

Annamalai University
Department of Microbiology
M.Sc., Microbiology CBCS (2 YEARS)

Code	Name of the paper	Hours	Credit	Internal mark	External mark	Total
	Year I Semester I					
MIBC101	Core Paper I General Microbiology	5	5	25	75	100
MIBC102	Core Paper II Microbial Taxonomy	5	5	25	75	100
MIBC103	Core Paper III Microbial physiology & metabolism	5	5	25	75	100
MIBP105	Core practical for Courses for MIBC 101,102 & 103	6	3	40	60	100
MIBO104	Elective I Bioinstrumentation & Research methodology	3	3	25	75	100
ENGO116	Soft skill	4	4	25	75	100
		28	25			
	Year I Semester II					
MIBC201	Core Paper IV Medical Microbiology	5	5	25	75	100
MIBC202	Core Paper V Immunology & Diagnostic technology	5	5	25	75	100
MIBC203	Core paper VI Environmental Microbial technology	4	4	25	75	100
MIBP205	Core practical for papers MIBC 201,202 &203	6	3	40	60	100
MIBO215-2	Elective II Statistical methods	4	4	25	75	100
MIBO204	Elective III Quality control & IPR	3	3	25	75	100
		27	24			
	Industrial Training / Internship for three/ four weeks					
	Year II Semester III					
MIBC301	Core Paper VII Microbial genetics &Molecular biology	5	5	25	75	100
MIBC302	Core Paper VIII Soil & Agricultural Microbiology	4	4	25	75	100
MIBC303	Core paper IX Genetic Engineering	5	5	25	75	100
MIBP304	Core practical for papers MIBC 301,302 & 303	6	3	40	60	100
MIBO315	Elective IV Computer applications	3	3	25	75	100
		23	20			
	Year II Semester IV					
MIBC401	Core Paper X Food & Dairy Microbiology	5	5	25	75	100
MIBC402	Core Paper XI Bioprocess Engineering and Technology	5	5	25	75	100
MIBP403	Core practical for papers MIBC 401,402	6	3	40	60	100
MIBO415	Elective V Genomics, proteomics & Bioinformatics	3	3	25	75	100
MIBP 404	Project		5			
		19	21			
	Total	97	90			

MIBC101Core Paper I General Microbiology

Objectives

To learn the general principles and applications of microbiology.

Unit I

Introduction, History and scope of Microbiology. Recent developments Spontaneous generation – Biogenesis. Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchnikoff, Edward Jenner and Fleming. Classification - Haeckel's three kingdom concept, Whittaker's Five-kingdom concept, Classification of Virus and Fungi, Classification of Bacteria according to Bergey's Manual.

Unit II

Microscopy: Simple, Compound, Dark-field, Phase contrast, Fluorescent and Electron microscopes. (SEM & TEM), Confocal microscopy – Principles and their applications. Staining-techniques: Nature of dyes, Simple, Differential and negative and spore staining. Culture methods: Culture media and Nutritional types, Growth curve.

Unit III

General characteristics and nature of Archaeobacteria, Eubacteria, Cyanobacteria, Mycoplasmas, Rickettsiae, Chlamydias, Spirochaetes, Actinomycetes, Protozoa, Algae, Fungi and Viruses. Cell walls of Gram negative and Gram positive bacteria, Cell wall synthesis, capsule types, composition and function. Structure and function of flagella and pili, Endospore types, structure and functions. **Fungi:** Cell wall – Chemical composition and functions.

Unit IV

Antimicrobial chemotherapy - Antibiotics – mode of action – antimicrobial resistance – Tests for sensitivity to antimicrobial agents.

Unit V

Isolation of different types of Bacteria, Fungi, Actinomycetes, Cyanobacteria and Protozoa. Preservation methods of microbes. Type culture collections. Sterilization Methods - Physical, chemical method.

Reference Books

1. Willey, Joanne M. *Prescott's Microbiology*. 9th Edition: McGraw-Hill Education - London, 2014. .
2. Pelczar, Chan & Kreig (2009). *Microbiology* 5th edition. Tata McGraw Hill, New Delhi.
3. Dubey, R.C. and Maheswari, D.K. (2011). *A Textbook of Microbiology*, S.Chand and Company Ltd., New Delhi.
4. Ananthanarayan. R. and Paniker C.K. *Text Book of Microbiology*, Orient Longman, 2009.
5. Stanier, R.Y., Ingraham, J.L., Wheels, M.L. and Painter, P.R. (1999). *General Microbiology*, Mac Millan Educational Limited, London.

MIBC102Core Paper II Microbial Taxonomy

Objectives

The aim of the course is to impart knowledge on principles of classification, rules and its applications

Unit I

An Introduction to Microbial Classification and Taxonomy, Taxonomic Ranks. Techniques used for determination of Microbial Taxonomy & Phylogeny, Systems of Prokaryotic and Eukaryotic Phylogeny.

Unit II

Classification systems in Prokaryotes, Bergey's Manual of Systematic Bacteriology. Prokaryotic groups with unusual characteristics: Cyanobacteria, Green and Purple sulphur bacteria, Gliding bacteria, Rickettsia and Chlamydia, Actinomycetes, Archaea- Classification, Significance.

