Rayat Shikshan Sanstha's

Karmaveer Bhaurao Patil College Vashi

[Autonomous College]

Syllabus (CBCGS Pattern)

Sr. No.	Heading	Particulars
1	**Title of Course**	**Applied Component: Biotechnology**
2	**Eligibility for Admission**	**S.Y.B.Sc. Microbiology [of recognized Boards]**
3	**Passing Marks**	**40%**
4	**Ordinances/Regulations (if any)**	-
5	**No. of Years/Semesters**	**One year/Two semester**
6	**Level**	**U.G.**
7	**Pattern**	**Semester**
8	**Status**	**Revised**
9	**Implemented from Academic year**	**2020-2021**

AC-04/04/2020

Item No-6.4

Rayat Shikshan Sanstha's

KARMAVEER BHAURAO PATIL COLLEGE VASHI

(AUTONOMOUS COLLEGE)

Sector-15- A, Vashi, Navi Mumbai - 400 703

Syllabus for T.Y.B.Sc. Microbiology

Program: B.Sc. Microbiology

Course: Applied Component: Biotechnology

(Choice Based Credit, Grading and Semester System

with effect from the academic year 2020-2021)

Preamble

Bachelor of Science (B.Sc.) in Microbiology is an under graduate program of Department of Microbiology, Karmaveer Bhaurao Patil College Vashi, Navi Mumbai [Autonomous College]

Microbiology is a branch of science that studies microorganisms such as bacteria, protozoa, algae, fungi, bacteria, viruses, etc. These studies integrate cytology, physiology, ecology, genetics and molecular biology, evolution, taxonomy and systematics with a focus on microorganisms.

The relevance and applications of microorganisms to the surrounding environment including human life and Mother Nature becomes part of this branch. Since inception of this branch of science, Microbiology has remained a field of active research and ever expanding in all possible directions; broadly categorized as pure and applied science.

Different branches of Pure Microbiology based on taxonomy are Bacteriology, Mycology, Protozoology and Parasitology, Phycology and Virology; with considerable overlap between these specific branches over each other and also with other disciplines of life sciences, like Biochemistry, Botany, Zoology, Cell Biology, Biotechnology, Nanotechnology, Bioinformatics, etc.

Areas in the applied Microbial Sciences can be identified as: Medical, Pharmaceutical, Industrial (Fermentation, Pollution Control), Air, Water, Food and Dairy, Agriculture (Plant Pathology and Soil Microbiology), Veterinary, Environmental (Ecology, Geomicrobiology); and the technological aspects of these areas.

Microbiological tools have been extensively used to study different life processes and are cutting edge technologies. There is a continual demand for microbiologists in the work force – education, industry and research. Career opportunities for the graduate students are available in manufacturing industry and research institutes at technical level.The content of a syllabus should be such that it maintains continuity with the course content of higher secondary class and post graduate course.The present curriculum is made keeping this in mind and is an effort to impart fundamental knowledge of the subject needed at this level. The curriculum is designed as per the guidelines for Choice Based Credit System and reflects the total credit, teaching hours and evaluation pattern.

Objectives of the Course:

1. To revise and impart to the students, knowledge of the basic techniques of biotechnology with respect to gene cloning and cloning vectors.
2. To give the students an overview of bioremediation of soil, water and the different methods of using genetically engineered microbes and plants. To provide a basic insight into the methods of generating transgenic animals and study their applications.
3. To give an insight into the role of microorganisms in industrial and marine biotechnology.
4. Aims at imparting knowledge on recent trends in plant and healthcare biotechnology.
5. Aims at highlighting the significance of bioenergy and biofuel.
6. Create awareness of the importance of Biotechnology in society

Program Outcomes (POs)

