle (structure, mechanism of contraction).

UNIT-III

Cardiovascular system: Morphology of blood vessels, classification of blood vessels, blood capillaries, blood circulation, functions, Cardiac muscle, Physiological Anatomy of heart and conduction system, Normal ECG, cardiac cycle, heart sounds, Cardiac output and blood pressure, Coronary circulation.

Lymphatic system: Formation of lymph, Lymphatic ducts, Thoracic duct, Lymph circulation, functions

UNIT-IV

Digestive System: Parts of alimentary canal, structure and functions of tongue, pharynx, oesophagus, stomach, small and large intestine and anus, principles of secretion and movements of gastrointestinal tract. (G.I tract).

Reproductive system: Male reproduction system- gross anatomy of penis, testis, epididymis, vas-deferens, seminal vesicles and prostate. Female reproductive system- gross anatomy of ovaries, uterine tube, uterus, vagina, menstruation cycle.

Excretory system: Parts of excretory system, gross anatomy of kidney, ureter, urinary bladder, and their functions. Functions of kidney, Juxta glomerular apparatus, Formation of urine, counter current mechanism, Role of kidney in maintenance of acid base balance, Renal function tests.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Anatomy & Physiology- Ross and Wilson	Anne Waugh & Allison Grant	Churchill Living Stone
2	Anatomy and Physiology: Understanding the Human Body	Robert Clark	Jones & Bartlett publishers
3.	Functional Histology	James S. lowe, Barbara young, Allen Stevens & John W heath	Elsevier
4.	Text book of human Histology with color Atlas and Practical Guide	Inderjit singh	Jaypee Brothers Medical publishers
5.	Understanding Human Anatomy and Physiology	William Davis	McGraw Hill



Biostatistics

Course Code	MAT515
Course Title	Biostatistics
Type of course	ID
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: 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 and Reference Books:

S. No	Name	Author(S)	Publisher
1.			
2			

Introductory Concepts of Computer Technology

Course Code	CSE554
Course Title	Introductory Concepts of Computer Technology
Type of course	ID
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, 6th edition	Sinha, P.K.	BPB Publications;
2	Windows Based Computer Courses	Sumit Kumar,	JBD Publishers
3	Fundamentals of Computers	Rajaraman	Prentice Hall of India



Applied Bacteriology (Practical)

Course Code	MMB504
Course Title	Applied Bacteriology (Practical)
Type of course	CC
L T P	0 0 4
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	The course aims to impart knowledge about 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. Have in-depth knowledge about collection, transportation and processing of various clinical samples & preservation of isolates 2. Be able to apply basic laboratory practices in the field of bacteriology including inoculation & isolation techniques 3. Be able to perform antibiotic susceptibility testing of clinical isolates using standard methods.

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:
 - Blood
 - Throat swab
 - Sputum
 - Pus
 - Urine
 - Stool for *Salmonella*, *Shigella* and *Vibrio cholera*
 - C.S.F. and other body fluids
4. To perform antibiotic susceptibility testing of clinical isolates by using
 - Stokes method
 - Kirby-Bauer method
5. Collection, transportation and processing of following articles for bacteriological examination:
 - water
 - milk
 - food
 - air samples
6. To demonstrate sterility testing of intravenous fluid with positive and negative controls
7. Demonstration of serotyping and bacteriocin typing.

8. Demonstration of lyophilization

9. 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.)

Molecular Biology & Recombinant DNA Technology (RDT) (Practical)

Course Code	MMB522
Course Title	Molecular Biology & Recombinant DNA Technology (RDT) (Practical)
Type of course	CC
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/ Bio-sciences/ Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	This course aims to impart hands-on practice on isolation, quantitative determination, and purification of DNA & RNA in order to equip students with the knowledge to handle DNA in vitro.
Course Outcomes	At the conclusion of the course, the students will: 1. Be able to prepare buffers used in the molecular biology lab. 2. Be able to demonstrate the process of DNA/RNA isolation, quantification, separation & amplification.

LIST OF PRACTICALS

1. Preparation of buffers used in molecular biology
2. Isolation of bacterial DNA
3. Isolation of plasmid DNA
4. Isolation of DNA from human blood
5. Isolation of RNA
6. Measure the OD ratio at 260 and 280 nm for supplied DNA and protein samples.
7. Separation of DNA fragments on agarose gel electrophoresis.
8. Demonstration of PCR

Microbial Physiology and Metabolism (Practical)

Course Code	MMB526
Course Title	Microbial Physiology and Metabolism (Practical)
Type of course	CC
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	This course aims to provide information on sources of energy and its utilization by microorganisms
Course Outcomes:	At the conclusion of the course, the students will: 1. Gain practical knowledge in controlling microbial growth in various environments. 2. Learn the enzymatic assays to analyze the growth characteristics.

