Master of Science in Microbiology
(M. Sc. Microbiology Semester System)

Revised Curriculum 2017

Tribhuvan University
Kirtipur, Kathmandu

March, 2017
Introduction

The M. Sc. Microbiology programme was started at Tribhuvan University in 1990 for the first time in Nepal at the Central Department of Microbiology, Tribhuvan University, Kirtipur. The course structure of the programme was changed in 1999 and revised in 2008 and 2009. However, the course was based on the annual examination system. The course structure of the programme was changed into semester system in 2013. Therefore, this is a revised semester system credit based course curriculum to make it more competitive and research oriented.

This revision in curriculum has been done to vertically align the M.Sc. microbiology course with the four year bachelor of science (B.Sc.) in microbiology course curriculum. The present curriculum is designed to upgrade M.Sc. microbiology degree of Institute of Science and Technology, Tribhuvan University to international level in accordance to current advances in microbiology. The new curriculum emphasizes on research based teaching learning practice. The new M.Sc. microbiology degree programme will be semester system credit based as per international trend. The present curriculum aims to produce qualified microbiologists, molecular biologists, researchers and scientists as per national and international demand. The master's degree holders will be able to use skills of modern molecular biology techniques in basic science research or in applied research areas of microbiology. The graduates will be able to work as a qualified scientist for investigating the potential uses of microorganisms to produce antibiotics, antibodies, steroids, vaccines, hormones and other products of microbial origin. The master's degree holders will be able to work as a microbiologist and research scientist in the laboratories for monitoring, identifying and helping to control infectious diseases. They will also be able to work as qualified researchers and scientists in the institutions related to food production, crop protection and soil fertility. The master's degree holders will be eligible to be the lecturers of microbiology programme offered by Institute of Science and Technology and other institutions of Tribhuvan University or other universities for teaching, mentoring and supervising bachelors and masters' level microbiology students.

Course Structure

The entire course is divided into four semesters within two academic years. The first semester course covers the disciplines of General/Advances in Microbiology, Immunology, Microbial Genetics, Microbial Biochemistry and Biotechnology and practical on these courses. The second semester offers track selection among four different disciplines of microbiology for specialization. The four disciplines from second semester include Medical Microbiology, Public Health Microbiology, Food and Industrial Microbiology and Agriculture Microbiology with their practical courses. The fourth semester is completely research oriented that includes internship based on selected track and dissertation. In the second semester, students are required to choose one of the four different disciplines offered and continue with it through the third and fourth semesters. Students are not allowed to change the discipline once they have chosen it. The selection of discipline of microbiology may depend upon the facilities available at the department. To gain exposure, students are encouraged to go for excursion after the second semester.
Eligibility and Admission Procedures

Candidates having a Bachelor’s Degree in Microbiology from Tribhuvan University or equivalent degree recognized by Tribhuvan University are eligible to apply for the M. Sc. Microbiology programme. Each applicant should appear and pass entrance examination conducted by the Central Department of Microbiology. The enrollment will be based on merit. The candidates failed to get minimum qualifying marks/pass marks in the entrance examination will not be enrolled in the program.

Hours of Instruction

1. Working days: 90 days in a semester
2. Class hours:
   - Theory: One credit is equivalent to 15 teaching hours in a semester. One theory paper of 1 credit will have 1 hour of lecture per week.
   - Practical: One credit is equal to 60 practical hours in a semester. One practical paper of 1.5 or 1 credit will have 4 hours of practical per week.

Total Credits: 64 credits within four semesters.

Attendance

Student should be regular in their classes. Students failing to maintain 80% presence are not allowed to appear in the semester-end examinations and regarded as “not qualified”. However, in case of serious illness the students with 70% attendance will be given chance to appear in the semester-end exam. In this case students have to submit an authorized medical certificate.

Normal and Maximum Duration of Study

The normal duration and the maximum duration for the completion of the requirements for the program is as follows:

Normal duration 24 months (4 academic semesters)
Maximum duration 60 months (10 academic semesters)

Students failing to complete the requirements in 60 months have to re-enroll.

Teaching Methodology

The general teaching methodology of the program includes interactive lectures, students’ presentations, case studies and projects.

Language of Instruction: English
Examination

Students must pass the internal assessment in order to appear for the final examination. There will be two internal assessments which will count as 40% internal evaluation. The pass marks for theory is 50% and practical subjects are 50%. Institute of Science and Technology, Tribhuvan University will conduct semester examination. The final semester examination of 1 credit theory subject will have 1 hour of duration \((3C \approx 3 \text{ hrs})\) and internal assessment will have one hour of duration for all subjects.

Evaluation/ Examination

The evaluation is based on the internal evaluation and final semester examination. The internal evaluation which is 40% of total evaluation is done by the department based on different criteria of evaluation listed below;

Internal evaluation (40%):
- Attendance: 5 marks
- Seminar/class test/home assignment: 5 marks
- Project work/case study: 5 marks
- Midterm exam: 10 marks
- Final term evaluation: 15 marks

The remaining 60% of the evaluation is done from semester examination taken at the end of the semester. The semester examination will be conducted by the office of the Dean of Science and Technology. Students are required to obtain 50% to pass internal exam (evaluation) as well as semester end examination.

Make-up/retake examination

Students failing in not more than two subjects in first, second and third semester shall appear in make-up exams in following cycle of exams. Students failing in two subjects in the fourth semester shall be given opportunity to appear in make-up exam within one month after the final result.

Grading

Total marks obtained in internal and semester-end exams shall be graded on absolute bases.

The performance of a student shall be made on four point scale ranging from 0 to 4 grades. A student must secure a minimum Grade Point Average (GPA) of 2.7 or Grade B minus (B-) in each course.
### Absolute grading scale

<table>
<thead>
<tr>
<th>Grade</th>
<th>CGPA</th>
<th>Percentage Equivalent</th>
<th>Performance Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.0</td>
<td>90 and above</td>
<td>Distinction</td>
</tr>
<tr>
<td>A-</td>
<td>3.7</td>
<td>80-89.9</td>
<td>Very Good</td>
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<tr>
<td>B+</td>
<td>3.3</td>
<td>70-79.9</td>
<td>First Division</td>
</tr>
<tr>
<td>B</td>
<td>3.0</td>
<td>60-69.9</td>
<td>Second Division</td>
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<tr>
<td>B-</td>
<td>2.7</td>
<td>50-59.9</td>
<td>Pass in individual subject</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>Below 50</td>
<td>Fail</td>
</tr>
</tbody>
</table>

The students shall receive their semester grades and academic transcript grades only in letter grades and GPA scores. Students securing only 2.7 in grade point are considered as “pass in individual subject”.

In order to pass the semester examination the student must secure a minimum of Grade ‘B’ or Cumulative Grade Point Average (CGPA) of 3.0. A student who secures CGPA less than 3 may request for the opportunity to improve the grade in two subjects. The office of the dean will provide one time opportunity to appear in semester exam. The exam of the courses to improve grade shall be held as per course cycle.

### Courses

#### Semester I

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>Nature of Course</th>
<th>Credits</th>
<th>Evaluation (40% internal assessment)</th>
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<tbody>
<tr>
<td>MB 501</td>
<td>Advances in Microbiology</td>
<td>T</td>
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<tr>
<td>MB 502</td>
<td>Immunology</td>
<td>T</td>
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<td>Microbial Genetics and Molecular Biology</td>
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<tr>
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## Discipline I: Public Health Microbiology

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<tr>
<td>MB 551</td>
<td>Human Anatomy and Physiology</td>
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<td>MB 552</td>
<td>Applied Environmental Microbiology</td>
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<td>MB 553</td>
<td>Fundamentals of Epidemiology</td>
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<td>Microbial Systematics</td>
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<td>Research Methods and Biostatistics</td>
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<td>MB 603</td>
<td>Emerging Infectious Diseases</td>
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<td>MB 604</td>
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### Semester IV

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S/US- Satisfactory (Pass)/unsatisfactory (Fail)
## Discipline II: Medical Microbiology

### Semester II

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<tbody>
<tr>
<td>MB 551</td>
<td>Human Anatomy and Physiology</td>
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<tr>
<td>MB 557</td>
<td>Systemic and Diagnostic Bacteriology-1</td>
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<tr>
<td>MB 558</td>
<td>Systemic and Diagnostic Virology-1</td>
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<tr>
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<tbody>
<tr>
<td>MB 601</td>
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<tr>
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<td>Systemic and Diagnostic Bacteriology-2</td>
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<tr>
<td>MB 608</td>
<td>Systemic and Diagnostic Virology-2</td>
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<tr>
<td>MB 609</td>
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<tr>
<td>MB 610</td>
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<td>MB 611</td>
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### Semester IV

#### Compulsory course

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<tbody>
<tr>
<td>MB 653</td>
<td>Hospital Based Internship</td>
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<td>MB 654</td>
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S/US- Satisfactory (Pass)/unsatisfactory (Fail)
## Discipline III: Food and Industrial Microbiology

### Semester II

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<th>Nature of Course</th>
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<th>Evaluation (40% internal assessment)</th>
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<tbody>
<tr>
<td>MB 562</td>
<td>Food Fermentation Technology</td>
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<td>3</td>
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<tr>
<td>MB 563</td>
<td>Food Biotechnology and Nutraceuticals</td>
<td>T</td>
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<tr>
<td>MB 564</td>
<td>Advanced Food Microbiology</td>
<td>T</td>
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<tr>
<td>MB 565</td>
<td>Food Safety Management and Toxicology</td>
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<tr>
<td>MB 566</td>
<td>Practical on (MB 562 + MB 563)</td>
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<tr>
<td>MB 567</td>
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### Semester III

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<th>Nature of Course</th>
<th>Credits</th>
<th>Evaluation (40% internal assessment)</th>
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<tbody>
<tr>
<td>MB 601</td>
<td>Research Methods and Biostatistics</td>
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<td>MB 612</td>
<td>Food Science and Nutrition</td>
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<tr>
<td>MB 613</td>
<td>Food Processing and Preservation Technology</td>
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<tr>
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### Semester IV

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<th>Evaluation (40% internal assessment)</th>
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<tbody>
<tr>
<td>MB 655</td>
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<td>MB 656</td>
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S/US- Satisfactory (Pass)/unsatisfactory (Fail)
## Discipline IV: Agriculture Microbiology

### Semester II

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<th>Nature</th>
<th>Credits</th>
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<tr>
<td>MB 568</td>
<td>Biological Control</td>
<td>T</td>
<td>3</td>
<td>75 (45+30)</td>
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<tr>
<td>MB 569</td>
<td>Soil Microbiology</td>
<td>T</td>
<td>3</td>
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<tr>
<td>MB 570</td>
<td>Microbial Metabolism in Soil</td>
<td>T</td>
<td>3</td>
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<tr>
<td>MB 571</td>
<td>Soil Fertilizers</td>
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### Semester III

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<tbody>
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<tr>
<td>MB 617</td>
<td>Microbial Inoculants in Agriculture, Livestock and Forestry</td>
<td>T</td>
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<td>MB 618</td>
<td>Applied Soil Microbiology</td>
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<td>Microbial Diseases and Agriculture Biotechnology</td>
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### Semester IV

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S/US- Satisfactory (Pass)/unsatisfactory (Fail)
## Compulsory Courses for All Disciplines

### Semester I

<table>
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<tr>
<th>Course code</th>
<th>Course Title</th>
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<td>Advances in Microbiology</td>
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<td>MB 502</td>
<td>Immunology</td>
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<td>MB 504</td>
<td>Biochemistry and Biotechnology</td>
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**Total** 16 400
MB 501 Advances in Microbiology

Course Title: Advances in Microbiology  
Course No.: MB 501  
Nature of Course: Theory (3 credits)  

Full Marks: 75  
Pass Marks: 37.5  
Semester: I

Objectives
Upon the completion of the course students will have knowledge on
a. Bacterial and viral taxonomy  
b. Structure and physiology of bacteria, virus and fungi  
c. Transport system and pathways of protein secretion  
d. Growth and recovery of bacteria and bacteriophage

Course Contents

Bergey's Classification of Bacteria  
7 hrs

Pathways of Protein Secretion  
5 hrs
General secretory pathway (GSP), Type I, Type II, Type III, Type IV secretion system, Bacterial invasion mediated by cytoskeletal function, Disruption of tight junction

Bacterial Structure and Transport Mechanism  
5 hrs
Overview of prokaryotic cell structure and function, Cell membrane and function, Cell wall and function, Passive diffusion, Facilitated diffusion, Active transport, Group translocation, Iron transport, ABC transporter

Bacterial Growth, Growth Kinetics  
4 hrs
Lag phase, Exponential or log phase, Stationary phase, Death phase, Generation time determination, Diauxic growth

Bacterial Metabolism  
10 hrs
Nutrient, Macro and Micro elements, Requirement of carbon, hydrogen and oxygen, Nutritional types of microorganisms, Free energy and reactions, Oxidation-Reduction reaction and electron carrier, Role of ATP in metabolism, Mechanism of generating ATP, Photophosphorylation, Substrate-level phosphorylation, Oxidative phosphorylation, Chemiosmotic theory, Overview of metabolism, Catabolism, Anabolism, Breakdown of glucose to pyruvate, Embden-Meyerhof pathway, Pentose phosphate pathway, Entner-Doudoroff pathway, Kreb cycle, Fermentation, Lactic acid fermentation, Ethanol fermentation, Mixed acid fermentation, Butanediol fermentation, Anaerobic respiration, Photosynthesis, Light dependent and light independent reaction
**Fungi: Structure, Classification and Physiology** 7 hrs
Classification, Fungal cell structure and function, Nutrition and metabolism, Reproduction and life cycle of yeast and mold

**Viruses: Structure, Classification and Replication** 7 hrs
Virus classification and nomenclature, Phylogenetic analysis and taxonomy of viruses and Bacteriophages, Morphology and structure of viruses, Propagation and identification of viruses and bacteriophages, Replication of viruses and bacteriophages, Virus purification and assays, Host-virus interaction

**References**
MB 502 Immunology

Course Title: Immunology                                      Full Marks: 75
Course No.: MB 502                                          Pass Marks: 37.5
Nature of Course: Theory (3 credits)                       Semester: I

Objectives
Upon completion of the course, students will be able to understand
a. Basic immunology and immunopathology of viral, bacterial, parasite, autoimmune, tumor and fungal diseases
b. Immunological techniques and assays

Course Contents

Basic Concept of Immunology                                  2 hrs
Immunology, Immunity; Anatomical feature and location of human lymphatic system, Role of organs, Cells, tissues and other components in immune system

