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DETAILED SYLLABUS

FOR

DISTANCE EDUCATION

B.Sc. (Microbiology)

(SEMESTER SYSTEM)

B.Sc. Microbiology

COURSE TITLE: B.Sc. (Mircobiology)
DURATION : 6 SEMESTERS
MODE : SEMESTERS

FIRST SEMESTER

COURSE TITLE	Paper Code	MARKS				
		THEORY		PRACTICAL		TOTAL
		INTERNAL	EXTERNAL	INTERNAL	EXTERNAL	
History and Scope of Microbiology	BMB/S/110	40	60			100
Diversity of the Microbial World	BMB/S/120	40	60			100
Elements of Biochemistry.	BMB/S/130	40	60			100

SECOND SEMESTER

COURSE TITLE	Paper Code	MARKS				
		THEORY		PRACTICAL		TOTAL
		INTERNAL	EXTERNAL	INTERNAL	EXTERNAL	
Biophysics, and Instrumentation.	BMB/S/210	40	60			100
Biomathematics and Biostatistics	BMB/S/220	40	60			100
Viruses and Bacteria	BMB/S/230	40	60			100

THIRD SEMESTER

COURSE TITLE	Paper Code	MARKS				
		THEORY		PRACTICAL		TOTAL
		INTERNAL	EXTERNAL	INTERNAL	EXTERNAL	
Algae and Cyanobacteria	BMB/S/310	40	60			100
Fungi and Protozoa	BMB/S/320	40	60			100
Microbial Physiology and Metabolism Research Methodology	BMB/S/330	40	60			100

FOURTH SEMESTER

COURSE TITLE	Paper Code	MARKS		
		THEORY	PRACTICAL	TOTAL

		INTERNAL	EXTERNAL	INTERNAL	EXTERNAL	
Genetics and Molecular Biology	**BMB/S/410**	**40**	**60**			**100**
Concepts of Ecology	**BMB/S/420**	**40**	**60**			**100**
Immunology	**BMB/S/430**	**40**	**60**			**100**

FIFTH SEMESTER

COURSE TITLE	Paper Code	MARKS				
		THEORY		PRACTICAL		TOTAL
		INTERNAL	EXTERNAL	INTERNAL	EXTERNAL	
Medical Microbiology	**BMB/S/510**	**40**	**60**			**100**
Plant Pathology	**BMB/S/520**	**40**	**60**			**100**
Soil and Food Microbiology	**BMB/S/530**	**40**	**60**			**100**

SIXTH SEMESTER

COURSE TITLE	Paper Code	MARKS				
		THEORY		PRACTICAL		TOTAL
		INTERNAL	EXTERNAL	INTERNAL	EXTERNAL	
Industrial Microbiology	**BMB/S/610**	**40**	**60**			**100**
Sewage and Pollution Microbiology	**BMB/S/620**	**40**	**60**			**100**
Microbial Genetics and Biotechnology	**BMB/S/630**	**40**	**60**			**100**

B.Sc. Microbiology

SEMESTER I

History and Scope of Microbiology **Course Code:BMB/S/110**

The Syllabus for History of Science shall be same as for other B.Sc. (H) Courses.
Important discoveries in the physical, chemical and biological sciences (plants and animals) – A historical account.
Importance of science (physical, chemical and biological) in human society. The scope of Microbiology.
The first microscopic observation; Leeuwenhock!s contributions and the microscope ; Spontaneous genecratioim versus biogenesis; The germ tgheory of disease; -The pure fulture concept; Immunization; Paitow's and Koch!& contribution and other – widening horizons; growth of organize. Microbiology in science; Microbes and fermentation; Microbiology in human welfait, indiatry, medicine, agriculture and environmental sanitation. I tatice of Microbiology in Molecular biology @d Biotechnology; Present status of Mimebiology; Microbiology and human society.

