Institute of Science and Technology

Master of Science in Microbiology

M.Sc. Microbiology

Curriculum

1999

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Master of Science in Microbiology

M.Sc.Microbiology

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Introuction:

Microbiology is one of the youngest branches of biological science. At the beginning, this subject was included either in Botany or in the Azoological field and was considered as a minor branch of these subjects. As there is the introduction of genetic engineering as revolutionary science, microbiology is being the research tool. In recent years, it is one of the main subjects of research throughout the world.

In Nepal, the undergraduate study of Microbiology was started in Tribhuvan University at Tri-Chandra college in 1979. After 11 years of two years B.Sc. programme in Tri- Chandra college , Central Department of Microbiology was established in Tribhuvan University , Kirtipur in 1990 to conduct M.Sc. programme in Microbiology.

In 1996 TU. has introduced three years Bachelor's programme with new curriculum and some part of the existing masters course has been transferred to the third year Bachelor level, there is an urgent need for a new M.Sc course. In order to fill the gap, the new course has been proposed. The other reason for the new M.Sc. course is that the previous one not only was classical but also has not been revised since its introduction in 1990. Hence, in order to make the course more competitive and at least up to the SAARC standard, the new course of study was proposed. It was also felt that the new course should be more applied and research oriented in nature. This course will hopefully therefore meet the demands of the different sectors of the country.

Eligibility for Admission:

The candidates who have passed B.Sc. Degree with major in Microbiology from Tribhuvan University or Equivalent Degree from Tribhuvan University or any other university recognized by Tribhuvan University shall be considered eligible to apply for the Admission to M.Sc. Microbiology.

Admission Criteria:

An applicant seeking admission to M.Sc. Microbiology must appear in an Entrance Examination of two hours' duration conducted by the Central Department of Microbiology / Campus. An applicant who fails to appear in the Entrance Examination or fails to obtain a minimum qualifying score will not be allowed admission. A merit list of the qualified applicants will be prepared on the basis of the percentage of their B. Sc. Examination and the marks obtained by them in the Entrance Examination. Admission of the students will be based strictly on the merit list and the enrolment capacity of the Central Department of Microbiology / Campus.

Objectives:

The new course will meet the objectives:

1. To make the course compare with SAARC standard. This will help the degree holders to pursue other degree course in international institutions and compete academically with the products of other universities.

2. To make the course relevant to the needs of the country for different sectors like in Environmental, Medical, Food and Agricultural fields.

3. To acquaint the students with the latest discoveries related with Microbiology and their relevant applications.

To meet the above objectives, the new course has been designed in the following course cycle:

Course Cycle For M.Sc. Microbiology

M.Sc. Ist Year.

Course No.	Course Title	Full Marks	Pass Marks
MB 511	Microbial Structure Physiology and Genetics	100	40
MB 512	Epidemiology, Immunology and Biostatistics	100	40
MB 513	Biochemistry, Total Quality Management and Quality Assurance	100	40
MB 514	Instrumentation and Biotechnology	100	40
MB 515	Practical Course on (MB511+ MB512)	50	20
MB 516	Practical Course on (MB513 + MB514)	50	20
	Total	500	

The above papers are compulsory for all M.Sc. Ist year Microbiology students

M.Sc. IInd Year

Course No.	Course Title	Full Marks	Pass Marks
	I Environmental Microbiology		
MB.611	Microbial Ecology	100	40
MB.612	Pollution Microbiology	100	40
MB.613	Public Health Microbiology	100	40
MB.614	Environmental Microbiology (Practical)	100	40
MB.615	Dissertation	100	40

Course No.	Course Title	Full Marks	Pass Marks
	II Medical Microbiology		
MB.621	Anatomy, Physiology and Immunology	100	40
MB.622	Bacteriology (Diagnostic and Systematic)	100	40
MB.623	Virology, Mycology and Parasitology	100	40
MB.624	Medical Microbiology (Practical)	100	40
MB.625	Dissertation	100	40

Course No.	Course Title	Full Marks	Pass Marks
III Food Microbiology			
MB.631	General Food Microbiology	100	40
MB.632	Applied Food Microbiology and Biotechnology	100	40
MB.633	Food Preservation and Quality Control	100	40
MB.634	Food Microbiology (Practical)	100	40
MB.635	Dissertation	100	40
Course No.	Course Title	Full Marks	Pass Marks
Agricultural Microbiology			
MB.641	Soil Microbiology & Microbial Population	100	40
MB.642	Plant Microbiology	100	40
MB.643	Soil Fertility and Fertiliser Effect	100	40
MB.644	Agricultural Microbiology (Practical)	100	40
MB.645	Dissertation	100	40

In the second year there are four different optional groups each carrying 500 marks. One has to study one of them. Though there are four different optional groups to choose from the Microbiology Subject Committee can offer at least two groups or more in a year depending upon the facilities available at the Department.

Course Duration:
The entire course is spread over two academic years. There will be a separate yearly examination after the end of each academic year.

Hours of Instruction:

a) Working days : 150 days in an academic year.

b) Class hour :

i) Theory: One theory paper of 100 marks will have 4 hours of lecture per week.

ii) Practical: One practical paper of 100 marks will have 16 hours of practical per week and that for 50 marks will have 8 hours of practical per week

c) Attendance : 70 percent attendance in the class is compulsory.

Examination:
All the students will have to appear in four hours' examination for theoretical courses each carrying 100 marks. Twelve hour long practical examination will

be conducted for 100 marks practical course and 6 hours practical examination will be conducted for 50 marks practical course.

Evaluation:

Institute of Science and Technology, Tribhuvan University will conduct annual examinations. The students will have to pass each level and each course numbers separately. The minimum pass marks is 40 percent, both for theory and practical.

A student having passed his / her two years of study will be graded on the basis of the two years' average marks as follows:

75 percent and above	Distinction
60 percent and above	First Division
50 percent and above	Second Division
40 percent and above	Third Division

Microbial Structure, Physiology and Genetics
M.Sc. Microbiology
First Year

Course Title: Microbial Structure, Physiology and Genetics — Full Marks: 100
Course No. MB 511 — Pass Marks: 40
Nature of Course: Theory — Year: I

Objective of Courses:

- To define and describe different forms of microorganisms;
- To describe the morphology and classification of different groups of microorganisms;
- To explain the factors influencing growth of microorganisms;
- To identify the critical points on the different physiology of microorganisms and its significance;
- To understand and describe the reproductive system of different groups of microorganisms; and
- To give detailed knowledge on the prokaryotic and Eukaryotic genetics.

Course Contents

Microbial Structure and Physiology.

Bacterial Classification: History, Basis of classification, classes of Bacteria characteristic of major groups of Bacteria e.g.:- Enterobacter, Bacillus, Mycobacterium, Gram positive cocci. **10 hrs**

Molecular Architecture and Chemical Composition of Bacterial Cell: Cell wall structure, bacterial cell membrane - structure and physiology, capsule and its function, spore and its significance. Lipopolysaccharide walls and its significance. **8 hrs**

Bacterial Growth: Growth in individual cell, continuous growth kinetic of cell growth, growth curve, synchronization procedures. Measuring of microbial growth in terms of number, volume and biomass. **4 hrs**

Bacterial Metabolisms:- Transport mechanism of nutrients, Respiration and fermentation, different types of fermentation. Major energy pathways and its significance: Embden Mayerhof-parnes Scheme, Warburgh- Dickens pathway, Entner-Doudoroff pathway, Kerbs cycle. Electron transfer, respiratory chain and oxidative phosphorylation. **10 hrs**

Fungi, Structure, and Physiology: Nature of fungi, classification of fungi, cultivation and growth of mould, structure of mould. Introduction of yeast, ultramicroscopic structure of yeast cell, reproduction and life cycle of yeast growth factors of yeast. Morphology of Actinomycetes. **8 hrs**

General Virology: Nature of viruses, structure of viruses. Shape of viruses, Isolation of viruses. Tissue culture of virus, measurement of virus. Lytic and transducing phases stages and its life-cycle: classification of viruses and basis of classification, replication and genetics. **14 hrs**

Microbial Genetics

The Molecular nature of the Genetic Material in Prokaryotic and Eukaryotic Cells: DNA: Molecular structure primary , secondary and tertiary, the Double helix , types; RNA: Molecular structure , types **2 hrs**

DNA Replication and Gene Expression: DNA Replication: Semiconservative Nature of DNA Replication, DNA Replication in Prokaryotic Cells, DNA Replication in Eukaryotic, Enzymes Involved in DNA Replication: Topoisomerases, Helicases, DNA Polymerases; Proofreading, Post - replication Modification of DNA. **10 hrs**

Trancription : Transferring information from DNA to RNA, Synthesis of RNA, RNA polymerase, Initiation and Termination of Transcription, Post transcription modification of the RNA. **5 hrs**

Protein Biosynthesis: translation of the genetic code, Genetic code, Translation of m RNA, Role of RNA in protein synthesis, Forming the polypeptides- elongation, Termination of the protein biosynthesis. **8 hrs**

Regulation of the Gene Expression: Regulating the Metabolism of lactose: the Lac- Operon, Catabolic repression, The trp Operon: regulating the biosynthesis of the tryptophan, Gene expression in Eucaryotic cells; Plasmids: Types, Maintainence of Plasmids, Function of plasmids. **10 hrs**

