DRAFT SYLLABUS FOR
MINOR COURSE
OR
B. Sc. (MULTIDISCIPLINARY) PROGRAM IN

MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Under National Education Policy-2020
(With effect from the session 2023-2024)

B. Sc. in Molecular Biology and Biotechnology

Based on NEP, 2020

Minor Course (3 + 2 = 5 credits each)

(Opted by Students of Four-Year B. Sc. Honours/Honours with Research/ 3-Year Multidisciplinary UG Programme)

Semester	Course Code	Paper Title	Credits	Hours
I	MBBCOR1O1T/MBBMIN101T	Biomolecules (Theory)	3	45
	MBBCOR1O1P/MBBMIN101P	Biomolecules (Practical)	2	60
II	MBBCOR2O2T/MBBMIN202T	Cell Biology and Genetics (Theory)	3	45
	MBBCOR2O2P/MBBMIN202P	Cell Biology and Genetics (Practical)	2	60
III	MBBCOR303T/MBBMIN303T	Enzymes and Metabolism(Theory)	3	45
	MBBCOR303P/MBBMIN303P	Enzymes and Metabolism(Practical)	2	60
IV	MBBCOR404T/MBBMIN404T	Principles Of Molecular	3	45
	MBBCOR404P/MBBMIN404P	Biology(Theory) Principles Of Molecular Biology (Practical)	2	60
V	MBBCOR505T/MBBMIN505T	Bio-Analytical Tools and Immunology(Theory)	3	45
	MBBCOR505P/MBBMIN505P	Bio-Analytical Tools and Immunology(Practical)	2	60
VI	MBBCOR606T/MBBMIN606T	Recombinant DNA Technology and Microbial Biotechnology (Theory)	3	45
	MBBCOR606P/MBBMIN606P	Recombinant DNA Technology and Microbial Biotechnology (Practical)	2	60

Special Minor course: (3 + 2 = 5 credits each)

(Opted by Students of Four-Year B. Sc. Honours / Honours with Research)

Semester	Course Code	Paper Title	Credits	Hours
VII	MBBSMC701T	Introduction to Applied Microbiology (Theory)	3	45
	MBBSMC701P	Introduction to Applied Microbiology (Practical)	2	60
VII	MBBSMC702T	Fundamentals Of Molecular Signalling (Theory)	3	45
	MBBSMC702P	Fundamentals Of Molecular Signalling (Practical)	2	60

Skill Enhancement Course: 3 credits each

(Opted by Students of 3-Year Multidisciplinary UG Programme)

Semester	Course Code	Paper Title	Credits	Hours
I / III / V	MBBGSE101M / MBBGSE301M / MBBGSE501M	Fundamentals of Biostatistics and Bioinformatics (Theory)	3	45
II/ IV / VI	MBBGSE202M / MBBGSE402M / MBBGSE602M	Biotechnology in Sustainable Development (Theory)	3	45

DETAILED SYLLABUS

Minor Course (3 + 2 = 5 credits each)

Semester I

MBBCOR1O1T/MBBMIN101T: BIOMOLECULES

THEORY (3 credits) TOTAL HOURS: 45

Unit 1: pH and Buffer (5 hrs): Ionization of water, Lowry Bronsted theory of acids and bases, pH and buffers, Henderson Hasselbalch Equation, Biological buffers, Importance of buffers in living system.

Unit 2:

Biomolecules (40 hrs):

Carbohydrates (12 hrs): Open chain and ring structures (Haworth projection formula) of Monosaccharides: Hexoses and Pentoses (Ribose and 2- deoxyribose), D- and L-configuration,Mutarotation, Anomers, and Epimers.Oxidation of sugars.Reducing and Non-reducing sugars, Disaccharides (sucrose, lactose, maltose), Structure of homopolysaccharides (glycogen, starch and cellulose).

Lipids (12 hrs): Classification of lipids, Nomenclature and structure of Saturated and Unsaturated Fatty acids, delta and omega-system; Essential fatty acids. Saponification number, Iodine number, Acetyl number of fats. Structure and Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol). Examples of Lipids as signalling molecules, cofactors and pigments.