LIST OF PRACTICALS

1. Study and plot the growth curve of *E. coli* by turbidometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data
3. Effect of temperature on growth of *E. coli*
4. Effect of pH on growth of *E. coli*
5. Effect of carbon and nitrogen sources on growth of *E. coli*
6. Effect of salt on growth of *E. coli*
7. To study ability of microorganisms to hydrolyse casein
8. To demonstrate phenylalanine deaminase activity of given bacterial culture.
9. To demonstrate L-lysine decarboxylase activity of bacterial culture.
10. To demonstrate Fat hydrolysis (lipase activity) by bacteria
11. To demonstrate degradation of sulphur containing amino acids by bacteria

Text & Reference Books:

S. No.	Name/Title	Author	Publisher
1	Microbial Physiology	Moat AG and Foster JW.	John Wiley & Sons
2	Microbial Physiology	Reddy SR and Reddy SM.	Scientific Publishers India
3	Bacterial Metabolism	Gottschalk G.	Springer Verlag
4	General Microbiology	Stanier RY, Ingrahm JI, Wheelis ML and Painter PR	McMillan Press

Introductory Concepts of Computer Technology Practical

Course Code	CSE556
Course Title	Introductory Concepts of Computer Technology Practical
Type of course	ID
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-to-day 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	CC
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	The course aims to develop insights into pathogenicity, diagnosis and prophylaxis of fungal infections.
Course Outcomes	At the conclusion of the course, the students will: 1. Have the conceptual knowledge about the basic structure and classification of medically important fungi. 2. Able to diagnose the various types of mycoses, and their clinical manifestations with the help of traditional and advanced techniques. 3. Learn to differentiate superficial, subcutaneous, systemic and opportunistic mycosis on the basis of pathogenesis & clinical features.

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*, *Penicilliosis*, *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, 2 nd Ed.	Kathleen S. Blevins	F.A. Davis Company
3	Fundamental Medical Mycology	Errol Reiss et al.	Wiley-Blackwell



Medical Virology

Course Code	MMB605
Course Title	Medical Virology
Type of course	CC
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Bio-sciences/ Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	This course aims to provide in-depth understanding 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. Gain knowledge about classification, nomenclature, structure and properties of viruses. 2. Understand the transmission, epidemiology, prevention and control measures of oncogenic viral infection. 3. Apply this knowledge to understand the cultivation, isolation, transmission, mode of infection of various viruses 4. Be able to analyze the role of molecular techniques in identification and diagnosis of disease and its 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.

Oncogenic viruses: Epstein-Barr Virus (EBV), Human Papillomavirus (HPV), Hepatitis B virus (HBV), Human Cytomegalovirus (CMV or HHV-5), Human Herpesvirus-8 (HHV-8), Kaposi's sarcoma-associated herpesvirus (KSHV) and Merkel Cell Polyomavirus (MCPyV). Hepatitis C virus (HCV), Human T-cell lymphotropic virus-1 (HTLV-1).

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), MMR virus, Zika virus and Ebola virus

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.	ASM Press 5 th Edition
3	Medical Virology: A practical Approach	U. Desselberger	Oxford University Press

Medical Parasitology & Entomology

Course Code	MMB627
Course Title	Medical Parasitology & Entomology
Type of course	CC
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 acquaint the students with the different types of Parasites & their diagnosis in the laboratory.
Course Outcomes	At the conclusion of the course, the students will: <ol style="list-style-type: none"> 1. Identify and classify different types of parasites and their hosts, including the culture, collection, handling, transportation, and preservation of clinical samples 2. Understand the general characteristics, morphology, life cycle, and laboratory diagnosis of protozoans & helminths 3. Gain knowledge about the mode of transmission & life cycle of important vector-borne 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, and 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

Protozoans

Intestinal and vaginal flagellates: Morphology, life cycle, mode of infection and laboratory diagnosis of *Giardia*, *Trichomonas sp.*

Blood and tissue flagellates: Morphology, life cycle, Mode of infection and laboratory diagnosis of *Toxoplasma gondii*, *Cryptosporidium parvum*

UNIT-III

Helminths

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

Trematodes: Morphology, life cycle, mode of infection, and laboratory diagnosis of *Schistosoma mansoni*, *Schistosoma haematobium*, *Paragonimus westermani*, *Fasciola hepatica*

Nematode-I: Morphology, life cycle, mode of infection and lab diagnosis of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Trichinella spiralis*, *Trichuris trichiura*.

