



Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Vocational Biotechnology

(Faculty of Science & Technology)

F.Y.B.Sc. (Vocational Biotechnology)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Title of the course: Vocational Biotechnology**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**.

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 & 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	Bio entrepreneurship and Biotechnology for Health.	2	30	50 (35 External +15 Internal)
	VBt-323	Project Work	2	30	50 (35 External +15 Internal)

Detailed Syllabus:

SEMESTER I
Paper Code: VBT -111- Biological Chemistry

2-Credit course
Total Lectures -30

Unit	Title and Contents	No. of Lectures
1.	Chemical Bonding <ul style="list-style-type: none"> • Introduction to biomolecules. • Types of bonds in biomolecules: Covalent: glycosidic, peptide, phosphodiester, Noncovalent ionic: hydrogen, van der Waals, hydrophobic, and coordination their formation and interaction. 	3
2	Chemical equilibrium <ul style="list-style-type: none"> • Equilibrium constant, Le Chatelier's Principle, Acid and Bases, pH, pK, and titration curves. • Concept of buffer, biological buffers, ionization, concept of osmosis: hypo- and hypertonic solution. • Properties of water, water as a reactant and interaction of biomolecules with water. 	4
3	Basics of Mole concept <ul style="list-style-type: none"> • Determination of molecular weight by Gram molecular volume relationship. • Concept of Mole & problems based on mole concepts. • Methods of expressing concentrations: Normality, Molarity, Molality & ppm. 	3
4	Carbohydrates <ul style="list-style-type: none"> • Definition and Classification of carbohydrates into sugars and non sugars & Monosaccharides, Oligosaccharides and Polysaccharides. • Monosaccharides: Structure and properties, ketoses and aldoses, D and L configuration, mutarotation, epimers & anomers. • Oligosaccharide: reducing and non-reducing sugars, Inversion of sugar. • Polysaccharide and its classification based on function, Storage polysaccharides (Starch, Glycogen and Inulin), Structural polysaccharides (Cellulose, Chitin). • Functions of carbohydrates. 	6
5	Lipids <ul style="list-style-type: none"> • Introduction, Classification of lipids, fatty acids, physical and chemical properties of lipids. 	4

	<ul style="list-style-type: none"> • Simple lipids, Complex lipids, Steroids, Structural & Storage lipids. • Functions of lipids. 	
6	Amino acids & Proteins <ul style="list-style-type: none"> • Structure and properties of amino acids, Classification of amino acids. • Chemistry of amino acids: Acid-base behavior, reactions of amino acids, Zwitter ion, Titration of amino acid, isoelectric pH. • Protein structure: Primary structure & peptide bond formation, Secondary structure, Tertiary structure, Quaternary structure (Hb as example) 	6
7	Vitamins <ul style="list-style-type: none"> • Classification, Structure and Biochemical functions of fat soluble and water soluble vitamins. • Co-enzymes: Thiamine, riboflavin, niacin, Co-enzyme A, Lipoic acid, Folic acid and B12 	4

Reference books:

1. Outlines of Biochemistry: 5th Edition, (2009), Erice Conn & Paul Stumpf; John Wiley and Sons, USA.
2. Fundamentals of Biochemistry. 3rd Edition, (2008), Donald Voet & Judith Voet, John Wiley and Sons, Inc. USA.
3. Principles of Biochemistry, 4th edition (1997), Jeffery Zubey, McGraw-Hill College, USA.
4. Biochemistry: 7th Edition, (2012), Jeremy Berg, Lubert Stryer, W. H. Freeman and Company, NY.
5. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY.
6. Biochemistry. 5th Edition, (copy right 2013), Reginald Garrett and Charles Grisham, Brook/Cole, Cengage Learning, Boston, USA.
7. An Introduction to Practical Biochemistry. 3rd Edition, (2001), David Plummer, Tata McGraw Hill Edu. Pvt. Ltd. New Delhi, India.
8. Biochemical Methods. 1st (1995), S. Sadashivam, A. Manickam, New Age International Publishers, India.

