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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 2012–2013)

S.Y.B.Sc. Biotechnology Syllabus

Credit Based and Grading System

To be implemented from the Academic year 2012-2013

SEMESTER III

Course Code	UNIT	TOPICS	Credits	L / Week
USBT 301	I	Microbial growth kinetics Biotechnology Medical Applications	2	1
	II	Microbiology of Air Microbiology of Water		1
	III	Fermenter and media Sterilization		1
USBT 302	I	Chromosomal basis of inheritance, sex linkage Genetic Recombination	2	1
	II	Replication of DNA DNA damage and repair		1
	III	Study of chromosomes Gene mutation		1
USBT 303	I	Enzymes Enzyme regulation	2	1
	II	Catabolism Amino acid metabolim		1
	III	Chromato-graphy Colorimeter		1
USBT P3	Practicals based on both courses in theory		3	9

SEMESTER IV

Course Code	UNIT	TOPICS	Credits	L / Week
USBT 401	I	Biotechnology Medical Applications Virology	2	1
	II	Microbiology of Waste Water Microbiology of Soil		1
	III	Types of fermentor Industrial Microbiology		1
USBT 402	I	Genetic Tools Genetic mapping in eukaryotes	2	1
	II	Transcription Translation		1
	III	Determination of sex Non Mendellian genetics		1
USBT 403	I	Bioenergetics Vitamins and Coenzymes	2	1
	II	Oxidative and reductive phosphorylation Photophosphorylation		1
	III	Microscope Electrophoresis		1
USBT P4	Practicals based on both courses in theory		3	9

Course Code	Title	Credits
USBT 301	Microbiology, Environmental Biotechnology, Industrial Biotechnology	2 Credits (45 lectures)
Unit I :	<p>Microbial growth kinetics Definition of growth, Growth curve - 4 phases, Measurement of growth-direct and indirect methods, Mathematical nature and expression of growth, calculation of generation time, Efficiency of growth, Growth yield, Synchronous growth, Effect of nutrients concentration, Continuous culture, arithmetic growth, Diauxic growth</p> <p>Biotechnology Medical Applications Diagnostics- Introduction, medical and diagnostic products: Diagnostic kits, DNA probe and Monoclonal antibodies as diagnostic tools and application. Preventive-Vaccines-Introduction, types and application</p>	15 Lectures
Unit II :	<p>Microbiology of Air The atmosphere, Aeromirobiological pathway, Number and kind of microorganism in air. Airborne diseases, Dust, droplet and droplet nuclei, Sampling, Quantitative and qualitative methods for enumeration of bacteria in air, Air sanitation (chemical and physical methods) Biosafety in laboratory.</p> <p>Microbiology of Water Introduction to hydrosphere environment its distribution on the planet, its diversity, scope of study, water as a valuable limiting resource for human development. Introduction to aquatic microbiology- Distribution of aquatic environment (fresh water, ground water, springs, rivers, ponds, lakes, brackish water, marine) their characteristic ecological features. Types of microorganisms. Microbiology of potable water a. Introduction-Definition and characteristics of potable water, standards for potable water, demand and use of potable water, various sources of potable water available, water borne diseases. b. Methods of purification of water-Types of impurities encountered</p>	15 Lectures

	<p>and treated, general steps in municipal water treatment, principle behind each steps, its working and significance, other methods for small scale/domestic purification based on filtration, chlorination, iodine treatment, UV treatment, reverse osmosis their advantages and limitation, various commercial equipment.</p> <p>c. Analysis of Potable water-List of physical, chemical and biological parameters analyzed.</p> <p>d. Microbiological analysis of drinking water- concept of microbiologically safe drinking water, concept of indicator organism of fecal pollutions, different indicator organism used/ proposed for this purpose, their advantages and limitations, Methods of detecting faecal pollution of drinking water , routine analysis steps, their interpretation, inferences its causes and correction, significance and limitations. Methods of detecting other nuisance bacteria-iron, sulphur and slime producers.</p>	
<p>Unit III :</p>	<p>Fermenter and media</p> <p>Basic design of a fermentor-baffles, spargers, impeller.</p> <p>Media composition – Water, energy sources, carbon, nitrogen, minerals, growth factors, buffers, precursors, inducers, antifoams.</p> <p>Inoculum and production media</p> <p>Sterilization</p> <p>Media sterilization, Sterilization of fermentor, Sterilization of feed, Sterilization of liquid wastes Filter sterilization</p>	<p>15 Lectures</p>

