

Rayat Shikshan Sanstha's Karmaveer

Bhaurao Patil College, Vashi

(AUTONOMOUS)



Syllabus for Approval

Sr. No.	Heading	Particulars
1.	Title of the Course	S.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	2022-23

Date:

Name of BOS Chairperson: _____ Signature: _____

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



**Proposed Syllabus
For
S.Y.B.Sc. in Biotechnology
2022-23**

Preamble of the Syllabus:

Bachelor of Science (B.Sc.) in Biotechnology is a under graduation course of Department of Biotechnology, KarmaveerBhaurao 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-III

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

Semester III

Course code	Course Title	Credits	Course code	Course Title	Credits	Credits Total
Core Courses						
UGBTC301	Cell Biology	4	UGBTC301	Cell Biology	2	6
UGBTC302	Genetics	4	UGBTC302	Genetics	2	6
UGBTC303	Molecular Biology	4	UGBTC303	Molecular Biology	2	6
Skill Enhancement Courses(Any 1)						
UGBTSEC301	Food Science & Nutrition	4				4
UGBTSEC302	Food Adulteration & Safety	4				4
Generic Elective Courses (Any 1)						
UGBTGE301	Research Methodology	4	UGBTGE P-301	Research Methodology	2	6
UGBTGE302	Entrepreneurship Development	4	UGBTGE P-302	Entrepreneurship Development	2	6

Core Courses

Title of Paper: UGBTC301 Cell Biology

Course Outcome	<p>Students will be able to –</p> <ul style="list-style-type: none"> ▮ Develop an understanding of the various aspects of cell biology. ▮ Understand the principles of cellular transport & its role in different processes in body. ▮ Understand the structures of cell skeleton & its role.
Unit 1: Cytoskeleton	<p>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. Motor Protein: Myosin. Muscle Contractility: Sliding Filament Model. Actin Binding Proteins: Examples of Non-muscular Motility. Intermediate Filaments: Structure and Composition; Assembly and Disassembly; Types and Functions</p>
Unit 2: Cell Membrane	<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>
Unit-3: Cell Division	<p>Introduction, Types, amitosis, Mitosis and cell cycle- Interphase, mitotic phase, cytokinesis, The evolution of mitosis, Significance of mitosis, meiosis and reproductive cycle- Kinds of meiosis, process of meiosis, Significance of meiosis, Spindle dynamics, Cytokinesis, Regulation of cell cycle, Mitotic poison and inhibitors, Chalone, comparison between mitosis and meiosis</p>
Unit 4: Cell Signaling and signal transduction	<p>General Principles of cell communication: Introduction, Extracellular signal molecules binding to receptors, Cell signaling & Signal Forms of intercellular signalling - Autocrine, Transduction Contact dependent, Paracrine, Synaptic and Endocrine. Role of gap junction in signaling response to multiple extracellular</p>

	<p>signal molecules Morphogens, Lifetime of intracellular molecule, Role of Nitric oxide and nuclear receptors Binding reaction and role of Kd, Extracellular messengers and their receptors, GPCRs RTKs, Second messengers, Role of Calcium- Introduction, Calcium binding proteins</p>
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References:

1. The Cell : Molecular Approach, Cooper
2. Molecular Biology of Cell, Bruce Alberts
3. Cell and Molecular Biology, Karp
4. Lehninger’s Biochemistry, Nelson Cox
5. Biochemistry, Satyanarayana
6. Harper’s Illustrated Biochemistry, Murray

Proposed Practicals

UGBTCP-301 Cell Biology

1.	Study of endocytosis of salts through semi-permeable membrane
2.	Study of exocytosis of salts through semi-permeable membrane
3.	Purification of proteins by dialysis
4.	Mitosis in onion root tip
5.	Meiosis in Tradescantia flower bud
6.	Effect of Colchicine on Mitosis

