

Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College, Vashi
(AUTONOMOUS)



Syllabus for Approval

Sr. No.	Heading	Particulars
1.	Title of the Course	T.Y.B.Sc. in Biotechnology
2.	Eligibility for Admission	H.S.C.
3.	Passing Marks	40%
4.	Ordinances/ Regulation	
5.	No. of Years/ Semester	1 Year / 2 Semesters
6.	Level	Undergraduate (UG)
7.	Pattern	Semester
8.	Status	Revised (Under Autonomous Status)
9.	To be implemented from Academic Year	2023-24

Date:

Name of BOS Chairperson: _____ Signature: _____

**RAYAT SHIKSHAN SANSTHA'S
KARMAVEER BHAURAO PATIL COLLEGE, VASHI
(AUTONOMOUS)**



**Proposed Syllabus
For
T.Y. B.Sc. in Biotechnology
2023-24**

Preamble of the Syllabus:

Bachelor of Science (B.Sc.) in Biotechnology is a under graduation course of Department of Biotechnology, Karmaveer Bhaurao Patil College Vashi, Navi Mumbai, affiliated to University of Mumbai (MH). Biotechnology is defined as the application of technological principles for the processing or manipulating biological agents to provide goods and services. It derives its strength by harnessing biological processes that sustain life. It is a technology that is more reliable and firm. Biotechnology has the potential to transform the lives of the people by impacting hugely on agriculture, animal husbandry, health and medicines, environment, sustainable development, etc. Biotechnology has accomplished tremendous applications in just a matter of time. People have just started to recognize the endless window of opportunities it has open. Biotechnology has revolutionized the recent advancements in research and development. CBSGS: The Choice Based Semester and Grading System to be implemented through this curriculum would allow students to develop a strong footing in the fundamentals and specialize in the disciplines of his/her liking and abilities.

Program Education Objective (PEO's):

To prepare students to prime for-

- Higher education and research in field of biotechnology and related subjects.
- Careers related broadly to biotechnology and life sciences. Students will embark upon diverse career paths medical coding/pharmaceutical/biotechnology industries, and use their education in a variety of related endeavors.

Course Objective:

- To produce students who understand fundamental principles of basic sciences and apply that understanding to analyze, solve problems and interrelate with current technological developments.
- To promote independent learning and add rationale thinking, knowledge ability by activity based learning, innovative, teaching learning and evaluation methods.

Name of the Faculty: Science and Technology

Name of the Program: B Sc

Program Outcomes (POs):

PO-1	Disciplinary Knowledge: Understand the basic concepts, fundamental principles, theoretical formulations and experimental findings and the scientific theories related to Physics, Chemistry, Mathematics, Microbiology, Computer Science, Biotechnology, Information Technology and its other fields related to the program.
PO-2	Communication Skills: Develop various communication skills such as reading, listening and speaking skills to express ideas and views clearly and effectively.
PO-3	Critical Thinking: Propose novel ideas in explaining the scientific data, facts and figures related to science and technology.
PO-4	Analytical Reasoning and Problem Solving: Hypothesize, analyze, formulate and interpret the data systematically and solve theoretical and numerical problems in the diverse areas of science and technology.
PO-5	Sense of Inquiry: Curiously ask relevant questions for better understanding of fundamental concepts and principles, scientific theories and applications related to the study.
PO-6	Use of Modern Tools: Operate modern tools, equipments, instruments and laboratory techniques to perform the experiments and write the programs in different languages (software).
PO-7	Research Skills: Understand to design, collect, analyze, interpret and evaluate information/data that is relevant to science and technology.
PO-8	Application of Knowledge: Develop scientific outlook and apply the knowledge with respect to subject.
PO-9	Ethical Awareness: Imbibe ethical, moral and social values and exercise it in day to day life.
PO-10	Teamwork: Work collectively and participate to take initiative for various field-based situations related to science, technology and society at large.
PO-11	Environment and Sustainability: Create social awareness about environment and develop sustainability for betterment of future.
PO-12	Lifelong Learning: Ability of self-driven to explore, learn and gain knowledge and new skills to improve the quality of life and sense of self-worth by paying attention to the ideas and goals throughout the life.

Name of the Faculty: Science and Technology

Name of the Program: B. Sc Biotechnology

Program Specific Outcomes (PSOs):

Students will be able to –

PSO-1	Identify, understand and analyze problems and propose valid solutions related to field of Biotechnology.
PSO-2	Critically evaluate biotechnological solutions on environment and societies keeping in mind the need for sustainable solutions.
PSO-3	Develop a research based ideology and technical skills to build career in Biotechnology.

Scheme of examination for Each Semester:

Continuous Internal Evaluation: 40 Marks (Common Test-20 Marks & 20 Marks for Assignment, Projects, Group discussion, Open book test, online test etc.)

