

**Ahmednagar Jilha Maratha Vidya Prasarak Samaj's  
New Arts, Commerce and Science College, Ahmednagar  
(Autonomous)  
(Affiliated to Savitribai Phule Pune University,  
Pune)**



**Choice Based Credit System (CBCS)  
Bachelor of Science (B.Sc. Biotechnology)**

**Syllabus of  
F. Y. B. Sc Biotechnology**

**Implemented from  
Academic year 2021 -22**

**Ahmednagar Jilha Maratha Vidya Prasarak Samaj's**  
**New Arts, Commerce and Science College, Ahmednagar**  
**(Autonomous)**

Board of Studies in Biotechnology

Sr. No.	Name	Designation
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2.	Dr. Sanjay T. Moharekar	Member
3.	Dr. Sarika R. Deshmukh	Member
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7.	Dr. Jyoti P. Jadhav	Academic Council Nominee
8.	Mr. Nitin Shirole	Industry Expert
9.	Mr. Sachin R. Adsare	Alumni
10.	Dr. Aparna A. Kulkarni	Member (co-opt)
11.	Mr. Girish P. Kukreja	Member (co-opt)

## 1. Prologue/ Introduction of the programme:

Biotechnology has expanded and established as an 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 importance 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 due to the deeper and intrinsic understanding of biotechnology.

The restructures syllabus is a choice based credit system with semester pattern. Biotechnology has grown extensively in last couple of decades. The syllabi till today had been sufficient to cater 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. The proposed credit based curriculum ensures the requirement of academia and industry. 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 being an interdisciplinary subject, this restructured syllabus will combine the principles of physical, chemical and biological sciences along with developing advanced technology.

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.

The basic aim of the revised course curriculum is to integrate various disciplines of life sciences which will cater the needs of human resources in academia and industry. The Overall objective of the Program is to promote education and research in biotechnology and provide academic and professional excellence for immediate productivity in academics, government organization, biomedical sectors, health and nutrition settings for ultimate benefit of society and sustainable development.

## **2. Programme Outcomes (POs)**

Students enrolled in the program complete a curriculum that exposes and trains students in a full range of essential skills and abilities. They will have the opportunity to master the following objectives.

The objectives of the course curriculum are:

- To introduce the concepts in various allied subjects
- To enrich students' knowledge in basic and applied aspects of life sciences.
- To help the students to build interdisciplinary approach in teaching/ learning and in research.
- To inculcate the sense of scientific responsibilities and social awareness
- To help students build-up a progressive and successful career in academia and industry.

The present course curriculum will generate skilled human resource required in academia and Industry. In general, as a result of this program, the student will be able to achieve basic and advance knowledge based proficiency in applied subjects of life sciences, create and develop students with interdisciplinary mind set for learning science, improve problem solving aptitude using scientific methods in biotechnology and allied subjects, will adopt scientific approach for implications of biotechnology in society, environment and education, will demonstrate knowledge and learn various biological processes at cellular and molecular level and get expertise in the different techniques used in the fields of Biotechnology.

**Programme Structure and Course Titles**

Sr. No.	Class	Semester	Course Code	Course Title	Credit
1.	F. Y. B.Sc.	I	BSC-BT 101T	Fundamentals of Chemistry I	02
2.	F. Y. B.Sc.	I	BSC-BT 102T	Fundamentals of Physics I	02
3.	F. Y. B. Sc.	I	BSC-BT 103T	Biochemistry I	02
4.	F. Y. B.Sc.	I	BSC-BT 104T	Biophysics and Bioinstrumentation	02
5.	F. Y. B.Sc.	I	BSC-BT 105T	Plant Biology	02
6.	F. Y. B.Sc.	I	BSC-BT 106T	Animal Biology	02
7.	F. Y. B. Sc.	I	BSC-BT 107T	Basic Microbiology	02
8.	F. Y. B.Sc.	I	BSC-BT 108T	Biomathematics and Biostatistics I	02
9.	F. Y. B.Sc.	I	BSC-BT 109P	Practical in Chemistry and Biochemistry	1.5
10.	F. Y. B.Sc.	I	BSC-BT 110P	Practical in Botany and Zoology	1.5
11.	F. Y. B.Sc.	I	BSC-BT 111P	Practical in Microbiology and Biostatistics	1.5
12.	F. Y. B.Sc.	I	BSC-BT 112P	Practical in Physics and Biophysics	1.5
13.	F. Y. B.Sc.	II	BSC-BT 201T	Fundamentals of Chemistry II	02
14.	F. Y. B.Sc.	II	BSC-BT 202T	Biochemistry II	02
15.	F. Y. B.Sc.	II	BSC-BT 203T	Bioinstrumentation	02
16.	F. Y. B.Sc.	II	BSC-BT 204T	Applied Plant Biology	02
17.	F. Y. B.Sc.	II	BSC-BT 205T	Applied Animal Biology	02
18.	F. Y. B.Sc.	II	BSC-BT 206T	Applied Microbiology	02
19.	F. Y. B.Sc.	II	BSC-BT 207T	Biomathematics and Biostatistics II	02
20.	F. Y. B.Sc.	II	BSC-BT 208T	Information Technology	02

21.	F. Y. B.Sc.	II	BSC-BT 209P	Practical In Chemistry and Biochemistry II	1.5
22.	F. Y. B.Sc.	II	BSC-BT 210P	Practical In Applied Botany and Zoology	1.5
23.	F. Y. B.Sc.	II	BSC-BT 211P	Practical In Microbiology and Bioinstrumentation	1.5
24.	F. Y. B.Sc.	II	BSC-BT 212P	Practical In Information Technology and Biostatistics	1.5
25.	S. Y. B.Sc.	III	BSC-BT 301T	Cell Biology I	02
26.	S. Y. B.Sc.	III	BSC-BT 302T	Cell Biology II	02
27.	S. Y. B.Sc.	III	BSC-BT 303T	Metabolic Pathways	02
28.	S. Y. B.Sc.	III	BSC-BT 304T	Genetics	02
29.	S. Y. B.Sc.	III	BSC-BT 305T	Immunology	02
30.	S. Y. B.Sc.	III	BSC-BT 306T	Ecology and Environmental Biotechnology	02
31.	S. Y. B.Sc.	III	BSC-BT 307P	Practical in Cell Biology	02
32.	S. Y. B.Sc.	III	BSC-BT 308P	Practical in Genetics and Immunology	02
33.	S. Y. B.Sc.	III	BSC-BT 309P	Practical in Metabolic and Ecology and Environmental Biotechnology	02
34.	S. Y. B.Sc.	III	BSC-BT 310T	Critical Thinking and Scientific Temper	02
35.	S. Y. B.Sc.	III	BSC-BT 311T	English/ Hindi Communication	02
36.	S. Y. B.Sc.	III	BSC-BT 312T	Laboratory Management (Biosafety and instrumentation)	02
37.	S. Y. B. Sc.	III	BSC-BT 313P	Practicals in Laboratory Management	02
38.	S. Y. B.Sc.	IV	BSC-BT 401T	Biodiversity and Evolution	02
39.	S. Y. B.Sc.	IV	BSC-BT 402T	Molecular Biology I	02

40.	S. Y. B.Sc.	IV	BSC-BT 403T	Molecular Biology II	02
41.	S. Y. B.Sc.	IV	BSC-BT 404T	Plant Development	02
42.	S. Y. B.Sc.	IV	BSC-BT 405T	Animal Development	02
43.	S. Y. B.Sc.	IV	BSC-BT 406T	Bioanalytical Techniques	02
44.	S. Y. B.Sc.	IV	BSC-BT 407P	Practical in Molecular Biology	02
45.	S. Y. B.Sc.	IV	BSC-BT 408P	Practical in Animal and Plant Development	02
46.	S. Y. B.Sc.	IV	BSC-BT 409P	Practical in Biodiversity and Evolution and Bioanalytical Techniques	02
47.	S. Y. B.Sc.	IV	BSC-BT 410T	Environmental awareness	02
48.	S. Y. B.Sc.	IV	BSC-BT 411T	Language Communication	02
49.	S. Y. B.Sc.	IV	BSC-BT 412T	Oenology	02
50.	S. Y. B.Sc.	IV	BSC-BT 413P	Practical in Oenology	02
51.	T. Y. B.Sc.	V	BSC-BT 501T	Food and Dairy Biotechnology	02
52.	T. Y. B.Sc.	V	BSC-BT 502T	Recombinant DNA Technology	02
53.	T. Y. B.Sc.	V	BSC-BT 503T	Genetic Engineering	02
54.	T. Y. B.Sc.	V	BSC-BT 504T	Plant Tissue Culture	02
55.	T. Y. B.Sc.	V	BSC-BT 505T	Animal Tissue Culture	02
56.	T. Y. B.Sc.	V	BSC-BT 506T	Medical Biotechnology	02
57.	T. Y. B.Sc.	V	BSC-BT 507P	Practical in Food, Dairy and Medical Biotechnology	02
58.	T. Y. B.Sc.	V	BSC-BT 508P	Practical in Plant Tissue Culture and Animal Tissue Culture	02
59.	T. Y. B.Sc.	V	BSC-BT 509P	Practical in Genetic Engineering	02
60.	T. Y. B.Sc.	V	BSC-BT 510T	Seminar and Term Paper Writing	02
61.	T. Y. B.Sc.	V	BSC-BT 511P	Preparation and Presentation on Term Paper	02

62.	T. Y. B.Sc.	VI	BSC-BT 601T	Industrial Biotechnology	02
63.	T. Y. B.Sc.	VI	BSC-BT 602T	Enzyme Technology	02
64.	T. Y. B.Sc.	VI	BSC-BT 603T	Pharmaceutical Biotechnology	02
65.	T. Y. B.Sc.	VI	BSC-BT 604T	Bioinformatics	02
66.	T. Y. B.Sc.	VI	BSC-BT 605T	Bio safety and Bioethics and IPR	02
67.	T. Y. B.Sc.	VI	BSC-BT 606T	Applied Biotechnology	02
68.	T. Y. B.Sc.	VI	BSC-BT 607P	Practical in Industrial and Applied Biotechnology	02
69.	T. Y. B.Sc.	VI	BSC-BT 608P	Practical in Enzyme Technology	02
70.	T. Y. B.Sc.	VI	BSC-BT 609P	Practical in Bioinformatics and Pharmaceutical Biotechnology	02
71.	T. Y. B.Sc.	VI	BSC-BT 610T	Research Methodology	02
72.	T. Y. B.Sc.	VI	BSC-BT 611Pr	SEC – IV Project	02
	<b>Total</b>	<b>06</b>	<b>72</b>		<b>140</b>