PO-1	**Disciplinary Knowledge:** (i) Acquire the knowledge with facts and figures related to various subjects in pure sciences such as Physics, Chemistry, Mathematics,Microbiology and Computer Science; and Biotechnology, Information Technology and itsother fields related to the program. (ii) Understand the basic concepts, fundamental principles, theoretical formulations and experimental findings and the scientific theories related to various scientific phenomena and their relevance in the day-to-day life.
PO-2	**Communication Skills:**Develope various communication skills such as reading, listening and speaking skills etc., which we will help in expressing ideas and views clearly and effectively.
PO-3	**Critical Thinking:** Think creatively to propose novel ideas in explaining the scientific data, facts and figures related to science and technology.
PO-4	**Analytical Reasoning and Problem Solving:**Identify, describe, formulate, interpret, analyze the data systematically and solve theoretical and numerical problems in the diverse areas of science and technology and provide alternate solutions to the problems.
PO-5	**Sense of Inquiry:**Curious for asking relevant questions like why and how for better understanding of the basic concepts, fundamental principles, scientific theories and applications related to the study.
PO-6	**Use of Modern Tools:**Use of modern tools, equipments, instrumentation and laboratory techniques to design and perform the experiments and write the programs in different languages (software).
PO-7	**Research Skills:** Ability to search for, find, collect, analyze, interpret and evaluate information/data that is relevant to the subjects related to science and technology being studied.
PO-8	**Application of Knowledge:** Develop scientific outlook with respect to the subjects related to science and technology and also participate in various social and cultural activities.
PO-9	**Ethical Awareness:** Imbibe ethical and social values in personal and social life leading to cultured and civilized personality.
PO-10	**Teamwork:** Work effectively within the groups and individuals, participate and take initiative for various field-based situations related to science, technology and society at large.
PO-11	**Environment and Sustainability:** Understand how development in science and technology and interdisciplinary subjects are taking place for protecting our environment and sustainable developments.
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.

Program Specific Outcomes [PSO's]: UG

By the end of the course, a student should develop the ability to

PSO_1: Understand the various aspects of microbial world and history of microbiology

PSO_2: Differentiate and classify different types of microorganism and its characteristics

PSO_3: Distinguish between Prokaryotes and Eukaryotes with respective to their ultra-structure and functions

PSO_4: Understand & differentiate the requirement of nutrients and environmental conditions for the growth of microorganisms

PSO_5: Apply the knowledge of basic instrumentation, basic techniques in microbiology and control of microorganism

PSO_6: Explain and describe types and functions of different biomolecules found in living cells

PSO_7: Describe the aspects of microbial ecology and industrial microbiology

PSO_8: Illustrate the basic immunology and medical microbiology

T.Y.B.Sc. Applied Component: Biotechnology Curriculum
Revised for Credit Based Semester & Grading System
To be implemented from the academic year 2020-2021
SEMESTER V

Theory:

COURSE CODE	UNIT	TOPIC HEADINGS	Credits	NH/ week
UGECBT 501 Concepts in Biotechnology	Unit I	Importance of Biotechnology and Tools in Genetic Engineering	4	4
	Unit II	Techniques in Genetic Engineering		
	Unit III	Bioinformatics and IPR		
	Unit IV	Industrial Biotechnology		

PRACTICAL:

COURSE CODE	TOPIC HEADINGS	Credits	NH/ week
UGECBTP05	Concepts in Biotechnology	1.5	4

SEMESTER V

Course Outcome: Paper I: UGECBT501

By the end of the course, a student should develop the ability to

CO1: Correlate between Modern and Traditional Biotechnology. [2] *

CO2: Illustrate the cloning and selection process for Cloned genes.[3] *

CO3: Differentiate various branches of Bioinformatics [4]*

CO4: Understand aspects of industrial production of Cheese, Yoghurt, Biopolymers, Ascorbic acid and Indigo [2]*

CO5: Solve analytical problems in Bioinformatics [4]*

CO6: Set up Immobilization of *Saccharomyces cerevisiae* using sodium alginate and perform Invertase assay [6]*