Amino acids and Proteins (16 hrs):

General structure and classification of Amino Acids, Essential and non-essential amino acids, Zwitterionic structure, Acid-Base properties, Titration of amino acids, pK values and Isoelectric point, Formol titration of glycine. Reactions of carboxyl and amino groups, formation of Peptide bond, Determination of N-terminal amino acid (Edman's method) and C–terminal amino acid (hydrazinolysis). Structural organization of proteins (primary, secondary, tertiary & quaternary), Covalent and Non-covalent interactions that stabilize the three-dimensional structures of proteins. Fibrous and globular proteins, Native structure of Proteins, Denaturation.

MBBCOR1O1P/MBBMIN101P: BIOMOLECULES

PRACTICAL (2 credits) TOTAL HOURS: 60

1. Preparation of phosphate buffer and measurement of pH.
2. Qualitative tests for reducing and non-reducing sugars, polysaccharide, lipid, amino acids and proteins.
3. Identification of unknown compounds (from sugars, polysaccharides, lipids, amino acids and proteins).
4. Formol titration of Glycine.

SUGGESTED READING

1. Das D. (1978) Biochemistry. Academic Publishers.
2. Conn EE and Stumpf PK. (1972) Outline of Biochemistry. John Wiley Publishers.
3. Tymoczko JL, Berg JM and Stryer L. (2012) Biochemistry: A short course, 2nd ed., W.H. Freeman.
4. Nelson DL and Cox MM. (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
5. Voet D and Voet JG. (2004) Biochemistry 3rd edition, John Wiley and Son.
6. Berg JM, Tymoczko JL and Stryer L. (2011) Biochemistry, W.H.Freeman and Company.

Semester II

MBBCOR2O2T/MBBMIN202T: CELL BIOLOGY AND GENETICS

THEORY (3 credits) TOTAL HOURS: 45

Unit 1: Cell Biology (15 hrs): Cells as basic functional unit of life,classification of organisms by cell structure.

Structure of prokaryotic cell, Gram staining, bacterial cell wall (gram positive & gram negative), prokaryotic cell membranes, cytoplasm, ribosomes, nucleoid.

Structure, chemical composition and functions of eukaryotic cell membrane, Fluid Mosaic model of plasma membrane, Passive and active transport, Endocytosis and Exocytosis.

Structure and functions of different cell organelles: Cytoskeleton, Nucleus, Endoplasmic reticulum, Golgi apparatus, Mitochondria, Chloroplast, Lysosome and Peroxisome.

Unit 2: Basic Microbiology (15 hours): Introduction to microbiology; general concepts on microbes and their distinctive characters; Morphology of bacteria; Physical conditions required for growth (temperature, oxygen, and pH); Basic nutritional requirements for growth (carbon source, nitrogen source, other growth factors like vitamin source, or any special requirement).

Unit 3: Mendelian Genetics (5 hrs): Mendel's Principles of inheritance; Law of Segregation, Law of Independent Assortment.

Unit 4: Microbial Genetics (10 hours): Genetic recombination in bacteria: Mechanism of bacterial transformation, conjugation (Discovery, F factor, *Hfr*and $F^{/}$strains) and transduction (Generalized transduction and Specialized transduction).

MBBCOR2O2P/MBBMIN202P: CELL BIOLOGY AND GENETICS

PRACTICAL (2 credits TOTAL HOURS: 60

1. Simple staining of bacteria.
2. Gram staining of bacteria.
3. Negative staining of bacteria using nigrosin.
4. Determination of relative sizes of nucleus and cytoplasm of squamous cells.
5. Project Work (Internal review work).

SUGGESTED READING

1. Rastogi SC.(2012) Cell and Molecular Biology. New age international publication.
2. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
3. De Robertis, EDP and De Robertis EMF. (2006) Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
4. Cooper GM and Hausman, RE. (2009) The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington, D.C.,Sinauer Associates, MA.
5. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings.
6. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. WileyIndia.
7. Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings.
8. Maloy SR, Cronan JE and FriefelderD(2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers.
9. Atlas RM. (1997) Principles of Microbiology. 2nd edition. WM.C.Brown Publishers.
10. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004) Microbiology. 5th edition. Tata McGraw Hill.
11. Tortora GJ, Funke BR, and Case CL. (2008) Microbiology: An Introduction. 9th edition Pearson Education.
12. Cappucino J and Sherman N. (2010)Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited.