Semester End Examination: 60 Marks will be as follows –

I	Theory:	
	Each theory paper shall be of two and half hour duration.	
	All questions are compulsory and will have internal options	
	Q-1	From Unit – I (having internal options.) 12 M
	Q-2	From Unit – II (having internal options.) 12 M
	Q-3	From Unit – III (having internal options.) 12 M
	Q-4	From Unit – IV (having internal options.) 12 M
	Q-5	Questions from all the FOUR Units with equal weightage of marks allotted to each Unit. 12 M
II	Practical:	The External examination per practical course will be conducted as per the following scheme.
Sr. No.	Particulars of Semester End Practical Examination	Total Marks
I	Semester end Practical Exam	300

SEMESTER-V

S.Y.B.Sc Biotechnology (Honours)
Proposed Semester-V Syllabus
2023-24

Semester V

Course code	Course Title	Credits	Course code	Course Title	Credits	Credits Total
Core Courses						
UGBTC501	Biochemistry-II	4	UGBTC501	Biochemistry-II	2	6
UGBTC502	Bio-analytical Techniques	4	UGBTC502	Bio-analytical Techniques	2	6
Discipline Specific Elective Courses (Any 2)						
UGBDSE501	Research Project	6				6
UGBDSE502	Plant & Animal Biotechnology	4	UGBDSEP502	Plant & Animal Biotechnology	2	6
UGBDSE503	Basic Pharmacology & Toxicology	4	UGBDSEP503	Basic Pharmacology & Toxicology	2	6
UGBDSE504	Developmental Biology	4	UGBDSEP504	Developmental Biology	2	6

Core Courses

Title of Paper: UGBTC501 Biochemistry-II

<p>Unit 1: Carbohydrate metabolism</p>	<p>Carbohydrate Metabolism: Glycolytic Pathway and its Regulation, Homolactic and Alcoholic Fermentation and its Energetics, Citric Acid Cycle and its Regulation; Gluconeogenesis; Pentose Phosphate Pathway; Glyoxalate Pathway; Reductive TCA . (Sequence of Reactions, Regulation & Energy Yield.) Electron Transport System: Electron Transport and Oxidative Phosphorylation. Inhibitors of ETS. Energy Rich Compounds: ATP as Energy Currency Carbohydrate biosynthesis and its regulation: Peptidoglycan in Bacteria ; Starch and sucrose in Plants ; Glycogen in Animals</p>
<p>Unit 2: Lipid metabolism</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. Energy Yield, Ketone Body Breakdown to Yield Energy. (Sequence of Reactions, Regulation & Energy Yield.) Biosynthesis and regulation of saturated and unsaturated fatty acids Triacylglycerol, Phospholipids and Cholesterol, Atherosclerosis.</p>
<p>Unit-3: Amino acid and nucleotide metabolism</p>	<p>Amino Acid Breakdown: Deamination, Transamination, Urea Cycle, Breakdown of Glucogenic and Ketogenic Amino Acids. Amino Acids as Biosynthetic Precursors: Biosynthesis of Epinephrine, Dopamine, Serotonin, GABA, Histamine, Glutathione. (Sequence of Reactions & Regulation.), Nucleotide Metabolism: Degradation of Purines and Pyrimidines.</p>
<p>Unit 4: Endocrinology</p>	<p>Mechanism of action of group I and II hormones; Structure, storage, release, transport, biochemical functions and disorders associated with hormones secreted by Hypothalamus ; Anterior Pituitary gland - GH, stimulating hormones) ; Posterior Pituitary gland – oxytocin and vasopressin ; Thyroid gland – Thyroxine, calcitonin ; Parathyroid gland – PTH ; Adrenal medulla – epinephrine and norepinephrine ; Adrenal cortex – Glucocorticoids ; Pancreas – insulin and glucagon ; Female Gonads – estrogen and progesterone ; Male gonads – testosterone ; Placenta – hCG .</p>

References:

1. Lehninger, principles of biochemistry, 4th edition (2005), David Nelson and Michael Cox W.H. Freeman and Company, New York.
2. Harper's Illustrated Biochemistry, 27th edition, RK Murray, DK Granner, PA Mayes and VW Rodwell, McGraw Hills publication.
3. Biochemistry, 4nd edition (2017), Satyanarayana and Chakrapani, Books & Allied (P) Ltd

Proposed Practicals**UGBTCP-501 Biochemistry-II**

1.	Determination of blood glucose levels for detection of diabetes mellitus.
2.	Determination of serum cholesterol (total, HDL and LDL ratio)
3.	Estimation of protein by Lowry's method
4.	Estimation of protein by Bradford method
5.	Liver Function Tests: (SGPT, SGOT)
6.	Kidney Function Test: (Urea from Serum).
7.	Estimation of Uric Acid and Creatinine in Urine.
8.	Qualitative Detection of Ketone Body in Urine.