***Note: [1]: Remembering, [2]: Understanding, [3]: Applying, [4]: Analyzing, [5]: Evaluating, [6]: Creating**

SEMESTER V Paper I		
Course Code	**Title**	**Credits**
UGECBT501	**Concepts in Biotechnology**	**4 Credits (60 Lectures)**
Unit I	**Importance of Biotechnology and Tools in Genetic Engineering** **1.1 History of Biotechnology** – Traditional and Modern Biotechnology. Biotechnology as an interdisciplinary area, Global impact and current excitements in Biotechnology. (Health care,Agriculture, environment, CRISPR/Cas9), Biodiversity and its preservation. **1.2 Tools in Genetic Engineering** a. Basic requirements: Electrophoresis, agarose gel electrophoresis, Pulse field gel electrophoresis (PFGE), SDS-PAGE,2Dgel electrophoresis. b. Spectrophotometry, Matrix assisted laser desorption ionization (MALDI), Surface enhanced laser desorption ionization (SELDI), Electrospray ionization (ESI), Random amplified polymerase DNA (RAPD), Probes. c. Genome mapping: genome maps, molecular markers,	**(15 Notional Hours)**

	Restriction fragment length polymorphism (RFLP) variable number tandem repeats (VNTR), chromosome jumping, chromosome walking,DNA amplification Finger Printing (DAF). **d.** Blotting Techniques: Southern, Northern and Western blotting. DNA sequencing, ELISA, RIA, Nick translation and in situ Hybridization.	
Unit II	**Techniques in Genetic Engineering** **2.1. Cutting and joining of DNA:** Exonucleases, Endonucleases,RestrictionEndonucleases(TypeI,II,III). Examples of some enzymes – DNA ligases, Alkaline Phosphatases, DNA polymerases, Use of Linkers and Adaptors. **2.2. Cloning Vectors**: Properties of good vector, Cloning and Expression vectors. *E. coli* vectors–Plasmid, Cosmid, Phagmid, Bacteriophage vectors. Vectors for other bacteria, Shuttle vectors, Yeast vectors,Vectors for animals and plants. **2.3. Steps in gene cloning:** Isolation of desired gene, cDNA library, Genomic library, Chemical synthesis of gene. Gene amplification by PCR, Introduction of vector into suitable bacterial host (various transformation methods), Selection of recombinant clones, selection of clones containing recombinant vector, selection of clones containing specific DNA inserts, colony hybridization test.	**(15 Notional Hours)**
Unit III	Bioinformatics and IPR **3.1 Bioinformatics** a. Introduction b. Definition, aims, tasks and applications of Bioinformatics. c. Database, tools and their uses - d. Importance, Types and classification of databases e. Nucleic acid sequence databases- EMBL, DDBJ, GenBank, GSDB, Ensembl and specialized Genomic resources. f. Protein sequence databases-PIR, SWISS-PROT, TrEMBL NRL-3D.Protein structure databases-SCOP, CATH, PROSITE, PRINTS and BLOCKS. KEGG. g. Brief introduction to Transcriptome, Metabolomics,Pharmacogenomics,Phylogenetic analysis, Phylogenetic tree, Annotation,	**(15 Notional Hours)**

	h. Sequence alignment-- global v/s local alignment, FASTA, BLAST. i. Genomics- structural, functional and comparative genomics. j. Proteomics- structural and functional proteomics. **3.2 Introduction to IPR**:Genesis, Role of WTO and TRIPS a. Overview of patent system b. Requirements for patentability c. Patent Categories d. Preliminary steps for patent applications e. Patent Procedures for biotech and microbiological products **3.3 Legal, Social and ethical aspects of Biotechnology.** Patent Laws, Bioethics.	
Unit IV	**Industrial Biotechnology** **4.1 Exploitation of Microorganisms to produce primary and secondary metabolites**: Amino acids (lysine), Vitamin B12 **4.2 Synthesis of Novel Antibiotics** – Engineering polykatid antibiotics, peptide antibiotics **4.3 Biotransformation of Steroids.** **4.4 Bioreactors**-Majortypes, solid–state fermentation, Immobilization techniques, Downstream processing, Enzyme extraction and Purification.(Amylases and proteases) **4.5 Production of SCP** – Yeast, Spirulina, Mushroom **4.6 Production of Biopolymer**s – biogums, biopolysaccharides, bioplastic. **4.7 Synthesis of small biological molecules:** synthesis of L-ascorbic acid and Indigo. **4.8 Protein engineering:** Engineering disulfide bonds, improving stability in other ways, changing binding site specificity, Biomaterial design relies on protein engineering	**(15 Notional Hours)**