Unit III

Viruses - Definition, Viroids and Prions, Classification systems of Viruses-LHT, Baltimore. General Structure of viruses, Concepts of Lytic and Lysogenic life cycles, Basic Concepts of Virus cultivation.

Unit IV

Eukaryotic Diversity- Three Domains of Life, Endosymbiotic theories, Eukaryotic cell cycle and Cell division – Mitosis and Meiosis

Fungi: Distribution and importance. Morphology of fungi –cell wall structure, fungal thallus and filamentous. Cytology of fungi- Mitochondria, Golgi bodies- Endoplasmic reticulum. Recent classification of fungi. Study of yeasts and moulds.

Unit V

Algae: photosynthetic protists- Algal classification with their characteristics features, Type of vegetative forms- heterocyst and non-heterocyst forms. Cytology of algae- pigment and cell inclusions. Distribution and importance. Classification of protozoa. Morphology of protozoa – shapes and size .Cytology of protozoa- Body covering and skeletons, locomotory and internal organelles.

Reference Books

1. Willey, Joanne M. Prescott's Microbiology. 9th Edition: McGraw-Hill Education - Europe, 2014
2. Foundations in Microbiology, Kathleen Park Talaro, 8th International edition 2011, McGraw Hill.
3. A Textbook of Biotechnology R.C. Dubey, 4th edition, First Multicolor Illustrative Edition, Reprint 2007
4. Brock Biology of Microorganisms, Michael.T.Madigan, John.M.Martinko, Paul V. Dunlap, David P. Clark- 12th edition, Pearson International edition 2009, Pearson Benjamin Cummings.
5. Microbiology – An Introduction, Gerard J.Tortora, BerdellR.Funke, Christine L. Case, 10th ed. 2008, Pearson Education.

MIBC103Core Paper III Microbial physiology & metabolism

Objectives

To enable the students to understand the physiology and metabolism of microorganisms.

Unit I

Biosynthesis of peptidoglycan - outer membrane, teichoic acid – Exopolysaccharides; cytoplasmic membrane, pili, fimbriae, S-layer. Transport mechanisms – active, passive, facilitated diffusions – uni, sym, antiports. Electron carries – artificial electron donors – inhibitors – uncouplers – energy bond – phosphorylation.

Unit II

: Phases of growth curve – measurement of growth – calculations of growth rate – generation time – synchronous growth – induction of synchronous growth, synchrony index – factors affecting growth – pH, temperature, substrate and osmotic condition. Survival at extreme environments – starvation – adaptative mechanisms in thermophilic, alkalophilic, osmophilic and psychrophilic. Bioluminescence - mechanism – advantages.

Unit III

Autotrophs - cyanobacteria - photosynthetic bacteria and green algae – heterotrophs – bacteria, fungi, myxotrophs. Brief account of photosynthetic and accessory pigments – chlorophyll – fluorescences, phosphorescences - bacteriochlorophyll – rhodopsin – carotenoids – phycobiliproteins

Unit IV

Carbohydrates – anabolism – autotrophy – oxygenic – anoxygenic Photosynthesis – autotrophic generation of ATP; fixation of CO₂ – Calvin cycle – C₃ – C₄ pathways. Respiratory metabolism – Embden Meyer Hoff pathway – Enter Doudroff pathway – glyoxalate pathway – Krebs cycle – oxidative and substrate level phosphorylation – reverse TCA cycle – gluconeogenesis – Fermentation of carbohydrates – homo and heterolactic fermentations.

Unit V

Cell division – endospore – structure – properties – germination. Microbial development, sporulation and morphogenesis. Hyphae vs yeast forms and their significance. Multicellular organization of selected microbes. Dormancy.

Reference Books

1. Moat A.G. Foster J.W.Spector M.P. 2009. Microbial Physiology (4th ed). Wiley.
2. Caldwell, D.R. 1999 Microbial Physiology and Metabolism, Wm. C. Brown Publishers, U.S.A.
3. White, D., 2006 The Physiology and Biochemistry of Prokaryotes, Oxford University Press
4. Gottschalk,G. 1985 Bacterial Metabolism, second edn, Springer
5. Microbiology – An Introduction, Gerard J.Tortora, BerdellR.Funke, Christine L. Case, 11th ed. 2012, Pearson Education.
6. Perry, J.J., Staley, J.T. and Lory, S. 2007. Microbial Life. Sinauer Associates, Publishers, Sunderland, Massachusetts.

MIBP 105 Core practical General microbiology, Microbial taxonomy & Microbial physiology

1. Different methods of sterilization.
2. Preparation of Media:
Nutrient broth, Nutrient agar, plates, slants, soft agar, Blood agar, Selective Media.
3. Determination of growth - growth curve
4. Pure culture technique:
Streak plate, spread plate and pour plate methods.
5. Measurement of microbial cell size – micrometry.
6. Enumeration of bacterial / yeast cells-viable count (Plate count) Total count (Haemocytometer count).
7. Motility determination
Hanging drop method.
8. Staining methods:
Simple, Negative, acid fast, Gram staining, spore, Capsule, Metachromatic granular staining, Lactophenol cotton blue staining for Fungai slide culture.
9. Morphology of
Bacteria
Yeast
Filamentous fungi
Protozoa
Algae
Viruses
10. Bacterial growth curve – Turbidity
11. Biochemical tests : a) Indole b) MR c) VP d) Citrate e) TSI f) Urease g) Catalase h) Oxidase
Carbohydrate fermentation test

MIBO 104 Elective I Bioinstrumentation & Research methodology

Objective:

Aim of the course is to understand the principles and applications of classical and modern techniques in Biology develop skill in preparation of reports, writing research communications and thesis.