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**Syllabus of F. Y. B. Sc. Biotechnology  
(Under Faculty of Biotechnology and Wine technology)**

<b>Semester – I</b>	<b>Paper - I</b>
<b>Course Code: BSC-BT- 101T</b>	<b>Title of the Course: Fundamentals of Chemistry I</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

**Course Outcomes (Cos)**

- CO1. Understand basic facts and concepts in Chemistry,  
 CO2. Learn atomic structure and models.  
 CO3. Understand the concept of chemical bonding and thermodynamics  
 CO4. Develop the ability to apply the principles of Chemistry.  
 CO5. Familiarized with the emerging areas of Chemistry

**Detailed Syllabus:**

<b>Unit</b>	<b>Topics</b>	<b>No. of Hours</b>
<b>I</b>	<b>Atomic Structure</b>	<b>7</b>
	<ul style="list-style-type: none"> <li>• Historical background, electronic structure of atom, Bohr's atomic model, atomic &amp; molecular orbitals, Shapes of s,p,d,f orbitals,</li> <li>• Pauli's exclusion principle</li> <li>• Hund's Rule of maximum multiplicity- Aufbau principle.</li> <li>• Selection rules to find electronic configuration of elements.</li> </ul>	

<b>II</b>	<b>Molecules</b>	8
	<ul style="list-style-type: none"> <li>• Diatomic molecules: homo and heteronuclear diatomic molecules, bond order,</li> <li>• Valence bond theory, VSEPR theory,</li> <li>• Types of overlap, formation of <math>\sigma</math> and <math>\pi</math> bonds S – S overlap, P-P overlap, p-d overlap with suitable examples</li> <li>• Hybridization involving s, p, d, orbitals(<math>sp, sp^2, sp^3, dsp^2</math>)</li> </ul>	
<b>III</b>	<b>Chemical Bonding-</b>	7
	<p>Types of bonds: covalent, ionic, hydrogen bonding, inter and intramolecular hydrogen bonding,</p> <ul style="list-style-type: none"> <li>• dipole- dipole, dipole-induced dipole interaction,</li> <li>• Hydrophobic &amp; hydrophilic interaction, oxidation state.</li> </ul>	
<b>IV</b>	<b>Thermodynamics</b>	8
	<ul style="list-style-type: none"> <li>• Types of systems, intensive and extensive properties,</li> <li>• Equilibrium and non-equilibrium states,</li> <li>• Reversible and irreversible processes,</li> <li>• Laws of thermodynamics, internal energy, enthalpy,</li> <li>• Entropy endothermic and exothermic reactions,</li> <li>• Free energy and work, Gibb's Helmholtz equations,</li> </ul>	

**Suggested Readings:**

1. General Chemistry, 1st edition (2000), C.N. R. Rao, Macmillan Publishers, India.
2. Principles of Physical Chemistry, 4th edition (1965), S.H. Maron and C.F. Prutton, Collier Macmillan Ltd
3. The elements of Physical Chemistry, 5th edition (2009), Atkins P, de Paula J. , W. H. Freeman Publication, USA
4. Physical Chemistry for biological sciences, 1st edition, (2005), Chang R., University Science Books, USA
5. Physical Chemistry, 1st edition, (2003) David Ball, Thomson Learning, USA.
5. Essentials of Physical Chemistry, 24th edition, (2000), B S Bahl, G D Tuli, ArunBahl, S. Chand Limited, India.
6. Concise Inorganic Chemistry. 5th edition (2008), Author: J. D. Lee, John Wiley & Sons, USA.

<b>Semester – I</b>	<b>Paper - II</b>
<b>Course Code: BSC-BT- 102T</b>	<b>Title of the Course: Fundamentals of Physics I</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

### Course Outcomes (Cos)

CO1. Study the interrelationship between Physics and Life sciences.

CO2. Learn the physical quantities, standards and units Mass Thermodynamic, sound waves, Doppler effect and audible, ultrasonic and infrasonic waves.

CO3. Learn stress and strain in solids, Hook's law Relevance of elasticity to life sciences.

CO4. Study Fluid Statics Fluid Dynamics (Viscosity): Streamline and turbulent flow concept of pressure energy, Bernoulli's theorem and its applications.

CO5. Learn the surface tension and surface energy, capillary action, angle of contact temperature dependence of surface tension.

### Detailed Syllabus:

Unit	Topics	Total Hours
<b>I</b>	<b>Measurements</b>	<b>5</b>
	<ul style="list-style-type: none"> <li>• Physical quantities, fundamental and derived units, System of Units, order of magnitude</li> <li>• Length: radius of proton to astronomical distances</li> <li>• Mass: atomic mass unit to mass of Earth</li> <li>• Time: fast elementary particle to age of Earth</li> <li>• Amount of substance</li> <li>• Luminous intensity</li> <li>• Inter-conversion of units.</li> </ul>	
<b>II</b>	<b>Fluid mechanics</b>	<b>5</b>
	<ul style="list-style-type: none"> <li>• Fluids: Definition, Pressure, density</li> <li>• Variation of pressure with depth in a fluid at rest</li> <li>• Measurement of pressure, Various units of pressure and their inter conversion</li> <li>• Streamline and turbulent flow</li> <li>• Equation of continuity, Flow of liquids through capillaries</li> <li>• Bernoulli's Principle, Applications of Bernoulli's Principle (Ventury Meter, Pitot Tube)</li> </ul>	

- Viscosity, Newton's law of viscosity, coefficient of viscosity, Ostwald's viscometer
  - Relevance to life sciences.
- III Surface Tension** **5**
- Surface tension and surface energy
  - Cohesive and adhesive forces
  - Capillary action, angle of contact
  - wettability
  - Factors affecting surface tension
  - Applications
  - Relevance to life sciences
- IV. Waves and oscillations** **8**
- Difference
  - Types of waves (transverse and longitudinal), Reflection of waves, Principle of superposition of waves
  - Standing and travelling waves
  - Sound waves as pressure waves
  - Audible, ultrasonic, and infrasonic waves
  - Characteristics of sound waves
  - Beats
  - Doppler Effect
  - Applications in life sciences.
- V Geometrical Optics** **7**
- Reflection, Refraction (Snell's Law)
  - Interference and Polarization, Concept of polarization
  - Types of lenses, combinational lenses, radius of curvature, focal length, Lens maker equation
  - Microscopes, Optical power, diopter, Magnification, Mirrors, Aberrations.

**Suggested Readings:**

1. Concepts of Physics. Volume I and Volume II. (2010). H. C. Verma.
2. David Halliday, Robert Resnick, Jearl Walker. Fundamentals of Physics, 9th edition (2010). Sears and Zeemanskys University Physics, 13th edition (2012).
3. Hugh Young, Roger Freedman, A. Lewis Ford. A Textbook of Optics (2001).
4. Dr. N. Subrahmanyam, BrijLal, Dr. M. N. Avadhanulu. by S. Chand publications.

<b>Semester – I</b>	<b>Paper - III</b>
<b>Course Code: BSC-BT- 103T</b>	<b>Title of the Course: Biochemistry I</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

**Course Outcomes (Cos)**

CO1. Learn the basic knowledge of structure of water

CO2. Learn the basic knowledge of structure and functions of major bio-molecules.

CO3. Learn to understand the catabolism as well as anabolism.

CO4. To Understand the concept of Carbohydrate and Lipids in details.

**Detailed Syllabus:**

<b>Unit</b>	<b>Topics</b>	<b>No. of Hours</b>
<b>I</b>	<b>Historical perspective:</b> <ul style="list-style-type: none"> <li>• Origin of life, abiotic production of biomolecules,</li> <li>• Cellular and chemical foundation of life.</li> </ul>	<b>3</b>
<b>II</b>	<b>Water:</b> <ul style="list-style-type: none"> <li>• Properties of water, Hydrogen bonding, ionization of water, interaction of biological molecules in water, osmosis, pH, titration curves, buffers, Biological buffers.</li> <li>• Types of bond, Covalent and noncovalent interactions in biomolecules with suitable example, functional groups and modification of functional group relevant to biomolecules.</li> </ul>	<b>7</b>

- |            |   |           |
|------------|---|-----------|
| <b>III</b> | <b>Carbohydrates:</b>   | <b>10</b> |
|            | <ul style="list-style-type: none"> <li>• Classification of carbohydrates, sugars and nonsugars, Monosaccharides, Oligosaccharides and Polysaccharide.</li> <li>• Monosaccharides: Structure &amp; properties of Monosaccharides, ketoses and aldoses, D and L configuration, mutarotation, epimers, anomers, chemical and physical properties ;glycosidic bond,</li> <li>• Oligosaccharides: sucrose, maltose and lactose, reducing and non-reducing sugars inversion of sugar</li> <li>• Polysaccharides and its classification based on function<br/>Storage polysaccharide: eg starch, glycogen<br/>Structural polysaccharides: eg. cellulose, chitin</li> <li>• Biological Functions of Carbohydrate</li> </ul> |           |
| <b>IV</b>  | <b>Lipid:</b>   | <b>10</b> |
|            | <ul style="list-style-type: none"> <li>• Fatty acids- Classification, nomenclature</li> <li>• Structure, chemical and physical properties of lipids</li> <li>• Classification of lipids: Simple &amp; complex lipids, and derived lipids</li> <li>• Simple lipids- Oil, Fat and wax</li> <li>• Complex lipids: Phospholipids and Glycolipids</li> <li>• Derived lipids: Steroids, terpenoids and carotenoids</li> <li>• Lipoproteins</li> <li>• Biological Function of lipids</li> </ul>  |           |

