Mahatma Education Society's

Pillai College of Arts, Commerce & Science (Autonomous)

Affiliated to University of Mumbai

New Panvel

Syllabus for S. Y. B.Sc. Semester IV
Program: B.Sc. Biotechnology

(Semester based Credit and Grading system for the academic year 2019-20)

S. Y. B. Sc Biotechnology

Semester IV						
Course Code	**Course Type**	**Course Title**	**Theory/ Practical**	**Marks**	**Credits**	**Lectures /Week**
PUSBT401	Core	Biochemistry	Theory	100	2	3
PUSBT402	Core	Applied Chemistry II	Theory	100	2	3
PUSBT403	Core	Medical Microbiology	Theory	100	2	3
PUSBT404	Core	Environmental Biotechnology	Theory	100	2	3
PUSBT405	Core	Bioinformatics and Biostatistics	Theory	100	2	3
PUSBT406	Core	Molecular Diagnostics	Theory	100	2	3
PUSBT407	Core	Entrepreneurship Development	Theory	100	2	3
PUSBT408P	Core	Practical (PUSBT401 + PUSBT402)	Practical	100	2	6
PUSBT409P	Core	Practical (PUSBT403 + PUSBT404)	Practical	100	2	6
PUSBT410P	Core	Practical (PUSBT405 + PUSBT406)	Practical	100	2	6
Total				1000	20	39

Theory

BOS	Biotechnology
Class	S. Y. B. Sc
Semester	IV
Subject Name	Biochemistry
Subject Code	PUSBT401
Level of Subject	Basic

Objectives:

To gain an insight into the Metabolic Processes associated with

1. Catabolism of Carbohydrates
2. Catabolism of Amino Acids
3. Catabolism of Lipids and Nucleotides.

Unit No.	**Name of Unit**	**Topic No.**	**Name of Topic**	**Number of Lectures**
I	Carbohydrate Metabolism, ETS and Energy Rich Compounds	1.1	Glycolytic Pathway and its Regulation, Homolactic Fermentation; AlcoholicFermentation; 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)	15
		1.2	Electron Transport System : Electron Transport and Oxidative Phosphorylation. Inhibitors of ETS.	
		1.3	Energy Rich Compounds **:**ATP as Energy Currency, Structure of ATP, Hydrolysis, Other Energy Rich Compounds other than ATP like PEP, Creatine Phosphate, etc.	
II	Amino Acid Metabolism	2.1	Deamination, Transamination, Urea Cycle, Breakdown of Glucogenic and KetogenicAmino Acids	15
		2.2	Amino Acids as Biosynthetic Precursors: Biosynthesis of Epinephrine, Dopamine,Serotonin, GABA, Histamine, Glutathione	
		2.3	Metabolic Disorders :Tyrosinemia, Albinism, Alkaptonuria, Phenylketonuria	
III		3.1	Mobilization of fat from adipose tissue, Transport of Fatty Acids.	15

	Lipid and Nucleotide Metabolism	3.2	Beta, Alpha and Omega Oxidation of Saturated Fatty Acids; Oxidation of Unsaturated Fatty Acids; Oxidation of Odd Chain Fatty Acids. Energy Yield, Ketone Body Breakdown to Yield Energy.(Sequence of Reactions, Regulation, Energy Yield and Metabolic Disorders of the above Pathways)	
		3.3	Nucleotide Metabolism : Degradation of Purines and Pyrimidines. Associated Metabolic disorders : Primary gout and Secondary Gout	
			TOTAL LECTURES	**45**

Expected outcomes: By the end of the course the student will be able to:

1. Understand various metabolic pathways operating in the body and its regulation
2. Understand the electron transport chain
3. Learn the disorders associated with metabolic pathway

Reference Books:

1. Biochemistry:3rd Edition, Satyanarayan and Chakrapani
2. Lehninger principles of biochemistry, 4th Edition, David Nelson and Michael Cox
3. Fundamentals of Biochemistry. 3rd Edition (2008), Donald Voet& Judith Voet , John Wiley and Sons, I. USA
4. Biochemistry: 7th Edition, (2012), Jeremy Berg, LubertStryer, W.H.Freeman and company, NY
5. Outlines of Biochemistry: 5th Edition, (2009), Erice Conn & Paul Stumpf ; John Wiley and Sons, USA
6. Principles of Biochemistry, 4th Edition (1997), JefforyZubey, McGraw-Hill College,USA

BOS	Biotechnology
Class	S. Y. B. Sc
Semester	IV
Subject Name	Applied Chemistry II
Subject Code	PUSBT402
Level of Subject	Moderate