Unit I

Research Methodology - Meaning and importance. Statement, Constraints, Review of literature - Review and synopsis presentation. Types of research, Research tools, Qualities of a good researcher. Research process, Research designs - Experimental and non-experimental. Preparation of research report. Guidelines for preparing an article. Computers in biological research.

Unit II

Thesis writing; defining research problem, research design, general format, literature survey, primary source - articles, reviews, abstract, current contents (both text and CCOD), reference card, data analysis, data interpretation, report writing, proof correction.

Unit III

Light Microscopy: Microscopic optics, components of microscopes. Basic principles and types of Bright field, Dark field, Phase contrast. Fluorescence, Polarization and confocal microscopes and their applications. Immunofluorescence – In situ hybridization. Electron Microscopy – Principle, Techniques and applications of Transmission Electron microscope (TEM) and Scanning Electron Microscope (SEM).

Unit IV

Spectroscopic methods – UV-Visible, Fluorescent Spectroscopy Atomic Absorption and Atomic Emission Spectroscopy. Centrifugation – Principles and types centrifugation Radioisotope techniques: Principles of radioactivity, GM counter & LS counter.

Unit V

Theory, principles and applications of paper, thin layer, gel filtration, ion exchange, affinity, GC and HPLC methods. Electrophoresis - Principle, types and methods. Horizontal, vertical, PAGE, Agarose electrophoresis, Applications. Pulse Field Gel Electrophoresis (PFGE) - Principle and applications. Gel documentation and molecular weight analysis.

Reference Books

1. R H. BaltzDemain, A.L. and Davies, J.E. (2010). Manual of Industrial Microbiology & Biotechnology, ASM Press.
2. John G. Webster. (2008). Bioinstrumentation. University of Wisconsin, John Wiley & Sons, Inc.
3. D B. Murphy, M W. Davidson. (2012) Fundamentals of Light Microscopy and Electronic Imaging, Wiley-Blackwell.
4. Westermeier, R (2001). Electrophoresis in practice – VCH – Federal Republic of Germany.
5. Wilson, K. and Walker (2000). Principles and Techniques of Practical Biochemistry, Cambridge University Press.
6. Kothari, C.R., 2013. Research methodology Methods and Techniques, New Age International Pvt Ltd Publishers., New Delhi.
7. Anderson, J., Duros, B.H. and Poole, M. 2011. Thesis and assignment writing, Wiley Eastern Ltd., New Delhi. MIBC201 Core Paper IV Medical Microbiology

MIBC201 Core Paper IV Medical Microbiology

Objectives

Aim of the course is to create awareness of microbial diseases of human beings and causes and cures.

Unit I

History, Koch & River's postulates, Role of Microbiology in Medicine, Classification of medically important microbes, Normal Microbial flora, Infections- Source, Mode of transmission, Prevention of medically important microbes.

Unit II

Morphology, classification, cultural characteristics, Pathogenicity, Pathology, laboratory diagnosis and Prevention control and treatment of diseases caused by; Staphylococci, Streptococci, Pneumococci, Neisseria (Gonococci and Meningococci), *Cornebacterium*, *Mycobacterium*, *Clostridium*, *Bacillus*. *Vibrio*, *Escherichia coli*, *Brucella*, Gram negative anaerobes - Spirochaetes, *Rickettsiae*, *Chlamydiae*, *Mycoplasma* and *Ureoplasma*

Unit III

Lifecycle, Pathogenicity, diagnosis, prevention and treatment Influenza viruses, Measles, Mumps, Chicken Pox, Hepatitis A,B,C, D& E, Poliomyelitis, AIDS, Human Papilloma Virus (HPV), Rabies, Yellow fever, Dengue and Japanese Encephalitis. Viroids, Prions, Satellite RNAs and virusoids. Emerging and reemerging viral diseases SARS virus - Swine flu and Dengue virus

Unit IV

Superficial mycosis - Tinea, Piedra - dimorphic fungi causing systemic mycosis - Blastomycosis and Histoplasmosis - Cutaneous mycosis-Dermatophytosis. Subcutaneous mycosis - Sporotrichosis, Mycetoma, Rhinosporidiosis, Opportunistic mycosis - Candidiasis, Cryptococcus and Aspergillosis.

Unit V

Transmission lifecycle, lab diagnosis, treatment for the following Protozoa diseases *Entamoeba*, *Toxoplasma*, *Cryptosporidium*, *Leishmania*, *Trypanosoma*, *Giardia*, *Trichomonas*, *Balantidium*. Helminthes – Cestodes - *Taeniasolium*, *T. Saginata*, *Echinococcus granulosus*, *Fasciola hepatica*, *Paragonimus* - *Schistosoma-Ascarislumbricoides*, *Ancylostomaduodenate*, *Trichinella*, *Enterobius* and *Wuchereriabancrofti*.

