

# **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 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%):

- a. Attendance: 5 marks
- b. Seminar/class test/home assignment: 5 marks
- c. Project work/case study: 5 marks
- d. Midterm exam: 10 marks
- e. 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*

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

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*

<b>Course code</b>	<b>Course Title</b>	<b>Nature of Course</b>	<b>Credits</b>	<b>Evaluation (40% internal assessment)</b>
<b>Compulsory courses</b>				
MB 501	Advances in Microbiology	T	3	75 (45+30)
MB 502	Immunology	T	3	75 (45+30)
MB 503	Microbial Genetics and Molecular Biology	T	3	75 (45+30)
MB 504	Biochemistry and Biotechnology	T	3	75 (45+30)
MB 505	Practical on (MB 501 + MB 502)	P	2	50
MB 506	Practical on (MB 503 + MB 504)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

## Discipline I: Public Health Microbiology

### *Semester II*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory courses</b>				
MB 551	Human Anatomy and Physiology	T	3	75 (45+30)
MB 552	Applied Environmental Microbiology	T	3	75 (45+30)
MB 553	Fundamentals of Epidemiology	T	3	75 (45+30)
MB 554	Microbial Systematics	T	3	75 (45+30)
MB 555	Practical on (MB 551 + MB 552)	P	2	50
MB 556	Practical on (MB 553 + MB 554)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

### *Semester III*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory courses</b>				
MB 601	Research Methods and Biostatistics	T	3	75 (45+30)
MB 602	Public Health Microbiology	T	3	75 (45+30)
MB 603	Emerging Infectious Diseases	T	3	75 (45+30)
MB 604	Public Health Laboratory	T	3	75 (45+30)
MB 605	Practical on (MB 602)	P	2	50
MB 606	Practical on (MB 603 + MB 604)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

### *Semester IV*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory courses</b>				
MB 651	Hospital/Field Based Internship	P	8	S/US
MB 652	Dissertation	P	8	200
<b>Total</b>			<b>16</b>	<b>200</b>

S/US- Satisfactory (Pass)/unsatisfactory (Fail)

## Discipline II: Medical Microbiology

### *Semester II*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
MB 551	Human Anatomy and Physiology	T	3	75 (45+30)
MB 557	Systemic and Diagnostic Bacteriology-1	T	3	75 (45+30)
MB 558	Systemic and Diagnostic Virology-1	T	3	75 (45+30)
MB 559	Systemic and Diagnostic Parasitology	T	3	75 (45+30)
MB 560	Practical on (MB 551 + MB 557)	P	2	50
MB 561	Practical on (MB 558 + MB 559)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

### *Semester III*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
MB 601	Research Methods and Biostatistics	T	3	75 (45+30)
MB 607	Systemic and Diagnostic Bacteriology-2	T	3	75 (45+30)
MB 608	Systemic and Diagnostic Virology-2	T	3	75 (45+30)
MB 609	Systemic and Diagnostic Mycology	T	3	75 (45+30)
MB 610	Practical on (MB 607)	P	2	50
MB 611	Practical on (MB 608 + MB 609)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

### *Semester IV*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory course</b>				
MB 653	Hospital Based Internship	P	8	S/US
MB 654	Dissertation	P	8	200
<b>Total</b>			<b>16</b>	<b>200</b>

S/US- Satisfactory (Pass)/unsatisfactory (Fail)

## Discipline III: Food and Industrial Microbiology

### *Semester II*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory courses</b>				
MB 562	Food Fermentation Technology	T	3	75 (45+30)
MB 563	Food Biotechnology and Nutraceuticals	T	3	75 (45+30)
MB 564	Advanced Food Microbiology	T	3	75 (45+30)
MB 565	Food Safety Management and Toxicology	T	3	75 (45+30)
MB 566	Practical on (MB 562 + MB 563)	P	2	50
MB 567	Practical on (MB 564 + MB 565)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

### *Semester III*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory courses</b>				
MB 601	Research Methods and Biostatistics	T	3	75 (45+30)
MB 612	Food Science and Nutrition	T	3	75 (45+30)
MB 613	Food Processing and Preservation Technology	T	3	75 (45+30)
MB 614	Total Quality Management and Quality Assurance	T	3	75 (45+30)
MB 615	Practical on (MB 612)	P	2	50
MB 616	Practical on (MB 613 + MB 614)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

### *Semester IV*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory courses</b>				
MB 655	Industry based Internship	P	8	S/US
MB 656	Dissertation	P	8	200
<b>Total</b>			<b>16</b>	<b>200</b>

S/US- Satisfactory (Pass)/unsatisfactory (Fail)



## Discipline IV: Agriculture Microbiology

### Semester II

Course	Course Title	Nature	Credits	Evaluation
<b>Compulsory courses</b>				
MB 568	Biological Control	T	3	75 (45+30)
MB 569	Soil Microbiology	T	3	75 (45+30)
MB 570	Microbial Metabolism in Soil	T	3	75 (45+30)
MB 571	Soil Fertilizers	T	3	75 (45+30)
MB 572	Practical on (MB 568 + MB 569)	P	2	50
MB 573	Practical on (MB 570 + MB 571)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

### Semester III

Course	Course Title	Nature	Credits	Evaluation
<b>Compulsory courses</b>				
MB 601	Research Methods and Biostatistics	T	3	75 (45+30)
MB 617	Microbial Inoculants in Agriculture, Livestock and Forestry	T	3	75 (45+30)
MB 618	Applied Soil Microbiology	T	3	75 (45+30)
MB 619	Microbial Diseases and Agriculture Biotechnology	T	3	75 (45+30)
MB 620	Practical on (MB 617 + MB 618)	P	2	50
MB 621	Practical on (MB 619)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

### Semester IV

Course	Course Title	Nature	Credits	Evaluation
<b>Compulsory courses</b>				
MB 657	Agriculture based Internship	P	8	S/US
MB 658	Dissertation	P	8	200
<b>Total</b>			<b>16</b>	<b>200</b>

S/US- Satisfactory (Pass)/unsatisfactory (Fail)

## Compulsory Courses for All Disciplines

### *Semester I*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory courses</b>				
MB 501	Advances in Microbiology	T	3	75 (45+30)
MB 502	Immunology	T	3	75 (45+30)
MB 503	Microbial Genetics and Molecular Biology	T	3	75 (45+30)
MB 504	Biochemistry and Biotechnology	T	3	75 (45+30)
MB 505	Practical on (MB 501 + MB 502)	P	2	50
MB 506	Practical on (MB 503 + MB 504)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