Semester III

MBBCOR303T/MBBMIN303T: ENZYMES AND METABOLISM

THEORY (3 credits) TOTAL HOURS: 45

Unit 1: Enzymes(20 hrs): Nomenclature and IUB classification, active site, cofactors, coenzymes and prosthetic groups, metalloenzymes and metal-activated enzymes, activation energy and transition state, catalytic efficiency, activity, specific activity and turnover no. Principles of Enzyme kinetics: Michaelis-Menten Equation, Significance of Km and Vmax, Determination of Km and Vmax, Lineweaver Burk Equation, Double reciprocal Plot, Effect of temperature, pH and Inhibitors (Reversible Inhibition: competitive, un-competitive and non-competitive and Irreversible Inhibition), Allosteric Enzymes and Feedback Inhibition, Isozymes.

Unit 2: Bioenergetics and Metabolism (25hrs): Bioenergetics: Importance of Gibb's free energy in living System, High energy compounds, Energy currency of the cell, Electron Transport Chain (ETC), Idea of Redox Potential, Chemiosmotic Hypothesis and Oxidative Phosphorylation, Inhibitors and Uncouplers.

Carbohydrate metabolism: Catabolism and Anabolism, Glycolysis - fate of pyruvate under aerobic and anaerobic conditions, Fermentation (only lactate and ethanol), TCA cycle, Gluconeogenesis, Pentose phosphate pathway, Overview of Glycogenesis and Glycogenolysis.

Catabolism of fatty acids: Transport of fatty acids into Mitochondria, β-oxidation of saturated fatty acids (Reactions and Energetics), Ketogenesis.

Catabolism of amino acids: Amino acids- Essential, non-essential, glucogenic and ketogenic, Transamination and oxidative deamination, Urea cycle (Reactions, enzymes, location, connection with TCA cycle).

MBBCOR303P/MBBMIN303P: ENZYMES AND METABOLISM

PRACTICAL (2 credits) TOTAL HOURS: 60

1. Study activity of any enzyme under optimum conditions.

2. Study the effect of pH on the activity of alkaline phosphatase or amylase enzyme. Determination of optimumpH.
3. Study the effect of temperature on the activity of alkaline phosphatase or amylase enzyme. Determination of optimum temperature.
4. Study of enzyme kinetics (alkaline phosphatase or amylase): Determination of Km and Vmax by Lineweaver Burk Plot. Calculation of specific activity.
5. Study the effect of any inhibitor on enzyme activity by Lineweaver Burk Plot.
6. Project Work.

SUGGESTEDREADING

1. Das D. (1978) Biochemistry. Academic Publishers.
2. Conn EE and Stumpf PK. (1972) Outline of Biochemistry. John Wiley Publishers.
3. Tymoczko JL, Berg JM and Stryer L. (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman.
4. Nelson DL and Cox MM. (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
5. Voet D and Voet JG. (2004) Biochemistry 3rd edition, John Wiley and Son.
6. Berg JM, Tymoczko JL and Stryer L. (2011) Biochemistry, W.H.Freeman and Company.

Semester IV

MBBCOR404T/MBBMIN404T: PRINCIPLES OF MOLECULAR BIOLOGY
THEORY (3 credits) TOTAL HOURS: 45

Unit 1: Structure and Organization of The Genetic Material (20 hrs):

Nucleic acids: Structure of Nucleotides, Nucleotides as source of energy, component of coenzymes, second messengers. DNA structure – Watson-Crick model. A, B & Z forms of DNA, DNA supercoiling – linking number, negative and positive supercoilng, topoisomerases, quardruplex DNA, denaturation and renaturation of DNA, melting temperature (Tm), UV absorption and hyperchromic effect. Nucleosome structure and Genome organization.Structureof major types of RNA.

DNA as a store of information: Genes are mutable units, one gene-one protein hypothesis, DNA is the almost universal genetic material (Griffith's experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment), Central Dogma of Molecular Biology.