Nematode-II: Morphology, life cycle, mode of infection and lab diagnosis of *Enterobius vermicularis*, *Strongyloides stercoralis*, *Dracunculus medinensis*.

UNIT IV**Medically important insects**

Vector, Life cycle, Mode of infection and laboratory diagnosis of: *Trypanosoma brucei gambiense*, *Leishmania donovani*, *Plasmodium spp.*, *Wuchereria bancrofti*, *Brugia malayi*.

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	Textbook of Medical Parasitology	Ck Jayaram Paniker	Jaypee Brothers Medical Publishers (P) Ltd
3	Essentials of Medical Parasitology	Apurba sankar sastry and sandhya bhat	Jaypee brothers medical publishers pvt. Ltd.

Microbial Omics

Course Code	MMB631
Course Title	Microbial Omics
Type of Course	DSE
L T P	3 0 0
Credits	3
Course Prerequisites	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/ Bio-sciences/ Medical Science & Allied Medical/ Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objectives (CO)	The objective of this course is to help the students understand the basis of genetics, molecular mechanism of mutations, and role of regulatory elements including cis & trans-acting, transposable elements and small RNAs
Course Outcomes	At the conclusion of the course students will: 1. Acquire basic knowledge and organization of the genetic material within prokaryotes and eukaryotes 2. Learn the classification and molecular basis of mutations 3. Understand the regulation and advancements in gene expression

UNIT- I

Genome and its organization: Introduction of genome, introns and exons, Organization of genetic material in prokaryotes and eukaryotes.

Nucleosomes structure and packaging of DNA, Genetic code and its properties, Wobble hypothesis.

UNIT- II

Mutation and its basis: Types of mutation (missense mutation, nonsense mutation, silent mutation, point mutation, frameshift mutation).

Physical and chemical mutagens. Molecular basis of mutation, Plasmids and Transposons as tool in microbial genetics

UNIT-III

Gene Expression in prokaryotes and eukaryotes: Principles of gene regulation, negative and positive regulation, Concept of operons; Lac and Trp operon, Cis and Trans acting elements, Enhancers, Silencers, Gene Specific Regulators, Transcription Factors- DNA interactions.

UNIT-IV

Recent advances in Eukaryotic Gene Expression: Regulation of Eukaryotic Gene Expression by Small RNAs (RNA Interference, RNAi), Genomics and Proteomics.

Text & Reference Books:

S. No.	Name/Title	Author	Publisher
1	Molecular Genetics	Stanley R. Maloy, John E. Cronan, Jr., David Freifelder	Jones and Barlett Publishers
2.	Molecular Genetics of Bacteria	Larry Snyder and Wendy Champness	ASM Press, Washington, D.C.

3.	Essentials of Molecular Biology	George M. Malacinski, David Freifelde	Jones and Barlett Publishers
4.	Genomes, Third Edition	T. A. Brown	Wiley-Liss

Applications of Microbiology

Course Code	MMB619
Course Title	Applications of Microbiology
Type of Course	DSE
L T P	3 0 0
Credits	3
Course Prerequisites	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/ Bio-sciences/ Medical Science & Allied Medical/ Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objectives (CO)	This course aims to help students understand the basic process of fermentation, reactor design and their applications to the various fields viz: industry, agriculture and environment.
Course Outcomes	At the conclusion of the course, students will: <ol style="list-style-type: none"> 1. Have a basic knowledge and understanding of fermentation processes and their types. 2. Gain comprehensive knowledge of types of bioreactors and their scaling up. 3. Learn the economics of fermentation for the total cost of production. 4. Able to apply their knowledge and understanding of microbes for the sustainability of agriculture and the environment.

UNIT - I

Fermentation: Introduction, isolation, screening and selection of industrially important microorganisms, Media used: molasses, corn steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates,

Types of fermentation processes: Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch (eg. baker's yeast) and continuous fermentations.