Innate Immunity                                              3 hrs
General overview of host pathogen interaction, Non-specific defense against the microbial infections, Physical and anatomical barriers, Cells and secretary molecules, Serum components, Phagocytosis

Complements                                                  2 hrs
Mechanism and significance of classical and alternative pathways of complement system

Cells and Tissues of Adaptive Immunity                        3 hrs
Types, functions and development (maturation, activation and differentiation) of T and B cells

Antigens                                                     2 hrs
Types and properties; Conditions of antigenicity

Antibodies and Immunoglobulins                                5 hrs
Molecular structure, Classes, Subclasses, Types, Subtypes, Genetic basis of diversity

In Vitro Antigen-Antibody Reactions                          5 hrs
Types, principle, procedures and applications of precipitation, Agglutination, Antibodies labelling methods; Immunofluorescence assay, ELISA, Radioimmuno assay, Immunoelectrophoresis, Immuno blotting methods

Cell Mediated Immune Response                                5 hrs
Cells involved in cell mediated immunity; Structure and function of MHC in antigen processing, Presentation and effector mechanism

Types and Function of Cytokines and TLR                      3 hrs
Immune Disorders 5 hrs
Immunological tolerance; Hypersensitivity, Autoimmunity and Allergy; Congenital and acquired Immunodeficiency

Immunopathology of Bacterial, Viral and Parasitic Infections 5 hrs

Vaccinology 5 hrs
Overview of vaccine and vaccination, Types of vaccines- killed organism as a vaccine, Attenuated vaccine, Methods of attenuation, New experimental vaccines, Vaccine production techniques, Quality and efficacy, Adverse events following immunization, Recent developments and prospects

References
MB 503 Microbial Genetics and Molecular Biology

Course Title: Microbial Genetics and Molecular Biology
Course No.: MB 503
Nature of Course: Theory (3 credits)

Full Marks: 75
Pass Marks: 37.5
Semester: I

Objective
Upon the completion of the course students will have knowledge on
a. Microbial genetics and techniques and applications of molecular biology

Course Contents

Fundamentals on Genes, DNA, RNA, Genome and Genetics 2 hrs

DNA Recombination and Transfer in Prokaryote 3 hrs

DNA Replication 5 hrs
Molecular mechanism of DNA, Replication in prokaryotic and eukaryotic cells

Gene Expression 5 hrs
Molecular mechanism and stages of transcription in prokaryotes, viruses and bacteriophages, Post transcriptional modifications

Process of Protein Synthesis 5 hrs
Role of RNA and translation of the genetic code, Steps involved in translation, Post translational modification of proteins, Post translational modifications

Regulation of Gene Expression 5 hrs
Mechanism of Lac-operon and Trp operon, Control of gene expression at transcriptional, post transcriptional, translational and hormonal level

Mutations 5 hrs
Types of Mutation, Mutagenic agents: Physical, chemical and biological, Detection of mutants

Recombinant DNA Technology 8 hrs
Principle, procedures and mechanism of gene cloning, Sources of DNA for cloning, Restriction enzymes and their characteristics, Formation of the recombinant DNA, Cloning vectors, Expression vectors, Detection of the recombinant DNA, Cloning of the eukaryotic genes in bacteria

Molecular Techniques 7 hrs
Extraction and purification of plasmid and chromosomal DNA and RNA, Principle, procedures and applications of PCR based techniques and blotting techniques in Microbiology: Plasmid profiling, PCR, Real time PCR, RFLP, DNA Finger printing, Western blotting, Southern blotting, Northern blotting, PFGE, Gene sequencing, DNA microarray
References
MB 504 Biochemistry and Biotechnology

Course Title: Biochemistry and Biotechnology                Full Marks: 75
Course No.: MB 504                                           Pass Marks: 37.5
Nature of Course: Theory (3 credits)                        Semester: I

Objectives
Upon completion of the course, students will have knowledge on
a. General and microbial biochemistry
b. Production, purification, and product recovery of industrial products of microbial origin

Course Contents

Biochemistry

Introduction to Biomolecules  2 hrs
Definition, classification, sources and function: Carbohydrates, Amino Acids and Proteins, lipids and fatty acids, and nucleic acids

Vitamins  3 hrs
Absorption, sources and functions: Fat-soluble vitamins, Water-soluble vitamins

Enzymology  2 hrs
Michaelis-Menten equation, Lineweaver- Burk equation, Enzyme inhibition: Competitive inhibition, non-competitive inhibition, uncompetitive inhibition

Metabolism of Carbohydrates  4 hrs
Metabolism of dietary carbohydrate, Pathway, metabolic regulation and significance: Glycogen metabolism, Glycolysis, Gluconeogenesis, Pentose phosphate pathway shunt, Uronic acid pathway, Metabolism of Disaccharides (sucrose, maltose, lactose)

Krebs Cycle  1 hr
Pathway, metabolic regulation and significance: Krebs cycle, Amphibolic role of cycle, Glyoxylate cycle

Oxidative Phosphorylation  1 hr
Pathway, metabolic regulation and significance: Electron transport chain and oxidative phosphorylation, Substrate level phosphorylation

Metabolism of Amino Acids  3 hrs
Metabolism of dietary proteins, Metabolism of ammonia, Biosynthesis of non-essential amino acids, Catabolism of essential amino acids, Pathway, metabolic regulation and significance: Urea cycle
Metabolism of Lipids 5 hrs
Metabolism of dietary lipids, Pathway, metabolic regulation and significance: Beta-Oxidation of fatty acids and energetic, Alpha-oxidation, Omega-oxidation, Biosynthesis of ketone bodies, Biosynthesis of saturated and unsaturated fatty acids, Biosynthesis of triacylglycerol

Metabolism of Nucleic Acids 2 hrs
Pathway, metabolic regulation and significance: Purine and pyrimidine nucleotide (De Novo and salvage pathways), Purine nucleotide interconversion, Formation of deoxyribonucleotides.

Biotechnology

Animal and Plant Biotechnology 4 hrs
Vector, Gene transfer techniques in plants (based on Ti and Ri Plasmid, Intermediate and helper plasmid, Binary vector, Virus as vector), Gene transfer techniques using Agrobacterium; Animal cell culture technology, Plant cell and tissue culture technology

Microbial Production, Purifications and Product Recovery of Metabolites and Fermented Foods 10 hrs
 Antibiotics (Benzyl Penicillin, Streptomycin), Vitamins (Riboflavin and vitamin B12) Amino acids (Glutamic acid, Lysine, Tryptophan), Nucleic acids, Organic acids (Citric acid, Lactic acid, Kojic acid), Enzymes (Amylase, Protease, Glucose isomerase), Alcoholic beverages (Wine, Beer, Distilled liquor-whisky), Fermented Foods (Kinema, Soya sauce, Natto, Kimchi), Single cell protein

Production and Product Recovery of 2 hrs
Human growth hormones, Interferon, Insulin

Types, Applications and Production Process of 3 hrs
Microbial bio-fertilizers (Rhizobium, Azotobacter, Bacillus, Cyanobacteria, VAM)

Types, Applications and Production Procedures of 3 hrs
Bacterial, Fungal and viral biopesticides and bioherbicides

References
MB 505 Practical on (MB 501 + MB 502)

Course Title: Practical on (MB 501+MB 502)  
Full Marks: 50
Course No.: MB 505  
Pass Marks: 25
Nature of Course: Practical (2 credits)  
Semester: I

Course Contents

**Advances in Microbiology**

**Bacterial Morphology**
1. Microscopy and staining

**Microbial Physiology**
2. Measurement of growth of bacteria
3. Enumeration techniques
4. Biomass determination
5. Determination of bacterial growth curve in broth medium
6. Effect of environmental factors on bacterial growth
7. Degradation experiments- Cellulose, Starch, Gelatin, Casein, Tween 80
8. Conventional biochemical testing for identification of Enterobacteriaceae family
9. Biochemical identification of unknown bacteria (Gram positive, Gram negative)
10. Antimicrobial susceptibility test

**Yeast, Mold and Actinomycetes**
11. Isolation, enumeration and morphological identification of yeast and molds
12. Growth of molds in different condition
13. Isolation and characterization of Actinomycetes

**Viruses**
14. Isolation and enumeration of bacteriophage
15. One step growth curve of bacteriophage

**Immunology**

1. Handling of laboratory animals
2. Animal inoculation techniques using different routes
3. Immunization of laboratory animals antiserum harvesting
4. Purification of immunoglobulins
5. In vitro serological tests
   - Precipitation (Gel: Single and Ouchterlony double diffusion)
   - Agglutination (Slide, Tube, Latex and Haemagglutination)
   - Neutralization test
   - ELISA
   - Immunelectrophoresis
   - Immunoflourescence technique
   - Immunochromatographic technique
- Complement fixation test
6. Hypersensitivity reactions (Montoux test, Allergy test)
7. Blood grouping from forensic samples
MB 506 Practical on (MB 503 + MB 504)

Course Title: Practical on (MB 503 + MB 504)  Full Marks: 50
Course No.: MB 506  Pass Marks: 25
Nature of Course: Practical (2 credits)  Semester: I

Course Contents

**Microbial Genetics and Molecular Biology**

1. Nucleus staining (Prokaryotic and Eukaryotic cells)
2. Nucleic acid Extraction- Extraction and purification of chromosomal and plasmid DNA from bacteria, Extraction and purification of DNA from yeast cells, Extraction and purification of RNA from Prokaryotic and Eukaryotic cells, Extraction of DNA from biological samples (viscera, body fluids, hair, skin, nails) for forensic analysis
3. Confirmation of DNA extraction by Agarose Gel Electrophoresis
4. DNA transformation experiments
5. Detection and isolation of mutants
6. Plasmid profiling, PCR, Blotting techniques

**Biochemistry and Biotechnology**

**Biochemistry**

1. Preparation of different solutions and buffer
2. Titration curves of amino acids
3. Qualitative tests for characterization of carbohydrates, proteins and lipids
4. Quantitative tests for characterization of carbohydrates, proteins and lipids
5. Identification of unknown carbohydrates
6. Isolation of protein
7. Study effect of pH, temperature and effectors on enzyme activity
8. Determination of enzyme kinetics Km and Vmax
9. Quantitative determination of blood sugar, cholesterol level, total protein, albumin
10. Determination of enzyme activities: ALT, GOT, amylase
11. Extraction of glycogen from liver
12. Separation of amino acids by single and double ascending paper chromatography
13. Separation characterization of sugars, amino acids and lipids by thin layer chromatography
14. Separation of amino acids and proteins by ion-exchange chromatography
15. Identification of drugs using chromatographic techniques for drug abuse cases, samples (blood, urine)
16. Analysis of serum proteins by Electrophoresis
17. Determination of molecular weight of proteins by SDS-PAGE
18. Purification proteins by Gel filtration
19. Analysis of biomolecules/bioactive compounds using colorimetry, spectrophotometry and fluorimetry
20. Analysis of body fluids (saliva, urine, blood, CSF, semen, tears) for forensic biology
Biotechnology

1. Isolation and identification of *Bacillus thuriengiensis* and purification of crystal protein
2. Production, purification and characterization of industrially important enzymes of microbial origin
3. Production, separation, partial purification and characterization of antimicrobial compounds from *Bacillus* spp. and actinomycetes
4. Production and purification of organic acids using microorganisms
5. Alcohol production and quality assessment
6. Forensic analysis of alcoholic and non-alcoholic beverages
7. Field visit to industries
## Discipline I: Public Health Microbiology

### Semester II

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<td>MB 552</td>
<td>Applied Environmental Microbiology</td>
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<td>MB 553</td>
<td>Fundamentals of Epidemiology</td>
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<td>MB 554</td>
<td>Microbial Systematics</td>
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MB 551 Human Anatomy and Physiology

Course Title: Human Anatomy and Physiology  Full Marks: 75
Course No.: MB 551  Pass Marks: 37.5
Nature of Course: Theory (3 credits)  Semester: II

Objectives
Upon completion of the course the students will be able to understand
a. Anatomy and physiology of various human organs and systems
b. Relationship of function and physiology of various anatomical structures with diseased conditions and infections

Course Contents

Musculoskeletal System  5 hrs
Skeleton: Definition, Basic functions, Types, Classification, Gross and microscopic anatomy,
Joints: Definition, Types and function, Muscles: Definition, Functions, Gross and microscopic anatomy

Gastro-Intestinal System  5 hrs
Different parts of the system, Functions, Gross and microscopic anatomy of the different parts,
Structure and functions of salivary glands, pancreas, liver and gall bladder

Respiratory System  5 hrs
Different parts of the system, Gross and microscopic anatomy of different parts of system,
functions of parts

Cardiovascular System  5 hrs
Gross and microscopic anatomy of different parts, functions of different parts

Blood, Reticuloendothelial and Immune System  5 hrs
Sites of formation of blood, Composition and functions of blood cells of blood and their functions, Blood grouping, Lymph and lymphatic vessels, Different organs of reticuloendothelial system, Gross microscopic anatomy and functions of the organs

Nervous System  5 hrs
Parts and function of the system, Gross structure and microscopic anatomy of nervous system,
Ventricular system and CSF and Meninges

Urinary System  4 hrs
Different organs of the system, Gross structure, Microscopic anatomy and functions of the organs, Mechanism of urine formation and its composition

Endocrine System  3 hrs
Definition, Different organs of the system, Functions of the organs
Sensory Organs
Different organs, Structure and functions of eye, ear, nose and tongue

Reproductive System
Different organs in male and female, Gross microscopic anatomy and functions of the organs

References
MB 552 Applied Environmental Microbiology

Course Title: Applied Environmental Microbiology                      Full Marks: 75
Course No.: MB 552                           Pass Marks: 37.5
Nature of Course: Theory (3 credits)               Semester: II

Objectives
Upon completion of the course, the students will have knowledge on
a. Principles, procedures and applications of methods used for water, soil, air and other environmental samples analysis
b. Drinking water microbiology, microbiology of solid waste and waste water, and on exploitation of environmental isolates of microorganisms in environmental biotechnology

Course Contents

Drinking Water Microbiology                       10 hrs
Safe water, Physico-chemical, Microbiological parameters of water quality, Indicators of water pollution, Water quality standards (WHO and Nepal standards), Water purification: Principle, Procedures, Removal of microorganisms, Principle and procedures of drinking water treatment: Large water supply systems (Multi barrier approach), Bottled and mineral water quality assurance

Water Microbiology and Water Pollution            5 hrs
Over view on water pollution: Sources of pollution of river and water bodies and consequences, Types of pollutants, Eutrophication, Removal methods, Rain water harvesting