Course Code	Title	Credits
USBT 302	Inheritance Pattern, Molecular Biology, Genetics	2 Credits (45 lectures)
Unit I :	<p>Chromosomal basis of inheritance, sex linkage Chromosome theory of inheritance, Sex chromosome, Sex linkage, X linked inheritance Gene and chromosome segregation in meiosis, Non disjunction Analysis of sex related traits in humans</p> <p>Genetic Recombination Mechanisms of Recombination – breakage and reunion, breakage & copying, complete copy choice. Types of Recombination – General, Holliday model</p>	15 Lectures
Unit II :	<p>Replication of DNA Semiconservative mode of replication, Messelsons and Stahls experiment; Enzymology of DNA synthesis Initiation, elongation, termination of replication Types of replication – Semi discontinuous, Rolling circle, Bidirectional, looped rolling circle. Replication in Eukaryotes.</p> <p>DNA damage and repair Photoreversal, Excision repair, Recombinational repair, SOS repair.</p>	15 Lectures
Unit III :	<p>Study of chromosomes Structure and shapes of metaphase chromosomes histone, non histone proteins Nucleosome and packing of DNA into chromosome Chromosome banding, karyotype analysis Study of normal human karyotype Study of genetic abnormalities – Turner syndrome, Klinefelter syndrome, Down syndrome, Cri-du-chat, Philadelphia chromosome.</p> <p>Gene mutation Detection of mutation in - bacteria, viruses, Neurospora, Drosophila, Humans. Reverse mutations. Mutation rate</p>	15 Lectures

Course Code	Title	Credits
USBT 303	Biochemistry, Metabolism, Instrumentation	2 Credits (45 lectures)
Unit I :	<p>Enzymes Working of Enzymes Concept of activation energy, transition state. Concept of optimum conditions – pH, temperature, enzyme concentration & substrate concentration Enzyme kinetics – Michaelis Menton equation, derivation, Lineweaver Burk equation, Haldane equation. Enzyme inhibition – competitive, noncompetitive, uncompetitive, mixed inhibition, feed back inhibition with suitable example.</p> <p>Enzyme regulation Enzyme regulation – allosteric enzymes Isoenzymes with suitable examples Concept of turnover number Difference between synthase and synthetase</p>	15 Lectures
Unit II :	<p>Catabolism Carbohydrates – Glycolysis, TCA, with energy yield and brief regulation. Lipid – Digestion by GI enzymes and breakdown of triacylglyceride.; α, β, ω oxidation of fatty acids; odd and even fatty acid</p> <p>Amino acid metabolim Amino acids – decarboxylation, deamination (oxidative and non-oxidative), transamination with mechanism; Urea cycle; fate of amino acids (Connection to TCA)</p>	15 Lectures
Unit III :	<p>Chromato-graphy Principles of chromatography, column, paper chromatography, TLC with application.</p> <p>Colorimeter Beer Lambert's law, construction working and application of simple colorimeter</p>	15 Lectures