## **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**

Nomenclature, Classification, Identification, Polyphasic taxonomy, Techniques used for determining Microbial Taxonomy and Phylogeny; Classical Characteristics method, Molecular Characteristics method, Phylogenetic tree, Cladograms, Dichotomous Keys, Basis for classification of bacteria, Introduction to Bergey's Manual

#### **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, Krebs 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**

1. *Bergey's Manual of Systematic Bacteriology*, Volume 1 (2001), Volume 2 (2005), Volume 3 (2009), Volume 4 (2009), Volume 5 (2009)
2. Madigan MT, Martinko JM and Parker J (2004), *Brock's Biology of Microorganisms*, 10<sup>th</sup> Edition, Prentice-Hall International
3. Prescott LM, Haley JP and Klein DA (2005), *Microbiology*, 7<sup>th</sup> Edition (International Edition) McGraw Hill

## **MB 502 Immunology**

Course Title: Immunology  
Course No.: MB 502  
Nature of Course: Theory (3 credits)

Full Marks: 75  
Pass Marks: 37.5  
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 secretory 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**

1. Abbas AK and Lichtman AH (2008), *Basic Immunology: Functions and Disorders of the Immune System*, 3<sup>rd</sup> Edition, W B Saunders Co
2. Abbas AK, Lichtman AH and Pillai S (2007), *Cellular and Molecular Immunology*, 6<sup>th</sup> Edition, Elsevier
3. Kindt TJ, Goldsby RA and Osborne BA (2006), *Kuby Immunology*, 6<sup>th</sup> Edition, W. H. Freeman
4. Roitt IM and Delves PJ (2001), *Roitt's Essential Immunology*, 10<sup>th</sup> Edition, ELBS, Blackwell Scientific Publications

## **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**

<b>Fundamentals on Genes, DNA, RNA, Genome and Genetics</b>	<b>2 hrs</b>
<b>DNA Recombination and Transfer in Prokaryote</b>	<b>3 hrs</b>
<b>DNA Replication</b> Molecular mechanism of DNA, Replication in prokaryotic and eukaryotic cells	<b>5 hrs</b>
<b>Gene Expression</b> Molecular mechanism and stages of transcription in prokaryotes, viruses and bacteriophages, Post transcriptional modifications	<b>5 hrs</b>
<b>Process of Protein Synthesis</b> Role of RNA and translation of the genetic code, Steps involved in translation, Post translational modification of proteins, Post translational modifications	<b>5 hrs</b>
<b>Regulation of Gene Expression</b> Mechanism of Lac-operon and Trp operon, Control of gene expression at transcriptional, post transcriptional, translational and hormonal level	<b>5 hrs</b>
<b>Mutations</b> Types of Mutation, Mutagenic agents: Physical, chemical and biological, Detection of mutants	<b>5 hrs</b>
<b>Recombinant DNA Technology</b> 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	<b>8 hrs</b>
<b>Molecular Techniques</b> 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	<b>7 hrs</b>

## References

1. Lewin B (2007), *Genes IX*, Oxford University Press and Cell Press
2. Snyder L and Champness W (2003), *Molecular Genetics of Bacteria*, 2<sup>nd</sup> Edition, ASM Press
3. Sambrook J and Russell DW (2001), *Molecular Cloning: A Laboratory Manual (Vol I, II and III)*, 3<sup>rd</sup> Edition, Cold Spring Harbor Laboratory Press



## **MB 504 Biochemistry and Biotechnology**

Course Title: Biochemistry and Biotechnology  
Course No.: MB 504  
Nature of Course: Theory (3 credits)

Full Marks: 75  
Pass Marks: 37.5  
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 B<sub>12</sub>) 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**

1. Nelson DL and Cox MM (2004), *Lehninger Principles of Biochemistry*, 5<sup>th</sup> Edition, Freeman
2. Plummer DT (1988), *An Introduction to Practical Biochemistry*, 3<sup>rd</sup> Edition, Tata McGraw Hill
3. Skoog DA, Holler FJ and Nieman TA (2005), *Principles of Instrumental Analysis*, 5<sup>th</sup> Edition, Thomson Books/Cole
4. Stryer L (1995), *Biochemistry*, 4<sup>th</sup> Edition, W.H. Freeman Company, New York
5. Voet D and Voet J (2004), *Biochemistry*, 3<sup>rd</sup> Edition, Wiley International Edition
6. Wilson K and Walker J (Eds)(2005), *Principles and Techniques of Biochemistry and Molecular Biology*, 6<sup>th</sup> Edition, Cambridge University Press
7. Mendham J, Denny RC, Barnes JD and Thomas M (2008), *Vogel's Text Book of Quantitative Chemical Analysis*, 6<sup>th</sup> Edition, Pearson Education
8. Cassida LE Jr (1996), *Industrial Microbiology*, New Age International Publishers

9. Crueger W and Crueger A (1990), *Biotechnology: A Textbook of Industrial Microbiology*.  
2<sup>nd</sup> Edition, T. D. Brock's Editor, Sunderland Mass Sinauer Associates
10. Smith JE (1996), *Biotechnology*, 3<sup>rd</sup> Edition, Cambridge University Press

## **MB 505 Practical on (MB 501 + MB 502)**

Course Title: Practical on (MB 501+MB 502)  
Course No.: MB 505  
Nature of Course: Practical (2 credits)

Full Marks: 50  
Pass Marks: 25  
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
  - Immunoelectrophoresis
  - Immunofluorescence 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)

Course No.: MB 506

Nature of Course: Practical (2 credits)

Full Marks: 50

Pass Marks: 25

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  $K_m$  and  $V_{max}$
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 thuriangiensis* 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*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory courses</b>				
MB 551	Human Anatomy and Physiology	T	3	75 (45+30)
MB 552	Applied Environmental Microbiology	T	3	75 (45+30)
MB 553	Fundamentals of Epidemiology	T	3	75 (45+30)
MB 554	Microbial Systematics	T	3	75 (45+30)
MB 555	Practical on (MB 551 + MB 552)	P	2	50
MB 556	Practical on (MB 553 + MB 554)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>



## **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 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****4 hrs**

Different organs, Structure and functions of eye, ear, nose and tongue

**Reproductive System****4 hrs**

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

**References**

1. Guyton AC and Hall JE (2003), *Medical Physiology*, 10<sup>th</sup> Edition, Indian Print: Saunders
2. Standring S (2005), *Gray's Anatomy: The Anatomical Basis of Clinical Practice*, 39<sup>th</sup> Edition, Elsevier Churchill Livingstone

