BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI – 620 024.

M.Sc. Microbiology - Course Structure under CBCS

(applicable to the candidates admitted from the academic year 2008-2009 onwards)

Semester	Course	Course Title	Ins. Hrs / Week	Credit	Exam Hrs	Marks		Total
						Int.	Extn.	
I	Core Course – I (CC)	General Microbiology	4	4	3	25	75	100
	Core Course – II (CC)	Virology	4	4	3	25	75	100
	Core Course – III (CC)	General Biochemistry	4	4	3	25	75	100
	Core Course – IV (CC)	Practical I - Pertaining CCI, CCII, CCIII	10	5	6	40	60	100
	Elective – I (CC)	Biological Techniques	4	4	3	25	75	100
	Elective – II(CC)	Food and Dairy Microbiology	4	4	3	25	75	100
		Total	30	25				600
II	Core Course – V (CC)	Microbial Physiology	4	4	3	25	75	100
	Core Course – VI (CC)	Environmental and Agri Microbiology	4	4	3	25	75	100
	Core Course – VII (CC)	Microbial Genetics and Molecular biology	4	4	3	25	75	100
	Core Course – VIII (CC)	Practical II - Pertaining CCV, CCVI, CCVII	10	5	6	40	60	100
	Elective – III (CC)	Any one from the list	4	4	3	25	75	100
	Elective – IV (CC)	Any one from the list	4	4	3	25	75	100
		Total	30	25				600
III	Core Course – IX (CC)	Immunology	4	4	3	25	75	100
	Core Course – X (CC)	Medical Microbiology	4	4	3	25	75	100
	Core Course – XI (CC)	Genetic Engineering	4	4	3	25	75	100
	Core Course – XII (CC)	Bioprocess Technology	4	4	3	25	75	100
	Core Course – XIII (CC)	Practical III - Pertaining CCIX, CCX,CCXI & CCXII	10	5	6	40	60	100
	Elective – V (CC)	Any one from the list	4	4	3	25	75	100
		Total	30	25				600
IV	Core Course – XIV (CC)	Biostatistics and Bioinformatics	4	4	3	25	75	100
	Project Work	Dissertation=80 Marks [2 reviews –20+20=40 marks Report Valuation = 40 marks] Viva = 20 Marks	26	11	3	--	--	100
		Total	30	15				200
		Grand Total	120	90				2000

Elective Course (EC) – Molecular Taxonomy and Phylogeny
Elective Course (EC) – Quality Control & IPR
Elective Course (EC) – Microbial Biotechnology
Elective Course (EC) – Microbial Bionanotechnology
Elective Course (EC) Marine Microbiology

} Any Three as Elective III, IV & V from the Five Electives

Project – 2 Reviews 20+20 marks
Project report 40 Marks
Project viva 20 marks

Internal marks for practicals : Attandance 05 Marks
Performance (Protocol writing, maintance of observation note book) 05 Marks
Evaluating experimental results 05 Marks
Practical Tests 25 Marks

Note:

Core Courses include Theory, Practicals & Project

No. of Courses 14 - 17
Credit per Course 4 - 5

Total Credits 70

Elective Courses
(Major based / Non Major / Internship)

No. of Courses 4 – 5
Credit per Course 4 – 6

Total Credits 20

	Internal	External
Theory	25	75
Practicals	40	60

Project

Dissertation 80 Marks [2 reviews – 20+20 = 40 marks
Report Valuation = 40 marks]
Viva 20 Marks 20 marks

Passing Minimum in a Subject

CIA 40%
UE 40%

} Aggregate 50%

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MSc. Microbiology Syllabus

Semester I Core Course I (CC) - General Microbiology

Unit I – Ultra structure and function:
Bacteria: Morphological types; cell wall – cell walls of Gram negative, Gram positive, halophiles. L-forms and Archaebacteria, Cell wall synthesis, capsule types composition and function. Structure and function of flagella, cilia and pili, gas vesicles, chlorosomes, carboxysomes, magnetosomes and phycobilisomes. Reserve food materials – polyhydroxybutyrate, polyphosphates, cyanophycin and sulphur inclusions. Nuclear material – bacterial chromosomes and bacterial plasmids.

Unit II – Classification:
Microbial Taxonomy - Definition and systematics, Nomenclatural rules and identification. Haeckel's three kingdom classification, Whittaker's five kingdom approach. Major characteristics used in taxonomy – morphological, physiological and metabolic, genetic and molecular. Classification and salient features of bacteria according to Bergey's Manual of Determinative Bacteriology (9th edition).

Unit III – Fungi

Fungi: Cell wall – chemical composition and functions, membranes and their function; Fine structure of flagella and somatic nuclei. Structure and life cycle of fungi – Ascomycetes (Aspergillus), Deuteromycetes (Candida), Zygomycetes (Mucor), Basidomycetes (Agaricus). Effect of environment on growth, prevention of fungal growth. Fungi and ecosystem: saprophytes, substrate groups. Parasitism, mutualism and symbiosis with plants and animals.

Unit IV – Algae and protozoans

Structure of algal cells – classification – reproduction and characteristics of Algae - Chlorophyta (Green algae), Diatoms, Rhodophyta (Red algae). Structure of Protozoa – classification – reproduction and characteristics of protozoa.

Unit V – Cultivation methods of microbes
Isolation of different types of bacteria - Fungi – Actinomycetes - Cyanobacteria - Protozoa. Preservation methods of microbes. Type culture collections. Physical, chemical methods for controlling microorganisms. A note on fossil microorganisms.

References:
Bernard D. Davis. Renato Dulbecco. Herman N. Eisen.and Harold, S. Ginsberg.(1990).Microbiology (4th edition).J.B.Lippincott company, Newyork.
Alexopoulus CJ and C W. Mims.(1993).Introductory Mycology(3rd edition).Wiley Eastern Ltd, NewDelhi.
Mara D.and Horan N. (2003).The Handbook of Water and waste water Microbiology. Academic Press-An imprint of Elsevier.
Elizabeth Moore-Landecker. (1996). Fundamentals of the fungi.(4th edition).Prentice Hall International, Inc, London.
Heritage,J. Evans E.G.V. and Killington, R.A. (1996). Introductory Microbiology. Cambridge University Press.

Holt, J.S., Kreig, N.R., Sneath, P.H.A and Williams, S.T. Bergey's Manual of Determinative Bacteriology (9th Edition), Williams and Wilkins, Baltimore.
John Webster (1993). Introduction to Fungi.(2nd edition).Cambridge University press,Cambridge.
Prescott LM Harley JP and Klein DA (2006). Microbiology (7th edition) McGraw Hill, Newyork.
Larry Mc Kane.and Judy Kandel (1996). Microbiology-Essentials and applications. (2nd edition). Mc Fraw Hill Inc, Newyork.
Madigan MT Martinko.JM and Parker J Brock TD (1997). Biology of Microorganisms.(8th edition).Prentice Hall International Inc, London.
Schaechter M and Leaderberg J (2004). The Desk encyclopedia of Microbiology. Elseiver Academic press, California.
Nester, E.W., Roberts, C.V. and Nester, M.T. (1995). Microbiology, A human perspective. IWOA, U.S.A.
Pelczar Jr, M.J. Chan, E.C.S. and Kreig, N.R. (1993). Microbiology, Mc. Graw Hill. Inc, New York.
Salle,A.J. (1996). Fundamental principles of Bacteriology.(7th edition).Tata McGraw-Hill publishing company Ltd, NewDelhi.