Mutations: Definition and Types of Mutation: Lethal Mutation, Nutritional mutation, Base substitution, Missense Mutation, Silent Mutation, Nonsense Mutation, Framshift Mutation, Suppressor Mutation; Mutation Rates Detection of Mutants: Replica plating; Complementation; Mutagenic agents: Radiation, Chemical mutagens; Ames tests; Photoreactivation; Recombination: Types, Homologous and Non Homologous, Transposable genetic elements, Insertion sequence, Transposon, Transposon mutagenesis. **10 hrs**

DNA Transfer in Procaryote: Transformation, Transduction, Generalized and Specialized, Conjugations, Genetic mapping. **8 hrs.**

Recombinant DNA Technology: Gene cloning, Protoplast fusion, DNA for Cloning, Formation of the Recombinant DNA, Cloning vectors, Expression vectors, Detection of the recombinant DNA, Cloning the Eucaryotic genes in bacteria, Benefit and Risk recombinant DNA technology. **8 hrs**

Basic Idea of Molecular Techniques: Extraction of DNA, RNA and Plasmids, PCR, PFGE, RFLP, DNA Finger printing, Western, Southern and Northern Blotting. **5 hrs**

Textbooks

1. Thomas D Brock and Michael T. Madigan : *Biology of Microorganisms* ,Prentice-Hall International. (1995)
2. Roger Y. Stanier, Edward A. Adelberrg and John L. Ingraham : *General Microbiology* ,The Macmillan Press Ltd. (1998)
3. Lewin B : *Genes VI*., Oxford University Press.
4. Atlas, R.M., *Principles of Microbiology*, Mosby Publisher.

Epidemiology, Immunology & Biostatistics

Course Title: Epidemiology, Immunology & Biostatistics — Full Marks: 100
Course No. MB 512 — Pass Marks: 40
Nature of Course: Theory — Year: I

Objectives:

- To give detailed knowledge on epidemiology, immunology and statistical aspects of diseases.
- To give practical knowledge on the epidemiological and immunological techniques which enable the students to work in different disciplines of science like clinical, public health and epidemiological fields.

Course Contents:

Epidemiology

Basic concept in the Epidemiology of Infections Diseases: History definition and principles. **3 hrs**

Measuring Health & Diseases: Definitions of health & disease measure frequency use of available information comparing disease occurrence. **3 hrs**

Environmental Factors in Epidemiology: Spread of infections, outbreak of infections, Source of infections and Route of transmission. **6 hrs**

Epidemiological Methods: Collection of observations, Descriptive analysis Epidemological survey and analytical studies, Epidemiological markers: Antigenic composition, Phagetyping, Biotyping, Antibiotic susceptibility, Potential errors in epidemiological studies ethical issues. **6 hrs**

Environmental Factors in Epidemiology: Investigation of outbreaks, preliminary inquiries, identification of cases, collection and analysis of data, control. **5 hrs**

Causation: epidemiology establishing the cause of a disease. **3 hrs**

Epidemiology & Prevention: Levels of prevention & screening. Communicable Disease epidemiology. **5 hrs**

Clinical Epidemiology: Natural history, prognosis, effectiveness of treatment, prevention in clinical practice. **6 hrs**

Environmental & Occupational Epidemiology: Environment & health, exposure & dose, Risk assessment of risk management, Special features of Environmental & occupational epidemiology, Epidemiology, health services & health policy, Hospital acquired infection & role of epidemiology in it. **10 hrs**

Role of Statistics in Epidemiology **2 hrs**

Immunology

Specific Immune Response: Lymphocytes, Antibody mediated immunity **2 hrs**

Antigens: Definition, Conditions of the antigenicity, Specificity, Types, Isoantigens, Heterophile, **4 hrs**

Antibodies: Molecular structure, Classes, Genetic basis of the Diversity, Protective effect, Harmful effect, B and T cells, Maturation of the B-cells. **10 hrs**

Antigen and Antibodies Reactions: Precipitation, Tube, Slide, Gel, Single radial immunodiffusion, Ouchterlony Double diffusion, Immunoelectrophoresis, Counter current immunoelectrophoresis. **4 hrs**

Agglutination: Tube Agglutination, Slide Agglutination, Latex particle Agglutination, Haemagglutination, Reverse Passive haemagglutination. **5 hrs**

Neutralizations Tests: Invivo, Invitro **2 hrs**

Antibodies Labelled Methods: Fluorscence, Direct, Indirect, Enzyme labelled, ELISA, Single, Double sandwiched, Radio labelled. **5 hrs**

Cell Mediated Immunoresponse: Lymphocyte Activation and Functions, Immunological Tolerance, Non specific Defense against the Microbial Infections. **3 hrs**

Physical Barriers: Skin, Mucous Membrane, Other structures, Chemical defense, Lysozymes, Acidity, Iron binding proteins. **3 hrs**

Interferon: Types, Mechanisms of actions. **2 hrs**

Complements: Classical and alternative pathways, Phagocytosis, Inflammatory Response, Fever. **3 hrs**

Hypersensitivity Reactions: Anaphylactic Hypersensitivity reactions, Antibody- mediated Hypersensitivity reactions, Immune complex mediated, Hypersensitivity reactions, Cell- mediated Hypersensitivity reactions. **5 hrs**

Biostatistics

Sampling Methods **4 hrs**

Population and Samples: Descriptive and sampling statistics parameters and estimates **6 hrs**

Frequency Distribution and Their Characteristics **4 hrs**

Significance Test: Students t, z and x^2 Tests, ANOVA **10 hrs**

Textbooks

1. Pavid Caneenwood ed : *Medical Microbiology*, RCB Slack, J.F. Pentherea ELBS
2. *Topley and Wilson's Principles of Bacteriology, Virology and Immunity Vol. 3*, DC Ddecker Inc., USA
3. B. K. Mahajan : *Biostastistics* , Jaypee Brothers Medical Publishers Pvt. Ltd., India

Biochemistry, Total Quality Management and Quality Assurance

Course Title: Biochemistry, Total Quality Management and Quality Assurance
Full Marks: 100
Pass Marks: 40
Course No. MB 513
Year: Year I
Nature of Course: Theory

Objectives:

- To upgrade the knowledge of biochemistry already acquired by the students of microbiology & to make them more competitive in various aspects of microbial biochemistry.
- To enable the students to work as teachers of biochemistry, researcher of biochemistry and quality control in various fields of biochemistry.

Course Contents:

Principles of Biochemistry: A general introduction to the science of biochemistry. Cell-fundamental unit of life. Cells composed of small molecules, macromolecules & organelles, chemical structure and biological functions of biomolecules, properties of water and aqueous solution, chemical equilibrium, thermodynamics in biochemistry, concepts of free energy. **6 hrs**

Biomolecules : Protein structure & function: Aminoacids, peptides & polypeptides. The three dimensional structures of protein; Functional diversity of proteins, methods for characterization and purification of proteins. **6 hrs**

Enzymes Catalysis & Enzyme Kinetics: Basic aspects of chemical kinetics & enzyme kinetics. Henri Michaelis - Menten equation; Effect of substrate concentration, pH, temperature & inhibitors on rates of reactions, inhibition of enzymatic reactions & kinetics, kinetics of enzymatic reactions involving two substrates, Mechanisms of enzyme catalysis; Structure and mechanisms of lysozyme; serine proteases & glutathione reductase; immobilised enzymes. **10 hrs**

Regulation of Enzyme Activities: Allosteric regulation, rate limiting enzymes, Isozymes & their roles, Enzymes & diagnosis of diseases, Nomenclature & principle of enzyme classification. **10 hrs**

Vitamins & Coenzymes: Role of vitamins, metals and other cofactors in enzyme functions. Water -soluble vitamins & their coenzymes. Thiamin pyrophosphate, pyridoxal - 5 phosphate, nicotinamide coenzyme, flavins, phosphopantetheine coenzymes (Coenzyme A), lipoic acid, biotin, folate coenzymes, Ascorbic acid, vit B_{12}, iron containing coenzymes, metal cofactors. Lipid - soluble vitamins: vit. D_3 (cholecalciferol), vit K, vit E (a - tocopherol), vit A (transretinol). **10 hrs**

Carbohydrates: Biological role: main source of energy, reserve carbohydrates, defense function, structural role, specific function. Extraction & isolation of carbohydrates. Monosaccharides, classification, structures, sugar derivatives; oligo and polysaccharides & carbohydrate analysis; structure polysaccharides; storage polysaccharides; other carbohydrates of biological interest, proteoglycans & diazoproteins structure and function. glycoproteins &

oligopeptides. Glycopeptides of micro-organisms Structure of peptidoglycan layer. Glycoproteins of mucous, bone tissue & blood plasma. Group specific properties of blood. Glycoproteins of membrane. Role of glycoproteins in recognition of molecules & cells. **8 hrs**

Lipids: Biological role of lipids, Role of lipids in providing energy and biomembrane. General properties, distribution, classification and nomenclature of lipids. Structure and properties of neutral fats & phospholipids. Glycolipids, steroid. Structural components of lipids. Hydrophobic components. Fatty acids with even & odd number of carbon atoms saturated & unsaturated fatty acids. **6 hrs.**