Sewage and Industrial Effluents                   5 hrs
Composition of domestic waste, Sewage and industrial waste, Microbiology of sewage, Analysis of sewage and industrial effluents, Sewage treatment: Principles and procedures with references to removal of pollutants, Sludge treatment, Bioremediation

Solid Waste Management                           5 hrs
Characterization of biodegradable and non-biodegradable solid waste, Types of microorganisms, Solid waste management: Collection, transportation, disposal (sanitary landfill, composting) and recycling methods

Air Microbiology and Air Pollution                5 hrs
Effect of meteorological and geographical condition on fate of microorganisms in atmosphere, Sources of air pollution and consequences, Types of air pollutants (chemical and microbiological), Monitoring of air quality (bacteriological and particulate matters), Methods of air pollution control

Bioactive Compounds of Microorganisms             5 hrs
Biopesticides, Bacterial, viral and fungal pesticides, Mechanism of action and applications, Antifungal, Antibacterial and bioactive compounds of actinomycetes, Bacillus and Lactobacillus
Medical Entomology  
10 hrs
An introduction to medically important arthropods and rodents, Insect morphology, biology and classification based on larval habitats of the vectors of Malaria, Japanese encephalitis, Lymphatic filariasis, Dengue, Chikungunya and Leishmaniasis, Different techniques and sampling equipments and tools for vector surveillance of Genera Aedes, Anopheles, Culex and genus Phlebotomus, objectives, specimen preservation, collection maintenance, Rearing of vector mosquitoes, Preservation, Use of keys to identify the taxonomic characters of certain vector species, Insecticide susceptibility test for adult and larval mosquitoes, Types and mechanisms of transmission of vector-borne diseases, Vector competence and vectorial capacity, Factors affecting vector competence, Components of vectorial capacity, Entomological indices, The combined effects of climate change, climatic factors, weather events and other factors in key vectors and vector-borne diseases, Entomological and ecological factors influencing the abundance of Aedes (Stegomyia) aegypti (L.) and Aedes (Stegomyia) albopictus (Skuse) in urban environment, Current problems and research trends in medical entomology in Nepal, Integrated Vector Management (IVM), Elements and strategies of Integrated Vector Management.

References
MB 553 Fundamentals of Epidemiology

Course Title: Fundamentals of Epidemiology          Full Marks: 75
Course No.: MB 553              Pass Marks: 37.5
Nature of Course: Theory (3 credits)          Semester: II

Objectives
Upon the completion of the course students will have knowledge on
a. Fundamentals of epidemiology
b. Scope and applications of epidemiology of infectious diseases

Course Contents

Concept of Epidemiology          2 hrs
Definitions of epidemiology, branches of epidemiology, uses of epidemiology, scope and
approaches of epidemiology, differences of epidemiology and clinical medicine

Epidemiological Measurements        4 hrs
Health and disease, Indicators of health and disease, Frequency measures (Mortality, Morbidity,
Incidence, Prevalence, Incidence density), Measures of effect

Epidemiological Studies         15 hrs
Cross-sectional study, Longitudinal study, Descriptive epidemiology, Analytical epidemiology-
Case control and cohort studies, Experimental epidemiology, Randomized controlled trials,
Quasi-experimental studies, Bias and errors in epidemiological studies, Types and sources of
error, Selection and information bias, Confounding and effect modification, Screening: Criteria
of a screening test, Selection and validity of a screening test (sensitivity, specificity, positive
predictive value, negative predictive value, accuracy)

Health Survey and Surveillance        4 hrs
Definitions, Types and design of survey, Steps of survey, Disease surveillance systems, Disease
surveillance systems in Nepal

Outbreak Investigation          4 hrs
Concept of Epidemic, Endemic, Sporadic and pandemic, Outbreak investigation, Management of
disease outbreaks

Infectious Disease Epidemiology and Natural History of Disease   8 hrs
Sources and reservoir of infection, Modes of transmission, Epidemiological markers
(Phenotypic, Genotypic markers), Interactions of agent, Host and environment, Biological laws
of diseases, Causation, Prognosis, Risk factors, Establishing cause of disease

Management of Diseases          4 hrs
Disease prevention, Control, Elimination and eradication
Environmental and Occupational Epidemiology  2 hrs
Environment and health, Exposure and dose, Dose-effect and dose–response relationship, Risk assessment, Risk management

Concept of Clinical Epidemiology, Molecular Epidemiology, Social Epidemiology, Field Epidemiology  2 hrs

References
MB 554 Microbial Systematics

Course Title: Microbial Systematics
Course No.: MB 554
Nature of Course: Theory (3 credits)

Objective
Upon completion of the course the students will be able to understand
a. Microbiology and diagnosis of medically important bacteria, viruses, parasites and fungi

Course Contents

Bacteriology 18 hrs
Classification, structure, physiology, pathogenesis, medical importance and control of bacteria: Escherichia coli, Salmonella, Shigella, Campylobacter, Vibrio, Haemophilus, Klebsiella, Corynebacterium, Staphylococcus, Streptococcus, Clostridium, Neisseria, Treponema, Chlamydia, Mycoplasma, Mycobacterium, Bacillus

Virology 10 hrs
Classification, general properties, structure, medical importance and control of viruses: Rotavirus, Poxviruses, Herpes viruses, Adenoviruses, Picorna virus, Orthomyxovirus, Paramyxovirus, Arbovirus, Rhabdo viruses, Hepatitis virus, Retroviruses (HIV, HTLV etc), Emerging Viruses (SARS, Oncogenic virus), Structure, Classification and life cycle of Bacteriophages

Parasitology 10 hrs
Classification, general structure, life cycle, medical importance and control of parasites: Entamoeba, Giardia, Trichomonas, Plasmodium, Cryptosporidium, Cyclospora, Toxoplasma, Leishmania, Wuchereria, Blastocystis, Ascaris, Trichuris trichura, Taenia, Echinococcus, Hymenolepis nana, Fasciola hepatica, Schistosoma, Loaloha

Mycology 7 hrs
Classification, general structure, physiology, medical importance and control of fungi: Tinea, Aspergillus, Candida, Fusarium, Cryptococcus, Histoplasma, Trichophyton, Epidermophyton, Blastomyces, fungal toxins and allergens

References

MB 555 Practical on (MB 551 + MB 552)

Course Title: Practical on (MB 551 + MB 552) Full Marks: 50
Course No.: MB 555 Pass Marks: 25
Nature of Course: Practical (2 credits) Semester: II

Course Contents

**Human Anatomy and Physiology**

1. Anatomical observation of human skeleton and organ system
2. Microscopic observation of histological and anatomical slides
3. Experiments on human physiology

**Applied Environmental Microbiology**

1. Isolation and characterization of thermophiles, psychrophiles, halophiles, alkalophiles and acidophiles from different environments
2. Isolation and characterization of methanogenic bacteria and bio-gas production
3. Isolation and characterization of *Thiobacillus ferrooxidans* and *Thiobacillus thiooxidans*
4. Microbiological and physico-chemical analysis of sewage/industrial effluent and solid waste
5. Drinking water quality analysis (bottle water, jar water, tap water, underground water: deep boring, shallow water)-MPN, MF, total coliform count and faecal coliform count and confirmation
6. Determination of BOD and COD in river water
7. Assessment of microbiology of solid waste
8. Microbial degradation of aromatic hydrocarbon containing compounds
9. Experiments on bio leaching of metals and biotransformation of pesticides
10. Indoor and outdoor air quality analysis
11. Isolation, screening and characterization of cellulose degrading microorganisms
12. Isolation, screening and characterization of antifungal and antibacterial actinomycetes
13. Isolation, screening and characterization of pesticides degrading microorganisms
MB 556 Practical on (MB 553 + MB 554)

Course Title: Practical on (MB 553 + MB 554)  
Course No.: MB 556  
Nature of Course: Practical (2 credits)  
Full Marks: 50  
Pass Marks: 25  
Semester: II

Course Contents

**Fundamentals of Epidemiology**
1. Prepare a report describing the epidemiology of major infectious diseases of Nepal

**Microbial Systematics**
2. Isolation and identification of medically important bacteria by conventional biochemical techniques
3. Serotyping, bacteriophage typing, biotyping and molecular typing of common medically important bacteria
4. Antibiotic susceptibility testing of bacteria
5. Determination of MIC of antibiotics
6. Serological identification-test kits, ELISA
7. Preparation of specimen for virus culture and transport media for virus isolation
8. Tissue culture and egg inoculation technique for the isolation of common medically important viruses
9. Isolation of bacteriophages, enumeration, plaque assay, characterization
10. One step growth curve experiments
11. Preparation of high titre bacteriophage stocks
12. Fungal stains preparation and staining techniques
13. Preparation of various fungal culture media and sterilization
14. Fungal culture techniques
15. Isolation and characterization of medically important fungi from clinical and environmental samples
16. Isolation and characterization of dimorphic fungi
17. Microscopic observation of medically important protozoans and helminthic parasites- *Entamoeba, Giardia, Plasmodium, Leishmania, Taenia, Ascaris* etc.
18. Stool sample collection and processing for observation of parasites by microscopy
19. Occult blot test in the stool samples
20. Stool culture techniques
**Discipline I: Public Health Microbiology**

*Semester III*

<table>
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<tr>
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<th>Nature of Course</th>
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<td>MB 601</td>
<td>Research Methods and Biostatistics</td>
<td>T</td>
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<tr>
<td>MB 602</td>
<td>Public Health Microbiology</td>
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<td>MB 603</td>
<td>Emerging Infectious Diseases</td>
<td>T</td>
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<td>Public Health Laboratory</td>
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MB 601 Research Methods and Biostatistics

Course Title: Research Methods and Biostatistics                         Full Marks: 75
Course No.: MB 601                                                Pass Marks: 37.5
Nature of Course: Theory (3 credits)                                      Semester: III

Objectives
Upon the completion of the course students will have knowledge on
a. Research methods in microbiology
b. Application of biostatistical methods in microbiological research

Course Contents

Research Methods

Research Methods          15 hrs
Introduction and objectives of research, Criteria of good research question, Research process, Priority areas, Objectives/Hypothesis, Literature review, Critical appraisal, Meta analysis, Research designs, bias and errors in research, Ethical issues in research: Salient point of the NHRC guidelines, General ethical principles, Informed consent

Scientific Writing          5 hrs
Paper writing, Proposal writing, Thesis/report writing

Biostatistics

Sampling, Data Collection and Frequency Distribution          5 hrs
Sample and Sampling, Sampling design and Sample selection, Sample size and calculation, Qualitative and quantitative data collection methods, Binomial distribution, Poisson distribution, Normal distribution of data

Data Analysis and Computer Application          20 hrs
Quantitative data analysis (descriptive analysis, inferential analysis- chi square, t-test, ANOVA, correlation, 95% CI, Standard error, Odds ratio, p-value, Regression analysis), Data entry and data analysis using computer software (SPSS, STATA, SAS, Epi Info etc.)

References
MB 602 Public Health Microbiology

Course Title: Public Health Microbiology
Course No.: MB 602
Nature of Course: Theory (3 credits)

Objectives
Upon completion of the course the students will have knowledge on
a. Epidemiology, pathogenesis, microbiology of causative organisms of infectious diseases of public health concern
b. Laboratory diagnosis, prevention and control of infectious diseases of public health concern

Course Contents

Water Borne Infections 8 hrs
Overview on common water-borne diseases, Microbiology of causative agents, epidemiology, pathogenesis, laboratory diagnosis, prevention and control of hepatitis, cholera, typhoid, amoebiasis, giardiasis, poliomyelitis, diarrhea (bacterial and viral)

Air Borne Infections 8 hrs
Overview on common air-borne diseases, Microbiology of causative agents, epidemiology, pathogenesis, laboratory diagnosis, prevention and control of pneumonia, diphtheria, tuberculosis, influenza, measles

Food Borne Diseases 8 hrs
Concept on food borne infections and food intoxication, Microbiology of causative microorganisms, epidemiology, pathogenesis, laboratory diagnosis, prevention and control of staphylococcal, clostridial food poisoning, salmonellosis, campylobacteriasis, travelers diarrhoea and shigellosis

Vector Borne Diseases 8 hrs
Overview on common vector-borne diseases and their vectors, Microbiology of causative organisms, epidemiology, pathogenesis, laboratory diagnosis and prevention and control of visceral leishmaniasis, malaria, filariasis, Japanese encephalitis, dengue and West Nile virus and plague

Sexually Transmitted Infections (STIs) 8 hrs
Overview on common STIs, Microbiology of causative agents, epidemiology, pathogenesis, laboratory diagnosis and prevention and controls of syphilis, gonorrhoea, chlamydial infections, HIV, herpes, hepatitis viruses, trichomoniasis

Hospital Acquired Infection 5 hrs
Concept on common nosocomial infections, Disinfection procedures of hospital environment, equipments and materials, methods of disposal of infective hospital waste and laboratory materials, monitoring of sanitation in hospital environment
References
Objective
Upon completion of the course the students will have knowledge on
a. Current issues and controversies on prevention and control of infectious diseases

Course Contents

Microbial Threats, Epidemiological Investigations, Pathogenicity Research, Vaccine Development and Other Strategies Tried to Control Disease Emergence and Spread of Diseases 20 hrs

Epidemic and pandemic influenza/coronaviruses (Review of the impact of previous influenza pandemics, details of responses to the influenza pandemic); Vector-borne disease (History and status of global vector borne diseases, national disease concerns including West Nile virus, tick-borne diseases, and future issues of vector borne diseases); HIV/AIDS (Review of changing natural history of infection and disease, HIV drug resistance); Tuberculosis (Review of a new and re-emerging threat to global health, implications of TB on immunocompromised populations, MDR, XDR tuberculosis and monitoring of drug resistance); Emerging pathogens (Zika virus, SARS, Ebola, monkeypox, hantavirus, E. coli O157:H7, drug resistant hospital acquired pathogens-drug resistance mechanisms and recent resistance strains of E. coli, Staphylococcus aureus, Pseudomonas aeruginosa)

Population Growth and Linkage with Poverty and Infectious Diseases 2 hrs

Global Climate Change and Infectious Disease 3 hrs

Sanitation and Related Diseases 5 hrs
History, Status of water-borne diseases and global, local, national issues and interests and future issues on water borne infectious diseases, Water safety plan

Immunization and Anti-Infectives 5 hrs
Role of vaccines and anti-infectives in public health practice and clinical medicine, Vaccine research, Development and availability, Immunization schedules, Investigation of adverse events, Efficacy

Biosafety, Biosecurity, Bioterrorism 5 hrs
Overview, Biosafety, Biosecurity and bioterrorism, Smallpox and polio, Eradication programs and reality of infectious diseases eradication

Foodborne Diseases 5 hrs
Current status of food borne diseases, Health implications, Prevention and food safety
References
Research papers based course, journals, websites of organizations (WHO, CDC, NIH etc.)
MB 604 Public Health Laboratory

Course Title: Public Health Laboratory Full Marks: 75
Course No.: MB 604 Pass Marks: 37.5
Nature of Course: Theory (3 credits) Semester: III

Objective
Upon completion of the course the students will have knowledge on
a. Laboratory diagnosis of infectious diseases of public health concern.