Title of Paper: UGBTC302 Genetics

Course Outcome	Students will be able to – <ul style="list-style-type: none"> ▮ Understand basic concepts in Mendelian genetics ▮ Learn various genetic changes in relation to mendelian genetics ▮ Understand molecular events in cell cycle ▮ Comment on various genetic abnormalities ▮ Use mapping techniques
Unit – 1: Mendelian Genetics	Terminologies, Monohybrid Cross: Principle of Dominance and Segregation. Dihybrid Cross: Principle of Independent Assortment, Punnett Square, Problems based on monohybrid, dihybrid cross, Extension of Mendelian Genetics, Incomplete Dominance and Codominance. Multiple Alleles, Allelic series, Gene Interaction, Epistasis Dominant and recessive epistasis, Environmental effect on the expression of the Human genes
Unit – 2: Study of Chromosomes	Overview of cell cycle, mitosis and meiosis, Structure and shapes of metaphase chromosomes, Histone and non-histone proteins, Nucleosome, packaging of DNA into chromosome, Chromosome banding. Karyotype analysis (Normal human karyotype), Study of genetic abnormalities, Chromosomal aberrations, Turners syndrome, Klinefelter syndrome, Down syndrome, Cri-du-chat, Philadelphia chromosome, Sex determination, Dosages compensation.
Unit – 3: Genetic Mapping in Eukaryotes	Genetic linkage, Crossing over, Mapping using two point, three point cross, Tetrad analysis, Numerical problems based on two point and three point cross, Mendel's Principle in Human Genetics – Pedigree analysis, characteristics of human autosomal and sexlinked traits, pedigree analysis.
Unit 4 Techniques in Genetics	Molecular markers: RFLP, RAPD, VNTRs, Fluorescence in-situ hybridization, Genetic and physical maps, DNA fingerprinting, Autoradiography

References

1. Genetics by Peter Russell, 5th Edition.
2. iGenetics :A molecular approach by Russell, 3rd Edition
3. Genes VIII by Benjamin Lewin
4. Concepts of Genetics by William S Klug and Michael R Cummings, 7th Edition

Proposed Practicals

UGBTCP-302 Genetics

1.	Problems on Mendelian genetics - Two point and three point cross
2.	Problems on Pedigree analysis
3.	RFLP
4.	RAPD

Title of Paper: UGBTC303 Molecular Biology & Instrumentation

Course Outcome	Students will be able to – <ul style="list-style-type: none"> ▮ Learn structures of nucleic acids ▮ Findout difference between prokaryotic & eukaryotic DNA replication ▮ Understand central dogma of life ▮ Learn concept of genetic code ▮ Describe translation & post translation events in organism
Unit– 1: Nucleic Acids and DNA Replication	Structure of DNA, RNA, DNA Replication in Prokaryotes and Eukaryotes, Semi-conservative DNA replication, DNA Polymerases and its role, <i>E.coli</i> Chromosome Replication, Bidirectional Replication of Circular DNA molecules. Rolling Circle Replication, DNA Replication in Eukaryotes DNA Recombination – Holliday Model for Recombination, Types of Mutations, DNA repair
Unit– 2: Transcription Gene expression	Types of RNA, Structural and functional genes, An overview of transcription process in prokaryotes, mRNA synthesis in eukaryotes - Promoters and enhancers, Initiation of transcription at promoters, Elongation and termination of RNA chain, Post transcriptional modifications
Unit – 3: Translation	Deciphering genetic code, Characteristics of Genetic code, Wobble Hypothesis Translation in Prokaryotes Initiation, Elongation and Termination, Post translational modifications, Protein sorting. Post translational modifications
Unit-4 Instrumentation	Colorimetry- Principle, Technique and applications, Spectrophotometry- Principle, Technique and applications Chromatography – Thin layer and paper chromatography - Principle, Technique and applications Electrophoresis - Principle, Technique and applications of Agarose gel electrophoresis and polyacrylamide gel electrophoresis – Native & SDS PAGE

References

1. Genetics by Peter Russell, 5th Edition
2. i Genetics A Molecular Approach by Russell, 3rd Edition
3. Genes VIII by Benjamin Lewin
4. Molecular Biology of the Gene by J.D. Watson and Baker, 5th Edition
5. Molecular Biology by Robert Weaver, 2nd Edition

Proposed Practicals

UGBTCP-303 Molecular Biology

1.	Qualitative test for DNA and RNA
2.	Extraction of genomic DNA from plant source

3.	Measurement of purity and quantity of DNA
4.	Agarose Gel Electrophoresis (Demonstration)
5.	Polyacrylamide gel electrophoresis (Demonstration)

