Savitribai Phule Pune University
Syllabus: Vocational Biotechnology (CBCS Semester Pattern)
Course Structure (wef. June 2019)
F.Y. B. Sc (Vocational Biotechnology)

Semester	Paper Code	Paper Title	Credits	No. of Lectures	Marks
I	VBt-111	Biological Chemistry	2	30	50 (35 External +15 Internal)
	VBt-112	Biotechnology: Concepts and Applications	2	30	50 (35 External +15 Internal)
	VBt-113	Lab Course I: Practical in Biochemistry	1.5	15 Practical	50 (35 External +15 Internal)
II	VBt-121	Bioinstrumentation	2	30	50 (35 External +15 Internal)
	VBt-122	Biostatistics & Computers for Biologists	2	30	50 (35 External +15 Internal)
	VBt-123	Lab Course II: Practical in Bioinstrumentation, Biostatistics & Computers.	1.5	15 Practical	50 (35 External +15 Internal)

S.Y.B.Sc (Vocational Biotechnology)

Semester	Paper Code	Paper Title	Credits	No. of Lectures	Marks
III	VBt-211	Cell biology & Microbial Genetics	2	30	50 (35 External +15 Internal)
	VBt-212	Molecular Biology	2	30	50 (35 External +15 Internal)
	VBt-213	Lab Course III: Practical in Cell & Molecular Biology.	2	15 Practical	50 (35 External +15 Internal)
IV	VBt-221	Genetic Engineering	2	30	50 (35 External +15 Internal)
	VBt-222	Bioinformatics	2	30	50 (35 External +15 Internal)
	VBt-223	Lab Course IV: Practical in Genetic Engineering & Bioinformatics	2	15 Practical	50 (35 External +15 Internal)

T.Y.B.Sc (Vocational Biotechnology)

Semester	Paper Code	Paper Title	Credits	No. of Lectures	Marks
V	VBt-311	Animal & Plant Tissue culture	2	30	50 (35 External +15 Internal)
	VBt-312	Industrial Biotechnology	2	30	50 (35 External +15 Internal)
	VBt-313	Lab Course V: Practical in Tissue Culture techniques & Industrial Biotechnology	2	15 Practical	50 (35 External +15 Internal)
VI	VBt-321	Biotechnology in Agriculture & Environment.	2	30	50 (35 External +15 Internal)
	VBt-322	Section I- Bioentrepreneurship Section II - Biotechnology for Health.	2	30	50 (35 External +15 Internal)
	VBt-323	Project Work	2	30	50 (35 External +15 Internal)

Savitribai Phule Pune University

Title of the course: Vocational Biotechnology

(Choice Based Credit System with Semester Pattern)
(To be implemented from Academic Year 2020-2021)

Preamble:

Biotechnology, being one of the youngest branch of Life Science, has expanded and established as advanced interdisciplinary applied science. The study of Life itself is at the core of it and the interdisciplinary networking potential of biotechnology has given it a separate status in fundamental research as well as in modern industrial enterprise. Global and local focus has slowly shifted to not only current "Century of Knowledge" but also on to technology development and application in life sciences. In the milieu of research and industrialization for economic development and social change, biotechnology is an ideal platform to work. The interdisciplinary nature of biotechnology integrates living systems including animal, plant and microbes and their studies from molecular biology to cell biology, from biochemistry to biophysics, from genetic engineering to stem cell research, from bioinformatics to genomics-proteomics, from environmental biology to biodiversity, from microbiology to bioprocess engineering, from bioremediation to material transformation and so on. The relevance and application of these studies on living organisms and their bioprocesses is extensively covered in this field with the help of technology. Green revolution and white revolution was possible in India thanks to the deeper and intrinsic understanding of biotechnology.

Economic and social renaissance is staged on biotechnology especially, since it's biomedical and cutting edge technological applications are tremendously powerful in shaping this century and exciting future.

