



Fergusson College (Autonomous)  
Pune

Learning Outcomes-Based Curriculum

for

F. Y. B. Sc. Biotechnology

With effect from June 2019

## Program structure

Semester	Course Code	Course Title	Course	No. of Credits
F.Y.B.Sc Sem-I	BTH1101	Concepts and application in Biotechnology	T	02
	BTH1102	Biological Chemistry - I	T	02
	BTH1103	Biophysics	T	02
	BTH1104	Animal Sciences I	T	02
	BTH1105	Plant Sciences I	T	02
	BTH1106	Introduction to Microbial World	T	02
	BTH1107	Quantitative methods in Biology I	T	02
	BTH1108	Ecology	T	02
	BTH1109	Practicals in Biological Chemistry and Biophysics	P	02
	BTH1110	Practicals in Plant & Animal Sciences I	P	02
	BTH1111	Practicals in Microbiology and Ecology	P	02
	BTH1112	Practicals in Biostatistics and Computers I	P	02
	<b>Total</b>			<b>24</b>
F.Y.B.Sc Sem-II	BTH1201	Evolutionary Biology and Biodiversity	T	02
	BTH1202	Biological Chemistry - II	T	02
	BTH1203	Bioinstrumentation	T	02
	BTH1204	Animal Sciences II	T	02
	BTH1205	Plant Sciences II	T	02
	BTH1206	Microbial Growth, Control and Applications	T	02
	BTH1207	Quantitative methods in Biology II	T	02
	BTH1208	Cell Biology I	T	02
	BTH1209	Practicals in Biochemistry and Bioinstrumentation	P	02
	BTH1210	Practicals in Microbiology and Cell Biology I	P	02
	BTH1211	Practicals in Plant & Animal Sciences II	P	02
	BTH1212	Practicals in Biostatistics and Computers II	P	02
	<b>Total</b>			<b>24</b>

Semester	Course Code	Course Title	Course	No. of Credits
S.Y.B.Sc Sem-III	BTH2301	Cell Biology -II	T	03
	BTH2302	Molecular Biology – I	T	03
	BTH2303	Metabolic Pathways	T	03
	BTH2304	Medical Microbiology and Immunology	T	03
	BTH2305	Fundamentals of Genetics	T	03
	BTH2306	Plant Development	T	03
	BTH2307	English\German\French	T	03
	BTH2308	Biotechnology Practicals I (Cell Bio II, Med. Micro and Immuno)	P	02
	BTH2309	Biotechnology Practicals II (Mol.Bio and Met. Pathways)	P	02
	BTH2310	Biotechnology Practicals III (Plant dev and Genetics)	P	02
		<b>Total</b>		<b>27</b>
S.Y.B.Sc Sem-IV	BTH2401	Disease Biology	T	03
	BTH2402	Molecular Biology – II	T	03
	BTH2403	Protein Biochemistry and Enzymology	T	03
	BTH2404	Food and Dairy Microbiology	T	03
	BTH2405	Environmental Biotechnology	T	03
	BTH2406	Animal Development	T	03
	BTH2407	Scientific Writing and Communication\German \French	T	03
	BTH2408	Biotechnology Practicals IV (Disease Biology and Protein Biochem)	P	02
	BTH2409	Biotechnology Practicals V (Mol.Bio, Food and Dairy Micro)	P	02
	BTH2410	Biotechnology Practicals VI (Animal Dev and Envir. Biotech)	P	02
		<b>Total</b>		<b>27</b>

Semester	Course Code	Course Title	Course	No. of Credits
T.Y.B.Sc Sem-V	BTH3501	Large Scale Manufacturing Processes –I	T	03
	BTH3502	Model systems in Biotechnology	T	03
	BTH3503	Genetics and Introduction to Genetic Engineering	T	03
	BTH3504	Animal Tissue Culture	T	03
	BTH3505	Applications in Medical and Microbial Biotechnology ( <b>Elective</b> )	T	03*
	BTH3506	Biosafety regulations and Bioethics ( <b>Elective</b> )	T	03*
	BTH3507	Introduction to Nanotechnology ( <b>Elective</b> )	T	03*
	BTH3508	Advanced Enzymology ( <b>Elective</b> )	P	03*
	BTH3509	Practicals in Biotechnology I (LSMP and Model Systems)	P	02
	BTH3510	Practicals in Biotechnology II (GE)	P	02
	BTH3511	Practicals in Biotechnology III (ATC)	P	02
		<b>Total</b>		<b>24</b>
T.Y.B.Sc Sem-VI	BTH3601	Large Scale Manufacturing Practices –II	T	03
	BTH3602	Analytical Techniques	T	03
	BTH3603	Applications and Techniques in Genetic Engineering	T	03
	BTH3604	Plant Tissue Culture	T	03
	BTH3605	Applications in Agri and Enviro Biotechnology ( <b>Elective</b> )	T	03*
	BTH3606	Introduction to Diagnostic Techniques ( <b>Elective</b> )	T	03*
	BTH3607	Introduction to Bioinformatics ( <b>Elective</b> )	T	03*
	BTH3608	Adv. Methods in Biotechnology ( <b>Elective</b> )	T	03*
	BTH3609	Practicals in Biotechnology IV (LSMP and Analytical Techniques)	P	02
	BTH3610	Practicals in Biotechnology V (GE)	P	02
	BTH3611	Practicals in Biotechnology VI (PTC)	P	02
		<b>Total</b>		<b>24</b>

## Programme Outcomes

PO1	Provide students an excellent academic experience and equip them with ability to solve a broad range of problems in our rapidly-changing technological environment.
PO2	Strong foundation and knowledge in scientific fundamentals with a capacity to know how, when and where to use the knowledge in specific ways.
PO3	Ability to identify, formulate, analyse and solve scientific problems.
PO4	Ability to integrate material from more than one subject and to apply appropriate scientific principles to arrive at correct and effective solutions.
PO5	Ability to develop good experimental and laboratory skills.
PO6	Strong oral and written communication skills.
PO7	Development of sense of social, ethical and professional responsibility.
PO8	Gain comprehensive understanding of the principles and practices of biotechnology and broad-based concepts in an interdisciplinary structure
PO9	Obtain broad based training in techniques utilised in biotechnology and understand the scope and applications of biotechnology.
PO10	Design, perform experiments, analyze and interpret data for investigating basic problems in biotechnology and related fields.
PO11	Apply appropriate tools and techniques in biotechnological manipulation and ability to combine experimental and computational approaches to address biotechnological research

**BTH1101 Concepts and Application in Biotechnology**  
**Credits: 2**

<p><b>Learning Outcomes:</b> <b>The students will be able to understand:</b></p> <ul style="list-style-type: none"> <li>• Overall knowhow about biotechnology subject</li> <li>• The role of biotechnology in the field of agriculture</li> <li>• The role of biotechnology in the medical field</li> <li>• The role of biotechnology in the field of environment conservation</li> <li>• Glimpse of current research in the field of biotechnology</li> </ul>	<p><b>Suggested Pedagogical Processes:</b></p> <p>ICT, presentations, blackboard teaching, discussions regarding current research trends</p>
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Sr. No.	Topic	Lecture (Total 36)
1	<p><b>What is Biotechnology</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Milestones in the history of biotechnology</li> <li>• Biotechnology in day to day life</li> </ul>	2
2	<p><b>Agriculture biotechnology</b></p> <ul style="list-style-type: none"> <li>• Recent developments in the field of agriculture biotechnology</li> <li>• Visit to agriculture research institute/ agro-industry and report writing, one guest lecture</li> </ul>	8
3	<p><b>Medical biotechnology</b></p> <ul style="list-style-type: none"> <li>• Recent development in the field of medical biotechnology</li> <li>• Visit to medical research institute/ diagnostic lab/ and report writing, one guest lecture</li> </ul>	8
4	<p><b>Applied biotechnology</b></p> <ul style="list-style-type: none"> <li>• Recombinant DNA technology-basics and applications</li> <li>• Visit to RDT product manufacturing units/labs and report writing, one guest lecture</li> </ul>	8
5	<p><b>Environmental biotechnology</b></p> <ul style="list-style-type: none"> <li>• Need for biotechnology in environment conservation</li> <li>• Current environmental issues and use of biotechnology in solving these issues</li> </ul>	5
6	<p><b>Introduction to national research funding institutes</b></p> <ul style="list-style-type: none"> <li>• (UGC, DBT, CSIR, ICMR, DST etc.), national and international research institutes (NIH, MIT, NIV, NCL, NCCS, ISSER, DRDO etc.)</li> </ul>	5