Core Course II (CC) – Virology

Unit I – General Virology

Brief outline on discovery of viruses, nomenclature and classification of viruses; Distinctive properties of viruses; morphology & ultrastructure. Capsids and their arrangements - types of envelopes and their composition-viral genome, their types and structures. Virus related agents (viroids, prions).

Unit II – General Methods of Diagnosis and Serology

Cultivation of viruses in embryonated eggs, experimental animals, and cell cultures. Primary & secondary cell cultures and monolayer cell cultures; cell strains, cell lines and transgenic systems. Serological methods – haemagglutination & HAI; complement fixation; immunofluorescence methods, ELISA and radioimmunoassays. Assay of viruses – physical and chemical methods (protein, nucleic acid, radioactivity tracers, electron microscopy). Infective assay (plaque method, end point method) – Infectivity assay of plant viruses.

Unit III – Bacterial Viruses

Bacteriophage - structural organization - life cycle -DNA replication - eclipse phase - phage production - burst size; lysogenic cycle. Brief details on M13, Mu, T4, Lambda and P1.

Unit IV – Plant Viruses

Classification and nomenclature; effects of viruses on plants; Common virus diseases of plants - paddy and sugarcane. Type species of plant viruses TMV, Cauliflower Mosaic Virus and Potato Virus X; Transmission of plant viruses with vectors - insects,

nematodes, fungi - without vectors (contact, seed and pollens). control measures of plant viruses- generation of virus-free planting material; vector control.

Unit V – Animal Viruses

Classification and nomenclature of animal human viruses. Epidemiology, lifecycle, pathogenicity, diagnosis, prevention and treatment of RNA Viruses - Picorna,
Orthomyxo, Paramyxo, Rhabdo, Rota, HIV - Oncogenic viruses. DNA viruses; Pox, Herpes, Adeno, SV 40; Hepatitis viruses. Viral vaccines (including DNA Vaccines with examples) interferons, and antiviral drugs.

Reference:

Alan J.Cann (1997). Principles of Molecular virology.(2nd edition). Academic press,California.

Ann Giudici Fettner (1990). The Science of Viruses.Quill William Marrow,Newyork.

Conrat HF, Kimball PC and Levy JA. (1988). Virology. II edition. Prentice Hall, Englewood Cliff, New Jersey.

Dimmock NJ, Primrose SB. (1994) Introduction to Modern Virology IV edition. Blackwell Scientific Publications, Oxford

Flint, S.J., Enquist, L.W., Krung, R. Racaniello, VR. and Skalka, A.M. (2000). Principles of Virology,
Molecular Biology, pathogenesis and control, ASM Press, Washinton D.C.

Maloy, S.R, Cronan Jr. J.E, Freifelder, D. (1998). Microbial genetics. Jones and Bartlett publishers.

Nicklin,J.Greame-Cook.and Killington, R. (2003). Instant Notes in Microbiology.(2nd edition).Viva Books private limited,NewDelhi.

Robert I.Krasner (2002). The microbial challenge:Human Microbe Interactions.American society for Microbiology,Washington.

Roger Hull (2002). Mathews' Plant Virology.(4thEdition).Academic press-A Harcourt Science and technology company,Newyork.

Tom Parker, Leslie, M. and Collie, H. (1990). Topley & Wilson’s Principles of Bacteriology, Virology and Immunity (VIII Edition).

Core Course III (CC) – General Biochemistry

Unit I – Cell and its function

Composition of living matter. Biochemistry of bacterial, animal and plant cell. Specialized components of microorganisms and their structure and function.

Unit II - Enzymes

Enzymes as biocatalysts, enzyme classification, specificity, active site, unit activity, isozymes. Enzyme kinetics: Michaelis – Menton equation for simple enzymes. Enzyme inhibition.

Unit III – Types of macromolecules and their biosynthesis

Structural features and chemistry of macromolecules. Nucleic acid – properties, biosynthesis and degradation of purines and pyrimidines - Structure of DNA and RNA. Proteins – classification – aminoacids - primary-secondary-tertiary – quarternery and three dimensional structure of proteins.Carbohydrates - mono, di, oligo and polysaccharides. Lipids and biomolecules: Fatty acids, properties, -oxidation - biosynthesis of cholesterol.

Unit IV - Bioenergetics

Bioenergetics and strategy of metabolism - flow of energy through biosphere, strategy of energy production in the cell. Oxidation – reduction reactions, coupled reactions and group transfer. ATP production, structural features of biomembranes, transport, free energy and spontaneity of reaction, G, G°, G' and equilibrium. Basic concepts of acids, base, pH and buffers.

Unit V – Metabolism – basic Concepts

Cell metabolism - catabolic principles and break down of carbohydrates, lipids, proteins and nucleic acids - biosynthesis of macromolecules - vitamins and their role as coenzymes.

Reference:

Christopher K. Mathews and Van Holde, K.E. (1996). Biochemistry.(2nd edition).The Benjamin/Cummings publishing company,Inc.

David E. Metzler. And Carol M. Metzler (2001). Biochemistry-The chemical reactions of living cells- Vol1&2.(2nd edition).Harcourt/Academic press, Newyork.

Donald Voet and Judith G. Voet (1995). Biochemistry – Second Edition. John Willey and Sons, Inc.

Freifelder, D. (1996) Molecular Biology, II Edition, Narosa Publishing House, New Delhi.

Geofferey, L and Zubay (1998). Biochemsitry. (Fourth Edition) Wm. C. Brown Publishers.

Jeremy M.Berg. John L. Tymoczko and Lubert stryer (2002). Biochemistry.(5th edition).W.H.Freeman and company, Newyork.

Lubert Stryer.(1995). Biochemistry.(4th edition). W.H. Freeman and company, Newyork.

Reginald, H., Garret & Charles M. Grishm. (1998). Biochemistry (Second Edition) Saundars College Publishing.
Thomas M. Devlin. (2002). Textbook of Biochemistry with clinical correlations.(5th edition).A John Wiley and sons,Inc.,publication,Newyork.
Trudy McKee.and James R.McKee. (1999). Biochemistry-An Introduction.(2nd edition).WCB McGraw- Hill,U.S.A

Core Course IV (CC) – Practical I: General Microbiology, Virology & General Biochemisty

General Microbiology

Principles and methods of sterilization.
Direct microscopic observations of bacterial shape – cocci, rods, chains, fungal spores, mycelium, yeast budding.
Preparation of Media: Nutrient broth, Nutrient agar, plates, slants, soft agar.
Pure culture technique: Streak plate, spread plate and pour plate methods.
Measurement of size of microbes – micrometry.
Motility determination – Hanging drop method.
Enumeration of bacterial / yeast cells-viable count (Plate count) Total count (Haemocytometer count).
Isolation and purification of cyanobacteria, actinomycetes, fungi and protozoans.
Staining methods: Simple, Negative, acid fast, Gram staining , spore, Capsule, Metachromatic granular staining, Lactophenol cotton blue staining - Fungal slide culture

Virology

Isolation and characterization of bacteriophage and cyanophage from natural resources.
Phage titration – T4 or Lambda or M13.
Determination of lysogeny using Lambda Phage or Staphylococcal indicator systems.
Study of virus infected plant samples – animal tissue culture – chick embryo fibroblast culture preparation (Demonstration).
Transmission methods – mechanical.