Objectives:

1. To build knowledge of natural products, polymers and techniques of separation.

Unit No.	Name of Unit	Topic No.	Name of Topic	Number of Lectures
I	Sampling and Separation Techniques	1.1	Sampling: Importance of Sampling and Sampling, Techniques. Types of Sampling - Random and Non-Random Sampling of Solids, Liquids and Gases. Separation Techniques: Types of Separation Techniques - Filtration, Zone Refining, Distillation, Vacuum Distillation.	15
		1.2	Solvent Extraction - Partition Coefficient and Distribution Ratio, Extraction Efficiency, Separation Factor.	
		1.3	Role of Complexing Agents, Chelation, Ion Pair Formation, Solvation, and Soxhlation. Centrifugation-Basic Principles of Sedimentation.	
II	Natural Product Chemistry	2.1	Natural Product Chemistry: Primary and Secondary Metabolites. Classification of Natural Products based on Bio-Synthesis	15
		2.2	Classification of Natural Products based on Structure- Alkaloids, Phenolics, Essential Oils and Steroids. Structure and uses of terpenes. Structure Determination of Natural Products. Commercial Synthesis of Natural Products	
		2.3	Chromatographic Separation of Natural Products: Gas Chromatography and its Applications. Liquid Chromatography: HPLC and its Applications. HPTLC for Separation and Analysis of Natural Products.	
III	Polymers and Nanomaterials	3.1	Polymers: Introduction to Polymers. Types of Polymers -Monomer, Polymer, Homopolymer, Copolymer, Thermoplastics and Thermosets, Addition and Condensation Polymers (Examples and Uses). Stereochemistry of Polymers. Biodegradable Polymers. Biomedical uses of synthetic and biopolymers polymer.	15
		3.2	Nanomaterials: Introduction to Nanomaterials. Forms of Nanomaterials: Nanoparticles,	

			Nanofilms and Nanotubes Synthesis and Characterization of Nanomaterials. Applications of Nanomaterials.	
			TOTAL LECTURES	**45**

Expected outcomes: By the end of the course the student will be able to:

1. Develop an understanding of the different aspects of Analytical Chemistry.
2. Gain knowledge of Natural Product Chemistry, its classification and techniques of separation.
3. Gain an understanding of basic concepts in Polymer Chemistry and Nanomaterials. Also the medicinal applications of polymer chemistry.

Reference Books:

1. Chemistry of natural products- S.V.Bhat.
2. Principles of polymer chemistry- Paul J.Flory
3. Selection of the HPLC Method in Chemical Analysis- Serban C. Moldoveanu, Victor David.
4. Basic Concepts of Analytical Chemistry- 2nd Edition by S.M.Khopkar.

BOS	Biotechnology
Class	S. Y. B. Sc
Semester	III
Subject Name	Medical Microbiology
Subject Code	PUSBT403
Level of Subject	Moderate

Objectives:

1. To gain insight into Disease Factors and Processes and Diseases Caused by microorganisms.
2. To provide knowledge on the students handling, isolating and identifying various bacteria.

Unit No.	**Name of Unit**	**Topic No.**	**Name of Topic**	**Number of Lectures**
I	Infectious Diseases	1.1	Host Parasite Relationship: Normal Flora; Factors Affecting the Course of Infection and Disease; Mechanisms of Infection and Virulence Factors.	15
		1.2	Infection: Patterns of Infection; Types of Infections; Signs and Symptoms; Epidemiology and Epidemiological Markers.	
		1.3	Diseases: Origin of Pathogens, Reservoir of infection; Acquisition of Infection; Koch's Postulates.	
II	Medical Microbiology Causative Organisms- I	Study of a few pathogens with respect to Morphological, cultural, biochemical characteristics, pathogenesis & clinical features, laboratory diagnosis, treatment and prevention		15
		2.1	*S. aureus*, *S. pyogenes*	
		2.2	*M. tuberculosis* *S. pneumoniae*	
		2.3	*E.coli* *Proteus*	
III	Medical Microbiology - Causative Organisms- II	Study of a few pathogens with respect to Morphological, cultural, biochemical characteristics, pathogenesis & clinical features, laboratory diagnosis, treatment and prevention		15
		3.1	*Salmonella sp.* *Shigella sp.*	
		3.2	HIV	
		3.3	*P. aeruginosa* *Candida albicans*	
			TOTAL LECTURES	**45**

Expected outcomes: By the end of the course the student will be able to:

1. List the factors playing a role in causing a disease.
2. Discuss the various aspects of Systemic Infections including Causative Agents, Symptoms and Prophylaxis.
3. Gain the technical capability of handling, isolating and identifying various Bacteria.