**Reference Books:**

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, 7<sup>th</sup> Edition)
4. Amann, R.I. Stromley, J. Stahl: Applied & Environmental Microbiology
5. Official websites for NCL, NIV, IISER, NCCS, DST, DRDO, and DAE can be used as references

**BTH1102 Biological Chemistry-I****Credits: 2**

<b>Learning outcome:</b> <b>The students will be able to understand:</b> <ul style="list-style-type: none"> <li>• Structure and function of biomolecules</li> <li>• Working of biological buffers</li> <li>• Basics of thermodynamics and electrochemistry</li> </ul>	<b>Suggested Pedagogical Processes:</b> ICT, presentations, blackboard teaching, model making by students, problem solving tutorials, discussions regarding current research trends, designing and planning simple biochemistry practicals.
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Sr No.	Title and Contents	Lecture (Total 36)
1	<b>Chemical bonding:</b> Types of bonds and factors affecting the bond formation, various theories, bond parameters, types of bonds in biomolecule [Covalent (glycoside, peptide, phosphodiester), ionic, hydrogen, Van der Waals, hydrophobic, coordinate)], Hydrophilic and hydrophobic interactions	7
2	<b>Introduction to biomolecules:</b> <b>Carbohydrates:</b> Introduction, biological importance. Definition, Classification (glyceraldehydes, Simple Aldose, Simple Ketoses, D-glucose, Conformation of D-glucose), disaccharides, polysaccharides (starch, glycogen) <b>Proteins:-</b> Amino acids; Structure and properties, Primary, Secondary, Tertiary and Quaternary structure <b>Lipids:</b> - Introduction, classes, fatty acids; physical and chemical properties, simple lipids <b>Nucleic acids:</b> Nucleosides, nucleotides, Polynucleotide, DNA and RNA,	9
3	<b>Thermodynamics and chemical equilibrium:</b> Thermodynamics: Introduction, scope and limitations, terms and basic concepts, types of systems, intensive and extensive properties, equilibrium and non-equilibrium states, reversible and irreversible processes, laws of thermodynamics, internal energy, enthalpy, endo and exothermic reactions, free energy and work, Gibb's Helmholtz equations, ATP and its role in bioenergetics. <b>Chemical Equilibrium:</b> Equilibrium constant, Le Chatelier's principle, Acid and bases, strength of acid & bases, pH of aqueous solutions, Acid-base titrations, indicators in titrations, Titration curves Solubility product & applications, ionic product, Condition for precipitation, Buffers, buffer action, Henderson equation & related problems, Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, Properties of water, water as a reactant, interaction of biomolecules with water	13
4	<b>Electrochemistry:</b> Redox reactions; basic concepts, free energy changes in redox reactions, EMF of a cell and its measurements, Nernst Equation Computation of cell EMF, Calculation of thermodynamic quantities of cell reactions ( $\Delta G$ , $\Delta H$ and $K$ ), standard electrode potential, sign conventions, electrochemical series	7

**Reference Books:**

1. The elements of Physical Chemistry, 5th edition (2009), Atkins P, de Paula J. W. H. Freeman Publication, USA
2. An Introduction to Electrochemistry, edition reprint, 2011, Samuel Glasstone, Biblio Bazaar, USA
3. Physical Chemistry for biological sciences, 1st edition, (2005), Chang R., University Science Books, USA
4. Organic Chemistry, 6th edition, (1992), Morrison Robert Thornton, Pearson Publication, Dorling Kindersley (India Pvt. Ltd.)
5. Biochemistry, 4<sup>th</sup> Edition, (2011), Voet and Voet, John Wiley and Sons, Inc.
6. Principles of Biochemistry, 7<sup>th</sup> edition (2017), Lehninger, Freeman W.H. and Company
7. Biochemistry, Berg J., Tymoczko J., Stryer L., 8<sup>th</sup> edition (2015), Freeman W. H. and Company



**BTH1103 Biophysics****Credits: 2**

<b>Learning Outcomes:</b> <b>The students will be able to understand:</b> <ul style="list-style-type: none"> <li>• Basic concepts of biophysics</li> <li>• Relevance of the subject to biological systems.</li> <li>• Should be able to relate it to day to day life.</li> </ul>	<b>Suggested Pedagogical Processes:</b> ICT, presentations, blackboard teaching.
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Sr. No.	Topic	Lecture (Total 36)
1	<b>Atomic structure:</b> Historical background upto Bohr model. Significance of second and third postulate of Bohr's model. Derivation of radius and energy value. Quantization of energy levels. Using Rydberg's constant, Atomic spectra is signature of the element. Bohr – Sommerfeld model. Vector atom model. Quantum numbers. Selection rules. Pauli's exclusion principle.	4
2	<b>Radioactivity:</b> Nuclear radiations and their properties - alpha, beta and gamma. Introduction, classification of radiations in radiobiology, irradiation of cells, type of radiation damage. Radioimmunoassay. Radiopharmaceuticals, Measurement of radiation - Dosimetry and detectors. Principle, construction and working of – GM counter. Scintillation Counter (Solid and liquid).	5
3	<b>Energy production, movement and force:</b> Tissue Specific metabolism: Kidney, Brain, Liver, Muscles, Blood: use of energy for their function Role of ATP, ADP and Phosphocreatine for energy generation. Glycolysis : reaction, energy production and need, fates of Pyruvate Mitochondria: ETC and ATP production overview Molecular motors: Cardiac and smooth muscle contraction. proteins involved and interrelation between energy, movement and force. Generation of action potential	12
4	<b>Homeostasis:</b> human as an example. Gaseous exchange : respiration, cellular and intracellular respiration. Thermoregulation: role of hormones, heat production by mitochondria. Osmoregulation: role of kidney	6
5	<b>Biophysics of light:</b> Properties of light, Photosynthesis, Photomorphogenesis, Visual processing, Circadian rhythms, Bioluminescence, and UV radiation effects.	9

**Reference Books:**

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. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson and Michael Cox, W.H. Freeman and company, NY.
4. *Biophysical Chemistry: Principles and Techniques* by Upadhyay, Upadhyay, Nath
5. Principles and Techniques of Biochemistry and Molecular Biology. Seventh edition. Edited by Keith Wilson and John Walker.