Biotechnologists are always in demand as an efficient work force in fundamental research and industries. Education and research sectors require such interdisciplinary trained workforce to develop future generations of science leaders. Career opportunities for graduate students are created and expanding at the biotechnology parks and in manufacturing industries, teaching, research institutes and IT industry

Introduction:

The syllabi till today had been sufficient to cater to the needs of students for building up their careers in industry and research. However, with the changing scenario at local and global level,

we feel that the syllabus orientation should be altered to keep pace with developments in the education and industrial sector. The need of the hour is to design appropriate syllabi that emphasize on teaching of technological as well as the economical aspects of modern biology. Theory supplemented with extensive practical skill sets will help a graduate student to avail the opportunities in the applied fields (research, industry or institutions), without any additional training. Thus, the university / college itself will be developing the trained and skilled man-power.

Biotechnology curricula are operated at two levels viz. undergraduate and postgraduate. The undergraduate curricula are prepared to impart primarily basic knowledge of the respective subject from all possible angles while postgraduate syllabus emphasizes on more applied courses. In addition, students are to be trained to apply this knowledge particularly in day-to-day applications of biotechnology and to get a glimpse of research.

Objectives of the course:

1. To develop skills to handle instruments independently.
2. To create and develop students with interdisciplinary mind set for learning science.
3. To create awareness about self-employment and motivate the students to go for Bio-entrepreneurship.
4. To train the students in various techniques related to Agricultural, Environmental, Industrial and Medical Biotechnology.

Eligibility for Admission:

First Year B.Sc.:

a. Higher Secondary School Certificate (10+2) or its equivalent Examination with English and Biology; and two of the science subjects such as Physics, Chemistry, Mathematics, Geography, Geology, etc.

OR

b. Three Years Diploma in Pharmacy Course of Board of Technical Education conducted by Government of Maharashtra or its equivalent.

OR

c. Higher Secondary School Certificate (10+2) Examination with English and vocational subject of + 2 level (MCVC) - Medical Lab. Technician (Subject Code = P1/P2/P3)

Admissions will be given as per the selection procedure / policies adopted by the respective college keeping in accordance with conditions laid down by Savitribai Phule Pune University. Reservation and relaxation will be as per the Government rules.
Medium of Instruction: English

For First year: Student has to select **3 different subjects** (from among the subjects offered by the College /Institute) **and Vocational Biotechnology**.

For Second year: Student has to select **2 different subjects** (**from among the 3 subjects chosen in first year**) and **Vocational Biotechnology**.

For Third year: Student has to select only **1 Principal subject** (**from among the 2 subjects opted in second year**) **and Vocational Biotechnology**. The student will study **4 theory papers** and **2 practical papers of Principal subject** along with **2 theory papers and 1 practical paper** of **Vocational Biotechnology in each semester.**

Examination:
A) Pattern of Examination
i) a) University assessment 70% and continuous internal assessment 30%.
b) For internal examination: minimum 2 tests/paper of which 1 has to be written test of 10 marks.
c) Method of assessment for internal exams: seminars, Viva-voce, Projects, Surveys, Field visits, Tutorials, Assignment, Group discussion.
ii) Pattern of question paper (As per University norms)
B) Standard of Passing (As per University norms)
C) ATKT rules (As per University norms)
D) Award of Class (As per University norms)
E) External Students: No external students
F) Setting of question paper/ Pattern of question paper (As per University norms)
G) Verification /revaluation (As per University norms)

University Terms
Dates for commencement and conclusion for the first and second terms will be declared by the University authorities. Terms can be kept by only duly admitted students. The term shall be granted only on minimum 80 percent attendance at theory and practical course and satisfactory performance during the term.

