

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

Revised Curriculum 2017



Tribhuvan University
Kirtipur, Kathmandu

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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

Grade	CGPA	Percentage Equivalent	Performance Remarks
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

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
Compulsory courses				
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
Total			16	400

Discipline I: Public Health Microbiology

Semester II

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
Compulsory courses				
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
Total			16	400

Semester III

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
Compulsory courses				
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
Total			16	400

Semester IV

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

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
Total			16	400

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
Total			16	400

Semester IV

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

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)
Compulsory courses				
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
Total			16	400

Semester III

Course code	Course Title	Nature of Course	Credits	Evaluation (40% internal assessment)
Compulsory courses				
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
Total			16	400

Semester IV

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

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

Discipline IV: Agriculture Microbiology

Semester II

Course	Course Title	Nature	Credits	Evaluation
Compulsory courses				
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
Total			16	400

Semester III

Course	Course Title	Nature	Credits	Evaluation
Compulsory courses				
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
Total			16	400

Semester IV

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

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)
Compulsory courses				
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
Total			16	400

MB 501 Advances in Microbiology

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

Full Marks: 75
Pass Marks: 37.5
Semester: I

Objectives

Upon the completion of the course students will have knowledge on

- a. Bacterial and viral taxonomy
- b. Structure and physiology of bacteria, virus and fungi
- c. Transport system and pathways of protein secretion
- d. Growth and recovery of bacteria and bacteriophage

Course Contents

Bergey's Classification of Bacteria

7 hrs

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*, 10th Edition, Prentice-Hall International
3. Prescott LM, Haley JP and Klein DA (2005), *Microbiology*, 7th 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*, 3rd Edition, W B Saunders Co
2. Abbas AK, Lichtman AH and Pillai S (2007), *Cellular and Molecular Immunology*, 6th Edition, Elsevier
3. Kindt TJ, Goldsby RA and Osborne BA (2006), *Kuby Immunology*, 6th Edition, W. H. Freeman
4. Roitt IM and Delves PJ (2001), *Roitt's Essential Immunology*, 10th 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

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

References

1. Lewin B (2007), *Genes IX*, Oxford University Press and Cell Press
2. Snyder L and Champness W (2003), *Molecular Genetics of Bacteria*, 2nd Edition, ASM Press
3. Sambrook J and Russell DW (2001), *Molecular Cloning: A Laboratory Manual (Vol I, II and III)*, 3rd 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 B₁₂) Amino acids (Glutamic acid, Lysine, Tryptophan), Nucleic acids, Organic acids (Citric acid, Lactic acid, Kojic acid), Enzymes (Amylase, Protease, Glucose isomerase), Alcoholic beverages (Wine, Beer, Distilled liquor-whisky), Fermented Foods (*Kinema*, Soya sauce, *Natto*, *Kimchi*), Single cell protein

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

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

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

References

1. Nelson DL and Cox MM (2004), *Lehninger Principles of Biochemistry*, 5th Edition, Freeman
2. Plummer DT (1988), *An Introduction to Practical Biochemistry*, 3rd Edition, Tata McGraw Hill
3. Skoog DA, Holler FJ and Nieman TA (2005), *Principles of Instrumental Analysis*, 5th Edition, Thomson Books/Cole
4. Stryer L (1995), *Biochemistry*, 4th Edition, W.H. Freeman Company, New York
5. Voet D and Voet J (2004), *Biochemistry*, 3rd Edition, Wiley International Edition
6. Wilson K and Walker J (Eds)(2005), *Principles and Techniques of Biochemistry and Molecular Biology*, 6th Edition, Cambridge University Press
7. Mendham J, Denny RC, Barnes JD and Thomas M (2008), *Vogel's Text Book of Quantitative Chemical Analysis*, 6th 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***.
2nd Edition, T. D. Brock's Editor, Sunderland Mass Sinauer Associates
10. Smith JE (1996), ***Biotechnology***, 3rd 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
		Compulsory courses
MB 551		Human Anatomy and Physiology
MB 552		Applied Environmental Microbiology
MB 553		Fundamentals of Epidemiology
MB 554		Microbial Systematics
MB 555		Practical on (MB 551 + MB 552)
MB 556		Practical on (MB 553 + MB 554)
		Total

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*, 10th Edition, Indian Print: Saunders
2. Standring S (2005), *Gray's Anatomy: The Anatomical Basis of Clinical Practice*, 39th 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*, 4th Edition, The Benjamin Cummins Publication Co. Inc
3. Bitton G (2011), *Wastewater Microbiology*, 4th Edition, Wiley and Sons
4. Hurst CJ (2001), *A Manual of Environmental Microbiology*, 2nd 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*, 3rd Edition, Cambridge University Press
11. Service M (2008), *Medical Entomology for Students*, 4th 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*, 4th Edition, Oxford University Press
2. Gordis L (2004), *Epidemiology*, 3rd Edition, Elsevier Saunders
3. Park K (2007), *Park's Textbook of Preventive and Social Medicine*, 19th 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*, *Loaloa*