Reference Books:

1. Pelczar M.J., Chan E.C.S., Krieg Pelczar M.J., Chan E.C.S., Krieg N.R., Microbiology(6th Edition) ,The McGraw Hill Companies Inc.NY
2. Presscott's Microbiology, (8th edition), Joanne M Willey, Joanne Willey,Linda Sherwood, Linda M Sherwood, Christopher J Woolverton, Chris Woolverton, McGrawHil Science Enginering,USA
3. Jawetz, Melnick and Adelberg's Medical Microbiology, 26th Edition, Lange publication
4. Ananthanarayan and P anicker's, Textbook of Microbiology, 8th edition
5. Tortora, Funke, Case- Microbiology- An introduction (9^{th} edition), Pearson pulication

BOS	Biotechnology
Class	S. Y. B. Sc
Semester	IV
Subject Name	Environmental Biotechnology
Subject Code	PUSBT404
Level of Subject	Moderate

Objectives:

1. The objective of this course is to gain awareness about different Types of Environmental Pollution and Related Issues.
2. to understand how to detoxify the harmful chemicals released in the environment by the use of microorganisms.

Unit No.	Name of Unit	Topic No.	Name of Topic	Number of Lectures
I	Environmental pollution	1.1	Sources of Pollution. Air Pollution :Types; Sources; Classification of AirPollutants; Air Pollution Monitoring andControl.	15
		1.2	Water Pollution Causes, Types and Classification;Eutrophication; Assessment of Water Quality-Pollutant Monitoring and Control;	
		1.3	Soil and Solid Waste Pollution : Characteristics of Wastes, Impacts of Solid Waste on Health, Occupational Hazards and Control.	
		1.4	Marine pollution : causes, effects and control majors	
II	Global Environmental Problems and Issues	2.1	Green House Effect :Factors Responsible for Green House Effect;Green House Gases.	15
		2.2	Global Warming; Ozone Depletion;	
		2.3	KyotoProtocol; UV Radiation; Acid Rain.	
III	Bioremediation	3.1	Concept of Bioremediation. Microorganisms in Bioremediation, Mycoremediation and Phytoremediation.	15
		3.2	Bioremediation Technologies. Measuring Bioremediation in the Field. Bioaugmentation and Biostimulation.	
		3.3	Monitoring the Efficacy of Bioremediation.	
			TOTAL LECTURES	**45**

Expected outcomes: By the end of the course the student will be able to:

1. Gain an understanding of the causes, types and control methods for Environmental Pollution.
2. Application of different life forms in Environmental Remediation.

Reference Books:

1. Industrial Microbiology- A. H. Patel
2. Environmental biotechnology – Indu shekhar thakur
3. Microbiology- Frobisher
4. Microbiology - 5th Edition- Pelczar
5. Fundamental of Bacteriology - 11th Edition- A. J. Salle

BOS	Biotechnology
Class	S. Y. B. Sc
Semester	IV
Subject Name	Bioinformatics and Biostatistics
Subject Code	PUSBT405
Level of Subject	Moderate

Objectives:

1. learning and understanding basic concepts of Bioinformatics and Biostatistics

Unit No.	**Name of Unit**	**Topic No.**	**Name of Topic**	**Number of Lectures**
I	Introduction to Computers and Biological Databases	1.1	Computer Basics : Organization of a Computer; I/O Units; Computer Memory; Processor; Binary Arithmetic; Logic Circuit; Architecture; Operating System. Internet Basics: Connecting to the Internet, E-mail, FTP, www, Difference between www and Internet.	15
		1.2	Biological Databases : Importance and Classification of Databases.Raw and Processed Database. Primary, Secondary and tertiary databases. Nucleic acid sequence databases: GenBank, EMBL, DDBJ; Protein sequence databases: Uniprot-KB: SWISS-PROT, TrEMBL	
		1.3	Protein Structure Databases: PDB, NDB, PubChem Classification Databases (CATH/SCOP). Model Organism Databases:SGD, MGD, FlyBase, Wormbase Protein Databases based on Composition, Motifs and Patterns. Protein Structure Visualization Software.	
II	BLAST and Sequence Alignment	2.1	Pairwise Alignment: Identity, Similarity and Homology; Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series Pairwise sequence alignments: basic concepts of sequence alignment (Global and Local Alignment), Dot Matrix	15
		2.2	BLAST and Sequence Alignment: BLAST and its Types. FASTA	
		2.3	Multiple Sequence Alignment: Goal of Multiple Sequence Alignment;	