SEMESTER I

Paper Code: VBT-112: Biotechnology: Concepts and Application

(2 Credit Course)

Total Lectures=30

Unit	Title and Contents	No. of Lectures
1	What is Biotechnology <ul style="list-style-type: none"> • Milestones in the History of Biotechnology • Introduction & Branches of Biotechnology • Biotechnology in day to day life 	05
2	Agricultural Biotechnology <ul style="list-style-type: none"> • Biofertilizers & Biopesticides • Introduction to GMOs with examples • Role of Biotechnology in Agriculture 	05
3	Medical Biotechnology <ul style="list-style-type: none"> • Disease diagnosis & Prognosis • Concept of Stem cells & Regenerative medicine • Vaccine 	05
4	Biotechnology in Food & Dairy <ul style="list-style-type: none"> • Prebiotics and Probiotics • Functional foods • Nutraceuticals • Single cell protein • Food safety 	05
5	Environmental Biotechnology <ul style="list-style-type: none"> • Biosensors • Waste water treatment • Bioremediation • Biofuels 	05
6	Opportunities in Biotechnology <ul style="list-style-type: none"> • In Research • In Industry, Start-ups & Entrepreneurship 	03
7	Visit to Biotech Industry / Research Institute and report writing	02

Recommended Textbooks and References

1. Milestones in Biotechnology: Classic papers in Genetic Engineering: J. A. Davis, W. S. Resnikoff
2. Plant biotechnology – J. Hammond & P. McGravey, V. Yushibov, Springer-Verlag.
3. Principles of Gene Manipulation & Genomics – Primrose and Twyman (2006, 7th Edition)
4. Amann, R.I. Stromley, J. Stahl : Applied & Environmental Microbiology
5. A textbook of Biotechnology by B. D. Singh

SEMESTER I**Paper Code: VBT-123****Lab Course I: Practical in Biochemistry****(1.5 Credit Course)****(Total Practical- 15 Practical (15x3 hrs.)**

Sr. No	Title of Experiment	No. of Practical
1	Biochemical calculations: Preparation of solutions and buffers, standardization of micropipettes	2
2	Qualitative tests for Carbohydrates, Proteins & Lipids	3
3	Working of Colorimeter & Spectrophotometer	1
4	Determination of Absorption spectra of Protein	1
5	Quantitative estimation of reducing sugars by DNSA method	1
6	Quantitative estimation of proteins by Biuret & Folin Lowry method	3
7	Quantitative estimation of Cholesterol	1
8	Determination of Saponification number of given lipid	1
9	Quantitative estimation of Ascorbic acid	1
10	Determination of Isoelectric point of glycine	1

SEMESTER II

Paper Code: Bt-121-Bioinstrumentation

(2 Credit Course)

Total Lectures=30

Unit	Title and Contents	No. of Lectures
1	pH meter: Principle, Construction, Working & applications.	01
2	Microscopy: Principle, Construction & working of the following microscopes: <ul style="list-style-type: none"> • Phase-contrast microscope • Inverted microscope • Electron microscope (TEM & SEM) 	05
3	Centrifugation <ul style="list-style-type: none"> • Theory (RCF, Sedimentation coefficient, types of centrifuges), • Differential centrifugation, • Density gradient centrifugation (Rate Zonal & Isopycnic) • Analytical centrifugation. 	05
4	Chromatography <ul style="list-style-type: none"> • Theory (Principle, Distribution co-efficient, Rf Value) • Thin Layer and Paper Chromatography • Affinity Chromatography • Ion-exchange Chromatography • Gel filtration Chromatography • Gas Chromatography. 	06
5	Spectroscopy <ul style="list-style-type: none"> • Definition. Electromagnetic wave. Electromagnetic spectrum. Applications of each region of electromagnetic spectrum for spectroscopy • Lambert-Beer's Law • Instrumentation of single beam and double beam instrument. • UV-visible spectroscopy • Principle, construction and working of colorimeter, Spectrophotometer. • Application of Spectroscopy to biomolecules 	07
6	Electrophoresis <ul style="list-style-type: none"> • Theory (Principle & factors affecting Electrophoretic mobility), • Agarose Gel Electrophoresis • PAGE. 	03

7	Radioisotopes in Biology <ul style="list-style-type: none"> • Radioactive nucleus, Nuclear radiations and their properties (alpha, beta & gamma), • Applications of Radioisotopes in Biology. • Principle, construction and working of – GM Counter, Scintillation counter (Solid & Liquid) 	03
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Recommended Textbooks and References

1. Instrumentation measurements and analysis – 2nd edition (2003). Nakra and Choudhari,
2. Tata Mc Graw Hill, India.
3. Biophysics: An Introduction. 1st edition. (2002) Cotteril R. John Willey and Sons Ltd., USA
4. Biophysics. 1st edition (2002), Pattabhi V and Gautham N. Kluwer, Academic Publisher, USA.
5. Wilson Keith and Kenneth H.Goulding (1994) Principles of techniques of Practical Biochemistry. 4th Edn. Cambridge University Press, London.
6. Biophysical chemistry: Principles and Techniques by Upadhyay & Nath
7. Khandpur R.S. (1989) Handbook of Analytical Instruments Tmh. Pub. Co. Ltd. New.