**Suggested Readings:**

1. Outlines of Biochemistry: 5th Edition, (2009), Eric 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

<b>Semester – I</b>	<b>Paper - IV</b>
<b>Course Code: BSC-BT- 104T</b>	<b>Title of the Course: Biophysics</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

**Course Outcomes (Cos)**

CO1. Understand the scope of biophysics

CO2. Understand Atomic structure

CO3. Understand chemical bonding and Radioactivity- ionic, covalent, hydrogen and peptide bonding and van der Waals forces

CO4. Learn about Radio isotope types and their importance in biology

CO5. To Understand about Cell membrane and action potential

**Detailed Syllabus:**

<b>Unit</b>	<b>Topics</b>	<b>No. of Hours</b>
<b>I</b>	<b>Introduction to Biophysics</b>	<b>2</b>
	<ul style="list-style-type: none"> <li>• Introduction, Scope and definition of Biophysics.</li> <li>• Biophysics at macroscopic, microscopic level and at the molecular level.</li> </ul>	
<b>II</b>	<b>Atomic structure</b>	<b>7</b>
	<ul style="list-style-type: none"> <li>• Historical background, Bohr model.</li> <li>• Significance of second and third postulate of Bohr's model.</li> <li>• Derivation of radius and energy value.</li> <li>• Quantization of energy levels. Vector atom model. Quantum numbers. Selection rules.</li> <li>• Pauli's exclusion principle. Emission spectra with respect to Na atoms to understand selection rules.</li> </ul>	
<b>III</b>	<b>Radioactivity</b>	<b>8</b>
	<ul style="list-style-type: none"> <li>• Nucleus, Properties. Nuclear forces. Nuclear models (liquid drop and shell model). Radioactive nucleus.</li> <li>• Nuclear radiations and their properties- alpha, beta and gamma. Half life, physical and biological handling of alpha and beta emitting isotopes.</li> <li>• GM counter- Principle, construction and working.</li> </ul>	

**IV. Cell membrane**

- Organization of plasma membrane. 6
- Diffusion- basics. Passive and active transport.
- Membrane potential, Nernst equation.
- Passive electrical properties of cell (capacitance, resistance), adsorption, osmosis, dialysis and colloids.

**V Action Potential**

- Active electrical properties. Electrical model (equivalent) of cell membrane. Depolarization, hyperpolarization of membrane (neuronal). Generation of action potential. 7
- Biopotentials: types and measurement

**Suggested Readings:**

1. Biophysics, an introduction. 1st edition. (2002) Cotteril R. John Willey and Sons Ltd., USA
2. Biophysics. 1st edition (2002), Pattabhi V and Gautham N. Kluwer Academic Publisher, USA.
3. Textbook of optics and atomic physics, 8th edition (1989) P.P. Khandelwal, Himlaya Publishing House, India.
4. Instrumentation measurements and analysis – 2nd edition (2003). Nakraand Choudhari, Tata McGraw Hill, India.
5. Nuclear Physics: An Introduction. 2nd edition (2011). S. B. Patel. Anshan Publication, India
6. Skoog & Lerry, Instrumental Methods of Analysis, Saunders College Publications, New York
7. H. H. Willard, Instrumental Methods of Analysis, CBS Publishers.
8. D.C. Harris, Quantitate Chemical Analysis, W. H. Freeman.
9. Christian G.D, Analytical Chemistry, John & Sons, Singapore
10. Skoog, West and Holler, Analytical Chemistry, Saunders College Publications, New York  
Vogel's Textbook of Qualitative Chemical Analysis, ELBS
11. J.A. Dean, Analytical Chemistry Notebook, McGraw Hill
12. John H. Kennedy, Analytical Chemistry: Principles, Saunders College Publication
13. W. Kemp, Organic Spectroscopy, ELBS
14. Hand book of Instrumental Techniques for Analytical Chemistry, Frank Settle, editor, Prentice Hall



<b>Semester – I</b>	<b>Paper - V</b>
<b>Course Code: BSC-BT- 105T</b>	<b>Title of the Course: Plant Biology I</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

### Course Outcomes (Cos)

CO1. Study Plant as a life form- General & Unique features of plants as a category of living organisms.

CO2.To learn taxonomy, classification and systematics.

CO3. Learn the concept of morphology of plant cell biology

### Detailed Syllabus:

Unit	Topics	No. of Hours
<b>I</b>	<b>Introduction to plant world &amp; classification</b> <ul style="list-style-type: none"> <li>• General &amp; Unique features of plants</li> <li>• Principles, aims and objectives of plant classification</li> <li>• Outline of the classification with example (Flowering &amp; Non flowering plants)</li> <li>• A general account of different groups (Algae, Fungi) traditionally studied in botany, their economic importance with example</li> <li>• A general account of Bryophytes, Pteridophytes, Gymnosperms and Angiosperms (Dicot and Monocot) their economic importance with example</li> </ul>	<b>10</b>
<b>II</b>	<b>Vegetative &amp; Reproductive Morphology of plants</b> <ul style="list-style-type: none"> <li>• Structure of typical plant and different parts of plant (Root, Stem &amp; Leaf)</li> <li>• Inflorescence: Definition, Types of inflorescence and Significance</li> <li>• Morphology of reproductive plant organs Flower: Definition and symmetry, Parts of flower: Pedicel, Thalamus, Floral whorls: calyx, corolla, androecium and gynoecium</li> </ul>	<b>10</b>
<b>III</b>	<b>Plant Tissues and tissue systems</b> <ul style="list-style-type: none"> <li>• Meristmatic tissues: Characters and types based on origin, position</li> </ul>	<b>7</b>

and plane of division and its functions

- Simple tissues: parenchyma, collenchyma, sclerenchyma and its functions
- Vascular tissues: - Components of xylem and phloem, types of vascular Bundles and its functions.
- Epidermal tissues:- Epidermis, structure of typical stomata, trichomes, motor cells; functions.

#### **IV Internal organization of plant body**

**3**

- Primary structure of leaf, stem and root (Dicot and Monocot)
- Concept of Secondary growth

#### **Suggested Readings:**

1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4<sup>th</sup> edition.
2. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
3. Bhojwani, S.S., & Bhatnagar, S.P. An embryology of Angiosperm
4. Chandurkar, P.J. (1983). Plant Anatomy. Oxford & IBH Publishing Co, Calcutta
5. Cummings, U.S.A. 10 edition.
6. Dutta A.C. (2000) A Classbook of Botany (Oxford University Press, UK)
7. Eames, A.J. & Macdaniels, L.H. (1947) An Introduction to Plant Anatomy. McGraw-Hill, N.Y. and London
8. Esau K. (1977) Anatomy of seed plants (Wiley, USA)
9. Fahh, A. (1997). Plant Anatomy. Pergamon Press, Oxford
10. Ganguli, Das Dutta (2011) – College Botany Vol I, II and III (New Central Book Agency, Kolkata)
11. Kumar H.D. (1999) Biodiversity and sustainable conservation (Oxford & IBH, New Delhi)
12. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2<sup>nd</sup> edition.
13. Lawrence G.H. (2012) Taxonomy of vascular plants (Scientific Publ)
14. Maheshwari, P. An Introduction to embryology of Angiosperm
15. Pandey, S.N. & Ajanta Chadha. Plant Anatomy and Embryology. Vikas Publishing House Pvt. Ltd., New Delhi
16. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
17. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
18. Roy Piyush (2012). Plant Anatomy. New Central Book Agency (P.) Ltd. Pune
19. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan
- Vasishta, P.C. (1981). Plant Anatomy. Pradeep Publications to embryology

<b>Semester – I</b>	<b>Paper - VI</b>
<b>Course Code: BSC-BT- 106T</b>	<b>Title of the Course: Animal Biology I</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

### Course Outcomes (Cos)

- CO1. Study overview of Kingdom Animalia classification.  
 CO2. Understand animal tissues (Histology)-Nervous tissue and muscle tissue.  
 CO3. Learn about animal metabolism: Digestion and Respiration.  
 CO4. Study endocrine system and important hormones.

### Detailed Syllabus:

<b>Unit</b>	<b>Topic</b>	<b>Number of hours</b>
<b>I</b>	<b>Introduction to Kingdom Animalia:</b> <ul style="list-style-type: none"> <li>• Outline Classification and Characteristics</li> <li>• Non-Chordates</li> <li>• Chordate</li> </ul>	<b>6</b>
<b>II</b>	<b>Animal Tissue types</b> <ul style="list-style-type: none"> <li>• Excitable tissues:</li> <li>• Nervous tissue: Structure of Nerve cell, Propagation of nerve impulses (Myelinated and Non- myelinated nerve fibers), Neuromuscular junction</li> <li>• Muscle Tissue: Skeletal muscle fiber structure; Sliding filament theory</li> </ul>	<b>7</b>
<b>III</b>	<b>Animal Metabolism</b> <ul style="list-style-type: none"> <li>• Digestion: Structure and function of Digestive gland (Liver, Pancreas and Salivary gland), Digestion and Absorption of Carbohydrates, Fats and Proteins.</li> <li>• Respiration: Internal and External Respiration, Oxygen and carbon dioxide transport in blood. Factors affecting Transport of gases.</li> </ul>	<b>10</b>
<b>IV</b>	<b>Endocrine system:</b> <ul style="list-style-type: none"> <li>• Structure and function of Pituitary, Thyroid, Parathyroid and Adrenal gland. ovaries, and testes</li> </ul>	<b>7</b>

**Suggested Readings:**

1. Jordan, E.L. and Verma P.S. 1978, (i) Chordate Zoology S. Chand & Company Ltd. Ram Nagar. New Delhi.
2. Jordan, E.L. and Verma P.S. 1978 (ii) Invertebrate Zoology. S. Chand & Company Ltd. Ram Nagar. New Delhi.
3. Modern Text Book of Zoology: Invertebrates., R.L.Kotpal. Publisher, Rastogi Publications, 2012.
4. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology.XI Edition.Hercourt Asia PTE Ltd. /W.B. Saunders Company.
5. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & son.