			Simultaneous Methods; Progressive Methods; Databases of Multiple Alignment; MSA and Phylogenetic Trees.	
III	Biostatistics	3.1	Theory and Problems based on Coefficient of Correlation and Regression Analysis	15
		3.2	Steps in Testing Statistical Hypothesis; Parametric Tests:- Z Test – Single Mean and Two Means, tTest – Single Mean, Paired and Unpaired; ChiSquare Test.	
			TOTAL LECTURES	**45**

Expected outcomes: By the end of the course the student will be able to:

1. Gain an understanding of the basic concepts of Bioinformatics and Biostatistics.
2. Understand the tools used in Bioinformatics.
3. Apply the various Statistical Tools for Analysis of Biological Data.

Reference Books:

1. Bioinformatics and Functional Genomics by Pevsner, J**.** A. John Wiley & Sons, Inc., USA(2009).
2. Bioinformatics: Methods and Applications. S. C. Rastogi, Namita Mendiratta, Parag Rastogi. PHI Learning Pvt Ltd.
3. Ideker et al. A new approach to decoding life: Systems Biology. Annual Review on Genomics and Human Genetics 2001, 2: 343-372.
4. Kitano, Systems Biology: A Brief Overview. Science, 2002, 295: 1662-1664.
5. Biostatistics. P. N. Arora and P. K. Malhan. Himalaya Pub. House (2010)
6. Introduction to Bio-Statistics. P. K. Banerjee. S Chand & Company

BOS	Biotechnology
Class	S. Y. B. Sc
Semester	IV
Subject Name	Molecular Diagnostics
Subject Code	PUSBT406
Level of Subject	Basic

Objectives:

1. Learning and understanding Molecular Techniques and utilizing these techniques in Diagnosis.

Unit No.	Name of Unit	Topic No.	Name of Topic	Number of Lectures
I	Basics of Molecular Diagnostics	1.1	Introduction to Molecular Diagnostics : Overview; History; Post Genomic Era; Future Prospects - Commercialising Molecular Diagnostics, Personalized Medicine, Theranostics.	15
		1.2	Characterisation and analysis of Nucleic – Acids and Proteins : Extraction, Isolation and Detection of DNA, RNA and Proteins, Use of Restriction endonuclease in molecular diagnostics.	
		1.3	Hybridisation Techniques : Southern, Northern, Western, Eastern blotting and FISH; Markers, Probes and its Clinical applications.	
II	Nucleic Acid Amplification Methods	2.1	Target amplification : PCR - General Principle; Components of a Typical PCR Reaction; Experimental Design; Primer Designing; Control of PCR Contamination and Mispriming; PCR Product Clean-up and Detection. PCR Types: Reverse Transcriptase and Real Time PCR.	15
		2.2	Probe amplification : Ligase Chain Reaction	
III	Molecular Biology based Diagnostics	3.1	DNA Polymorphism and Identification: RFLP in Parentage Testing and Sickle-Cell Anaemia.	15
		3.2	Molecular Diagnostics for Infectious Diseases: *Mycobacterium tuberculosis, Candida and* HIV-1;	
		3.3	Genetic Testing and Genetic Counselling: Genetic Testing- Need and Uses;	

			Case Studies- Diagnostic Testing for Cystic Fibrosis; Fragile X Diagnostic and Carrier Testing. Genetic Counselling Ethical, Social and Legal Issues in Genetic Testing	
			TOTAL LECTURES	**45**

Expected outcomes: By the end of the course the student will be able to:

1. Gain an understanding of the basic Principles used in Molecular Diagnosis.
2. Gain critical thinking and analytical skills to understand new Diagnostic Methods.
3. Apply the knowledge and skills gained in the course should be useful in developing new Diagnostic Kits.

Reference Books:

1. Molecular diagnostics- Fundamentals, methods and clinical applications –Buckingham and Flaws F.A. Davis Company Philadelphia.
2. iGenetics- Peter Russell -Pearson Education
3. Molecular diagnostics for the clinical laboratorian by coleman and Tsongalis, Humana press
4. Genetics in medicin-by Thompson and Thompson
5. Emery's Elements of Medical Genetics-by Peter D Turnpenny & Sian Ellard

BOS	Biotechnology
Class	S. Y. B. Sc
Semester	IV
Subject Name	Entrepreneurship Development
Subject Code	PUSBT407
Level of Subject	Basic

Objectives:

1. To develop and systematically apply an Entrepreneurial way of thinking that will allow identification and creation of Business Opportunities.