## BTH1104 Animal Sciences I

Credits: 2

<b>Learning Outcomes:</b> <b>The students will be able to understand:</b> <ul style="list-style-type: none"><li>• basic animal sciences.</li><li>• differences between invertebrate and vertebrate systems.</li><li>• various vertebrate and invertebrate model systems which are analogous to the human system, required for research purposes.</li></ul>	<b>Suggested Pedagogical Processes:</b> ICT, presentations, blackboard teaching.
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Sr. No.	Topic	Lecture (Total 36)
1	<b>Introduction to Kingdom Animalia:</b> Outline of classification and characterization of non-chordates and chordates with examples. Adaptations in animal kingdom (with respect to environment in which they live).	6
2	<b>Type Study: Honey bee</b> Morphology, Structure of Head , Mouthparts , Legs, wings, Sting Apparatus and Pollen Basket., Social Organization of Honey Bee and Bee Products (apiculture).	8
3	<b>Parasitology:</b> Study of Plasmodium sp., Entamoeba histolytica, Fasciola hepatica, Taenia solium on (i) lifecycle, (ii) adaptations and evolution of host-parasite interactions (iii) infectivity (iv) control and treatment measures.	9
4	<b>Model System:</b> i) Drosophila as a model system ii) Zebra fish as a Model system ii) Chick embryo as a model system	8
5	<b>Economic Zoology:</b> Vermiculture, aquaculture, sericulture, pearl culture, lac culture.	5

### Reference Books:

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 Publishers.

## BTH1105 Plant Sciences I

Credits: 2

<b>Learning Outcomes:</b> <b>The students will be able to understand:</b> <ul style="list-style-type: none"><li>the gradual progression of sporophytic and gradual regression of gametophytic generations</li><li>the terminology used in Morphology and Anatomy.</li><li>diversity in plant kingdom and need of classification</li></ul>	<b>Suggested Pedagogical Processes:</b> ICT, presentations, blackboard teaching.
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Sr.No.	Topic	Lecture (Total 36)
1	<b>Unique features of plants-</b> Cell wall, plasmodesmata, Chloroplasts, Growth and Development Plant Tissue Systems- Epidermal, Ground, Vascular, Mechanical tissue systems	5
2	<b>Conquest of land</b> <b>Cryptogams-</b> General characters (Habit, habitat, Reproduction, Alternation of generations) and Economic Importance of Algae, Fungi, Bryophytes and Pteridophytes <b>Phanerogams-</b> General characters (Habit, habitat, Reproduction, Alternation of generations) and Economic Importance of Gymnosperms and Angiosperms	8 5
3	<b>Major Aspects of plant sciences-</b> <b>Structural</b> Morphology- Vegetative and reproductive plant parts Anatomy- Vegetative and reproductive plant parts Taxonomy-Binomial nomenclature, Systems of Classification, ICBN, Study of some families	18

### Reference Books:

1. Botany for Degree students-Algae by B. R. Vashishta
2. Botany for Degree students- Fungi by B. R. Vashishta
3. Botany for Degree students- Bryophyta by B. R. Vashishta
4. Botany for Degree students- Pteridophyta by B. R. Vashishta
5. Botany for Degree students- Gymnosperms by B. R. Vashishta
6. Botany for Degree students- Angiosperms by B. R. Vashishta
7. Class book of Botany- by A.C.Dutta
8. College Botany Vol.I, II, III by Ganguli, Das dutta.
9. Taxonomy of Vascular Plants by G H. Lawrence
10. Plant Physiology- by Taiz,L. and Zeiger E.

## BTH1106 Introduction to Microbial World

Credits:2

<p><b>Learning Outcomes:</b>  <b>The students will be able to understand:</b></p> <ul style="list-style-type: none"> <li>• Landmarks in Microbiology. Fundamental aspects of Prokaryotic and Eukaryotic Cell structure and function, and the differences between these cells</li> <li>• Principles of working of the light microscope and to be able to apply this knowledge in the laboratory.</li> <li>• Develop analytical skills, critical &amp; creative thinking</li> </ul>	<p><b>Suggested Pedagogical Processes:</b></p> <p>ICT, presentations, blackboard teaching.</p>
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Sr. No.	Topic	Lecture (Total 36)
1	<p><b>HISTORY OF MICROBIOLOGY</b>                      Important developments leading to major discoveries: (pre golden, golden and post golden era)</p> <ul style="list-style-type: none"> <li>• Discovery of microscope (Anton von Leeuwenhoek and Robert Hooke)</li> <li>• Abiogenesis v/s biogenesis</li> <li>• Contributions of various Scientists (Aristotle, Francesco Redi, Louis Pasteur, Tyndall and others)</li> <li>• Germ theory of Diseases, Discovery of microbes as pathogens, Koch's postulates &amp; River's postulates, concept of antiseptic surgery</li> <li>• Role of microorganisms in transformation of organic matter, anaerobes, germ theory of fermentation.</li> <li>• Vaccination and Chemotherapy</li> <li>• Contributions of Nobel Laureates in Immunology, Molecular Biology &amp; Biotechnology</li> </ul>	5
2	<p><b>CLASSIFICATION AND MORPHOLOGY</b>  <b>Classification:</b>                      Principles in classification of Bacteria (Introduction to Bergey's Manual of Determinative and Systemic Bacteriology) and viruses (ICTV)  <b>Morphological and differentiating characters of microorganisms:</b></p> <ul style="list-style-type: none"> <li>• Bacteria</li> <li>• Rickettsia</li> <li>• Protozoa</li> <li>• Algae</li> <li>• Fungi (Molds and Yeasts)</li> <li>• Viruses, viroids and prions</li> </ul>	4
3	<p><b>Studies on structure, chemical composition and functions of the following components in bacterial cell:</b></p> <ul style="list-style-type: none"> <li>• Size, shape and arrangement of bacterial cells</li> <li>• Structures External to Cell Wall</li> <li>• Cell wall (Gram Positive, Gram Negative, Archaea)</li> <li>• Glycocalyx</li> <li>• Capsule</li> </ul>	13

	<ul style="list-style-type: none"> <li>• Flagella</li> <li>• Fimbriae and Pili</li> <li>• Axial Filaments</li> </ul> <p><b>c. Structures Internal to Cell Wall</b></p> <ul style="list-style-type: none"> <li>• Cell membrane (Gram Positive, Gram Negative, Archaea)</li> <li>• Chromosomal &amp; extra-chromosomal material Ribosomes</li> <li>• Cell inclusions (Gas vesicles, carboxysomes, PHB granules, metachromatic granules and glycogen bodies)</li> </ul> <p><b>d. Endospores</b></p> <ul style="list-style-type: none"> <li>• Formation and Germination</li> </ul>	
4	<p><b>EUKARYOTIC CELL STRUCTURE AND FUNCTION :</b></p> <ul style="list-style-type: none"> <li>• Overview of eukaryotic cell structure: General structure and types of cells</li> <li>• Comparison of Prokaryotic and Eukaryotic cells</li> <li>• Structure &amp; Function</li> </ul>	2
5	<p><b>Units of measurement:</b></p> <p><b>I. Modern SI units (Length, volume, Weight)</b></p> <p><b>II. Microscopy:</b></p> <ul style="list-style-type: none"> <li>• Bright field microscopy: Structure, working and principle of a compound light microscope; Concepts of magnification, numerical aperture and resolving power. Focal Length, Working distance, Depth of Focus.</li> </ul> <p><b>III. Staining Techniques :</b></p> <ul style="list-style-type: none"> <li>• Definitions of Stain; Types of stains (Basic and Acidic), Leuco compounds.</li> <li>• Properties and role of Fixatives, Mordants, Decolorisers and Accentuators</li> <li>• Principles of staining techniques for following: <ul style="list-style-type: none"> <li>i. Monochrome staining and Negative (Relief) staining</li> <li>ii. Differential staining - Gram staining ,Acid fast staining</li> <li>iii. Special staining- Spore, flagella, cell wall, nucleic acid, capsule</li> </ul> </li> </ul>	12