Diversity of the Microbial world **Course Code: BMB S120**

A broad outline describing various type of microorganisms (vi – rules, bacteria, algae, fungi and protozoa); Microscopic observations of some important members of bacteria, algae, fungi, and protozoa to elaborate the various shapes affia thallus range in these groups. The virus studies should be undertaken using electron microscopic and diagramatic photographs Detailed studies of life cycle patterns in bacteria, algae, fungi and protcaoa. The study should include history, classification, occurrence, cell structure, cytology, reproduction, life cycle patterns and importance of each group. Basic physiological factors of growth (pH, temperature, nutritional requirements) should also be discussed with reasons. Each group should be covered in such a way that representative members of all classes are discussed.

Elements of Biochemistry **Course Code: BMB/S/130**

Introduction to biochemistry – Historical background and molecular logic of living systems.
Cell Chemistry – Building blocks and macromolecules, sugars, fatty acids, aminoac nucleotides; polysaccharides, lipids, proteins and nucleic acids.
Enzymes – Structural and functional proteins; Primary, secondary, teritairy and quarternary structures of proteins; Enzymes, classification and nomenclature; Coenzymes and cofactors; Allosteric effects; Active sites,; Multienzyme complexes.
Intermediary metabolism of sugars – Gycolysis, alcoholic fermentation, pentose phosphate shunt, reversal of glycolysis, tricarboxylic acid cycle, generation of high energy bonds, oxidative phosphorylation – chemiosmotic theory.

Nucleic acids – History and structure of DNA and RNA; Nucleotides, nucleosides, organization of DNA – double helix structure, RNA structure and types, replication, transcription, translation; Operon theory.

SEMESTER II

Biophysics and Instrumentation **Course Code:BMB/S/210**

Biophysics

Cell – as a dynamic system (type, structure and function), cell wall, plasma membrane, nucleus, plastids, mitochondria, endoplasmic reticulum, golgi complex, lysosomes, ribosomes.

Life and the laws of thermodynamics, thermodynamic potentials, Maxwell – Boltzmann statistics. Transport of solutes and lions, Transport, equations (Planck – Henderson Nernsi – Plank equations), Membrane transport, Active transport in biomembranes, coupling of transport processes, Onsager's equations, membrance potential, water potential, osmotic pressure, cell turgor.

Radiation Biology – General account

Electrophysiology and excitable cell, electrochemical potentials in neutrons.

Instrumention

A basic understanding of principles and working of various instruments used in biological sciences.

Microscopy – Principles and use of light microscope, flourescent microscope, phase contrast, dark field, electron microscope TEM avid SEM.

Sterilization & Disinfection – Dry and wet sterilization and chemical disinfectants.

Osmosis and measurement of osmotic pressure in microbes.

Chromatography – Paper and the thin layer chromatography.

Electrophoresis.

Fundamentals of X- ray crystallography, X – ray diffraction.

Auto – radiography and its biological applications.

Biomathematics and Biostatistics **Course Code:BMB/S/220**

Biomathematics

Revision of 10 + 2 Syllabus, Taylor's theorem, Functions of more than one variable, Differentiation and integration, Differential equations (Linear separable and exact), Vector – spaces and Matrices, System or linear equations with constant coefficients, Rate of chemical reactions (First and second order). Radio – active decay, Vector analysis gradient. Curl and diverance, Path integrals, Strokes and Gauss's theorem, Differential equations (oscillations, chemical reactions) Maxwell's equations, diffusion (Fick's first and second law Euler's and Bernouli's hydrodynamic equation, Heagen Poissdevilles Law.

Biostatistics:

Revision of biostatistics syllabus from 10 + 2 with examples from biology and microbiology. Descriptive statistics incorporating graphic and tabular description, of data, measures of central tendency and dispersion, introduction to probability, and distribution, sampling theory and errors, tests of significance.

Viruses and Bacteria **Course Code:BMB/S/230**

Virology

Introduction: The science of virology, virology as a biological science, origin of virological knowledge, general methodology of virus teaching and research; Nature and structural morphology of virus (Explain RNA/DNA viruses).