Course Contents

Laboratory Safety and Quality Control 2 hrs
Laboratory organization and quality control of Microbiology laboratory and laboratory safety

Common Diagnostic Methods of Identification and Typing of Bacteria 10 hrs
Principle and procedures of diagnostic methods, Conventional identification methods, Microscopic methods, Serological methods, Typing methods, Methods for testing antimicrobial susceptibility

Laboratory Diagnosis of Various Clinical Conditions 10 hrs
Selection, collection and transport of specimen for microbiological examination, Conventional and rapid diagnosis methods for: Bacterimia, Septicemia, Pyrexia, Meningitis, Respiratory tract infection (Lower and Upper), Urinary tract infection, Gastrointestinal tract infection, Food poisoning, Cholera, Genital Tract Infections: Bacterial vaginosis, Pelvic Inflammatory Disease (PID), Sexually transmitted infections, Eye Infection, Ear Infection, Oral Infections, anaerobic infection of oral cavity, Gas gangrene, Tuberculosis and Leprosy

Laboratory Diagnosis of Viral, Parasitic and Fungal Infections 17 hrs
Specimens, methods for diagnosis of parasite, virus and fungal infections

Molecular Methods for Disease Diagnosis 3 hrs

Field Level Laboratory Testing Requirements 3 hrs

References
MB 605 Practical on (MB 602)

Course Title: Practical on (MB 602)  Full Marks: 50
Course No.: MB 605  Pass Marks: 25
Nature of Course: Practical (2 credits)  Semester: III

Course Contents

1. Laboratory diagnosis of vector borne diseases and identification of common insect vectors
2. Laboratory diagnosis of cholera
3. Laboratory diagnosis of enteric fever by blood culture
4. Laboratory diagnosis of gastrointestinal tract infection by stool culture
5. Sputum culture and microscopy
6. Laboratory diagnosis of blood and tissue parasites- preparation of thick and thin smear of blood sample, staining and detection of blood and tissue parasites
7. Use of rapid test kits for the diagnosis of infectious diseases- malaria, visceral leishmaniasis, filariasis, HIV, Hepatitis B, Rota virus
Course Title: Practical on (MB 603 + MB 604)  
Course No.: MB 606  
Nature of Course: Practical (2 credits)  
Full Marks: 50  
Pass Marks: 25  
Semester: III

Course Contents
1. Laboratory diagnosis of enteric fever by blood culture  
2. Laboratory diagnosis of gastrointestinal tract infection by stool culture  
3. Throat swab culture  
4. Sputum culture and microscopy  
5. Pus culture  
6. Culture of vaginal swabs  
7. Microscopy of Treponema  
8. Laboratory diagnosis of eye infections  
9. Laboratory diagnosis of ear infections  
10. Physiological and molecular detection of ESBL, MBL, MDR pathogens  
11. Analysis of effects of climate, population growth, poverty on infectious diseases (malaria, cholera, tuberculosis, HIV infection, vectors, JE, and other emerging diseases)
Discipline I: Public Health Microbiology

Semester IV

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S/US- Satisfactory (Pass)/unsatisfactory (Fail)
MB 651 Hospital/Field based Internship

Course Title: Hospital/Field based Internship
Course No.: MB 651
Nature of Course: Practical (8 credits)

Full Marks: X
Pass Marks: S/US
Semester: IV

Objectives

Upon completion of the internship, students will be able to
a. Develop hands on skills of microbiology laboratory
b. Understand laboratory protocols and procedures
c. Understand recording and reporting of laboratory/public health data

Course Description

Student will do at least six month internship in relevant hospital/District (Public) Health Office and above or other relevant microbiology laboratories. The letter/certificate of internship from the internship institution and report of the internship in prescribed format of the department/campus/college should be submitted by the student after completion of the internship.
MB 652 Dissertation

Course Title: Dissertation   Full Marks: 200
Course No.: MB 652             Pass Marks: 100
Nature of Course: Laboratory based Research Project (8 credits)   Semester: IV

Objectives
Upon the completion of dissertation the students will
a. Have knowledge and skills to conduct original scientific research
b. Have deep understanding of research methods related to Microbiology
c. Be able to design an experiment, generate, analyze scientific data and conclude important findings
d. Develop scientific writing and presentation skills

Course Description

Individual students will be assigned relevant research topics related to their field of study by concerned central department/campus/college. Students will perform required field work and laboratory experiments within this semester. The research will be supervised by faculty member(s) of microbiology of concerned central department/campus/college. Students should submit research proposal on assigned topic within first week of this semester and must be approved by the institutional review board. After completion of research work, the student should write the dissertation/thesis in standard format on the basis of data/findings generated during the research works. The student will submit required number of copies of their dissertation to concerned department/campus/college for evaluation. The submitted dissertation will be approved by head of the central department/campus chief/coordinator. On the recommendation of head of department/campus chief/coordinator, the Institute of Science and Technology will appoint a related expert as an external examiner from the panel of approved examiners to evaluate the submitted dissertation. On the recommendation of external examiner, viva-voce open defense will be organized for evaluation of dissertation by concerned department/campus/college. The final evaluation of dissertation will be made by a panel of external and internal examiners, head of the department and supervisor(s). Students will be encouraged to publish the dissertation findings in peer reviewed microbiology journals in the form of original research article.
## Discipline II: Medical Microbiology

### Semester II

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MB 551 Human Anatomy and Physiology

Course Title: Human Anatomy and Physiology
Course No.: MB 551
Nature of Course: Theory (3 credits)
Full Marks: 75
Pass Marks: 37.5
Semester: II

Objectives
Upon completion of the course the students will be able to understand
a. Anatomy and physiology of various human organs and systems
b. Relationship of function and physiology of various anatomical structures with diseased conditions and infections

Course Contents

Musculoskeletal System 5 hrs
Skeleton: Definition, Basic functions, Types, Classification, Gross and microscopic anatomy,
Joints: Definition, Types and function, Muscles: Definition, Functions, Gross and microscopic anatomy

Gastro-Intestinal System 5 hrs
Different parts of system, Functions, Gross and microscopic anatomy of the different parts, Structure and functions of salivary glands, pancreas, liver and gall bladder

Respiratory System 5 hrs
Different parts of system, Gross and microscopic anatomy of different parts of system, Functions of parts

Cardiovascular System 5 hrs
Gross and microscopic anatomy of different parts, Functions of different parts

Blood, Reticuloendothelial and Immune System 5 hrs
Sites of formation of blood, Composition and functions of blood cells of blood and functions, Blood groups, Lymph and lymphatic vessels, Different organs of reticuloendothelial and system, Gross, microscopic anatomy and functions of the organs

Nervous System 5 hrs
Parts and function of system, Gross structure and microscopic anatomy of nervous system, Ventricular system and CSF, Meninges

Urinary System 4 hrs
Different organs of system, Gross structure, Microscopic anatomy and functions of the organs, Mechanism of urine formation and its composition

Endocrine System 3 hrs
Definition, Different organs of the system, Functions of the organs
Sensory Organs
Different organs, Structure and functions of eye, ear, nose and tongue

Reproductive System
Different organs in male and female, Gross microscopic anatomy and functions of the organs

References
MB 557 Systemic and Diagnostic Bacteriology-1

Course Title: Systemic and Diagnostic Bacteriology-1 Full Marks: 75
Course No.: MB 557 Pass Marks: 37.5
Nature of Course: Theory (3 credits) Semester: II

Objectives
Upon the completion of the course students will have knowledge on
a. Structure, physiology, pathogenesis, isolation, characterization, identification and typing of medically important bacteria
b. Principles, procedures and applications of diagnostic methods useful to detect bacteria from clinical specimens

Courses Contents

Laboratory Safety and Quality Management 5 hrs
Laboratory organization and biosafety requirements of Microbiology laboratory, Quality control and management of Microbiology laboratory, Concepts of biosecurity, Bioterrorism

Methods of Identification and Typing of Bacteria 7 hrs
Principles and procedures of different diagnostic methods: Conventional identification methods including morphological, cultural and biochemical properties, Microscopic methods, Rapid and automated methods, Serological methods. Typing methods: Principle, procedure and application of biotyping, serotyping, phagetyping, Molecular typing methods, Methods for testing antimicrobial susceptibility –Kirby Bauer disc diffusion method, MIC determination, ESBL testing

Selection, Collection, Transportation and Processing of Specimens for Conventional and Rapid Laboratory Diagnosis of Bacterial Infections 5 hrs

Classification, Structure, Physiology, Pathogenesis, Medical Importance and Laboratory Diagnosis of Aerobic/Microaerophilic Gram Negative Rods and Cocci 8 hrs
Campylobacter, Helicobacter, Brucella, Legionella, Neisseria, Branhamella, Acinetobacter, Bordetella and Psuedomonas

Facultative Anaerobic Gram Negative Rods 8 hrs
Salmonella, Shigella, Yersinia, Vibrio, Aeromonas, Escherichia, Citrobacter, Enterobacter, Klebsiella, Proteus and Haemophilus

Gram Positive Cocci 3 hrs
Micrococcus, Staphylococcus, Streptococcus, Peptococcus, Peptostreptococcus and other bacteria

Gram Positive Endospore Forming Rods and Cocci 2 hrs
Bacillus, Clostridium and other bacteria
Clinical Manifestation and Laboratory Diagnosis

Respiratory tract infection, Urinary tract infection, Gastrointestinal tract infection: Cholera and other diarrhoeal diseases, food poisoning, Gonorrhoea, Gas gangrene, Peptic ulcer, Enteric fever

References
1. Baron EJ, Peterson LR and Finegold SM (1990), Bailey and Scott’s Diagnostic Microbiology, Mosby
MB 558 Systemic and Diagnostic Virology-1

Course Title: Systemic and Diagnostic Virology-1 Full Marks: 75
Course No.: MB 558 Pass Marks: 37.5
Nature of Course: Theory (3 credits) Semester: II

Objectives
Upon the completion of the course students will have knowledge on
a. Structure, physiology, pathogenesis, isolation, characterization and identification of medically important viruses
b. Principles, procedures and applications of diagnostic methods useful to detect viruses from clinical specimens

Course Contents

Techniques of Diagnostic Virology 10 hrs
Cultivation and purification of viruses, Principles and applications of serodiagnostic methods: haemagglutination and haemagglutination inhibition tests, complement fixation, neutralization, western blot, RIPA, flowcytometry and immunohistochemistry, Nucleic acid based diagnosis: Nucleic acid hybridization, polymerase chain reaction, microarray and nucleotide sequencing, Microscopic techniques: Fluorescence, confocal and electron microscopic techniques

Selection, Collection, Transportation and Processing of Specimens for Laboratory Diagnosis of Viral Infections 8 hrs

Classification, Structure, Physiology, Pathogenesis, Medical importance, Control and laboratory Diagnosis of Poxviruses 2 hrs
Smallpox virus

Herpesviruses 7 hrs
Alphaherpesviruses Herpes Simplex and Varicella Zoster, Betaherpesviruses, Cytomegaloviruses, Human herpesviruses 6 and 7, Gammaherpesviruses Epstein Barr viruses

Picornaviruses 2 hrs

Orthomyxovirus 3 hrs
Influenza virus

Paramyxoviruses 3 hrs
Measles virus, Mumps virus, Human parainfluenza viruses, Human respiratory syncytial virus

Arboviruses 5 hrs
Togaviridae and Flaviridae (Dengue virus, Japanese encephalitis virus, Yellow fever virus)

Retroviruses 5 hrs
HIV and HTLV
References
MB 559 Systemic and Diagnostic Parasitology

Course Title: Systemic and Diagnostic Parasitology  
Course No.: MB 559  
Nature of Course: Theory (3 credits)  
Full Marks: 75  
Pass Marks: 37.5  
Semester: II

Objectives
Upon the completion of the course students will have knowledge on
a. Structure, physiology, pathogenesis, isolation, characterization and identification of medically important parasites
b. Principles, procedures and applications of diagnostic methods useful to detect parasites from clinical specimens

Course Contents

Parasites, Parasitism, Host Relations, Parasitic Diseases Prevalent in Nepal and World  
2 hrs

Structure, Life Cycle, Pathogenesis, Laboratory Diagnosis, Including Enumeration of Important Human Parasite  
25 hrs

Lumen dwelling/intestinal protozoa: Amoebae: *Entamoeba histolytica*, Flagellates: *Giardia lamblia*, *Trichomonas vaginalis*  
Intestinal Nematodes: *Ascaris lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale*, *Necator americanus*, *Strongyloides stercoralis*, *Enterobius vermicularis*  

Parasitic infections in the compromised host, Nosocomial and acquired parasitic infections, Immunology of parasitic infections, Medically important arthropods  
3 hrs

Diagnostic Procedures  
15 hrs
Collection, preservation and shipment of parasitological specimens for laboratory diagnosis of parasites, Macroscopic and microscopic examination of specimens, Techniques for processing and examination of stool, urogenital specimens, sputum, blood, aspirates and biopsy material. Parasite recovery: Culture methods, animal inoculation and xenodiagnosis, Fixation and special preparation of fecal parasite specimens and arthropods, Artifacts that confused with parasitic organisms, Equipment, Supplies, Safety and quality assurance recommendations for a diagnostic parasitology laboratory
References

MB 560 Practical on (MB 551+MB 557)

Course Title: Practical on (MB 551+MB 557)        Full Marks: 50
Course No: MB 560                Pass Marks: 25
Nature of Course: Practical (2 credits)            Semester: II

Course Contents

Human Anatomy and Physiology

1. Anatomical observation of human skeleton and organ system
2. Microscopic observation of histological and anatomical slides
3. Experiments on human physiology