Reference Books

1. Ananthanarayan. R. And Paniker C.K. Text Book of Microbiology, Orient Longman, 2009..
2. Greenwood, D. Slack R.B and Peutherer J.F (2012). Medical Microbiology, 18th Edn Churchill Livingstone, London.
3. L C. Norkin (2010) Virology: Molecular Biology and Pathogenesis , American Society for Microbiology
4. Morag. C, and M.C. Timbury, (1994) Medical virology (10th Edition), Churchill Livingston, London.
5. Chander.J (2009). A text book of Medical mycology. Interprint, New Delhi.
6. Parija S.C (2013). Textbook of Medical Parasitology, Protozoology and Helminthology. (4th Edition). All India Publishers and distributors, Medical Book Publisher, New Delhi.

MIBC202Core Paper V Immunology &Diagnostic technology

Objectives

The aim of this course is to impart knowledge on the basic concepts of cells and components of immune system and immuno diagnostic techniques.

Unit I

Types of immunity: Innate and acquired - Humoral immunity and cell mediated Immunity: Central and peripheral lymphoid organs. Thymus, Bone marrow, spleen, lymph nodes and other peripheral lymphoid tissue- GALT. Cells of the Immune system - detailed aspects of T cell and B cell, Macrophages, phagocytes, NK cells, T cell and B cell receptor and function

Unit II

Antigens: Types, Properties, Haptens, Epitopes, Adjuvants, Auto antigens, Blood group antigens. Immunoglobulin structure, types, properties and function. Theories of antibody production-Clonal selection theory, Antibody diversity. Factors governing antigen - antibody interactions - Affinity, avidity, valency, cross reactivity.

Unit III

Antigen - Antibody reactions – Agglutination - Precipitation, Complement fixation - Immunofluorescence, ELISA, RIA, Immuno electrophoresis. Hybridoma technology and Monoclonal antibodies - applications. Vaccines - DNA vaccines recombinant vaccines - Edible vaccines, multivalent, subunit and anti - Idiotype vaccines. Autoimmune disorders

Unit IV

Guidelines for the collection, Transport, Processing and analysis of clinical specimens- Blood, Urine, Cerebro spinal Fluid, Swabs, Fluids. Detection and identification of pathogens and reporting of cultures from specimens. NABL, CISL regulations.

Unit V

Laboratory diagnosis of bacterial diseases, Laboratory diagnosis of mycological and Parasitological diseases, Laboratory diagnosis of viral diseases, Antibiotic sensitivity test. Molecular diagnosis-PCR, immuno blotting

Reference Books

1. P J. Delves, SJ. Martin, D R. IM. Roitt(2011). Roitt's Essential Immunology. Blacwell Scientific Publications, Oxford.
2. Rao, C.V (2008). Immunology, Narosa Publishing House, India.
3. T J. Kindt, R A. Goldsby, B A. Osborne, Janis Kuby 2008. Cuby Immunology III Edn. Panimabook company limited. New Delhi.
4. Goldsby, 2004. Immunology. 5th Edn. New Era Books, Bangalore.
5. Microbiology Lab Manual (2007) John P. Harley 7th edition McGraw Hill Medical Publication division
6. Ramani Sood. Laboratory technology (Methods and interpretations) 6th Ed. 2009 J.P. Bros, New Delhi, .

MIBC203Core paper VI Environmental Microbial technology

Objectives

To create awareness on basic concepts of environment and role of microorganisms in environment.

Unit I

Environment and Ecosystems-Definitions, biotic and abiotic environment. Environmental segments. Composition and structure of environment. Concept of biosphere, communities and ecosystems. Ecosystem characteristics structure and function. Food chains, food webs and trophic structures. Ecological pyramids.

Unit II

Eutrophication Water pollution and its control: Need for water management. Sources of water pollution. Measurement of water pollution, Eutrophication: Definition – causes -microbial changes in eutrophic bodies of water induced by various inorganic pollutants. Effects of eutrophication on the quality of water environment - factors influencing eutrophication. Algae in eutrophication, algal blooms, their effects and toxicity, coloured waters, red tides, and cultural eutrophication. Physico-chemical and biological measures to control eutrophication.

Unit III

Aerobiology-Droplet nuclei, aerosol, assessment of air quality, - solid – liquid – impingement methods – Brief account of air borne transmission of microbes – viruses –bacteria and fungi, their diseases and preventive measures.

Unit IV

Waste treatment techniques-Wastes – types – solid and liquid wastes characterization – solid – liquid; treatments – physical, chemical, biological – aerobic – anaerobic – primary – secondary – tertiary; solid waste treatment – saccharification – gasification – composting. Utilization of solid wastes – food (SCP, mushroom, yeast): fuel (ethanol, methane) fertilizer (composting), liquid waste treatment – trickling filter– activated sludge – oxidation pond – oxidation ditch.

Unit V

Bioremediation & Global environmental problems Microbiology of degradation of xenobiotics in the environment, ecological considerations, decay behavior, bio magnification and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants and pesticides. Genetically Modified Organisms released and its environmental impact assessment and ethical issues-Ozone depletion, UV-B, greenhouse effect and acid rain, their impact and biotechnological approaches for management. .