Conformation and Properties of Fatty Acids. Fatty alcohols, glycerol, diols, inositol, etc. Carbohydrate components, amino alcohol/sphingozine/aminoacids, phosphates, sulfates. Neutral lipids. Acylgycerides/mono, di & trigycerides. Waxes. Steroids cholesterol & its ethers. Steroid derivatives. Fatty acids & their role in lipid metabolism. Some hormones of steroid nature. **10 hrs**

Biological Membrane: Biological functions structure membrane lipids & their properties. Formation of artificial membrane, their use in biology & medicine. Dynamic properties of membrane lipids. Classification, characteristics and distribution & orientation of membrane proteins. Integral & peripheral proteins. Their functions, extraction & isolation. Movements of main proteins & lipids, Asymmetry of membrane, factors influencing on membrane fluidity. Transport of Materials across membrane. Types of transport syste:. Passive & Active. **8 hrs**

Metabolism of Carbohydrates, Proteins, and Lipids: (Basic mechanisms of metabolism and energy conversion), Metabolism and metabolic pathways. Linear, cyclic and spiral metabolic pathways. ATP as a cellular energy currency, NAD+ and NADP+/NADH & NADPH (Oxidizing & reducing agents) **3 hrs**

Metabolism of Proteins and Aminoacids.: Catabolism Enzymatic hydrolysis of proteins proteolytic enzymes & their specificity. Modern concepts of activation of proteolytic enzymes. Degradation of aminoacids in organisms. Transamination and its mechanism. various types of deamination. Urea cycle, link between urea cycle Kreb's cycle. Metabolism of Ammonia. Deamination & carboxylation of aminoacids ketogenic & glucogenic amino acids. Essential & non-essential aminoacids. Amines & their physiological role. proteineous nitrogeneous substances & their bio synthesis, degradation & biological functions. **6 hrs**

Metabolism of Carbohydrates: Interconversion of carbohydrates. Coenzymatic functions of nucleotides (e.g. UTP UDP). Anaerobic and aerobic degradation of carbohydrates. Different types of fermentation. Glycolysis. Oxidative phosphorylation in the level of substrate . Glyconeogenesis Oxidative degradation of glucose 6 phosphate (pentose pathway) & its significance. Oxidative decarboxylation of pyruvic acid. Pyruvate dehydrogenase complex. Cycle of di- and tri-carbonic acids & their biological role. Terminal processes of oxidation. Electron transport system (Respiratory chain). Energetic significance of cascade process of electron transport from

substrate to oxygen. Oxidative phosphorylation of respiratory chain. Concept of conjugated oxidation and phosphorylation in respiratory chain. Transmembrane potential of hydrogen ions. Energetic effect of glycolysis & respiration. Gluconeogenesis: substrates of gluconeogenesis (lactate, pyruvate & other C_3 compounds, acetate, glyoxylate) **6 hrs**

Metabolism of Lipids: Enzymatic degradation of triglycerols & absorption by cell membrane. Degradation of fatty acids by β-oxidation. β-oxidation in mitochondria (eukaryotic cells) & bacteria (prokaryotic cells), steps & enzymes involved in β-oxidation. Large amount of ATP generation (yield) on complete oxidation of fatty acids, Additional enzymes required for oxidation of unsaturated fatty acids.Biosynthesis of Fatty acids-seven reactions catalyzed by fatty acid synthase, different routes of biosynthesis & degradation. biosynthesis of neutral fats & phospholipids, & cholesterol. **8 hrs**

General Secondary Metabolites: Interaction between metabolism of proteins, carbohydrates & lipids metabolism United system of process **3 hrs**

Nucleic Acids and Their Metabolism: Structure of Nucleic acids. Purines & pyrimidines bases. Carbohydrate components. Mononucleotides. Nucleoside mono, di- and tri-phosphates. DNA & RNA, their localization in cell. Biosynthesis of nucleosides. degradation of nucleotides various enzymes involved in degradation of Nucleic acids. Biosynthesis & degradation of nitrogenous bases. **8 hrs**

Total Quality Management and Quality Assurance: Principle and Methods for Quality Control, Quality Assurance and Quality Auditing. **14 hrs**

Textbooks:

1. Geoffrey L. Zubay William W. Parson Dennis E. Vance *Principles of Biochemistry* W. M. C. Brown Publsihers 1995.
2. J. David : *Biochemistry, International edicition* ,Rawn Towson state University Neil Patterson Publishers. North Carolina. 1989.

Instrumentation and Biotechnology

Course Title: Instrumentation and Biotechnology
Course No. MB 514
Nature of Course: Theory

Full Marks: 100
Pass Marks: 40
Year: Year I

Objectives:

- To give detailed knowledge on various biochemical techniques and instrumentation, required for conducting analysis and research.
- To enable the students to use various biochemical techniques and instruments.

Course Contents:

Instrumentation (Biochemical Techniques): General principles & approaches to biochemical investigations. In vivo, in vitro studies, physiological solutions: Buffer solutions, Microbial cell media, higher plant cell media, Animal cell media, Media for tissue homogenization & separation. **4 hrs**

Cell Disruption: Introduction, methods of disruption of tissues and cells. Protein purification: Background factors, protein extraction, preliminary fractionation procedures, chromatographic & electrophoretic techniques, monitoring the purification process. **5 hrs**

Basic Methods of Separation and Extraction of Substances in Biochemical Investigation. **2 hrs**

Introduction, Principle, Types and Uses: Centrifugation techniques, Filtration, Gel Filtration, Chromatography, Paper Chromatography, Thin layer chromatography, Column chromatography, Ion exchange chromatography, Affinity Chromatography, Electrophoretic techniques, Spectrophotometry, Fluorimetry & spectrofluorimetry, Microscopy **51 hrs**

Biotechnology

Introduction : History and definition, scope and importance of Biotechnology, Biotechnology a three component central core, interdisciplinary nature & Biotechnology and the developing world. **5 hrs**

Plant Cell and Tissue Culture: definition, culture media, cell culture technique & application, micropropagation, somaclonal variation endoseperm and nucellus culture, germplasm storage including cryopresevation, production haploids uses of haploids in plant breeding, protoplast culture & regeneration of plants, protoplast fusion and somatic hybridization, cytoplasmic hybrid or cybrid. **7 hrs**

Animal Cell and Tissue Culture:- Basic techniques embryo transfer, transgenic animals, genetically engineered hormones and vaccines from animal tissue xenoplantation. **5 hrs**

Biofertilizer: Bacterial biofertilizer including cynobecteria, mycorrhizae as biofertilizer, benefits from biofertilizer. **4 hrs**

Biopesticides: Antagonism, amensalism, competition, predation and parasitism, microbial pesticides bacterial, viral and fungal pesticide: insects as biological control. **5 hrs**

Gene Transfer and Production of Transgenic Plants: Target for transformation, vector gene transfer (based on Ti & Ri plasmid, intermediate & helper plasmid, binary vector, viruses as vectors, gene transfer technique using *Agrobacterium* transfer technique. Agroinfection and gene transfer, physical delivery method or DNA mediated gene transfers (DMGT),PEG stimulated microinjection, particle gun, electroporation etc, Transgenic plants for crop improvements, transgenic plants for molecular farming, transgenic plants to study regulated gene expression. **8 hrs**

Microbial Biotechnology: Microorganisms of industrial importance, microbial growth kinetics fermentation; solid state fermentation and submerged state fermentation. Design of fermenter, fermentation process, product recovery (extracellular and intracellular products). Alcohol beverages, organic acids and aminoacids, vitamins, enzymes, production of medically important byproducts; antibiotics, human growth hormones, interferon, insulin, vaccines, monoclonal antibodies. **10 hrs**

Biotechnology and Intellectual Property: Intellectual property right and intellectual property protection, patenting of biological material, patents protection, trade secrets. **5 hrs**

Biohazards and Bio-safty in Biotechnoloy: problems of organism pathogenecity, problems of biologically active biotechnological products. **3 hrs**

Handling of Lab Animals: Animal houses & its equipments, feeding & breeding methods, stock recording to handling of animals, use of animals for diagnosis of human infections, animal inoculation for diagnosis of various microbial infections. **6 hrs**

Textbooks

1. Keith Wilson and John Walker Ed., *Practical Biochemistry Principles & Techniques*, Cambridge University Press London.
2. John E. Smith, *Biotechnology* ,Cambridge University Press, London
3. R.K. Gupta, *Elements of Biotechnology*, Rastogi Publication.

Microbiology I

Course Title: Microbiology I
Course No. MB 515
Nature of Course: Practical

Full Marks: 50
Pass Marks: 20
Year: I

Objectives:

- To enable the students to apply methods of microbial growth in laboratory conditions.
- To determine the optimum physical and chemical factors of microbial growth.
- To apply the knowledge of carbohydrate and protein metabolisms of microorganisms in laboratory and illustrate the results.
- To examine the mode of multiplication of yeast in different types of media.
- To apply the skill of fungal growth and its identification.
- To examine the effect of different chemicals on bacterial cells.
- To isolate phage virus in laboratory conditions
- To understand the utilization of substrate by bacteria.
- To identify the unknown bacteria.