Title of Paper: UGBTC502 Bio-Analytical Techniques

Unit – 1: Spectroscopy	UV-Visible Spectroscopy-Principle, instrumentation, working and applications of: Fluorescence Spectroscopy, Light scattering spectroscopy, Infrared Spectroscopy, Atomic absorption Spectroscopy, Mass Spectroscopy, NMR, ESR, Surface plasmon resonance
Unit – 2: Centrifugation	Basic principle of sedimentation; Types of rotors - fixed-angle rotors, vertical tube rotors and swinging-bucket rotors; Types of centrifugation – Preparative & Analytical, Differential centrifugation – Principle, Working and Applications, Density-gradient centrifugation - Principle, Working and Applications, Ultracentrifugation
Unit - 3 Chromatography	Principle, working and applications of: Paper chromatography, TLC, Affinity chromatography, Ion-exchange chromatography, Molecular (size) exclusion chromatography; HPLC; Gas Chromatography - Method development and validation.
Unit – 4: Electrophoresis	General principle, Support media, Electrophoresis of Proteins – Native PAGE , SDS-PAGE, Isoelectric Focusing, 2D-PAGE, Cellulose acetate electrophoresis (Principle, Instrumentation, Detection, application); Electrophoresis of nucleic acids – Agarose Gel Electrophoresis, Pulsed-field gel electrophoresis (Principle, Instrumentation, Detection, application), Capillary electrophoresis, DGGE (Density gradient gel electrophoresis)

References

1. Principles and Techniques in Biochemistry and Molecular Biology (2010), Keith Wilson and John Walker, 7th edition, Cambridge University Press
2. Biophysics (2002) Vasantha Pattabhi and N. Gautham, Kluwer Academic Publishers
3. Physical Biochemistry: principles and applications, 2nd edition (2009), David Sheehan , John Wiley & Sons Ltd
4. HPLC method validation for pharmaceuticals: a review (2013), Harshad V. Paithankar, International Journal of Universal Pharmacy and Bio Sciences 2(4): July-August.

Proposed Practicals

UGBTCP-502 Bio-Analytical techniques

1.	Separation of components from a mixture using Affinity chromatography (Kit may be used)
2.	Separation of components from a mixture using ion exchange chromatography (Kit may be used)
3.	Separation of components from a mixture using Size exclusion chromatography (Kit may be used)
4.	HPLC method validation.
5.	Separation of components using density gradient centrifugation
6.	Separation of components using differential centrifugation
7.	SDS - PAGE
8.	Study of Beer- Lambert's Law by Spectropotometry.

Discipline Specific Elective Courses (Any2)

Title of Paper: UGBTDSE501; Research Project

Students have to complete an individual research project and submit their dissertation at the end of semester-5, which will be evaluated by internal and external examiners for certification.

Review of literature presentation (20 Marks)	Planning and Designing of experiments (10 Marks)	Pilot experiments (10 Marks)	1 st Progress Report (20 Marks)	2 nd Progress Report (20 Marks)	Final Report and Presentation (Dissertation) (20 Marks)
July Last Week	August 2 nd Week	September 1 st Week	September Last Week	October 1 st Week	Oct-Last Week

Note: Above are the tentative dates and are subjected to change as per academic calendar.

Title of Paper: UGBTDSE502; Plant & Animal Biotechnology

Unit I Introduction to Plant Tissue Culture	History of PTC, Cell Theory, Concept of Cell Culture, Cellular Totipotency, Organization of Plant Tissue Culture Laboratory Equipments and Instruments used in PTC Laboratory organization: Washing and storage facilities, Media preparation room, Transfer area, Culture room, Aseptic Techniques: Washing of Glassware, Media and explant Sterilization, Aseptic Workstation, Precautions to maintain Aseptic Conditions.
Unit II Media preparation and Applications of PTC	Culture Medium: Nutritional requirements of the explants, PGR's and their in-vitro roles, Media Preparation: Media composition, Inorganic nutrients, Carbon and Energy source, Organic supplements, Growth regulators, Solidifying agents, pH, Widely used media in PTC Callus Culture Technique: Introduction, Principle and Protocols, Applications of PTC: Industrial applications, Applications to Horticulture and Forestry
Unit III: Introduction to Animal Tissue Culture	Experimental animals as model organisms and their maintenance, Basics of Animal Tissue Culture Introduction: Cell Culture Techniques, Equipment and Sterilization Methodology. Introduction to Animal Cell Cultures: Nutritional and Physiological parameters, Growth Factors and Growth Parameters. General Metabolism and Growth Kinetics Primary Cell Cultures : Establishment and Maintenance Secondary cell cultures and its maintainance, Adherent and Non-Adherent Cell Lines with examples.
Unit IV: Applications of ATC and Biosafety in Biotechnology	Recombinant proteins, Use of cell lines in research, Basic concept of animal cloning, Cloning for conservation of endangered species, Hybridoma technology, Tissue engineering, Vaccine production, Biosafety and Biosafety cabinets