Unit2: Mutation and Mutagenic agents (5 hrs): Definition of mutation, Gain of function and Loss of function mutation, Forward and Reverse mutation, Point mutation (Transitions, transversions, Missense mutation, Nonsense mutation, silent mutation, Frame shift mutation), Spontaneous mutation and Induced mutation, Mutagen – physical (Ionizingradiation, UV radiation), chemical (Base analogs, Nitrous acid, Acridine dyes, Alkylating agents), Ames test.

Unit 3: Replication of DNA (5 hrs): Semiconservative nature of DNA replication (Messelson and Stahl's experiment), Mechanism of bidirectional DNA replication in prokaryotes, Bacterial DNA Polymerases, Pre-primingproteins, Primosome and Replisome.

Unit4: Gene Expression and Regulation (15 hrs):

Transcription: Transcription in prokaryotes with *E. coli* as model system: RNA polymerase, promoter, initiation, elongation and termination of transcription, rho dependent and independent termination.Inhibitors of transcriptionActinomycin D and α- Amanitin.

Genetic code: Features of Genetic code,Wobble hypothesis.

Translation in prokaryotes: Role of m-RNA, t-RNA and r-RNA in protein synthesis, ribosome structure and assembly, Charging of t-RNA, aminoacyl t-RNAsynthetases, initiation, elongation

and termination of protein synthesis in bacteria, Action of antibiotics that act as protein synthesis inhibitors - Streptomycin, Tetracyclin, Kanamycin, Chloramphenicol and Puromycin.

Regulation of transcription: Operon model of gene regulation, negative and positive regulation in prokaryotes, *lac* operon.

MBBCOR404P/MBBMIN404P: PRINCIPLES OF MOLECULAR BIOLOGY PRACTICAL (2 credits) TOTAL HOURS: 60

1. Quantitative estimation of DNA by diphenylamine reaction usingcolorimeter.
2. Quantitative estimation of RNA by orcinol method using colorimeter.
3. Study of absorption spectra of DNA and protein using UV-Visible spectrophotometer.
4. Extraction of chromosomal DNA from *E. coli* or from plant tissue.
5. Determination of Purity of DNA using UV-Visible spectrophotometer (A260/ A280 measurement).

SUGGESTEDREADING

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R. (2014) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab Press, Pearson Publication.
2. Alberts B and Jhonson AD.(2014) Molecular Biology of the Cell, 6thedition, Garland Science.
3. Krebs J, Goldstein E, Kilpatrick S. (2013) Lewin's Essential Genes,3rdEd., Jones and Bartlett Learning.
4. Gardner EJ, Simmons MJ, SnustadDP. (2008) Principles of Genetics. 8thEd.Wiley-India.
5. Brown TA. (2007) Genomes-3. Garland Science Publishers.
6. Rastogi SC. (2012) Cell and Molecular Biology. New age international publication.

Semester V

MBBCOR505T/MBBMIN505T: BIO-ANALYTICAL TOOLS AND IMMUNOLOGY

THEORY (3 credits) **TOTAL HOURS: 45**

Unit 1: Centrifugation (4 hours): Theory of ultracentrifugation, Relative centrifugal force (RCF), Sedimentation rate sedimentation coefficient, Isopycnic (equilibrium) sedimentation (discussion with example e.g. Meselson andStahl Experiment).

Unit 2: Spectrophotometry (4 hours): Electromagnetic spectrum, Introduction to concepts of absorption and emission spectroscopy, Absorption of light, Transmittance, Absorbance (Optical density), Lambert-Beer's law and its limitations, Concept of Molar extinction co-efficient, Study of absorption spectra of Proteins and Nucleic Acids, Analysis of Proteins and Nucleic Acids using UV and Visible spectroscopy, Colorimetry.

Unit 3: Chromatography (8 hours): Partition co-efficient, paper chromatography and its applications (including 2-D), Thin layer chromatography. Column packing andfraction collection, Gel filtration chromatography, Ion- exchange chromatography and affinity chromatography, GLC, HPLC.

Unit 4: Electrophoresis (4 hours): Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, 2D gel electrophoresis, Agarose gel electrophoresis.

Unit 5: Microscopy (5 hours): Optical microscopy: the nature of light—its particle and wave character. Ray diagrams and image formation. Simple and compound microscopes, Applications of optical microscopes, Numerical Aperture (NA), Resolution, Contrast, magnification, limit of resolution, Basic principles of oil immersion microscope. Limitations of optical microscopes. Electron microscopy---Basic working principle of TEM and SEM.