<b>Semester – I</b>	<b>Paper - VII</b>
<b>Course Code: BSC-BT- 107T</b>	<b>Title of the Course: Basic Microbiology</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

**Course Outcomes (Cos)**

CO1. Understand the history of microbiology

CO2. Study the contributions of phenomenal scientists in the field of Microbiology

CO3. Study the branches of Microbiology

CO4. Learn classification of microorganisms and bacterial cell structure analysis.

**Detailed Syllabus:**

<b>Unit</b>	<b>Topics</b>	<b>No. of Hours</b>
<b>I</b>	<b>Introduction to Microbial World:</b> <ul style="list-style-type: none"> <li>• Introduction, History, Branches and Scope of Microbiology:</li> <li>• Biogenesis and Abiogenesis</li> <li>• Milestones and scope of microbiology.</li> <li>• Prokaryotic and Eukaryotic cells</li> <li>• Importance, occurrence and types of microorganisms (Archaeobacteria, Eubacteria, fungi, viruses, viroid, prions, protozoa and algae)</li> </ul>	<b>5</b>
<b>II</b>	<b>Classification of Microorganisms:</b> <ul style="list-style-type: none"> <li>• Classification systems of organisms and Classification of microorganisms.</li> <li>• Classification of bacteria on the basis of their basic nutritional requirements (Macro and micro nutrients), and environmental requirements (pH, Temperature, Oxygen and Salt)</li> <li>• Introduction to Bacterial Classification Guide : Bergey's Manual of Systemic and Determinative Bacteriology</li> </ul>	<b>6</b>
<b>III</b>	<b>Growth and Reproduction in microorganisms</b> <ul style="list-style-type: none"> <li>• Logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate</li> <li>• Sexual and Asexual Mode of Reproduction in microorganisms: Transformation, Transduction, Conjugation, Binary Fission, Budding, Fragmentation, Spore production</li> </ul>	<b>6</b>

<b>IV</b>	<b>Bacterial cell structure:</b>	<b>6</b>
	<ul style="list-style-type: none"> <li>• Ultrastructure of Bacteria- Cell wall (Gram Positive and Gram negative), Cell Membrane,</li> <li>• Capsule, Slime layer, Flagella, Pili, Fimbriae, Endospore</li> <li>• Cell Cytoplasm: Nucleoid, Ribosome, Plasmid, Mesosomes, Cell inclusions: Gas vesicles, Carboxysomes, magnetosomes, PHB granules, Glycogen bodies, metachromatic granules</li> </ul>	
<b>IV.</b>	<b>Microscopy and Observation of Microorganisms:</b>	<b>7</b>
	<ul style="list-style-type: none"> <li>• History of Microscopy</li> <li>• Wet Mount, hanging drop technique</li> <li>• Theory of staining: Classification of stains, Stain (Basic and Acidic), Fixative, Mordant, Decoloriser, Accentuator</li> <li>• Principles and methods of staining techniques for following (Monochrome, Negative, Differential (Gram, Acid fast ), Special staining- Endospore, flagella, cell wall, nucleic acid, capsule)</li> </ul>	

**Suggested Readings:**

1. Microbiology. by Michael J. Pelczar Jr., Roger D. Reid, et al.
2. Microbiology: An Introduction, Global Edition. Edited by Gerard J. Tortora
3. Brock Biology of Microorganisms (14th Edition) 14th Edition by Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl, Thomas Brock
4. Stanier, Y., Doudoroff, M., & Adelberg, E. A. (1958). General microbiology. *General microbiology*.
5. Prescott's Microbiology 10th Edition. By Joanne Willey and Linda Sherwood and Christopher J. Woolverton
6. Black, J. G. (2017). *Microbiology: principles and explorations*. John Wiley & Sons.
7. Talaro, K. P., & Chess, B. (2018). *Foundations in microbiology*. McGraw-Hill.
8. Foster, J. W., & Slonczewski, J. L. (2017). *Microbiology: an evolving science*. WW NORTON.

<b>Semester – I</b>	<b>Paper -VIII</b>
<b>Course Code: BSC-BT- 108T</b>	<b>Title of the Course: Biomathematics and Biostatistics I</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

**Course Outcomes (Cos)**

CO1. Acquire knowledge of basic algebra, trigonometry, matrices, coordinate geometry etc.

CO2. Apply these concepts to solve complex mathematical problems

CO3. Students will visualize and analysis any experiment by using statistical tools and techniques  
Analysis of the data of any experiment statistically to extract meaningful result.

CO4. Students will get idea for handling of any real life data set. Learn the classification of data, frequency distribution and graphical distribution of data.

**Detailed Syllabus:**

<b>Unit</b>	<b>Topics</b>	<b>No. of Hours</b>
	<b>Mathematics</b>	
<b>I</b>	<b>Fundamentals Mathematical Calculations</b>	
	<ul style="list-style-type: none"> <li>• <b>Exponents &amp; Powers:</b> Definition and Simple Powers with Numbers, Algebraic rules for working with Powers.</li> <li>• <b>Logarithm:</b> Definition, Laws of logarithm and Change of base theorem (without proofs) Examples based on laws.</li> <li>• <b>Permutations &amp; Combinations:</b> Counting Principle, Permutations with Repetitions (like &amp; dislikes), Circular Permutations, Permutations with r-particular things included/excluded.</li> <li>• <b>Co-ordinate geometry</b> – Area of triangle and quadrilateral, equation of straight line – in slope form, intercept form and perpendicular form. Conics (ellipse, parabola, hyperbola).</li> </ul>	7
<b>II</b>	<ul style="list-style-type: none"> <li>• <b>Matrices:</b> Definition, types of matrices, (zero, Identity, square, unit, scalar, triangular, diagonal, upper triangular, lower triangular, symmetric) Addition of matrices, multiplication of matrices, determinant (singular, non-singular).</li> <li>• <b>Vector spaces</b> Definition of vector spaces (10 axioms), subspace of vector space, linear combination, linear dependence, Independence of vectors, Dot and Cross product, The dimension of a vector space, Rank, Applications of vectors spaces in biology.</li> </ul>	8

## Biostatistics

### III Introduction to Statistics

- Definition of Statistics, Importance of Statistics, Need of Statistics in biology, collection and organization/classification, summarization and analysis of biological data 8
- Experimental design, Raw data, Data, Nature of data (Qualitative and Quantitative / Variable), Types of data (Primary and Secondary data),
- Sampling Methods: Census, populations and sample, parameter, Statistic, types of sampling Methods (random and Non- random sampling),
- Representation of data: Frequency Distribution.
- Diagrammatic representation: Bar, Subdivided, Multiple, Pie diagram
- Graphical representation: Histogram, Frequency polygon, Frequency curve, Ogive curves
- Numerical Examples

### IV Descriptive biostatistics

- Measure of central tendency: Concepts Measures of Central Tendency, Types of Central Tendency 7
- Mean, (Definition, merits and demerits & formulae for ungrouped and grouped data)
- Median (Definition, merits and demerits and Graphical representation, formulae for ungrouped and grouped data)
- Mode (Definition, merits and demerits and graphical representation, formulae for ungrouped and grouped data)
- Partition Values: Quartiles, Deciles and Percentiles (formulae for ungrouped and grouped data)
- Numerical examples based types of central tendency
- Measures of dispersion: Concepts Measures of dispersion, Range, Mean deviation, Variance (Definition, simple problems), Standard deviation, Coefficient of variance (Merits and Demerits for ungrouped and grouped data).
- Numerical based on range, Mean deviation, Variance and Standard deviation for ungrouped and grouped data

### V Correlation and Regression:

- Correlation: Definition of Correlation, Scatter diagram, interpretation of scatter diagram
- Types of Correlation, (Positive and negative correlation)
- Calculation of correlation coefficient (Karl Pearson Coefficient of Correlation, Bowley's Coefficient of Correlation) and their interpretation
- Regression: Concept of Regression, Lines of regression equation (X on Y and Y on X) Types of regression (linear and non-linear regression)
- Numerical problems based on Correlation and linear regression.



**Suggested Readings:**

1. Fundamentals of Mathematical Statistics by S.C. Gupta and V. K. Kapoor. Sultan Chand & Co.
2. Discrete Mathematics by B.S. Verma, Vishwa Prakashan.
3. Mathematics for Biological Science by Jagdish Arya & Ladner. 1979. Prentice Hall
4. 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).
5. Mathematics for Biological Scientists, M. Aitken, B. Broadhursts, S. Haldky, Garland Science (2009).
6. P.S.S. Sunderrao and J. Richards-An introduction to Biostatistics, Prentice Hall Pvt. Ltd. India
7. Fundamentals of Biostatistics. By Irfan A Khan.
8. Campbell R.C.- Statistics for Biologists, Cambridge University Press, Cambridge.

<b>Semester – I</b>	<b>Paper - IX</b>
<b>Course Code: BSC-BT- 109P</b>	<b>Title of the Course: Practicals in Chemistry &amp; Biochemistry</b>
<b>Credits: 1.5</b>	<b>Total Hours: 45, No. of Practicals: 15</b>

**Course Outcomes (Cos)**

- CO1. Learn safety measures in chemical laboratory  
 CO2. Perform practical on Safety Measures gas constant Crystal Models Freezing point depression  
 CO3. Understand the concept of Thermochemistry and determination of an order of reaction.  
 CO4. Learn the acid-base titrations Molarity, molality, normality Unit volume & weight measurements pH measurement Optical activity  
 CO6. Learn the Reagent Preparation  
 CO7. Study the basic concept of Biochemical calculation.