References

1. Culture of Animal cells- Ian Freshney -- John Wiley & Sons
2. Introduction to Plant tissue culture,
2. Principles and Practice of Animal Tissue culture- Sudha Gangal - University Press
3. Plant Biotechnology- K. G. Ramavat S.Chand Publications
4. Experiments in Plant tissue culture- Dodds and Roberts- Cambridge University Press

Proposed Practicals

UGBTDSE-502 Bio- Plant & Animal Biotechnology

1.	1. Working and use of various Instruments used in Biotechnology Laboratory (Autoclave, Hot air Oven, Centrifuge, Incubator, Rotary Shaker, Filter Assembly, LAF, pH meter and Colorimeter)
2.	Laboratory Organization and Layout for Plant and Animal Tissue Culture Laboratory
3.	Preparation of Stock Solutions and Preparation of Media for PTC
4.	Aseptic Transfer Technique, Surface Sterilization and Inoculation for Callus Culture
5.	Media Preparation and Sterilization (ATC)
6.	Trypsinization of Tissue and Viability Count

Title of Paper: UGBTDSE 503 : Basic Pharmacology & Toxicology

Unit-1 General Principles of Pharmacology	Routes of drug administration, Mechanism of drug action, drug receptors and biological responses, second-messenger systems, the chemistry of drug-receptor binding, dose-response relationship, therapeutic index, ED, LD, Potency and Intrinsic Activity, drug antagonism.
Unit-2: Drug Absorption and Distribution	Drug development process, Absorption of drugs from the alimentary tract, factors affecting rate of gastrointestinal absorption, absorption of drugs from lungs, skin, absorption of drugs after parenteral administration, factors influencing drug distribution, binding of drugs to plasma protein, Physiological barriers to drug distribution.
Unit-3: Metabolism and Excretion of drugs	Biotransformation: Synthetic and Non-synthetic, Inhibition of drug metabolism, Microsomal enzyme induction, Consequences and possible uses, first pass metabolism Excretion of drugs, Urine, Feces, Exhaled air, Saliva, Sweat and Milk, Renal excretion
Unit-4: Basic Toxicology and Regulatory Toxicology	Background Definitions, Causation: degrees of certainty Classification, Causes Allergy in response to drugs, Effects of prolonged administration, Chronic organ toxicity, Adverse effects on reproduction, Poisons: Deliberate and accidental self-poisoning, Principles of treatment, Poison-specific measures, General measures, Specific poisonings: cyanide, methanol, ethylene glycol, hydrocarbons, volatile solvents, heavy metals, herbicides and pesticides, biological substances, Overdose of medicinal drugs is dealt with under individual agents, Incapacitating agents: Drugs used for torture, Non-medical use of drugs.

References

1. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders
2. Modern Pharmacology with clinical Applications Craig. C.R, Stitzel. R.E, 5th edition
3. Clinical Pharmacology Bennet. P.N, Brown. M.J, Sharma.P, 11th edition Elsevier
4. Biochemistry Metzler, D.E Elsevier