General Biochemistry

Preparation of Buffer; (Tris, phosphate, acetate buffer). Acid-Base titration – pKa value determination – Determination of [H+] ion concentration.
Verification of Beer-Lambert's law using coloured solution (CuSO4).
Preparation of standard graph for the following and estimating the concentration in a microbial sample (i) glucose – anthrone method (ii) bovine serum albumin (Lowry's method) and (iii) Nucleic acid – DNA (diphenylamine method), RNA (Orcinol method).
Separation of aminoacids by paper chromatography and identification of aminoacid.
Separation of proteins by polyacrylamide gel electrophoresis and determination of molecular weight of unknown protein.

References:

Wilson, K. and Walker, J. (2000). Practical Biochemistry, 5th Edition, Cambridge University Press.

Cappuccino and James, G (1996) Microbiology a laboratory manual, Addison Wesley Publishing Company Inc. 4th edition, England, California.
David R. Brooke. Bergey's Manual of Systematic Bacteriology (Vol. I), Eastern Halz, Springer Publication.
Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (1994) Methods of General and Molecular Bacteriology, Ed. American Society for Microbiology, Washington D.C.
James T. Stanley, Marvin P. Bryant. Bergey's Manual of Systematic Bacteriology (Vol. II), Nobert Fleming Springer Publishers.
Wilson K. Walker (1995). Practical Biochemistry, Principles and Techniques, Cambridge University Press.
Gerhardt, P., Murray, R.G., Crood, W.A. and Kreig, N.R. (1994) Methods for general and molecular bacteriology, ASM, Washington D.C.
Jeanne Dejkstra, Ces.P.de Jager (1998) Practical plant virology, Springer Verlag, Lab Manual, Berlin, Heidel Berg, New York.
Miller, J.H. (1992) A short course in bacterial genetics, Cold Spring Harbor.

Elective Course I (EC) – Biological Techniques

Unit I Microscopy and Related Techniques

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), Atomic Force Microscope (AFM). Photomicrography and Video micrography.

Unit II Analytical Techniques

Spectroscopic methods – UV-Visible, Atomic Absorption and Atomic Emission Spectroscopy. Centrifugation – Principles and types centrifugation Electroanalytical methods – electrolytic – Potentiometric, conductimetric, coulometric & voltametric analysis. Biosensors.

Radioactive Analysis : Principles of radioactivity, GM counter & LS counter.

Unit III Principles & Applications of Chromatographic Techniques :

Adsorption – Ion exchange and gel permeation – affinity chromotography for separation of compounds GC and HPLC methods.

Unit IV - Electrophoresis Techniques

Electropohoretic techniques – protein – nucleic acid – immuno – two dimensional electrophoresis.

Unit V Molecular Biological Techniques

a) Isolation of chromosomal and plasmid DNA. Polymerase chain reaction – isolation of specific genes using PCR.

b) Restriction digestion and Phosphatase treatment of cloning vectors. Cloning techniques – separationand quantification of DNA by spectrophotometric and electrophoretic techniques, gene transfer mechanisms – chemical and electroporation.

c) Methods of detection of clones – Nucleic acid transfer by blotting, Hybridization plaque, colony hybridization. Histochemical detection of β -galactosidase, antibody screening including colour development reaction.

Reference:

Cynthia Gibas & Per Jambek (2001). Developing Bioinformatics Computer Skills, Shroff Publishers & Distributors Pvt. Ltd., O'reilly) Mumbai.
Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology & Biotechnology, ASM Press.
Glick, B.R. and Pasternak, J.J. (1994). Molecular Biotechnology, ASM Press.
John G. Webster. (2004). Bioinstrumentation. University of Wisconsin, John Wiley & Sons, Inc.
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Rashidi, H.H., and Buehler, L.K. (2002). Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.
Sambrrok, J. and Ruseell, D.W. (2001) Molecular Cloning – A Laboratory Manual (3rd eidition, Vol. 1,2,3) Cold Spring Laboratory Press, New York.
Savile Pradbury. (1991). Basic measurement techniques for light microscopy, Oxford University Press, Royal Microscopical Society.
Surzeki, S. (2000). Basic Techniques in Molecular Biology, Springer.
Westermeier, R (1993). Electroporesis in practice – VCH – Federal Republic of Germany.
Willett, J.E. (1991). Gas Chromatography, John Wiley & Sons.
Wilson, K. and Walker (1995). Practical Biochemistry Principles and Techniques, Cambridge University Press.

Elective Course 2: Food and Dairy Microbiology

Unit 1: Introduction- Importance of food and dairy microbiology- Types of microorganisms in Food Spoilage source of contamination- Factors influencing microbial growth in food

Unit 2: Food fermentations: methods of fermentations and organisms used -Cheese, bread, wine, beer. Fermented vegetables. Food and enzymes from microorganisms-single cell protein. Production of amylase and protease.

Unit 3: Contamination, spoilage and preservation of cereals and cereals products, sugar and sugar products, Vegetables and fruits, meat and meat products – fish and othe sea foods, egg and poultry – dairy and fermentative products (ice cream, Yoghurt and Kefir)

Unit 4: Food borne diseases, intoxication and food poisoning – *Staphylococcus, Clostridium, Escherichia coli and Salmonella* infections, Hepatitis, Amoebiosis and Mycotoxins. EHEC and enteropathogens – general food contamination.

Unit 5: Food preservations: principles- methods of preservations-Physical and chemical methods, food sanitations. Good manufacturing practices (GMP)- hazard analysis, critical control points and personnel hygiene.

Reference
Frazier and Westhoff, DC. 1988. Food Microbiology. TATA McGraw Hill Publishing Company LTD., New Delhi
Adams, M.R and Moss, MO. 1995. Food Microniology. The Royal Society of Chemistry, Cambridge.

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Semester II

Core Course V (CC) -Microbial Physiology

Unit I : Cell structure and function
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 : Microbial growth
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 : Microbial pigments
Autotrophs - cyanobacteria - photosynthetic bacteria and green algae – heterotrophs – bacteria, fungi, myxotrophs. Brief account of photosynthetic and accessory pigments – chlorophyll – fluorescences, phosphoroscenses - bacteriochlorophyll – rhodpsin – carotenoids – phycobiliproteins;
Unit IV : Carbon assimilation
Carbohydrates – anabolism – autotrophy – oxygenic – anoxygenic Photosynthesis – autotrophic generation of ATP; fixation of CO_2 – Calvin cycle – C3 – C4 pathways. Respiratory metabolism – Embden Mayer 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 : Spore structure - function
Cell division – endospore – structure – properties – germination. Microbial development, sporulation and morphogenesis. Hyphae vs yeast forms and their significance. Multicellular organization of selected microbes. Dormancy.

References:

Caldwell, D.R. (1995). Microbial Physiology and metabolism, Wm. C. Brown Publishers, USA
Lansing M. Prescott, John P. Harley and Donald A. Klein. (2003). Microbiology.(5th edition).McGraw-Hill company, Newyork.
Moat, A.G., Foster, J.W. and Spector, M. P (2002). Microbial Physiology (4th Edition). John Wiley & Sons, New York.