## **MB 552 Applied Environmental Microbiology**

Course Title: Applied Environmental Microbiology

Course No.: MB 552

Nature of Course: Theory (3 credits)

Full Marks: 75

Pass Marks: 37.5

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

1. Alexander M (1971), *Microbial Ecology*, John Wiley and Sons Inc., New York
2. Atlas RM and Bartha R (1998), *Microbial Ecology, Fundamentals and Applications*, 4<sup>th</sup> Edition, The Benjamin Cummins Publication Co. Inc
3. Bitton G (2011), *Wastewater Microbiology*, 4<sup>th</sup> Edition, Wiley and Sons
4. Hurst CJ (2001), *A Manual of Environmental Microbiology*, 2<sup>nd</sup> Edition, ASM Publications
5. Kushner DJ (1978), *Microbial Life in Extreme Environments*, Academic Press, London
6. Michel R (1999), *Introduction to Environmental Microbiology*, ASM book
7. Mohapatra PK (2008), *Textbook of Environmental Microbiology*, IK International Publishing House Pvt. Ltd
8. Darsie RF and Pradhan SP (1990), The mosquitoes of Nepal: Their identification, distribution and biology. *Mosquito systematics*, 22(2): 69-130
9. Kalra NL and Bang YH (1988), *Manual on Entomology in Visceral Leishmaniasis*, WHO, Regional Office for South-East Asia, New Delhi
10. Service MW (2004), *Medical Entomology for Students*, 3<sup>rd</sup> Edition, Cambridge University Press
11. Service M (2008), *Medical Entomology for Students*, 4<sup>th</sup> Edition, Cambridge University Press

## **MB 553 Fundamentals of Epidemiology**

Course Title: Fundamentals of Epidemiology

Course No.: MB 553

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. 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**

1. Detels R, McEwen J, Beaglehole R and Tanaka H (2002), *Oxford Text Book of Public Health*, 4<sup>th</sup> Edition, Oxford University Press
2. Gordis L (2004), *Epidemiology*, 3<sup>rd</sup> Edition, Elsevier Saunders
3. Park K (2007), *Park's Textbook of Preventive and Social Medicine*, 19<sup>th</sup> Edition, Banarasidas Bhanot Publications, India

## MB 554 Microbial Systematics

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

Full Marks: 75  
Pass Marks: 37.5  
Semester: II

### 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*, *Loaloe*

#### 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

1. Chatterjee KD (1981), P. Ed, *Parasitology (Protozoology and Helminthology)*, 12<sup>th</sup> Edition, Chatterjee Medical Publishers, Calcutta.
2. Greenwood D, Slack R, Barer M and Irving W (2012), *Medical Microbiology*. 18<sup>th</sup> Edition, Churchill Livingstone
3. John DT and Petri Jr WA (2006), *Markell and Voge's Medical Parasitology*, 9<sup>th</sup> Edition, Saunders
4. Fields BN, Knipe DM, Howley PM, Chanock RM, Melnick JL, Monath TP, Roizman B, and Strus SE, eds (2001), *Fields Virology*, Volume 1 and 2, 3<sup>rd</sup> Edition Lippincott-Raven, Philadelphia, PA
5. Larone DH (2002), *Medically Important Fungi: A Guide to Identification*, 4<sup>th</sup> Edition, ASM Publications

6. Murray PR, Rosenthal KS and Pfaller MA (2005), *Medical Microbiology*, 5<sup>th</sup> Edition, Elsevier Mosby
7. Geoffrey R, Smith and Charles SF, Easmon Ed (1990), *Topley and Wilson's Principles of Bacteriology, Virology and Immunity*, 8<sup>th</sup> Edition, Volume 1-5, Edward Arnold Publication UK



## **MB 555 Practical on (MB 551 + MB 552)**

Course Title: Practical on (MB 551 + MB 552)

Course No.: MB 555

Nature of Course: Practical (2 credits)

Full Marks: 50

Pass Marks: 25

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*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory courses</b>				
MB 601	Research Methods and Biostatistics	T	3	75 (45+30)
MB 602	Public Health Microbiology	T	3	75 (45+30)
MB 603	Emerging Infectious Diseases	T	3	75 (45+30)
MB 604	Public Health Laboratory	T	3	75 (45+30)
MB 605	Practical on (MB 602)	P	2	50
MB 606	Practical on (MB 603 + MB 604)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

## **MB 601 Research Methods and Biostatistics**

Course Title: Research Methods and Biostatistics  
Course No.: MB 601  
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. 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*, 8<sup>th</sup> Edition, Wiley
2. Mahajan BK (2007), *Methods in Biostatistics for Medical Students and Research Workers*, Jaypee Brothers Medical Publishers Pvt. Ltd, India

## **MB 602 Public Health Microbiology**

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

Full Marks: 75  
Pass Marks: 37.5  
Semester: III

### **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

1. Cook G (1996), *Manson's Tropical Diseases*, 20<sup>th</sup> Edition, WB Saunders Company Ltd. London (UK)
2. Baron EJ, Peterson LR and Finegold SM (1994), *Bailey and Scott's Diagnostic Microbiology*, Mosby
3. Greenwood D, Slack RCB and Peutherer JF (2007), *Medical Microbiology*, 17<sup>th</sup> Edition, Churchill Livingstone
4. Park K (2005), *Park's Textbook of Social and Preventive Medicine*, 18<sup>th</sup> Edition, Banarasidas Bhanot, Jabalpur, India
5. Collier L, Balows A, Sussman M and Hausler WJ (1998), *Topley and Wilson's Microbiology and Microbial Infections*: Volume 1-5

## MB 603 Emerging Infectious Diseases

Course Title: Emerging Infectious Diseases  
Course No.: MB 603  
Nature of Course: Theory (3 credits)

Full Marks: 75  
Pass Marks: 37.5  
Semester: III

### 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  
Course No.: MB 604  
Nature of Course: Theory (3 credits)

Full Marks: 75  
Pass Marks: 37.5  
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: Bacteremia, 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