Skill Enhancement Courses

Title of Paper: UGBTSEC301: Food Science and Nutrition

Course Outcome	Student will be able to – <ul style="list-style-type: none"> ∣ Learn basic concepts of food ∣ Physicochemical properties of food ∣ Identify daily nutrient requirement of human body ∣ Classify food as per role and functions ∣ develop food regime for different age group people ∣ learn various food laws
Unit-1 Basic Food Science & Nutritional Biochemistry	Basic concept of food, nutrition and nutrients, classification of food, and nutrients. Introduction to the biochemistry and the main properties of the principle constituents of foods- lipids, proteins, carbohydrates, vitamins, minerals in nutrition. Physicochemical properties of food
Unit-2: Human Physiology, Microbiome and Human Nutrition – I	Overview of human physiology – body systems, Human gut microbiome, Basis for computing nutrient requirements Body fluids and water balance Body composition
Unit-3: Human Nutrition – II and Nutraceuticals	Energy metabolism Regulation of food intake Nutrition during life span Functional foods Overview of nutraceuticals Food laws
Unit-4 Healthy Diet, Over nutrition and Malnutrition	Healthy diet, Constituents Over nutrition & health risk Malnutrition & health risk Health Risks of Being Underweight Major nutritional problems prevalent in India Nutrition policy and programs Advances in nutritional sciences Geriatrics and pediatric nutrition

References

1. Fundamentals of Foods, Nutrition and diet Therapy, 5th Ed. ,Mudambi, SR and Rajagopal MV.
2. Food Science, 2nd Ed., Mudambi, S, Rao SM and Rajagopal MV.
3. Handbook of Foods and Nutrition, 5th Ed., M Swaminathan.
4. Textbook of Human Nutrition, Bamji MS, Rao NP, Reddy V.

Proposed Practicals

UGBTSECP-301 Food Science & Nutrition

1.	Determination of pulse rate in resting condition and after exercise
2.	Determination of blood pressure by Sphygmomanometer
3.	Preparation of food from different food groups and their significance in relation to health.
4.	Preparation of supplementary food for different age group and their nutritional significance.
5.	Planning and preparation of low cost diet for malnourished child.
6.	Comparison with norms and interpretation of the nutritional assessment data and its significance, Weight for age, height for age, weight for height, body Mass Index (BMI), Waist - Hip Ratio (WHR), Skin fold thickness.
7.	Planning and preparation of adequate meal for different age groups with special reference to different physiological conditions: infants, pre-schooler, school children, adolescents, adults, pregnancy, lactation and old age.
8.	Planning and preparation of normal diets.
9.	Planning and preparation of Diets for the diseases.
10.	Preparation of dishes suitable for older person- soft, semisolid and easily digestible balanced diet.

Title of Paper: UGBTSEC302 :Food Adulteration & Safety

Course Outcome	<p>Student will be able to –</p> <ul style="list-style-type: none"> ▮ Learn basic concepts of food ▮ Physicochemical properties of food ▮ Identify daily nutrient requirement of human body & deficiency related disorders ▮ Learn various aspects of food safety
Unit-1 Nutritional aspect of food	<p>Food Chemistry (Occurrence, chemistry, source, structure, and composition)</p> <ul style="list-style-type: none"> • Carbohydrates- mono, di, oligo, polysaccharides. Example sugar, starch, glycogen, pectin, gums, cellulose, hemicellulose • Proteins- amino acids, essential and non-essential, classification of proteins, structure of protein • Lipids- properties, functions, sources, classification of fatty acids, triglycerides, steroid, phospholipids • Fat soluble vitamins (A, D, E, K) and water soluble vitamins (B complex, vitamin C): occurrence, chemistry, daily requirements • Inorganic ions: calcium, phosphorus, iron, sodium, potassium, magnesium and trace elements (dietary sources and biochemical importance) <p>Types of food Cereals Pulses Wheat Rice Corn Fruits & Vegetables Milk, milk products, Meat, fish and poultry Oil seeds, spices Balanced diet</p>
Unit-2: Food Deficiency Diseases, Metabolic disorders	<p>Carbohydrate deficiency diseases: Ketosis, Acidosis, Hypoglycemia, Muscle wasting etc. Protein deficiency</p>

and Symptoms	diseases: protein energy malnutrition, Kwashiorkor, Marasmus etc. Lipid deficiency diseases: Alopecia, thrombocytopenia, scaly dermatitis Vitamin (A,B,C,D, E and K) deficiency diseases Mineral deficiency diseases: Na, K, Ca, P, Fe, Mg etc. Metabolic Disorders: Diabetes, Arteriosclerosis, Atherosclerosis
Unit-3: Food Adulteration	Commonly used adulterants and adverse effects in: Tea leaves, Coriander and cumin powder, Green vegetables, Arhar pulse, Black pepper, Rice, Wheat, Coffee powder, Jaggery, Asafoetida, Gram powder, Processed food, Parched rice, Turmeric powder, Dry red chilli, Sweet potato, Dry turmeric root, Mustard oil, Edible oil, Soda lemonade, Milk, Sweet curd, Rabdi, Ghee etc.
Unit-4: Food safety	Aspects of food safety- HACCP, GMP, role of FDA, Agmark, ISI, fssai Concept of sanitation and hygienic production of food Food Act, Food rules and Quality control