UNIT -II

Bioreactors: Design and components of basic fermenter, specialized fermenters for specific purposes – continuous, anaerobic, for gaseous nutrients, for treatment of wastes, trickle flow reactors, cyclone reactors, submerged types, tube reactors, packed bed reactors, lab scale to pilot to industrial – scale-up process, online monitoring.

UNIT -III

Bioprocessing – Downstream processing of industrial fermentation processes, product purification and recovery, Physico-chemical basis of bio-separation processes, techniques for purification of end products – chromatography, electrophoresis, distillation, crystallization, filtration. Economics of a fermentation process, determination of cost and its recovery, cost-cutting strategies, cell and enzyme immobilization, biological waste treatment, hygiene and safety in fermentation industries

UNIT -IV

Microbes in environment – Role and diversity, Solid and Liquid waste Treatment of sewage and industrial effluents, Secondary waste treatment – aerobic, anaerobic and Composting.

Role of Microbes in Agriculture – Bio-inoculants, bio-degradation and bio-remediation of xenobiotic compounds, technique of bioremediation using microbes, Bio-leaching of Metals, Bio-fuels, Microbes as food, Bioplastics, GEMs – Application and hazards.



Epidemiology and Public Health

Course Code	MMB633
Course Title	Epidemiology and Public Health
Type of Course	DSE
L T P	3 0 0
Credits	3
Course Prerequisites	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/ Bio-sciences/ Medical Science & Allied Medical/ Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objectives (CO)	The objective of this course is to help the students to train students for the sectors needing epidemiologically churning of data for decision making.
Course Outcomes	At the conclusion of the course students will: <ol style="list-style-type: none"> 1. Be able to explain the principles of disease transmission and occurrence. 2. Learn the concept of disease control, prevention and management during outbreaks. 3. Understand the concept of EBM (Evidence Based Medicine) and its tools. 4. Use the health resources to the best possible effect.

UNIT I

Basic Epidemiology: Introduction, history/evolution of epidemiology. Dynamics of disease transmission. Measuring the occurrence of disease and types of study with examples and illustrations of classical case studies.

UNIT II

Epidemiology of Communicable and Non-communicable

Basic concepts of Communicable Diseases in terms of Host, Environment and Agent with focus on control and prevention, including investigation and management of outbreak of diseases, their indicators and evaluation. Epidemiology of locally prevalent diseases

Methods of measurement and evaluation

Viral diseases: Dengue, Japanese Encephalitis (JE)

Chronic diseases: Tuberculosis, Leprosy, HIV, Cardiovascular, Diabetes and Hypertension.

UNIT III

Clinical Epidemiology: Utility Hospital-Based Studies, Epidemiological Measures used in Clinical Epidemiology; Clinical Trials and Experimental Designs, Concepts of EBM and converting Epidemiological Studies into EBM Tools

UNIT IV

Health Informatics: Medical Records Management and its Statistical Measures: Indoor and Outdoor admissions Statistics, Bed Occupancy, Average Stay, Bed Turnover Rate, Including Generating Evidence Based Medicine using service data.

International Classification of Diseases: Concepts, Certification of birth and death, Generation of reports, Notifiable diseases

Text & Reference Books:

S. No.	Name/Title	Author	Publisher
1	Epidemiology Principles and Methods	Mac. Mohan & Pugh	Little Brown & Co. Boston. U.S.A
2.	Public Health Administration and Practice	John J. Hanlon	MOSBY
3	Maxcy-Roseman Public Health and Preventive Medicine	Maxy Roseman John M. Last	Appleton-Century-Crofit, Newyork
4	Practical Epidemiology	Barker D.J.P.	Churchill Livingstone
5	The Theory and Practice of Public Health	Hobson W	Oxford Med. Publication
6	Principles of Medical Statistics	Sir Austin Bradford Hill	The Lancet Ltd. Adelphine, London

Bio-informatics

Course Code	MMB623
Course Title	Bio-informatics
Type of course	SECC
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	The course aims to impart knowledge about the principles and computational methods used to search and compare DNA, RNA and proteins. .
Course Outcomes	At the conclusion of the course, the students will 1. Acquire basic knowledge regarding bioinformatics and its role in molecular data analysis 2. Acquire knowledge about sequence alignment, analysis and algorithms 3. Acquire conceptual knowledge about structural bioinformatics including different databases. 4. Apply the learned concepts in different molecular techniques.

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).

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

Structural Bioinformatics: Properties of amino acids and peptide bonds, Ramachandran Plot. Motifs and Folds; Protein structure-related databases, Protein Fold Classification, Protein structure comparison, CATH and SCOP Databases.