**Detailed Syllabus:**

<b>Sr. No.</b>	<b>Title of Experiment</b>	<b>No. of practical</b>
<b>Chemistry</b>		
1.	Safety Measures and practices in chemistry laboratory	1
2.	Molarity, molality, normality, ppm, ppb	1
3.	Titration To determine alkali content in antacid tablet using HCl	2
4.	Hardness of water : To estimate hardness of water by using EDTA	1
5.	To determine pH of given solution by pH indicator	1
6.	pH -metry: To determine the pKa value of a given weak acid by pH-metry titration with strong base.	1
<b>Biochemistry</b>		
1.	Biochemical calculations, Preparation of solutions and buffers	1
2.	Isolation and identification of starch from plant source	1
3.	Qualitative analysis-	2

- Spot tests for sugars
  - Spot tests for lipids
4. Oil extraction from plant source and determination of concentration of free fatty acids from sample. 2
  5. To estimate concentration of reducing sugar in given sample by DNSA method 2

<b>Semester – I</b>	<b>Paper - X</b>
<b>Course Code: BSC-BT- 110P</b>	<b>Title of the Course: Practical in Botany and Zoology</b>
<b>Credits: 1.5</b>	<b>Total Hours: 45, No. of Practicals: 15</b>

**Course Outcomes (Cos)**

- CO1. Understand the concept of basic sectioning techniques  
 CO2. Learn maceration technique  
 CO3. Study *Paramecium*, *Drosophila*, *Plasmodium spp.*, *Fasciola spp.* etc.  
 CO4. Perform Enumeration of RBC

**Detailed Syllabus:**

<b>Sr. No.</b>	<b>Title of Experiment</b>	<b>No. of Practical</b>
	<b>Botany</b>	
1	Study of Algae, fungi, bryophytes, pteridophytes , gymnosperms and Angiosperms with one example each	2
2	Study of morphological parameters of angiosperms	1
3	Study on anatomy of root, stem & leaf of dicot plant	1
4	Study on anatomy of root, stem & leaf of monocot plant	1
5	Study of epidermal tissue system – non-glandular and glandular trichomes, typical stomata (dicot and monocot).	2
	<b>Zoology</b>	
6	Wet mount of freshwater sample and Study of Paramecium • Morphology • Reproduction-Binary fission & Conjugation	2
7	Study and Dissection of Honey Bee, Mounting of Mouth parts, pollen basket, Antenna Cleaner, Sting Apparatus, legs and wings	2
8	Enumeration of red blood cells using haemocytometer.	1
9	Detection of Salivary Amylase enzyme by Starch Iodine test	1
10	Collection, Classification and preservation of Insects	2

<b>Semester – I</b>	<b>Paper - XI</b>
<b>Course Code: BSC-BT- 111P</b>	<b>Title of the Course: Practical in Microbiology &amp; Biostatistics</b>
<b>Credits: 1.5</b>	<b>Total Hours: 45, No. of Practicals: 15</b>

**Course Outcomes (Cos)**

CO1. To learn about instruments used in laboratory and to understand their practical handling.

CO2. Study Aseptic Transfer Techniques Wet Mount Monochrome Staining Gram staining, Spore staining, Fungal staining, etc.

CO3. Learn the preparation of media Isolation of bacteria Enumeration Techniques Enrichment Techniques, Observation of motility

CO4. Learn Biological data analysis using mathematical and statistical methods.

**Detailed Syllabus:**

<b>Sr. No.</b>	<b>Title of Experiment</b>	<b>No. of practical</b>
<b>Microbiology</b>		
1	Introduction to Microbiology Laboratory	1
2	Use and Care of Compound Microscope	1
3	Monochrome staining and Negative staining	2
4	Differential staining (Gram's staining)	1
5	Special staining (Endospore staining)	1
6	Fungal staining and Motility- Hanging drop technique	2
<b>Biostatistics</b>		
1	Use of MS Excel formulas Addition, subtraction, multiplication, division, percentage, max, min	2
2	Data presentation <ul style="list-style-type: none"> <li>• Bar diagram</li> <li>• Histogram</li> <li>• Frequency curve</li> <li>• Pie chart</li> <li>• Scatter plot</li> </ul>	2
3	Measures of central tendency <ul style="list-style-type: none"> <li>• Mean</li> <li>• Mode</li> <li>• Median</li> </ul>	1
4	Analysis of variance and standard deviation	1
5	Experimental design, correlation and regression	1

analysis of data and graphical representation

<b>Semester – I</b>	<b>Paper -XII</b>
<b>Course Code: BSC-BT- 112P</b>	<b>Title of the Course: Practical in Physics and Biophysics</b>
<b>Credits: 1.5</b>	<b>Total Hours: 45, No. of Practicals: 15</b>

**Course Outcomes (Cos)**

CO1. Perform practicals on Viscosity measurement using Ostwald's viscometer.

CO2. Study surface-tension measurement, Temperature measurement, Beer and Lambert's Law.

CO3 Learn to calibrate spectrophotometer.

<b>Sr. No.</b>	<b>Title of Experiment</b>	<b>No. of Practical</b>
<b>Physics</b>		
1	Study of Vernier Callipers and Micrometer Screw Gauge	2
2	To study the components and working of travelling microscope	1
3	Surface-tension measurement: Using Jaeger's method/, soap bubble Method	2
4	Viscosity measurement using Ostwald's viscometer (for known and Unknown viscosity)	1
5	To study Plane diffraction grating	1
<b>Biophysics</b>		
1	Calibration of spectrophotometer	1
2	Problems based on Radioactive decay and half life	2
3	Determination of Diffusion Pressure Deficit using potato tubers	1
4	Dialysis	2
5	Working of a G.M. counter	2

<b>Semester – II</b>	<b>Paper - I</b>
<b>Course Code: BSC-BT- 201T</b>	<b>Title of the Course: Fundamentals of Chemistry II</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

### Course Outcomes (Cos)

- CO1. After understanding basic facts and concepts in Chemistry  
 CO2. To develop the ability to apply the principles of Chemistry.  
 CO3. Applications of chemical reactions in various spheres of Chemical sciences and life science.  
 CO4. Understand the different chemical processes used in industries and their applications.  
 CO5. To understand Ionic equilibria, concept of pH and indicators  
 CO6. Chemical kinetics, Electrochemistry, concept of stereochemistry

### Detailed Syllabus:

Unit	Topics	Hours
<b>I</b>	<b>Ionic equilibria –</b>	<b>6</b>
	<ul style="list-style-type: none"> <li>pH, buffer, Equilibrium constant, Le Chatelier's principle, Acid and bases, strength of acid &amp; bases, dissociation constant, pK values, solubility product, Acid–base titrations, indicators used in titrations, Titration curves, Solubility product</li> <li>Ionic product of water, Condition for precipitation,</li> <li>Henderson Hasselbalch equation &amp; related problems, Osmosis, law of osmotic pressure and its measurement</li> </ul>	
<b>II</b>	<b>Chemical kinetics –</b>	<b>6</b>
	<ul style="list-style-type: none"> <li>Rates of reactions, order of reaction; zero, first &amp; second order reaction.</li> <li>Molecularity</li> <li>Differential and integrated rate equations for first &amp; second order reaction.</li> <li>Half-life periods, Arrhenius equation, collision theory of reaction rate, temperature dependent reaction rates</li> </ul>	
<b>III</b>	<b>Electrochemistry-</b>	<b>6</b>
	<ul style="list-style-type: none"> <li>Electrochemical cell, Classification of electrochemical cells, Faraday's Law of electrolysis, half cell reaction, reduction potential, electrochemical series, Liquid junction potential, Huckel theory, Conductometric titration</li> </ul>	
<b>IV</b>	<b>Basics of Organic Chemistry</b>	<b>5</b>
	<ul style="list-style-type: none"> <li>Nomenclature: Common name &amp; IUPAC nomenclature (Alkane, Alkene, alkyne, alcohol)</li> </ul>	

- Organic reactions- oxidation, reduction, elimination, addition, substitution (electrophilic/ Nucleophilic)

<b>V</b>	<b>Basics of stereochemistry:</b>	<b>7</b>
	1. Representation of molecules	
	a. Projection formulae.	
	b. Sawhorse	
	c. Newman,	
	d. Fisher formula	
	2. Conformation isomerism	
	a. Conformation of isomers	
	b. 'C' rotation about C-C bond,	
	b. Propane, Ethane, Butane.	
	c. Relative stability	
	3. Optical Isomerism	
	a. Optical isomers	
	b. Types of symmetry—simple , plane, Centre of symmetry, Alternating axes of symmetry,	
	4. Geometrical isomerism	
	a. Open chain molecule	
	b. Condition of geometric isomer	
	c. Cis-trans and E-Z nomenclature	

### Suggested Readings:

1. University General Chemistry, 1st edition (2000), C.N. R. Rao, Macmillan Publishers, India,
2. Principles of Physical Chemistry, 4th edition (1965), S.H. Maron and C.F. Prutton, Collier Macmillan Ltd
3. The elements of Physical Chemistry, 5th edition (2009), Atkins P, de Paula J., W. H. Freeman Publication, USA
4. An Introduction to Electrochemistry, edition reprint, 2011, Samuel Glasstone, BiblioBazaar, USA
5. Physical Chemistry for biological sciences, 1st edition, (2005), Chang R., University Science Books, USA
6. Physical Chemistry, 1st edition, (2003) David Ball, Thoson Learning, USA.
6. Essentials of Physical Chemistry, 24th edition, (2000), B S Bahl, G D Tuli, ArunBahl, S. Chand Limited, India.
7. Concise Inorganic Chemistry.5th edition (2008), Author: J. D. Lee, John Wiley & Sons, USA.



8. Organic Chemistry, 6 th edition, (1992), Morrison Robert Thornton, Pearson Publication, Dorling Kindersley (India Pvt. Ltd.)
9. Guide book to Mechanism in Organic Chemistry by Peter Sykes, 6th edition, (1996), Prentice Hall, India.

<b>Semester – II</b>	<b>Paper - II</b>
<b>Course Code: BSC-BT- 202T</b>	<b>Title of the Course: Biochemistry II</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

### Course Outcomes (Cos)

- CO1. Learn structure and functions of major bio-molecules.  
 CO2. Understand the catabolism as well as anabolism and overall concept of Metabolism.  
 CO3. Study the concepts of enzyme kinetics, regulation and specificity.