Unit No.	**Name of Unit**	**Topic No.**	**Name of Topic**	**Number of Lectures**
I	Introduction to Entrepreneurship Development	1.1	Concept of Entrepreneur; Entrepreneurship; Need and Importance;	15
		1.2	Factors Influencing Entrepreneurship; Essentials of a Successful Entrepreneur	
		1.3	Examples of Biotech Entrepreneurs	
II	Setting-up of an Enterprise and Planning	2.1	Location of Enterprise; Real Estate and Human Resource Planning, Financial Planning; Role of Government and Financial Institutions in Entrepreneurship Development; Raising Money from Venture Capitalists, Government Grants	15
		2.2	Product Selection and Ideas; Project Planning and Formulation; Project Feasibility Assessment;	
		2.3	Regulatory Affairs, Corporate Laws, Innovation, IPR generation and Protection, Preparation of a Business Plan, Characteristics and Importance of Planning;	
III	Marketing, Sales, Advertising and International Market research	3.1	Marketing Plan for an Entrepreneur; Strategic Alliances, Advertising and Sales Promotion;	15
		3.2	Market Assessment, Need for International Market Research, Domestic *vs.* International Market Research, Cost and Methodology of Market Research, Desk and Field Research	
IV	Internal Evaluation	4.1	Submission and Presentation of Business Proposal for any Biotechnological Product/ Enterprise	

TOTAL LECTURES	**45**

Expected outcomes: By the end of the course the student will be able to:

1. Develop an understanding of the systematic process and to select and screen a Business Idea.
2. Design strategies for successful implementation of ideas.
3. Write a Business Plan.

Reference Books:

1. Entrepreneurship – Kurup
2. Handbook of Entrepreneurship development- Basotia and Sharma

PRACTICALS

	SEMESTER III	
Course code	**Title**	**Credits**
UBTP401 (PRACTICALS based on UBT401and UBT402)	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 and Creatinine in Urine. 5. Qualitative Detection of Ketone Body in Urine. 6. Isolation of Mitochondria and Demonstration of ETC using a Marker Enzyme. 7. Separation of Binary (Solid-Solid) Mixture (Min 4 Compounds). 8. Identification of Organic Compound of Known Chemical Type (Min 4 Compounds). 9. HPLC analysis and Interpretation of any one Secondary Metabolite from Plants 10. Analysis of Essential Oils from any Plant Source using GC. 11. HPTLC fingerprint analysis of any one Medicinally Important Plant. 12. Chemical and Biological Synthesis of Silver Nanoparticles and its Characterisation by UV- VIS Spectrophotometer.	**2**
Course code	**Title**	**Credits**
UBTP402 (PRACTICALS based on UBT403and UBT404)	1. Identification of *S.aureus*-Isolation, Catalase, Coagulase Test. 2. Identification of *E.coli*-Isolation, Sugar Fermentations, IMViC. 3. Identification of *Salmonella*- Isolation, Sugar Fermentations, TSI Slant. 4. Identification of *Shigella*- Isolation, Sugar Fermentations, TSI Slant. 5. Identification of *Proteus*- Isolation, Sugar Fermentations, IMViC. 6. Identification of *Pseudomonas* - Isolation, Urease test, Oxidase Test, TSI Slant. 7. RPR Test (Kit Based). 8. Permanent Slide- *Mycobacterium*. 9. Biological Oxygen Demand (BOD). 10. Chemical Oxygen Demand (COD). 11. Isolation of Bacteria from Air by Gravity Sedimentation Method. 12. Most Probable Number (MPN) – Presumptive, Confirmed and Completed Tests.	**2**

Course code	Title	Credits
UBTP403 (PRACTICALS based on UBT405and UBT406)	1. Familiarization with NCBI, EMBL, DDBJ, PIR, KEGG Databases. 2. Use of NCBI BLAST Tool. 2. Pairwise and Multiple Sequence Alignment and Phylogeny. 3. Classification of Proteins using CATH/SCOP. 4. Visualization PDB Molecules using Rasmol/Raswin. 5. Handling and Calibration of Micropipette. 6. Isolation, Quantitative Analysis and AGE of Genomic DNA from Bacteria and Yeast. 7. Isolation and Detection of RNA from Bacteria and Yeast. 8. Restriction Enzyme Digestion. 9. RFLP- Kit Based. 10. Primer Designing through Open Online Source NCBI- BLAST. 11. DNA Amplification – PCR.	**2**