References

1. Food Chemistry 4th Ed, H.D. Belitz
2. Harpers Illustrated Biochemistry
3. Manual for Detection of the Common Food Adulterants, Edwin M Bruce
4. Food Microbiology, Frazier and Westhoff, Tata McGraw Hill Publishers, New Delhi
5. Nutrition science, B. Srilaxmi, New age international (P) Ltd
6. Quick test for some adulterants in food, Instruction manual- Part II, FSSAI
7. Restaurant X Food Safety Training Manual

Proposed Practicals

UGBTSECP-302 Food Adulteration & Safety- Testing of commonly used adulterants in:

Sr. No.	Food Groups	Food Items
1	Beverages	Tea, coffee, soda lemonade etc
2	Pulses	Arhar pulse, moong, chick pea, matki etc
3	Grains	Rice, wheat, ragi,
4	Dairy & dairy products	Milk, curd, ghee, butter etc
5	Sweeteners	Sugar & Jaggery
6	Spices & condiments	Black pepper, asafoetida, turmeric, chilli, mustard, coriander powder etc
7	Fats	Edible oil

Generic Elective Courses

Title of Paper: UGBTGE301 Research Methodology

Course Outcome	Student will be able to – <ul style="list-style-type: none"> ∥ Understand the principles of research methodology and its significance ∥ Understand the methods of data collection, interpretation and report writing ∥ Understand the importance of communication and its role in science
Unit 1: Introduction to research methodology	Meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology, criteria of good research, problems encountered by researchers in India
Unit 2: Research problem, Research design and Data collection	Research problem, selecting the problem, necessity of defining the problem, techniques involved in defining the problem Need for research design, Features of a good design, Primary data, Secondary data, Different methods for the collection of primary and secondary data, other methods of data collection, Case study method..
Unit 3: interpretation and Report writing	Interpretation, Technique of interpretation, Precautions in interpretation, Significance of report writing, Different steps in writing report, Layout of the research report, Mechanics in writing report Examples of scientific and unscientific writing, Writing papers, Reviews, Bibliography Plagiarism- Introduction to plagiarism, Examples of plagiarism
Unit 4: Communication in Science	Introduction to communication elements, Scope of communication and communication as part of science Communication elements: verbal and non-verbal communication Principles of effective communication, oral presentations Communication methods in science

References:

1. Research Methodology, C.R.Kothari
2. Basic Communication Skills for Technology, Andea J. Rutherford

Proposed Practicals

UGBTGEP-301 Research Methodology

1	Assignment on problems faced by researchers in India
2	Survey Based project
3	Review paper writing
4	Research proposal writing

Title of Paper: UGBTGE302 Entrepreneurship Development

Course Outcome	Students will be able to - <ul style="list-style-type: none"> ▮ Develop an understanding of the systematic process ▮ Identify the business idea ▮ Design strategies for successful implementation of Ideas
Unit 1: Introduction to entrepreneurship development	Concept of Entrepreneur; Entrepreneurship; Need and Importance; Factors Influencing Entrepreneurship; Essentials of a Successful Entrepreneur
Unit 2: Entrepreneurship as Innovation and Problem Solving, Entrepreneurship Journey	Competencies, Risk taking, Determination, Initiative, problem solving ability, Adaptability to changing technologies Concept of Social Entrepreneurship Feasibility Study and opportunity, Idea generation
Unit 3: Setting up an enterprise and planning	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, Product Selection and Ideas; Project Planning and Formulation; Project Feasibility Assessment; Regulatory Affairs, Corporate Laws, Innovation, IPR generation and Protection, Preparation of a Business Plan, Characteristics and Importance of Planning
Unit 4: Marketing, Sales, Advertising and International market research	Marketing Plan for an Entrepreneur; Strategic Alliances, Advertising and Sales Promotion; Market Assessment, Need for International Market Research, Domestic vs. International Market Research, Cost and Methodology of Market Research, Desk and Field Research

References:

1. Introduction to Entrepreneurship, National Open University of Nigeria
2. Entrepreneurial Development, M. C. Garg
3. Entrepreneurship Development and management, Dr. A. K. Singh
4. Entrepreneurship Development, Khudra
5. Entrepreneurship Development, Jayshree Suresh