Origin and Nature of Viruses : Viruses as independent genetic systems, theories of virus origin : The regressive theory of circus originy viruses and the genetic elements of cell, RNA viruses and cellular RNA, virus origin and the origin of the cell.

Classification and nomenclature of ciruses: Systematic virology (Family names only), ciruses of various vertebrates and their hosts; Statistical methods in virological studies.

Introduction in animal cell biology animal viruses : Adsorption and entry into the cell, animal virus multiplication, RNA/DNA and retroviruses; Effects of animal cruises on host cell and organisms; Animal virus transmission and control.

Bacterial viruses : general properties, multiplication and their importance.

Plant viruses : general account of plant ciruses and their transmission.

A general account of important human, animal and plant viral diseases.

Bacteriology

Introduction – General account

Classification – Systems of classification

Cell Organisation – Cell size and arrangement;

anatomy-surface layers, capsul, appendages (flagella, axial filament, and pili), cell wall of Cram positive and Cram negative bacteria, function of bacterial ocell wall; effects of antibiotics and enzymes on cell wall. Protoplast and spheroplasts. Plasma membrane structure, chemical composition & function, measosomes, cytoplasm & cytoplasmic inclusion, ribosomes, bacterial chromosomes and plasmid.

Endospore- structure and chemical composition.

Growth – requirements of growth-physical & chemical, culture media; growth of bacterial cultures-bacterial cell civision, generation time, phases of growth; measurement of bacterial growth-direct microscopic Count, optical density measurement and cell dry weight.

Reproduction – Asexual and sexual, methods of genetic recombination in bacteria – conjugation, transformation, & transduction. Role of episomes and plasimids as genetic engineering tools.

Pathology- A general account of plant & animal bacterial diseases.

Economic Importance – Role in agriculture, industry, pharmaceuticals, beverages, dairy & food; bacterial pollution- a general account.

SEMESTER III

Algae and Cyanobacteria **Course Code:BMB/S/310**

Algae- general characteristics and systematic position of major taxa with evolutionary tendencies among them (with regard to their vegetative structure, asexual and sexual reproduction.)
Cynobacteria – a general account with reference to Nostoc and Anabactia.
Chlorophyceae – Chlamydomonas, Volvox, Osdogonium Coleochaete, chara Acetabularia.
Xanthophyceae – a general account (Vaucheria)
Phaeophyceae – a general account
Rhodophyceae – a general account
Economic importance of algae
Habitat,Morphology, Cellwall and Sheath, Protoplasmic Structure, Gas Vacuoles, Pigments and Photosynthesis, Akinetes, Hetrocysts, Gliding Movement, Asexual Reproduction, parasexuality in Cyanobacteria, Anaerobic Metabilism, Obligate Phototrophy, Symbiosis.
Croococcales, Chamaesiphonales, Pleurocapsales, Nostocale, Stigonematales.

Fungi and Protozoa **Course Code:BMB/S/320**

Fungi – general characteristics and systematic position of major taxa with evolutionary tendencies among them (with regard to their vegetative structure, asexual and sexual reproduction.) and economic importance.
Morphology and life history of the following taxa-Myxomycetes, Saprolegnia, Achlya, Synchytrium, phytophthorc, Psronospora, Saksenea, Rhizopus, Saccharomycas, Candida, Asperifillus, Psnicillium, Claviceps, Neurospora, puccinla Utilago and Agaricu.
A general account of Deuteromycetes with emphasis on Fusarium and Collstotrichum. Parasexual mechanism in fungi.
Fungal – animal and human diseases- a general account
Outlines of classification of animal kingdom.
Protozoa
Detailed classification with special emphasis on the following taxa – Amoeba Trypanosoma Platsmodium Euglena and Paramecium.

Microbial Physiology and Metabolism **Course Code: BMB/S/330**

A general account of microbial Physiology – an overview of metabolic processes.
chemistry of microbial cell (bacteria, virus, algae & fungi).
Physiology of growth – microbial nutrition and growth dynamics in solid, liquid, batch, continuous and chemostat cultures, Kinetics of cell growth, synchronous growth. Physiology of sporulation, Biomass conservation. Effect of physical & chemical factors on growth of microbes.