Unit 6: Immunology (20hours): Immune response – An overview, Primary and secondary immune response, Cells and molecules involved in innate and adaptive immunity (Stem cell, T-cell, B-Cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell and Dendritic cell). Antigens, antigenicity and immunogenicity, Epitope, Immunoglobulin or antibodies (basic ideas), Monoclonal and polyclonal antibody, MHC molecules, Humoral and cell-mediated immunity, Antigen-antibody reaction (basic ideas), Immunological techniques (agglutination, precipitation, ELISA, RIA, immunofluorescence, flow cytometry Western blot),Vaccination, hypersensitivity and autoimmunity (basic concept).

MBBCOR505P/MBBMIN505P:BIO-ANALYTICAL TOOLS AND IMMUNOLOGY

PRACTICAL (2 credits) TOTAL HOURS: 60

1. Separation of amino acids by paper chromatography.
2. Measurement of refractive index of a biological solution with the help of travelling microscope.
3. Separation of proteins by SDS- PAGE.
4. Separation of lipids by TLC.
5. Detection of blood group.
6. Immunodiffusion:Ouchterlony double diffusion technique.

SUGGESTED READING

1. Freifelder D. (1982) Physical Biochemistry: Applications to Biochemistry and Molecular Biology, W. H. Freeman.
2. Wilson K and Walker J. (2010).Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.
3. Nelson DL and Cox MM. (2008) Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
4. Hallett FR, Speiglet PA and Stinson RH. (1982) Physics for the biological sciences. Chapman and Hall.

5. Kindt TJ, Osborne BA and Goldsby RA. (2006) Kuby Immunology, 6th Edition. W. H. Freeman & Company.
6. Lydyard PM, Whelan A and Fanger MW.(2000) Instant Notes in Immunology, BIOS Scientific publishers).
7. Reimer L and Kohl H. (1984) Transmission electron microscopy, Springer.
8. Sharma VK.(1991) Techniques of microscopy. Tata McGraw Hill publication.

Semester VI

MBBCOR606T/MBBMIN606T: RECOMBINANT DNA TECHNOLOGY AND MICROBIAL BIOTECHNOLOGY

THEORY (3 credits) **TOTAL HOURS: 45**

Unit 1: Introduction to Molecular Cloning (30 hrs): Vectors: Characteristics of cloning vectors, Plasmids (pSC101, pBR322, pUC18/I9), Bacteriophage lambda insertion and replacement vectors, M13 based vectors, Cosmids, YACs and Ti plasmid. Shuttle vectors and Expression vectors: *E.coli lac* and T7 promoter-based vectors. Enzymes used in Molecular Cloning: Restriction enzymes. Types I, II and III, nomenclature, use of Type II restriction enzymes in cloning, Isoschizomers and Neoschizomers, Restriction Mapping, Restriction Fragment Length Polymorphism (RFLP). DNA ligases, Terminal deoxynucleotidyltransferase, Polynucleotide Kinase, Phosphatases and Reverse Transcriptase. Cloning strategies: Construction of recombinant DNA: Joining of cohesive ends and blunt ends, c-DNA synthesis and cloning. Transformation of *E.coli*host by Calcium chloride method and electroporation. Methods used in Molecular Cloning: Agarose gel electrophoresis of DNA, Southern, Northern and Western blotting.

Unit 2: PCR Techniques (5 hrs): Principle of Polymerase Chain Reaction, RT-PCR, Real-Time PCR and their applications.

Unit 3: Microbial Biotechnology (10 hrs): Applications in human therapeutics (insulin, hGH), agriculture (Bt-cotton, brinjal)and food technology (Flavoursavour tomato). Recombinant microbial production processes in pharmaceutical industries - recombinant vaccines (Hepatitis B vaccine).

Immobilization methods and their application: Whole cell immobilization.