References:

1. Biotechnology- Applying the Genetic Revolution by David P. Clark and Nanette J. Pazdernik
2. Biosimilar drug product development by Laszlo Endrenyi & Dr. Paul Declerck & Shein-Chung Chow (volume 216)
3. Bernard R Glick and Jack J Pasternak. Molecular Biotechnology: Principles and Applications ofrecombinant DNA. 3rd Edition.
4. B. D. Singh. Biotechnology. Kalyani Publishers.
5. S. N. Jogdand. Advances in Biotechnology. 2005. 5t Edition.
6. S. B. Primrose. Modern Biotechnology 1989. Blackwell Scientific Publ.
7. Primrose and others. Principles of Gene manipulations. 6th edition. 2004 Blackwell Science.
8. AluizinoBorent and others. Understanding Biotechnology. 2004 Pearson Education.
9. James Watson and Others. Recombinant DNA. 2001. Scientific American Books.
10. S.Ignacimuthu, (2005), "Basic Bioinformatics", Narosa publishing house
11. Arthur Lesk, (2009), "Introduction to Bioinformatics", 3rd edition, Oxford UniversityPress

Practical Syllabus Based on UGECBTP501

Course Code: UGECBTP05/I

[Credits: 1.5, Notional hours: 60]

1. Quantitation of DNA and Protein using U.V absorption
2. PAGE for proteins.
3. Western blot technique (Demo)
4. Production of Microbial polysaccharide and determination of yield.
5. Production of SCP (Yeast) and its quantitative estimation
6. Production of Biogum.(biopolysaccharide) and its qualitative estimation
7. Production of bioplastic (PHB)
8. Immobilization of *Saccharomyces cerevisiae* using alginate andinvertase assay.
9. Production, Purification and Estimation of Amylase /Protease.
10. Bioinformatics practical: Online Practical
    a. Visiting NCBI and EMBL websites & list services available, software tools availableand databases maintained
    b. Visiting & exploring various databases mentioned in syllabus and
        i. Using BLAST and FASTA for sequence analysis
        ii. Fish out homologs for given specific sequences (by teacher – decide sequence ofsome relevance to their syllabus and related to some biological problem e.g.sevolution of a specific protein in bacteria, predicting function of unknown proteinfrom a new organism based on its homology)
        iii. Six frame translation of given nucleotide sequence
        iv. Restriction analysis of given nucleotide sequence
        v. Pair-wise alignment and multiple alignment of a given protein sequences
        vi. Formation of phylogenetic tree

T.Y.B.Sc. Applied Component: Biotechnology Curriculum
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SEMESTER VI

Theory

COURSE CODE	UNIT	TOPIC HEADINGS	Credits	NH/ week
UGECBT601 Applied Biotechnology	Unit I	Agricultural biotechnology	4	4
	Unit II	Methodology in Animal and Plant Biotechnology		
	Unit III	Environmental Biotechnology		
	Unit IV	Health Care Biotechnology		

PRACTICAL:

COURSE CODE	TOPIC HEADINGS	Credits	NH/ week
UGECBTP06	Applied Biotechnology	1.5	4

Course Outcome: Paper I

By the end of the course, a student should develop the ability to

CO1: Explain the application of microbes as Biofertilizers **[2]***
CO2: Justify the use of bacteria and their natural system for the delivery of genes. [4]*
CO3: Apply the principles of gene manipulation for bioremediation of Xenobiotics. **[4]***
CO4: Construct a diagrammatic representation on disease diagnosis and drug designing. [5] *
CO5: Produce Nanoparticle by chemical & microbial methods. **[6]***
CO6:Isolate and cultivate Azotobacter, Rhizobium, Phosphatesolubilizers and prepare Biofertilizers. **[6]***