Transport mechanisms in microbes-mechanism of nutrient transport across the membrane. isolation and characterisation of transporting protiens, galactosidasc & galactise transport in E coli. Molecular basis of transport mechanisms.

Autotrophic co2 fixation –a general account. Bacterial photosynthesis and cukaryotic photosynthetic mechanism.

Heterotrophic Co2 assimilation- a general account.

Carbohyderate Metabolism- aerobic and anaerobic respiration.Fermentation mechanism in different micro-organisms. Difference between fermentation & anaerobic respiration.Types of fermentations and their industrial applications.

Electron transport mechanism and oxidative phosphorylation in microbes- a general survey.

Ignorganic nitrogen assimilation. Role of microbes in nitrogen cycle in nature; Nitrification and denitrification. Nitrigen fixation. nitrogenese and modern aspects of biological nitrogen fixation by auto and heterotrophic nitrogen fixation.

Secondary metabolites – a general account, microbial vitamins, hormones, toxins, bacteriocins with a comment on their applications.

SEMESTER IV

Genetics and Molecular Biology **Course Code: BMB/S/410**

History of Genetics: Pre and Post Mendelian concepts
Asexual and sexual reporduction.
Cell division – Mitosis, Meiosis, Cell cycle.
Chromosome structure – Organisation and Morphology, special types of chromosome – Lampbrush and polytene chromosome.
Mendal's Laws of Inheritance.
Deviations from mendelian Laws:
Allelic interactions: Incomplete dominance.
Codominance, over dominance, Lethal genes.
Nonallelic interactions : Epistasis, complimentary genes, inhibitory and duplicate genes.
Chromosome theory of inheritance; Linkage and crossing – over, gene mapping, machanism of recombination.
Concept of multiple alleles and pseudo – alleles, Cis – trans complementation; Fine structure mapping.
Chemical Basis of Meredity – Evidence for the DNA and RNA as gene; material, Walston – Crick model of DNA structure Z – DNA.
DNA replication – mode and mechanism of DNA replication.
Gene – Protein relationship – One gene – One enzyme and one gene – one Polypeptide concept. Colinearity of genes and proteins, protein syntesis: Transription and Translation, genetic code.
Regulation of gene expression in prokaryotes and eukaryptes.
Mulation and Repair of DNA – Classification of mutation, physical & chemical mugagens, molecular basis of mutation, damage and repair of DNA.
Sex determination and Sex – linked Inheritance.
Variations in the number and structure of chromosomes – Haploidy, polyploidy, chromosomal aberrations.
Quantitative inheritance and materual efffect.
Cytoplasmic inheritance and materual effect.
Evolution – The genetic rnachanism.

Concepts of Ecology **Course Code:BMB/S/420**

Historical developments and the significance of ecology as a synthetic science, environmental science, and microbial ecology.
General concepts of ecology – Definitions of Ecology and eco – systems, components of ecosystems, levels of organisation of biosphere, energetics, trophic levels, food chains and food webs, ecological pyramids, synecology and autecology.

Microorganisms in their natural environments.

terrestrial environment
acquatic environment
air/atmosphere
animal as an environment microbial population of alimentary tract, skin & rumen.

Structure and development of microbial communities and ecosystems. (Succession of microflora in decomposing plant materials).

Biological Interactions:

microbe – microbe interactions
microbe – plant interactions
Microbe – animal interactions.

Biogeochemical cycling and applied aspects of microbial ecology:

Role of microorganisms in cycling of carbon, nitrogen phosphorus, sulphur and iron.
Ecological aspects of biodeterioration and control.
Micro – organisms and pollution problems.
Microbes in mineral recovery.

Microbial population dynamics a general account.

Immunology **Course Code:BMB/S/430**

Introduction Historical background. Immunity & Hper – sensitivity, specific & nonspecific immune responses: Immunologic balance, concept of immunisation; Antibody diversity & specificity and Memory.