Proposed Practicals

UGBTGEP-302 Entrepreneurship Development

1	Assignment based on steps of Entrepreneurship Development
2	Types of advertisement
3	Different Marketing strategies for product selling
4	Success Story of any one entrepreneur
5.	Business proposal writing

SEMESTER-IV

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

Semester IV

Course code	Course Title	Credits	Course code	Course Title	Credits	Credits Total
Core Courses						
UGBTC401	Immunology	4	UGBTCP401	Practicals of Immunology	2	6
UGBTC402	Genetic Engineering	4	UGBTCP402	Practicals of Genetic Engineering	2	6
UGBTC403	Medical Microbiology	4	UGBTCP403	Practicals of Medical Microbiology	2	6
Skill Enhancement Courses(Any 1)						
UGBTSEC401	Biofertilizer Production	4				4
UGBTSEC402	Mushroom Cultivation	4				4
Generic Elective Courses (Any 1)						
UGBTGE401	Evolution & Ecology	4	UGBTGE P-401	Practicals of Evolution and Ecology	2	6
UGBTGE402	Bioethics and Biosafety	4	UGBTGE P-402	Practicals of Bioethics and Biosafety	2	6

Core Courses

Title of Paper: UGBTC401 Immunology

Course Outcome	Students will be able to – <ul style="list-style-type: none"> ▮ Describe the interaction between antigens and antibodies ▮ Understand significances of various methods of antigen/antibody detection and quantification ▮ Understand the receptors involved in signal transduction to elicit an immune response ▮ Understand the negative effects of overexpression of immune response
Unit 1: Introduction to Immunology and Effectors of Immune Response	Overview of Immune system. Innate and Adaptive Immunity. Hematopoiesis Cells of the Immune System: Lymphoid Cells [B Lymphocytes (B Cells), T Lymphocytes (T Cells)], Natural Killer Cells, Mononuclear Phagocytes, Granulolytic Cells, Mast Cells, Dendritic Cells, Follicular Dendritic Cells. Organs of the Immune System: Primary Lymphoid Organs, Secondary Lymphoid Organs
Unit 2: Antigens and Antibodies	Antigens: Immunogenicity Versus Antigenicity, Epitopes, Types of Antigens, Haptens, Adjuvants Antibodies: Basic Structure of Antibodies, Antibody Classes and Biological Activity, Antigenic Determinants on Immunoglobulins Monoclonal Antibodies, Hybridoma Technology
Unit 3: Antigen – Antibody Interaction	Precipitation reaction, Precipitin curve, Immunodiffusion reactions – single/ double/ radial, immunoelectrophoresis Agglutination reactions, Radioimmunoassay ELISA, ELISPOT, Western blotting, CFT, Immunoprecipitations, Immunofluorescence, Chemiluminiscence, Flow cytometry
Unit 4: Vaccines	Active and Passive Immunization Attenuated Vaccines, Inactivated or "Killed" Vaccines, Subunit Vaccines, Peptide Vaccines, Vector Vaccines, Conjugate Vaccines, Genetic Immunization, Anti Covid-19 vaccines Role of Biotechnology in Vaccine Production.

References:

1. Immunology, Barbara A. Osborne and Janis Kuby
2. Textbook of Microbiology, Ananthnarayan
3. Immunology, C.V.Rao
4. New Generation Vaccines, 4 th ed., Myrone M. Levine
5. Molecular Biotechnology, Glick and Pasterneck

Proposed Practicals

UGBTCP-401 Immunology

1.	Determination of relationship between 2 given antigen by Ouchterlony's method
2.	Determination of the concentration of antigen using Radial immunodiffusion technique
3.	To determine the presence of antigen by sandwich ELISA method
4.	To determine the presence of antigen by DOT ELISA method
5.	To determine the RA antigen
6.	Hemagglutination

Title of Paper: UGBTC402 Genetic Engineering

Course Outcome	Students will be able to – <ul style="list-style-type: none"> Learn enzymes used in genetic engineering Understand properties of vector Learn various concepts of recombinant DNA technology Describe techniques in transgenic animal and plants
Unit 1: Enzymes in Gene Cloning	Sources, Mode of Action, Applications of Nucleases – Endo, exo, DNase –I, RNase, S1 Nuclease, Mung bean nuclease Restriction endonucleases - types, nomenclature, target sites, nature of cut ends, host control restriction and modification, star activity, isoschizomeres, neoschizomeres, examples with restriction sites. Ligases, DNA polymerase, Reverse transcriptase, Alkaline phosphatases, Polynucleotide kinase, Terminal transferase
Unit 2: Vectors	Properties of ideal vector, copy number Plasmid cloning vector – pBR322, pUC19 Phage vectors – Lambda phage vectors, M13 Cosmids, Shuttle vectors, Expression vectors pET vectors YAC, BAC Plant vectors – Ti Plasmid derived vector, Plant viruses derived vectors
Unit 3: Techniques in Genetic Engineering	Recombinant DNA technology, Detection of clones, Electrophoresis, Construction and screening of gDNA and cDNA libraries, Restriction digestion, Southern Blot analysis, Northern Blot analysis, Western blot analysis, DNA sequencing, Polymerase chain reaction and variations, Chromosome walking, jumping
Unit 4: Genetic Engineering in Plants and Animals	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: 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