Course Contents:

Microbial Structure, Physiology and Genetics

Microbial growth: Methods of colony count, colorimetry method Biomass, Linear growth -Conditions for microbial growth: pH requirement, temperature requirement, carbon requirement, Nitrogen requirement, water activities and gases requirement. ,Carbohydrate metabolism , Protein metabolism , Examine the mode of multiplication of different types of yeast., Titration of phase and test for lysogeny , Growth of fungi in different condition., Identify the fungi from given culture. , The effect of lysozyme on the bacterial cell , Effect of detergent on the bacterial cell wall, Utilization of substrate by microorganisms: starch hydrolysis, dextran production, gelatin hydrolysis and casein hydrolysis, Different biochemical test for the identification of bacteria.Voges-proskauer, methyl red test indole production, sugar test, H_2S production, citrate test, Nitrate reduction. Oxidese test, catalase test., Identify the unknown bacteria using, Gram reaction and biochemical test., Determination of growth curve in both medium, Nucleus staining of the procaryotic and eucaryotic cells., Extraction of the DNA from the procaryotic and eucaryotic cells., Extraction of the plasmids from *E.coli*., Experiments on the genetic transfer in *E.coli* by: conjugation, transformation, Effect of radiation (UV) on the microorganisms, Generation, detection and isolation of mutants, Study of genetic techniques like: PCR and Plasmid profiling.

Epidemiology, Immunology and Biostatistics

Animal inoculation for diagnosis of microbial infection, Harvesting of peritoneal fluid of inoculated animal for diagnostic use, Productions of the antibodies against E.coli and Staphylococcus., Study on the different serological techniques like: Precipitation, Agglutination Neutralization, ELISA,

CCIEP, IFT florescence techniques., Complement fixation test., Epidemological study of infectious diseases by different epidemiological techniques like; serotyping, Phage typing and antibiogram

Microbiology II

Course Title: Microbiology II
Course No. MB 516
Nature of Course: Practical

Full Marks: 50
Pass Marks: 20
Year: I

Objectives:

- To give the students detailed practical knowledge on various biochemical techniques and instrumentation, required for conducting analysis, research.
- To enable them to use various biochemical techniques and instruments.

Course Contents:

Biochemistry, Total Quality Management and Quality Assurance

- To learn various techniques of filtration & dialysis ,
- To disintegrte liver cells and separate organelles by differential centrifugation, To separate and identify aminoacids by single and double ascending paper chromatography,
- To separate and identify sugars by thin layer chromatography,
- To separate and identify various lipids (non-polar, phospholipids etc) by thin layer chromatography,
- To separate aminoacids by ion-exchange chromatography using Ambelite IR 120,
- To separate proteins by DEAE - cellulose,
- To analyse serumproteins by cellulose acetate papers.,
- To analyse proteins by SDS-PAGE.,
- To purify proteins by Gel filtration,
- To learn the principle & techniques of colorimetry & spectrophotometry,
- To learn the principle & techniques of fluorimetry,
- To learn principle of phase contrast & electron microscope,
- Quantitative determination of aminoacids in biological material using Ninhydrin method.,
- Quantitative determination of proteins using coloured reactions, Fractionation of serum proteins by ammonium sulfate precipitation ,
- Determination of isoelectrical points of protein and separation,
- Quantitative determination of blood sugar level using various methods, Quantitative determination of cholesterol in blood,
- Production of extracellular enzymes from *Bacillus* spp., extraction and purification,
- Determination of enzyme activities of clinical importance: ALT,GOT, amylase and Determination of enzyme kinetics km & Vmax

Instrumentation and Biotechnology

- Study of various techniques of filtration & dialysis,
- Study of disintegration of liver cells and separation organelles by differential centrifugation,

- Separation and identification of aminoacids by single and double ascending paper chromatography,
- Separation and identification of sugars by thin layer chromatography,
- Separation and identification of various lipids (non-polar, phospholipids etc) by thin layer chromatography,
- Separation of aminoacids by ion-exchange chromatography using Amberlite IR 120,
- Separation of proteins by DEAE-Cellulose,
- Separation of serum proteins by cellulose acetate papers,
- Analysis of proteins by SDS-PAGE.,
- Purification of proteins by Gel filtration,
- Study of plasmid profile by PCR technology ,
- Study of plant tissue culture using different media,
- Isolation and identification of *Rhizobium* sps.,
- Study of student model fermenter,
- Determination and estimation of alcohol percentage during ethanol fermentation.,
- Study of medically imporant byproducts such as antibiotics through fermentation.

Microbial Ecology
Second Year

I. Environmental Microbiology
Course Title: Microbial Ecology
Course No. MB 611
Nature of Course: Theory

Full Marks: 100
Pass Marks: 40
Year: II

Objectives:
The objectives of the proposed course are:

- To give detailed knowledge on the microbial ecology and its importance in global environment:
- To give detailed knowledge on the probability of the use on Microorganisms on the bio-remedation.
- To give detailed knowledge on the practical aspects of environmental pollution and it's assessment.
- To produce able manpower needed for the different dis[illegible] division, biotechnology and agriculture.

Course Contents:

Ecological Concepts: History components of ecology Ecosystem and microbial association, Ecological concepts, ecosystems and energy, differences between general and microbial ecology. **12 hrs**

Energy and Energy Relations: Techniques of the study of microbial ecosystem and microbial interaction in ecosystem. **20 hrs**

Environmental Limits: Temperature, pH, Humidity and Salinity for microbial growth and reproduction Relationship of microbial cell morphology and cytology to ecology. **13 hrs**

Microbes in Extreme Environment: Temperature, pH, Osmotic pressure and others **10 hrs**

Communities and Ecosystems: Population Interactions, Types of interactions- Commensalism, Cocatabolism, Epiphytes, Synergism, Syntrophism, Rhizospheric effects, **8 hrs**

Mutualism: Lichens, Endosymbionts, Nitrogen fixing Symbiosis, Mycorrhiza, Ruminants, Bioluminescence, Fungal garden of the insects. **8 hrs**

Competition, Amensalism - Predations, Parasitisms **8 hrs**

Biological Control: Bacterial Pesticides, fungal pesticides and viral pesticides, **20 hrs.**

Biogeochemical Cycles: Carbon Cycles, Nitrogen Cycles: Nitrogen Fixation, Ammonification, Nitrification, Denitrification Sulfur cycle: Other elemental cycles, Phosphorus, Iron, Calcium and Silicon **21 hrs.**

Textbook:

1. W.O., Learnt P.E. Long, *Environmental Microbiology*, Blackie, London.
2. D.J. Kushnen., *Microbial Life in Extreme Environment*, Academic Press.
3. Heinz Stolp., *Microbial Ecology*, Cambridge University
4. R. Campbell, *Microbial Ecology*, Blackwell Scientific Publication.

Pollution Microbiology

Course Title: Pollution Microbiology
Course No. MB 612
Nature of Course: Theory

Full Marks: 100
Pass Marks: 40
Year: II

Objectives:

- After completion of this course, the students would be able to;
- Deal with microbial environment both in fields and laboratory condition;
- Tackle and analyze the importance of water, air, solid waste sewerage and industrial effluents with reference to microbial problems;
- Identify the environmental problems with reference to micro-organisms;
- Analyze the importance of water, air, solid wastes and food in relation to sanitation and public health;
- Identify the importance of waste and industrial effluents disposal methods; and
- Suggest feasible methods of environmental control due to microorganisms.

Course Contents

Introduction to Environment Microbiology: Microorganisms and its relation to environment pollution. Normal flora of human: types and characters. 4 hrs

Water Microbiology: The aquatic environment; Microorganisms in natural water and its effect with Huydrostatic pressure, light, turbidity, pH and inorganic and organic constitutions. Types of Natural Water: Surface water and ground water and its characters. 10 hrs

Water Pollution: Definition, sources of water pollution, Biological indicaters of water pollution, water quality criteria and standards of drinking water, WHO guide line values of drinking water and other countries. Purification of drinking water in large scale (city supply water) and small scale (domestic and community level) survillance of drinking water quality. 20 hrs

River Pollution: - Types of river pollution: Chemical and microbiological, sources of river pollution: solid waste, domestic waste, industrial waste and sewage. "Standard for river water; treatment of river water up to drinking level: chemical, physical and Biological. 10 hrs

Microbiology of Sewage and Industrial Effluents: Introduction of sewage and industrial effluents. Composition of domestic waste, sewage and industrial waste (distillary, tannery, pulp and paper industry and food industry). Methods of analysis of sewage and industrial effluents dissolve oxygen. Biochemical oxygen demand, chemical oxygen demand, phosphate, total nitrogens, Ammonia, Total bacteria, enteric pathogens stabilization and treatment of sewage and industrial waste: physical, chemical and biological methods. Disposal of organic waste. 15 hrs

Solid Waste: Introduction, classification, characterization of biodegradable and non-biodegradable solid waste. Types of microorganisms - beneficial for decaying and pathogenic organisms. Methods, of analysis of solid waste -

physical and microbiological. Management of solid waste and its recycling value **10 hrs**

Biological Treatments of Wastes and Pollutants : Solid waste disposal, Sanitary landfill , Composting , Treatment of liquid waste , Biodegradation of the Environmental pollutants. **10 hrs**

Microbiology of Air: Air composition, classification and characterization of atmosphere. Types of air pollutants: chemical and microbiological. Sources of air pollution (indoor and outdoor). Effect of meteorological and geographical condition for dispersal and fate of microorganisms in atmosphere. Outdoor and indoor air-pollution in relation to microorganisms. Monitoring of air pollutions (Bacteriological and suspended solid materials). Controls of air pollution: Ultraviolet ray, laminar air flow filtration and ventilation. **15 hrs**

Soil Pollution: Sources of microbial pollution of soil. Role of microorganisms in the cycling of bioclements (carbon, nitrogen, phosphorus, sulphur) Effect of pesticides and insecticides of soil microflora. persistence of pesticides and the role of microbes. Degradation of pesticides. Biopesticides and Biosecticides and its mechanisms. **12 hrs**

Microbial Degradation and Deterioration of Materials: Introduction, difference between degradation and deterioration. Degradation of cellulose, wood, fabric materials: Composition of above materials, types of microorganisms involve, mechanisms of degradation and its controls.

