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Item No. 4.34

UNIVERSITY OF MUMBAI



Syllabus for the S.Y.B.Sc.

Program: B.Sc.

Course : Biotechnology

(Credit Based Semester and Grading System with
effect from the academic year 2015–2016)

Theory

Semester III

Course	Title	Unit	Topics	Credits	L/week
USBT301	Immunology and Medical Biotechnology	I	Introduction to Immunology	2	1
		II	Infectious diseases		1
		III	Medical Biotechnology		1
USBT302	Biochemistry	I	Enzymology	2	1
		II	Metabolism of carbohydrates, lipids and amino acids		1
		III	Oxidative Phosphorylation and Photophosphorylation		1
USBT303	Genetics and Molecular Biology	I	DNA replication	2	1
		II	DNA mutation and repair		1
		III	Genetic mapping of eukaryotes		1
USBTP3		Practical Based on theory		3	9

Semester IV

Course	Title	Unit	Topics	Credits	L/week
USBT401	Instrumentation and fermentation Technology	I	Introduction to fermentors	2	1
		II	Microbial growth kinetics		1
		III	Instrumentation- Chromatography, Colorimeter and Spectrophotometer		1
USBT402	Ecology and Environmental Biotechnology	I	Ecology and biodiversity	2	1
		II	Microbiology of Air and Soil		1
		III	Microbiology of water and waste water		1
USBT403	Molecular biology and Instrumentation	I	Transcription and post transcriptional modifications	2	1
		II	Translation and post translational modifications		1
		III	Instrumentation- Electrophoresis.		1
USBTP4		Practical Based on theory		3	9

Semester III

Course code	Title	Credits
USBT301	Immunology and Medical Biotechnology	2 credits
Unit I Introduction of Immunity	Immunity: Innate immunity, Acquired immunity, Local and Herd Immunity, Humoral and Cellular immunity - Factors influencing and mechanisms of each. Antigens and Antibodies: Types of antigens, General properties of antigens, Haptens and Superantigens Discovery and Structure of antibodies (Framework region) Classes of immunoglobulins, Antigenic determinants.	15 lectures
Unit II Infectious Diseases	Host Parasite Relationship: Normal flora, Factors affecting the course of an infection and disease, Mechanisms of infection and virulence factors. Infection: Patterns of infection, Types of infections, Signs and symptoms, Epidemiology and Epidemiological markers. Diseases: Origin of Pathogens, Vectors, Acquisition of Infection, Nosocomial infections, Koch's postulates	15 lectures
Unit III Medical Biotechnology	Diagnostics: Monoclonal antibodies, DNA probes- definition and applications. Vaccines: Live, Killed and Toxoid. Problems with traditional vaccines, Impact of Biotechnology on vaccine development, Modern vaccines- Subunit, Conjugate, DNA and Edible vaccines.	15 lectures

Course code	Title	Credits
USBT302	Biochemistry	2 credits
Unit I Enzymology	<p>Enzymes: Sources of enzymes, Classification of enzymes, Units of enzyme activity. Definitions: Zymogen, Coenzyme, Cofactors, Apoenzyme and Isoenzymes.</p> <p>Mechanism of action: Concept of activation energy and transition state, Koshland's induced fit hypothesis. Effect of pH, temperature and substrate concentration.</p> <p>Kinetics: Michaelis – Menton equation, Lineweaver-Burke equation and their derivations.</p> <p>Enzyme inhibitors and inhibition - Competitive, non-competitive, mixed and feedback inhibition Allosteric enzymes and regulatory enzymes.</p> <p>Applications of enzymes: Invertase, cellulase and amylase</p>	15 lectures
Unit II Metabolism of carbohydrates, lipids and amino acids	<p>Carbohydrate Catabolism Glycolysis, Krebs cycle, ED pathway, Pentose phosphate pathway with regulation and energy balance equation.</p> <p>Lipid catabolism: β, ω, and α oxidation of fatty acids; Oxidation of fatty acids with odd and even number of carbon atoms.</p> <p>Amino acid metabolism: Urea cycle, Mechanism of transamination, deamination and decarboxylation reactions with examples.</p>	15 lectures
Unit III Phosphorylation	<p>Oxidative phosphorylation and photophosphorylation: Oxidative phosphorylation: Electron transfer reactions in mitochondria, Electron acceptors, Electron flow from complexes I to V, ATP</p>	15 lectures