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**UGBTCP-402 Genetic Engineering**

1	Isolation of genomic DNA from E.coli
2	Isolation of plasmid DNA
3	Separation of DNA by AGE
4	Study of restriction digestion
5	To amplify the gene using PCR
6	To separate protein samples using SDS PAGE
7	Detection of specific protein by western blotting technique.

Title of Paper: UGBTC403 Medical Microbiology

<p>Course Outcome</p>	<p>Students will be able to –</p> <ul style="list-style-type: none"> ▮ Learn various concepts in medical microbiology ▮ List the factors playing a role in causing a disease. ▮ Discuss the various aspects of systemic infections including causative agents, symptoms and prophylaxis ▮ Gain the technical capability of handling, isolating and identifying various bacteria.
<p>Unit 1: Infectious Diseases</p>	<p>Normal Flora- Origin, Gnotobiotic life, rearing germ free animals Etiology of infectious disease- Koch’s Postulates. Classifying infectious diseases (Types of infection), Signs and Symptoms, Stages of disease Factors In The Development Of Infection- portal of entry, adhesion, invasion of host (antiphagocytic factors, exoenzymes, toxins), portal of exit Origin Of Pathogens- Reservoirs (human, animal and non-living) Transmission Of Disease- Contact, Vehicle and vector transmission Nosocomial Infections Epidemiology of infectious diseases</p>
<p>Unit 2: Medical Microbiology Causative Organisms-I</p>	<p>Skin : S. aureus, S. pyogenes. Tinea Infections Respiratory Tract Infections : M. tuberculosis, (Characteristics Transmission, Course of Infection, Lab Diagnosis, Management of TB, Prevention and Control, Immuno and Chemoprophylaxis, DOTS and MDR). S. pneumoniae, SARS CoV2 (viral genome, Transmission of COVID 19, Pathogenesis, Lab diagnosis, Treatment, Prophylaxis and preventive measures- social distancing) Urinary Tract Infections : E.coli : Characteristics, Virulence, Clinical disease, Proteus spp.</p>
<p>Unit 3: Medical Microbiology Causative Organisms-II</p>	<p>GI Tract Infections : E.coli: enteropathogenic strains of E. coli Salmonella and Shigella spp. (Characteristics, Virulence-Pathogenesis and Immunity, Clinical Disease, Carriers Lab Diagnosis, Prophylaxis and Treatment). Sexually Transmitted Diseases : Syphilis and Gonorrhoea. Nosocomial Infections : Ps. aeruginosa Parasitic Blood infection-Malarial parasites: Life Cycle, Diagnosis and Treatment Medical mycology – Tinea Infections</p>
<p>Unit 4: Chemotherapeutic Agents</p>	<p>Chemotherapeutic drugs, Discovery and Design of antimicrobial agents, Classification of Antibacterial agents, selective toxicity, MIC, MLC, Inhibition of cell wall synthesis (Mode of action for): Beta lactam antibiotics: Penicillin, Cephalosporins; Glycopeptides: Vancomycin; Polypeptide: Bacitracin, Injury to plasma membrane: Polymyxin, Inhibition of protein synthesis: Aminoglycosides, Tetracyclines, Chloramphenicol, Macrolides- Erythromycin, Inhibition of Nucleic acid synthesis: Quinolones, Rifampicin, Metronidazole, Antimetabolites: Sulphonamides, Trimethoprim drug Resistance: Mechanism, Origin and transmission of drug resistance, Use and misuse of antimicrobial agents.</p>

References:

1. Textbook of Microbiology, Anantnarayan & Paniker, 10th Edition
2. Microbiology, An Introduction, Tortora, Funke, Case, 10th Edition
3. Medical Microbiology, Murray, Rosenthal, Pfaller, 7th edition
4. Microbiology, Prescott, Harley and Klein, 5th edition