1. Ash LR and Orihel TC (1987), *Parasites: A Guide to Laboratory Procedures and Identification*, American Society of Clinical Pathologists, Chicago, Illinois
2. Baron EJ, Peterson LR and Finegold SM (eds) (1990), *Bailey and Scott's Diagnostic Microbiology*, 9<sup>th</sup> Edition. St. Louis: Mosby
3. Cheesbrough M (1996), *Medical Laboratory Manual for Tropical Countries*, Vol: 1 and 11, Butterworth Heinmann Ltd. Oxford
4. Collee JG, Fraser AG, Marmion BP and Simmons A (eds) (1996), *Mackie and McCartney Practical Medical Microbiology*, 14<sup>th</sup> Edition, Churchill Livingstone, New York
5. Cook G (1996), *Manson's Tropical Diseases*, 20<sup>th</sup> Edition, WB Saunders Company Ltd.: London (UK)

6. Garcia LS (2004), *Clinical Laboratory Management*, ASM Press
7. Murray PR, Baron EJ, Jorgensen JH, Pfaller MA and Tenover FC (ed) (2003), *Manual of Clinical Microbiology*, 8<sup>th</sup> Edition, Washington, DC, ASM Press
8. Geoffrey R, Smith and Charles SF, Easmon Ed (1990), *Topley and Wilson's Principles of Bacteriology, Virology and Immunity*, 8<sup>th</sup> Edition, Volume 1-5, Edward Arnold Publication UK

## **MB 605 Practical on (MB 602)**

Course Title: Practical on (MB 602)  
Course No.: MB 605  
Nature of Course: Practical (2 credits)

Full Marks: 50  
Pass Marks: 25  
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

## **MB 606 Practical on (MB 603 + MB 604)**

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*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory courses</b>				
MB 651	Hospital/Field based Internship	P	8	S/US
MB 652	Dissertation	P	8	200
<b>Total</b>			<b>16</b>	<b>200</b>

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

Course No.: MB 652

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
- 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*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
MB 551	Human Anatomy and Physiology	T	3	75 (45+30)
MB 557	Systemic and Diagnostic Bacteriology-1	T	3	75 (45+30)
MB 558	Systemic and Diagnostic Virology-1	T	3	75 (45+30)
MB 559	Systemic and Diagnostic Parasitology	T	3	75 (45+30)
MB 560	Practical on (MB 551 + MB 557)	P	2	50
MB 561	Practical on (MB 558 + MB 559)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>



## **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****4 hrs**

Different organs, Structure and functions of eye, ear, nose and tongue

**Reproductive System****4 hrs**

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

**References**

1. Guyton AC and Hall JE (2003), *Medical Physiology*, 10<sup>th</sup> Edition, Indian Print: Saunders
2. Standring S (2005), *Gray's Anatomy: The Anatomical Basis of Clinical Practice*, 39<sup>th</sup> Edition, Elsevier Churchill Livingstone

## **MB 557 Systemic and Diagnostic Bacteriology-1**

Course Title: Systemic and Diagnostic Bacteriology-1  
Course No.: MB 557  
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, 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, phage typing, 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**

**7 hrs**

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 Tenover FC (1990), *Bailey and Scott's Diagnostic Microbiology*, Mosby
2. Collier L, Balows A, Sussman M and Hausler WJ (1998), *Topley and Wilson's Microbiology and Microbial Infections: Volume 3: Bacterial Infections*
3. Collee JG, Fraser AG, Marmion BP and Simmons A (eds) (1996), *Mackie and McCartney Practical Medical Microbiology*. 14<sup>th</sup> Edition, Churchill Livingstone, New York
4. Geoffrey R, Smith and Charles SF, Easmon Ed (1990), *Topley and Wilson's Principles of Bacteriology, Virology and Immunity*, 8<sup>th</sup> Edition, Volume 2-4, Edward Arnold Publication UK

# MB 558 Systemic and Diagnostic Virology-1

Course Title: Systemic and Diagnostic Virology-1  
Course No.: MB 558  
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

- Structure, physiology, pathogenesis, isolation, characterization and identification of medically important viruses
- 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

Alpha herpesviruses Herpes Simplex and Varicella Zoster, Beta herpesviruses, Cytomegaloviruses, Human herpesviruses 6 and 7, Gamma herpesviruses 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

1. Topley WWC and Wilson GS (1990), Parker MT and Collier LH (Editor) *Topley and Wilson's Principles of Bacteriology, Virology and Immunity*, 8<sup>th</sup> Edition. Hodder Arnold.
2. Fields BN, Knipe DM, Howley PM, Chanock RM, Melnick JL, Monath TP, Roizman B, and Strus SE., eds (2001), *Fields Virology Volume 1 and 2*, 3<sup>rd</sup> Edition Lippincott-Raven, Philadelphia, PA.
3. Stephenson JR and Warnes A (1998), *Diagnostic Virology Protocols: Methods in Molecular Medicine*, Humana press.
4. Flint SJ, Enquist LW, Krung R, Racaniello VR and Skalka AM (2000), *Principles of Virology*, Molecular Biology, Pathogenesis and Control. ASM Press

## 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

- Structure, physiology, pathogenesis, isolation, characterization and identification of medically important parasites
- 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* **Ciliates:** *Balantidium coli*, **Sporozoa:** *Isospora belli*, **Coccidia:** *Cryptosporidium parvum*, *Cyclospora*, **The Trematodes: Intestinal flukes:** *Fasciolopsis buski*, **The liver flukes:** *Fasciola hepatica*, **The Blood Flukes:** *Schistosoma mansoni*, **The Lung Flukes:** *Paragonimus westermanii*, **Cestodes:** *Taenia solium*, *T. saginata*, *T. saginata asiatica*, *Echinococcus granulosus*, *Hymenolepis nana* **Intestinal Nematodes:** *Ascaris lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale*, *Necator americanus*, *Strongyloides stercoralis*, *Enterobius vermicularis* **Anisakiasis:** *Anisakis (Terranova)*, **Blood and tissue dwelling nematodes:** *Filariae*, *Wuchereria bancrofti*, *Onchocerca volvulus* **The Guinea worm:** *Dracunculus medinensis*, **Other tissue nematodes:** *Trichinella spiralis*, **Visceral larva migrant:** *Toxocara canis*, **Angiostrongylus cantonensis:** *A. cantonensis (rats lungworms)* **Malaria:** *Plasmodium* Tissue schizonts, hypnozoites, gametocytes **Other Blood and Tissue Dwelling Protozoa:** *Trypanosoma* **Leishmania spp. The Tissue Coccidia:** *Toxoplasma gondii*, *Sarcocystis* spp. **Opportunistic free living Amoebae:** *Acanthamoeba* spp.