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)*, 12th Edition, Chatterjee Medical Publishers, Calcutta.
2. Greenwood D, Slack R, Barer M and Irving W (2012), *Medical Microbiology*. 18th Edition, Churchill Livingstone
3. John DT and Petri Jr WA (2006), *Markell and Voge's Medical Parasitology*, 9th 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, 3rd Edition Lippincott-Raven, Philadelphia, PA
5. Larone DH (2002), *Medically Important Fungi: A Guide to Identification*, 4th Edition, ASM Publications

6. Murray PR, Rosenthal KS and Pfaller MA (2005), *Medical Microbiology*, 5th Edition, Elsevier Mosby
7. Geoffrey R, Smith and Charles SF, Easmon Ed (1990), *Topley and Wilson's Principles of Bacteriology, Virology and Immunity*, 8th 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)
Compulsory courses				
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
Total			16	400

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*, 8th 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*, 20th 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*, 17th Edition, Churchill Livingstone
4. Park K (2005), *Park's Textbook of Social and Preventive Medicine*, 18th 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 Tenover FC (eds) (1990), *Bailey and Scott's Diagnostic Microbiology*, 9th 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 Simmonds A (eds) (1996), *Mackie and McCartney Practical Medical Microbiology*, 14th Edition, Churchill Livingstone, New York
5. Cook G (1996), *Manson's Tropical Diseases*, 20th 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 and Tenover FC (ed) (2003), *Manual of Clinical Microbiology*, 8th 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*, 8th 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)
Compulsory courses				
MB 651	Hospital/Field based Internship	P	8	S/US
MB 652	Dissertation	P	8	200
Total			16	200

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
Total			16	400

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*, 10th Edition, Indian Print: Saunders
2. Standring S (2005), *Gray's Anatomy: The Anatomical Basis of Clinical Practice*, 39th 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

- 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

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, phagotyping, 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*. 14th 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*, 8th 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*, 8th 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*, 3rd 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)*, 12th 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*, 3rd Edition, ASM Press
5. John DT and Petri Jr WA (2006), *Markell and Voge's Medical Parasitology*, 9th 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*, 4th 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 TCID₅₀
3. Detection of virus/viral gene/viral antigen/antiviral antibody by ELISA, Immunofluorescence assay, Haemagglutination, Agar gel diffusion, Polymerase Chain Reaction
4. Use of rapid test kits for the diagnosis of viruses
5. Demonstration of Electron Microscopy
6. Preparation of high titre bacteriophage stocks and one step growth curve experiments

Systemic and Diagnostic Parasitology

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

Discipline II: Medical Microbiology

Semester III

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
Total			16	400

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*, 8th 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*, 14th 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 Caliciviruses and Astroviruses	2 hrs
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 Types of viral vaccines, Vaccines recommended in Nepal, Other viral vaccines, Antiviral drugs	10 hrs

References

1. Topley WWC and Wilson GS (1990), Parker MT and Collier LH (Editor), *Topley and Wilson's Principles of Bacteriology, Virology and Immunity*, 8th 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*, 3rd 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*, *Coccidioidomycoses*, *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*, 8th 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)
Compulsory course				
MB 653	Hospital Based Internship	P	8	S/US
MB 654	Dissertation	P	8	200
Total			16	200

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)
Compulsory courses				
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
Total			16	400

MB 562 Food Fermentation Technology

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

Full Marks: 75
Pass Marks: 37.5
Semester: II

Objective

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

- a. Understand the role, function, and implication of microorganisms in the bio-processing, preservation, safety and nutritional enrichment of food resources

Course Contents

Fermentation and Biochemical Engineering **15 hrs**

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

Microbiology of Fermented Foods **15 hrs**

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

Food and Enzymes from Microorganisms **6 hrs**

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

Isolation and Improvement of Industrial Microorganisms **9 hrs**

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

References

1. Banwart GJ (1987), *Basic Food Microbiology*, 1st Edition, SK Jain for CBS Publisher and distributors, Delhi
2. Bailey JE and Ollis DF (1986), *Biochemical Engineering Fundamentals* (2nd 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* (2nd 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*, 3rd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi
2. Jay JH (1987), *Modern Food Microbiology*, 3rd Edition CBS. Pub and Distributors, Delhi
3. ICMSF (2005), *Microbial Ecology of Food Commodities*, 2nd 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)
Compulsory courses				
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
Total			16	400