Qualification of Teachers:
With minimum undergraduate and postgraduate degree in Microbiology/ Biotechnology and qualified as per UGC regulations

Savitribai Phule Pune University
Syllabus: Vocational Biotechnology (CBCS Semester Pattern)(wef. June 2020)
S.Y.B.Sc(Vocational Biotechnology)

Objectives of the course:

1) To give the exposure to the student as to be self employed

2) To develop skills to handle instruments

3) To train the student in various techniques related to Cell biology and genetics, molecular biology, genetic engineering and bioinformatics

Course structure

Semester	Paper Code	Paper Title	Credits	No. of Lectures	Marks
III	VBt-211	Cell biology & Microbial Genetics	2	30	50 (35 External +15 Internal)
	VBt-212	Molecular Biology	2	30	50 (35 External +15 Internal)
	VBt-213	Lab Course III: Practical in Cell & Molecular Biology.	2	15 Practical	50 (35 External +15 Internal)
IV	VBt-221	Genetic Engineering	2	30	50 (35 External +15 Internal)
	VBt-222	Bioinformatics	2	30	50 (35 External +15 Internal)
	VBt-223	Lab Course IV: Practical in Genetic Engineering & Bioinformatics	2	15 Practical	50 (35 External +15 Internal)

Savitribai Phule Pune University, Pune
S.Y. B.Sc. Voc Biotechnology (CBSC Semester pattern)
Revised Syllabus wef, June 2020
Subject Code: VBt -211- Cell biology & Microbial Genetics

2-Credit course
Total Lectures -30

	Section I- Cell biology	**No. of lectures**
1.	Cell theory and morphology of cell	1
2.	Types of Cells i. Plant Cell ii. Animal Cell	1
3.	Structure and functions of cell organelles i. Golgi Complexes ii. Endoplasmic Reticulum iii. Lysosomes iv. Nucleus v. Mitochondria vi. Chloroplast	4
4.	Cell membrane i. Components: Lipids And Proteins ii. Fluid Mosaic Model iii. Introduction to Membrane Transport	3
5.	Introduction to Cell signaling Types of cell signaling Pathway-G protein	3
6.	Neoplasia &Apoptosis	2
7.	Cell junctions Cell Junction Molecules i. Selectins ii. Cadherins iii. Integrins iv. Immunoglobulin superfamily Types of cell junctions i. Adherent ii. Tight iii. Gap Junctions iv. Desmosomes v. Hemidesmosomes vi. Plasmodesmata	4
8.	Extracellular matrix (ECM) and cell matrix interaction	2
	Section II- Microbial Genetics	

1.	Transformation Discovery of transformation – Griffith's experiment Mechanism of Transformation : *Eg. Streptococcus pneumonia, Hemophillis influenzae*	2
2.	Transduction i.Discovery of transduction – Lederberg and Tatum's experiment ii. Introduction to Generalized and Specialized transduction	2
3.	Conjugation i. Discovery of conjugation ii.Types of conjugation (F+ ,F-, Hfr)	2
4.	Recombination i. Definition of recombination ii. Types of recombination iii. Homologous recombination (Holliday model)	2
5.	Mobile elements (Prokaryotes and Eukaryotes) RetroTransposons and DNA Transposons	2

Reference books:

1. Molecular Cell Biology Fifth Edition by Lodish, Harvey; Berk, Arnold; Matsudaira, Paul; Kaiser, Chri published by W. H. Freeman Hardcover
2. Cell: a molecular. 5th Edition–Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter.
3. Gene VIII- Benjamin Lewin, Publisher Pearson (16 December 2003)
4. Lehninger. A.L Principles of Biochemistrry 2nd edition 1993, CBS Publications
5. General Microbiology by Roger Y Stainer, John L Ingraham , Mark L Wheelis, Page R Painter, Author - Roger Y Stainer, 5th edition, Macmillon publication
6. The cell: A Molecular approach by Goeffler M Cooper and Robert E Heisman, 6th Edition, ASM press 2004
7. Cell and Molecular biology by Gerald Carp, Janet Owasa, Wallace Marshall, 6th edition, Wiley Publisher.