Proposed Practicals**UGBTCP-403 Medical Microbiology**

1.	Determination of MIC & MLC of antibiotic
2.	Determination of AST & Synergy
3.	Identification of <i>S.aureus</i> -Isolation, Catalase, Coagulase Test.
4.	Identification of <i>E.coli</i> -Isolation, Sugar Fermentations, IMViC.
5.	Identification of <i>Salmonella</i> - Isolation, Sugar Fermentations, TSI Slant
6.	Identification of <i>Shigella</i> - Isolation, Sugar Fermentations, TSI Slant
7.	Identification of <i>Proteus</i> - Isolation, Sugar Fermentations, IMViC
8.	Identification of <i>Pseudomonas</i> - Isolation, Urease test, Oxidase Test, TSI Slant

Skill Enhancement Courses

Title of Paper: UGBTSEC401: Biofertilizer Production

Course Outcome	Student will be able to – <ul style="list-style-type: none">• Learn importance of biofertilizer• Understand classification of biofertilizer• Properties of biofertilizers• Discuss applications of biofertilizers
Unit-1: Introduction	Introduction, History and concept of Bio fertilizers, status scope and importance of Bio fertilizers, Classification of Bio fertilizers, Nitrogen fixation.
Unit-2: Types of Biofertilizers	Structure and characteristic features of bacterial Bio fertilizers- Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia; Cynobacterial biofertilizers- Anabaena, Nostoc, Hapalosiphon and fungal biofertilizers- AM mycorrhiza and ectomycorrhiza
Unit-3: Production technology	Strain selection, sterilization, growth and fermentation, equipment, mass production of carrier based and liquid bio fertilizers. FCO specifications and quality control of bio fertilizers.
Unit-4: Applications	Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers -Storage, shelf life, quality control and marketing. Factors influencing the efficacy of bio fertilizers.

References

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

Proposed Practicals

UGBTSECP-401 Biofertilizer production

1	Isolation of Rhizobium from leguminous plants
2	Isolation of Azotobacter
3	Isolation of phosphate solubilizing bacteria
4	Immobilization Technique – Preparation of Agrobeads
5	Consortium Preparation and checking its efficiency

Title of Paper: UGBTSEC402 : Mushroom Cultivation

Course Outcome	Student will be able to – <ul style="list-style-type: none">• Learn aspects in mushroom cultivation• Understand classification of mushroom• Learn properties of various mushroom• Design model strategy for mushroom cultivation
Unit-1 : Introduction	Introduction to mushrooms Mushrooms -Taxonomical rank -History and Scope of mushroom cultivation - Edible and Poisonous Mushrooms- Vegetative characters
Unit-2: Types of Mushrooms	Common edible mushrooms, Button mushroom (<i>Agaricus bisporus</i>), Milky mushroom (<i>Calocybe indica</i>), Oyster mushroom (<i>Pleurotus sajorajju</i>) and paddy straw mushroom (<i>Volvariella volvcea</i>).
Unit-3: Mushroom Cultivation	Principles of mushroom cultivation Structure and construction of mushroom house. Sterilization of substrates. Spawn production - culture media preparation- production of pure culture, mother spawn, and multiplication of spawn. Composting technology, mushroom bed preparation. Spawning, spawn running, harvesting. Cultivation of oyster and paddy straw mushroom. Problems in cultivation - diseases, pests and nematodes, weed moulds and their management strategies. .
Unit-4: Health Benefits of Mushrooms	Health benefits of mushrooms Nutritional and medicinal values of mushrooms. Therapeutic aspects- antitumor effect, Post harvest technology, Preservation of mushrooms - freezing, dry freezing, drying, canning, quality assurance and entrepreneurship. Value added products of mushrooms.

References

1. Industrial Microbiology, Prescott & Dunn
2. Marimuthu, T. et al. (1991). Oyster Mushroom. Department of Plant Pathology. Tamil Nadu Agricultural University, Coimbatore.
3. Nita Bhal. (2000). Handbook on Mushrooms. 2nd ed. Vol. I and II. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Pandey R.K, S. K Ghosh, 1996. A Hand Book on Mushroom Cultivation. Emkey Publications.
5. Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur.
6. Tewari Pankaj Kapoor, S. C. (1988). Mushroom Cultivation. Mittal Publication, New Delhi.
7. Tripathi, D.P. (2005) Mushroom Cultivation, Oxford & IBH Publishing Co. PVT.LTD, New Delhi.