**Reference Books:**

1. Brock Biology of Microorganisms, Michael .T. Madigan, John. M. Martinko, Paul V. Dunlap, David P. Clark- 12th edition, Pearson International edition 2009, Pearson Benjamin Cummings.
2. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3<sup>rd</sup> Edition. Thomson Brooks / Cole.
3. Madigan M.T., Martinko J.M. (2006). Brock's Biology of Microorganisms. 11<sup>th</sup> Edition. Pearson Education Inc.
4. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata MacGraw Hill Press.
5. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 6th Edition. MacGraw Hill Companies Inc.
6. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6<sup>th</sup> Edition, McGraw Hill Higher Education
7. Willey J. M., Sherwood L. M. and Woolverton C. J. (2013) Prescott's Microbiology, 8<sup>th</sup> Edition, McGraw-Hill Higher Education
8. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Hill Publishing Co.
9. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5<sup>th</sup> Edition. Macmillan Press Ltd.
10. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8<sup>th</sup> Edition. Pearson Education Inc

## BTH1107 Quantitative methods in Biology I

**Credits: 2**

<p><b>Learning Outcomes:</b>  <b>The students will be able to understand:</b></p> <ul style="list-style-type: none"> <li>• Basic mathematics.</li> <li>• Basics of the use of statistical tools for biological data.</li> <li>• Understand the basic computer tools for data management.</li> </ul>	<p><b>Suggested Pedagogical Processes:</b>            ICT, presentations, blackboard teaching.</p>
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Sr. No.	Topic	Lecture (Total 36)
1	<p><b>Introductory Mathematics</b>            Linear equations, functions: slopes-intercepts, forms of two-variable linear equations; constructing linear models in biological systems</p>	3
2	<p><b>Mathematical Operations</b>            Imaginary numbers, complex numbers, adding-subtracting-multiplying complex numbers, basics of vectors, introduction to matrices</p>	3
3	<p><b>Biochemical calculations</b>            Atomic and molecular mass,            Avogadro's law and Avogadro's number            Per cent composition            Concentration of solutes in solutions            Normality, molarity, molality and their conversions</p>	3
4	<p><b>Introductory Statistics</b>            The need of statistics in biology            Variables and constants            Types of variables – discrete, continuous            Types of data – raw, grouped            Graphical representation of data – bar graphs, scatter plots, frequency diagrams, pie chart, histogram, polygon, curve</p>	3
5	<p><b>Descriptive Statistics</b>            Definition and simple problems related to Measures of Central Tendency – Mean, median and mode            Quartiles, quartile plots, box plots            Measures of dispersion – Standard deviation, variance, coefficient of variance            Skewness and kurtosis</p>	5
6	<p><b>Probability</b>            Classical definitions and its limitations            Independence and conditional probability            Probability sampling            Population, sample, sampling methods – Simple random, stratified</p>	4
7	<p><b>History of Computers</b>            Evolution, generations of computers – I to V            Classification of computers – mainframe, mini, micro, workstations, parallel processing and super            Comparison with respect to memory, power, cost and size            Client server architecture</p>	

8	<p><b>Introduction to Operating systems</b> Operating system concept, Windows 98/XP and later versions, Unix, Linux</p> <p><b>Data processing and presentation</b> – Introduction to MS Office (Word, Excel and PowerPoint)</p>	
9	<p><b>Computer Viruses</b> An overview of computer viruses – What is virus? virus symptoms, how do they get transmitted? What are the dangers? General precautions</p> <p>Various types of Antiviruses</p>	

**Reference Books:**

1. R.G. Bartle and D.R. Sherbert 2nd edition, ( 1992), Introduction to real analysis, John Wiley, USA
2. Introductory biostatistics. 1st edition. (2003), Chap T. Le. John Wiley, USA
3. High YieldTMBiostatistics. (2001) Antony N Glaser. Lippincott Williams and
4. Wilkins, USA
5. Introduction to Mathematics for Life Scientists. 3rd edition (1979). Edward
6. Batschalet,
7. Mathematics for the Biological Sciences. Illustrated edition (1979) J.C. Acharya and
8. Lardner, Prentice Hall, USA.
9. Sinha P. & Sinha P. 2011. Computer Fundamentals. BPB Publications, Connaught Place, Delhi, 478 pp.

## BTH1108 Ecology

Credits: 2

<p><b>Learning Outcomes:</b>  <b>The students will learn the basics of:</b></p> <ul style="list-style-type: none"> <li>• Ecosystems ecology</li> <li>• Community ecology</li> <li>• Inter and intra-specific interactions</li> <li>• Animal behavior</li> <li>• Biogeography of India</li> </ul>	<p><b>Suggested Pedagogical Processes:</b>            ICT, presentations, blackboard teaching.</p>
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Sr. No.	Topic	Lecture (Total 36)
1	<p><b>Ecology:</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Concept</li> <li>• Scope</li> </ul>	1
2	<p><b>Ecological Factors:</b></p> <ul style="list-style-type: none"> <li>• Tolerance</li> <li>• Optimal ranges</li> <li>• Ecological Niches – fundamental and realized</li> </ul>	4
3	<p><b>Ecosystems - Concept of Ecosystem</b></p> <ul style="list-style-type: none"> <li>• Biotic &amp; Abiotic components and their interactions</li> <li>• Types of Ecosystem</li> <li>• Dynamics (Food Chain, Food Web, Ecological pyramids)B</li> <li>• Biogeochemical cycles (C, N, P, Water)</li> </ul>	10
4	<p><b>Habitat Ecology:</b></p> <ul style="list-style-type: none"> <li>• Aquatic, Terrestrial and Desert</li> <li>• Animal adaptations to water, temperature, salinity, predation</li> <li>• Plant adaptations to water, temperature, salinity, predation</li> <li>• Plant-animal relationships</li> </ul>	12
5	<p><b>Concept of Population and Community Ecology</b></p>	2
6	<p><b>Animal Behavior:</b></p> <ul style="list-style-type: none"> <li>• Sensory inputs</li> <li>• Habituation</li> <li>• Imprinting</li> <li>• Cognition and Problem Solving</li> <li>• Spatial Learning</li> <li>• Associative Learning</li> <li>• Altruism</li> <li>• Inclusive Fitness.</li> </ul>	4
7	<p><b>Biogeography in Indian context:</b></p> <ul style="list-style-type: none"> <li>• Patterns and types of distribution; role of geology, climatic fluctuations in shaping the distribution patterns of plant and animal species</li> </ul>	3



**Reference Books:**

1. An Introduction To Geographic Information Technology (2009) Suchandra Choudhury I K International Pvt Ltd., New Delhi
2. Concepts and Techniques of Geographic Information Systems C.P.Lo.AlbertK.W.Yeung 2nd edition, Prentice Hall, Inc., New Jersey
3. Ecology and environment (2005) Sharma PD Rastogi Publication, New Delhi
4. Ecology and environmental biology (2011) Saha T K Books & Allied (p) Ltd, Kolkata
5. Ecology science and practice (2001) Faurie et al Oxford & IBH Publ. Co. Pvg. Ltd, New Delhi
6. Ecology: Principles and Applications (1998) J. L. Chapman, M. J. Reiss Cambridge
7. The biology of biodiversity : M.Kato Ridley M.