Systemic and Diagnostic Bacteriology-1

1. Isolation and identification of medically important facultative anaerobic and microaerophilic bacteria following conventional culture methods
2. Serotyping, and molecular typing of medically important bacteria
3. Antibiotic susceptibility testing of the bacterial isolates in above experiments
4. Serological/Immunological tests for detection of bacterial infections-
   ▪ RPR
   ▪ TPHA
   ▪ ASO titre
   ▪ Widal test
   ▪ Direct/Indirect immunofluorescence test
   ▪ precipitation test
   ▪ Mantoux test
   ▪ ELISA
   ▪ Western blot
   ▪ CFT
   ▪ RIA
5. Laboratory diagnosis of enteric fever
6. Laboratory diagnosis of GIT infections including cholera, diarrhea, dysentery, peptic ulcer
7. Laboratory diagnosis of upper and lower respiratory tract infection
8. Laboratory diagnosis of urinary tract infection
9. Laboratory diagnosis of STI including, gonorrhea, syphilis
10. Investigation of nosocomial infections in hospital environment, detecting the point sources of infection
MB 561 Practical on (MB 558 + MB 559)

Course Title: Practical on (MB 558 + MB 559)          Full Marks: 50
Course No.: MB 561                                      Pass Marks: 25
Nature of Course: Practical (2 credits)              Semester: II

Course Contents

**Systemic and Diagnostic Virology-1**

1. Propagation of viruses: Tissue culture and egg inoculation technique for the isolation of common medically important viruses, Routes of inoculations in embryonated eggs
2. Preparation of virus stocks: Plaque assay and determination of TCID50
3. Detection of virus/viral gene/viral antigen/antiviral antibody by ELISA, Immunofluorescence assay, Haemagglutination, Agar gel diffusion, Polymerase Chain Reaction
4. Use of rapid test kits for the diagnosis of viruses
5. Demonstration of Electron Microscopy
6. Preparation of high titre bacteriophage stocks and one step growth curve experiments

**Systemic and Diagnostic Parasitology**

1. Microscopic observation of medically important protozoans and helminthic parasites- *Entamoeba, Giardia, Plasmodium, Leishmania, Taenia, Ascaris* etc.
2. Stool sample collection and processing for observation of parasites by microscopy, Copro-Antigen detection (intestinal parasites)
3. Occult blood testing in the stool sample
4. Laboratory diagnosis of blood and tissue parasites- preparation of thick and thin smear of blood sample, staining and detection of blood and tissue parasites
   - Malaria
   - Kala-azar (Visceral leishmaniasis)
   - Lymphatic filariasis
5. Laboratory diagnosis of vector borne diseases and identification of common insect vectors
   - Mosquitoes: *Anopheles, Aedes, Culex*
   - Sand flies: *Phlebotomus*
6. Culture and enumeration of intestinal and blood parasites for research purpose
7. Fixation of slides containing parasitic specimens for referral
8. Packaging of parasitic specimens for transportation following IATA regulation for referral
9. Molecular techniques in diagnosis of parasitic infections
10. Modern rapid and ELISA based techniques used in the sero-diagnosis of parasitic infections
## Discipline II: Medical Microbiology

### Semester III

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<td>Systemic and Diagnostic Mycology</td>
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MB 601 Research Methods and Biostatistics

Course Title: Research Methods and Biostatistics  Full Marks: 75
Course No.: MB 601           Pass Marks: 37.5
Nature of Course: Theory (3 credits)  Semester: III

Objectives
Upon the completion of the course students will have knowledge on
a. Research methods in microbiology
b. Application of biostatistical methods in microbiological research

Course Contents

Research Methods

Research Methods  15 hrs
Introduction and objectives of research, Criteria of good research question, Research process,
Priority areas, Objectives/Hypothesis, Literature review, Critical appraisal, Meta analysis,
Research designs, bias and errors in research, Ethical issues in research: Salient point of the
NHRC guidelines, General ethical principles, Informed consent

Scientific Writing  5 hrs
Paper writing, Proposal writing, Thesis/report writing

Biostatistics

Sampling, Data Collection and Frequency Distribution  5 hrs
Sample and Sampling, Sampling design and Sample selection, Sample size and calculation,
Qualitative and quantitative data collection methods, Binomial distribution, Poisson distribution,
Normal distribution of data

Data Analysis and Computer Application  20 hrs
Quantitative data analysis (descriptive analysis, inferential analysis- chi square, t-test, ANOVA,
correlation, 95% CI, Standard error, Odds ratio, p-value, Regression analysis), Data entry and
data analysis using computer software (SPSS, STATA, SAS, Epi Info etc.)

References
1. Daniel WW (2004), Biostatistics: A Foundation for Analysis in the Health Sciences, 8th
   Edition, Wiley
2. Mahajan BK (2007), Methods in Biostatistics for Medical Students and Research Workers,
   Jaypee Brothers Medical Publishers Pvt. Ltd, India
Objectives
Upon the completion of the course students will have knowledge on
a. Structure, physiology, pathogenesis, isolation, characterization, identification and typing of medically important bacteria
b. Principles, procedures and applications of diagnostic methods useful to detect bacteria from clinical specimens

Course Contents

Classification, Structure, Physiology, Pathogenesis, Medical Importance and Laboratory Diagnosis of Gram Negative Rods and Cocci 7 hrs
Acetobacter, Kingella, Moraxella, Comomonas, Alcaligens, Francisella, Providencia, Gardenella, Pleisomonas, Hafnia, Morganella, Serratia, Pasteurella and other bacteria

Gram Negative Anaerobic Rods and Cocci 2 hrs
Bacteroides, Veillonella and other bacteria

Gram Positive Non Sporing Rods 3 hrs
Lactobacillus, Listeria, Corynebacterium and other bacteria

Actinomycetes, Nocardia and Related Bacteria 2 hrs

Mycobacterium 4 hrs
Mycobacterium tuberculosis, MOTT, Mycobacterium leprae

The Spirochaetes: Leptospira, Treponema, Borrelia 4 hrs

Rickettsia: Coxiella, Riketssia, Chlamydia 4 hrs

Mycoplasma 1 hr

Clinical Manifestation and Laboratory Diagnosis 15 hrs
Genital tract infections-Bacterial vaginosis, Pelvic Inflammatory Diseases (PID), Sexually transmitted infections- Syphilis, Chlamydial infection, Eye infection, Ear infection, Oral infections: Mandibular abscess, Gingivitis, and anaerobic oral infections, Tuberculosis, Leprosy, Bacteremia, Septicemia (Meningitis, Endocarditis)

Emerging Bacterial Diseases, Bioterrorism, Biosecurity 3 hrs
References
1. Baron EJ, Peterson LR and Finegold SM (1990), *Bailey and Scott’s Diagnostic Microbiology*, Mosby
3. Topley WWC and Wilson GS (1990), Parker MT and Collier LH (Editor), *Topley and Wilson’s Diagnostic Bacteriology*, Hodder Arnold.
MB 608 Systemic and Diagnostic Virology-2

Course Title: Systemic and Diagnostic Virology-2                                      Full Marks: 75
Course No.: MB 608                                                               Pass Marks: 37.5
Nature of Course: Theory (3 credits)                                             Semester: III

Objectives
Upon the completion of the course students will have knowledge on
a. Structure, physiology, pathogenesis, isolation, identification and characterization of medically important viruses
b. Principles, procedures and applications of diagnostic methods useful to detect viruses from clinical specimens

Course Contents

Classification, Structure, Physiology, Pathogenesis, Medical Importance and Laboratory Diagnosis of
Rhabdoviruses                                        3 hrs
Hepatitis Viruses                                      5 hrs
Coronaviruses, Toroviruses and Arteriviruses              3 hrs
Human Enteric RNA Viruses                              2 hrs
Calciviruses and Astroviruses
Reoviruses, Rotaviruses, Orbiviruses and Coltiviruses     4 hrs
Adenoviruses, Parvoviruses, Papovaviruses               2 hrs
Bunyaviruses, Arenaviruses, Filoviruses                 3 hrs
Prions                                                   4 hrs
Emerging Viral Infections and Their Early Diagnosis     9 hrs

Immunoprophylaxis of Viral Diseases                    10 hrs
Types of viral vaccines, Vaccines recommended in Nepal, Other viral vaccines, Antiviral drugs

References
MB 609 Systemic and Diagnostic Mycology

Course Title: Systemic and Diagnostic Mycology  
Course No.: MB 609  
Nature of Course: Theory (3 credits)  
Full Marks: 75  
Pass Marks: 37.5  
Semester: III

Objectives
Upon the completion of the course students will have knowledge on
a. Structure, physiology, pathogenesis, isolation, characterization and identification of medically important fungi
b. Principles, procedures and applications of diagnostic methods useful to detect fungi from clinical specimens

Course Contents

Techniques of Diagnostic Mycology  
Direct microscopic examination and culture, Serological diagnosis, Histological diagnosis, Principles and applications of molecular methods in the diagnosis of fungal infections  
5 hrs

Selection, Collection, Transportation, Processing and Preservation of Specimens for Laboratory Diagnosis of Fungal Infections  
3 hrs

Laboratory Diagnosis of Fungal Diseases  
Cutaneous, Subcutaneous, Systemic, Opportunistic mycoses, Fungal sinusitis  
4 hrs

Classification, Structure, Physiology, Pathogenesis, Medical Importance, Control and Laboratory Diagnosis of
- Trichophyton, Epidermatophyton, Microsporum, Mycetoma, Chromoblastomycosis, Phaeohyphomycosis, Sporotrichosis, Zygomyces: Lobomycosis, Rhinosporidiosis  
12 hrs

Classification, Structure, Physiology, Pathogenesis, Medical Importance and Laboratory Diagnosis of
- Candida, Fusarium, Chromomycosis, Aspergillus, Cryptococcus, Blastomyces, Histoplasma, Cocciidioidomycosis, Paracoccidioidomycosis, Penicillium, Pneumocystis jirovecii infections  
16 hrs

Fungal Toxins and Allergies  
2 hrs

Antifungal Agents  
3 hrs
Potential targets and modes of action of antifungal agents, Antifungal agents in clinical practice, Susceptibility testing, Antifungal drug resistance, Monitoring antifungal therapy

References
Course Title: Practical on (MB 607)  
Course No: MB 610  
Nature of Course: Practical (3 credits)  

Course Contents

**Systemic and Diagnostic Bacteriology-2**

1. Isolation and identification of medically important anaerobic bacteria by conventional methods
2. Microscopic and culture methods for diagnosis of *Mycobacterium tuberculosis*
   - AFB staining: Ziehl-Neelsen, Rhodamine Auramine stain, etc
   - AFB culture: LJ media, Middle Brook, etc
   - Molecular diagnosis of *Mycobacterium*
3. Antibiotic susceptibility testing of anaerobic bacteria and *Mycobacterium*
4. Laboratory diagnosis of gas gangrene
5. Laboratory diagnosis of meningitis
6. Laboratory diagnosis of ocular infections
7. Laboratory diagnosis of ear infections
8. Laboratory diagnosis of oral/dental infections
9. Laboratory diagnosis of syphilis
MB 611 Practical on (MB 608 + MB 609)

Course Title: Practical on (MB 608 + MB 609)  
Course No: MB 611  
Nature of Course: Practical (2 credits)  
Full Marks: 50  
Pass Marks: 25  
Semester: III

Course Contents

**Systemic and Diagnostic Virology-2**

1. Laboratory diagnosis of HIV infection using rapid, ELISA and molecular methods
2. Laboratory diagnosis of HBV infection using rapid and ELISA methods
3. Laboratory diagnosis of HCV using rapid and ELISA methods
4. Laboratory diagnosis of Japanese encephalitis virus infection
5. Laboratory diagnosis of Dengue virus infection using rapid, ELISA and molecular methods
6. Laboratory diagnosis of Measles and Rubella viruses using ELISA methods

**Systemic and Diagnostic Mycology**

1. Preparation of fungal stains and performing the staining following the techniques
   - LPCB
   - KOH
2. Fungal culture including preparation of media for culture and preparation of sugar fermentation tests useful for identification of fungal organisms
3. Isolation and characterization of medically important fungi from clinical specimens
4. Isolation and characterization of dimorphic fungi
5. Fixation of slides containing fungal elements for referral
6. Packaging of parasitic and fungal specimens for transportation following IATA regulation for referral
7. Molecular techniques in diagnosis of fungal infections
8. Modern rapid and ELISA based techniques used in the diagnosis of fungal infections
## Discipline II: Medical Microbiology

### Semester IV

<table>
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<th>Nature of Course</th>
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<td>Hospital Based Internship</td>
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S/US- Satisfactory (Pass)/unsatisfactory (Fail)
MB 653 Hospital based Internship

Course Title: Hospital based Internship  
Course No.: MB 653  
Nature of Course: Practical (8 credits)

Objectives

Upon completion of the internship, the students will be able to
a. Develop hands on skills of clinical microbiology laboratory
b. Understand laboratory protocols and procedures
  c. Understand recording and reporting of laboratory data

Course Description

Student should do at least six month internship in relevant hospital or other relevant diagnostic microbiology laboratories. The letter/certificate of internship from the internship institution and report of the internship in prescribed format of the department/campus/college should be submitted by the student after completion of the internship.
Objectives
Upon the completion of dissertation the students will
a. Have knowledge and skills to conduct original scientific research
b. Have deep understanding of research methods related to Microbiology
c. Be able to design an experiment, generate, analyze scientific data and conclude important findings
d. Develop scientific writing and presentation skills

Course Description
Individual students will be assigned relevant research topics related to their field of study by concerned central department/campus/college. Students will perform required field work and laboratory experiments within this semester. The research will be supervised by faculty member(s) of microbiology of concerned central department/campus/college. Students should submit research proposal on assigned topic within first week of this semester and must be approved by the institutional review board. After completion of research work, the student should write the dissertation/thesis in standard format on the basis of data/findings generated during the research works. The student will submit required number of copies of their dissertation to concerned department/campus/college for evaluation. The submitted dissertation will be approved by head of the central department/campus chief/coordinator. On the recommendation of head of department/campus chief/coordinator, the Institute of Science and Technology will appoint a related expert as an external examiner from the panel of approved examiners to evaluate the submitted dissertation. On the recommendation of external examiner, viva-voce open defense will be organized for evaluation of dissertation by concerned department/campus/college. The final evaluation of dissertation will be made by a panel of external and internal examiners, head of the department and supervisor(s). Students will be encouraged to publish the dissertation findings in peer reviewed microbiology journals in the form of original research article.
## Discipline III: Food and Industrial Microbiology