Course Code	Title	Credits
USBT P3 (301)	Microbiology, Environmental Biotechnology, Industrial Biotechnology <ol style="list-style-type: none"> 1. Qualitative and quantitative analysis of air flora by solid impaction method. 2. Sterilization and sanitization effect of UV radiation. 3. Routine analysis of potable water 4. Enrichment of <i>Clostridia</i>, <i>Streptococci faecalis</i>. 5. Growth curve by Optical density 	1
USBT P3 (302)	Inheritance Pattern, Molecular Biology, Genetics <ol style="list-style-type: none"> 1. Karyotype analysis 2. Study of Drosophila for mutation 3. Gradient plate technique 4. Isolation of antibiotic resistant mutants by replica plate technique. 5. Isolation of genomic DNA 	1
USBT P3 (303)	Biochemistry, Metabolism, Instrumentation <ol style="list-style-type: none"> 1. Study of Beer and Lambert's law and absorption maxima 2. Standard curve using glucose by DNSA. 3. Enzyme kinetics- Amylase: pH, Temp. , substrate conc., enzyme conc., and effect of inhibitor (copper sulphate) 4. Chromatography of amino acids and sugars 5. TLC of fatty acids. 	1

Course Code	Title	Credits
USBT 401	Microbiology, Environmental Biotechnology, Industrial Biotechnology	2 Credits (45 lectures)
Unit I :	<p>Biotechnology Medical Applications Preventive- Vaccination, principles of vaccine preparation, history, killed vaccine (TAB), attenuated vaccine (BCG, Sabin, Salk), polysaccharide (Hib), toxoid, limitation to current mode of vaccine production, route of administration and side effect of vaccines. Hormones – Insulin, human growth hormone, somatostatin, erythropoietin. Microbial enzymes – medical uses.</p> <p>Virology Structure of viruses - Bacteriophage, Animal viruses - Small pox, Influenza, Plant viruses-TMV, CMV Classification and Enumeration Cultivation - Plant, Animal and Bacterial viruses Life cycle of Bacterial Viruses – T-4, Lambda</p>	15 Lectures
Unit II :	<p>Microbiology of waste water- a. Definition, source, types and composition of waste water, domestic sewage and industrial waste water. Impact of waste water on environment, need and objective of processing, obligatory/legal responsibility. b. Methods of analysis of waste water- Std. parameters for physical, chemical and biological analysis, microbiological analysis, rationales and methods, their significance and limitations. c. Treatment of waste water- Objectives of waste water treatment and uses of treated water. General steps used in domestic/ municipal/industrial waste water treatment, principle behind each step, its working and significance d. Primary treatment: (Chemical/Physical) sedimentation, screening, coagulation, flocculation, dilution, neutralization, equalization etc. Secondary treatment: (Biological/ biochemical) Activated sludge process, Trickling filters, anaerobic filters, sludge digestion, Aerated lagoons, Algal ponds, Evapo- transpiration system.</p>	15 Lectures

	<p>Tertiary treatment-clarification, disinfections- Disposal of treated water and sludge methods, Imhoff tank, septic tank.</p> <p>Microbiology of Soil</p> <p>Introduction, Physical and chemical properties of soil.</p> <p>Microbial flora of soil</p> <p>Methods used for isolation and studying soil flora-Winogradsky's column.</p> <p>Rhizosphere flora- definition of Rhizosphere, rhizosphere effect, associative and antagonistic effect of rhizosphere, root exudates.</p> <p>Biogeochemical cycles- carbon, nitrogen and sulfur.</p> <p>Nitrogen fixation- symbiotic and non-symbiotic.</p> <p>Nitrification and Denitrification.</p>	
<p>Unit III :</p>	<p>Types of fermentor</p> <p>Introduction to-Batch and Continuous fermentation</p> <p>Surface and submerged fermentation</p> <p>Aerobic and Anaerobic fermentation</p> <p>Solid state fermentation.</p> <p>Industrial Microbiology</p> <p>Introduction to screening-Primary and secondary</p> <p>Preservation</p> <p>Strain development- general, mutation, selection of mutants, recombination, regulation (one example of each)</p>	<p>15 Lectures</p>