### Detailed Syllabus:

<b>Units</b>	<b>Topics</b>	<b>Hours</b>
<b>I</b>	<b>Proteins:</b> <ul style="list-style-type: none"> <li>• Functions of proteins</li> <li>• Polymer of amino acids, Classification of amino acids,</li> <li>• Chemistry of amino acids: Ionisation of amino acid side chains, Configuration, zwitterion, reactions of amino acids, titration of amino acid, Isoelectric pH.</li> <li>• Protein structure: Fibrous and globular proteins, Primary structure and peptide bond formation, Secondary structure, Tertiary and Quarternary structure (eg.Haemoglobin).</li> <li>• Protein denaturation and renaturation.</li> </ul>	<b>9</b>
<b>II</b>	<b>Vitamins:</b> <ul style="list-style-type: none"> <li>• Sources, deficiency diseases, Classification, Structure and Biochemical functions of fat soluble and water soluble Vitamins.</li> <li>• Coenzymes: Thiamine, Riboflavin, Niacin, PIP, Coenzyme A, lipoicacid , Folicacidand B12.</li> </ul>	<b>4</b>
<b>III</b>	<b>Enzymes:</b> <ul style="list-style-type: none"> <li>• General properties &amp; classification of enzymes</li> <li>• Biocatalyst, Active site, Specificity, Energy of activation, Reaction Rate. Rate law for enzyme catalyzed reaction</li> <li>• Enzyme units, specific activity, turnover number.</li> <li>• Models of enzyme catalysis- Lock and key, Induced fit hypothesis.</li> </ul>	<b>9</b>

- Parameters affecting enzyme activity (temperature, pH, substrate concentration, cofactor, enzyme concentration, activator, inhibitor)
- Enzyme inhibition- Irreversible and reversible inhibition

#### **IV Nucleic acids:**

8

- Purine, Pyrimidines, Nucleosides, Nucleotides, Polynucleotide.
- Covalent structure of DNA and RNA
- Forces stabilizing nucleic acid structure
- Properties of Nucleic Acid.
- Denaturation & renaturation of Nucleic Acids.
- Different forms of DNA
- Types of RNA- mRNA, tRNA and rRNA

#### **Suggested Readings:**

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, (copyright 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

<b>Semester – II</b>	<b>Paper - III</b>
<b>Course Code: BSC-BT- 203T</b>	<b>Title of the Course: Bioinstrumentation</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

**Course Outcomes (Cos)**

CO1. Learn the principles and applications of different analytical techniques such as chromatography, centrifugation, Spectroscopic techniques, atomic absorption spectroscopy, etc.

CO2. To learn the basic concept of Electrophoresis.

CO3. Learn about the types and importance of Microscopes

CO4. Understand about Thermoregulation

**Detailed Syllabus:**

<b>Unit</b>	<b>Topics</b>	<b>No. of hours</b>
<b>I Bio instrumentation:</b>		<b>2</b>
	<ul style="list-style-type: none"> <li>• Introduction, Concepts- Analytical techniques</li> </ul>	
<b>II Spectroscopy:</b>		<b>7</b>
	<ul style="list-style-type: none"> <li>• Definition. Electromagnetic wave. Electromagnetic spectrum. Applications of each region of electromagnetic spectrum for spectroscopy.</li> <li>• Lambert-Beer's Law, types of sources, Instrumentation of single beam and double beam instrument. Introduction to molecular energy levels. Excitation, Absorption, Emission, Rotational spectra, Energy levels of rigid diatomic molecules.</li> <li>• Electron spectroscopy, UV-visible spectroscopy, Mass spectroscopy (Bainbridge mass spectrometer), Atomic absorption spectrometer (AAS).</li> <li>• Principle, construction and working of colorimeter, Spectrophotometer. Application to biomolecules (proteins, DNA, Hb, chlorophyll).</li> </ul>	
<b>III Separation methods:</b>		<b>3</b>
	<ul style="list-style-type: none"> <li>• Theory of chromatography, Types of chromatography, instrumentation and applications of Thin layer chromatography (TLC)</li> </ul>	

- IV. Bioinstruments:** **8**
- Concepts- Analytical techniques, Principle construction, working and applications for analysis of biomolecules of following instruments.
  - **pH meter**, isoelectric pH.
  - **Centrifuge** (RCF, sedimentation concept), different types of centrifuges. different rotors, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications
- V Microscopes:** **5**
- Concepts - Resolving power. Construction and working principles of the following microscopes–
- Light microscopy
  - Bright & Dark Field microscopy
  - Stereo zoom (Dissecting)
  - Compound
  - Inverted
  - Phase contrast
  - Fluorescence
  - Electron microscope: SEM and TEM
- VI Thermoregulation:** Thermometric properties and types of thermometers **5**
- Clinical
  - Thermocouple
  - Bimetallic
  - Platinum resistance
  - Thermistor – thermometers
  - Body temperature and its regulation.

**Suggested Readings:**

1. Biophysics, an introduction. 1st edition. (2002) Cotteril R. John Willey and SonsLtd., USA
2. Biophysics. 1st edition (2002), Pattabhi V and Gautham N. Kluwer AcademicPublisher, USA.
3. Textbook of optics and atomic physics, 8th edition (1989) P.P. Khande lwal,Himlaya Publishing House, India.
4. Instrumentation measurements and analysis – 2nd edition (2003). Makraand Choudhari, Tata McGraw Hill, India

<b>Semester – II</b>	<b>Paper - IV</b>
<b>Course Code: BSC-BT- 204T</b>	<b>Title of the Course: Plant Biology II</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

**Course Outcomes (Cos)**

CO1. Study permeability, Absorption and adsorption of water.

CO2. Learn major pathways in plant metabolism, nutrition Photo-biology and physiology of flowering.

CO3. Understand the concept of plant growth and economical importance of plants.

**Detailed Syllabus:**

<b>Unit</b>	<b>Topic</b>	<b>No. of hours</b>
<b>I</b>	<b>Plant water relationship and its importance</b>	<b>9</b>
	<ul style="list-style-type: none"> <li>• Definition, significance and mechanism: Permeability, Diffusion &amp; imbibitions, Osmosis &amp; its types</li> <li>• Relation between osmotic pressure (OP), turgor pressure (TP) and wall pressure (WP), DPD (Suction pressure)</li> <li>• Absorption and Transport of water, Introduction and mechanism of Ascent of sap – Transpiration and guttation, Translocation of mineral elements. (Capillarity, Imbibition, Atmospheric pressure and Cohesion-tension), Phloem loading and unloading</li> </ul>	
<b>II</b>	<b>Plant Metabolism</b>	<b>6</b>
	<ul style="list-style-type: none"> <li>• Photosynthesis: - Structure of Chloroplast, Photosynthetic pigments, concept of two photo systems, photophosphorylation, calvin cycle, photorespiration, C<sub>4</sub> plants CAM plants</li> <li>• Overview of Respiration, Oxidative Vs Photo-phosphorylation</li> <li>• Nitrogen metabolism</li> </ul>	
<b>III</b>	<b>Growth and development of plants</b>	<b>8</b>
	<ul style="list-style-type: none"> <li>• Essential nutrients for Plant growth and their role</li> <li>• Plant growth regulators</li> <li>• Photo-biology: movement and photo-morphogenesis (vegetative)</li> </ul>	

- Introduction to physiology of flowering: Photoperiodism and Vernalisation
- Plant response to stress (biotic and abiotic)

#### **IV Economic importance of plants**

7

- Cereals, Pulses, Oil seeds, Fiber plants, Medicinal Plants, Timber yielding, Beverages with examples

#### **Suggested Readings:**

1. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi. Co. Ltd.
2. Biochemistry and Molecular Biology of Plants, 2nd Edition Bob B. Buchanan (Editor), Wilhelm Gruissem (Editor), Russell L. Jones (Editor) ISBN: 978-0-470-71421-8 July 2015
3. Devlin R.M. (1983) - Fundamentals of Plant Physiology (Mac. Millan, New
4. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4<sup>th</sup> Edition.
5. Lehninger A. L. (1987), Principles of Biochemistry, CBS Publishers and Distributors (Indian Reprint).
6. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, New York, USA.
7. Nobel P. S. (1998), Physiochemical and Environmental Plant Physiology (Second Edition), Academic Press, San Diego, USA.
8. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing

<b>Semester – II</b>	<b>Paper - V</b>
<b>Course Code: BSC-BT- 205T</b>	<b>Title of the Course: Applied Animal Biology</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

**Course Outcomes (Cos)**

CO1. To learn Animal interactions

CO2. Understand Model organisms in Animal Biology.

CO3. To learn the concept of Animal breeding and different advanced methods used in it.

CO4. To learn the Economic importance of zoology.

CO5. To understand applications of Animals in the field of Biotechnology

**Detailed Syllabus:**

<b>Unit</b>	<b>Topic</b>	<b>Number of Hours</b>
<b>I</b>	<b>Animal Interactions:</b>	<b>7</b>
	<ul style="list-style-type: none"> <li>• Host: Definitive host and Intermediate Host.</li> <li>• Host parasite interaction-</li> <li>• Positive interaction: Mutualism, Commensalism</li> <li>• Negative interaction: Parasitism, Parasitoids, Competition (Competitive exclusion Principle)</li> <li>• Life cycle of – Plasmodium- Taenia sp., Fasciola sp.</li> </ul>	
<b>II</b>	<b>Model systems:</b>	<b>5</b>
	<ul style="list-style-type: none"> <li>• Hydra</li> <li>• Honey bee</li> <li>• Drosophila</li> </ul>	
<b>III</b>	<b>Animal Breeding:</b>	<b>5</b>
	<ul style="list-style-type: none"> <li>• Introduction to animal breeding, Inbreeding Interspecific and intraspecific breeding</li> <li>• Methods of animal breeding: Artificial insemination, Multiple Ovulation Embryo transfer</li> </ul>	



- Concept of Livestock Farming

<b>IV</b>	<b>Economic zoology:</b>	<b>8</b>
	<ul style="list-style-type: none"> <li>• Vermiculture</li> <li>• Apiculture</li> <li>• Sericulture</li> <li>• Aquaculture</li> </ul>	
<b>V</b>	<b>Applications of Animals in Biotechnology</b>	<b>5</b>
	<ul style="list-style-type: none"> <li>• Genetically modified Animals           <ol style="list-style-type: none"> <li>1. Glofish</li> <li>2. Engineered mosquitoes.</li> <li>3. Transparent frogs</li> <li>4. Engineered cows and their role in Livestock farming</li> <li>5. Monkey.</li> </ol> </li> <li>• General ethics related to Genetic modification of animals</li> </ul>	