UNIT IV

Techniques in Genomics and Proteomics: Gene Sequencing, Protein sequencing, 2 D Gel electrophoresis, Microarray. Next Generation Sequencing, WGS.

Text & Reference Books:

S.No.	Name/Title	Author	Publisher
1	Bioinformatics: Principles and Applications	Zhumur Ghosh , Bibekanand Mallick	oxford

Molecular Diagnostics

Course Code	MMB635
Course Title	Molecular Diagnostics
Type of Course	SECC
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 course is to enhance the skills and knowledge of students in using advanced molecular techniques for disease diagnosis
Course Outcomes	At the conclusion of the course students will: <ol style="list-style-type: none"> 1. Familiarize with molecular diagnostic techniques 2. Able to get the knowledge about different sequencing methods. 3. Build their ability to apply the knowledge to chip based diagnostic procedures. 4. Learn to diagnose different infectious diseases through advanced molecular methods.

UNIT- I

Introduction and Tools of Molecular Diagnostics: Brief History & importance of Molecular Diagnostics, PCR (Polymerase Chain Reaction) RT PCR and qPCR, Modifications of PCR-Hot start, Touch down, nested PCR, Multiplex, Single-cell PCR, Fast-cycling PCR, Methylation-specific PCR (MSP).

UNIT-II

Sequencing Methods: Principles (Sanger sequencing, Overview of NGS Technologies and Platform, Application of NGS in Molecular Diagnostics. DNA Fingerprinting.

UNIT-III

Chip Based Diagnostics: DNA Microarray, FISH (Fluorescence in situ Hybridization), DNA protein interaction- chromatin immune precipitation. RNA interference and detection methods, CrispR-CAS9 technology

UNIT-IV

Molecular Diagnostics of Infectious Diseases: Molecular Diagnostics in Cancer Management & Cancer markers, Molecular diagnostics in rare genetic disorders. Restriction Fragment length Polymorphism (RFLP), Amplified Fragment Length Polymorphism (AFLP), Denaturing high-performance liquid chromatography (DHPLC), Multiplex Ligation Dependent Probe Amplification (MLPA)

Text & Reference Books:

S. No.	Name/Title	Author	Publisher
1	Molecular Diagnostics – Techniques and Applications for the Clinical Laboratory	R.M. Nakamra, F.L. Kiechle, W.W. Grody and C. Strom	Academic Press
2	Molecular Diagnostics – Fundamentals, Methods and Clinical Applications	Lela Buckingham and Maribeth L. Flaws	F.A. Davis Company

Research Methodology

Course Code	MMB615
Course Title	Research Methodology
Type of Course	AECC
L T P	3 0 0
Credits	3
Course Prerequisites	M.Sc. Medical Microbiology as Ability Enhancement course
Course Objectives (CO)	The objective of this course 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: <ol style="list-style-type: none"> 1. 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

Course Code	MMB603
Course Title	Medical Mycology (Practical)
Type of course	CC
L T P	0 0 4
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 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. To perform the cultivation and identification of fungi on media used in mycology (SDA, PDA, RSA & CMA)
2. To collect and process clinical samples for laboratory diagnosis of fungal infections:
 - Skin
 - Nail
 - Hair
 - Body fluids and secretions.
3. Direct examination of specimens by KOH, Gram, Kinyoun's, Giemsa, Lactophenol cotton blue stains.
4. Isolation and identification of pathogenic yeasts and moulds and recognition of common laboratory contaminants.
5. Special techniques like Wood's lamp examination, hair baiting, hair perforation, paraffin baiting and slide culture.
6. 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 Mc Graw Hill
2	Text book of Microbiology	Ananthanarayan And Paniker's Text Book of Microbiology	Universities Press
3.	Medical Microbiology	Paniker & Satish Gupte	Universities Press

Medical Virology Practical

Course Code	MMB607
Course Title	Medical Virology (Practical)
Type of course	CC
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	The course aims to 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. Preparation of different type of media for the cultivation of viruses 2. Collect blood samples for the diagnosis of viruses through serological tests. 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. To perform Dengue test.
5. Serological tests
 - ELISA and rapid tests for HIV
 - RPHA for HbsAg
 - Haemagglutination inhibition for influenza
 - AGD and counter-immuno-electrophoresis for detection of viral antigens or antiviral antibodies.
6. Demonstrate the handling of mice, rats, guinea pigs, rabbits for collection of blood, pathogenicity test.
7. To demonstrate structure of viruses and their multiplication from charts etc.
8. To perform Giemsa stain, Seller's stain, immuno-fluorescent staining procedures for diagnosis of viral infections