Organization of the System. Cells and organs of the immune system their structure, development, properties and functions.

Antigens & Hopines. Classification & Properties, adjuvants – a general account.

Antibody and Immnoglobulins. Structure & function, evolutionary aspects, genesis of antibody variability, theories of antibody production, monoclonal antibodies. Hybridoma technology.

Complement System – a general account.

Antigen – Antibody reactions & Immunological methods. Agglutination, precipitation, phagocytosis, cytotoxicity, Immunodiffusion, Immunoclactrophores, ELISA, RIA, FIA. Enzyme Linked Immunosorbent Assay, Radio Immune Assay, Fluorescent Immuno Assy)

Cell Mediated Immum Rewtions. Cell type and effector mechenisms, effector molicules of cell mediated reactions.

Major Histocompatibility gone complex – A general account.

Autoimmunity & Immunoinflamatory disorder – A general account.

Regulation of Immune responsiveness. Immunopotentiation immunosuppression, tolerence – A general account.

Immunology in relation to Human Health – An overview, Nonimmuuno – logical and immunologic defences against diseases. Immunity to infection (bacterial diseases, viral infection & parasitic infections). Role of lymphocyte, circulating & secretory antibody in residence to infection, phagocytosis. Cancer and immune responses to tumor. Immunotherapy, transplantation immunity.

SEMESTER V

Medical Microbiology **Course Code:BMB/S/510**

Introduction and historical account of Medical Microbiology with important discoveries; a brief account of different patterns of diseases.

Classification of medically important virus es, bacteria, fungi and protozoa, following Bergey's Manual of Systematic Bacteriology.

Study of important viral diseases—influenza, measles and rabies; their symptomatology and clinical diagnosis-A general accunt of gastroenteritis, common cold, cna conjunctivitis, Hepatitis virus A & B; and non A non B, oncogenic viruses, Rubella, Arboviruses

Medically important bacterial diseasa-a brief account of their symptomatology, clinical diagnosis and antimicrobial therapytyphoid, cholera, dysentry, tuberculosis, a general account of normal human flora and a brief account of bacterial diseases of the following systems of the body (Respiratory, digestive, urino genital and sexually transmitted diseases), Diphtheria, Medically important anaerobic bacteria.

A general account of important fungal diseases :--

Symptomatology, clinical diagnosis, pathogenesis and antimicrobial therapy in dermatomycosis, candidiasis and aspergillosis.

Important protozoan diseases-an overview, symptomatology, clinical diagnosis, pathogenesis and antimicrobial therapy in maleria, amoebiasis and Kala Azar.

A general account of routinely employed diagnostic in microbial discases—culture, smear biochemical test antimicrobial testing, introduction to animal inoculation, skin tests and serological tests-precipitation, Immunoclec trophoresis, flocculation-VDRL, agglutination-WIDAL, imunofluorescence, haemagglutination, neutralization and ELISA.

A general concept of antimicrobial therapy-mechanism of action of clinically used antimicrobial drugs under the following heads :--

inhibition of cell wall synthesis e.g. Penicillin.

alteration of cell membrane function e.g. Amphotericin B,

inhibition of protein synthesis e.g. chloramphenicol

inhibition of nucleric, acid synthesis e.g. sulphonanides; Drug resistance; general concept of chemoprophylaxis.

\Plant Pathology **Course Code:BMB/S/520**

Introduction to phytopathogenic microorganisms—an overview of economically important viral, bacterial and fungal plant diseases of Indian field crops.

Methods of studying plant diseases—Symptoms, principles of infection and spread of diseases

Host-parasite relationships (including genetical aspects) disease forecasting, quarantine, causative factors and plant disease control.

Mode of infection and pathogenesis and general account of diseases caused by bacteria, viruses and fungi, studied in IInd year (H). (e.g. Citrus canker, soft rot of potago, bacterial blight and crown gall, T.M.V. *Phytophtora, Peronospora, Penicillium, Claviceps. Puccinta and Ustilago*).

Defence mechanisms in plants against microbial diseases and prevention of epidemics.