Deterioration of Metals: composition of metals, types of microorganisms and its mechanisms in deterioration of metals, control of metals deterioration.

14 hrs

Textbooks

1. Miller G.T. : *Environment Science an Introduction 2nd ed.* , Belmost, California.1988
2. Trivedy R. F. and Goel P. K.: *Chemical and Biological Methods for Water Pollution Studies*, Environmental Publication , Karela, India.1986

Public Health Microbiology

Course Title: Public Health Microbiology
Course No. MB 613
Nature of Course: Theory

Full Marks: 100
Pass Marks: 40
Year: II

Objectives:

- The students are to be oriented to the basic concepts of Public health and its determinants and to the concepts of epidemiological triad and theories of diseases occurrence.
- The students are to be enabled to identify the environmental problems in relation to microbial diseases, to describe the principles and importance of making a community diagnosis of microbial diseases, to describe and apply measures to control water borne, airborne, arthropods and food borne diseases and to describe the epidemiology, prevention and control of communicable disease of public health importance.

Course Contents

Public Health: Definition of public health, indicators of health, community and health planning, National health programmes. Roles of microbiologist in public health. **15 hrs**

Epidemiology: - Introduction, principles of epidemiology, epidemiology approach, epidemiological methods: analytic and experiments, prevention and controls of epidemic diseases.

Air Borne Disease: Airborne transmission of pathogens, List of respiratory infection (Viral, bacterial). Sources of infection, characters or organisms and controls of followings diseases:- (a) Bacterial pneumonia (b) Diphtheria, (c) Tuberculosis (d) Influenza, (e) Measles. **20 hrs**

Water Borne Disease :- Definition of safe water. Water sanitation. Water borne transmission of pathogens List (Viral, bacterial, protozoan). Source of water pollution. Source of infection, characters of organisms and control of following diseases: (a) Hepatitis A (b) Cholera (c) Typhoid (d) Giardiasis (e) Hepatitis E (f) Poliomyelites **20 hrs**

Food Borne Diseases: Definition, Pathogenic organisms transmitted by food. Types of food borne diseases. Causal organisms characters, mode of infection and control of following diseases: (a) Food poisoning (b) Salmonellosis (c) Traveler's diarrhea. **18 hrs**

Insect Transmitted Diseases: Definition List of insect that transmitted pathogenic organisms, control of insect transmitted diseases. Types of organisms character of organisms, control of following diseases:
(a) Kala-azar (b) Malaria (c) Arboviral diseases (d) Plague **15 hrs**

Sexual Transmitted Diseases:- Definition, mode of transmission. List of sexual transmitted diseases. Control of sexual transmitted diseases. Characters of causal organisms and control of following diseases. (a) Syphilis (b) Acquired Immune Deficiency Syndrome (AIDS) (c) Herpies. **18 hrs**

1. **Hospital - Acquired Infection**, Prophylactic immunization, Disposal of infective hospital and laboratory materials. Monitoring of sanitation in community. **14 hrs**

2. Hall International. 1993
3. K. Park - *Text book of Preventive and social medicine, 15th edition* M / S Banarsidas Bhanot Jabalpur, India. (1997)

Environmental Microbiology

Course Title: Environmental Microbiology
Course No. MB 614
Nature of Course: Practical

Full Marks: 100
Pass Marks: 40
Year: II

Objectives:

To give the students practical knowledge and experience on what they have learnt in the theory.

Course Contents

Isolation and identification of microorganisms from Natural Water (non-polluted water)., Qualitative and quantitative study of city supply water and justification the results with WHO guide line value (Microbial and a biochemical) , Study the effect of water detergents on water treatment., Surveillance of drinking water quality in different community., Bacteriological and biochemical studies of rivers., Bacteriological and biochemicals studies of industrial waste, domestic waste and sewage including enteric bacteria., Characterization of solid waste of different community by analysis of i) Different types of biodegradable waste (ii) different types of non-biodegradable waste., Analysis of bacteria from solid waste., Study of air microbiology : (a) Enumeration of air-microbes in outdoor air.

II. Medical Microbiology

Course Title: Anatomy, Physiology & Immunology — Full Marks: 100
Course No. MB 621 — Pass Marks: 40
Nature of Course: Theory — Year: II

Objectives:

This course is taught with a view to helping the students know about anatomy and physiology of different organ system of human body and basic immune functions involved.

At the end of this course, the students will be able to describe basic anatomy and physiology of particular organs in order to collect appropriate specimens for the isolation of micro-organisms according to the size of infection.

Course Contents

Introduction to Human Anatomy **4 hrs**

Musculoskeletal System: Skeleton: Definition, basic functions, types, classification, Gross and microscopic anatomy. Joints: Definition, types and funciton. Muscles: Definition, functions, Gross and microscopic anatomy. **7 hrs**

Gastro Intestinal System: 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. **8 hrs**

Respiratory System: Different system, Different parts of the system, Gross and microscopic anatomy of different parts of the system, Functions of the parts **7 hrs**

Cardiovascular System: Gross and microscopic anatomy of the different parts, Functions of the different parts **7 hrs**

Blood, Reticuloendothelial, and Immune System: Sites of formation of blood, Composition and functions of blood, Cells of blood and their functions, Blood groups, Lymph and Lymphatic vessels, Different organs of reticuloendothelial and system, Gross, microscopic anatomy and functions of the organs. **7 hrs**

Nervous System: Parts and function of the system, Gross structure and microscopic anatomy of nervous system, Ventricular system and CSF, Meninger. **7 hrs**

Urinary System: Different organs of the system, Cross, microscopic anatomy and functions of the organs, Mechanism of urine formation and its composition **7 hrs.**

Endocrine System: Definition, Different organs of the system, Functions of the organs **7 hrs**

Special Senses: Different organs, Structure and functions of eye, ear, nose and tongue. **7 hrs**

Reproductive System: Different organs in male and female, Gross, microscopic anatomy and functions of the organs. **7 hrs**

Immunology:

Introduction to Clinical Immunology: Infection, Innate Immunity, Acquired immunity Active and passive immunity, Antigen-antibody reaction, Immune response. **6 hrs**

Cell Mediated Immunity: Origin of immune cells, 'T' -cells, B-cells, Cytokines, macrophages, Test for evaluation of cell mediated immunity. **7 hrs**

Antibodies: Immunoglobulin structures their types and functions of each type, Isotype, Allotype, Idio types. **8 hrs**

Primary, Secondary Immune Response **5 hrs**

Complements **5 hrs**

Hyper Sensitivity Reactions **6 hrs**

Antigen-Antibody Reaction: Invitro methods. Principle interpretation validity and limitation of each type of method. **10 hrs**

Textbooks

1. Ivan M. Roitt Ed. *Essential Immunology, 8th Edition*. Blackwell Scientific Publication. UK 1991
2. H. Hugh Fudenbertg. Damiel P. Stites, Joseph L. Coldwell and J. Vivian Ed: *Basic and Clinical Immunology, 2nd Edition*, Wells. Published from lange Medical Publication.USA 1978.
3. Cathleen J. W. Wilson OBE anne Wangh : *Anatomy and Physiology in Health and Illness*. Churchil Livingstone publication, UK, NY , 1996

Bacteriology (Diagnostic and Systematic)

Course Title: Bacteriology (Diagnostic and Systematic) Full Marks: 100
Course No. MB 622 Pass Marks: 40
Nature of Course: Theory Year: II

Objectives:
This course is taught in order to make the students able to understand diagnostic and systematic bacteriology to diagnose bacterial infection, determine antibiotic sensitivity profiles of the organism along with pathogenesis, prevention, control and epidemiological markers.
At the end of the course, the students will be able to

- Perform routine and special laboratory investigations including both cultural and non-cultural techniques such as antigen, antibody detection, DNA probe, PCR,
- Interpret the results and explain the underlying principles in each investigation.
- Prepare reagents required for routine and special investigations
- Conduct research work
- Participate in teaching learning activities
- Introduce quality control system in the laboratory
- Perform managerial work supervision of subordinates, preparation of periodic charts and maintain inventory work.