MBBCOR606P/MBBMIN606P: RECOMBINANT DNA TECHNOLOGY AND MICROBIAL BIOTECHNOLOGY

PRACTICAL (2 credits) **TOTAL HOURS: 60**

1. Study yeast cell immobilization in calcium alginate gels.
2. Isolation of plasmid DNA.
3. Agarose Gel Electrophoresis of plasmid DNA.
4. Preparation of competent cells for transformation by calcium chloride method.
5. Transformation of *E.coli*host cell with plasmid DNA.
6. Digestion of plasmid DNA using restriction enzymes and analysis by agarose gel electrophoresis.

SUGGESTED READING

1. Brown TA. (2010) Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. Primrose SB and Twyman RM. (2006) Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
3. Sambrook J and Russell D. (2001) Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
4. Ratledge C and Kristiansen B. (2001) Basic Biotechnology. 2nd Edition. Cambridge University Press.
5. Gupta PK. (2009) Elements of Biotechnology. 2nd edition. Rastogi Publications.
6. Glazer AN and Nikaido H. (2007) Microbial Biotechnology. 2nd edition. Cambridge University Press.

Special Minor Course (3 + 2 = 5 credits each)

Semester VII

MBBSMC701T: INTRODUCTION TO APPLIED MICROBIOLOGY

THEORY (3 credits) TOTAL HOURS: 45

Unit 1: Introduction to Microbiology (8 hrs): Definition of Microbiology; Introduction to microbes with special emphasis on bacteria, Whittaker's Five kingdom classification concept. Bacterial systematics – overview according to Bergey's Manual of Determinative Bacteriology.

Unit 2: Morphology of Bacteria (8hrs): Bacterial cell size and shape, bacterial cell wall – structural components and functional properties. Bacterial cell appendages and cell inclusions – Overview to introduce the terms and working /functions of each appendage.

Unit 3: Bacterial growth and reproduction (7 hrs): Nutritional types of bacteria. Binary fission, fragmentation and budding. A brief outline on Bacterial growth curve.

Unit 4: Algae and Fungi (7 hrs): General characteristics of algae and fungi. Morphology and mode of reproduction (asexual and sexual)

Unit 5: Control of microorganisms (10 hrs): Fundamental of control. Definition of physical agents (high and low temperature, radiation, filtration) and chemical agents (phenol and phenolic compounds, alcohol, Chemotherapeutic agents). Introduction to antibiotics, mode of action of antibiotics like – penicillin, streptomycin, tetracycline and chloramphenicol. Antibiotic resistance in microbes.

Unit 6: Applied Microbiology (5hrs): Use of beneficial bacteria in food and industrial microbiology (Brief idea about microorganism related to production of enzymes, vitamins, vaccines, and other pharmaceutical products). Use of bacteria in waste management and biofertilizer production.

MBBSMC701P: INTRODUCTION TO APPLIED MICROBIOLOGYPRACTICAL (2 credits)

TOTAL HOURS: 60

1. Preparation of different media: Nutrient Agar & broth, Luria broth.
2. Simple staining of bacteria.
3. Gram staining of bacteria.
4. Isolation of pure cultures of bacteria by streaking method.
5. Isolation of any food borne bacteria from food products.

SUGGESTED READING

1. Atlas RM. (1997) Principles of Microbiology. 2nd edition. WM.C.Brown Publishers.
2. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004) Microbiology. 5th edition. Tata McGraw Hill.
3. Tortora GJ, Funke BR, and Case CL. (2008) Microbiology: An Introduction. 9th edition Pearson Education.
4. Cappucino J and Sherman N. (2010)Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited.
5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005)General Microbiology. 5th edition McMillan.
6. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer.
7. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
8. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
9. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.

MBBSMC702T: FUNDAMENTALS OF MOLECULAR SIGNALLING

THEORY (3 credits) TOTAL HOURS: 45

Unit 1:Signalling molecules (5 hrs): Structure and function of Second messengers - cAMP, cGMP, IP3, diacyl glycerol, Ca2+, NO and their role in signal transduction.

Unit 2: Cellular communication and mechanism of Signalling (6 hrs) : General principle of cell communication, cell adhesion, Gap junction extracellular matrix, integrins. Brief idea of cell cycle and apoptosis. General principles of cell signalling, Hormones and Chemical signals and cellular receptors.