**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

1. Chatterjee KD (Editor) (1981), *Parasitology (Protozoology and Helminthology)*, 12<sup>th</sup> Edition, Chatterjee Medical Publishers, India
2. Cox FE, Kreier JP and Wakelin D (1998), *Topley and Wilson's Microbiology and Microbial Infections* Vol 5: Parasitology, Hodder Arnold
3. Fleck SL and Moody AH (1973), *Diagnostic Techniques in Medical Parasitology*, University Press, Cambridge
4. Garcia LS and Bruckner DA (1997), *Diagnostic Medical Parasitology*, 3<sup>rd</sup> Edition, ASM Press
5. John DT and Petri Jr WA (2006), *Markell and Voge's Medical Parasitology*, 9<sup>th</sup> Edition, Saunders
6. Grell KG (1973), *Protozoology*, Springer Verlag, Heidelberg
7. Sleigh M (1973), *The Biology of Protozoa*: Volume I-VIII, Edward Arnold (London) and American Elsevier (New York)
8. Sleigh MA (1989), *Protozoa and Other Protists*, 4<sup>th</sup> Edition, Edward Arnold, London



## **MB 560 Practical on (MB 551+MB 557)**

Course Title: Practical on (MB 551+MB 557)  
Course No: MB 560  
Nature of Course: Practical (2 credits)

Full Marks: 50  
Pass Marks: 25  
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)  
Course No.: MB 561  
Nature of Course: Practical (2 credits)

Full Marks: 50  
Pass Marks: 25  
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 TCID<sub>50</sub>
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*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
MB 601	Research Methods and Biostatistics	T	3	75 (45+30)
MB 607	Systemic and Diagnostic Bacteriology-2	T	3	75 (45+30)
MB 608	Systemic and Diagnostic Virology-2	T	3	75 (45+30)
MB 609	Systemic and Diagnostic Mycology	T	3	75 (45+30)
MB 610	Practical on (MB 607)	P	2	50
MB 611	Practical on (MB 608 + MB 609)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

## **MB 601 Research Methods and Biostatistics**

Course Title: Research Methods and Biostatistics  
Course No.: MB 601  
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. 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*, 8<sup>th</sup> Edition, Wiley
2. Mahajan BK (2007), *Methods in Biostatistics for Medical Students and Research Workers*, Jaypee Brothers Medical Publishers Pvt. Ltd, India

## MB 607 Systemic and Diagnostic Bacteriology-2

Course Title: Systemic and Diagnostic Bacteriology-2  
Course No. MB 607  
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

- Structure, physiology, pathogenesis, isolation, characterization, identification and typing of medically important bacteria
- 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, Rickettsia, 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 Tenover FC (1990), *Bailey and Scott's Diagnostic Microbiology*, Mosby
2. Collee JG, Fraser AG, Marmion BP and Simmons A (eds) (1996), *Mackie and McCartney Practical Medical Microbiology*, 14<sup>th</sup> Edition, Churchill Livingstone, New York
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  
Course No.: MB 608  
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, 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

1. Topley WWC and Wilson GS (1990), Parker MT and Collier LH (Editor), *Topley and Wilson's Principles of Bacteriology, Virology and Immunity*, 8<sup>th</sup> Edition, Hodder Arnold
2. Fields BN, Knipe DM, Howley PM, Chanock RM, Melnick JL, Monath TP, Roizman B, and Strus SE., eds (2001), *Fields Virology Volume 1 and 2*, 3<sup>rd</sup> Edition Lippincott-Raven, Philadelphia, PA
3. Stephenson JR and Warnes A (1998), *Diagnostic Virology Protocols: Methods in Molecular Medicine*, Humana press

4. Flint SJ, Enquist LW, Krung R, Racaniello VR and Skalka AM (2000), *Principles of Virology, Molecular Biology, Pathogenesis and Control*, ASM Press



## 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

- Structure, physiology, pathogenesis, isolation, characterization and identification of medically important fungi
- Principles, procedures and applications of diagnostic methods useful to detect fungi from clinical specimens

### Course Contents

#### Techniques of Diagnostic Mycology

5 hrs

Direct microscopic examination and culture, Serological diagnosis, Histological diagnosis, Principles and applications of molecular methods in the diagnosis of fungal infections

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

3 hrs

#### Laboratory Diagnosis of Fungal Diseases

4 hrs

Cutaneous, Subcutaneous, Systemic, Opportunistic mycoses, Fungal sinusitis

#### Classification, Structure, Physiology, Pathogenesis, Medical Importance, Control and Laboratory Diagnosis of

12 hrs

*Trichophyton*, *Epidermatophyton*, *Microsporum*, *Mycetoma*, *Chromoblastomycosis*, *Phaeoerythromycosis*, *Sporotrichosis*, *Zygomycosis: Lobomycosis*, *Rhinosporidiosis*

#### Classification, Structure, Physiology, Pathogenesis, Medical Importance and Laboratory Diagnosis of

16 hrs

*Candida*, *Fusarium*, *Chromomycosis*, *Aspergillus*, *Cryptococcus*, *Blastomyces*, *Histoplasma*, *Coccidioidomyces*, *Paracoccidioidomyces*, *Penicillium*, *Pneumocystis jirovecii* infections

#### 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

- Larone DH (2002), *Medically Important Fungi: A Guide to Identification*, ASM Press
- Topley WWC and Wilson GS (1990), Parker MT and Collier LH (Editor), *Topley and Wilson's Principles of Bacteriology, Virology and Immunity*, 8<sup>th</sup> Edition. Hodder Arnold

## **MB 610 Practical on (MB 607)**

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

Full Marks: 50  
Pass Marks: 25  
Semester: III

### **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*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory course</b>				
MB 653	Hospital Based Internship	P	8	S/US
MB 654	Dissertation	P	8	200
<b>Total</b>			<b>16</b>	<b>200</b>

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)

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 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.