Course Code	Title	Credits
USBT 402	Inheritance Pattern, Molecular Biology, Genetics	2 Credits (45 lectures)
Unit I :	<p>Genetic Tools Tetrad analysis, problems; Pedigree analysis, problems</p> <p>Genetic mapping in eukaryotes Discovery of genetic linkage, Crossing over, Mapping of chromosome using three point cross.</p>	15 Lectures
Unit II :	<p>Transcription Initiation, elongation and termination, RNA polymerase in E. coli, Transcription in eukaryotes, Post transcriptional processing, Reverse transcription.</p> <p>Translation Properties of genetic code, Aminoacylation of Trna, Translation process</p>	15 Lectures
Unit III :	<p>Determination of sex Genetic control of sex determination in hermaphrodite animals Monoecious and diecious plants Chromosomal mechanism of sex determination – XX-XO, XX-XY and ZW methods Haplodiploidy, Gene balance theory, Environmental control of sex determination – Bonelia, Crepidula Hormonal control of sex determination, sex reversal, Freemartin cattle, sex chromatin – barr body</p> <p>Non Mendellian genetics Origin of mitochondria and chloroplast, Rules and examples of non mendelian inheritance Mutant of neurospora; Yeast Genetics of Chlamydomonas Mitochondrial DNA defects, maternal effects.</p>	15 Lectures

Course Code	Title	Credits
USBT 403	Biochemistry, Metabolism, Instrumentation	2 Credits (45 lectures)
Unit I :	<p>Bioenergetics Laws of thermodynamics, Concept of enthalpy, Entropy Free energy with relation to living system. Standard free energy change and equilibrium constant Energy rich compounds – ATP as energy currency Structure of ATP hydrolysis, Other energy rich compounds other than ATP.</p> <p>Vitamins and Coenzymes Vitamin A, D, E, K – structure, function Water soluble vitamins – function and gross structure – thiamine, riboflavin, folic acid, pyridoxine, B-12, niacin, pantothenic acid, biotin, Vitamin C, lipoic acid.</p>	15 Lectures
Unit II :	<p>Oxidative and reductive phosphorylation ETC –Concept of redox potential Electrochemical gradient Electron flow from complexes I – V (in brief) Inhibitors of ETC; Reductive TCA</p> <p>Photophosphorylation Photophosphorylation – photosystems, reaction centers, pigments, cyclic and non cyclic photophosphorylation, Z pathway Comparison of oxidative and reductive phosphorylation</p>	15 Lectures
Unit III :	<p>Microscope Principle, working and applications of - Confocal microscope Fluorescent microscope, TEM, SEM</p> <p>Electrophoresis Principle, factors involved in electrophoresis, types. Types of electrophoresis – moving boundary, zone, paper, gel, PAGE Application in biotechnology</p>	15 Lectures

Course Code	Title	Credits
<p style="text-align: center;">USBT P4 (401)</p>	<p>Microbiology, Environmental Biotechnology, Industrial Biotechnology</p> <ol style="list-style-type: none"> 1. Study Winogradsky's column 2. Analysis of raw and treated sewage 3. Determination of soil pH 4. Contact Slide method 5. Isolation of <i>Rhizobium</i> from root nodules 6. Isolation of <i>Azotobacter</i> 7. Isolation of nitrifying organism. 8. Study of blue green algae 	<p>1</p>
<p style="text-align: center;">USBT P4 (402)</p>	<p>Inheritance Pattern, Molecular Biology, Genetics</p> <ol style="list-style-type: none"> 1. Pedigree analysis 2. Problems on gene mapping 	<p>1</p>
<p style="text-align: center;">USBT P4 (403)</p>	<p>Biochemistry, Metabolism, Instrumentation</p> <ol style="list-style-type: none"> 1. Extraction and separation of plant pigment by paper chromatography 2. Hill reaction 3. Study of Absorption spectrum of plant pigment 4. Estimation of Vitamin C by iodometry 5. Agarose gel electrophoresis of DNA 6. Polyacrylamide gel electrophoresis. –demonstration 	<p>1</p>