Course Contents

Diagnostic Bacteriology: Laboratory organisation, quality control laboratory and hospital acquired infection, laboratory safety. **5 hrs**

Handling of Clinical Specimen for Microbial Study.: Selection, collection and transport of specimen for microbiological examination. Optical methods for laboratory diagnosis of infectious diseases. Cultivation and isolation of viable pathogens, conventional and rapid microbiological method for identification of bacteria and fungi. Non-traditional methods for identification principle of automized methods used in clinical. microbiology methods for testing antimicrobial effectiveness, recent advances in medical microbiology. **8 hrs**

Sexually Transmitted Diseases (STD): VDRL, TPHA, FTA-ABS Dark ground microscopy, fentana stain, RCUT, Betalactamase test. ELISA, Immunoflurescence test, Serology of common bacterial pathogens: such as: *Salmonella, Streptococcus, Brucella, Yersinia, Mycoplasma and Rickettsiae.* Mantoux test, Immunoglobulin estimation, Radio Immunoassay (RIA), Indirect Haemagglutination (IHA), Haemagglutination (HA), Haemagglutination inhibition (HAI), Counter current immunoelectrophoresis (CCIEP), Toxin antitoxic titration. **6 hrs.**

Laboratory Diagnosis: of (with emphasis in etiology conventional and rapid diagnosis methods) Enteric fever, Typhoid fever, Bacterial endocarditis, Bacterimia, Septicemia, Pyrexia, Respiratory tract infection (Lower & upper),

Urinary tract infection Gastrointestinal tract infection, Food poisoning, Traveler's diarrhoea, Cholera. **6 hrs**

Eye Infection: (with emphasis in corneal ulcer & meningitis, otitis media, mandibular abscess, conjunctivitis) gingivitis and anaerobic infection of oral cavity. Gas gangrene (with emphasis in rapid diagnosis) Drain, Pus, body tissue, bone infection). Peptic ulcer (with emphasis in mechanism of peptic ulcer caused by *Helicobacter pylori*). **6 hrs**

Mycobacterial Infection *(Mycobacterium tuberculosis*, leprosy, a typical mycobacterial infection) bacterial vaginesis, pelvic inflammatory disease, Gonorrhoea, Syphilis, Chlamydia, and other Sexually transmitted diseases and Infection syndrome. **6 hrs**

Pharmaceutical Microbiology: Mechanisms of action of antibiotics, bacterial resistence to antibiotics, chemical disinfectants, Antiseptic and preservatives, evaluation of antibiotics and non-antibiotics agents. **23 hrs**

Systematic Bacteriology: Morphology, laboratory diagnosis, pathogenesis prevention, control and epidemiology of the following organism: *Staphyloccus, Micrococcus, Streptococcus* **5 hrs**

Enterobacteriaceae: *Citrobacter, Edwardsiella, Enterobacter, Escherichia coli, Hafhia, Klebsiella, Morganella, Proteus, Providencia, Salmonella, Shigella, Serratia, Yersinia.* **6 hrs**

Non Fermentative Gram Negative Bacilli and Cocobacilli: *Pseudomonas, Alcaligens, Acinetobacter, Moraxella, Eikenella, Kingnella, Flavobacterium, Agrobacterium.* **6 hrs**

Gram Negative Facultative Anaerobic Bacilli and Aerobic Coccobacilli: *Francisella, Brucella, Bordetella, Haemophilus, Actinobacter, Pasteurella* **6 hrs**

Vibriniaceae Family: *Vibrio, Aeromonas, Plesiomonas, and Campylobacter* **4 hrs**

Anaerobic Gram Negative Bacilli.: *Bacteriodes Fusobacterium, Leptotrichia,* Anaerobic vibrios and curve bacillus. **5 hrs.**

Anaerobic Cocci: *Peptococcus, peptostreptococcus, Vellionella, Acidaminococcus, Megasphaeria* and *Ruminococcus, Coprococus.* **6 hrs**

Others: *Gardnerella, Listeria, Legionella, Clostridia* of wound infection, *Chlamydia, Mycoplasma, Ureaplasma, Rickettsiae* **6 hrs**

Spirochetes: *Treponema, Borrelia, Leptospira, Brachyspira,* **2 hrs**

Aerobic Facultative Spore Forming Bacilli: *Bacillus* spp. **2 hrs**

Aerobic non-spore forming gram positive bacilli: *Corynebacterium, Actinomyces pyogens, Nocardia, Mycobacterium*, MOTT bacilli, (Atypical mycobacteria) Hansen's bacillus. **6 hrs**

Anaerobic Gram Positive Bacilli: *Bifidobacterium, Eubacterium, Actinomyces, Propionebacterium, Arachenia, Clostridium* **6 hrs..**

Textbooks

1. Geoffrey R. Smith and Charles S. F. Easmon Ed.: *Topley and Wilson's Principles of Bacteriology Virology and Immunity, Eighth Edition., Volume 2 - 4,* Edward Arnold Publication UK 1990.

2. Bailey & Scotts, *Diagnostic Microbiology, 8th Edition*, Edited by Ellen Jo Barson & Syndey M. Finegold, The C.V. Mosby Company. 1990

Virology, Mycology, Parasitology

Course Title: Virology, Mycology, Parasitology
Course No. MB 623
Nature of Course: Theory

Full Marks: 100
Pass Marks: 40
Year: II

Objectives:
This course is taught with aims to make the students know about the fundamentals of virology, parasitology, mycology, and basic immunology and able to diagnose the infections caused by viruses, parasites and fungi.

Course Contents

Virology
General properties of viruses including structure, classification of medically important viruses. Virus host interaction, bacteriophage. Classification of medically important viruses: Pathogenesis and lab. diagnosis (by both culture and serology) of pox viruses, Herpes viruses, Adenovirus, Picorna virus, orthomyxovirus, Paramyxovirus, Arbovirus, Rhabdo viruses, Hepatitis virus, HIV, antiviral drugs. **60 hrs**

Mycology
Introduction to Clinical Mycology:. Classification of medically important fungi, such as continuous subcutaneous and systemic mycosis. Opportunistic fungi. Pathogenesis, Laboratory diagnosis, prevention and control of the following fungi: *Aspergillus spp., Candida albicans, Fusarium spp., Cryptcoccus neoformans, Histroplasma capsulatum, Sporothrix spp., Philophora spp., Trichophyton microsprum, Epidermphyton spp. Blstomyces dermastitidis, Coccidiodis immitens,, Antifungal sensitivity test* **30 hrs**

Parasitology
Introduction of Human Parasitology: Life cycle, pathogenesis, clinical findings, Laboratory diagnosis, prevention and control of the following parasites: *Entamoeba histolytica ,Giardia lamblia, Trichomonas spp., Plasmodium spp,. Pneumocystis carinii, Toxoplasma spp., Leishmania spp., Ascaris spp.,* Anacyclostoma and Necator, *Enterobius vermicularis, Trichuris trichiura, Strongloides spp.,Taenia spp., Echinococcus spp., Hymonodepisinana spp., Wacheria spp., Brugia, LoaLoa, Oncocerca, Dracuhculus.* **30 hrs**

Textbooks.

1. K.D. Chartejee P Ed., *Parasitology (Protozoology and Helminthology), 12th Edition* ,Charterjee Medical Publishers, Calcutta 1981;
2. Chester. W. Emmons, *Medical Mycology 3rd edition*, Chapman- H. Binford, John P. Utz, K. And K.J. Kwon - Chun.
3. Evan E. and Gentles J.C. ; *Essentials of Medical Mycology*, Churchill Livingstone, New York 1995

Medical Microbiology

Course Title: Medical Microbiology
Course No. MB 624
Nature of Course: Practical

Full Marks: 100
Pass Marks: 40
Year: II

Objectives:
This practical should be hospital based at the end of this course, the students should be able to know every detail to procedures/protocols/methodology for laboratory diagnosis of bacterial/fungal/parasitic/viral infections of human being using conventional as well as modern molecular biological techniques, such as:

- Culture media, tests, Reagents & different approaches modalities for diagnosis of bacterial infections - URTI, LRTI, Oral, GI, enteric, eye, ear, GUT, & other body infections a) Conventional methods b) Routine culture & sensitivity c) Modern molecular biological methods d) Rapid diagnostic techniques.
- Materials Methods/Diagnostic modalities in Medical Parasitology ;in Medical Mycology and in clinical virology.

- Collection: Handling and storage of different samples for the Lab. Diagnosis of human microbial infections.

Course Contents
Mycology: Collection and transport of fungal specimens, Preparation of fungal culture media, Preparation of fungal stains, and Principle of staining of fungi, Isolation, identification of medically important fungi., Mycological techniques: Slide culture, germ tube test carbohydrate fermentation and assimilation test Serodiagnosis of following fungal infection. 1.*Cryptococcus neoformans.* 2.*Histoplasma capsulatum.*
Antifungal senstivity tests.
Bacteriology: Isolation and identification of all medically important bacteria , Coagulase test, catalase test, oxidase test, β-lactamase test, CAMP Test, Lecithinase test. Invitro toxigenicity test for *corynebacterium diphtheriae*, Methods of anaerobiosis., Serotyping of salmonella, shigella, *E.coli*, streptococcus, Isolation and identification of Mycoplasma, All routine biochemical test including IMVIC and decarboxylase test, PCR, DNA probe BAC-TEC, system, Bacteriophase typing, Bacteriocin typing, Preparation of glassware for laboratory use, sterilization of culture media and preparation of routine & special media, Preparation of H and O antigen of salmonella for widal test, Laboratory safety, Quality control of media & equipment, Mantoux test, ELISA, Western blot, TPHA, IHA, HA, Direct/Indirect Immunofluorescence test Co-agglutination test, precipitation test, latex agglusination test. CFT, RA Test, ASO titre, Preparation of stains including special stains, principle, procedure and interpretation of the staining results in microbiology laboratory, Care and handling of laboratory animals. Inoculation of laboratory animals.