## **MB 654 Dissertation**

Course Title: Dissertation

Course No.: MB 654

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
- 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*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory courses</b>				
MB 562	Food Fermentation Technology	T	3	75 (45+30)
MB 563	Food Biotechnology and Nutraceuticals	T	3	75 (45+30)
MB 564	Advanced Food Microbiology	T	3	75 (45+30)
MB 565	Food Safety Management and Toxicology	T	3	75 (45+30)
MB 566	Practical on (MB 562 + MB 563)	P	2	50
MB 567	Practical on (MB 564 + MB 565)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

## 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*, 1<sup>st</sup> Edition, SK Jain for CBS Publisher and distributors, Delhi
2. Bailey JE and Ollis DF (1986), *Biochemical Engineering Fundamentals* (2<sup>nd</sup> Edition) McGraw-Hill, New York
3. Carl SP (1979), *Microbiology of Food Fermentations*, AVI Publishing Company
4. Rose AH (1982), *Fermented Foods*, Academic Press
5. Ayers JC, Mundt JO and Sandine WE (1980), *Microbiology of Foods*, WH Freeman and Company



6. Varnam AH and Sutherland JP (2009), ***Beverages: Technology, Chemistry and Microbiology***, Springer (India) Private Limited, New Delhi

## **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**

1. Shetty K, Paliyath G, Podetto A and Levin RE (2006), *Food Biotechnology*, Taylor and Francis, CRC Press, USA
2. Okafor N (2007), *Modern Industrial Microbiology and Biotechnology*, Science Publisher, USA
3. Bailey JE and Ollis DF (1986), *Biochemical Engineering Fundamentals* (2<sup>nd</sup> Edition) McGraw-Hill, New York
4. Shang-Tian Y (2007), *Bioprocessing for Value Added Products from Renewable Resources*, Elsevier International, Netherlands
5. Biolecki S (2000), *Food Biotechnology*, Elsevier Science
6. Byong HL (1996), *Fundamentals of Food Biotechnology*, John Wiley and Sons
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  
Course No.: MB 564  
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. 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**

1. Frazier WC and Westhoff DC (1986), *Food Microbiology*, 3<sup>rd</sup> Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi
2. Jay JH (1987), *Modern Food Microbiology*, 3<sup>rd</sup> Edition CBS. Pub and Distributors, Delhi
3. ICMSF (2005), *Microbial Ecology of Food Commodities*, 2<sup>nd</sup> Edition, Kluwer Academic / Plenum Publishers, New York
4. McKellar Robin C and Xuewen Lu (2004), *Modeling Microbial Responses in Food*, CRC Press, Florida

# MB565 Food Safety Management and Toxicology

Course Title: Food Safety Management and Toxicology  
Course No.: MB 565  
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. 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
2. Blackburn CW and Peter J (2005), *Mcclure, Foodborne Pathogens*, CRC Press, New York
3. WHO/IPCS (2001), *Safety Evaluation of Certain Mycotoxins in Foods*
4. WHO/IPCS (2004), *Safety Evaluation of Certain Food Additives and Contaminants*
5. Betty CH and Diane R (1987), *Food Poisoning and Food Hygiene*, Edward Arnold, London
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 *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

## **MB 567 Practical on (MB 564+MB 565)**

Course Title: Practical on (MB 564+MB 565)

Course No.: MB 567

Nature of Course: Practical (2 credits)

Full Marks: 50

Pass Marks: 25

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*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory courses</b>				
MB 601	Research Methods and Biostatistics	T	3	75 (45+30)
MB 612	Food Science and Nutrition	T	3	75 (45+30)
MB 613	Food Processing and Preservation Technology	T	3	75 (45+30)
MB 614	Total Quality Management and Quality Assurance	T	3	75 (45+30)
MB 615	Practical on (MB 612)	P	2	50
MB 616	Practical on (MB 613 + MB 614)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

## **MB 601 Research Methods and Biostatistics**

Course Title: Research Methods and Biostatistics  
Course No.: MB 601  
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. 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*, 8<sup>th</sup> Edition, Wiley
2. Mahajan BK (2007), *Methods in Biostatistics for Medical Students and Research Workers*, Jaypee Brothers Medical Publishers Pvt. Ltd, India



## MB 612 Food Science and Nutrition

Course Title: Food Science and Nutrition  
Course No.: MB 612  
Nature of Course: Theory (3 credits)

Full Marks: 75  
Pass Marks: 37.5  
Semester: III

### 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

1. Heldman DR and Lund DB (2007), *Handbook of Food Engineering*, 2<sup>nd</sup> Edition, CRC Press, Taylor and Francis group, New York
2. Owen R. Fennema (1996), *Food Chemistry*, 3<sup>rd</sup> Edition, Marcel Dekker, New York
3. John M. deMan, (1999), *Principles of Food Chemistry*, 3<sup>rd</sup> Edition, Aspen Publishers, Inc. Gaithersburg, Maryland
4. Berdanier CD, Dwyer J and Feldman EB (2008), *Handbook of Nutrition and Food*, 2<sup>nd</sup> edition, CRC Press, Taylor and Francis group, New York

## **MB 613 Food Processing and Preservation Technology**

Course Title: Food Processing and Preservation Technology  
Course No.: MB 613  
Nature of Course: Theory (3 credits)

Full Marks: 75  
Pass Marks: 37.5  
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
2. Fellows PJ (1990), *Food Processing Technology – Principles and Practices*, Ellice Harwood Ltd, UK
3. Rahman MS (1999), *Handbook of Food Preservation*, Marcel Dekker, Inc, NY
4. Cruess WV (1966), *Commercial Fruit and Vegetable Products*, Mc-Graw Hill Book Company
5. Prescott CS and Proctor EB (1937), *Food Technology*, Mc-Graw Hill Book company
6. Desrosier EN (1963), *The Technology of Food Preservation*, AVI Publishing Company, New York
7. Bowers J (1992), *Food Theory and Applications*, Maxwell Macmillan International, New York

## **MB 614 Total Quality Management and Quality Assurance**

Course Title: Total Quality Management and Quality Assurance  
Course No.: MB 614  
Nature of Course: Theory (3 credits)

Full Marks: 75  
Pass Marks: 37.5  
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**

Food regulation and standard in prospective of codex in Nepalese context enforcement and control agencies (FDA), Food laws, Problems of regulations, Food standards, Microbiological criteria for foods, Quality control/ quality assurance and International Food Trade, Sanitary Phytosanitary (SPS), Technical Barrier to Trade (TBT), Cleaning In Place (CIP), ISO-9000 Standards: ISO 9001:2008, ISO 9004, ISO 22000:2005, ISO 17025, ISO 14000 and developing ISO 9001 modules for food enterprises.