**BTH1109 Practicals in Biological Chemistry and Biophysics**  
**2-Credits**

**Learning Outcome:**

The students will be able to understand:

- Qualitative and quantitative methods for carbohydrates and fats
- Determination of UV-Vis absorption maxima of proteins
- How pI can be determined in the lab

<b>Sr. No.</b>	<b>Topic</b>	<b>Practical (15Px2H)</b>
1	Calibration and use of micropipettes and glass pipettes	3
2	Problems on radioactivity	1
3	To determine hemolysis in solutions of different osmolarity	1
4	To study the effect of light on pigment production.	1
5	Mathematical Calculations, problems based on normality, molarity, stock and working standard preparation	2
6	Isolation of Carbohydrates from a natural source and its qualitative estimation	2
7	Determination of Absorption maxima of proteins isolated from natural sources and its estimation by Biuret/ Bradford reagent	2
8	Determination of pI by titration	2
9	Saponification of fats	1

**BTH1110 Practicals in Plant & Animal Sciences I**  
**Credits: 2**

**Learning Outcome:**

**The students will be able to understand:**

- Mounting, Sectioning, Staining of plant material
- morphological terminology to describe the plant and study of the plant families.
- dissection and microscopy which is highly needed for any type of research work in animal sciences.

Sr. No.	Topic	Practical (15Px2H)
	<b>Plant Science:</b>	
1	Study of one example each of the following- Algae, Fungi, Bryophytes, Pteridophytes Gymnosperms and Angiosperms	2
2	Study of anatomical features of root, stem and leaves of Dicotyledons and Monocotyledons. Study of plant tissues by sectioning, staining, maceration	2
3	Study of Morphological features of plants and plant families.	2
4	Study of plant diseases	2
	<b>Animal Science:</b>	
5	<b>Study of Paramecium:</b> Morphology Reproduction	1
6	<b>Study of Hydra :</b> Morphology Reproduction Regeneration	1
7	Dissection of Honey Bee, Mounting of Mouth parts, pollen basket, Sting Apparatus, legs and wings.	2
8	<b>Study of Fasciola, Plasmodium and Taenia:</b> Morphology Life cycle	3

**BTH1111 Practicals in Microbiology and Ecology**  
**Credits: 2**

**Learning Outcomes:**

**The students will be able to understand:**

- Safety rules when in the Microbiology Laboratory and become proficient in Aseptic techniques
- To gain proficiency in the use of Micropipettes and glass pipettes
- To learn principles of Microscopy, to gain proficiency in the use and care of the Compound Microscope and to successfully focus and observe stained bacteria
- To become proficient in observing motility of bacteria.

Sr. No.	Topic	Practical (15Px2H)
1	Biosafety in the Microbiology Laboratory- practices and rules involved Introduction to Microbiology Laboratory and common microbiology laboratory instruments e.g. Incubator, Hot Air Oven, Autoclave, Colorimeter, pH Meter, Distillation Unit, Chemical Balance, Laminar air flow hood, Clinical Centrifuge	1
2	Use and care of bright field microscope Observation of microorganisms using bright field microscope - Bacteria, Protozoa, Molds and Yeasts, Algae – from natural habitat	2
3	Observation of microorganisms using staining techniques: <ul style="list-style-type: none"> <li>• Monochrome staining and</li> <li>• Negative /Relief staining (Capsule staining)</li> <li>• Gram staining of bacteria</li> <li>• Endospore staining</li> <li>• Staining of yeast and fungi</li> </ul>	5
4	Observation of motility in bacteria using: <ul style="list-style-type: none"> <li>• Hanging drop method</li> <li>• Swarming growth methods</li> </ul>	2
5	Activity for students: SOP's of the instruments, Preparation of charts, depicting size, shape and arrangements of bacteria, motility types. Quiz etc. activity	2
6	Isolation of nitrogen fixing /phosphate solublizing bacteria from soil(Demonstration)/Winogradskys Column	2
7	Study of ecological adaptations in Plants (Hydrophytes/mesophytes/Xerophytes)/ FC adaptations (Botanical gardens ) --- Photo documentation	1

**BTH1112 Practicals in Biostatistics and Computers - I**  
**Credits:2**

**Learning Outcome:**

**The students will be able to understand:**

Sr. No.	Topic	Practical (15Px2H)
1	Data Presentation By Preparing Frequency Table	1
2	Data Presentation <ul style="list-style-type: none"> <li>• Bar Diagrams</li> <li>• Histograms</li> <li>• Frequency Curves</li> <li>• Pie Chart</li> <li>• Scatter Plot</li> </ul>	1
3	Measures of central tendency <ul style="list-style-type: none"> <li>• Mean</li> <li>• Mode</li> <li>• Median</li> </ul> Measures of dispersion <ul style="list-style-type: none"> <li>• Variance</li> <li>• Standard Deviation</li> </ul> Correlation	5
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, Statistical analysis of the data using Excel.	3
5	Word Processing (Microsoft Word): Creating, Saving & Operating a document, Editing, Inserting, Deleting, Formatting, Moving & Copying Text, Find & Replace, Spell Checker & Grammar Checker, Document Enhancement (Borders, Shading, Header, Footer), Printing document (Page layout, Margins), Introduction to the use of Wizards & Templates, Working with Graphics (Word Art), Working with Tables & Charts, Inserting Files (Pictures, Databases, Spreadsheets)	3
6	Usage of multimedia – Creation of Computer Presentations with graphics (Microsoft Power Point): Creation of slides, Rapid Presentation design using wizards	2

- By the end of this course students should be able to do the statistical analysis independently, and able to use the computational tools for data analysis

**BTH1201 Evolutionary Biology and Biodiversity**  
**Credits:2**

<p><b>Learning Outcomes:</b></p> <ul style="list-style-type: none"> <li>• The students will understand what is organic evolution.</li> <li>• They are expected to learn the theories proposed by naturalists to explain evolution</li> <li>• Learn natural selection and sexual selection</li> <li>• Understand how characters can be used in systematic</li> </ul>	<p><b>Suggested Pedagogical Processes:</b> ICT, presentations, blackboard teaching.</p>
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Sr No.	Topic	Lectures (Total 36)
1	<p><b>Evolution:</b> Concept, time line of evolution Origin of Life: Earliest life on Earth, Unicellular to Multi cellular, Diversification of life Evidence of Evolution: Index fossils, common descent, chemical and anatomical similarities Species concepts – What exactly is a species? Origin of Species: Speciation: Allopatric, Sympatric</p>	10
2	<p><b>Theories of Evolution:</b> Historical Evolutionary Thought, Lamarck’s theory of acquired characters, De Vries theory of Mutation, Darwin’s theory of Natural Selection, and Neo-darwinism Evolution of Sexual Reproduction Sexual selection – Fisher’s Runaway and Zahavi’s Handicap Evolution and Biogeography of Islands – Dispersal, establishment and extinction, adaptive radiation</p>	10
3	<p><b>Biological Systematics and Conservation Biology</b> Systematics and taxonomy History of systematic Characters – Shared, derived, reversal and convergence Taxonomic Characters Phenetics and Phylogenetics Biodiversity and the need for conservation Conservation of Biodiversity – Shortfalls (Linnean and Wallacean), IUCN, CITES Protected Areas (Wildlife Protection Act, 1972), Schedules of the WPA.</p>	13
4	<p><b>Effects on Ecosystems:</b> Human and Natural Changes Green house effect Global warming Climate change</p>	3

## Reference Books:

1. Strickberger's Evolution by Brian K. Hall and Benedikt Hallgrímsson 5<sup>th</sup> Ed 2013
2. Handbook of Evolutionary Biology by Richard Arber 2015
3. The Origin of Species by Charles Darwin.
4. An Introduction To Geographic Information Technology (2009) Suchandra Choudhury I K International Pvt Ltd., New Delhi
5. Concepts and Techniques of Geographic Information Systems C.P.Lo. Albert K.W. Yeung 2nd edition, Prentice Hall, Inc., New Jersey
6. Ecology science and practice (2001) Faurie et al Oxford & IBH Publ. Co. Pvg. Ltd, New Delhi
7. Ecology: Principles and Applications (1998) J. L. Chapman, M. J. Reiss Cambridge
8. The biology of biodiversity : M.Kato

