



The Kelkar Education Trust's
V. G. Vaze College of Arts, Science and Commerce (Autonomous)
Affiliated to University of Mumbai
(Re Accredited by NAAC with Grade A)

Revised Syllabus for SYBSc Biotechnology
Semester III & IV
Based on NEP-2020 Guidelines

To Be Implemented From
Academic Year 2024-25

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SYBT Sem III

MAJOR	VGUVFSBMCB301	CELL BIOLOGY
MAJOR	VGUVFSBMMB301	MOLECULAR BIOLOGY
MAJOR	VGUVFSBMCBP301	PRACTICALS OF CELL BIOLOGY
MAJOR	VGUVFSBMMBP301	PRACTICALS OF MOLECULAR BIOLOGY
MINOR	VGUVFSBNI301	IMMUNOLOGY
MINOR	VGUVFSBNIP301	PRACTICALS OF IMMUNOLOGY
Open Electives	VGUVUOE	ENVIRONMENTAL STUDIES- I
VSEC	VGUVFSBVSE301	BIOPROCESS TECHNOLOGY
ABILITY ENHANCEMENT COURSE	VGUVFAE301	MARATHI- I / HINDI- I
FP	VGUVFP301	FIELD PROJECT
CC	VGUVUCC	

SYBT Sem IV

MAJOR	VGUVFSBMB401	BIOCHEMISTRY
MAJOR	VGUVFSBMMB401	MEDICAL BIOTECHNOLOGY
MAJOR	VGUVFSBMBP401	PRACTICALS OF BIOCHEMISTRY
MAJOR	VGUVFSBMMBP401	PRACTICALS OF MEDICAL BIOTECHNOLOGY
MINOR	VGUVFSBNBN401	INTRODUCTION TO BIOINFORMATICS & NANOTECHNOLOGY
MINOR	VGUVFSBNBNP401	PRACTICALS OF BIOINFORMATICS & NANOTECHNOLOGY
Open Electives	VGUVUOE	ENVIRONMENTAL STUDIES- II
VSEC	VGUVFSBVSE401	ENTREPRENEURSHIP DEVELOPMENT
ABILITY ENHANCEMENT COURSE	VGUVFAE401	MARATHI- II / HINDI- II
COMMUNITY ENGAGEMENT	VGUVCEP	COMMUNITY ENGAGEMENT
CC	VGUVUCC	

Course Code	Title	Credits	No. of lectures
	CELL BIOLOGY AND CYTOGENETICS	2	
UNIT I Cytoskeleton	<p>Cytoskeleton : Overview of the Major Functions of Cytoskeleton. Microtubules: Structure and Composition. MAPs: Functions- Role in Mitosis, Structural Support and Cytoskeleton Intracellular Motility. Motor Proteins: Kinesins, Dynein; MTOCs. Dynamic Properties of Microtubules. Microtubules in Cilia and Flagella. Microfilaments: Structure, Composition, Assembly and Disassembly.</p>		15
UNIT II Cell Membrane & Cytogenetics	<p>Cell Membrane : Uptake of Nutrients by Prokaryotic Cells; Cell Permeability. Principles of Membrane Transport- Transporters and Channels; Active Transport, Passive Transport; Types of Transporters; Types of ATP Driven Pumps - Na⁺ K⁺ Pump. Cell Junctions; Cell Adhesion and Extracellular Material Microvilli; Tight Junctions, Gap Junctions; Cell Coat and Cell Recognition. Cellular Interactions.</p> <p>Cytogenetics : Structure of Chromosome - Heterochromatin, Euchromatin, Polytene Chromosomes.</p> <p>Variation in Chromosomal Structure and Number : Deletion, Duplication, Inversion, Translocation, Aneuploidy, Euploidy and Polyploidy and Syndromes- Klinefelter, Turner, Cri-du-Chat, Trisomy -21, Trisomy 18 and Trisomy 13.</p>		15

	Title	Credits	No. of Lectures
	MOLECULAR BIOLOGY	2	
UNIT I Gene Expression- Transcription	<p>Gene Expression- an Overview.</p> <p>Transcription Process in Prokaryotes : RNA Synthesis; Promoters and Enhancers; Initiation of Transcription at Promoters; Elongation and Termination of an RNA Chain.</p> <p>Transcription in Eukaryotes : Eukaryotic RNA Polymerases; Eukaryotic Promoters; Transcription of Protein Coding Genes by RNA Polymerase; Eukaryotic mRNA's; Transcription of other genes; Spliceosomes; RNA editing.</p>		15
UNIT II Gene Expression- Translation & Operons	<p>Nature of Genetic Code.</p> <p>Wobble Hypothesis.</p> <p>Translation : Process of Protein Synthesis (Initiation, Elongation, Translocation, Termination);</p> <p>Post Translation Modifications.</p> <p>Protein sorting.</p> <p><i>In Bacteria :</i> <i>lac</i> Operon of <i>E.coli</i>; <i>trp</i> Operon of <i>E.coli</i>.</p> <p><i>In Viruses :</i> Lytic / Lysogenic Regulation</p>		15