### Semester II

<table>
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<td>Food Fermentation Technology</td>
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<td>3</td>
<td>75 (45+30)</td>
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<tr>
<td>MB 563</td>
<td>Food Biotechnology and Nutraceuticals</td>
<td>T</td>
<td>3</td>
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<td>MB 564</td>
<td>Advanced Food Microbiology</td>
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<td>MB 565</td>
<td>Food Safety Management and Toxicology</td>
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<td>MB 567</td>
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MB 562 Food Fermentation Technology

Course Title: Food Fermentation Technology  
Course No.: MB562  
Nature of Course: Theory (3 credits)  

Full Marks: 75  
Pass Marks: 37.5  
Semester: II

Objective
Upon completion of this course, the students will be able to
a. Understand the role, function, and implication of microorganisms in the bio-processing, preservation, safety and nutritional enrichment of food resources

Course Contents

Fermentation and Biochemical Engineering  
15 hrs
Principles of fermentation, Fermentation process, Bioengineering and Bioreactor Design: Basic concepts in Bioengineering: Dimensions and units, Equilibrium and rate, Coefficients for mass and heat transfer, Volumetric coefficient and mass balance, Bioreactor design, Batch, Fed-batch, Continuous culture, Solid state, Submerged fermentation, Fermentation system design, Sterilization for fermentation

Microbiology of Fermented Foods  
15 hrs
Production of cultures for food fermentation: General principles of culture maintenance and preparation (Bacterial cultures, Yeast cultures, Molds cultures), Indigenous food fermentation (microbiology, production, biochemical changes) and improvements: Fermented vegetables: Gundruk, Sinki, Tama, Sauerkraut; Milk products: Chhurpi, Yoghurt, Cheese; Alcoholic beverages: Cider, Brandy, Sake, Jaand, Rakshi, Chhyang; Soyabean products: Soya sauce, Miso, Tempe, Kinema, Natto, Sufu, Tofu

Food and Enzymes from Microorganisms  
6 hrs
Microorganisms as food: Fats from microorganisms, Baker’s yeast; EPS (Xanthan gum, dextran), Biofilms, Food flavour (diacetyl), Glucose isomerase

Isolation and Improvement of Industrial Microorganisms  
9 hrs
Bacteria: Lactic Acid Bacteria (Lactobacillus), Acetic acid bacteria (Acetobacter), Bacillus spp, E. coli; Yeast: Saccharomyces cerevisiae (in Murcha); Lipolytic and proteolytic microorganisms; Molds: Aspergillus oryzae, Aspergillus niger, Rhizopus spp, Microbial starters for food fermentation: Ragge, Luckpang, Bubod, Murcha, Koji, Nuruk

References
1. Banwart GJ (1987), Basic Food Microbiology, 1st Edition, SK Jain for CBS Publisher and distributors, Delhi
3. Carl SP (1979), Microbiology of Food Fermentations, AVI Publishing Company
5. Ayers JC, Mundt JO and Sandine WE (1980), Microbiology of Foods, WH Freeman and Company
MB 563 Food Biotechnology and Nutraceuticals

Course Title: Food Biotechnology and Nutraceuticals  
Course No.: MB 563  
Nature of Course: Theory (3 credits)  
Full Marks: 75  
Pass Marks: 37.5  
Semester: II

Objective
Upon completion of this course, the students will be able to
a. Use application of biotechnological techniques and tools for improvement of biotechnological food processes

Course Contents

History of Food Biotechnology  
10 hrs
History of food biotechnology, Tools of food biotechnology, Application of biotechnology for improvement of food products (dairy, winery, brewery, meat), GM foods (Plant and animal), GMOs (Production, uses and impacts), Evaluation of GM food, patenting

Functional Foods and Nutraceuticals  
15 hrs
Food and nutrition, Nutritional quality of foods, Lantibiotics, Probiotics, Prebiotics, Production of functional foods (dairy, meat, soya, fruit products), omega-3-fatty acids

Metabolic Engineering and Microbial Proteomics  
10 hrs
Comprehensive models, Regulation of metabolic pathways, Metabolic engineering, Metabolic pathway synthesis, Metabolic flux analysis, Metabolic control analysis, Proteomics of Corynebacterium glutamicum, Lactococcus lactis, Bacillus subtilis

Methods and Processes in Biotechnology  
10 hrs
Methods and application of molecular cloning, Analytical methods in structure elaboration of fermented products: Low molecular weight compounds (bioactive compound), qPCR, Microarrays, MALDI-TOF MS, DNA sequencer, Amino acid analyzer, Lyophilizer

References
2. Okafor N (2007), Modern Industrial Microbiology and Biotechnology, Science Publisher, USA
7. El-Mansi EMT, Bryce CFA, Demain AL and Allman AR (2009), Fermentation Microbiology and Biotechnology, CRC Boca Raton
MB 564 Advanced Food Microbiology

Course Title: Advanced Food Microbiology   Full Marks: 75
Course No.: MB 564   Pass Marks: 37.5
Nature of Course: Theory (3 credits)   Semester: II

Objectives
Upon completion of the course the students will be able to understand
a. Fundamental facts and principles of microbiology dealing with foods
b. Application of knowledge of food microbiology for assuring safe food supplies

Course Contents

Microorganisms Associated with Food         5 hrs
Types of microorganisms in food, Sources and survival, Growth of microorganisms and factors affecting growth

Food Contamination and Food Spoilage        15 hrs
Contamination and spoilage of sugars and sugar products, Fish and fish products, Dehydrated foods, Spices and other condiments, Canned foods, Milk and milk products, Meat and meat products, Poultry products, Eggs and egg products, Beverages, Fruit and fruit products, vegetables and vegetable products, Cereals and cereal products, Chocolate and confectionery

Predictive Food Microbiology               10 hrs
Primary Models, Secondary Models, Model Fitting and Uncertainty, Predictive Microbiology in Quantitative Risk Assessment, Predictive Mycology

Analytical Food Microbiology               15 hrs
Sampling techniques, Separation and concentration of samples, Culture methods, Electrical methods, ATP bioluminescence, Microscopy techniques: DEFT and flow cytometry, Immunological techniques: Immunochromatography, Enzyme linked immunofluorescent assays and agglutination techniques, ELISA: Genetic techniques: PCR, NASBA, Hybridization, Microarrays, Molecular subtyping methods, New biosensors for microbiological analysis of food

References
MB565 Food Safety Management and Toxicology

Course Title: Food Safety Management and Toxicology   Full Marks: 75
Course No.: MB 565   Pass Marks: 37.5
Nature of Course: Theory (3 credits)   Semester: II

Objectives
Upon completion of the course the students will be able to understand
a. Principle of food poisoning and diseases caused by microbial infection and intoxication
b. The mechanism and control measures food poisoning and contaminating microbes

Course Contents

**Food Safety Management Systems**  
5 hrs
Fundamentals and elements of food safety management system, Risk and control in food supply chain, Food assurance systems

**Food Poisoning and Disease**  
20 hrs
Food-borne infections and intoxication; Microbiology, Epidemiology, Pathogenesis, Laboratory diagnosis, Prevention and control of food poisoning by microorganisms: Bacterial food poisoning: *Staphylococcus, Listeria, Clostridium, Shigella, Bacillus cereus, Campylobacter, Salmonella, Escherichia coli, Vibrio, Yersinia enterocolitica*, Toxigenic fungi and mycotoxins, Foodborne viruses, Toxigenic algae, *Rickettsia*, Parasites, Spongiform encephalopathies and seafood toxicants

**Investigation of Food Borne Disease Outbreak**  
5 hrs
Epidemiology, Outbreaks of food poisoning, Field investigation of disease outbreak, Laboratory testing, Interpretation and application of results, Preventive measures

**Food Toxicology**  
10 hrs
Science, Principles and methodology of toxicology, Determination of Toxicants in Foods, Biotransformation, Toxic Phytochemicals, Analysis of Chemical Toxicants and Contaminants in Foods, Generation and Interpretation of toxicological data

**Food Adulteration**  
5 hrs
Detection of possible adulterants in food supply chain, Test kits and application in daily monitoring of food quality and safety

References
1. Helferich W and Winter CK (2001), *Food Toxicology*, CRC Press, USA
3. WHO/IPCS (2001), *Safety Evaluation of Certain Mycotoxins in Foods*
6. WHO/ IPCS (1990), *Principles for the Toxicological Assessment of Pesticide Residues in Food*
MB 566 Practical on (MB 562+MB 563)

Course Title: Practical on (MB 562+MB 563)  
Course No.: MB 566  
Nature of Course: Practical (2 credits)  
Full Marks: 50  
Pass Marks: 25  
Semester: II

Course Contents

1. Isolation and screening of fermentative yeast from murcha
2. Preservation of industrially important bacteria, yeast and molds
3. Preparation of Gundruk, Sauerkraut
4. Isolation and screening of lactic acid bacteria from indigenous fermented food
5. Preparation of yoghurt using pure culture of lactic acid bacteria
6. Preparation of \textit{tofu, kinema, jaand}
7. Immobilization of enzyme
8. Screening of probiotic lactic acid bacteria
9. Preparation of wine, cider
10. Screening of lactic acid bacteria for bacteriocin production
11. Preparation of functional foods
12. Identification of lactic acid bacteria using PCR
Course Title: Practical on (MB 564+MB 565)  
Full Marks: 50
Course No.: MB 567  
Pass Marks: 25
Nature of Course: Practical (2 credits)  
Semester: II

Course Contents

1. Determination of microbial quality of milk
2. Determination of microbial quality of cheese, yoghurt
3. Determination of microbial quality of meat and meat products
4. Determination of microbial quality of eggs
5. Determination of microbial quality of fruits and beverages
6. Isolation of internal flora from various dried foods
7. Water quality analysis
8. Screening of toxigenic *Aspergillus* spp
9. Qualitative and quantitative determination of aflatoxin using chromatography
10. Detection of *Salmonella* spp, *Clostridium perfringens*, *Bacillus cereus*, *Listeria* spp from various food
11. Isolate and identify various parasites from vegetables
12. Detection of various adulterants in milk
13. Determination of pesticide residue in food samples
### Discipline III: Food and Industrial Microbiology

#### Semester III

<table>
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<tr>
<th>Course code</th>
<th>Course Title</th>
<th>Nature of Course</th>
<th>Credits</th>
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<td>MB 601</td>
<td>Research Methods and Biostatistics</td>
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<tr>
<td>MB 612</td>
<td>Food Science and Nutrition</td>
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<td>MB 613</td>
<td>Food Processing and Preservation Technology</td>
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<tr>
<td>MB 614</td>
<td>Total Quality Management and Quality Assurance</td>
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<td>MB 615</td>
<td>Practical on (MB 612)</td>
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**Total** 16 400
MB 601 Research Methods and Biostatistics

Course Title: Research Methods and Biostatistics                              Full Marks: 75
Course No.: MB 601                                                        Pass Marks: 37.5
Nature of Course: Theory (3 credits)                                        Semester: III

Objectives
Upon the completion of the course students will have knowledge on
a. Research methods in microbiology
b. Application of biostatistical methods in microbiological research

Course Contents

Research Methods

Research Methods 15 hrs
Introduction and objectives of research, Criteria of good research question, Research process, Priority areas, Objectives/ Hypothesis setting, Literature review, Critical appraisal, Meta analysis, Ethical issues in research: Salient point of the international guidelines, General ethical principles, Informed consent

Scientific Writing 5 hrs
Paper writing, Proposal writing, Thesis/report writing (Seminar presentations)

Biostatistics

Sampling, Data Collection and Frequency Distribution 5 hrs
Sample and Sampling, Sampling design and Sample selection, Sample size and calculation, Qualitative and quantitative data collection methods, Frequency distribution

Data Analysis and Computer Application 20 hrs
Quantitative data analysis (descriptive analysis, inferential analysis- chi square, t-test, ANOVA, correlation, 95% CI, Standard error, Odds ratio, p-value, Regression analysis), Data entry and data analysis using computer software (SPSS, STATA, SAS, Epi Info etc.)

References
Objective
Upon completion of this course the students will be able to
a. Understand basic concepts of food engineering, food chemistry and human nutrition

Course Contents

Unit Operations 5 hrs
Fundamentals, Dimensions, Engineering units, Material balances, Energy balances, Thermodynamics

Food Chemistry 15 hrs
Introduction to the chemical, physical and biochemical properties of food, Carbohydrates, Proteins, Lipids, Vitamins, Minerals, Pigments and colors, Flavors, Food additives: Non nutritive sweeteners, Antioxidants, Food Emulsifiers, Pectin, Chelating agents, Preservatives; Food rheology and texture; Chemical and Biochemical changes in foods: Maillard reaction, Lipid oxidation, Enzymatic browning, Protein denaturation

Human Nutrition 25 hrs
Nutrition Science: Role of Macro and Micro nutrients on human health, Nutritional importance of different food groups, Loss of nutrients during food processing, Calculation of energy value of foods, NPU, BV, NPR, Anti nutritional compounds in foods

Nutrition Assessment: Nutritional Survey/ Assessment, Dietary assessment, Determining nutritional status, Nutrition during life stages, Nutritional requirement for general population, Basic of Menu Planning and Therapeutic diet, Microbial assessment of essential amino acids and vitamins

Clinical Nutrition: Malnutrition: Overnutrition (Obesity), Undernutrition, Causes of malnutrition, Nutrient Deficiency Disorders: PEM, VAD, IDA, IDD, Preventive measures

References
MB 613 Food Processing and Preservation Technology

Course Title: Food Processing and Preservation Technology  Full Marks: 75
Course No.: MB 613  Pass Marks: 37.5
Nature of Course: Theory (3 credits)  Semester: III

Objective
Upon completion of this course the students will be able to
a. Have knowledge and perform experiments dealing with preservation, processing and quality aspects of foods

Course Contents

**Principles of Food Preservation**  15 hrs
Control of microorganisms: Introduction, Control of microorganisms by retarding growth: Low temperature storage, Drying, Chemicals added to food, Control of microorganisms by destruction: Gas treatments, Heat treatment, Control of microorganisms by irradiation, Recent developments in food preservation technology: High pressure, Inactivation by High Intensity Pulsed Electric Field (HIPEF), Microwave, Ohmic heating, Hurdle technology

**Methods of Preservation of Food and Fruit Products**  20 hrs
Cereal grains and meals, Flour, Bread, Cakes and other bakery products, Biscuits, Crackers, Macaroni, Noodles, Pasta, Sucrose, Maple sap and syrup, Honey, Candy, Egg products, Poultry and poultry products, Milk and milk products, Meat and meat products, Fruit based products (jam, jellies, sauce, juices, marmalade, tomato paste) and Vegetable, Beverages