## BTH1202 Biological Chemistry-II

Credits: 2

<b>Learning outcome:</b> <b>The students will be able to understand:</b> <ul style="list-style-type: none"><li>• Basics of kinetics and catalysis</li><li>• Different types of reactions in biological system</li><li>• Different types of isomers and their properties</li></ul>	<b>Suggested Pedagogical Processes:</b> ICT, presentations, blackboard teaching.
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Sr No.	Topic	Lectures (Total 36)
1	<b>Chemical Kinetics:</b> Definition, Reaction rate, Rate laws, Molecularity of reaction, Zero order, Pseudo-order, first order, second order reactions, Half-life of a reaction, Methods to determine order of reaction, Collision theory, effect of temperature on reaction rate, Activation energy.	10
2	<b>Catalysis:</b> Catalysis types, characteristics of catalysed reactions, classification of catalysis, enzyme catalysis; classification of enzymes, modes of enhancement of bond cleavage rate by enzymes, rate enhancement and activation energy, role of non-protein organic and inorganic molecules, coenzymes, prosthetic groups, role of vitamins as coenzyme precursors	11
3	<b>Organic reaction mechanism:</b> Biologically important nucleophiles and electrophiles. Group transfer reactions: acyl, phosphoryl and glycosyl group transfer. Oxidations and reductions: reactions of FAD and NAD. Eliminations: Dehydration reaction. Isomerizations and Rearrangements: aldose-ketose isomerisation. Reactions that make and break carbon-carbon bonds	10
4	<b>Stereochemistry:</b> Representation of molecules; projection formulae, Newman and Fisher formula. Isomerism; conformational, optical and geometrical isomerism	5

### Reference books:

1. The elements of Physical Chemistry, 5th edition (2009), Atkins P, de Paula J. W. H. Freeman Publication, USA
2. Organic Chemistry, 6th edition, (1992), Morrison Robert Thornton, Pearson Publication, Dorling Kindersley (India Pvt. Ltd.)
3. Biochemistry: 4<sup>th</sup> Edition, (2011), Voet and Voet, John Wiley and Sons, Inc.
4. Principles of Biochemistry, 7<sup>th</sup> edition (2017), Lehninger, Freeman W.H. and Company
5. Biochemistry, Berg J., Tymoczko J., Stryer L., 8<sup>th</sup> edition (2015), Freeman W. H. and Company



## BTH1203 Bioinstrumentation

**Credits: 2**

<b>Learning Outcomes:</b> <b>The students will be able to understand:</b> <ul style="list-style-type: none"> <li>various techniques and their relevance in biological sciences</li> <li>principle behind the working of different instruments.</li> </ul>	<b>Suggested Pedagogical Processes:</b> ICT, presentations, blackboard teaching.
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Sr. No.	Topic	Lecture (Total 36)
1	<b>pH meter &amp; conductivity meter</b> : Principle, construction, working, calibration, maintenance and applications.	
2	<b>Spectroscopy:</b> Definition. Electromagnetic wave. Electromagnetic spectrum. Applications of each region of electromagnetic spectrum for spectroscopy. Beer Lambert's law. Introduction to molecular energy levels. Excitation. Absorption. Emission. Rotational spectra. Energy levels of rigid diatomic molecules. Electron spectroscopy. UV-visible spectroscopy. Applications of spectroscopy. Principle, construction and working of colorimeter, Spectrophotometer, Fluorimeter. Applications.	
3	<b>Centrifuge:</b> RCF and sedimentation concepts, principle, construction, working, centrifuge types, rotor types and application of preparative & analytical centrifuges, gradient centrifuge.	
4	<b>Microscopes:</b> Construction and Biophysical working principles of the following Microscopes: - Stereozoom (Dissecting) - Compound - Bright and Dark field - Inverted - Electron microscopes: TEM and SEM (compare and contrast and applications)	
5	<b>Electrophoresis:</b> Agarose gel electrophoresis, Poly acrylamide gel electrophoresis, Application for isolation and characterization of biomolecules.	
6	<b>Basic principles of Chromatography:</b> elaborate paper chromatography and Thin Layer Chromatography	

### Reference Books:

1. Instrumentation measurements and analysis – 2nd edition (2003). Nakra and Choudhari, Tata McGraw Hill, India.
2. Nuclear Physics: An Introduction. 2nd edition (2011). S. B. Patel. Ansha Publication, India.
3. Biophysical Chemistry: Principles and Techniques by Upadhyay, Upadhyay, Nath
4. Principles and Techniques of Biochemistry and Molecular Biology. Seventh edition. Edited by Keith Wilson and John Walker

## BTH1204 Animal Sciences II

Credits: 2

<b>Learning outcomes:</b> <b>The students will be able to understand:</b> <ul style="list-style-type: none"><li>• homeostatic regulation of different body processes.</li><li>• concept of cells, tissues and organ systems.</li><li>• introductory animal histology.</li></ul>	<b>Suggested Pedagogical Processes:</b> ICT, presentations, blackboard teaching.
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Sr. No.	Topic	Lecture (Total 36)
1	<b>Introduction to principles of Physiology:</b> Homeostasis, concept of pH and maintenance of body temperature.	5
2	<b>Types of animal cells:</b> Concept of different cell types, specialized cell types (photoreceptors, auditory hair cells, egg as a single cell, ciliated cells) and functions.	7
3	<b>Tissues:</b> Different types of animal tissues (columnar, cuboidal, squamous epithelium, osteoblasts, blood cells) and extracellular matrix.	5
4	<b>Organ systems:</b> Sensory systems, cardiovascular system, urino-genital system, nervous system, endocrine system, gastro-intestinal system.	14
5	<b>Animal histology methods:</b> Principles of cell type specific detection staining methods.	5

### Reference Books:

1. Principles of Anatomy and Physiology by Gerard Tortora and Bryan Derrickson 14<sup>th</sup> Edition. 2014
2. Animal Physiology by Christopher Moyes and Patricia Schulte, second edition (Pearson), 2014.
3. Animal Physiology by Hill, Wyse and Anderson, third edition, 2012.
4. Practical Manual of Histology for Medical students by Neelkanth Kote, Jaypee Brothers Medical Publishers; second edition (2014)

**BTH1205 Plant Sciences II**  
**Credits: 2**

<p><b>Learning outcomes:</b> <b>The students will be able to understand:</b></p> <ul style="list-style-type: none"> <li>• Basic Plant physiology and plant pathology</li> </ul>	<p><b>Suggested Pedagogical Processes:</b> ICT, presentations, blackboard teaching.</p>
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Sr. No.	Topic	Lecture (Total 36)
1	<p><b>Major aspects of plant sciences- Functional-</b> Plant Physiology- Photosynthesis, Respiration, Mineral Nutrition, Plant water relation</p>	12
2	Plant Breeding-Introduction, need and methods	3
3	<p>Plant Resources and their Utilization- Plants as natural resources Forest as potential resource, Secondary metabolites in plants Plant resources used in Cosmetics and Pharmaceuticals Bioprospecting- Introduction, Concept and scope, Untapped potential resources like sea weeds, Lichens Economic Botany</p>	13
4	Horticulture, Floriculture and Green house technology	4
5	Plant Pathology- Introduction, Concept, Pathogens, Diseases (2-3 examples)	4