Unit 3: Neurobiophysics (10 hours): Neurons, Resting Membrane potential (Gibbs-Donnan effect; Nernst potential). Threshold potential. Characteristics of Action potential. Axonal conduction and speed of propagation. Synaptic transmission (chemical).

Unit 4: Electrical signals from the heart – Electrocardiogram (ECG) (4 hours): Blood circulation in the heart. Physical basis of electrocardiography. Recording of ECG. Einthoven's triangle, measurement of Heart beat.

Unit 5: Physics of vision (10 hours): Optical elements of the human eye. Mechanism of image formation by Human eye (Itsaccommodation, refractive power, defects of human vision and their rectification). Visual acuity and its testing. Retina and photoreceptors. Mechanism of rod and cone vision. Colour blindness.

Unit 6: Physics of audition (10 hours): Nature of sound. Values of sound velocity in air, water, iron, human body. Energy, power and intensity of sound wave (definitions only). Sound impedance (qualitative idea). Loudness, pitch and quality of sound (definitions). Intensity level. Values of intensity level of some standard sounds. Human ear and the process of hearing. Echolocation by bats (qualitative discussion).

MBBSMC702P: INTRODUCTION TO APPLIED MICROBIOLOGY PRACTICAL (2 credits) TOTAL HOURS: 60

1. Determination of heart rate of a human being from the ECG records.
2. Interpretation of ECG.
3. Determination of blood pressure.

4. Detection of colour blindness with the help of Ishihara chart.

5. Interpretation of visual acuity by Snellen's chart.

SUGGESTED READING

1. Srivastava PK. (2005) Elementary Biophysics: An Introduction. 2 nd Ed. Alpha Science International.

2. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.

3. Cooper GM and Hausman, RE. (2009) The Cell: A Molecular Approach. 5 th Edition. ASM Press & Sunderland, Washington, D.C., Sinauer Associates, MA.

4. Alberts B and Jhonson AD. (2014) Molecular Biology of the Cell, 6th edition, Garland Science.

Skill Enhancement Course: 3 credits each

Semester I / III / V

MBBGSE101M / MBBGSE301M / MBBGSE501M: FUNDAMENTALS OF BIOSTATISTICS AND BIOINFORMATICS

THEORY (3 credits) **TOTAL HOURS: 45**

Unit 1: Introduction to Biostatistics (8 hrs):

Keywords and terms used in biostatistics. Concept of frequency distribution (frequency distribution table, simple and group frequency distribution, data presentation), mean, median, mode, standard deviation, Simple problems on mean, median, mode and standard deviation.

Unit 2: Statistical Distribution (12 hrs):

Normal, binomial, poisson's distribution.

Unit 3: Introduction to Bioinformatics (25hrs):

Idea of Computational Biology and it's need in biological study. Nucleic acid and protein sequence database and information retrieval; sequence file formats - FASTA & GENBANK.

Sequence alignment – Concept on local and global alignment; pairwise and multiple sequence alignment. Pairwise alignment tool - BLAST and multiple sequence alignment tool - Crustal ω. Protein and nucleic acid structure database: The Protein Database (PDB); information retrieval from structural database. Visualisation of protein 3D structures using RASMOL/PyMol.

Semester II / IV / VI

MBBGSE202M / MBBGSE402M / MBBGSE602M: BIOTECHNOLOGY IN SUSTAINABLE DEVELOPMENT

THEORY (3 credits) TOTAL HOURS: 45

Unit 1: Biofertilization, Phytosimulation, Bioinsecticides (15 hours):

Plant growth promoting bacteria, biofertilizers – symbiotic (*Bradyrhizobium, Rhizobium, Frankia*), Non-Symbiotic (*Azospirillum*, *Azotobacter*, Mycorrhizae, Phosphate solubilizers, algae), Novel combination of microbes as biofertilizers.

Unit 2: Secondary Agriculture Biotechnology (15 hours):

Biotech feed, Silage, Biomanure, biogas, biofuels – advantages and processing parameters.

Unit 3: GM crops (15 hours):

Advantages, social and environmental aspects, Bt crops, golden rice, transgenic animals.

SUGGESTED READING

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.

2. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

3. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA.

4. Altman A (1998). Agriculture Biotechnology, Ist edition, Marcel decker Inc.

5. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.

6. Reddy, S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.