Reference Books

1. Bioremediation: Principles and Applications (Biotechnology Research) by R L. Crawford , D L. Crawford 2005.. Cambridge University Press
2. Wastewater Microbiology: A Handbook for Operators, T. Glymph.(2005) Amer Water Works Assn
3. Environmental Biotechnology. B.C. Bhattacharyya, R Banerjee.(2007) Oxford University Press
4. Biocatalysis and Biodegradation: Microbial transformation of organic compounds. 2001 by Lawrence P. Wacekett, C. Douglas Hershberger. ASM Publications.
5. A Manual of Environmental Microbiology. 2nd Edition. 2007 by Christon J. Hurst (Chief Editor), ASM Publications.

**MIBP 205 Core practical for papers Medical microbiology, Immunology &
Diagnostic technology & Environmental microbiology**

- 1) Identification of pathogenic microorganisms from given samples
- 2) Cultivation of virus in chick embryo
- 3) Skin/nail scrapings for fungi identification
- 4) Isolation & identification of yeast from clinical specimens
- 5) Isolation of ova/cyst in feces (Direct and concentration methods).
- 6) Spotters of *Anopheles*, *Glossina*, Ticks, Mites, *Aedes* etc.
- 7) Blood smear examination for malarial parasites.
- 8) Blood group typing
- 9) WIDAL test
- 10) RPR test
- 11) Immuno electrophoresis
- 12) Ouchterlony's double Immuno diffusion
- 13) Identification of leukocytes from blood Smear
- 14) ELISA
- 15) Bacterial examination of water (qualitative and quantitative).
- 16) Enumeration of microorganism from air-Settle plate technique.
- 17) Estimation of Dissolved Oxygen (DO).
- 18) Estimation of BOD.
- 19) Estimation of COD.

MIBO 204 Elective III Quality control& IPR

Unit I

Bioethics - Definition – Principles of Bio ethics –General issues related to environmental release of genetically modified microorganisms. Ethical issues related to the use of animal as models for microbial diseases- Animal ethics norms in India - Licensing of animal house - Ethical clearance norms for conducting studies on human subjects. Ethical issues related to research in embryonic stem cell cloning.

Unit II

Biosafety – Introduction. Different levels of biosafety. Guidelines for recombinant DNA research activities in microorganisms. Good Laboratory Practices (GLP). Containments – Types. Basic Laboratory and Maximum Containment microbiology Laboratory research.

Unit III

Introduction to Intellectual Property- IPR - Definition - Types of IPR: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, IP as a factor in R&D; IPs of relevance to Microbiology / Biotechnology and few Case Studies WTO - Definition - Functions - Forms of IPR Protection.

Unit IV

Agreements and Treaties-History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments

Unit V

Basics of Patents and Concept of Prior Art IPR & edits. Introduction to Patents; Types of patent applications: Ordinary,PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; process of patenting, Indian and international agencies involved in IPR & patenting, Global scenario of patents and India's position, patenting of biological material, GLP, GMP.

Reference Books

1. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007.
3. Frederic H. Erbisch, Karim M. Maredia (2004). Intellectual Property Rights inAgricultural Biotechnology, CABI Publisher.
4. Mittal D.P. (1999). Indian Patents Law. Taxmann Allied Services (p) Ltd.
5. Christian Lenk, Nils Hoppe, Roberto Andorno (2007). Ethics and Law of Intellectual Property: Current Problems in Politics, Science and Technology, Ashgate Publisher (p) Ltd.
6. Felix Thiele, Richard E. Ashcroft (2005). Bioethics in a Small World. Springer.
7. John Bryant (2005) Bioethics for Scientists. John Wiley and Sons
8. Recombinant DNA safety guidelines (January1990), Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.
9. Glick, B.R., and Pasternak, (2009), Molecular Biotechnology, 4thEdition, J.J., ASM Press, Washington, DC.

MIBC301Core Paper VII Microbial genetics &Molecular biology

Objective

Objective of the course is to give knowledge about molecular biology and genetics of microorganisms.

Unit I

Recombination, Transformation, Transduction - Generalized, Specialized, Conjugation, Hfrtriparental mating.

Unit II

Central dogma of Molecular biology, *Escherichia coli*, Chromosome, Plasmids. Concepts of gene - Typical Structure of protein coding genes. Eukaryotic genome - nucleosome & higher order chromatin structure.

Unit III

Replication – Messelson Stahl Experiment. Enzymes & proteins involved in replication. Steps in replication - Initiation, Elongation, Termination. DNA damage & repair - Photo reactivation & Excision.

Unit IV

Transcription, RNA Polymerase Promotor, Steps in transcription, Initiation, elongation & termination, Reverse transcription, post transcriptional processing.