Course Code	Title	Credits	No. of lectures
	IMMUNOLOGY	2	
UNIT I Effectors of Immune Response	<p>Haematopoiesis; Cells of the Immune System; Primary and Secondary Lymphoid Organs.</p> <p>Complement System- Classical, Alternate and Lectin; Regulation and Biological Effects of Complement System; Deficiencies of Complement System</p> <p>T-cell Receptor Complex : Structure and Activation.</p> <p>MHC Classes - General Organization and Inheritance; Structures and Peptide Interactions; Class I and II Diversity and Polymorphism; Antigen Presentation - Endocytic and Exocytic Pathways; MHC Restriction.</p> <p>B-cell Receptor : Structure, Maturation and Activation</p> <p>B-T Cell Interaction (B-T cell Cooperation).</p>		15
UNIT II Immuno- Techniques	<p>Precipitation Reactions :</p> <p>Immunoprecipitation, Immunoelectrophoresis, CIEP, Rocket Electrophoresis and 2-D Immunoelectrophoresis.</p> <p>Agglutination Reactions :</p> <p>Passive, Reverse Passive, Agglutination Inhibition.</p> <p>Coomb's Test; Complement Fixation Tests, RIA, ELISA, ELISPOT, Chemiluminescence, Western Blot, Immunofluorescence, Flow Cytometry.</p>		15

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Course Code	Title	Credits	No. of Lectures
	BIOPROCESS TECHNOLOGY	2	
UNIT I Microorganisms in Industrial Processes	<p>Types of Microorganisms used in Industrial Processes: Bacteria, Actinomycetes, Fungi and Algae.</p> <p>Screening and Maintenance of Strains: Primary Screening and Secondary Screening; Cultivation; Preservation of Industrially Important Microbial Strains. Inoculum development. Bioavailability and Bioequivalence Studies</p>		15
UNIT II Fermenter and Fermentation Processes	<p>Design of a fermenter: Stirred Tank Fermenter- Basic Design; Parts of a Typical Industrial Fermenter.</p> <p>Fermentation Media: Components; Design and Optimization.</p> <p>Sterilization: Sterilization of Fermenter and Fermentation Media.</p> <p>Process Parameters: <i>pH</i>, Temperature, Aeration, Agitation, Foam, etc.</p> <p>Types of Fermentation: Surface and Submerged; Batch and Continuous, Aerobic and Anaerobic.</p> <p>Product Isolation and Purification.</p> <p>Study of Representative Fermentation Processes: Outline of Penicillin and Ethanol Production by Fermentation along with a <i>flow-diagram</i>.</p>		15

Course Code	Title	Credits	No. of Lectures
SBT401	BIOCHEMISTRY	2	
UNIT I Carbohydrate Metabolism, ETS and Energy Rich Compounds	<p>Carbohydrate Metabolism: Glycolytic Pathway and its Regulation, Homolactic Fermentation; Alcoholic Fermentation; Energetics of Fermentation; Citric Acid Cycle and its Regulation; Gluconeogenesis; Pentose Phosphate Pathway; Glyoxalate Pathway; Reductive TCA. (Sequence of Reactions, Regulation, Energy Yield and Metabolic Disorders of the above Pathways)</p> <p>Electron Transport System: Electron Transport and Oxidative Phosphorylation. Inhibitors of ETS.</p> <p>Energy Rich Compounds: ATP as Energy Currency, Structure of ATP, Hydrolysis, Other Energy Rich Compounds other than ATP like PEP, Creatine Phosphate, etc.</p>		15
UNIT II Metabolism of Aminoacids, Lipids & Nucleotides	<p>Amino Acid Breakdown: Deamination, Transamination, Urea Cycle, Breakdown of Glucogenic and Ketogenic Amino Acids.</p> <p>Lipid Metabolism: Mobilization, Transport of Fatty Acids. Beta, Alpha and Omega Oxidation of Saturated Fatty Acids; Oxidation of Unsaturated Fatty Acids; Oxidation of Odd Chain Fatty Acids.</p> <p>Nucleotide Metabolism: Degradation of Purines and Pyrimidines.</p>		15