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*, 8th 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*, 2nd Edition, CRC Press, Taylor and Francis group, New York
2. Owen R. Fennema (1996), *Food Chemistry*, 3rd Edition, Marcel Dekker, New York
3. John M. deMan, (1999), *Principles of Food Chemistry*, 3rd Edition, Aspen Publishers, Inc. Gaithersburg, Maryland
4. Berdanier CD, Dwyer J and Feldman EB (2008), *Handbook of Nutrition and Food*, 2nd 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*, 5th Edition, Food Science Text Series, Springer Link
3. McSwane D, Rue NR and Linton R (2004), *Essentials of Food Safety and Sanitation*, 4th 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 SO₂, Benzoic acid in food
9. Assay of amino acids and vitamins in food
10. Determination ascorbic acid, sugar content of fruit juice

MB 616 Practical on (MB 613+MB 614)

Course Title: Practical on (MB 613+MB 614)

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)
Compulsory courses				
MB 655	Industry based Internship	P	8	S/US
MB 656	Dissertation	P	8	200
Total			16	200

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
Compulsory courses				
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
Total			16	400

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 Cometalobism 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*, 9th 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*, 4th 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*, 2nd 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, Phenylcarbamates, Phenylureas, Thiocarbamates, PCNB, Chloroneb, Mercurial 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*, 4th 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

- a. Understand the effect and utilize the commercial inorganic, organic fertilizer and biofertilizer
- b. Use organic green manuring for better yield of crop

Course Contents

Chemical Fertilizers

5 hrs

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

Biofertilizers

2 hrs

Importance of Biofertilizers in the present context

Microorganisms used in Biofertilizers

23 hrs

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

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
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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
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8. Somasegran P and Hoben H (1994), *Hand book of Rhizobia, Methods in Legume Rhizobium Technology*, University of Hawaii. NiFTAL Project
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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
Compulsory courses				
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
Total			16	400

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*, 8th Edition, Wiley
2. Mahajan BK (2007), *Methods in Biostatistics for Medical Students and Research Workers*, Jaypee Brothers Medical Publishers Pvt. Ltd, India

MB 617 Microbial Inoculants in Agriculture, Livestock and Forestry

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

Objectives

Upon completion of the course the student will be able to

- a. Understand how to prepare microbial inoculants in mass scale
- b. Carry out different methods of using the inoculants on seed and soil
- c. Have knowledge of crop response to microbial inoculants

Course Contents

Importance of Microbial Inoculants in Agriculture, Livestock and Forestry	2 hrs
Types and Methods of Mass Production of Bacterial Inoculants	18 hrs
<i>Azotobacter</i> inoculants	
<i>Azospirillum</i> inoculants	
Rhizobial inoculants	
Blue Green Algal inoculants	
Mycorrhizal inoculants	
<i>Frankia</i> 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
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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

- Understand the use of biotechnology in agriculture
- Apply the biotechnology to identify microbial plant diseases
- 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 (polerovirus), Rice tungro virus, mosaic disease of sugarcane;
Transmission of plant viruses: mechanical transmission, vegetative and graft transmission, pollen transmission, seed transmission, nematode transmission, fungal transmission, insect vector transmission, dodder transmission
Effect of virus on plant: external and internal symptoms
Viroids, virusoids and satellites

Bacterial Plant Diseases and Detection

8 hrs

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

Fungal Plant Diseases and Detection

10 hrs

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

Nematodal Plant Diseases

2 hrs

Characteristics, symptoms, identification and control of Sugar beet cyst nematode, Soyabean cyst nematode, Burrowing nematode affecting bananas.

Green Revolution

2 hrs

Green revolution, Benefits, disadvantages and limitations of green revolution

Transgenic Plants

3 hrs

Genetically modified plants: Production of disease resistant and stress resistant plants

Ecological Consideration in Release of Transgenic Plants

2 hrs

Public acceptance, Benefits of transgenic plants

Biosafety Issues **2 hrs**
Biosafety issues in use of transgenic plants

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

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

Indigenous Fermentation Products of Nepal **3 hrs**

References

1. Dubey RC and Maheshwari DK (2013), *A Textbook of Microbiology*, S Chand
2. Subba Rao NS (2007), *Soil Microbiology*, Oxford Publications, New Delhi
3. Walia RK and Bajaj HK, *Text Book on Introductory Plant Nematology*
4. Dropkin VH, *Introduction to Plant Nematology*,
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9. Bhojwani SS and Rajdan MK (1983), *Plant Tissue Culture: Theory and Practice*, Elsevier: Amsterdam, Oxford
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11. Agarios GN (1988), *Plant Pathology*, 3rd 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
Compulsory courses				
MB 657	Agriculture based Internship	P	8	S/US
MB 658	Dissertation	P	8	200
Total			16	200

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.