Proposed Practicals

UGBTDSEP503, Basic Pharmacology & Toxicology

1.	LD50 evaluation using suitable models
2.	ED50 evaluation using suitable models
3.	Case study on poisoning

Title of Paper: UGBTDSE504; Developmental Biology

Unit 1: Introduction to Developmental Biology	Overview of modern era of developmental biology, Stages of development, cell fate & commitment, concept of embryonic stem cells, terminal differentiation, lineages of three germ layers, fate map; Mechanisms of differentiation- cytoplasmic determinants, embryonic induction, concept of morphogen, mosaic and regulative development, Pattern formation—axis specification, positional identification (regional specification),
Unit 2: Fertilization	Fertilization: Structure of the Gametes - Sperm, Egg, Recognition of egg and sperm. External Fertilization in Sea Urchins: Sperm attraction: Action at a distance, The acrosome reaction, Recognition of the egg's extracellular coat, Fusion of the egg and sperm cell membranes, The fast block to polyspermy, The slow block to polyspermy, Calcium as the initiator of the cortical granule reaction Internal Fertilization in Mammals: Getting the gametes into the oviduct: Translocation and capacitation, In the vicinity of the oocyte: Hyperactivation, thermotaxis and chemotaxis, Recognition at the zona pellucida, Gamete fusion and the prevention of polyspermy, Fusion of genetic material
Unit 3: Early Embryonic Development	Cleavage, Pattern of embryonic cleavage, The cytoskeletal mechanisms of mitosis, Gastrulation, Formation of the extra-embryonic membranes, Axis-formation, Anterior-posterior axis, dorsal-ventral axis and right-left axis, Control of blastomere identity, Cell specification
Unit 4: Sex Determination	Primary Sex Determination in Mammals: The developing gonads, Mechanisms of mammalian primary sex determination, Secondary Sex determination in Mammals - The genetic analysis of secondary sex determination, Hormonal Regulation of the Sexual Phenotype in mammals Chromosomal Sex Determination: The Sex-lethal gene, Dosage Compensation

References:

1. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., K Reiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA
2. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA
4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA
5. Developmental Biology; Scott Gilbert; 9th Edition

Proposed Practicals

UGBTPDSE504; Developmental Biology

1.	Study of different stages of Meiosis (Permanent Slides of animal origin)
2.	Study of different stages of Mitosis (Permanent Slides of animal origin)
3.	Study of chick embryo development stages (With permission of Ethical Committee only Demonstration)
4.	Effect of heavy metal (HgCl ₂ / PbNO ₃ / AgCL ₂) on development of chick embryo (With permission of Ethical Committee only Demonstration)
5.	Model organisms in Developmental biology with examples (Group activity).

SEMESTER-VI

S.Y. B. Sc Biotechnology (Honours)
Proposed Semester IV Syllabus
2022-23

Semester VI

Course code	Course Title	Cre dits	Course code	Course Title	Cre dits	Credit s Total
Core Courses						
UGBTC601	Regulation, Genomes & Omics	4	UGBTCP601	Regulation, Genomes & Omics	2	6
UGBTC602	Bioprocess Technology	4	UGBTCP602	Bioprocess Technology	2	6
Discipline Specific Elective Courses (Any 2)						
UGBDSE601	Agribiotechnology	4	UGBDSE601	Agribiotechnol ogy	2	6
UGBDSE602	Marine Biotechnology	4	UGBDSE602	Marine Biotechnology	2	6
UGBDSE603	Environmental Biotechnology	4	UGBDSE603	Environmental Biotechnology	2	6
UGBDSE604	Bioinformatics	4	UGBDSE604	Bioinformatics	2	6

Core Courses

Title of Paper: UGBTC601 ; Regulation, Genomes & Omics

<p>Unit 1: Regulation of Gene Expression in Prokaryotes and Eukaryotes</p>	<p>Unit 1: Prokaryotes (In Bacteria):lac operon of E. coli (revision), trp operon of E. coli, Ara operon In Viruses: Lytic / Lysogenic Regulation In Eukaryotes: Control of Transcriptional Initiation by GTF, activator and co-activator, Re-modelling of chromatin (Histone acetylase and nucleosome remodelling concept), Gene Silencing by Methylation, telomere position effect and Genomic Imprinting, Post-Transcriptional Control</p>
<p>Unit 2:Genetic Engineering in Plants and Animals</p>	<p>Transgenic plants: Physical methods of transferring genes to plants: electroporation, microprojectile bombardment, liposome mediated, protoplast fusion; Chemical Methods for transferring genes to plants :Calcium phosphate, DEAE dextran Transgenic Animals: Models of Transgenic animals in diabetes, CVD, BP, Kidney stones, Transgenic mice- methodology-retroviral method, DNA microinjection, ES method; genetic manipulation with cre-loxP; Vectors for animal cells; Transgenic animals recombination system; Cloning live stock by nuclear transfer; Transgenic Livestock, Synthetic biology- improvement of seed quality proteins and transgenic fish.</p>
<p>Unit 3: Gene Sequencing and Editing</p>	<p>Gene sequencing and editing, Maxam Gilbert’s method, Sanger’s method, Automated DNA sequencing, Pyro-sequencing; Next generation Sequencing; Human genome mapping and its implications in health and disease; RNAi, ZNF(Zinc finger nucleases), TALENS (Transcription Activator Like Effectors Nucleases), CRISPER/Cassystem (Clustered Regularly Interspersed Repeats), DNA fingerprinting, Gene therapy (Sickle cell anemia, Cystic fibrosis)</p>
<p>Unit 4: Introduction to “Omics”</p>	<p>Introduction and History of “Omics”, Types of Omics, Components of Omics; Goal, Principle, Techniques, Applications of – Genomics, Epigenomics, Transcriptomics, Proteomics, Metabolomics, Bioinformatics based approach for “Omics”.</p>