Course Code	Title	Credits	No. of lectures
	MEDICAL BIOTECHNOLOGY	2	
UNIT I Infectious Diseases	<p>Host Parasite Relationship: Normal Flora; Factors Affecting the Course of Infection and Disease; Mechanisms of Infection and Virulence Factors.</p> <p>Infection: Patterns of Infection; Types of Infections; Signs and Symptoms; Epidemiology and Epidemiological Markers.</p> <p>Diseases: Origin of Pathogens; Vectors; Acquisition of Infection; Koch's Postulates.</p> <p>Skin: <i>S. aureus.</i></p> <p>Respiratory Tract Infections: <i>M. tuberculosis</i></p> <p>Urinary Tract Infections: <i>E.coli</i></p> <p>GI Tract Infections: <i>Salmonella and Shigella spp</i></p> <p>Sexually Transmitted Diseases: Syphilis and Gonorrhoea.</p> <p>Nosocomial Infections: <i>Ps. Aeruginosa</i></p>		15
UNIT II Basics of Molecular Diagnostics	<p>Introduction to Molecular Diagnostics: Overview of Molecular Diagnostics; History of Molecular Diagnostics; Molecular Diagnostics in Post Genomic Era; Areas used in Molecular Diagnostics; Future Prospects - Commercialising Molecular Diagnostics, Personalized Medicine, Theranostics.</p> <p>Characterisation and analysis of Nucleic – Acids and Proteins: Extraction, Isolation and Detection of DNA, RNA and Proteins; Restriction Endonucleases and Restriction Enzyme Mapping.</p> <p>Hybridisation Techniques: Southern, Northern, Western and FISH; Markers, Probes and its Clinical Applications</p> <p>PCR: General Principle; Components of a Typical PCR Reaction; Experimental Design.</p>		15

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Course Code	Title	Credits	No. of Lectures
	BIOINFORMATICS and NANOTECHNOLOGY	2	
UNIT I Introduction to Computers and Biological Databases	<p>Computer Basics : Organization of a Computer; I/O Units; Computer Memory; Processor; Binary Arithmetic; Logic Circuit; Architecture; Operating System.</p> <p>Internet Basics : Connecting to the Internet, E-mail, FTP, www, Difference between www and Internet.</p> <p>Biological Databases : Classification of Databases - Raw and Processed Databases; Primary (NCBI), Secondary (PIR) and Tertiary or Composite (KEGG) Databases; Structure and Sequence Databases. Specialized Databases - Protein Pattern Databases; Protein Structure and Classification Databases (CATH/SCOP).</p> <p>Genome Information Resources: DNA Sequence Databases Specialized Genomic Resources. Protein Databases based on Composition, Motifs and Patterns.</p> <p>Protein Structure Visualization Software.</p>		15
UNIT II Nanotechnology	<p>Nanomaterials : Introduction to Nanomaterials. Forms of Nanomaterials : Nanoparticles, Nanofilms and Nanotubes Synthesis and Characterization of Nanomaterials. Applications of Nanomaterials.</p>		15

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Course Code	Title	Credits	No. of Lectures
SBT407	ENTERPRENEURSHIP DEVELOPMENT	2	
UNIT I Introduction to Entrepreneurship Development	Concept of Entrepreneur; Entrepreneurship; Need and Importance; Factors Influencing Entrepreneurship; Essentials of a Successful Entrepreneur; Location of Enterprise; Financial Planning; Role of Government and Financial Institutions in Entrepreneurship Development		15
UNIT II Setting-up of an Enterprise and Planning	Project Planning and Formulation; Project Feasibility Assessment; Preparation of a Business Plan, Market Research, Marketing Plan for an Entrepreneur		15
Internal Evaluation	Submission and Presentation of Business Proposal for any Biotechnological Product/ Enterprise		

PRACTICALS

SEMESTER III		
Course code	Title	Credits
(PRACTICALS Based on Cell biology)	<ol style="list-style-type: none"> 1. Extraction of plant genomic DNA and Separation by Agarose Gel Electrophoresis. 2. Determination of Purity of DNA using UV Spectrophotometry. 3. Study of Chromosomal Aberrations- Deletion, Duplication, Inversion, Translocation and Syndromes- Trisomy 21 Trisomy 13 Trisomy 18, Klinefelter, Turner and Cri-du-Chat. 4. Induction of Polyploidy by PDB Treatment using Suitable Plant Material. 5. Study of Polytene Chromosomes. 6. Mapping based on Tetrad Analysis and Three Point Cross. 7. Pedigree Analysis- Autosomal and Sex-Linked. 	2
Course code	Title	Credits
(PRACTICALS based on Molecular Biology)	<ol style="list-style-type: none"> 1. Study of <i>E.coli</i> Diauxic Growth Curve- (Lactose and Glucose). 2. Study of <i>lac</i> Gene Expression using Blue-White Selection. 3. Expression of β-galactosidase and Measurement of Activity. 4. Characterization of expressed protein using SDS-PAGE. 5. Isolation of RNA from yeast. 6. Isolation of coliphages from sewage. 	2