#### **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
2. Marriott NG and Gravani RB (2006), *Principles of Food Sanitation*, 5<sup>th</sup> Edition, Food Science Text Series, Springer Link
3. McSwane D, Rue NR and Linton R (2004), *Essentials of Food Safety and Sanitation*, 4<sup>th</sup> Edition, Prentice Hall
4. Roberts D and Greenwood M (2002), *Practical Food Microbiology*, Wiley-Blackwell
5. Inteeaz A (2004), *Food Quality Assurance (Principles and Practices)*, CRC Press
6. Anderes JV (2004), *Quality Assurance for the Food Industry (A Practical Approach)*, CRC Press

## **MB 615 Practical on (MB 612)**

Course Title: Practical on (MB 612)  
Course No.: MB 615  
Nature of Course: Practical (2 credits)

Full Marks: 50  
Pass Marks: 25  
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  $\text{SO}_2$ , 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)

Course No.: MB 616

Nature of Course: Practical (2 credits)

Full Marks: 50

Pass Marks: 25

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*

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
<b>Compulsory courses</b>				
MB 655	Industry based Internship	P	8	S/US
MB 656	Dissertation	P	8	200
<b>Total</b>			<b>16</b>	<b>200</b>

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

Course No.: MB 656

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
- 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*

Course	Course Title	Nature	Credits	Evaluation
<b>Compulsory courses</b>				
MB 568	Biological Control	T	3	75 (45+30)
MB 569	Soil Microbiology	T	3	75 (45+30)
MB 570	Microbial Metabolism in Soil	T	3	75 (45+30)
MB 571	Soil Fertilizers	T	3	75 (45+30)
MB 572	Practical on (MB 568 + MB 569)	P	2	50
MB 573	Practical on (MB 570 + MB 571)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

## MB 568 Biological Control

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

Full Marks: 75  
Pass Marks: 37.5  
Semester: II

### Objectives

Upon completion of the course the student will be able to

- Have detail knowledge about the soil borne microbial and nematode diseases of plant
- Distinguish between pathogenic and deficiency disease in plant
- Understand the mechanism of genetic trait transfer in soil borne and pathogenic microbes

### Course Contents

#### Microbial Interaction

8 hrs

Inter specific 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 (*Steinernamatids* 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**

1. Alcamo IE (2000), *Fundamentals of Microbiology*, Second Edition, The Benjamin /Cummings Publishing Company
2. Singh RS (1990), *Plant Diseases*, 9<sup>th</sup> Edition, IBH and Oxford Publishing Private Ltd
3. Singh RS (2001), *Plant Diseases Management Principles and Practice*, Science Publisher India
4. Mehrotra RS (2003), *Plant Pathology*, Tata McGraw Hill, Education
5. Naik MK and Devika Rani GS (2008), *Advances in Soil-borne Plant Diseases*, New India Publishing
6. Baker KF and Cook RJ (1974), *Biological Control of Plant Pathogens*, WH Freeman and Company, San Fransisco
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

1. Rangaswami G and Bagyaraj DJ (2004), *Agricultural Microbiology*, Prentice Hall Private Ltd
2. Alexander M (1961), *An Introduction to Soil Microbiology*, Wiley Eastern Ltd.
3. Brady NC and Weil RM (1969), *Study Guide for Nature and Properties of Soil*.
4. Paul H (Ed) (2006), *Soil Microbiology, Ecology and Biochemistry*, Lohinis and Fred Publications
5. Atlas RM (1998), *Microbial Ecology, Fundamental and Application*, 4<sup>th</sup> Edition, Benjamin/Cummings Publishing Company Inc
6. Tortora GJ, Funke BR and Case CL (2010), *Microbiology: An Introduction*, Benjamin/Cummings Publishing Company Inc
7. Dubey RC and Maheshwari DK (2013), *A Textbook of Microbiology*, S Chand
8. Balandreau J and Knowles R (1978), *The Rhizosphere: In Interactions between Non Pathogenic Soil Microorganisms and Plants*, Eds. Dammergues YR and Krupa SV. Elsevier, Amsterdam.
10. Garrett SD (1981), *Soil Fungi and Soil Fertility*, 2<sup>nd</sup> Edition, Pergamon Press, Oxford

## MB 570 Microbial Metabolism in Soil

Course Title: Microbial Metabolism in Soil  
Course No.: MB 570  
Nature of Course: Theory (3 credits)

Full Marks: 75  
Pass Marks: 37.5  
Semester: II

### 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, Phenylcarbarnates, Phenylureas, Thiocarbarnates, 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 Bagyaraj 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
4. Steward FC (1963), *Inorganic Nutrients of Plants*, Elsevier Publications
5. Atlas RM (1998), *Microbial Ecology, Fundamental and Application*, 4<sup>th</sup> Edition, Benjamin/Cummings Publishing Company Inc
6. Tortora GJ, Funke BR and Case CL (2010), *Microbiology: An Introduction*, Benjamin/Cummings Publishing Company Inc
7. Gray TRG Williams ST (1971), *Soil Microorganisms*, Longman Group Limited, London

## MB 571 Soil Fertilizers

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

Full Marks: 75  
Pass Marks: 37.5  
Semester: II

### Objectives

Upon completion of the course the student will be able to

- Understand the effect and utilize the commercial inorganic, organic fertilizer and biofertilizer
- 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

Free living Nitrogen fixers: *Azotobacter*, *Azospirillum*, *Azomonas*, *Derexia*, Associative symbiotic Nitrogen fixers: *Azotobacter paspali*, *Azospirillum*, Symbiotic Nitrogen fixers: Different types of rhizobia, Nitrogen fixation in actinorrhizal plants, Nitrogen fixation by Blue Green Algae, Phosphate solubilizing bacteria and mycorrhizae

#### 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

- Rangaswami G and Bagyaraj DJ (2004), *Agricultural Microbiology*, Prentice Hall Private Ltd
- Tisdale SL, Nelson WL and Beaton JD (1985), *Soil Fertility and Fertilizers*, Macmillan Technology and Engineering
- Steward FC (1963), *Inorganic Nutrients of Plants*, Elsevier Publications
- Atlas RM (1998), *Microbial Ecology, Fundamental and Application*, 4<sup>th</sup> Edition, Benjamin/Cummings Publishing Company Inc
- Tortora GJ, Funke BR and Case CL (2010), *Microbiology: An Introduction*, Benjamin/Cummings Publishing Company Inc
- Subba Rao NS (2007), *Soil Microbiology*, Oxford Publications, New Delhi
- Singh RN (1961), *The Role of Blue Green Algae in Nitrogen Economy of Indian Agriculture*, ICAR. New Delhi



8. Somasegran P and Hoben H (1994), *Hand book of Rhizobia, Methods in Legume Rhizobium Technology*, University of Hawaii. NiFTAL Project
9. Venkaraman GS (1972), *Algal Fertilizer and Rice Cultivation*, Today and Tomorrow's Printers and Publishers, New Delhi

## **MB 572 Practical on (MB 568 + MB 569)**

Course Title: Practical on (MB 568 + MB 569)