**Reference Books:**

1. Plant Physiology- by Taiz,L. and Zeiger E.
2. College Botany Vol.I, II, III by Ganguli Das Dutta.

## BTH1206 Microbial Growth, Control and Applications

Credits: 2

<p><b>Learning Outcomes:</b>  <b>The students will be able to understand:</b></p> <ul style="list-style-type: none"> <li>• Basic concepts of microbial nutrition, growth and control</li> <li>• Principles and basic methods involved in the study and control of microbes</li> <li>• Basic techniques of pure culture isolation and preservation of microbes.</li> <li>• Critical &amp; analytical thinking</li> </ul>	<p><b>Suggested Pedagogical Processes:</b>            ICT, presentations, blackboard teaching.</p>
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Sr. No.	Topic	Lecture (Total 36)
1	<p><b>Cultivation and isolation</b></p> <ul style="list-style-type: none"> <li>• Nutritional requirements and classification of bacteria</li> <li>• Design of media: Common ingredients, Types of media and Composition with examples</li> <li>• Handling of microorganisms and Biosafety measures.</li> <li>• Concept of Pure culture, axenic culture, co-culture and Mixed culture</li> <li>• Isolation of microorganisms and pure culture techniques: Streak , Spread, Serial Dilution, Pour plate, Enrichment (Role of dyes), Single cell isolation</li> <li>• Colony characteristics</li> <li>• Preservation and maintenance of microorganisms</li> <li>• Culture collection centers and their role.</li> </ul>	8
2	<p><b>Sterilization and Disinfection</b></p> <ul style="list-style-type: none"> <li>• Definition: Sterilization, disinfection, antisepsis, different cidal and static agents</li> <li>• Chemical agents and their mode of action - Aldehydes, Halogens, Quaternary ammonium compounds, Phenol and phenolic compounds, Heavy metals, Alcohol, Detergents and Ethylene oxide.</li> <li>• Physical Agents - Heat, Radiation, Filtration</li> <li>• Characteristics of an ideal disinfectant</li> <li>• Checking of Efficiency of Sterilization – Biological and Chemical Indicators</li> <li>• Checking of Efficiency of Disinfection - Phenol Coefficient</li> </ul>	10
3	<p><b>Microbial Growth</b></p> <ul style="list-style-type: none"> <li>• Growth curve; definitions of Generation time, Growth rate and specific growth rate</li> <li>• Reproduction in microorganisms: Binary Fission, Asexual, Sexual, Lytic, Lysogenic Cycle.</li> <li>• Methods of enumeration:               <ol style="list-style-type: none"> <li>a. Microscopic methods (Direct Microscopic Count, Counting cells using Neubauer chamber) ii. Plate counts (Total Viable Count)</li> <li>b. Estimation of Biomass (Dry mass, Cell volume) Chemical methods (Cell Carbon and Nitrogen estimation)</li> <li>c. Turbidometric methods</li> </ol> </li> <li>• Factors affecting bacterial growth (pH, Temperature, Solute concentration (Salt and Sugar) and Heavy metals.</li> </ul>	10

	<ul style="list-style-type: none"> <li>• Diauxic and Synchronous growth</li> </ul>	
4	<p><b>Microbial Interactions ( Tabulation of good bacteria and bad bacteria )</b> (Any 2 examples each)</p> <ul style="list-style-type: none"> <li>• Microbe-Plant,</li> <li>• Microbe-Animal</li> <li>• Microbe-Microbe interaction</li> </ul>	4
5	<p><b>Applications of Microbiology</b></p> <ul style="list-style-type: none"> <li>• Significance of normal flora and probiotics in human health.</li> <li>• Microbes as Biofertilizers and Biocontrol Agents (e.g. Nitrogen fixers, Phosphate Solubilizers and <i>Bacillus thuringensis</i>)</li> <li>• Microbes in Fermentation Industries</li> </ul>	4

### Reference Books:

1. Brock Biology of Microorganisms, Michael.T.Madigan, John.M.Martinko, Paul V. Dunlap, David P. Clark- 12th edition, Pearson International edition 2009, Pearson Benjamin Cummings.
2. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3rd Edition.Thomson Brooks / Cole.
3. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata MacGraw Hill Press.
4. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6<sup>th</sup> Edition, McGraw Hill Higher Education
5. Willey J. M., Sherwood L. M. and Woolverton C. J. (2013) Prescott's Microbiology, 8thEdition, McGraw-Hill Higher Education
6. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGrawHillPublishing Co.
7. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5th Edition.Macmillan Press Ltd.
8. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc

## BTH1207 Quantitative methods in Biology - II

**Credits:2**

<p><b>Learning Outcomes:</b>  <b>The students will be able to understand:</b></p> <ul style="list-style-type: none"> <li>• Basic mathematics.</li> <li>• Basics of the use of statistical tools for biological data.</li> <li>• Understand the basic computer tools for data management.</li> </ul>	<p><b>Suggested Pedagogical Processes:</b>            ICT, presentations, blackboard teaching.</p>
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Sr. No.	Topic	Lecture (Total 36)
1	<p><b>Advanced Equations and functions</b>            Quadratic equations (solving, graphing, features of, interpreting quadratic models <i>etc.</i>), introduction to polynomials, graphs of binomials and polynomials; Symmetry of polynomial functions</p>	3
2	<p><b>Basic Trigonometry</b>            Basics of trigonometric functions, Pythagorean theory, graphing and constructing sinusoidal functions</p>	3
3	<p><b>Differential Equations</b>            Differential calculus (limits, derivatives), integral calculus (integrals, sequences and series <i>etc.</i>)</p>	3
4	<p><b>Standard Probability Distributions</b>            Normal – Gaussian Curve, z-test            Binomial – Bernoulli’s trials, Binomial theorem            Poisson distribution            Central Limit Theorem</p>	3
5	<p><b>Experimental Design</b>            Types of questions,            Types of hypothesis,            Experimental design – sample size, trials</p>	5
6	<p><b>Inferential Statistics</b>            Sampling distributions            Hypothesis testing            Type I and Type II error            One-tailed and two-tailed tests            Alpha values            Comparison of means – paired, unpaired; population vs. sample mean            Independence of attributes and goodness of fit – Chi-square test</p>	10
7	<p><b>Computer Networking</b>            Introduction to Networking, associated hardware devices or gadgets (routers, switches), services and resources  <b>Network topologies and protocols</b>            LAN, WAN, MAN, PAN, CAN            Star, bus, hybrid, ring topologies            World Wide Web (www)  <b>Network security, Firewalls</b></p>	

8	<p><b>Databases</b></p> <p>Types of Databases</p> <p>Basic concepts in:</p> <ol style="list-style-type: none"> <li>1. Data abstraction</li> <li>2. Data models</li> </ol> <p>Instances and schemes</p> <p>E-R model (Entity and entity sets, relations and relationship sets, E-R diagrams, reducing E-R diagrams to tables)</p> <p>Network data model, Basic concepts, multimedia databases</p> <p>Text databases</p> <p>Introduction and overview of biological database</p> <p>Concepts in text-based searching – MEDLINE, PubMed, bibliographic databases</p>	
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### Reference Books:

1. R.G. Bartle and D.R. Sherbert 2nd edition, ( 1992), Introduction to real analysis, John Wiley, USA
2. Introductory biostatistics. 1st edition. (2003), Chap T. Le. John Wiley, USA
3. High Yield T M Biostatistics. (2001) Antony N Glaser. Lippincott Williams and Wilkins, USA
4. Introduction to Mathematics for Life Scientists. 3rd edition (1979). Edward Batschalet,
5. Mathematics for the Biological Sciences. Illustrated edition(1979) J.C. Acharya and R. Lardner, Prentice Hall, USA
6. Sinha P & Sinha P. 2011. *Computer Fundamentals*. BPB Publications, Connaught Place, Delhi, 478 pp.