Unit V

Genetic code, steps in translation - Amino acid activation, initiation, chain elongation & termination. Inhibitors of protein synthesis. Post transcriptional modification, Regulation of gene expression. Brief account of *lac* operon

Reference Books

1. Friedberg EC, Walker GC, Siede W. (2006). DNA repair and mutagenesis. ASM press
2. KhalifaAbd El MaksoudZaied, 2011, Fundamental Microbial Genetics. LAP Lambert Academic Publishing
3. James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann (2013, Molecular Biology of the Gene, 7th Edition , Pearson Publication
4. Antony JF, Griffiths, Gilbert WM, Lewontin RC and Miller JH (2002). Modern Genetic Analysis, Integrating Genes and Genomes, 2nd edition, WH
5. J E. Krebs, E S. Goldstein, S T. Kilpatrick. (2012). Lewin's GenesXI. Oxford University press
6. Maloy SR, Cronan Jr. JE, Freifelder D (2004). Microbial genetics. Jones and Bartlett publishers.
7. Watson JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AM. (2013). Molecular biology of the gene, 7th edition, Benjamin/Cummings publishing company.

MIBC302Core Paper VIII Soil &Agricultural Microbiology

Objective

Objective of the course is to learn about the role of microorganisms, their applications in agriculture.

Unit I

Development of soil Microbiology – characteristics and classification of soil – Distribution of soil microorganisms in soil fertility – influence of soil and environmental factors on soil microflora. Interaction of microorganism – beneficial and harmful.

Unit II

Microbial ecology – nature of soil organisms and their interactions – positive and negative interactions – mycorrhizal symbiosis – management of mycorrhizae – inoculum production and use – applied aspects of ecto and endomycorrhizae. Rhizosphere and spenosphere.

Unit III

Fate of nitrogen in soil – biological dinitrogen fixation – symbiotic and non -symbiotic significance. Nitrogenase enzyme complex – associative dinitrogen fixation – process – physiology and genetics of dinitrogen fixation – influence of environmental parameters – new developments in nitrogen fixation.

Unit IV

Plant diseases: symptoms, disease cycle and control measures – Bacterial diseases- Blight of rice, Citrus canker and wilt of potato. Viral diseases- Tungro disease of rice, TMV and CMV. Fungal diseases-rust of wheat, smut of sugarcane, wilt of cotton, tikka leaf spot in groundnut.

Unit V

Microbial control of insect pests – control of soil borne microbial pathogens and nematodes – interaction of pesticides with soil microorganisms. Effects of microorganisms on pesticides. Effect of plant protection chemicals on soil microorganisms. Microbial herbicides.

Reference Books

1. Mishra R.R., (2004). Soil Microbiology. CBS Publishers & Distributors., New Delhi.
2. Dirk, J. Elsas, V., Trevors, J.T., Wellington, E.M.H. (2006). Modern Soil Microbiology, Marcel Dekker INC, New York, HongKong.
3. S A Waksman, Soil Microbiology. Nabu Press, 2011
4. SubbaRao, N.S., (1995). Soil Microorganisms and plant growth. Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi.
5. Atlas Ronald, M., Bartha, and Richard (1997). Microbial Ecology 4th Edition. Benjamin/Cummings Publishing Company, California.

MIBC303Core paper IX Genetic Engineering

Objective

Objective of this course is to educate with the advanced tools and techniques in genetic engineering.

Unit I

Basic steps in cloning. Restriction Endonucleases - types. Nomenclature and mechanism of action of type II restriction endonucleases, ligases and other enzymes involved in gene cloning.

Unit II

Cloning vectors - properties. Cloning in plasmid (PBR 322), phage λ . Brief account of cosmids, BACs, TACs, Shuffle vectors. Expression vectors.

Unit III

Methods of gene transfer - Calcium Phosphate Co-precipitation, Viral Vectors, lipofection, micro injection. *Agrobacterium* mediated transformation. Host organisms for cloning.

Unit IV

Screening of recombinants - Insertional inactivation (antibiotic resistance, blue white selection) colony hybridization, immunological screening. Cloning strategies, genomic & cDNA cloning.

Unit V

Blotting techniques - Southern, Northern, Western. PCR - basic principle & applications. DNA sequencing (brief account only). - Chemical & enzymatic methods. Site - directed mutagenesis - (brief account only). Hazards & safety aspects of genetic engineering.

Reference Books

1. An Introduction To Genetic Engineering (2010) Desmond S. T. Nicholl, Cambridge University Press
2. Molecular Biology Of Genetics (2008) Manorma Singh, Discovery Publishing House.
3. iGenetics: A Molecular Approach by Peter J Russell (2009) 3rd edition Benjamin-Cummings Publishing Company.
4. Molecular Biotechnology (2003) Bernard R. Glick and Jack J. Pasternak., 3rd edition by American Society for Microbiology press.
5. Gene Cloning and DNA analysis (2010) T.A. Brown 6th edition. By American Society for Microbiology press.
6. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010). Glick & Pasteneuk.

MIBP304 Core practical for papers Molecular biology & Microbial genetics, Soil & agricultural microbiology & Genetic engineering

1. Isolation of antibiotic resistant microbes
2. Induction of mutation by ultra-violet radiation and chemical mutagens – NTG, MNNG.
3. Transformation (competent cell preparation)
4. Isolation of microbial genomic DNA
5. Isolation of plasmid DNA from *Escherichia coli* (mini preparation).
6. Isolation of plasmid DNA cyanobacteria (mini preparation)
7. Agarose gel electrophoresis
8. Restriction digestion
9. PCR
10. Western Blotting (Demo)
11. RAPD Fingerprinting (Demo)
12. Southern and Northern Blotting (Demo)
13. Isolation and enumeration of soil microorganisms (fungi, bacteria and actinomycetes).
14. Isolation of free living nitrogen fixing bacteria from soil – *Azotobacter*
15. Isolation of Symbiotic nitrogen fixing bacteria from root nodule – *Rhizobium*.
16. Isolation of phosphate solubilizers, ammonifiers and denitrifiers.
17. Study of Mycorrhizae, Cyanobacteria and *Azolla*.