SEMESTER II

Paper Code: VBT -122 Biostatistics and Computer for Biologists

2-Credit course

Total Lectures -30

Unit	Title and Contents	No. of lectures
Biostatistics		
1	Introduction to Statistics <ul style="list-style-type: none"> • Need of Biostatistics in biology, Basic definitions, notations and applications. • Sampling: Representative sample, sample size, sampling techniques. Data collection and presentation, types of data, methods of collection of primary and secondary data. • Data presentation (Line, Histogram, polygon, ogive curves, bar graphs and Pie diagram). 	4
2	Descriptive statistics <ul style="list-style-type: none"> • Measure of central tendency: Mean, median, mode (Definition & simple problems) • Measure of Variability: Standard deviation, Range, Mean deviation, & Coefficient of Variation (Definition & simple problems) • Skewness: Definition, types of skewness, graphical representation, and example. • Kurtosis: Definition, types of Kurtosis, graphical representation and example. 	6
3	Correlation and Regression <ul style="list-style-type: none"> • Definition & Concept • Negative and Positive correlation, Correlation coefficient. • Linear regression and Regression equation 	3
4	Probability theory and distribution <ul style="list-style-type: none"> • Concept of probability. • Binomial, Poisson & Normal distribution and its application in Biosciences. 	3
5.	Hypothesis testing and correlation <ul style="list-style-type: none"> • Purpose of hypothesis testing, data, assumptions and hypothesis, significance level, types of errors. • Student's t – test, Z – test & chi square test 	4

Computers for Biologists		
6	History of Computers <ul style="list-style-type: none"> • Generations of computers (I, II, III, IV, V) • Modern Computers: The workstation, Minicomputer, Mainframe Computers, Parallel processing Computer & the Super Computer. 	2
7	Introduction to computers: <ul style="list-style-type: none"> • Overview and functions of a computer system • Input and output devices • Storage devices 	1
8	Computer viruses: <ul style="list-style-type: none"> • An overview of computer viruses • General precautions 	1
9	Data processing & presentation <ul style="list-style-type: none"> • Introduction to MS Excel & Power Point 	2
10	Internet searches <ul style="list-style-type: none"> • Search engines (Google and Yahoo) • Concepts in text-based searching • Searching Medline, PubMed, bibliographic databases 	2
11	Databases <ul style="list-style-type: none"> • Introduction • Need and types of databases 	1
12	Introduction to Bioinformatics	1

List of reference books:

1. Introduction to the Practice of Statistics, by David S. Moore, George P. McCabe, and Bruce A. Craig, 9th Edition, W.H. Freeman and Co., New York (2017).
2. P.S.S. Sunderrao and J. Richards-An introduction to Biostatistics, Prentice Hall Pvt. Ltd. India
3. Fundamentals of Biostatistics. By Irfan A Khan.
4. Campbell R.C. - Statistics for Biologists, Cambridge University Press, Cambridge.
5. Wardlaw A.C. Practical statistics for experimental biologists.
6. Cochran W.G. and G.W. Snedeco statistical methods –Sixth Ed.
7. Bioinformatics Databases, Tools and Algorithms: OrpitaBosu, SimminderKaurThukral
8. Bioinformatics Sequence and Genome Analysis: David Mount.
9. Computer fundamentals, 4th edition (2004) P.K. Sinha, BPB publication, India.
10. Computer Networks. 4th edition (2008). Tanenbaum. Pearson Education, India.

SEMESTER II

Paper Code: Vbt-123

Lab Course II: Practical in Bioinstrumentation, Biostatistics & Computers

(1.5 Credit Course)
(15 Practical (15x3 hrs.))

Sr. No.	Title of Experiment	No. of Practical
Bioinstrumentation		
1	Standardization and calibration of pH meter. Preparation of buffers and measurement of pH	1
2	Demonstration of working of Centrifuge	1
3	Demonstration of Beer and Lambert's Law	1
4	Separation and identification of amino acids by paper chromatography	1
5	Separation and identification of plant pigments/ sugars by TLC	1
6	Demonstration & working of different types of Microscopes	1
7	Demonstration of working of Agarose Gel Electrophoresis	1
Biostatistics & Computers		
1	Introduction MS Excel and use of spreadsheets for data organization & applications	1
2	Data presentation using various graphical types <ul style="list-style-type: none"> • Bar Diagram • Histogram • Frequency Curve • Pie Chart • Scatter plot 	2
3	Measure of central tendency <ul style="list-style-type: none"> • Mean • Median • Mode • Standard deviation and correlation 	2
4	Hypothesis testing using Data Analysis Tools <ul style="list-style-type: none"> • Chi square test • t- test 	2
5	Internet searches : Search Engines: Google & Yahoo Literature mining using PubMed & PubMed Central (PMC)	1