**Food Packaging**  10 hrs
Principle of food packaging, Food packing materials chemical and physical properties, Interaction between food and the packaging materials, Evaluation of packaging materials and system: Selection of packing materials including edible packaging materials, Modified atmospheric and flexible packaging materials, Shelf life evaluation of packaging products

References
1. Potter NP (1987), *Food Science*, CBS Pub, India
MB 614 Total Quality Management and Quality Assurance

Course Title: Total Quality Management and Quality Assurance
Full Marks: 75
Course No.: MB 614
Pass Marks: 37.5
Nature of Course: Theory (3 credits)
Semester: III

Objective

Upon completion of this course, the students will be able to
a. Understand quality system certification and quality assurance technique for improvement of quality and safety of food products

Course Contents

Quality Systems, Regulations and Certification 15 hrs

Quality Assurance and Food Sanitation and Hygiene 10 hrs
Principle of food quality control, Microbiology in food plant sanitation: Bacteriology of water, Sewage and waste treatment and disposal, Microbial quality of food products, Good Agriculture Practices (GAP), Good Hygienic Practice (GHP), Good Manufacturing Practice (GMP), Hazard Analysis of Critical Control Points (HACCP) and HACCP modules for perishable foods, Risk analysis: Risk assessment, Risk management and risk communication, Health of employees, Good Laboratory Practice (GLP), Principle of laboratory accreditation, Principle of reference material, Principle of quality assurance, Principle of quality auditing, Conventional systems

Total Quality Management (TQM) Principles 5 hrs
Evolution of TQM, TQM Models, Customer satisfaction, Customer perception of quality, Customer complaints, Service quality, Customer retention, Employee involvement, Motivation, Empowerment, Teams, Recognition and reward, Continuous process improvement, PDCA cycle

Statistical Process Control (SPC) 15 hrs
Control chart and importance, Procedures for creating X Bar and R charts, Procedures for constructing attribute charts, Chart patterns using control chart as quality management tool, Seven tools of quality, Pareto diagram, Scatter diagram, Ishikawa diagram, Implementation of quality control program, Six sigma, Samples: Sampling plans, Samples from different distribution, Sample size, Sampling technique, Types of samples, Types of inspection, Sampling risk
References
1. Lightfoot NF and Maier EA (1999), Microbiological Analysis of Food and Water: Guidelines for Quality Assurance, Elsevier Science
MB 615 Practical on (MB 612)

Course Title: Practical on (MB 612)  Full Marks: 50
Course No.: MB 615  Pass Marks: 25
Nature of Course: Practical (2 credits)  Semester: III

Course Contents

1. Calculation on mass balance for preparation of sugar syrup
2. Determination of chlorophyll, carotene from various food samples
3. Determination artificial colours in food
4. Analysis of fats and oils (acid value, saponification number, iodine value, peroxide value)
5. Determine protein content in food using Kjeldal
6. Calculation of energy value of food
7. Determination of BMI value
8. Determination of SO₂, Benzoic acid in food
9. Assay of amino acids and vitamins in food
10. Determination ascorbic acid, sugar content of fruit juice
MB 616 Practical on (MB 613+MB 614)

Course Title: Practical on (MB 613+MB 614)  Full Marks: 50
Course No.: MB 616  Pass Marks: 25
Nature of Course: Practical (2 credits)  Semester: III

Course Contents

1. Determination of D value of bacteria
2. Preparation of cake, jam, ketchup and their quality evaluation
3. Determination of water absorptiveness, NaCl, chemical resistance of packaging materials
4. Identification of various plastics
5. Shelf life evaluation of packaging products
6. Determination of fat, SNF, protein, lactose content in milk
7. Design HACCP module for pasteurized milk, meat and other perishable food product
8. Determination of moisture content, ash content, crude fat of food
9. Determination of antioxidants in food
Discipline III: Food and Industrial Microbiology

**Semester IV**

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<th>Course Title</th>
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S/US- Satisfactory (Pass)/unsatisfactory (Fail)
**MB 655 Industry based Internship**

Course Title: Industry based Internship  
Course No.: MB 655  
Nature of Course: Practical (8 credits)  
Full Marks: X  
Pass Marks: S/US  
Semester: IV

**Objectives**

Upon completion of the internship, the students will be able to
a. Develop hands on skills of microbiology laboratory
b. Understand laboratory protocols and procedures
c. Understand recording and reporting of food industries data

**Course Description**

Student will do at least six month internship in relevant food industries/institutions or other relevant food microbiology laboratories. The letter/certificate of internship from the internship institution and report of the internship in prescribed format of the department/campus/college should be submitted by the student after completion of the internship.
MB 656 Dissertation

Course Title: Dissertation                     Full Marks: 200
Course No.: MB 656                             Pass Marks: 100
Nature of Course: Laboratory based Research Project (8 credits)    Semester: IV

Objectives
Upon the completion of dissertation the students will
a. Have knowledge and skills to conduct original scientific research
b. Have deep understanding of research methods related to Microbiology
c. Be able to design an experiment, generate, analyze scientific data and conclude important findings
d. Develop scientific writing and presentation skills

Course Description

Individual students will be assigned relevant research topics related to their field of study by concerned central department/campus/college. Students will perform required field work and laboratory experiments within this semester. The research will be supervised by faculty member(s) of microbiology of concerned central department/campus/college. Students should submit research proposal on assigned topic within first week of this semester and must be approved by the institutional review board. After completion of research work, the student should write the dissertation/thesis in standard format on the basis of data/findings generated during the research works. The student will submit required number of copies of their dissertation to concerned department/campus/college for evaluation. The submitted dissertation will be approved by head of the central department/campus chief/coordinator. On the recommendation of head of department/campus chief/coordinator, the Institute of Science and Technology will appoint a related expert as an external examiner from the panel of approved examiners to evaluate the submitted dissertation. On the recommendation of external examiner, viva-voce open defense will be organized for evaluation of dissertation by concerned department/campus/college. The final evaluation of dissertation will be made by a panel of external and internal examiners, head of the department and supervisor(s). Students will be encouraged to publish the dissertation findings in peer reviewed microbiology journals in the form of original research article.
Discipline IV: Agriculture Microbiology

**Semester II**

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<td>MB 569</td>
<td>Soil Microbiology</td>
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<td>MB 570</td>
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<td>Soil Fertilizers</td>
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MB 568 Biological Control

Course Title: Biological Control
Course No.: MB 568
Nature of Course: Theory (3 credits)

Objectives
Upon completion of the course the student will be able to
a. Have detail knowledge about the soil borne microbial and nematode diseases of plant
b. Distinguish between pathogenic and deficiency disease in plant
c. Understand the mechanism of genetic trait transfer in soil borne and pathogenic microbes

Course Contents

Microbial Interaction 8 hrs
Interspecific relationship, Neutralism, Commensalism, Synergism, Antagonism, Mutualism, Parasitism, Competition, Ammensalism, Predation, Effects of Synchronism and Cometabolism in microorganisms

Biological Control of Pests 10 hrs
Introduction and origin of herbivores insects and importance of their management, Natural controls, Biological controls, Biorational controls, Biotechnological controls, Host plant resistance, Microbial controls, Rationale of biological control, Status and constraints of biological control works in Nepal, Major biocontrol agents of insect parasitoids, predators, pathogens and weed feeding arthropods, Approaches of biocontrol (inoculation, augmentation, inundation and conservation and encouragement), Desirable attributes of biocontrol agents, Biology of insect parasitoids within insect arthropods, Tritrophic interactions between crops, pests and biocontrol agents

Insect Pathogens 3 hrs
Important groups of insect pathogens, Major characteristics of insect pathogens (specific to insect pathogens)

Microbial Insecticides (Fungi) 4 hrs
Insect pathogenic fungi (*Metarhizium anisopliae*) and (*Beauveria bassiana*) useful against crop pests, Target insects, Mode of infection, General life cycle, Host symptoms, Major fungal based microbial insecticides (exotic and indigenous) useful to insect control

Microbial Insecticides (Bacteria) 4 hrs
Insect pathogenic bacteria (*Bacillus thuringiensis*), Target insects, Mode of infection, life cycle, Host symptoms, Major microbial insecticides based on insect bacteria

Microbial Insecticides (Virus) 4 hrs
Insect pathogenic virus (Nuclear polyhedrosis virus and granulosis virus), Target insects, Mode of infection, Host symptoms, Life cycle, Major microbial insecticides based on insect virus
Microbial Insecticides (Nematodes and Protozoa)  4 hrs
Insect pathogenic nematodes (Steinernematids and Heterorhabditis) and protozoa, Target insects, Mode of infection, Host symptoms, Major microbial insecticides based on insect nematodes and protozoa, Role of EPNs, Problem associated with EPNs uses

Approaches in Biological Control  8 hrs
Environmental friendly microbial and botanical products available in Nepal, Steps for quality control and improving biological control agents, Storage techniques and method of application and release of biocontrol agents, Types/Principles of biological control, Evaluation of natural enemies and pesticide selectivity: Introduction to pesticide selectivity, Pesticide side effects in natural enemies, Selective pesticide application, Some commercially available biocontrol agents and their places in Integrated Pest Management (IPM)

References
3. Singh RS (2001), Plant Diseases Management Principles and Practice, Science Publisher India
5. Naik MK and Devika Rani GS (2008), Advances in Soil-borne Plant Diseases, New India Publishing
7. Rangaswami G (1988), Soil-Plant-Microbe Interrelationship, Indian Phytopath 41: 165-172
**MB 569 Soil Microbiology**

**Course Title:** Soil Microbiology  
**Course No.** MB 569  
**Nature of Course:** Theory (3 credits)  
**Full Marks:** 75  
**Pass Marks:** 37.5  
**Semester:** II

**Objectives**

Upon completion of the course, the students will be able to

a. Understand the formation of soil
b. Have basic knowledge about the soil plant microbes inter-relationship
c. Have knowledge about the mineral transformation and residual pesticide in soil

**Course Contents**

**Properties of Soil**  
10 hrs  
Soil Quality: Elements of soil formation and laterization, Pseudolization, Physical and chemical properties of soil: Components of soil and their importance for plant and microbial growth (Mineral matter, Organic matter, Soil moisture, Soil atmosphere, O/R potential)

**Microbes in Soil**  
7 hrs  
Bacteria (*Actinomycetes* and others), Fungi, Algae, Bacteriophages, Protozoa, Nematodes

**Ecological Group of Microorganisms**  
5 hrs  
Based on oxygen requirement: aerobes, microaerophiles, anaerobes; Based on carbon source: autotrophs, heterotrophs; Based on temperature: psychrophiles, mesophiles, thermophiles, hyperthermophiles, super heterophiles, barophiles; Based on nutrition: saprophytism, parasitism, Symbiosis, Habitat, Ecological niche

**Decomposition of Different Components of Plants**  
7 hrs  
Decomposition of cellulose, hemicelluloses, pectin, inulin and lignin

**Plant Microbial Interactions**  
6 hrs  
Interaction in above ground parts: Destructive association- bacterial, algal, fungal, mycoplasma diseases; Beneficial association: phylloplane microflora, morphological and physiological characteristics of phylloplane microflora: nutrition, radiation, pH, temperature, floral part microflora, stem nodule

Interaction on below ground parts: Destructive association- bacterial, fungal, nematode diseases; Beneficial association: cyanobacterial, bacterial associative interaction, plant growth promoting rhizobacteria (PGPR); Legume rhizobium symbiosis; actinomycetes non-legume symbiosis; fungal symbiosis: mycorrhiza; Rhizosphere and rhizoplane microorganisms, increase microbial activity in rhizosphere, rhizosphere effect

**Biogeochemical Cycles**  
10 hrs  
Role of different soil microorganisms in Carbon, Nitrogen, Phosphorus and Sulphur cycles
References
Objectives
Upon completion of the course the student will be able to
a. Understand physiology of soil borne and pathogenic microorganisms
b. Understand contributing factors affecting growth of microbes in soil

Course Contents

Degradation of Pesticides, Insecticide, Herbicide and Fungicide in Soil 15 hrs
Process of degradation of pesticides, Insecticide, Herbicide and fungicide in soil and their effect on soil microbes, like Rhizobium and other in biogeochemical cycle
Degradation of DDT, Aldrin, Heptachlor, Lindane, Aliphatic acids, Phenylcarbamates, Phenylureas, Thiocarbamates, PCNB, Chloroneb, Murcurial fungicides
Degradation pathways, Detoxication, Degradation and conjugation formation with the steps (defusing, activation, detoxification, addition reaction and degradation reaction and transformation of 2-4-D)

Physiology and Biochemistry of Soil Microorganisms 5 hrs
Enzymes, nutrition, growth and multiplication of microbes: Pectinolytic, Lignolytic, Lipolytic, Cellulolytic enzymes of soil microbes

Factors Affecting Growth and Population of Microbes 10 hrs
Factors affecting growth of soil microbes in raining, Drought, Arid condition, Change of microbial population, Dominance in microbial flora according to climatic condition

Synthesis of Cell Constituents, Secondary Metabolites of Microbes Influencing Plant Growth 15 hrs
Carbohydrate, Protein and lipid synthesis, Indole acetic acid, Gibberellins, Cytokinins, Ethylene, Antibiotics, Toxins, Mycotoxins

References
1. Rangaswami G and Bagyarat DJ (2004), Agricultural Microbiology, Prentice Hall Private Ltd
2. Alexander M (1961), An Introduction to Soil Microbiology, Wiley Eastern Ltd
3. Tisdale SL, Nelson WL and Beaton JD (1985), Soil Fertility and Fertilizers, Macmillan Technology and Engineering
MB 571 Soil Fertilizers

Course Title: Soil Fertilizers
Course No.: MB 571
Nature of Course: Theory (3 credits)

Objectives
Upon completion of the course the student will be able to
a. Understand the effect and utilize the commercial inorganic, organic fertilizer and biofertilizer
b. Use organic green manuring for better yield of crop

Course Contents

Chemical Fertilizers 5 hrs
Use of commercial Nitrogen, Phosphorous and Potassium chemical fertilizers. Impact of indiscriminate use of these fertilizers on soil and crop plants

Biofertilizers 2 hrs
Importance of Biofertilizers in the present context

Microorganisms used in Biofertilizers 23 hrs

Organic Fertilizers 10 hrs
Farm Yard Manures, Night soil, Oil cakes, bone meal, aerobic and anaerobic composting, and vermicomposts

Different types of Green Manures 5 hrs
Leguminous and non leguminous green manuring plants, Azolla