Savitribai Phule Pune University, Pune
S.Y. B.Sc. Voc Biotechnology (CBSC Semester pattern)
Revised Syllabus wef, June 2020
Subject Code: VBt-212 – Molecular Biology

2-Credit Course
Total lectures – 30

Unit	Title and Contents	No of Lectures
1.	Prokaryotic and Eukaryotic genome • Structure and organization of prokaryotic and eukaryotic genome	2
2.	DNA Replication • Semi-conservative model of DNA (Messelson's and Stahl experiment) • Proteins and enzymes involved in DNA replication • Prokaryotic DNA replication • Eukaryotic DNA replication • DNA topoisomerases and its types	6
3.	DNA damage and repair • DNA damage by physical, chemical and intercalating agents • Direct repair • Mismatch repair • Nucleotide excision repair • Base excision repair	6
4.	Transcription • Enzymes involved in transcription • Prokaryotic transcription • Eukaryotic transcription • Post-transcriptional modifications (5'capping and 3' polyadenylation, intron removal)	6
5.	Translation • Features of genetic code • Structure of t-RNA, m-RNA and ribosomes • Types of amino-acyl t-RNA synthetases and its proof reading ability • Prokaryotic translation • Eukaryotic translation • Inhibitors of translation	8
6.	Post translational modifications • Glycosylation and Ubiquitination	2

Reference books

1. Molecular Biology of gene, 6th Edition, James D Watson, Tania Baker
2. Genes X , 10th edition (2009) Benjamin Lewin, publisher – Jones and Barlet Publishers Inc. USA
3. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., KReiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA.
4. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY.Biochemistry. 4th Edition(2008), Reginald Garett and Charles Grisham, Brook/Cole, Cengage Learning, Boston, USA.
5. Molecular biology by Clark David, Pazdernik Nanette Jean, 2nd edition, Publisher-Academic press
6. Molecular biology by Robert Weaver, 3rd edition, Mc Grab Hill Science publication
7. IGenetics : A Molecular approach, Peter J Russell, 3rd edition, published by Benjamin Cummings.

Laboratory practical

VBt 213: Lab Course III: Practical in Cell & Molecular Biology

	Cell biology, Microbial genetics and Molecular biology	Total Practicals (15)
I.	Isolation of nuclei and mitochondria	2
II.	Isolation of chloroplast and Lysosome	2
III.	RBC count by Neuber's chamber	1
IV.	Study of Mitosis in Onion root tip	1
V.	Preparation of molecular buffers and Agarose Gel electrophoresis	2
VI.	Isolation of Genomic DNA from Bacteria	2
VII.	Quantification of DNA by UV spectroscopy and Diphenylamine method	2
VIII.	Isolation of Plasmid DNA from bacteria	2
IX.	Quantification of RNA by Orcinol method	1

Reference books

1. Biochemical methods by S.Sadasivam and A. Manickam, 2nd edition, New Age International (P) Ltd., Publishers.

2. Practical methods in Molecular biology by Robert F. SchleifPieter C. Wensink, Illustrated edition, Springer New York Publisher.

Savitribai Phule Pune University, Pune
S.Y.B.Sc. Voc Biotechnology (CBSC Semester pattern)
Revised Syllabus wef, June 2020
Subject Code: VBt-221-Genetic Engineering

2-Credit course
Total Lectures -30

Unit	Title and Contents	No of Lectures
1.	Introduction to r-DNA technology • Enzymes used in r-DNA technology - Restriction enzymes, DNA ligases, DNA modifying enzymes	5
2.	Vectors used in r-DNA technology • Features of ideal Vectors And types of vectors – Cloning vectors and expression vectors • Plasmids – pBR322 • Phage Vectors : Structure of lambda phage, lambda insertion vectors, Replacement vectors, In-vitro packaging method • Cosmids • Artificial chromosomes – BAC, YAC	8
3.	Transformation and transfection methods for introduction of r-DNA in host cell • Transformation - Calcium chloride method to make host cells competent • Transfection methods – Electroporation, Particle gun method	3
4.	Screening and selection of transformants • Non-radioactive detection methods • Southern blotting • Northern blotting • Western blotting	5
5.	Polymerase chain reaction (PCR) • Principle of PCR • RT-PCR	2
6.	DNA sequencing methods • Chemical method - Maxam Gilbert method • Enzymatic method - Sanger's method • Automated sequencing	4
7.	Applications of r-DNA technology • Applications in Animal and Plant biotechnology, medicine and diagnostics, Environment and industry	3