Virology: Preparation of specimen for virus culture and transport media for virus isolation, Preparation of glassware in virology lab., Tissue culture and Egg inoculation technique for the isolation of common viruses, Care and handling of microscope including Electron microscope, phase contrast microscope, Dark ground field microscope and principle of each type of microscope.

Parasitology: Routine examination of stool samples , Occult blot test in the stool sample , Laboratory diagnosis of blood and tissue parasites, Preparation of thick and thin smear of blood sample, Staining and detection of blood and tissue parasites including bone marrow aspirates, Routine examination of genital specimens for parasitology including urinary parasites, Culture of intestinal parasites.

General Food Microbiology

Food Microbiology
Course Title: General Food Microbiology
Course No. MB 631
Nature of Course: Theory

Full Marks: 100
Pass Marks: 40
Year: II

Objectives:
After studying this course the students will be able to

- state and apply fundamental facts and principles of microbiology dealing with foods.
- apply knowledge of understanding food microbiology in familiar and unfamiliar situations.

Course Contents

Microrganisms Associated with Food: History of microorganisms in food, The role & significance of microorganisms, Food as a substrate for microorganisms, Microorganisms importance in food microbiology **30 hrs**

Contamination & Spoilage of Foods: Contamination and spoilage of sugars & sugar products; contamination and spoilage of fish and fish products; contamination and spoilage of dehydrated foods; contamination of spoilage of spices and other condiments; contamination and spoilage of canned foods; contamination and spoilage of Jam, Jellies, sauce, marmalades. **8 hrs**

Foods in Relation to Disease: Indicator organisms, Foodborne Infections and Intoxication - Bacterial: poisoning by microorganisms and their products (*S. aureus, Listeria, Clostridia* etc.), Food intoxications, Food infections; Foodborne poisonings, infection & intoxications: Non bacterial: Mycotoxins, Viruses, Rickettsia Various parasites, Seafood Toxicants Poisoning by chemicals; Investigations of food borne disease outbreaks: Food-borne diseases, Objectives of investigations, Personnel involved in investigation, Materials & Equipment required,The field investigation, Laboratory Testing, Interpretation & application of results preventive measures. **37 hrs**

Microbiology of Fermented Foods: Principles of fermentation, Fermentative pathways, Fermentation process,Production of cultures for food fermentation: General principles of culture maintenance & preparation,Bacterial cultures,Yeast cultures, Mold cultures; Indigenous food fermentation: fermented vegetables, coffee, cocoa, yeast extracts, mizo, chhurpi, Soyabean products - soyasauce, tempe, Tofu, kinaema, natto. **20 hrs**

Foods & Enzymes from Microorganisms: Microorganisms as food - single cell protein (SCP), Fats from microorganisms, production of amino acids, production of other substances added to foods, production of enzymes. **20 hrs**

Microbial Analysis of Foods: Number of microorganisms in foods, Sampling,Total cell counts, Membrane filter method, Most probable number (MPN), Estimation of microorganisms based on metabolism: Reductase test, Chemical indicators of decomposition, ATP test, Physical test, Measurement of gas production, Use of instruments (Instrumentation). **10 hrs**

Textbooks:

1. Frazier, W.C. & D.C. Westhoff. *Food Microbiology (3rd Edn.)* Tata McGraw-Hill Publishing Company Limited, New Delhi, 1986.
2. Jay, J.H. Modeern *Food Microbiology (3rd Edn.)* CBS. Pub. & Distributors, Delhi 1987.

Applied Food Microbiology and Biotechnology

Course Title: Applied Food Microbiology and Biotechnology
Course No. MB 632
Nature of Course: Theory

Full Marks: 100
Pass Marks: 40
Year: II

Objectives:
After studying this course the students will be able to :

- appreciate the scientific, social, economical, environmental and technological contributions and applications of food microbiology.
- develop new food products in future and apply academic knowledge in food industry.

Course Contents

Processing Technology & Quality Parameter of Fermented Foods and Beverages: fermented foods & beverages: Cheese, yoghurt, diary products, meat, sausages, bread, biscuit/crackers, doughs; soyabeen products (soya. sauce, tempe, tofu), traditional fermented products of Asia & Africa, fermented vegetable products; Tea, cocobeans, coffee beans; alcoholic beverages (beer, wine, Champaign, cider, distilled spirit, rum, chhang, gin, brandy, vodka, whisky, Gundruk, sinkki, tama; Non fermented food: Jam, Jellies, sauce, Juices, marmalade, tomato paste. **35 hrs**

The Isolation & Improvement of Industrial Microorganisms: Bacteria- *Lactobacillus, Acetobacter*, Acetic acid bacteria,Yeast - *S. cerevisiae* (in murcha), Molds - *Aspergillus oryzae*, *Aspergillus niger*, *Rhizopus*, Lipolytic and proteolytic microorganisms. **35 hrs**

Food Biotechnology: History of food biotechnology: Tools of food biotechnology, Genetic engineering, DNA probe, Plant tissue culture; Application of biotechnology for the improvement of food products: production & improvement of enzymes, improvement of traditional fermented foods, microbial synthesis of food ingredients; Regulatory aspects of biotechnologically produced foods; Rapid methods for detection of contaminating organisms/chemicals infood: Environmental Impact Assay (EIA), Chromatography, Polymerase Chain Reaction (PCR), Immuno Diffusion, Immunofluorescence etc. **50 hrs**

Textbooks:

1. Banwart, George, J. *Basic Food Microbiology 1st Edition*, SK Jain for CBS Publisher & Distributors, Delhi, 1987.
2. Baily, James E. & David F. Ollis, *Biochemical Engineering Fundamentals*, McGraw - Hill Book Company.

Food Preservation & Quality Control

(S13)

Course Title: Food Preservation & Quality Control
Course No. MB 633
Nature of Course: Theory

Full Marks: 100
Pass Marks: 40
Year: II

Objectives:

- After studying this course the students will be able to;
- Perform experiments dealing with preservation, processing and quality aspects of foods.

Course Contents

Principles of Food Preservation: 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 treatments; ontrol of microorganisms by irradiation. **35 hrs**

Methods of Preservation of Food and Fruit Products:.Cereal grains & meals, flour, Bread, cakes & other bakery products, biscuits, crackers, Macaroni, noodles, pasta, Sucrose, maple sap & syrup, honey, candy, Vegetable & veg. Products, meat & meat products, Fish & fish products, Eggs & egg products, Poultry & poultry products, Milk & milk products, Fruit based products - jam, jellies, sauce, juices, marmalade, tomato paste. **20 hrs**

Food Sanitation, Control & Inspection: Principle of food quality control, Microbiology in food plant sanitation: Bacteriology of water, Sewage and waste treatment & disposal, Microbial quality of food products, Good manufacturing practices, Hazard Analysis of Critical Control Points (HACCP), Risk Analysis Management and Risk Communication, Health of employees, Principle of Laboratory Accredation, Principle of Reference Material, Principle of Quality Assurance, Principle of Quality Auditing. **15 hrs**

Food Regulations & Standards: In the prospective of codex in Nepalese Context Enforcement & Control Agencies (FDA), Food laws, Problems of regulations, Food standards, Microbiological criteria for foods, Quality Control/quality assurance & International Food Trade Sanitary Phytosanitary (SPS), Technical Barrier to Trade (TBT), Good Manufacturing Practices (GMP), ISO-9000 & other Hygienic Requirements etc., Good Laboratory Practice (GLP) **25 hrs**

Sensory Evaluation of Food: Principle, Application. **10 hrs**

Food Packaging: Principle of food packaging, Food packing materials - chemical & physical properties, Interaction between the food and the packaging materials, evaluation of packaging materials & system: Selection of packing materials including edible packaging materials, modified atmospheric & flexible packaging materials, shelf life evaluation of packaging products. **15 hrs**

Textbooks:

1. Desrosier, *The Technology of Food Preservation 4th Edition*. S.K. Jain for CBS Publisher & Distributors, Delhi 1987.

Food Microbiology

Course Title: Food Microbiology
Course No. MB 634
Nature of Course: Practical

Full Marks: 100
Pass Marks: 40
Year: II

Objectives:

- to familiarise the students with different qualitative and quantitative techniques involved in food Microbiology and enable them to have practical experience of food microbiology.

Course Contents

Practical:

Determination of shelf-life of packaged food stuffs in different flexible packaging materials, Physical tests of packaging materials, Determination of barrier properties of packaging material, Analyses of gas in food packaging, Canning/bottling of fruits, vegetables & meat, Measurements of heat penetration & sterilization, Can seaming , Food preservation : Jam.Jellies and marmalade, Fruit juice, veg. juice, Tomato paste, Dehydration of foods & their quality evaluation, Adequacy of blanching, Milk pasteurization, Determination of amylase activity & perp^{n} of crude enzyme production, Citric acid fermentation, Fermentation Beverages: Wine, Beer, Brandy, Jand, their quality evaluation, Traditional fermented food preparation & their quality assessment, Lactic acid fermentation & recovery of baker's yeast.