## BTH1208 Cell Biology I

Credits:2

<b>Learning Outcomes:</b> <b>The students will be able to understand:</b> <ul style="list-style-type: none"><li>• Ultra structure of organelles in a eukaryotic cell</li><li>• Structure of cytoskeletal elements, plasma membrane and Cell wall</li><li>• Cell Cycle phases, its regulation and its importance.</li></ul>	<b>Suggested Pedagogical Processes:</b> ICT, presentations, blackboard teaching.
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Sr. No.	Topic	Lecture (Total 36)
1	<b>Introduction to Cell and its functions.</b> Comparative account of archeabacteria, prokaryotic and eukaryotic cells. Cell structure, cellular diversity, cell types.	6
2	<b>Structure and function of cell organelles:</b> Endoplasmic reticulum, Mitochondria, Chloroplast, Ribosomes, Golgi body, nucleus, lysosomes, vacuoles, peroxisomes and Glyoxysomes, Plastids	10
3	<b>Plasma membrane, cytoskeleton and extra cellular matrix:</b> Organization and properties of plasma membrane. Cytoskeleton- Structure- assembly and disassembly of cytoskeleton elements, Extracellular matrix and cell junctions- relevance to tissue structure, Plasmodesmata- structure and function Plant cell wall - primary and secondary, glycocalyx	10
4	<b>Cell Cycle and its regulation:</b> Mitosis, meiosis in plants and animals, Phases of cell cycle. Checkpoints and regulation of cell cycle	10

### Reference Books:

1. Molecular Cell Biology. Lodish H., Berk A, Kaiser C., K Reiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., 7th Edition, (2012) W.H. Freeman and Co., USA
2. Molecular Biology of the Cell, Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, 5th Edition (2007) Garland Science, USA
3. Cell Biology, Gerald Karp. 6th edition, (2010) John Wiley & Sons., USA
4. The Cell: A Molecular Approach, Geoffrey M. Cooper, Robert E. 6th edition (2013), Hausman, Sinauer Associates, Inc. USA
5. Becker's World of then Cell, Jeff Hardin, Gregory Bertoni, Lewis J.Kleinsmith, 8<sup>th</sup> Edition (2016), Pearson Education Limited, USA



**BTH1209 Practicals in Biochemistry and Bioinstrumentation**  
**Credits:2**

**Learning Outcomes:**

**The students will be able to understand:**

- Standardization and calibration of pH meter and conductivity meter
- Introduction to essential techniques such as microscopy, chromatography and agarose gel electrophoresis.
- Qualitative analysis of various biomolecules

<b>Sr. No.</b>	<b>Topic</b>	<b>Practicals (15P x 2 H)</b>
1	Standardization and calibration of pH meter	1
2	Working and components of various types of Centrifuges	2
3	Paper chromatography and detection of biomolecules viz. amino acids	1
4	TLC- to study separation of molecules viz. pigments	1
5	Microscopy – Components and working of Bright field compound microscope	1
6	Agarose gel electrophoresis	1
7	Determination of Amylase function by DNSA method	2
8	To find the order of given reaction	2
9	Biochemical tests for detection of: oxidation-reduction (DCPIP)	2
10	To study conformation of biomolecules through model making	2

**BTH1210 Practicals in Microbiology and Cell Biology – I**  
**Credits:2**

**Learning Outcomes:**

**The students will be able to understand:**

- techniques of cultivation, isolation and preservation of bacteria
- use physical and chemical methods to control the growth of micro-organisms.
- the techniques of enumeration of micro-organisms.
- how to critically observe and record the observation of all experimentation.
- how to observe and identify different stages of cell division and see the effect of chemicals on it.
- how to calculate the cell size using a micrometer.

Sr. No.	Topic	Practicals (15P x 2 H)
1	<ul style="list-style-type: none"> <li>• Cultivation of microorganisms: Preparation of simple laboratory nutrient media (solid and liquid) and using them to cultivate bacteria. Aseptic transfer techniques (slant to slant, broth to broth, broth to agar and Agar to agar using glass and micro pipettes)</li> </ul>	2
2	<ul style="list-style-type: none"> <li>• Isolation of bacteria by streak plate technique</li> <li>• Enumeration of bacteria from fermented food / soil / water by:</li> <li>• Spread plate method</li> <li>• Pour plate method</li> <li>• Observation of the growth of cultures and reporting of colony and cultural characteristics (Nutrient and MacConkey's agar)</li> </ul>	2
3	<ul style="list-style-type: none"> <li>• To study the effect of different parameters on growth of <i>E. coli</i>: pH, temperature, sodium chloride concentration</li> <li>• Study of Oligodynamic action of heavy metal</li> </ul>	2
4	<ul style="list-style-type: none"> <li>• Activity for students: Evaluation of disinfectants (domestic disinfectants/Toothpaste) check their phenol coefficient (qualitative) , Study colonies of bacteria on differential and Specific media, Petri dish art, Quiz,</li> </ul>	2
5	<ul style="list-style-type: none"> <li>• Study of mitosis (onion root tip ) – preparation of slides and identification of different stages</li> <li>• Effect of colchicine on mitosis.</li> </ul>	2
6	<ul style="list-style-type: none"> <li>• Study of meiosis (grasshopper testis/<i>Tradescantia</i>)– preparation of slides and identification of different stages</li> </ul>	2
7	<ul style="list-style-type: none"> <li>• Enumeration of yeast cells using a counting chamber</li> </ul>	1
8	<ul style="list-style-type: none"> <li>• Micrometry – measurement of cell size and nucleus from various cell types</li> </ul>	2

**BTH1211 Practicals in Plant and Animal Sciences-II**  
**Credits:2**

**Learning Outcomes:**

**The students will be able to understand:**

- homeostatic regulation of different body processes.
- concept of cells, tissues and organ systems.
- introductory to animal histology.

Sr. No.	Topic	Practicals (15P x 2 H)
<b>Plant sciences</b>		
1	Study the process of Osmosis	1
2	To determination of Transpiration under different conditions of shade, wind and light.	1
3	Determination of Diffusion Pressure Deficit by using potato tubers	1
4	Plant resources and their utilization- Food crops - Botanical and common names, description and Phytochemical tests for stored food material Medicinal and aromatic plants - Botanical and common names, plant parts used, medicinal uses, Herbarium of some medicinal plants Qualitative tests for secondary metabolites	3
5	Visit to greenhouse	1
<b>Animal Science:</b>		
6	Study of tissue histology	2
7	Peripheral blood smear for total and differential count	2
8	Study of sensory physiology (Gustatory/ visual/ auditory/ olfactory)	2
9	Check response of tactile receptors to temperature changes	1
10	Testing reflexes and reactions	1

**BTH1212 Practicals in Biostatistics and Computers – II**  
**Credits: 2**

**Learning Outcomes:**

**The students will be able to understand:**

- concepts in statistical analysis
- computational tools and techniques for the data analysis

<b>Sr. No.</b>	<b>Topic</b>	<b>Practicals (15P x 2H)</b>
1	Regression and correlation of Biological Data	2
2	Biological data collection for analysis in lab	2
3	Fitting of the following standard distributions: binomial, Poisson, normal	2
4	Chi square test, T-test, ANOVA	2
5	Diversity indices – Shannon-Weaver, Simpson's, Similarity and Dissimilarity	2
6	Database Applications (Microsoft Access): Fields, Records, Files, Organization of Files, Access Modes; Updating Records, Querying, Reports, Forms & subforms, Demonstration of Searching and Information Retrieval of Biological Databases :Through Entrez and SRS Search Engines:	3
7	File handling: copy, rename, delete, type Directory structure: make, rename, move directory	2