	synthesis, Inhibitors of ETC. Photophosphorylation: Light driven electron flow, Concepts of photosystems, Reaction centres, Cyclic and Non-cyclic photophosphorylation. Water splitting complex, ATP synthesis.	
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Course code	Title	Credits
USBT303	Genetics and Molecular Biology	2
Unit I DNA replication	DNA replication: Conservative, Semi-conservative and Dispersive. Messelson and Stahl's experiment Models of replication: Unidirectional, Bi-directional, Looped circle model, Rolling circle model. Enzymology of replication: Concepts of leading, lagging strands and Okazaki fragments. Initiation, elongation and termination of replication. Regulation of replication in prokaryotes and eukaryotes. Control of replication.	15 lectures
Unit II DNA mutation and repair	Mutations and Chromosomal aberrations: Definition and types. Mutagenesis and mutagens (Examples of physical, chemical and biological mutagens). DNA repair: Photoreversal, Base excision repair, Nucleotide excision repair, Mismatch repair, SOS repair, Recombination repair.	15 lectures
Unit III Genetic mapping in eukaryotes	Genetic mapping in eukaryotes: Genetic linkage, Gene recombination and Chromosomal exchange. Holliday model.	15 lectures

	<p>Construction of genetic maps: Tetrad analysis, Two point cross, Three point cross (with problems), Interference and Coincidence.</p> <p>Pedigree analysis (with problems)</p> <p>Human genetic traits.</p>	
Practicals		
Course code	Title	Credits
USBTP3	<ul style="list-style-type: none"> • Preparation and sterility checking of TAB vaccine. • Normal flora from skin and mouth (saliva, tooth tartar) • Flora from fomites. 	1
USBTP3	<ul style="list-style-type: none"> • Enzyme kinetics- Amylase: Effect of pH, temperature, substrate concentration and inhibitor concentration • Hill's reaction 	1
USBTP3	<ul style="list-style-type: none"> • Problems on gene mapping, tetrad analysis and pedigree analysis • Effect of mutagens (Colchicine and UV rays on mitotically active cells/ larval cells - Demonstration) • Isolation of antibiotic resistant mutants by replica plate technique • Estimation of DNA by Diphenylamine method 	1

Semester IV

Course code	Title	Credits
USBT401	Instrumentation and fermentation Technology	2
Unit I Instrumentation to fermentors	Introduction to fermentors Basic design and function of various parts (Stirred Tank Reactors). Sterilization: Maintenance of aseptic conditions (Media and fermentor) Inoculum development: Addition of inoculum, nutrients and other supplements. Types of fermentations – Significance and applications of batch and continuous, surface and submerged, aerobic and anaerobic, solid state fermentation.	15 lectures
Unit II	Microbial growth kinetics Phases of Growth curve. Direct and indirect methods of measuring growth, Mathematical nature and expression of growth, Efficiency of growth, Synchronous growth, Diauxic growth, Effect of environment and nutrient factors, Chemostat and Turbidostat.	15 lectures
Unit III Instrumentation	Chromatography- Principle, working and applications of Column, Paper and TLC Colorimeter and spectrophotometer - Principle, working and applications of colorimeter and UV- Visible spectrophotometer with types	15 lectures

Course code	Title	Credits
USBT402	Ecology and Environmental Biotechnology	2
Unit I Ecology and biodiversity	<p>Microbial Ecology Microorganisms and ecosystems, Microenvironment, Concepts of autecology, synecology, habitats, dispersal, colonization and succession. Biogeochemical cycles: Carbon, Nitrogen and Sulphur.</p> <p>Biotic interactions: Symbiosis, Syntrophy, Commensalism, Amensalism, Mutualism, Antagonism and Competition.</p> <p>Diversity of the microbial world: Introduction to Archea, Deinococci, Photosynthetic bacteria, Myxobacteria, Mollicutes, Actinomycetes and Eumycota.</p>	15 Lectures
Unit II Microbiology of air and soil	<p>Air Microbiology Introduction, Composition of air, number and kinds of microorganisms in air.</p> <p>Enumeration Impingement in liquid- Lemon Sampler and Kluyver and Visser, Impingement on solids, Impaction on solid surfaces - Hollaender sampler, Andersen air Sampler. Filtration, Sedimentation, Centrifugation, Electrostatic precipitation. Dust, Droplets and Droplet nuclei; Airborne diseases. Air Sanitation- Introduction, Suppression of dust, Effect of mists and sprays, Effect of UV light, Room sanitation.</p> <p>Soil Microbiology: Introduction, Nature of soil,</p>	15 Lectures