### **Suggested Readings:**

1. Economic Zoology, Shukla & Upadhyaya, 4th Edition., Rastogi Publications, 2009.
2. Modern Parasitology: A Textbook of Parasitology, 2nd edition, (1993) F. E. G. Cox, Wiley & Sons, USA
3. Sericulture: [www.csb.gov.in/publications/books](http://www.csb.gov.in/publications/books) by Central Silk Board, Ministry of Textiles - Govt of India
5. A Textbook of Zoology, Vol. II- T. Jeffery Parker and William. A. Haswell Low Price Publications
6. Zoology- S. A. Miller and J. B. Harley, Tata McGraw Hill
7. Livestock Production Management by Nilotpal' Ghosh
8. Model Organisms, Cambridge University Press, Rachel A. Ankeny and Sabina Leonelli

<b>Semester – II</b>	<b>Paper - VI</b>
<b>Course Code: BSC-BT- 206T</b>	<b>Title of the Course: Applied Microbiology</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

**Course Outcomes (Cos)**

- CO1. Study different types of microbial culture media
- CO2. Study isolation and cultivation of microorganisms along with pure culture techniques.
- CO3. Understand sterilization, its principles and instruments used for aseptic techniques
- CO4. Study different methods for the control of microbial growth
- CO5. Learn maintenance and preservation of microorganisms, Lyophilization, Cryopreservation, etc.
- CO6. Understand the applications of microorganisms in biotechnology and other industries.

**Detailed Syllabus:**

<b>Unit</b>	<b>Topic</b>	<b>Hours</b>
<b>I</b>	<b>Introduction to Applied Microbiology</b>	<b>3</b>
	<ul style="list-style-type: none"> <li>• Importance of study of Microbiology and relevance in Biotechnology</li> <li>• Different Branches of Microbiology (Brief discussion of application of Microbiology in various fields) and application in biotechnology</li> <li>• Handling of microorganisms and Biosafety measures</li> </ul>	
<b>II</b>	<b>Isolation, Cultivation and Preservation of microorganisms:</b>	<b>9</b>
	<ul style="list-style-type: none"> <li>• Classification, types and use of media (Bacterial and Fungal)</li> <li>• Isolation of microorganisms and pure culture techniques: Serial Dilution, Spread plate, Pour plate and Streak plate</li> <li>• Cultivation –Concept of Pure culture, co-culture and mixed culture, Colony characteristics.</li> <li>• Preservation and Maintenance methods- Refrigeration, Paraffin method or glycerol stock method, Cryopreservation, and Lyophilization (freeze-drying)</li> </ul>	

- II. Control of microbial growth: 14**
- Concept and Definition of Sterilization, Disinfection and Asepsis
  - Physical, Mechanical and Chemical methods of sterilization:
    - A) Physical method** – Heat (Dry and Moist heat), Principle and working of Autoclave and Hot air oven pasteurization, Radiation. Sterilization Efficiency testing  
Concept of D value, F value and Z value.
    - B) Mechanical method** -Filtration
    - C) Chemical Agents and their Mode of Action** - Aldehydes, Halogens, Quaternary Ammonium Compounds, Phenol and Phenolic Compounds, Heavy Metals, Alcohol, Dyes, and Detergents
  - **Antibiotics and other chemotherapeutic agents-** Examples and mode of action (one example each), Concept of MIC and MBC
- III. Microbial Interactions (One examples of positive and negative interaction) 4**
- Microbe-Plant
  - Microbe-Animal
  - Microbe-Microbe interaction

### Suggested Readings:

1. Microbiology. by Michael J. Pelczar Jr., Roger D. Reid, et al.
2. Microbiology: An Introduction, Global Edition. Edited by Gerard J. Tortora
3. Brock Biology of Microorganisms (14th Edition) 14th Edition by Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl, Thomas Brock
4. Stanier, Y., Doudoroff, M., & Adelberg, E. A. (1958). General microbiology. *General microbiology*.
5. Prescott's Microbiology 10th Edition. By Joanne Willey and Linda Sherwood and Christopher J. Woolverton
6. Black, J. G. (2017). *Microbiology: principles and explorations*. John Wiley & Sons.
7. Talaro, K. P., & Chess, B. (2018). *Foundations in microbiology*. McGraw-Hill.
8. Foster, J. W., & Slonczewski, J. L. (2017). *Microbiology: an evolving science*. WW NORTON.

<b>Semester – II</b>	<b>Paper - VII</b>
<b>Course Code: BSC-BT- 207T</b>	<b>Title of the Course: Biomathematics and Biostatistics II</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

### Course Outcomes (Cos)

CO1. Acquire knowledge of basic algebra, matrices, coordinate geometry, etc.

CO2. Apply these concepts to solve complex mathematical problems

CO3. Learn the classification of data, frequency distribution and graphical distribution of data.

CO4. Calculate mean, median and mode Measures of dispersion and mean deviation, variance, standard deviation and coefficient of variation Hypothesis testing.

CO5. Learn student's t test and chi-square test, ANOVA etc.

CO6. Understand probability, binomial, probability, poisson, normal distribution and their applications.

### Detailed Syllabus:

Unit	Topics	No. of Hours
<b>Mathematics</b>		
<b>I</b>	<b>Linear equations</b>	<b>7</b>
	<ul style="list-style-type: none"> <li>• Homogeneous and non-homogeneous linear equation system</li> <li>• Eigen values and Eigenvectors,</li> <li>• Row reduction and echelon forms, consistency, Gaussian elimination method.</li> <li>• Applications of linear equations in biology</li> </ul>	
	<b>Differentials equations</b>	
	<ul style="list-style-type: none"> <li>• Types (ordinary and partial), order and degree of differential equation.</li> <li>• Homogeneous and non-homogeneous differential equation.</li> <li>• Applications: growth and decay, law of cooling.</li> </ul>	

<b>II</b>	<b>Differential Calculus</b>	<b>8</b>
	<ul style="list-style-type: none"> <li>• Derivative and its physical significance, derivative of a function, implicit function, basic rules for differentiation, maxima and minima – their applications in biology (wave equation, heat equation, Laplace equation).</li> </ul>	
	<b>Integral Calculus</b>	
	<ul style="list-style-type: none"> <li>• Integration of functions, basic rules for integration, definite and indefinite integrals, geometric meaning of integration, applications in finding area under curves, Applications of integration in biology.</li> </ul>	
	<b>Biostatistics</b>	
<b>III</b>	<b>Probability and probability distribution</b>	<b>8</b>
	<ul style="list-style-type: none"> <li>• Concept of Probability, random variable</li> <li>• Probability theory experiments with real life examples.</li> <li>• Discrete Probability Distribution- Probability Mass function, Binomial distribution and the Poisson distribution, and application in biosciences</li> <li>• Continuous Probability Distribution- Probability density function, Normal distribution and application in biosciences</li> </ul>	
<b>IV</b>	<b>Testing of hypothesis</b>	<b>7</b>
	<ul style="list-style-type: none"> <li>• Definition of Hypothesis,</li> <li>• Types of hypothesis,</li> <li>• Purpose of hypothesis testing,</li> <li>• Parameter and Statistic, steps of hypothesis assumptions and hypothesis, significance level, types of errors,</li> <li>• Critical region, P- value</li> </ul>	
	Test statistics:	
	<ul style="list-style-type: none"> <li>• Small and Large sample test</li> <li>• Testing mean,</li> <li>• Testing variance,</li> <li>• Distribution of test statistics.</li> <li>• Student's t – test,</li> <li>• Chi square test,</li> <li>• F- test</li> </ul>	

**Suggested Readings:**

1. Fundamentals of Mathematical Statistics by S.C. Gupta and V.K.Kapoor. Sultan Chand &Co.
2. Discrete Mathematics by B.S. Verma, VishwaPrakashan.
3. Mathematics for Biological Science by JagdishArya& Ladner.1979. Prentice Hall.
4. Thomas' Calculus, by George B. Thomas, Joel Hass, Christopher Heil, Maurice D. Weir, 14th edition,Pearson Publishers (2018).
5. Elementary Differential Equations and Boundary Value Problems, by William E. Boyce and Richard C.DiPrima, 10th edition, Wiley publication (2012).
6. 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).
7. Mathematics for Biological Scientists, M.Aitken, B.Broadhursts, S. Haldky, Garland Science (2009).
8. Fundamentals of Biostatistics. byIrfan A Khan.
9. P.S.S. Sunderrao and J. Richards-An introduction to Biostatistics, Prentice Hall Pvt. Ltd. India.

<b>Semester – II</b>	<b>Paper - VIII</b>
<b>Course Code: BSC-BT- 208T</b>	<b>Title of the Course: Information Technology</b>
<b>Credits: 02</b>	<b>Total Hours: 30</b>

### Course Outcomes (Cos)

- CO1. Study the history of evolution and generations of computers.
- CO2. Classify the generations of computers.
- CO3. Study the overview and functions of a computer system.
- CO4. Learn the modern computers, operating systems, data processing & computer viruses.
- CO5. Understand the concept of computer networking, internet searches, algorithms, flowcharts & programming concepts of databases.
- CO6. Study the applications of Information Technology.