8. V.N. Pathak, Nagendra Yadav and Maneesha Gaur, Mushroom Production and Processing Technology/ Vedams Ebooks Pvt Ltd., New Delhi (2000)

Proposed Practicals

UGBTSECP-402 Mushroom Cultivation

1	Media preparation
2	Preparation of Spawn
3	Cultivation of oyster mushroom
4	Assignment on Medicinal value of Mushrooms

Generic Elective Courses

Title of Paper: UGBTGE401 Evolution and Ecology

Course Outcome	Student will be able to – <ul style="list-style-type: none"> • Learn aspects various aspects in Evolution and related theories • Understand concepts of speciation • Learn properties of Ecosystem • Design model for varied interactions • Understand the concept of nutrient recycling
Unit Evolution 1:	Origin of Life; Theories of Evolution, Lamarckism and Darwinism; Evidences of Evolution; Natural Selection, Evidences, Modes, Sexual selection; Pattern of evolution, Convergent, Coevolution, Parallel, Adaptive radiation, Red queen hypothesis
Unit 2: Species and speciation	Species concept; reproductive isolations, Haldane's rule Speciation, Types, Evolutionary forces involved in speciation, Pattern of evolutionary changes; Nature of evolution Molecular Phylogeny, Molecular clock, Phylogenetic tree, classification
Unit Ecosystem and Interactions 3:	Ecology and Biogeography. Ecosystems, Definition and Components, Structure and Function of Ecosystems. Aquatic and Terrestrial Ecosystems, Biotic and Abiotic Factors, Trophic Levels, Food Chain and Food Web, Ecological Pyramids (Energy, Biomass and Number) Interactions, Commensalism, Mutualism, Predation and Antibiosis, Parasitism

Unit 4: Biogeochemical Cycles	Nutrient Cycle and Biogeochemical Cycles: Water, Carbon, Oxygen, Nitrogen, Sulphur & Phosphorus, Biological control of chemical factors in environment, Production and decomposition in nature, Biodistribution of elements, Ozone layer.
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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

UGBTGEP-401 Ecology and Ecosystem

1	Study of Interactions Commensalism, Mutualism, Predation and Antibiosis, Parasitism
2	Setting up of Winogradsky column and it's study
3	Study of Nutrient Cycle and Biogeochemical Cycles
4	Problems based on phylogenetic tree
5	Project based on evolutionary studies

Title of Paper: UGBTGE402 Bioethics and Biosafety

Course Outcome	Student will be able to – <ul style="list-style-type: none"> • Learn the concept of Biosafety cabinet • Understand the concept of bioethics • Design work practices in biosafety cabinet • Learn ethical issues in rDNA technology • Learn risk assessment and management aspects in bioethics
Unit 1: Introduction to Biosafety	Introduction, Biological Risk Assessment, Hazardous Characteristics of Agent, Genetically modified agent hazards, Cell cultures, Hazardous Characteristics of Laboratory Procedures, Potential Hazards Associated with Work Practices, Safety Equipment and

	Facility Safeguards Pathogenic risk and management
Unit 2: Biosafety Levels & Risk management	Biosafety cabinets, Primary containments for biohazards, Biosafety levels, GMOs, LMOs and their environmental impact, Roles of institutional biosafety committee, Review committee for genetic manipulation (RCGM), Genetic engineering appraisal committee (GEAC) for GMO applications in food and agriculture risk analysis assessment and management
Unit 3: Introduction to Bioethics	Introduction to bioethics, Bioethical issues related to health care, medicine, food and agriculture genetic engineering Human genome project and genetic testing environmental problems, Ethical implications on biotechnological products and techniques, Social and ethical implications of biological weapons
Unit 4: Management Aspects	Bioethics and assisted reproductive technology Management aspects of biotechnology and genetic engineering. Recommended biosafety levels for infectious agents and infected animals Ethical issues related to rDNA technology, GM crops, Gene therapy and Stem cell research

References:

1. Pharmaceutical Microbiology - Hugo, W.B, Russell, A.D 6th edition Oxford Black Scientific Publishers.
2. Biosafety in Microbiological and Biomedical Laboratories - 5th Edition, L. CaseyChosewood Deborah E. Wilson U.S. Department of Health and Human ServicesCenters for Disease Control and Prevention National Institutes of Health.
3. Molecular Biotechnology –Principles and Applications of Recombinant DNA Glick,B.R, Pasternak, J.J Patten, C.L 3rd edition ASM press

Proposed Practicals

UGBTGEP-402 Bioethics and Biosafety

1	Assignment on different Biosafety levels
2	Assignment on ethical issues in assisted reproductive technology
3	Assignment on ethical issues related to GM crops