References:

1. iGenetics A Molecular Approach 3rd Edition Peter J. Russell.
2. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
3. Principles of Gene Manipulation 7th Edition Primrose S.B., Twyman R.M
4. Biotechnology 3rd Edition S.S. Purohit.
5. Genomes 3rd Edition T.A. Brown.
6. Biotechnology B.D. Singh.
7. Gene Cloning and DNA Analysis 6th Edition T.A. Brown.
8. Genomics Cantor C.R., and Smith C.L. John Wiley & Sons. (1999)
9. Drug Discovery and Evaluation, H. Gerhard Vogel

Proposed Practicals

UGBTCP601 ; Regulation, Genomes & Omics

1.	Transformation in E.coli.
2.	Genomic DNA Extraction: Animal cells.
3.	Restriction enzyme digestion and ligation (Kit may be used).
4.	Polymerase chain reaction. (Demonstration)
5.	Gradient plate technique
6.	Bacterial gene expression (Kit may be used).

Title of Paper: UGBTC602 ; Bioprocess Technology

Unit 1: Introduction: Fermentation technology and types of microorganisms used in fermentation	Definition, Applications of fermentation technology in Food and other Industries. Types of Microorganisms used in Industrial Processes: Bacteria, Actinomycetes, fungi and algae. Screening and maintainance of Strains: Primary Screening, Secondary Screening, Cultivation Preservation of Industrially Important Microbial Strains
Unit-2: Basic design of fermenter	Fermenter and Fermentation processes Design of fermenter Stirred Tank Fermenter- Basic Design, Parts of a Typical Industrial fermenter. Fermentation Media: Components, Design and Optimization. Sterilization: Sterilization of fermenter and fermentation media. Introduction to Inoculum development, Bacterial and fungal inoculum development with one example each, Process parameters: pH, Temperature, Aeration, Agitation(Dissolved Oxygen), Foam etc. Types of fermentation: Surface and submerged, Batch and continuous, Aerobic and Anaerobic.
Unit-3: Down Stream Processing	Introduction of DSP; Foam separation; Types of Precipitation; Filtration, Centrifugation; Chromatography in DSP; Cell disruption-physical and chemical methods, Solvent recovery, Membrane processes, Drying, Crystallization and Whole broth processing.
Unit 4: Fermentation Process	Production of Streptomycin, Protease, Citric acid, Lysine, Ethanol production, Beer and wine production, Penicillin, cheese, Butter, Acetic acid

References

1. Biotechnology, S.S. Purohit
2. Principles of Gene Manipulations, Primrose
3. Gene Cloning, T.A.Brown
4. The Dictionary of Cell and Molecular Biology, 4th ed., J.M. Lackie

Proposed Practicals

UGBTCP602 Bioprocess Technology

1.	Estimation of Milk protein-Pynes method
2	Microbial analysis of Milk by MBRT and RRT
3	Phosphatase test in Milk
4	DMC of milk sample
5	Isolation of Normal flora from milk and curd

Discipline Specific Elective Courses (Any2)

Title of Paper: UGBTDSE601: Agri Biotechnology

<p>Unit-1: Precision Agriculture and Agriculture Systems</p>	<p>Introduction to Agriculture and Agriculture systems, Green house Technology- Types of green house, importance, functions and features of green house, Design criteria and calculation, Construction material, covering material and its characteristics, growing media, green house irrigation system, nutrient management, Greenhouse heating, cooling and shedding and ventilation system, Computer controlled environment, Phytotrons, fertigation and roof system, Precision Cultivation- tools, sensors for information acquisition</p>
<p>Unit-2: Plant Stress Biology</p>	<p>Abiotic Stress –Physiological and molecular responses of plants to water stress, salinity stress, temperature stress – heat and cold, Photo-oxidative stress, stress perception and stress signaling pathways, Ionic and osmotic homeostasis, reactive oxygen species scavenging, Biotic stress - plant interaction with bacterial, viral and fungal pathogens, plant responses to pathogen– biochemical and molecular basis of host-plant resistance, toxins of fungi and bacteria, systemic and induced resistance –pathogen derived resistance, signaling</p>
<p>Unit-3: Molecular Markers in Plant Breeding</p>	<p>Genetic markers in plant breeding- Classical markers, DNA markers (RFLP, RAPD, AFLP,SSR, SNP, Application of Molecular Markers to Plant Breeding [quantitative trait locus (QTL) mapping], Plant DNA Barcoding- Barcoding Markers (matK, rbcL, ITS, tmHpsbA), steps, recent advances, Benefits, Limitations</p>
<p>Unit-4: Biofertilizers and Biopesticides</p>	<p>Biofertilizer, Nitrogen-fixing Rhizobacteria - Symbiotic Nitrogen Fixers, Nonsymbiotic Nitrogen Fixers, Plant Growth Promoting Microorganisms – Phosphate Solubilizing Microbes (PSM), Phytohormones and Cytokinins, Induced Systemic Resistance, Plant Growth Promotion by Fungi - Mycorrhizae, Arbuscular, Mycorrhizae, Ectomycorrhizae, Microbial Inoculants - Inocula, Carriers, and Applications, Monoculture and Co-culture Inoculant Formulations Biocontrol, Polymicrobial Inoculant Formulations, Biopesticides –types, Bacillus thuringiensis, insect viruses and entomopathogenic fungi (characteristics, physiology, mechanism of action and application)</p>