Soil & Food Microbiology **Course Code: BMB/S/530**

Soil Microbiology

Introduction and historical background of soil microbiology.

Role of microbes in weathering of minerals and soil formation, components of soil, texture and classification of soils, and soil profile.

Soil microflora—bacteria, fungi, actinomycetes, algae, protozoa, and viruses, role of microorganisms in cycling of carbon, nitrogen phosphorous, sulphur and degradation of pesticides.

Interactions among soil microorganisms : neutralism, symbiosis, protocooperation, commensalism, amensalism, parasitism and predation.

Rhizoplane and rhizosphere microflora, plant-microbe interactions, soil-borne plant diseases.

Food and Dairy Microbiology

Important microorganisms in food (meats, poultry, vegatables, dairy products, dehydrated foods)—moulds, yeasts, yeast like fungi, and bacteria.

Principles of food preservation and spoilage of foods.

Food-borne diseases, food poisoning and prevention.

SEMESTER VI

Industrial Microbiology **Course Code:BMB/S/610**

Industrial Microbiology

Scope and historical development of industrial microbiology.

Fundamentals of fermentation processes :--

Definition and types of fermentation processes.

Fermention in tubes, shakes, flasks and fermentors, different parts of a typical fermentor.

Aerobic and anaerobic fermentations

Fermentation equipment and its uses-pH, temperature, oxygen, redox probes, agitation, air filten, automation and computer.

Industrial fermentations, for the production of (organisms, processes, uses) :--

Food and feed yeasts, and baker's yeast

Bacterial insecticides and legume inoculants

Antibiotics-penicillin, streptomycin, tetracyclines

Industrial alcohol, beer, wines, whisky, rum, and brandy

Steroid drugs (sterod transformations)

Vitamin—B_{12}, riboflavin

Organic acids—lactic and citric acid

Enzymes—amylases, collulasm pectinases, lipases, invertase, glucose oxidase and glucose isomerase

Aminoacids-L-glutamics acid, L-lysine

Sewage and Pollution Microbiology **Course Code:BMB/S/620**

Sewage Microbiology

Variation in the composition of sewage, kinds of sewerage systems- sanitary, storm and combined sewers

Microorganisms in sewage—fungi, protozoa, algae, bacteria and Viruses

COD and BOD of sewage and pollution problem

Sewage treatment and disposal

Pollution Microbiology

Microbial deterioration of grains, oil seeds, textiles, wood, corrosion of metals.

Persistance and biomagnification of xenobiotic molecules Recalcitrant hydrocarbons, synthetic polymers, alkylbtnzyl sulfonates, pesticides.

Microbial interactions with some inorganic pollutants-

Acid mine drainage

Microbial conversions of nitrate
Microbial methlyations
Microbial accumulation of heavy metals and radionuclides.

Microbial Genetics and Biotechnology. **Course Code:BMB/S/630**

Microbial Genetics

Introduction to microbes as tools in genetis, life cycle of some important microbes (from genetical view point e. g. Viruses, E. coli, Neurospora, Saccharomyces, Chlamydomonas and Paramecium.

Genome Organisation in viruses, bacteria and eukaryotic microbes; extrachromosomal genetic structure, genetic mobile elements.

Basic principles of microbial genetics.

Origin of variations in microbial populations, spontaneous and induced mutations, repair mechanisms and molecular basis of mutations.

Mechamisma of gene transrer—conjugation, transformamations, and transduction; genetic recombination and gene mapping.

Biotechnology

Introduction to basic biotechnology—what is biotechnology. Biotechnology as operational method; what cells can do for us?

Micmbial screening, selection and strain improvement.

Recombinant DNA technology—basic concepts, basis of restriction endonucleases, purification and analysis of plasmid DNA, construction of recombinant DNA, basic procedures involved in a recombinant DNA experiment, construction of suitable vectors, choice of vectors, principal features of phage lambda vectors, choice of host for recombinant DNA work and examples of the applications of recombinant DNA in microbial Technology.