MIBO315 Elective IV Computer applications

Unit I

Introduction to computers – Application of computers – Concepts of Data and information – A Typical computer system – Memory concepts – History of computers - Types of computer. Input – Output Devices – Data storage Devices – Software – The Definitions – The Role of Software – Housekeeping.

Unit II

The computer internals – Typical PC Configuration – Booting – Virus, Vaccine – Versions of software. Operating system – Definition – Classification – Basic of MDDos – Introduction to windows operating system – Features of windows OS – Desktop and Desktop icon – Starting programs – Setting – Taskbars and creating shortcuts.

Unit III

Introduction to internet – Client server Basic, E- Mail , Telnet and Archive – FTP – Gopher Jughead and Veronica – WAIS and world Wide Web. Fundamentals of HTML , TC/IP and E – Commerce

Unit IV

Introduction to Microsoft Office – Create and Modify Documents – Format the Text, Tables within the Documents – Merge the Documents and print – Create and modify spreadsheets – Formate the Cells – Different 2D and 3D Charts – Creation and Modification – Budget preparation – Functions – Printing of Spreadsheet and Charts.

Unit V

Multimedia – Concept, Requirements, Applications and future – Hardware and software Requirements for multimedia Development and Delivery platforms – Multimedia methodologies – Fundamentals and use of Hypertext, Hypermedia, sound , image, Animation, Video. Multimedia Interface, Planning and Developments of Multimedia projects.

Reference Books

1. Paul Sanna and Alan Wright Windows 8.1 Absolute Beginner's Guide (2013), How Que Publishing
2. Web Wise Seniors, The Internet for Beginners, 2005, Web Wise Seniors, Inc.
3. Alexis Leon & Mathews Leon. Fundamentals of Information Technology (2013) Leon Press, Chennai
4. Tay Vaughan, Multimedia: Making it work,2010 Osborne Tata McGraw Hill
5. Joe Habreken , Microsoft Office 2000, PHI, 1998.
6. Microsoft Office 2000 Complete, Sybex, 1999.

MIBC401Core Paper X Food & Dairy microbiology

Objective

Objective of the course is to give knowledge about the beneficial and harmful role of microorganisms in food and food safety regulations.

Unit I

Importance of food microbiology – types of microorganisms in food – source of contamination (Primary Sources) – factors influencing microbial growth of food (extrinsic and intrinsic) Regulations in food industry-The Food Safety and Standards Authority of India ,INFOSAN.

Unit II

Food fermentation: Cheese, bread, wine, beer, fermented vegetables- methods and organisms used. Food and enzymes from microorganisms-single cell protein. Production of amylase, protease and other enzymes from food.

Unit III

Contamination, spoilage and preservation of cereals and cereals products, sugar and sugar products, Vegetables and fruits, meat and meat products – fish and the sea foods, egg and poultry – dairy and fermentative products (ice cream and other products)

Unit IV

Food borne diseases, intoxication and food poisoning – *Staphylococcus*, *Clostridium*, *Escherichia coli* and *Salmonella* infections, Hepatitis, Amoebiosis and Mycotoxins. Encounter of *Aeromonas* in food. EHEC and enteropathogens.

Unit V

Food preservation: Principles- methods of preservation-Physical and chemical methods, food sanitation. Good manufacturing process- hazard analysis, critical control points and personnel hygiene.

Reference Books

1. Adams , M.R. and M.O Moss., 2008.Food Microbiology , the Royal Society of Chemistry, Cambridge.
2. Doyle , M.P. 2005. Handbook of Hygiene Control in the Food Industry. 1nd Edn. Woodhead Publishing
3. Frazier, W.C and WesthoffD.C 2013. Food Microbiology. TATA McGraw Hill Publishing Company Ltd. New Delhi.
4. Jay, J.M.2013. Modern Food Microbiology. 7th Edn. CBS Publishers and Distributors, New Delhi.
5. Stanbury, P.F., Whittaker, A. and Hall, S.J., 2009. Principles of fermentation technology, 2nd edition, Pergamon press.

MIBC402Core Paper XI Bioprocess Engineering and Technology

Objective

Objective of the course is to understand the application of microorganisms in industrial fermentations and products from microorganisms.

Unit I

Industrially important microorganisms - Isolation, preservation and improvement of strains - handling - development of inoculum for various fermentation processes, upstream processing - media for industrial fermentation - formulation - sterilization.

Unit II

Fermentor design - Body construction, individual parts, heat production - gas liquid exchange - mass transfer - heat transfer - oxygen transfer - stirring and mixing - Newtonian, non-Newtonian fluids - effect of viscosity - scale up - control of temperature, pH, foam, pressure - Sterilization of Bioreactors and nutrients, computer application in fermentation technology.