References

1. Textbook of Biotechnology, R C Dubey
2. Biofertilizers in agriculture and Forestry, N. S. Subbarao

Proposed Practicals

UGBTDSEP601: Agri Biotechnology

1	RAPD analysis demonstration experiment
2	Isolation of Rhizobium
3	Isolation of Azotobacter
4	Isolation of Phosphate solubilising bacteria
5	Study of effect of abiotic stress on plants.
6	Rapid screening tests for abiotic stress tolerance (Drought, PEG, Mannitol & salinity NaCl)
7	Estimation of antioxidants and antioxidant enzymes – Ascorbate & Proline
8	Visit to green house facility and submission of field visit report.

Title of Paper: UGBTDSE602: Marine Biotechnology

Unit-1 :Marine Biotechnology Introduction & Bioprospecting	Introduction to Marine Biotechnology; Applications of Marine Biotechnology The marine ecosystem and its functioning: intertidal, estuarine, salt marsh, mangrove, coral reef, coastal & deep sea ecosystems. Hydrothermal vents, Bioprospecting, Marine Microbial Habitats and their Biotechnologically relevant Microorganisms, Biotechnological Potential of Marine Microbes, Bioactive compounds from other Marine Organisms: fungi, Microalgae, Seaweeds, Acinimycetes, sponges.
Unit-2: Marine Drugs and Enzymes	Drugs from Marine organisms: Pharmaceutical compounds from marine flora and fauna – marine toxins, antiviral and antimicrobial agents. Approved Marine Drugs as Pharmaceuticals Marine Natural products and its Challenges; Marine Natural Products and Clinical Trials, Marine Microbial Enzymes: Marine Extremozymes and Their Significance, Current Use of Marine Microbial Enzymes.
Unit-3: Marine Functional Foods and Nutraceuticals	Marine Functional Foods: Marine sources as healthy foods or reservoirs of functional ingredients, Marine-derived Ingredients with biological properties, Functional Foods Incorporating Marine-Derived Ingredients, Marine Nutraceuticals: Marine Bioactives as Potential Nutraceuticals, Functional Carbohydrates, Polyunsaturated Fatty Acids, Carotenoids, Soluble Calcium, Fish Collagen and Gelatin, Marine Probiotics, Nutraceutical Market Trends and Quality Control.
Unit-4: Marine Bioresources and Cosmetics	Marine Bioresources, Marine Secondary Metabolites, Marine Proteins, Marine Lipids; Future trends in Marine Pharmaceuticals, Cosmetics from Marine Sources: Scenario of Marine Sources in the Cosmetic Industry, cosmetics: Definition and Regulations, Cosmeceuticals, Target Organs and Cosmetics Delivery Systems, Components of Cosmetics, Major Functions of Some Marine Components in Cosmetics and Cosmeceuticals, Treatments Based on Marine Resources, Products Based on Marine Resources

References

1. Kim, S.K. Springer Handbook of Marine Biotechnology; Springer: Berlin, Germany; Heidelberg, Germany, 2015.
2. Nollet, Leo M. L- Marine microorganisms- extraction and analysis of bioactive compounds-CRC Press_Taylor& Francis (2017)
3. R. S. K. Barnes, R. N. Hughes(auth.)-An Introduction to Marine Ecology, Third Edition-Wiley-Blackwell (1999)
4. Blanca Hernández-Ledesma, Miguel Herrero-Bioactive Compounds from Marine Foods-Plant and Animal Sources-Wiley-Blackwell (2013)
5. Fabio Rindi, Anna Soler-Vila, Michael D. Guiry (auth.), Maria Hayes (eds.)-Marine Bioactive Compounds_Sources, Characterization and Applications-Springer US (2012)
6. W. Evans-Trease and Evans Pharmacognosy 15th ed.-Saunders (2010)

Proposed Practicals

UGBDSE602 Marine Biotechnology

1	Study of any 5 marine bacteria and algae (Macro and micro)
2	DPPH assay for antioxidant extracted from marine algae
3	Extraction of carotenoids from marine algae/Bacteria/Fungi
4	Extraction and estimation of Gelatin / Collagen.
5	Extraction of alkaloids from marine organisms and their separation by TLC.