Pelczar Jr, M.J. Chan, E.C.S. and Kreig, N.R. (1993). Microbiology, Mc. Graw Hill. Inc, New York.
Salle,A.J. (1996). Fundamental principles of Bacteriology(7th edition).Tata McGraw-Hill publishing company limited, NewDelhi.
White, D. (1995). The physiology and biochemistry of Prokaryotes, Oxford University Press, Oxford, New York.
Rabert Poole, K. (2007) Advances in Microbial Physiology, Volume 53 Elsevier Science & Technology

Semester II

Core Course VI (CC) – Environmental and Agricultural Microbiology

Unit I : Biogeochemical cycles & Air microbiology

Roles of microbes in biogeochemical cycles – carbon, nitrogen, phosphorus, sulphur. Soil microbes and fertility of soil. Air microbiology: a brief account.

Unit II : Aquatic microbiology and bioremediation

Microbes in marine and fresh water environment – eutrophication – Biodegradation and bioaccumulation – bioremediation concepts, microbial and phytoremediation – composting – solid waste treatment – saccarification and pyrolisis.

Unit III : Liquid waste and treatment

Water pollution – sources and nature of pollutants in water – sewage – treatment of liquid waste – primary, secondary and tertiary treatment – water born diseases – Assessment of water quality – BOD and COD determinations.

Unit IV : Soil Microbiology

Microbial association – beneficial – nitrogen fixing organism – symbiosis, asymbiosis, associate symbiosis – bacteria, actinomycetes, cyanobacteria – mycorrhiza – ecto and endo mycorrhiza – phosphate solubilizers – application of biofertilizers in agriculture. Biology of nitrogen fixation – genes and regulations in *Rhizobium – Agrobacterium* and plant tumours.

Unit V : Plant diseases and its control

Plant pathogens – bacterial – viral – fungal pathogens. Morphological, physiological changes with reference to disease establishment in plants – plant protection – phenolics – phytoalexins and related compounds. Bioinsecticides – viral, bacterial and fungal – a brief note.

References:

Atlas Ronald, M., Bartha, and Richard (1987). Microbial Ecology 2nd Edition. Benjamin/Cummings Publishing Company, California.
Dirk, J. Elasas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, New York, HongKong.
Ec Eldowney S, Hardman DJ, Waite DJ, Waite S. (1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical.

Mitchel, R. (1992). Environmental Microbiology. Wiley – John Wiley and Sons. New York.
Clescri, L.S., Greenberg, A.E. and Eaton, A.D. (1998). Standard Methods for Examination of Water and Waste Water, 20th Edition, American Public Health Association.
Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (1994). Methods for General and Molecular Bacteriology, ASM Publications, Washington D.C.
Patricia Cunning (1995). Official Methods of Analysis, Vol. I and II, 16th Edition, Arlington, Virginia, USA.
Richard G. Burus and Howard Slater (1982). Experimental Microbial Ecology, Blackwell Scientific Publishers.

Semester II
Core Course VII (CC) – Microbial Genetics and Molecular Biology

Unit - I: DNA replication and repair

Identification of genetic material (Griffith, Avery and Hershey and Chase experiments). DNA replication - Meselson – Stahl experiment , Molecular mechanisms of DNA Replication – bidirectional and rolling circle replication. Differences in prokaryotic and eukaryotic replication. Plasmids – types, structure and replication. DNA repair – mechanism of excision repair, SOS repair and mismatch repair.

Unit – II: Transcription and translation

Process of transcription – initiation, elongation – termination. Synthesis of mRNA in prokaryotes and eukaryotes. Synthesis of rRNA and tRNA. RNA processing – capping and polyadenylation. Genetic code, process of translation – initiation, elongation and termination. Signal sequences and protein transport.

Unit – III: Concept of Gene & Gene regulation

Organization of Gene in Prokaryotes and Eukaryotes - Introduction - Operon concept, lac and trp operons, promoters and repressors. Regulation of gene expression – Transcriptional control – promoters, terminators, attenuators and anti terminators; Induction and repression; Translational control – ribosome binding, codon usage, antisense RNA; post-transcriptional gene silencing – RNAi.

Unit - IV: Gene transfer mechanisms

Transformation – competence cells, regulation, general process; Transduction – general and specialized; Conjugation – Hfr, triparental mating, self transmissible and mobilizable plasmids, pili.

Unit – V: Transposable elements

Introduction - Discovery insertion sequences, complex and compound transposons – T10, T5, and retroposon – Nomenclature- Insertion sequences – Mechanism – Transposons of E.coli, Bacteriophage and Yeast.

References:

Friedberg EC, Walker GC, Siede W. (2005). DNA repair and mutagenesis. ASM press
James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann (20080, Molecular Biology of the Gene, Fifth Edition
Antony JF, Griffiths, Gilbert WM, Lewontin RC and Miller JH (2002). Modern Genetic Analysis, Integrating Genes and Genomes, 2nd edition, WH
Blackburn GM, Gait MJ. (1996). Nucleic acids in chemistry and biology. Oxford University press.
Malacinski GM & Freifelder D (1998) Essentials of Molecular Biology, 3 edition, John and Bartlett Publis.
Lewin B. (2000). Genes VII. Oxford University press
Maloy SR, Cronan Jr. JE, Freifelder D (1994). Microbial genetics. Jones and Bartlett publishers.
Singer M, Berg P. (1991). Genes and Genomes. University Science Books.
Watson JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AM. (1998). Molecular biology of the gene, 4th edition, Benjamin/Cummings publishing company.
Ajoy Paul (2007) Text Book of Cell and Molecular Biology, Books & Allied (P) Ltd.Kolkata

Semester II

Core Course VIII (CC)

Practical II- Microbial Physiology, Environmental & aAricultural Microbiology and Microbial Genetics & Molecular Biology

Microbial Physiology

Bacterial growth curve – Turbidity
Biochemical tests : a) INdole b) MR c) VP d) citrate e) TSI f) Urease g) Catalase & h) Oxidase
Carbohydrate fermentation test

Environmental & Agricultural Microbiology

Isolation and enumeration of soil microorganisms (fungi, bacteria and actinomycetes).
Staining of vesicular Arbuscular mycorrhizae from plant.
Isolation and culturing of *Rhizobium* from root nodules.
Study of the following diseases: a) Tobacco mosaic; b) Bacterial blight of paddy; c) Downy mildew of bajra; d) Powdery mildew of cucurbits; e) Head smut of sorghum; f) Red rot of sugar cane.
Isolation and identification of air-borne bio-particles using Andersen sampler.
Determination of BOD of polluted/pond water.
Determination of COD of polluted/pond water.
Assessment of water quality by MPN technique.

Microbial Genetics & Molecular Biology

Isolation of antibiotic resistant microbes
Induction of mutation by ultra-violet radiation and chemical mutagens – NTG, MNNG.
Transformation (competent cell preparation) and Transduction using P1.
Isolation of microbial genomic DNA
Isolation of plasmid DNA from *E.coli* (mini preparation).

Isolation of plasmid DNA from Gram Negative (bacteria) and cyanobacteria (mini preparation)
Characterization of plasmid DNA by agarose gel electrophoresis.

References:

Atlas Ronald, M., Bartha, and Richard (1987). Microbial Ecology 2nd Edition. Benjamin/Cummings Publishing Company, California.
Dirk, J. Elasas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, New York, HongKong.
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Mitchel, R. (1992). Environmental Microbiology. Wiley – John Wiley and Sons. Inc. Publications, New York.
Clescri, L.S., Greenberg, A.E. and Eaton, A.D. (1998). Standard Methods for Examination of Water and Waste Water, 20th Edition, American Public Health Association.
Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA and Struhl K (1994).
Current protocols in molecular biology (2007), Vol. 1 & 2. John Wicey & Sons Inc.
Sambrook J and Russell DW (2001) Molecular cloning - A laboratory manual (3rd edition, Vol 1,2,3), Cold Spring Laboratory Press, New York.
Surzyeki S (2000). Basic Tecniques in Molecular Biology. Springer.