Unit III

An Introduction to fermentation process - The range of fermentation process, chronological development - component parts of fermentation process - fermentation economics. Fermentation types - submerged and solid state fermentation.

Unit IV

Downstream processing - Recovery of intracellular and extra cellular products - Biomass separation by centrifugation, filtration, flocculation and other recent developments, Cell disintegration - physical, chemical and enzymatic methods. Extraction - solvent, two phase, liquid extraction, whole broth, aqueous multiphase extraction. Purification by different methods, Concentration by precipitation, ultra filtration, reverse osmosis. Drying and crystallization.

Unit V

Microbial production of organic acids - Amino acids, antibiotics - enzymes - vitamins - alcoholic beverages - wine and beer, Fermented foods - bread, cheese.

Reference Books

1. Stanbury, P.F., Whittaker, A. and Hall, S.J., 2009. Principles of fermentation technology, 2nd edition, Pergamon press.
2. Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton, A., 2001 Industrial Microbiology: An Introduction, 2nd edition, Sinavos association, InoSundeland.
3. Cassida, J.E., 2007. Industrial Microbiology, New Age International
4. Prescott and Dunn, S., 2009. Industrial Microbiology. Agrobios publishers
5. Pepler, H. J. and Pearlman, D. 2009. Microbial Technology, Vol 1 and 2, Elsevier press.
6. Belter, P.A., Cussler, E.L. and Hu, W.S., Bio separation, 2011. Downstream processing for Biotechnology, John Wiley and Sons, N.Y.

MIBP403 Core practical for papers Food & dairy microbiology & Bioprocess engineering & Technology

1. Microbial Spoilage of Vegetables
2. Microbial spoilage of Fruits
3. Isolation of Mycotoxigenic fungi from cereals and oil seeds
4. Examination of unspoiled canned foods for sterility and quality
5. Isolation and Enumeration of yeast from rice batter (Fermented Foods)
6. Spoilage of Sea foods
7. Spoilage of Eggs
8. Effect of sodium chloride on the growth of food
9. Effect of sucrose on the growth of food microflora
10. Role of yeast in Bread making
11. Direct Microscopic counting of bacteria in Milk
12. Isolation of lactic acid bacteria from curd.
13. Wine production – Alcohol Estimation, Sugar Estimation.
14. Production of
 - (i) Alcohol
 - (ii) Citric acid
 - (iii) Protease
 - (iv) Amylase
 - (v) Lipase
- 15 Immobilization technique (sodium alginate method)

MIBO415 Elective V Genomics, proteomics & Bioinformatics

Unit I

Definition of Genomics -Mapping Genome – size-complexity- structure and function of prokaryotic and eukaryotic genome. Physical mapping of genome-Sequencing whole genome-Restriction mapping - FISH - STS mapping - Hybridization assays - Physical mapping without cloning- Mapping by genetic techniques - DNA markers - RFLPs, SSLPs, SNPs - Linkage analysis - Cross breeding and pedigree analysis.

Unit II

Sequence analysis Computational methods, homology algorithms (BLAST) for proteins and nucleic acids, open reading frames, annotations of genes, conserved protein motifs related structure / function (PROSITE, PFAM, Profile Scan). DNA analysis for repeats (Direct and inverted), palindromes, folding programmes. Use of Internet, public domain databases for nucleic acid and protein sequences (EMBL, GeneBank), database for protein structure (PDB).

Unit III

Tools of protein separation, analysis and characterization. Protein digestion techniques. Protein fingerprinting. 2D electrophoresis. Mass spectrometry - ESI and MALDI - TOF, SELDI - TOF (surface enhanced laser desorption time of flight), NMR, X - ray crystallography, phage display, yeast 2+ Hybrid system, surface plasma resonance Applications of proteomics - mining proteomes, protein expression profiling, identifying protein - protein interactions and protein complex, mapping protein modifications

Unit IV

Introduction to bioinformatics, scope of bioinformatics, role of computers in biology. Database concepts – Database, database system, database management systems – Hierarchical, Rational and Network, Database security. Biological databases, Types – sequence and structure databases. Genome and organism specific databases. Miscellaneous databases. Data submission, data retrieval with Entrez, DBGET / Link DB and SRS

Unit V

Obtaining, viewing and analyzing structural data, structural alignment. Classification of protein structures. CATH and SCOP. Protein structure prediction- secondary structure prediction, Tertiary structure prediction- Homology modelling, protein threading, ab initio protein folding. CADD Molecular docking, Metabolic pathway reconstruction- Kegg

Reference Books

1. Lesk, A.M. Introduction to Bioinformatics. Oxford, 2009.
2. Campbell and Heyer. Discovering Genomics, Proteomics and Bioinformatics. Cold Spring Harbour Laboratory. Press & Benjamin Cummings, 2008.
3. Gibas and Per Jambeck. Developing Bioinformatics Computer Skills. O'Reilly & Associates, 2001.
4. Primrose, Principles of Genome Analysis, 2006, Blackwell Science.
5. Dale and Schantz, From Genes to Genomes, 2011, Wiley-Blackwell
6. Brown TA, Genomes 3, 2006 Garland Science.