Course code	Title	Credits
(PRACTICALS based on Immunology & Bioprocess Technology)	<ol style="list-style-type: none"> 1. Complement Fixation Test (CFT). 2. Passive Agglutination- RA Factor Test. 3. Immunoelectrophoresis. 4. Ouchterlony test. 5. DOT-ELISA. 6. Flow Cytometry - Lab Visit. 7. Screening for an Antibiotic Producing Strain of Microorganism. 8. Screening for an Alcohol Producing Strain of Microorganism. 9. Lab Scale Production of Ethanol. 10. Purification of Ethanol from Broth Culture of <i>Saccharomyces spp.</i> by Distillation. 11. Estimation of <i>Penicillin</i> from Recovered Broth by Biological 	2+2

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	(Bioassay) Method. 12. Estimation of Alcohol from Recovered Broth by Dichromate Method.	
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PRACTICALS

SEMESTER IV		
Course code	Title	Credits
(PRACTICALS Based on Biochemistry)	<ol style="list-style-type: none"> 1. Determination of Lactate Dehydrogenase (LDH) Activity in Blood Serum. 2. Determination of Total, LDL and HDL Cholesterol in Serum. 3. Organ Function Tests: Liver (SGPT, SGOT); Kidney (Urea from Serum). 4. Estimation of Uric Acid in Urine. 5. Estimation of Creatinine in Urine 6. Qualitative Detection of Ketone Body in Urine. 7. Isolation of Mitochondria and Demonstration of ETC using a Marker Enzyme. 	2
Course code	Title	Credits
(PRACTICALS based on Medical Biotechnology)	<ol style="list-style-type: none"> 1. Identification of <i>S.aureus</i>-Isolation, Catalase, Coagulase Test. 2. Identification of <i>E.coli</i>-Isolation, Sugar Fermentations, IMViC. 3. Identification of <i>Salmonella</i>- Isolation, Sugar Fermentations, TSI Slant. 4. Identification of <i>Shigella</i>- Isolation, Sugar Fermentations, TSI Slant. 5. RPR Test (Kit Based). 6. Permanent Slide- <i>Mycobacterium</i>. 7. Isolation, Quantitative Analysis and AGE of Genomic DNA from Bacteria. 8. Restriction Enzyme Digestion. 9. Restriction Mapping. 10. Primer Designing through Open Online Source NCBI- BLAST. 11. DNA Amplification – PCR. 	2

Course code	Title	Credits
(PRACTICALS based on Bioinformatics & Nanotechnology)	<ol style="list-style-type: none"> 1. Familiarization with NCBI, EMBL, DDBJ, PIR, KEGG Databases. 2. Use of NCBI BLAST Tool. 3. Pairwise and Multiple Sequence Alignment and Phylogeny. 4. Classification of Proteins using CATH/SCOP. 5. Visualization PDB Molecules using Rasmol/Raswin. 	2

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	<ol style="list-style-type: none">6. Chemical Synthesis of Silver Nanoparticles.7. Biological Synthesis of Silver Nanoparticles.8. Characterisation of Silver Nanoparticles by UV- VIS Spectrophotometer.	
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Course code	Title	Credits	
SBTP303	<ol style="list-style-type: none">1. Study of <i>E.coli</i> Diauxic Growth Curve- (Lactose and Glucose).2. Study of <i>lac</i> Gene Expression using Blue-White Selection.3. Expression of β-galactosidase and Measurement of Activity.4. Screening for an Antibiotic Producing Strain of Microorganism.5. Screening for an Alcohol Producing Strain of Microorganism.6. Lab Scale Production of Penicillin (Static and Shaker).7. Purification of <i>Penicillin</i> from Broth Culture of <i>Penicillium spp.</i> by Solvent Extraction.8. Lab Scale Production of Ethanol.9. Purification of Ethanol from Broth Culture of <i>Saccharomyces spp.</i> by Distillation.10. Estimation of <i>Penicillin</i> from Recovered Broth by Chemical (Iodometric) Method.11. Estimation of <i>Penicillin</i> from Recovered Broth by Biological (Bioassay) Method.12. Estimation of Alcohol from Recovered Broth by Dichromate Method.	2	