Title of Paper: UGBTDSE603: Environmental Biotechnology

Unit 1: Environmental Pollution and its Effects	Sources of Pollution, Air Pollution: Types, Sources, Classification of Air Pollutants, Air Pollution Monitoring and Control, Water Pollution: Causes, Types and Classification, Eutrophication, Assessment of Water Quality, Pollutant Monitoring and Control, Soil and Solid Waste Pollution: Characteristics of Wastes, Impacts of Solid Waste on Health, Occupational Hazards and Control, Soil Erosion: Concept, Causes and Effects, Green house effect, Global Warming, Ozone Depletion, Kyoto Protocol, UV Radiation, Acid Rain.
Unit 2: Renewable Resources	Energy sources renewable – Solar energy, Wind power, Geothermal energy and Hydropower, Biomass energy, Biogas technology- Biogas plant & types, Bio-digester, Biogas- composition, production and factors affecting production, uses; Bio-fuels – Ethanol production, Microbial hydrogen production Biodiesel, Petro-crops
Unit 3: Effluent & Wastewater Treatment	Biological processes for industrial effluent treatment, aerobic biological treatment- activated sludge process, CASP, advanced activated sludge processes (any two) Biological filters, RBC, FBR, Anaerobic biological treatment- Contact digesters, Packed bed reactors, Anaerobic baffled digesters, UASB, Solid waste treatment, Pollution indicators & Biosensors
Unit 4: Bioremediation	Concept of Bioremediation, Biodegradation of xenobiotics- Persistent compounds, Chemical properties influencing biodegradability, Microorganisms in Biodegradation, Use of immobilized enzymes or microbial cells for treatment, Heavy metal pollution – Sources, microbial systems for heavy metal accumulation, Techniques used for heavy metal removal, Bioaugmentation and Biostimulation, Biosorption by bacteria, Fungi and algae, Factors affecting Biosorption, limitations of Biosorption

References:

1. Environmental Biotechnology Allan Scragg Oxford University press
2. Environmental Biotechnology (Basic concepts and applications) Indu Shekar Thakur IK International
3. Environmental Biotechnology (Industrial pollution management) S.D. Jogdand Himalaya Publishing House

Proposed Practicals

UGBTDSEP603 Environmental Biotechnology

1.	Study the effect of heavy metals on the growth of bacteria.
2.	Determination of Total Solids from an effluent sample.
3.	Study of physico-chemical (pH, color, turbidity, BOD, COD) parameters of any one industrial effluent sample
4.	Estimation of chromium from Effluents (Demonstration)
5.	Visit to ETP/CETP

Title of Paper: UGBTDSE604 Bioinformatics

Unit 1: Bioinformatics and Biological Databases	Bioinformatics, History, Goals, applications of bioinformatics 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). Genome Information Resources: DNA Sequence Databases Specialized Genomic Resources. Protein Databases based on Composition, Motifs and Patterns. Protein Structure Visualization Software
Unit 2: BLAST and Sequence Alignment	BLAST and its Types; Retrieving Sequence using BLAST. Pairwise Alignment : Identity and Similarity; Global and Local Alignment; Pairwise Database Searching. Multiple Sequence Alignment: Goal of Multiple Sequence Alignment; Computational Complexity; Manual Methods; Simultaneous Methods; Progressive Methods; Databases of Multiple Alignment; Secondary Database Searching; Analysis Packages;
Unit-3 Homology, Phylogeny, & Evolutionary trees	Homology & Similarity, Phylogeny & relationships, Approaches used in phylogenetic analysis, Phylogenetic trees- tree building methods, Molecular approaches to phylogeny, Phylogenetic analysis databases
Unit-4 Drug Discovery & Pharmainformatics	Discovering a drug, Target identification & validation, Identifying a Lead Compound, Optimization of Lead compound, Pharmainformatics, Chemical libraries, Search programs ; Cheminformatics - Chemical Structure Representation (SMILE & SMART).Chemical databases: CSD, ACD, WDI, ChemBank, hazardous chemical database, PUBCHEM Chemical Structure Representation (SMILE & SMART).Chemical databases: CSD, ACD, WDI, ChemBank, hazardous chemical database, PUBCHEM

References:

1. Basic Bioinformatics, S. Ignacimuthu
2. Introduction to Bioinformatics, T.K.Attwood
3. Introduction to Bioinformatics, Sundara Rajan

Proposed Practicals

UGBTDSEP604Bioinformatics

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.
6.	Chemical structure representation