Soil Microbiology and Microbial Population

IV. Agricultural Microbiology

Course Title: Soil Microbiology and Microbial Population — Full Marks: 100
Course No. MB 641 — Pass Marks: 40
Nature of Course: Theory — Year: II

Objective of Courses:

- to acquaint the student with the basic phenomena of soil related to plant and microbial growth
- to impart a basic knowledge on soil inhabiting mircoorganisms.

Course Contents

A. Soil Formation Composition and Properties:

Elements of soil formation and laterization, podso- lization, texture and profile. **10 hrs**

The major components of soil and their importance for plant and microbial growth. Viz., (a) Mineral matter, (b) Organic matter, (c) soil moisture, (d) soil moisture, (d) soil atmospher, (e) pH (g) O/R potential **15 hrs**

Soil hydrology, form of water in soil, physico-chemical and biological properties of types of water in soil. **8 hrs**

Thermal and Aregimes of Soil: Distribution of heat and air as factors influencing these regimes. **5 hrs**

Absorptive Properties of Soils ::Electrically charged surfaces, exchangeable cations and cation exchange capacity. The diffuse layer. Characteristics of cation exchange, selectivity of cation adsorption; Anion retention adsorption of organic molecules Sorption of gases. **8 hrs**

Soil as a Medium for Plant Growth: Plant development and growth, Restrictions to root growth, requirement of plants for water and nutrients. The rhizosphere, Nutrients in natural ecosystems. **8 hrs**

Soil Acidification: Soil pH and buffer capacity, Percentage base saturation processes of soil acidification, Effects of soil acidity on plants, acid rain, acidification of ecosystems Environmental effects. **8 hrs**

Soil Erosion: Natural erosion. The environmental problem, Erosion by water, Erosion by wind, physical principles Causes of accelerated erosion., Soil conservation **8 hrs**

Soil in the Environment: problems and solutions. **2 hrs**

B. Soil Microbial Population and Their Role:

(a) Protozoans (b) Bacteria, (c) Alga (d) Fungi (e) Nematodes (f) Mycorrhiza (g) Virus (h) Mycoplasma **32 hrs**

Methods of Isolation and/or Study of the Organisms Using RespirometricT,: buried slide technique., fluorescent antibody technique., select enrichment techniques, decomposition of organic matter, humus formation, synthesis and metabolism of polysaccharides in soil. **16 hrs**

Textbooks:

1. Alexander, M. *Introduction to Soil Microbiology* John Wiley & Sons, New York 1977.
2. Rangaswami and Bagyaraj, *Agricultural Microbiology*. Prentice Hall Co. India ,1996.

References:

1. Ambasht R.S. *Environment and Pollution*, Pub. Student's Frines Co. Zanka, Varanasi 221005 India.

Plant Microbiology

Course Title: Plant Microbiology
Course No. MB 642
Nature of Course: Theory

Full Marks: 100
Pass Marks: 40
Year: II

Objectives:

- To provide thorough knowledge in plant pathology, control of disease; pesticide microbiology and tissue culture with reference to mass production and disease resistance

Course Contents

Plant Pathology Resistance Microbial Diseases of Crops: Symptoms of plant diseases, mechanisms of microbial pathogenicity, and transmissions of plant pathogens. Factors affecting disease resistance.

Study of Major plant diseases of Nepal:- with special reference to identification, nomenclature, classification, and general biology of species that have importance in agriculture: **6 hrs**

Fungal Diseases:- Rust, smuts, wilts., Root rots., Soft and dry rots, and storage diseases of fruits and vegetables, Leaf spot. **4 hrs**

Bacterial Diseases: Blight, Cankers, leaf spots, Rots, crown gall, Brown rot, wild fire, greasy spot, wilt **4 hrs**

Viral Diseases: Mosaics , Dwarfs., Stunts., yellow, leaf curl., witches brown , Ring spots, wilt. **4 hrs**

Diseases Incited by Actinomycetes: Scabs. **2 hrs**

Diseases Incited by Namatodes: ear-cockle, root-nots, root lesions and diseases incited by Algae: red rust **6 hrs**

Deficiency Diseases: **4 hrs.**

Control of Crop Diseases: Plant quarantine eradication and international plant protection, Cultural practices in disease control, Chemical control-chemical pesticides., Biological control of plant pests and diseases - Microbial biopesticides- Viral, bacterial and fungal pesticides, Resistant crop varieties., Sanitary practices , Integrated pest management. **30 hrs**

Pesticide Microbiology: Persistence, Transformation, Biomagnification and Biodegradation in soil and the microorganisms related with the process.; Biocides or pesticides in soil and effect., organic phosphates-compounds, Chlorinated hydrocarbons, Arsenic containing pesticides, Sodium flucoroacetate , Herbicides and weedicides. **30 hrs**

Tissue Culture Technology: Shoot tip and meristem culture for virus eradication, Somaclone for disease resistance., Micropropagation for storage of genetic resources, Callus culture for mass production and plant resistance. **30 hrs**

Textbooks

1. Atlas, M. *Microbial Pathology Fundamentals and Application* - Mc Millan 1988.
2. Singh R.P. *Introduction Biotechnology*, Central Book Dept., Allahabad, India

References

1. Baker, K.E. & Cook, R.J. *Biological Control of Plant Pathogens*, W.H. Freeman & Co-San Francisco 1974.

Soil Fertility, Fertility and Fertilizer Effect

Course Title: Soil Fertility, Fertility and Fertilizer Effect
Course No. MB 643
Nature of Course: Theory

Full Marks: 100
Pass Marks: 40
Year: II

Objectives:

- to provide knowledge to the students about the production of some biofertilizers and other promoting factors of soil fertility in organic farming:- Soil Fertility and Fertilizers.

Course Contents

Biological Fertilizers: for Agricultural Crops and Agro-Forestry.: Applied aspects of BNF technology related to :(a) Rhizobium (b) Azotobacter, (c) Azospirilluim (d) Cynobacterium (Blue green algae). (e) Azolla anabaena system. **20 hrs**

a.. Mass production of Rhizobium inoculant and benefits, b. Mass production of Azospirillium inoculant benefits, c. Mass production of Cynobacteria inoculant and benefits, d. Mass production of Azolla inoculant and benefits. **20 hrs**

Organic Matter and Manures and Other Crop Nutrition Factors.: Practices of organic recycling by different methods depending on the farming system and agro-climatic conditions., Solid waste, including sewage, sludge, animal dungs, droppings, fish meal and manure recycling for fertilizer purpose., Recycling of organic mater by composting. Microbiology of composting and composting technique, Microbiological method for hastening composting and improvement of its quality., Plant surface microflora and plant nutrition., Rhizosphere microorganisms and plant growth, Phosphate solubilizers for plant growth, Green manuring as fertilizer, Genetically engineered microorganisms for agricultural production, Crop rotation, Microbial activities in aquaculture. **80 hrs**

Text Books:

1. Rao, N.S. Subba, *Advances in Agricultural Microbiology*, Oxford & IBH Publishing Co. 1982.
2. Rao, N.S. Subba, *Soil Microorganisms and Plant Growth*, Oxford & IBH Publishing Co. New Delhi, 1977.

References:

1. Tisdale, S.L., Nelson W.L. and Beaton J.D. *Soil fertility & fertilizers*. Macmillan New York 1985.

Agricultural Microbiology

Course Title: Agricultural Microbiology
Course No. MB 644
Nature of Course: Practical

Full Marks: 100
Pass Marks: 40
Year: II

Objectives:

- to familiarise the students with and have practical knowledge about different qualitative and quantitative techniques involved in agricultural microbiology

Course Contents

Practical

Estimation of cation exchange capacity of a soil sample., Estimation of NPK in a soil sample., Estimation of organic matter in a soil sample, Estimation of O/R potential of a soil sample, Isolation, estimation and identification of soil inhabiting: (a) bacteria (b) Protozoans, (c) Nematodes from a soil sample., Use of respirometric technique-warberg apparatus to study respiration of microorganism and germinating seedlings, Use of fluorescent antibody and microscopic technique to study certain bacteria in a soil sample, Study of metabolism of polysaccharide sample by soil inhabiting fungi. bacteria., Study of carbon dioxide evolution in a soil sample, Use of selective enrichment technique to isolate protozoa, fungi, bacteria etc from soil, Isolation of plant pathogenic organisms viz. bacteria, fungi, actinomycetes, and study on their physiological and pathogenic characters., Study on disease resistance and observation of biocidic effect of plant products and bacteriocin an plant pathogenic microorganisms., Studies on biological control of pests., Studies on pesticide degrading characteristics of microorganisms, Study on Azospirillium, cyanobacteric and azolla, on fertilizer effect on plants., Studies on composting practices, with special reference to compositing microorganisms and estimation of N.P.K., Estimation and study of fertility effect of certain livestock dungs, birds droppings on plant growth, Studies on mass production of bio fertilizers, Studies and isolation of mycorrhiza from a suitable host plant.