### Detailed Syllabus:

<b>Unit</b>	<b>Topics</b>	<b>Hours</b>
<b>I</b>	<p><b>History:</b></p> <ul style="list-style-type: none"> <li>• Generations of computers (I, II, III, IV, V)</li> <li>• Modern computers: The workstation, The Minicomputer, Mainframe Computers, Parallel processing Computer &amp; The Super Computer.</li> </ul> <p><b>Introduction to computers:</b></p> <ul style="list-style-type: none"> <li>• Overview and functions of a computer system</li> <li>• Input and output devices</li> <li>• Storage devices: Hard disk, Diskette, Magnetic tape, RAID, ZIP devices, Digital tape, CD-ROM, DVD (capacity and access time)</li> </ul> <p><b>Introduction to operating system:</b></p> <ul style="list-style-type: none"> <li>• Operating system concept-Windows and Unix/Linux</li> </ul>	<b>7</b>

<b>II</b>	<b>Data processing &amp; presentation:</b> <ul style="list-style-type: none"> <li>• Introduction: MS office (Word, Excel &amp; Power Point)</li> </ul> <b>Computer viruses:</b> <ul style="list-style-type: none"> <li>• An overview of Computer viruses</li> <li>• What is a virus? Virus symptoms, how do they get transmitted?</li> <li>• General Precautions</li> </ul> <b>Internet searches:</b> <ul style="list-style-type: none"> <li>• Concepts in text-based searching, Searching Medline. Pub Med, bibliographic database</li> </ul>	<b>8</b>
<b>III</b>	<b>Computer Networking:</b> Introduction to networking: various terminologies Associated hardware devices, gadgets (Router, Switch) tools, services, and resources Network Topologies and Protocols, LAN, WAN and MAN World Wide Web (WWW) Network security: fire walls	<b>8</b>
<b>IV</b>	Introduction & need of databases, Types of databases Introduction & Overview of Biological database, Types of Biological Database Bioinformatics: Introduction to bioinformatics, History, Goals, Relation to other fields.	<b>7</b>

**Suggested Readings:**

1. Computer Fundamentals, 4th edition (2004) P.K. Sinha, BPB publication, India
2. Computer Networks. 4th edition (2008). Tanenbaum. Pearson Education, India
3. Introduction to Database Management Systems, 1st edition, (2004), Atul Kahate, Pearson education, India
4. Bioinformatics –Principles and Applications by Zhumur Ghosh, Bibekan and Mallick-Oxford university press
5. Introduction to Bioinformatics by Teresa Attwood and David.J. Parry, Smith Pearson education
6. Computer Fundamentals, 4th edition (2004) P.K. Sinha, BPB publication, India
7. Computer Networks. 4th edition (2008). Tanenbaum. Pearson Education, India
8. Introduction to Database Management Systems, 1st edition, (2004), Atul Kahate, Pearson education, India.



<b>Semester – II</b>	<b>Paper - IX</b>
<b>Course Code: BSC-BT- 209P</b>	<b>Title of the Course: Practical In Chemistry and Biochemistry II</b>
<b>Credits: 1.5</b>	<b>Total Hours: 45, No. of Practicals: 15</b>

### Course Outcomes (Cos)

CO1. Study Acid-Base titration based on conductivity measurement.

CO2. Learn to perform the determination of content of acetic acid in vinegar using NaOH

CO3. Learn the Reagent Preparation Spot Test Isolation of starch from potato protein from plant source oil from plant source

CO4. Understand the concept of estimation of protein by Biuret method Lowry method.

CO5. Learn to perform the techniques of thin layer chromatography, saponification of fats and estimation of reducing sugars by DNSA method.

CO6. To perform measurement of pH by conductivity measurement (Conductometry)

### Detailed Syllabus:

<b>Sr. No.</b>	<b>Title of Experiment</b>	<b>No. of Practicals</b>
<b>Chemistry</b>		
1.	To study Acid base titration based by conductivity measurement	1
2.	Titration : To determine content of acetic acid in vinegar using NaOH	1
3.	Titration: To determine normality/molarity using acid base volumetric titration	2
4.	Stereochemistry: To study different conformations of biomolecules using models.	1
5.	Chemical Kinetics: To study kinetics of ester hydrolysis	2
6.	Separation techniques: <ul style="list-style-type: none"> <li>• To study Separation Techniques like recrystallization, distillation, sublimation</li> </ul>	2

**Biochemistry**

- |    |   |   |
|----|---|---|
| 1. | Qualitative tests for amino acids and proteins  | 1 |
| 2. | Estimations: <ul style="list-style-type: none"><li>• Estimation of concentration of protein by Biuret method</li><li>• Estimation of concentration of protein by Lowry's method</li></ul> | 2 |
| 3. | Enzyme activity: To find out enzyme activity (amylase)  | 1 |
| 4. | Melting temperature of nucleic acid: To determine $T_m$ of DNA  | 1 |
| 5. | Determination of Ascorbic acid  | 1 |

<b>Semester – II</b>	<b>Paper - X</b>
<b>Course Code: BSC-BT- 210P</b>	<b>Title of the Course: Practical in Applied Botany and Zoology</b>
<b>Credits: 1.5</b>	<b>Total Hours: 45, No. of Practicals: 15</b>

**Course outcomes (COs)**

CO1. Study of plant cell types, rate of respiration Osmosis and Turgor pressure

CO2. Learn wet mount of freshwater sample Study of *Hydra*

CO3. Study of *Drosophila*, establishment and maintenance of *Drosophila* culture

CO4. Study of *Plasmodium sps.*, *Fasciola sp.* Dissection of Honey Bee

**Detailed Syllabus:**

<b>Sr. No.</b>	<b>Title of Experiment</b>	<b>No. of Practical</b>
<b>Plant Biology</b>		
1	Determination of rate of respiration in germinating seeds	1
2	Estimation of chlorophyll content in photosynthesizing and non-photosynthesizing leaf	1
3	To study effect of plant growth regulators on leaf	1
4	Estimation of chlorophyll stability index and carotenoid stability index in leaf tissue/Estimation of membrane stability index as drought tolerance character	2
5	Studies on economically important plants: Students should prepare herbarium specimens with their uses Stability Index	2
<b>Applied Zoology</b>		
6	Study of <i>Hydra</i> : Permanent slides • Morphology • Reproduction • Regeneration in <i>Hydra</i>	2
7	Culturing and Study of Life cycle of <i>Drosophila</i>	2
8	Study of <i>Drosophila</i> : Characters, sexual dimorphism – eye & wing mutations	2
9	Study of <i>Plasmodium sp.</i>	1
10	Study of <i>Fasciola sp.</i>	1

<b>Semester – II</b>	<b>Paper - XI</b>
<b>Course Code: BSC-BT- 211P</b>	<b>Title of the Course: Practical In Microbiology and Bioinstrumentation</b>
<b>Credits: 1.5</b>	<b>Total Hours: 45, No. of Practicals: 15</b>

**Course Outcomes (Cos)**

CO1. Study of different bacterial and fungal media along with their preparation

CO2. Learn the practical isolation of bacteria by following pure culture techniques such as streak plate, Spread plate and pour plate technique.

CO3. Study the maintenance of bacterial and fungal culture.

CO4. Learn Absorption spectrum of protein, absorption spectra isoelectric point of amino acids.

CO5. Understand the pH meter, electronic components of Bright field, compound microscope and electronic balance for micro measurements.

**Detailed Syllabus:**

<b>Sr. No.</b>	<b>Title of Experiment</b>	<b>No. of Practical</b>
	<b>Microbiology</b>	
1	Preparation of Media and Glassware Bacterial growth media- Nutrient broth, Nutrient agar plates, butts and slants, MacConkey's agar plates. Fungal growth media- potato dextrose agar plates	2
2.	Aseptic transfer techniques	1
3.	Demonstration of microbes in air, on table surface, finger tips on nutrient media. Cultivation of microorganisms: Isolation and purification of bacteria by streak plate technique	2  1
4.	Enumeration of bacteria from food/ water/ curd by using following techniques: Spread plate (CFU/ml) Serial dilution and Pour plate Turbidometric method Neubauer's chamber (yeast cells)	2

**Bioinstrumentation**

1	Working and components of various types of Centrifuges	1
2	Microscopy – Components and working of Bright field compound microscope	1
3	Separation and identification of amino acids by paper chromatography.	1
4	Separation and identification of sugars by TLC	1
5	Absorption spectra of DNA melting and protein	1
6	Beer and Lambert's Law – Components and working of Colorimeter, Spectrophotometer	2

<b>Semester – II</b>	<b>Paper - XII</b>
<b>Course Code: BSC-BT- 212P</b>	<b>Title of the Course: Practical In Information Technology and Biostatistics</b>
<b>Credits: 1.5</b>	<b>Total Hours: 45, No. of Practicals: 15</b>

### Course Outcomes (Cos)

CO1. Learn Biological data analysis using mathematical and statistical methods.

CO2. Perform practicals on Tutorials operating systems file handling, Scanning for viruses and using anti-virus programs

CO3. Understand to use Microsoft word - Creating, Saving & Operating a document Printing Document Working with Tables and Charts.

CO4. Learn the use of internet -Downloading & Installing software/plugin on Windows 98/XP and later versions searching/Surfing on the WWW.

CO5. Learn Spreadsheet Applications (Microsoft Excel): Worksheet Basics: Entering information in a Worksheet, Saving & Opening a Worksheet, Editing, Copying & Moving data.

CO6. Study Usage of multimedia - Creation of Computer Presentations

### Detailed Syllabus:

<b>Sr. No.</b>	<b>Title of Experiment</b>	<b>No of Practical</b>
	<b>Computer</b>	
1	A: Tutorials operating systems: DOS and windows File handling: copy, rename, delete, type Directory structure: make, rename, move directory	2
2	Word Processing (Microsoft Word): Creating, Saving & Operating a document, Editing, Inserting, Deleting, Formatting, Moving & Copying Text, Find & Replace, Spell Checker & Grammar Check, Document Enhancement (Borders, Shading, Header, Footer), Printing Document (Page Layout, Margins),	2
3	Introduction to the use of Wizards & Templates, Working with Graphics (Word Art), Working with Tables & Charts, Inserting Pictures	2

4	Spreadsheet Applications (Microsoft Excel): Worksheet Basics: Entering information in a Worksheet, Saving & Opening a Worksheet, Editing, Copying & Moving Data, Inserting, Deleting & Moving Columns & Rows, Clearing.	1
5	Usage of multimedia – Creation of Computer Presentations with graphics (Microsoft Power Point): Creation of slides, Rapid Presentation design using wizards	2

### **Biostatistics**

1	Use of Pivot table for data analysis	1
2	Hypothesis testing using 'Data analysis tools': t-test, Chi square test.	2
3	Fitting of following distribution: Binomial, Poisson, Normal	2
4	Calculate Skewness and kurtosis using MS Excel	1