Semester III

Core Course IX (CC) – Immunology

Unit I: Immune System

Historical perspective – Discovery, early theories, Immunodeficiency conditions, Lymphocyte Traffic, Hematopoiesis, Innate and adoptive immune response in protection.

Unit II: Antigen and Antibody Molecules

Antigen engineering for better immunogenicity, Use for vaccine development, whole-organism vaccines, recombinant vaccines, DNA vaccines, synthetic peptide, multivalent subunit and anti-idiotype vaccines. Antibody engineering, Antibody for diagnosis, Antibody for therapy, Hybridoma Technology.

Unit III: MHC, Cytokines and Complements

Structure of MHC molecules, Antigen presentation, Antigen presentation by non MHC molecules, Cytokine structure and their receptors, Cytokine therapy, Complements, Lymphocyte Migration and Inflammation, Hypersensitivity reactions, auto immunity.

Unit IV: B and T Cell Activation

B cell receptor complex, B cell maturation, Generation of antibody diversity, Understanding self-nonself discrimination, TH Cell subpopulation, Organisation of T cell receptor, Cell mediated effector responses.

Unit V: Immunotechnology and its applications

Precipitation techniques, agglutination techniques, radiology in immunotechniqes, Enzyme-Linked immunosorbent assay (ELISA), Western blotting, immunofluorescence, Flowcytometry and immunoelectron microscopy. Infectious diseases - immune system in AIDS, transplantation immunology, cancer and the immune system.

References:

Ivan M. Roit (1994) Essential Immunology – Blackwell Scientific Publications, Oxford
Kuby J (2001) Immunology Fourth Edition – WH Freeman and Company, New York
Chapel H and Halbey M (1986) Essentials of Clinical Immunology, ELBS London
Donal M. Weir, John Steward (1993) Immunology – VII edition. ELBS, London
Richard M. Hyde (1995). Immunology III edition. National Medical series, Williams and Wilkins, Harward Publishing company.
Hue Davis (1997) Introductory Immunology Chapman &Hall Publisher, London.

Semester III
Core Course X (CC) – Medical Microbiology

Unit-I: Introduction of Medical Microbiology:

History, Koach & 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: Systematic Medical Bacteriology:

Mechanism of Bacterial pathogenesis of medically important bacteria Staphylococcus aereus, Group A Streptococci, Pathogenic, Enterobacteriaceae, Vibrio, Nieserriae, Haemophilus influenza, Corynebacterium, Pseudomonas, Chlamydia, Mycoplasama, anaerobic bacteria & infections, Mycobacterium tuberculosis, Atypical Mycobacterium, Clamadiya, Bacillus, Rickettsia, Zoonotic bacteria, Helicobacter pylori.

Unit-III: Mycology & Protozoalogy:

Mechanisms of Fungal Pathogenesis, Superficial and Cutaneous Mycoses, Subcutaneous Mycoses, Systemic Mycoses, Opportunistic Mycoses, Mycotoxicoses, Intestinal, Blood and Tissue Protozoa.

Unit-IV: Viral diseases:

Influenza viruses, Measels, Mumps, Chicken Pox, Hepatitis A,B,C, D& E, Poliomyelitis, AIDS, Human Papilloma Virus (HPV), Rabies, Yellow fever, Dengue and Japanease Enchapalitis.

Unit-V: Laboratory Diagnosis:

Laboratory diagnosis of bacterial diseases, Laboratory diagnosis of mycological and Parasitological diseases, Laboratory diagnosis of viral diseases, Antibiotic sensitivity test. Molecular diagnosis.

References:

Medical Microbiology(2001) Jawetz, Melnickand Adelberg's 22nd edition McGraw Hill Medical Publication division
Medical Microbiology(2000) David Greenwood, Richard Slack and John Peutherer 15th edition,ChurchHill Living stone Publication.
Medical Microbiology (1990) Anathanarayanan & Jeyaram Paniker, Orient Publications, New Delhi.
Medical Parasitology (2007) K.D Chatterjee 7th edition.
Foundations in Microbiology (2005) Cathleen park Talaro 6th edition, McGraw Hill Medical Publication division.
Microbiology Lab Manual (2007) John P. Harley 7th edition McGraw Hill Medical Publication division.
Microbiology (2007). Prescott, Harley, Klein's 7th edition McGraw Hill Medical Publication division.
Medical Microbiology (2007) S. Rajan MJP Publishers Chennai.

Semester III
Core Course XI (CC) – Genetic Engineering

Unit – I: Introduction to Basics of genetic engineering

Gene as a unit of mutation and recombination. Mutagenesis, mutations and mutants – biochemical basis of mutations, spontaneous and induced mutations, isolation of mutants, mutagenesis, reversion, suppression, genetic analysis of mutants. Recombination methods – conjugation and transformation.

Unit – II: Tools of genetic engineering

Enzymes in Genetic Engineering - DNA Polymerase, Polynucleotide kinase, T4 DNA ligase, Nick translation system, Terminal deoxynucleotidyl transferase, Reverse transcriptase Restriction endonucleases Type I & II. Vectors – plasmid, bacteriophage and other viral vectors, cosmids, Ti plasmid, yeast artificial chromosome.

Unit – III: Techniques of Genetic Engineering I

Strategy of recombinant DNA technology; Gene library - Genomic library, cDNA library – Cloning strategies - Use of linkers, adoptors, homopolymer tails - Nucleic acid hybridization - Colony hybridization, plaque hybridization; Blotting techniques - Southern, Northern, Western and dot blotting.

Unit – IV: Techniques of Genetic Engineering II

PCR – principles, techniques and applications. Gene isolation, cloning and expression, DNA sequencing, oligonucleotide synthesis, Southern and Northern hybridization, FISH, RAPD, PCR-RFLP, STRR, LTRR. DNA fingerprinting and their applications for diagnosis of disease, site-directed mutagenesis, Gene silencing, Gene transfer technologies.

Unit-V: Functional genomics and Applications of Genetic Engineering

DNA chips and microarray gene screen technology; site directed mutagenesis, transgenic animals and gene knockout techniques, cell culture based techniques Genetic diagnosis. Applications in medical field, biology, transgenic plants, transgenic animals, Recombinant vaccines development. Gene therapy; Molecular basis of genetic diseases, genetic counseling.

References:

Molecular biology and Microbial genetics (1994) David Frifielder, Stanely R. Maloy, 2nd edition Jones and Barlett Publishers.
Genetics by Peter J Russell (1997) 5th edition Benjamin-Cummings Publishing Company.
Molecular Biotechnology (2003) Bernard R. Glick and Jack J.Pasternak., 2nd edition by ASM press.
Gene Cloning and DNA analysis (2004) T.A.Brown 2nd edition. By ASM press.
Application of rDNA Technology (2003). Glick & Pasteneuk.

Principles of Gene Manipulation and Genomics (2006) Sandy Primrose. 7th Edition, Black Well Publishers.

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Semester III
Core Course XII (CC) – Bioprocess technology

Unit I – Industrially important microbes and their development

Screening methods for industrial microbes – detection and assay of fermentation products – classification of fermentation types – strain selection and improvement. Mutation and recombinant DNA techniques for strain development.