	<p>Microorganisms in soil and their functions. Rhizosphere, Rhizosphere effect.</p>	
<p>Unit III Microbiology of Water and waste water</p>	<p>Water and waste water microbiology Introduction, Microbiology of potable water supplies, Sanitation of water for domestic use, Preventive treatment, Sedimentation, Coagulation and Flocculation. Filtration – Slow sand filter, Rapid sand filter, Diatomite filter, Reverse osmosis. Disinfection of potable water, Bacteriological examination of drinking water - Index organisms of fecal pollution, other indicator organisms and their significance. Bacteriological analysis of water - Test for coliforms- MPN, Presumptive, Confirmed, Completed and IMViC, Standard Membrane filter technique. Sewage and its disposal:- Introduction and composition of sewage, Treatment of waste water - Single dwelling unit, Imhoff tank and Septic tank. Primary treatment - Physical or Mechanical. Secondary treatment – Chemical. Biological stabilization of sewage – Anaerobic process and Aerobic process. Sludge digestion and disposal; Tertiary treatment.</p>	<p>15 Lectures</p>

Course code	Title	Credits
USBT403	Molecular biology and Instrumentation	2
Unit I Transcription and post transcriptional modification	Gene expression: Transcription in prokaryotes: Initiation, elongation and termination. Transcription in eukaryotes: Promoters and enhancers, Initiation, elongation and termination. Processing of mature mRNA: 5' and 3' modifications, Spliceosomes, RNA editing.	15 lectures
Unit II Translational and post translational modification	Translation Nature and characteristics of genetic code, Wobble hypothesis. Process of translation: Initiation, elongation, translocation and termination, Post translational modifications, Protein sorting.	15 lectures
Unit III Instrumentation - Electrophoresis	Electrophoresis: General principles, support media: agarose and polyacrylamide gels. Electrophoresis of proteins and nucleic acids: PAGE - Native and SDS. Detection of proteins in gels. AGE.	15 lectures

Practicals		
Course code	Title	Credits
USBTP4	<ul style="list-style-type: none"> • Enumeration of microorganisms by pour plate method and spread plate method, • Growth curve of <i>E.coli</i>. (Turbidometry) • Breed's count • TLC of oils 	1

USBTP4	<ul style="list-style-type: none"> • Enrichment and isolation of Azotobacter, Rhizobium, Nitrifiers and Nitrosifiers. • Qualitative and quantitative analysis of air microflora - solid impaction method. • MPN of water sample - presumptive, confirmed and completed tests. • Isolation of organisms from raw and treated sewage. 	1
USBTP4	<ul style="list-style-type: none"> • Extraction of genomic DNA from plant source. • Agarose gel electrophoresis of genomic DNA • Protein estimation by Folin-Lowry • PAGE-Demonstration 	1

Reference Books

Title	Author	Publisher
Medical Microbiology	Ananthnarayan 8th edition	Orient Longman
Immunology	C V Rao	Narosa Publishing House
Foundations In Microbiology	Talaro and Talaro 3rd edition	W.C Brown Publishers
Textbook of Microbiology	Pelczar, Kreig and Chan	Tata Mc Graw Hill
Biotechnology expanding horizons	BD Singh	Kalyani Publishers
Modern Industrial Microbiology and Biotechnology	Nduka Okafor	Science Publishers
Principles of Biochemistry	Lehninger, Nelson and Cox 4th edition	WH Freeman & co
Biochemistry	Voet & Voet 3rd edition	John Wiley & sons
Fundamentals of Ecology	Odum and Barrett	Cengage Learning
Essential Igenetics	Peter Russell	Pearson Education
Industrial Microbiology	L.E.Casida	John Wiley & sons
Microbiology in Health and Disease	Frobisher WB	Saunders and Company
Principles of fermentation technology	P.F.Stanbury and A. Whitaker 2nd edition	Elsevier
Principles of genetics	Gardner, Simmons and Snudstad	John Wiley & sons
General Microbiology	Roger Y. Stanier 5th edition	Prentice-Hall of India
Bioinstrumentation	L. Veerakumari	MJP Publishers
Biochemistry and Molecular Biology	Keith Wilson and John Walker 6th edition	Cambridge University Press
Microbiology	Prescott Harley and Klein 5ed	Mc Graw Hill
Microbiology- Dynamics and Diversity	Perry and Stanley	Saunders College
Microbial Ecology- Fundamentals and applications	Atlas and Bartha	Benjamin Cummings
Fundamentals Principles of Bacteriology	Salle, A.J	Tata Mc Graw Hill
Biophysical chemistry	Upadhyay Upadhyay and Nath	Himalaya Publishing House