***Note: [1]: Remembering, [2]: Understanding, [3]: Applying, [4]: Analyzing, [5]: Evaluating, [6]: Creating**

SEMESTER VI Paper I		
Course Code	**Title**	**Credits**
UGECBT601	**Applied Biotechnology**	**4 Credits (60 Lectures)**
Unit I	**Agricultural biotechnology** **1.1 Biofertilizer, Biopesticides** **1.2 Development of Insect, pathogen and herbicide resistant plants:** Development of stress and senescence tolerant plants, genetic manipulation of flower pigments, Modification of plant nutrient content, Modification of food plant taste and appearance, plants as bioreactors . **1.3 Application of transgenic animals, animal bioreactors, molecular farming (pharming), cloning live stock by nuclear transfer.**	**(15 Notional Hours)**
Unit II	**Methodology in Animal and Plant Biotechnology** **2.1. Animal cell cultures** – Principles of mammalian cell culture, establishment of cell line. Continuous	**(15 Notional Hours)**

	cell lines. Media and equipment for animal cell culture. Hybridoma technology. In vitro fertilization and embryo transfer, animal cloning. **2.2. Transgenic animals**, transfection methods, embryonic stem cell transfer, targeted gene transfer, detection of transgenic and trans gene transfer. **2.3. Plant tissue cell and organ culture**- regeneration of plants, plant breeding – recombinant and nonrecombinant approaches, germ plasm bank. **2.4. Genetic engineering of plants:** Agrobacterium mediated gene transfer, Agro infection and direct gene transfer methods, integration, using the $C_{RE}/l_{OX}P$ System,inheritance analysis and confirmation of transgenic plants.	
Unit III	**Environmental Biotechnology** **3.1** Culture enrichment for environmental samples,Biological fuel generation, sources of biomass, ethanol and methane from biomass. Hydrogen production, petroleum prospecting, enhanced oil recovery. **3.2** Bioremediation: Methods, bioremediation of hydrocarbons, dyes, paper and pulp industry, heavy metals, xenobiotics. **3.3** Biofilters, bioaugmentation, vermicomposting and bioleaching, biosensors and biochips.	**(15 Notional Hours)**
Unit IV	**Health Care Biotechnology** 4.1 **Disease prevention** – vaccines: conventional vaccines, purified antigen vaccines, recombinant vaccines. DNA vaccines, synthetic vaccines. 4.2 **Disease Diagnosis** – Probes, monoclonal antibodies and detection of genetic diseases. 4.3 **Disease treatment** – Products from non-recombinant and recombinant organisms., interferons, growth factors, antisense nucleotides as therapeutic agents, monoclonal antibodies. 4.4 Drug designing, pharmacogenomics, drug delivery	**(15 Notional Hours)**

	and targeting, Biosimilar, artificial tissue / organ, gene therapy, enzyme therapy and replacement, therapeutic proteins and blood products 4.5 **Nanoparticles in cancer therapy:**Detection of viruses by Nanowires, Controlled denaturation of DNA by Gold nanoparticles, controlled change of Proteinand shape by DNA	

References

1. Biotechnology- Applying the Genetic Revolution by David P. Clark and Nanette J. Pazdernik
2. BIOSIMILAR DRUG PRODUCT DEVELOPMENT by Laszlo Endrenyi & Dr. Paul Declerck & Shein-Chung Chow (volume 216)
3. Bernard R Glick and Jack J Pasternak. Molecular Biotechnology: Principles and Applications ofrecombinant DNA. 3rd Edition.
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7. Primrose and others. Principles of Gene manipulations. 6th edition. 2004 Blackwell Science.
8. AluizinoBorent and others. Understanding Biotechnology. 2004 Pearson Education.
9. James Watson and Others. Recombinant DNA. 2001. Scientific American Books.

Practical Syllabus Based on UGECBTP06

Course Code: UGECBTP06/I

[Credits: 1.5, Notional hours: 60]

1. Demonstration of cell fusion.
2. Isolation and cultivation of Azotobacter, Rhizobium, Phosphatesolubilizers and preparation of biofertilizers.
3. Production of Biopesticides (*Bacillus thuringiensis*)
4. Plant Tissue culture (callus formation)
5. Production of Nanoparticle – chemical & microbial methods.
6. Preparation of Vermicompost.
7. Isolation of dye degraders.
8. Animal Tissue culture (Demonstration)