Unit II – Fermenter – types and function

Fermenters – Basic functions, design and components – asepsis and containment requirements – body construction and temperature control – aeration and agitation systems – sterilization of fermenter, air supply, and medium; aseptic inoculation methods – sampling methods, valve systems – a brief idea on monitoring and control devices and types of fermenters.

Unit III – Food microbiology

Microbiology of fermented milk – starter cultures, butter milk, cream, yoghurt, kafir, kumiss, acidophilus milk and cheese. Microbes as sources of food (*Spirulina*, *Saccharomyces cerviceae*, *Rhizopus* sp.). Food and water borne infections and food microbial poisoning. Food sanitation in food manufacture and in the retail trade; Food control agencies and its regulations.

Unit IV – Large scale fermentation

Fermentation in batch culture: Microbial growth kinetics, measurement if growth (cell number, direct and indirect methods) growth and nutrient, growth and product formation, heat evolution, effect of environment (temperature, pH, high nutrient concentration) media formulation. Sterilization, kinetics of thermal death of micro-organisms, batch and continuous sterilization. (All in relation to fermentation).

Unit V - Legal protection and IPR

GATT and IPR, forms of IPR, IPR in India, WTO ACT, Convention on Biodiversity (CBD), Patent Co-operation Treaty (PCT), forms of patents and patentability, process of patenting, Indian and international agencies involved in IPR & patenting, Global scenario of patents and India's position, patenting of biological materials.

Reference:

Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology and Biotechnology. ASM Press.
Glick, B.R. and Pasternak, J.J. (1994). Molecular Biotechnology, ASM Press.
Stanbury, P.F., Whitaker, A. and Hall, S.J. Principles of Fermentation Technology, Pergamon Press.

Glick, B.R. and Pasternak, J.J. (1998). Molecular Biotechnology, II Edition, ASM Press, New York.
Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
Tortora, G.J., Fernke, B.R. and Case, C.L. (2001), Microbiology – An Introduction, Benjamin Cummings.
Venkataraman, L.V. (1983). A monograph on *Spirulina platensis*, CFTRI, Mysore.
Kalaichelvan, P T. & Arul Pandi (2007) Bioprocess Technology MJP Publishers Chennai.

Semester III
Core Course XIII (CC) – Practical III
Immunology, Medical Microbiology, Genetic Engineering & Bioprocess Technology

Immunology
Collection of venous blood from human and separation and preservation of serum/plasma
Agar gel diffusion – Ouchterlony's method
Counter immuno electrophoresis
Electrophoresis – serum proteins
Blood grouping
Latex agglutination test – ASO, RF
Widal tube and slide agglutination technique
Enzyme Linked Immunosorbent Assay (ELISA)
Western blotting
Immunization of protocols and raising antibody
Dissection of primary and secondary lymphoid organs in a selected animal

Medical Microbiology
Collection and transport of clinical specimens for microbiological examinations
Isolation and identification of upper respiratory tract bacterial pathogen – *Streptococcus pyogens*
Isolation and identification of lower respiratory tract bacterial pathogen – *Pseudomonas aeuroginosa*
Isolation and identification of gastrointestinal bacterial infection – *Salmonella / Shigella / Vibrio*
Isolation and identification of urinary tract infection (UTI) – *E. coli & Klebsiella pnemoniae*
Isolation and identification of Typhoid fever – *Salmonella typhi, S. paratyphi* A & B
Fungal skin pathogens – Dermatophytes & *Candida*
Demonstration of intestinal parasites (trophozoites / cysts / ova)

Genetic Engineering
Genomic DNA isolation
Plasmid DNA isolation
Restriction digestion
Transformation
PCR
Western Blotting (Demo)
RAPD Fingerprinting (Demo)

Competent cell preparation and transformation
Southern and Northern Blotting (Demo)

Bioporcess technology

Production, quantification, extraction and characterization of followings:
i) Alcohol, ii) Citric acid, iii) Amylase, iv) Lipase, v) protease
Hydrogen production assay by gas Chromatographic technique

References

John P. HarleyMicrobiology Lab Manual (2007) 7th edition McGraw Hill Medical Publication division.
Donal M. Weir, John Steward (1993) Immunology – VII edition. ELBS, London
Richard M. Hyde (1995). Immunology III edition. National Medical series, Williams and Wilkins, Harward Publishing company.
Sambrook, J & Russell, D W (2001) Molecular Cloning – A Laboratory manual. Cold Spring Harbour Laboratory Press New York
Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology and Biotechnology. ASM Pres
Gerhardt, P. Murray R G, Wood, W A. and Kreig, NR (1994) Methods for General and Molecular Bacteriology ASM Washington D C.

Semester IV
Core Course XIV (CC) – Biostatistics and Bioinformatics

Unit I: Biology in the computer age

Computational Approaches to Biological questions. Basics of computers – servers, workstations, operating systems, Unix, Linux. World Wide Web. Search engines, finding scientific articles - Pubmed – public biological databases.

Unit II: Genomics

Sequence analysis – Sequencing genomes – sequence assembly – pairwise sequence comparison - geneome on the web – annotating and analysing genome sequences. Genbank – sequence queries against biological databases – BLAST and FASTA– multifunctional tools for sequence analysis. Multiple sequence alignments, Phylogenetic alignment – profiles and motifs.

Unit III: Proteomics

Protein Data Bank, Swiss-prot - biochemical pathway databases -Predicting Protein structure and function from sequence – Determination of structure – feature detection – secondary structure prediction – predicting 3 D structure - protein modeling.

Unit IV: Biostatistics I

Introduction – Population and sample – Variables – Collection and presentation of data – Descriptive statistics - Measures of Central tendency – mean (arithmetic, harmonic & geometric) median and mode – Measures of dispersion – range, mean deviation, variance & standard deviation, Skewness and Kurtosis.

Unit V: Biostatistics II

Inferential statistics – Probability and distributions – Poisson, Binomial and Normal distribution – Chi-square test – Hypothesis test - Student's t-test – Correlation and Regression – ANOVA.

References:

W.J. Ewens, Gregory Grant,(2005). Statistical Methods in Bioinformatics: An Introduction (Statistics for Biology & Health), Springer
Bryan Bergeron,(2003).Bioinformatics Computing First Indian Edition, Prentice Hall,
Cynthia Gibas & Per Jambeck (2001). Developing Bioinformatics Computer Skills: Shroff Publishers & Distributors Pvt. Ltd (O'Reilly), Mumbai
HH Rashidi & LK Buehler (2002). Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London
Des Higgins & Willie Taylor (2002). Bioinformatics: Sequence, structure and databanks, Oxford University Press
Baxevanis AD & Ouellette BEF (2001) Bioinformatics: A practical guide to the analysis of genes and proteins, Wiley Interscience – New York
Arora PN & Malhon PK (1996). Biostatistics Imalaya Publishing House, Mumbai.
Sokal & Rohif (1973). Introduction to Biostatistics, Toppan Co. Japan.
Stanton A & Clantz, Primer of Biostatistics (2005). The McGraw Hill Inc., New York.