Course No.: MB 572

Nature of Course: Practical (2 credits)

Full Marks: 50

Pass Marks: 25

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)

Course No.: MB 573

Nature of Course: Practical (2 credits)

Full Marks: 50

PassMarks: 25

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*

Course	Course Title	Nature	Credits	Evaluation
<b>Compulsory courses</b>				
MB 601	Research Methods and Biostatistics	T	3	75 (45+30)
MB 617	Microbial Inoculants in Agriculture, Livestock and Forestry	T	3	75 (45+30)
MB 618	Applied Soil Microbiology	T	3	75 (45+30)
MB 619	Microbial Diseases and Agriculture Biotechnology	T	3	75 (45+30)
MB 620	Practical on (MB 617 + MB 618)	P	2	50
MB 621	Practical on (MB 619)	P	2	50
<b>Total</b>			<b>16</b>	<b>400</b>

## **MB 601 Research Methods and Biostatistics**

Course Title: Research Methods and Biostatistics  
Course No.: MB 601  
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. 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*, 8<sup>th</sup> 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**

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
3. Steward FC (1963), *Inorganic Nutrients of Plants*, Elsevier Publications
4. Atlas RM (1998), *Microbial Ecology, Fundamental and Application*, 4<sup>th</sup> Edition, Benjamin/Cummings Publishing Company Inc.
5. Tortora GJ, Funke BR and Case CL (2010), *Microbiology: An Introduction*, Benjamin/Cummings Publishing Company Inc
6. Subba Rao NS (2007), *Soil Microbiology*, Oxford Publications, New Delhi

7. Singh RN (1961), *The Role of Blue Green Algae in Nitrogen Economy of Indian Agriculture*, ICAR. New Delhi
8. Somasegran P and Hoben H (1994), *Hand book of Rhizobia, Methods in Legume Rhizobium Technology*, University of Hawaii. NiFTAL Project
9. Venkaraman GS (1972), *Algal Fertilizer and Rice Cultivation*, Today and Tomorrow's Printers and Publishers, New Delhi

## MB 618 Applied Soil Microbiology

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

Full Marks: 75  
Pass Marks: 37.5  
Semester: III

### Objectives

Upon completion of the course the student will be able to

- Understand the role of major soil flora and fauna in crop productivity
- Apply the role of soil microorganisms in soil health
- 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., *Volvariella* 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

- Suman BC, Sharma V, Suman B and Sharma VP (2007), *Mushroom Cultivation in India*, Daya Publishing House
- Choudhary GR (1995), *Biological Degradation and Bioremediation of Toxic Chemicals*, Timber Press, Portland.
- Subba Rao NS (2007), *Soil Microbiology*, Oxford Publications, New Delhi



4. Dubey RC and Maheshwari DK (2013), *A Textbook of Microbiology*, S Chand and Company.
5. Dubey RC (1998), *A Textbook of Biotechnology*, S Chand and Company
6. Crawford JH (1983), *Composting of Agricultural Waste: A Review*, Biochem 1, 2: 14-18
7. Raymond L (1974), *Agriculture Waste Management*, Elsevier Inc
8. Shuler ML (1980), *Utilization and Recycle of Agriculture Wastes and Residues*, CRC Press
9. Bahl Nita (1984), *Handbook on Mushrooms*, Oxford & IBH Publishing Co; New Delhi
10. Chang ST and Miles PG (1989), *Edible Mushrooms and Their Cultivation*, CRC Press: Florida (USA)
11. Garcha HC (1984), *A Manual on Mushroom Growing*, Punjab Agricultural University; Ludhiana
12. Kapoor JN (1989), *Mushroom Cultivation*, ICAR, New Delhi Publication

## **MB 619 Microbial Diseases and Agricultural Biotechnology**

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

Full Marks: 75  
Pass Marks: 37.5  
Semester: III

### **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), Potyvirus group – potato virus Y (PVY), Tymovirus group – cucumber mosaic virus (CMV), Tomato spotted wilt virus (TSWV), Cauliflower mosaic virus (CaMV), Potato leaf roll virus (pulerovirus), 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

<b>Biosafety Issues</b>	<b>2 hrs</b>
Biosafety issues in use of transgenic plants	
<b>Patents</b>	<b>2 hrs</b>
National legislation, patents of indigenous microbes and plants	
<b>Tissue Culture</b>	<b>6 hrs</b>
Explant culture, callus formation and culture, organogenesis, root culture, shoot culture, cell culture, somatic embryogenesis, protoplast culture	
<b>Indigenous Fermentation Products of Nepal</b>	<b>3 hrs</b>

### 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 Nematology*,
5. Robertson HD, Hovvell SH, Zaitlin M, Mamberg RL (1983), *Plant Infectious Agents: Viruses, Viroids, Virusoids and Satellites*, Cold Spring Harbor, New York.
6. Garrett SD (1970), *Pathogenic Root Infecting Fungi*, Cambridge University Press
7. Natash S, Chopra VL and Ramachandran S (1987), *Biotechnology in Agriculture*, Oxford and IBH Publishers Co, New Delhi
8. Bhojwani SS and Dantu PK (2013), *Plant Tissue Culture: An Introductory Text*, Springer. India
9. Bhojwani SS and Rajdan MK (1983), *Plant Tissue Culture: Theory and Practice*, Elsevier: Amsterdam, Oxford
10. Tuite J (1969), *Plant Pathological Methods. Fungi and Bacteria*, Burgess: Minneapolis, Minnesota
11. Agarios GN (1988), *Plant Pathology*, 3<sup>rd</sup> Edition. Academic Press, New York
12. Thorpe TA (1981), *Plant Tissue Culture- Methods and Application in Agriculture*, Academic Press: New York, London

## **MB 620 Practical on (MB 617 + MB 618)**

Course Title: Practical on (MB 617 + MB 618)

Course No.: MB 620

Nature of Course: Practical (2 credits)

Full Marks: 50

Pass Marks: 25

Semester: III

### **Course Contents**

1. Identification and mass multiplication of selected Bacterial inoculants: *Azotobacter*, *Azospirillum*, *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*

Course	Course Title	Nature	Credits	Evaluation
<b>Compulsory courses</b>				
MB 657	Agriculture based Internship	P	8	S/US
MB 658	Dissertation	P	8	200
<b>Total</b>			<b>16</b>	<b>200</b>

S/US- Satisfactory (Pass)/unsatisfactory (Fail)

## **MB 657 Agriculture based Internship**

Course Title: Agriculture based Internship

Course No.: MB 657

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 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 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.