References
1. Rangaswami G and Bagyaraj DJ (2004), Agricultural Microbiology, Prentice Hall Private Ltd
2. Tisdale SL, Nelson WL and Beaton JD (1985), Soil Fertility and Fertilizers, Macmillan Technology and Engineering
7. Singh RN (1961), The Role of Blue Green Algae in Nitrogen Economy of Indian Agriculture, ICAR. New Delhi
MB 572 Practical on (MB 568 + MB 569)

Course Title: Practical on (MB 568 + MB 569)                          Full Marks: 50
Course No.: MB 572                                                  Pass Marks: 25
Nature of Course: Practical (2 credits)                               Semester: II

Course Contents

1. Estimation of organic carbon in soil
2. Estimation of organic nitrogen, phosphorus in soil
3. Estimation soil texture by sieve method and water holding capacity
4. Isolation of nitrate reducers in soil
5. Isolation of fungal organism by buried slide technique
6. Estimation of total nitrogen by kit method
7. Isolation and identification of microorganisms from phyllosphere, rhizoplane and rhizosphere
8. Isolation of antibiotic producing microbes from soil
9. Isolation and identification of Bacillus thuringiensis from soil
10. Production of B. thuringiensis as a biological control agent
MB 573 Practical on (MB 570+MB 571)

Course Title: Practical on (MB 570+MB 571)  
Full Marks: 50
Course No.: MB 573  
PassMarks: 25
Nature of Course: Practical (2 credits)  
Semester: II

Course Contents

1. Screening and identification of cellulolytic organism in soil per gram of soil
2. Screening and identification of proteolytic organism in soil per gram of soil
3. Screening and identification of lipolytic organism in soil
4. Screening and identification of xylan degrading organism in soil
5. Isolation and identification of *Azotobacter* in soil
6. Evaluation of *Azotobacter* fixed nitrogen by Kjeldahl method
6. Isolation and identification of *Rhizobium* in soil
7. Evaluation of rhizobium by seed inoculation
7. Isolation and identification of *Mycorrhiza* in soil
8. Evaluation of effect of *Mycorrhiza* by inoculation
9. Isolation and identification of blue green algae in soil
10. Evaluation of blue green algae by pot method
11. Isolation and identification of *Actinomycetes* in soil
12. Evaluation of soluble phosphorus due to *Actinomycetes* by pot method
13. Isolation of amino acid producer from soil
**Discipline IV: Agriculture Microbiology**

**Semester III**

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<td>Research Methods and Biostatistics</td>
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<td>MB 617</td>
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<td>Applied Soil Microbiology</td>
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MB 601 Research Methods and Biostatistics

Course Title: Research Methods and Biostatistics                     Full Marks: 75
Course No.: MB 601                                                Pass Marks: 37.5
Nature of Course: Theory (3 credits)                               Semester: III

Objectives
Upon the completion of the course students will have knowledge on
a. Research methods in Microbiology
b. Application of biostatistical methods in microbiological research

Course Contents

Research Methods

Research Methods                    15 hrs
Introduction and objectives of research, Criteria of good research question, Research process,
Priority areas, Objectives/ Hypothesis setting, Literature review, Critical appraisal, Meta
analysis, Ethical issues in research: Salient point of the international guidelines, General ethical
principles, Informed consent

Scientific Writing                   5 hrs
Paper writing, Proposal writing, Thesis/report writing (Seminar presentations)

Biostatistics

Sampling, Data Collection and Frequency Distribution         5 hrs
Sample and Sampling, Sampling design and Sample selection, Sample size and calculation,
Qualitative and quantitative data collection methods, Frequency distribution

Data Analysis and Computer Application                20 hrs
Quantitative data analysis (descriptive analysis, inferential analysis- chi square, t-test, ANOVA,
correlation, 95% CI, Standard error, Odds ratio, p-value, Regression analysis), Data entry and
data analysis using computer software (SPSS, STATA, SAS, Epi Info etc.)

References
1. Daniel WW (2004), Biostatistics: A Foundation for Analysis in the Health Sciences,
   8th Edition, Wiley
2. Mahajan BK (2007), Methods in Biostatistics for Medical Students and Research Workers,
   Jaypee Brothers Medical Publishers Pvt. Ltd, India
MB 617 Microbial Inoculants in Agriculture, Livestock and Forestry

Course Title: Microbial Inoculants in Agriculture, Livestock and Forestry Full Marks: 75
Course No.: MB 617 Pass Marks: 37.5
Nature of Course: Theory (3 credits) Semester: III

Objectives
Upon completion of the course the student will be able to
a. Understand how to prepare microbial inoculants in mass scale
b. Carry out different methods of using the inoculants on seed and soil
c. Have knowledge of crop response to microbial inoculants

Course Contents

Importance of Microbial Inoculants in Agriculture, Livestock and Forestry 2 hrs

Types and Methods of Mass Production of Bacterial Inoculants 18 hrs
Azotobacter inoculants
Azospirillum inoculants
Rhizobial inoculants
Blue Green Algal inoculants
Mycorrhizal inoculants
Frankia inoculants

Methods of Inoculation 12 hrs
Liquid inoculants
Carrier based inoculants and choice of carriers
Seed inoculation
Soil inoculation
Nursery inoculation of forestry tree seedlings
Inoculation of pasture grasses for livestock developments
Factors affecting survival microbial inoculants

Crop Responses due to Different Microorganisms Inoculations on Agricultural Crops, Forest Trees and Livestock Pasture Grasses 13 hrs

References
7. Singh RN (1961), *The Role of Blue Green Algae in Nitrogen Economy of Indian Agriculture*, ICAR. New Delhi
MB 618 Applied Soil Microbiology

Course Title: Applied Soil Microbiology
Course No.: MB 618
Nature of Course: Theory (3 credits)

Objectives
Upon completion of the course the student will be able to
a. Understand the role of major soil flora and fauna in crop productivity
b. Apply the role of soil microorganisms in soil health
c. Conserve and exploit soil micro-organisms

Course Contents

Organic Waste Decomposition 10 hrs
Composition of litter, Carbon assimilation and immobilization, Organic waste dynamics in soil, Factors affecting organic matter decomposition – litter quality, temperature, aeration, soil pH, inorganic chemical moisture, microbial biomass as an index of soil fertility, soil fertility

Agriculture Waste Management and Bioconversion 25 hrs
Recycling of agriculture waste as fertilizer: organic compost, composting, factors affecting composting, role of compost; vermicomposting, process of vermicomposting

Recycling of agriculture waste as food: edible mushroom culture, fungi involved in mushroom culture – Agaricus spp., Volvoriella spp., process and practice of safe mushroom growing practice (free from toxic mushrooms); single cell protein, Microorganism used in SCP, production and factors affecting the manufacture of SCP

Recycling of agriculture waste as fuel: biogas, microorganisms involved in methanogenesis (biogas production), biogas production, factors affecting methane formation

Recycling of agriculture waste as feed: Single cell protein: Saccharomyces, Spirulina; production of SCP from agricultural waste

Microorganisms in Miscellaneous Roles 10 hrs
Microbiology of air in relation to crop disease, Microbiology of water in relation to crop disease, Insect microbiology: Beneficial insects in crop disease controls (Bugs, Praying Mantis), Microbiology of wood degradation and silage production, Microbiology of jute and hemp curing, Microbiology of deterioration of leather and other products

References
Course Title: Microbial Diseases and Agricultural Biotechnology  
Course No.: MB 619  
Nature of Course: Theory (3 credits)

Objectives 
Upon completion of the course the student will be able to 
a. Understand the use of biotechnology in agriculture  
b. Apply the biotechnology to identify microbial plant diseases 
c. Introduce to new techniques used in agricultural biotechnology

Course Contents

**Plant Viruses, Their Transmission and Detection**  5 hrs  
Tobamovirus group – Tobacco mosaic virus, Potex virus group – Potato virus X (PVX), Polyivirus group – potato virus Y (PVY), Tymovirus group – cucumber mosaic virus (CMV), Tomato spotted witt virus (TSWV), Cauliflower mosaic virus (CaMV), Potato leaf roll virus (polerovirus), Rice tungro virus, mosaic disease of sugarcane;  
Transmission of plant viruses: mechanical transmission, vegetative and graft transmission, pollen transmission, seed transmission, nematode transmission, fungal transmission, insect vector transmission, dodder transmission  
Effect of virus on plant: external and internal symptoms  
Viroids, virusoids and satellites

**Bacterial Plant Diseases and Detection**  8 hrs  
Characteristics, symptoms, identification and control of Fire blight of pome fruits, Soft rot of vegetables, Angular leaf spot of cucumber and cotton, Bacterial leaf blight of rice, Bacterial wilt of banana, Pierce's disease of grape, Citrus variegation chlorosis, Citrus greening disease

**Fungal Plant Diseases and Detection**  10 hrs  
Characteristics, symptoms, identification and control of Cereal rusts, Cereal smuts, Ergot of rye and wheat, Late blight of potato, Powdery mildew of grapes, Downy mildew of grapes and tobacco, Karnal bunt of wheat, Soyabean rust, Citrus black spot, Vascular wilt of banana.

**Nematodal Plant Diseases**  2 hrs  
Characteristics, symptoms, identification and control of Sugar beet cyst nematode, Soyabean cyst nematode, Burrowing nematode affecting bananas.

**Green Revolution**  2 hrs  
Green revolution, Benefits, disadvantages and limitations of green revolution

**Transgenic Plants**  3 hrs  
Genetically modified plants: Production of disease resistant and stress resistant plants

**Ecological Consideration in Release of Transgenic Plants**  2 hrs  
Public acceptance, Benefits of transgenic plants
Biosafety Issues  2 hrs
Biosafety issues in use of transgenic plants

Patents  2 hrs
National legislation, patents of indigenous microbes and plants

Tissue Culture  6 hrs
Explant culture, callus formation and culture, organogenesis, root culture, shoot culture, cell culture, somatic embryogenesis, protoplast culture

Indigenous Fermentation Products of Nepal  3 hrs

References
1. Dubey RC and Maheshwari DK (2013), A Textbook of Microbiology, S Chand
2. Subba Rao NS (2007), Soil Microbiology, Oxford Publications, New Delhi
3. Walia RK and Bajaj HK, Text Book on Introductory Plant Nematology
4. Dropkin VH, Introduction to Plant Nematolog,
8. Bhojwani SS and Dantu PK (2013), Plant Tissue Culture: An Introductory Text, Springer. India
Course Title: Practical on (MB 617 + MB 618)  
Full Marks: 50
Course No.: MB 620  
Pass Marks: 25
Nature of Course: Practical (2 credits)  
Semester: III

Course Contents

1. Identification and mass multiplication of selected Bacterial inoculants: *Azotobacter*, *Azospirillium*, *Azomonas*
2. Isolation and identification of *Rhizobium leguminosarum*, *R. trifolii*, *Bradyrhizobium japonicum*
3. Mass production techniques of selected Microbial inoculants: *Azotobacter*, *Azospirillum* and *R. trifolii*
4. Different types of carriers and their quality assessment
5. Preparation of carrier based inoculants
6. Study of inoculation response of bacterial fertilizers in laboratory
7. Study of inoculation response of bacterial fertilizers in pot cultures
8. Composting of garden waste
9. Vermicomposting kitchen wastes
10. Study of quality of different organic fertilizers
11. Mushroom culture
12. Production of single cell protein
MB 621 Practical on (MB 619)

Course Title: Practical on (MB 619)  
Course No.: MB 621  
Nature of Course: Practical (2 credits)  
Full Marks: 50  
Pass Marks: 25  
Semester: III

Course Contents

1. Detection of fungal disease in plant by macroscopic observation  
2. Study of symptoms of cereal, vegetable, fruit, legume diseases - Fungal  
3. Study of symptoms of cereal vegetable, fruit, legume diseases- Bacteria  
4. Study of symptoms of cereal vegetable, fruit, legume diseases – Nematodes  
5. Identification of stem, root, and leaf diseases of crops and vegetables  
6. Isolation of fungi from diseased plant  
7. Detection of fungal disease in plant by agar gel diffusion  
8. Detection of fungal disease in plant by ELISA  
9. Dot immunoblotting assay  
10. Tissue culture (meristem culture)
### Discipline IV: Agriculture Microbiology

**Semester IV**

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<td>MB 658</td>
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S/US- Satisfactory (Pass)/unsatisfactory (Fail)
MB 657 Agriculture based Internship

Course Title: Agriculture based Internship                          Full Marks: X
Course No.: MB 657                                               Pass Marks: S/US
Nature of Course: Practical (8 credits)                          Semester: IV

Objectives

Upon completion of the internship, the students will be able to
a.  Develop hands on skills of microbiology laboratory
b.  Understand laboratory protocols and procedures
   c.  Understand recording and reporting of agricultural data

Course Description

Student will do at least six month internship in relevant agriculture industry/institution or other
relevant agriculture microbiology laboratories. The letter/certificate of internship from the
internship institution and report of the internship in prescribed format of the
department/campus/college should be submitted by the student after completion of the
internship.
**MB 658 Dissertation**

**Course Title:** Dissertation  
**Course No.:** MB 658  
**Nature of Course:** Laboratory based Research Project (8 credits)  
**Full Marks:** 200  
**Pass Marks:** 100  
**Semester:** IV

**Objectives**

Upon the completion of dissertation the students will

a. Have knowledge and skills to conduct original scientific research
b. Have deep understanding of research methods related to Microbiology

a. Be able to design an experiment, generate, analyze scientific data and conclude important findings
b. Develop scientific writing and presentation skills

**Course Description**

Individual students will be assigned relevant research topics related to their field of study by concerned central department/campus/college. Students will perform required field work and laboratory experiments within this semester. The research will be supervised by faculty member(s) of microbiology of concerned central department/campus/college. Students should submit research proposal on assigned topic within first week of this semester and must be approved by the institutional review board. After completion of research work, the student should write the dissertation/thesis in standard format on the basis of data/findings generated during the research works. The student will submit required number of copies of their dissertation to concerned department/campus/college for evaluation. The submitted dissertation will be approved by head of the central department/campus chief/coordinator. On the recommendation of head of the central department/campus chief/coordinator, the Institute of Science and Technology will appoint a related expert as an external examiner from the panel of approved examiners to evaluate the submitted dissertation. On the recommendation of external examiner, viva-voce open defense will be organized for evaluation of dissertation by concerned department/campus/college. The final evaluation of dissertation will be made by a panel of external and internal examiners, head of the department and supervisor(s). Students will be encouraged to publish the dissertation findings in peer reviewed microbiology journals in the form of original research article.