Elective Course I (EC) – Biological Techniques

Unit I Microscopy and Related Techniques

Light Microscopy : Microscopic optics, components of microscopes. Basic principles and method of Bright field, Dark field, Phase contrast. Fluorescence, Polarization and confocal microscopes. Applications of various types of microscopy such as immunofluorescence – *In situ* hybridization. Electron Microscopy – Principle, Techniques and applications of Transmission Electron microscope (TEM) and Scanning Electron Microscope (SEM), Atomic Force Microscope (AFM).
Photomicrography and Video micrography , Developing and printing of microphotographs

Unit II Analytical Techniques

Spectroscopic methods – UV-Visible, Atomic Absorption Spectrophotometer, Atomic Emission Spectroscopy.
Centrifugation – Principles, various types including centrifugation Electroanalytical methods – electrolytic all 4 golvanic cell – Potentiometric, conductimetric, coulometric & voltametric analysis. Biosensors.

Radioactive Analysis : Principles of radioactivity, GM counter & LS counter.

Unit III Principles & Applications of Chromatographic Techniques :

Adsorption – Ion exchange and gel permeation – affinity chromotography for separation of compounds including GC and HPLC.

Unit IV - Electrophoresis Techniques

Electropohoretic techniques – protein – nucleic acid – immuno – two dimensional electrophoresis.

Unit V Molecular Biological Techniques

Microbiological techniques – purification, storage, measurement of microbial growth rate.
Isolation and amplification of nucleic acid – Plasmid isolation, chromosomal DNA isolation. Polymerase chain reaction.
Gene cloning techniques – Restriction digestion and Phosphatase treatment of cloning vectors. Cloning technique, separation and staining of DNA, qualification of DNA, gene transfer mechanisms – chemical and electroporation.
Methods of detection of clones – Nucleic acid transfer by blotting, Hybridization plaque, colony hybridization, histochemical detection of β -galactosidase, antibody screening including colour development reaction.

Reference:

Cynthia Gibas & Per Jambek (2001). Developing Bioinformatics Computer Skills, Shroff Publishers & Distributors Pvt. Ltd., O'reilly) Mumbai.
Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology & Biotechnology, ASM Press.
Glick, B.R. and Pasternak, J.J. (1994). Molecular Biotechnology, ASM Press.
John G. Webster. (2004). Bioinstrumentation. University of Wisconsin, John Wiley & Sons, Inc.
Misener, S. and Krawetz, S.A. (2000). Bioinformatics Methods and Protocols. Human Press, Totowa, New Jersey.
Rashidi, H.H., and Buehler, L.K. (2002). Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.
Sambrrok, J. and Ruseell, D.W. (2001) Molecular Cloning – A Laboratory Manual (3rd eidition, Vol. 1,2,3) Cold Spring Laboratory Press, New York.
Savile Pradbury. (1991). Basic measurement techniques for light microscopy, Oxford University Press, Royal Microscopical Society.
Surzeki, S. (2000). Basic Techniques in Molecular Biology, Springer.
Westermeier, R (1993). Electroporesis in practice – VCH – Federal Republic of Germany.
Marimuthu, R. (2007) Microscopy and Microtechnique.MJP publishers, Chennai.
13. Sambrook, J & Russell, D W (2001) Molecular Cloning – A Laboratory manual.
Cold Spring Harbour Laboratory Press New York

Elective Course II (EC): Food and Dairy Microbiology

Unit 1: Introduction- Importance of food and dairy microbiology- Food – Uses, Nutition – types of Nutrition, Food used in different ages – infants, children, school age, adult, pregnant women and old age. Importance of mother milk. Types of microorganisms in Food- Source of contamination- Factors influencing microbial growth in food

Unit 2: Food fermentations: Cheese, bread, wine, beer, fermented vegetables- methods and organisms used. Food and enzymes from microorganisms-single cell protein. Production of amylase and protease and other enzymes from food.

Unit 3: Contamination, spoilage and preservation of cereals and cereals products, sugar and sugar products, Vegetables and fruits, meat and meat products – fish and othe sea foods, egg and poultry – dairy and fermentative products (ice cream and other products)

Unit 4: 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 – general food contamination.

Unit 5: Food preservations: principles- methods of preservations-Physical and chemical methods, food sanitations. Good manufacturing process- hazard analysis, critical control Jpoints and personnel hygiene. Unhygienic food handling diseases.

Reference :

Frazier and Westhoff, DC. 1988. Food Microbiology. TATA McGraw Hill Publishing Company LTD., New Delhi

Adams, M.R and Moss, MO. 1995. Food Microniology. The Royal Society of Chemistry, Cambridge

Maheshwary. Nutrition and dietetic. New Delhi.

ELECTIVE COURSE III (EC)
MOLECULAR TAXONOMY AND PHYLOGENY

Unit – I: Microbial Taxonomy

Introduction to microbial taxonomy – morphological taxonomy, biochemical taxonomy, and molecular taxonomy. Numerical taxonomy – basic concepts of taxonomy. Positive and negative aspects of each taxonomical methods. Morphological phylogeny

UNIT- II: Biochemical & molecular taxonomy

Chemotaxonomy - fatty acid, protein finger printing , Isozyme typing, pigments & polyamines. Biochemical phylogeny. Molecular taxonomy –- G +C content, DNA – DNA hybridization, Plasmid profiles, RFLP, RAPD, STRR & LTRR, REP –PCR, rRNA based DNA finger printing methods

Unit – III: 16S rRNA based finger printing

Types of rRNA - 23s rRNA, 16S rRNA & 5S rRNA. Importance of 16SrRNA in microbial identification and taxonomy. Methods of 16S rRNA / rDNA fingerprinting - Isolation of rRNA, RT- PCR, Isolation of DNA, amplification of 16S rDNA using PCR, Cloning, transformation, Blue-white screening, Plasmid isolation, Dot blot/Southern blot hybridization using specific probes Sequencing of 16S rDNA using chain-termination method.

UNIT – IV: Sequence analysis.

Submission of rDNA sequences in GenBank – Bankit & Sequin guidelines. NCBI, EMBL & DDBJ – retrieving sequences. RNA structure prediction, Restriction enzyme patterns. Ribosomal Database Project - Designing primers & probes. Sequence comparison, alignment and data base searching – ClastalW, FASTA & BLAST. DNA barcoding.

UNIT – V: Molecular phylogeny.

Introduction to Molecular phylogeny – tree terminology, software programs for making phylogenetic trees – MEGA, Phylib, RAPDistance. Cladogram, additive trees and ultrametric trees, rooted, unrooted trees and tree shapes.

References:

Roderic D. M. Page, Edward C. Holmes (1998). Molecular Evolution: A Phylogenetic Approach. Blackwell publishing, USA.
Principles of Genome Analysis: A Guide to Mapping and Sequencing DNA from Different Organisms by S. B. Primrose (Paperback - Jan 1998)
Microbial Genome Methods by Kenneth W. Adolph (Hardcover - Oct 28, 1996)
Genome Mapping and Sequencing by Ian Dunham (Hardcover - Sep 1, 2003).
Brendan Wren (Editor), Nick Dorrell (2002) Functional Microbial Genomics (Volume 33) (Methods in Microbiology), Academic Press, UK.
Sandy B. Primrose Richard M. Twyman (2005) Principles of Genome Analysis and Genomics, Blackwell Publishing, USA.

Elective Course IV (EC) – Quality Control & IPR

Unit – I : Bioethics

Legalty, morality and ethics, the principles of bioethics, autonomy, human rights, beneficience, privacy justice equality etc.