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

Medical Parasitology & Entomology(Practical)

Course Code	MMB629
Course Title	Medical Parasitology & Entomology(Practical)
Type of course	CC
L T P	0 0 4
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	The course aims to acquaint students with the examination and diagnosis of diseases 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 for the identification of the parasite. 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 macroscopic examination
- Routine examination of stool and sputum for parasitic infections by microscopic examination
- Preparation of permanently stained smear of the stool sample

2. 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. Staining:

(A) **Leishman stain & Giemsa stain:** To prepare and perform the (given) stain for the identification of malarial parasite, Microfilaria from blood sample

(B) **Field stain:** To prepare and perform the (given) stain for the identification of malarial parasite from blood sample

(C) **Jaswant Singh Bhattacharjee stain:** To prepare and perform the (given) stain for the identification of malarial parasite from blood sample

6. Culture Methods

- Boeck and Drbohlav's diphasic medium
- Balamuth's monophasic liquid medium
- NNN medium
- Schneider's insect tissue culture medium

Text & Reference Books:

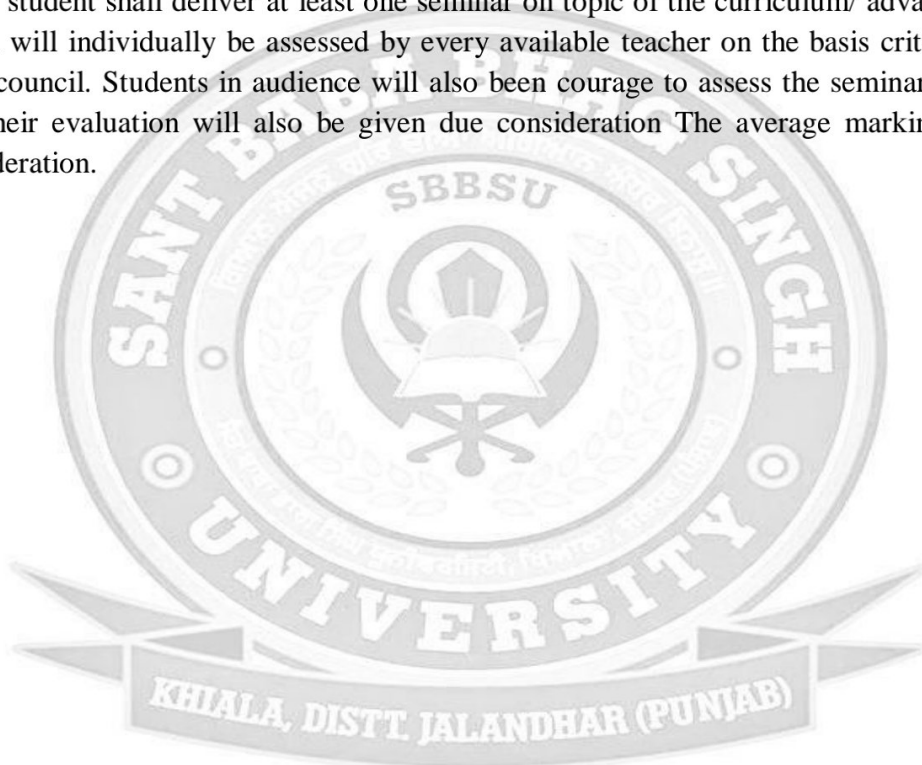
S.No.	Name/Title	Author	Publisher
1	Medical parasitology	V. Baveja, C.P. Bavej	4 th edition

2.	Medical parasitology	D.R. Arora	5 th edition
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Seminar

Course Code	MMB617
Course Title	Seminar
Type of course	CC
L T P	0 0 2
Credits	1
Course prerequisite	M. Sc Medical Microbiology as Skill Enhancement Course
Course Objective (CO)	The students will become well versed with the presentation skills on research specific topics
Course Outcome	At the conclusion of the course students will: 1. Understand the application and usage of MS office. 2. Develop Critical Thinking, Interdisciplinary Inquiry 3. Improve presentation and communication skills.

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

Course Code	MMB602
Course Title	Dissertation/Project
Type of course	CC
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 6 months research project 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.