Reference books

1. Gene cloning and analysis, 5th edition by TA Brown
2. Principles of gene analysis, Sixth edition by Sandy B. Primrose and Richard Twyman
3. Singh, B. D.; Plant breeding; principles and methods, 11th edition, (2009), Kalyani Publisher, India.
4. An introduction to genetic engineering by Desmond S T Nicholl, 3rd edition , Publisher - Cambridge University Press.
5. Recombinant DNA technology by Keya Chaudhari , Publisher - The energy and resources institute, 1st edition
6. Molecular Biotechnology; Principles and applications of recombinant DNA technology, by Bernard R Glick, Jack J Pasternak, 3rd edition , Publisher -American society of Microbiology.
7. Recombinant DNA : Genes and Genomes by James Watson, Amy A Caudy, Richard M Myers, Jan A Witkowski, 3rd edition, Publisher - W H Freeman.

SavitribaiPhule Pune University, Pune
S.Y. B.Sc. Voc Biotechnology (CBSC Semester pattern)
Revised Syllabus wef, June 2020
Subject Code: VBt-222-Bioinformatics

2-Credit course
Total Lectures -30

	Bioinformatics	**No. of lectures**
1)	i) Introduction and Definition ii) History and Scope iii) Application in various fields	4
2)	Open Access Bibliographic Resources And Literature Databases i) PubMed ii) PubMed Central iii) BioMed Central iv) Public Library of Sciences (PloS)	4
3)	SEQUENCE DATABASES: formats, querying & retrieval i) Nucleic acid sequence databases: GenBank, EMBL, DDBJ ii) Protein sequence databases: SWISS-PROT, TrEMBL, PIR-PSD. iv) Specialized Genome Databases at NCBI, EBI, TIGR, SANGER , Viral Genomes, Archeal and Bacterial Genomes and Eukaryotic genomes	10
4)	i) Structure Databases: PDB, NDB, PubChem, Derived Databases. Knowledge of the following databases with respect to: basic concept of derived databases, sources of primary data and basic principles of the method for deriving the secondary data, organization of data, contents and formats of database entries, identification of patterns in given sequences and interpretation of the same. ii) Prosite, Pfam ,CATH, SCOP, DSSP, PDB Goodies, Extraction of knowledge from databases on Immunology, Plant, animal &infectious diseases: search new databases & servers using NAR Database & Web server Issue, BMC Bioinformatics	6
5)	**DATABASE SEARCHES** i) Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues. ii) Scoring matrices: basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, principles based on which these matrices are derived. iii) Keyword-based Entrez and SRS, Sequence-based: BLAST &	6

	FASTA, Use of these methods for sequence analysis including the on-line use of the tools and interpretation of results from various sequence and structural as well as bibliographic databases.	

Reference books suggested:

1. Bioinformatics Databases, Tools and Algorithms: OrpitaBosu, SimminderKaurThukral
2. Bioinformatics Sequence and Genome Analysis, Second edition by David Mount.
3. Text Books: 1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004
4. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009

Laboratory practical

VBt 223: Lab Course IV: Practical in Genetic engineering & Bioinformatics

1.	Restriction digestion of DNA	1
2.	Ligation of DNA	1
3.	Transformation: Making host cell as competent cells	1
4.	PCR	1
5.	Demonstration on Real Time-PCR	1
6.	Literature mining using PubMED, PubMED central and MEDLINE	2
7.	Retrieving Protein and DNA Sequences using Entrez at NCBI, SRS at EBI	2
8.	Website navigation to PDB, Swissprot, and Uniprot	2
9.	Explore: Derived databases of structures: DSSP, Families of structurally similar proteins (FSSP), CATH & SCOP	2
10.	Perform FASTA and BLAST search for DNA and Protein Data	2

Reference Books

1. Biotechnology procedures and experiments handbook by S Harisha , Publisher - Jones and Bartlett Publishers Inc.

2. Techniques in biotechnology by V Kumaresan, Saras Publication.