Unit – II : Biosafety

Concept and issues, rational Vs subjective perceptions of risks and benefits – relationship between risk hazard, exposure, and safe gaurds – biosafety concerns at the level of individuals, institutions, society, region country and the world – Lab associated infections.

Unit – III : Biosafety assessment (BSA)

BSA of biotechnology and pharmaceutical products such as drugs – vaccines – biomolecules etc.

Unit – IV : Quality control

Quality control in food process technology – WHO standards – Quality control in dairy product technology – Quality control for potable water.

Unit – V : IPR

GATT and IPR, forms of IPR, IPR in India, WTO Act, Convention on Biodiversity (CBD), Patent Co-operation Treaty (PCT), forms of patents and patentability, 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.

References:

Frederic H. Erbisch, Karim M. Maredia (2004). Intellectual Property Rights in Agricultural Biotechnology, CABI Publisher.
Mittal D.P. (1999). Indian Patents Law. Taxmann Allied Services (p) Ltd.
Christian Lenk, Nils Hoppe, Roberto Andorno (2007). Ethics and Law of Intellectual Property: Current Problems in Politics, Science and Technology, Ashgate Publisher (p) Ltd.
Felix Thiele, Richard E. Ashcroft (2005). Bioethics in a Small World. Springer.
John Bryant (2002) Bioethics for Scientists. John Wiley and Sons Publisher.

Elective Course V (EC) – Microbial Biotechnology

Unit - I: Algal Biotechnology

Definition, Concepts - biotechnological potentials of microalgae – food – feed – Colourant - fuel and pharmaceutically variable compounds.

Unit II: Microbial biofertilizers

Production of microbial biofertilizers – Mass cultivation of cyanobacteria (Spirullina), Azolla and other N2 fixers (*Azospirillum, Azatobactger & Rhizobium*)

Unit-III: Microbial Pesticides

Basic principle – antagonism, amensalism, siderophores, parasitism, nematophagy. Microbial herbicides, microbial insecticides - bacterial insecticide Pseudomonas, Bacillus sp. – Bacillus thrungiensis - toxins - BT cotton - viral insecticide - entomophathogenic fungi.

Unit- IV: Industrial Processes and Products

Production microbial products – malt beverages – alcohol - vinegar - lactic acid- citric acid- penicillin - streptomycin- L-lysine- L-glutamic acid – protease – lipase - pectinase and riboflavin.

Unit – V: Bioremediation

Microbes in abatement of heavy metal pollution - heavy metal tolerant microbes - Mechanism of heavy metal and antibiotic resistance - role of biosorption - biotransformation of Xenobiotics - Superbug - rDNA application. Biodegradation of oil and petroleum products. Microbial leaching - Copper - Uranium.

References:

Raledge C and Kristiansen B Eds (2001). Basic Biotechnology, 2nd edition, Cambridge University Press.

Balasubramanian D, Bryce CFA, Dharmalingam K, Green J, Jayaraman K. (1996). Concepts in Biotechnology University Press, India.

Borowitzka MA, Borowitzka LJ (1989). Microalgal Biotechnology, Cambridge University Press.

Alan T. Bull. Microbial Diversity and Bioprospecting. ASM press. Washington, D.C

Gerbardt P, Murray RG, Wood WA , Kreig NR. (1994) Methods for General and Molecular Bacteriology – American Society for Microbiology Washington D.C.

Glazer AN, Nikaido H. (1994) Microbial Biotechnology – Fundamentals of Applied Microbiology WH Freeman and Company, New York.

Pnolella P (1998) Introduction to Molecular Biology, WCB Mc Graw Hill, Boston, Massacheutts.

Walsh G, Headon DR. (1994). Protein Biotechnology, John Wiley & Sons, New York.

Elective Course VI (EC) – Microbial Bionanotechnology

Unit – I

History – bionanotechnology – concept and future prospects – application in Life Sciences. Terminologies – nanotechnology, bionanotechnology, nanomedicine, nanowires, quantum Dots, nanocomposite, nanoparticles.

Unit – II

Molecular nanotechnology – nanomachines – collagen. Uses of nanoparticles – cancer therapy – manipulation of cell and biomolecules. Cytoskeleton and cell organelles. Types of nanoparticles production – physical, chemical and biological. Microbial synthesis of nanoparticles

Unit – III

Nanoparticles – types, functions – Silver, Gold and Titanium. Physical and chemical properties of nanoparticles. Characterization of nanoparticles – UV-Vis spectroscopy, Electron Microscopy – HRTEM, SEM, AFM, EDS, XRD.

Unit – IV

Uses of nanopartcles in biology : Drug delivery – protein mediated and nanoparticle mediated. Uses of nanoparticles in MRI, DNA and Protein Microarrays. Nanotechnology in health sectors. Toxicology in nanoparticles – Dosimetry.

Unit – V

Advantages of nanoparticles – drug targeting, protein detection, MRI, development of green chemistry – commercial viability of nanoparticles. Disadvantages – health risk associated with nanoparticles, inadequate knowledge on nanoparticles research.

References:

Parthasarathy, B.K. (2007). Introduction to Nanotechnology, Isha Publication.

Elisabeth Papazoglou and Aravind Parthasarathy (2007). Bionanotechnology. Morgan & Claypool Publishers.

Bernd Rehm (2006). Microbial Bionanotechnology: Biological Self-assembly Systems and Biopolymer-based Nanostructures. Horizon Scientific Press.

David E. Reisner, Joseph D. Bronzino (2008). Bionanotechnology: Global Prospects. CRC Press.

Ehud Gazit (2006). Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology. Imperial College Press.

Elective Course VII (EC) Marine Microbiology

Unit: I Marine Microbial disserts

Marine environment – see-benthic & littoral zone, saltpan, mangroves and estuarine microbes, microbial loop – marine microbial community – planktons, bacteria, fungi, protozoa.

Unit: II Marine Extremophiles

Survival at extreme environments – starvation – adaptive mechanisms in thermophilic, alkalophilic, asmophilic and barophilic, psychrophilic microorganisms – hyperthermophiles and halophiles – importance in biotechnology.

Unit: III Symbiotic microbes

Microbe-microbe interactions – Lichens, antagonistic interactions – amensalism, mycoparasitism – Animal-microbe interaction – Ectosymbiosis of Protozoa, Runinant symbiosis – Plant-microbe interaction – *Rhizobium, Mycorrhizae, Anabaena* – sponge.

Unit: IV Marine Microbial Disease

Marine food borne pathogens & Water borne pathogens – *Aeromonas, Vibrio, Salmonella, Pseudomonas, Leptospira, Cornybacter.*

Unit: V Marine Microbial Biotechnology

Production and applications of marine microbial products – pigments – Astaxanthin, β carotene – enzyme – antibiotics – polysaccharide – sea food preservation methods.

References:

Prescott, L.M., Harley J.P. Klein (1999). Microbiology, WCB, Mc Grow Hill Publications

Raina M. Maier, Ian L. Pepper, Charles, P. Gerba (2006). Environmental Micrology, Academic press.

Jamesh W. Nybakker (2001). Marine Biology, Benjamin Cummings

Shimshon Belkin and Rita R. Colwell (2005). Ocean and Health: Pathogens in the marine environment. Springer.

Scheper, T. (2005). Advances in Biochemical Engineering/Biotechnology-Marine Biotechnology I. Springer

Bhakuni, D.S. and Rawat, D.S. (2005). Bioactive marine natural products. Anamaya Publishers, New Delhi.