



Karmaveer Bhaurao Patil University, Satara

Syllabus for

B. Sc. I Biotechnology

Under

Faculty of Science and Technology

(As per NEP 2020)

With effect from Academic Year 2024-2025

Syllabus for Bachelor of Science Biotechnology

- 1. Title: B. Sc. Biotechnology**
- 2. Year of Implementation:** The syllabus will be implemented from June,2024 onwards
- 3. Preamble:** As per the NEP 2020 guidelines this updated syllabus is prepared for first year undergraduate students of Biotechnology. At this level, to develop their interest towards Biotechnology as applied science and also to prepare them for the academic and industrial exposure simultaneously. Introduction of life science subjects will help to form a basic foundation of concepts for students. The interdisciplinary approach with vigor and depth is compatible to the syllabi of other universities, at the same time is not rigid for the students at first year of their graduation. The units in the syllabus are well defined with scope and the number of lectures. The Reference books are mentioned with relevance.
- 4. General Objectives:**
 - 1) Construction and redesigning of the courses to suite local needs
 - 2) More emphasis on applied aspects of biotechnology
 - 3) To develop aptitude of students in the field of research
 - 4) Enrichment of basic knowledge in areas of Biotechnology

5. Program Outcomes:

PO No.	PO Statement After completing the Bachelor of Science in Biotechnology students will be able to.....
PO -1	Graduate with proficiency in the biotechnology
PO -2	Eligible to continue higher studies in the subject
PO -3	Eligible to peruse post graduate study in abroad
PO -4	Eligible to appear for the examination for job in government sector.

6. Program Specific Objectives:

- 1) The students are expected to understand the fundamentals, principles, concept and recent developments in Biotechnology.
- 2) The practical course is framed in relevance with theory courses to improve understanding of various concepts in biotechnology.
- 3) It is expected to inspire and boost interest of students in Biotechnology.
- 4) To enrich students' knowledge and train them in various branches of Biotechnology.

7. **Program Specific Outcomes:**

PSO No.	PSO Statement
	After successful completion of B.Sc. Biotechnology Entire Course student will be able to
PSO -1	Understand basics of Biotechnology
PSO -2	Learn, design and perform experiments in the labs to demonstrate the concepts, principles and theories learnt in the classroom
PSO -3	Develop the ability to apply the knowledge acquired in classroom and laboratories to specific problems in theoretical and experimental biotechnology
PSO -4	Identify the area of interest in the academic research and development
PSO -5	Perform job in various fields like food, pharmaceutical, agriculture, healthcare, public services and business etc.
PSO -6	Be an entrepreneur with precision, analytical mind, innovative thinking, and clarity of thought, expression and systematic approach.

8. **Duration:** One Year

9. **Pattern:** Semester wise

10. **Medium of Instruction:** English

11. **Structure of Course:**

Semester I				
Sr. No.	Course	Course Code	Name of the Paper	Credits
1	Course 1	BBTT 111	Fundamental of Biotechnology (P-I)	2
		BBTT 112	Biomolecules (P-II)	2
		BBTP 113	Practical based on theory paper BBTT111 and BBTT 112	2
2	Course 2	BBTT 114	Microbiology I (P-III)	2
		BBTT 115	Plant Science (P-IV)	2
		BBTP 116	Practical based on theory paper BBTT114 and BBTT 115	2
3	Course 3	BBTT 117	Basics in computers (P-V)	2
		BBTT 118	Basics in Bioinformatics (P-VI)	2
		BBTP 119	Practical based on theory paper	2

			BBTT117 and BBTT 118	
4	OE	BBTTOE 1	Instrumentation studies	2
5	IKS	BBTTIKS 1	Introduction to Indian Knowledge System I	2
			Total	22
Semester II				
Sr. No.	Course	Name of the course	Name of the Paper	Credits
1	Course 1	BBTT 121	Environmental of Biotechnology (P-VII)	2
		BBTT 122	Proteins and Enzymes (P-VIII)	2
		BBTP 123	Practical based on theory paper BBTT121 and BBTT 122	2
2	Course 2	BBTT 124	Microbiology II (P-IX)	2
		BBTT 125	Animal science (P-X)	2
		BBTP 126	Practical based on theory paper BBTT124 and BBTT 125	2
3	Course 3	BBTT 127	Biostatistics (P-XI)	2
		BBTT 128	Cell biology I (P-XII)	2
		BBTP 129	Practical based on theory paper BBTT1 and BBTT 112	2
4	OE	BBTTOE 2	Instrumentation studies	2
5	VEC	BBTTVEC 1	Democracy, Election and Indian Constitution	2
			Total	22

B.Sc.I Semester I

BBTT 111: Fundamentals of Biotechnology

Course Objectives: The students should be able to...

1. Know about biotechnology
2. Understand different areas in biotechnology
3. Interpret the applications of biotechnology in health care
4. Know different research institutes from all over india.

Credit 02	BBTT 111: Fundamentals of Biotechnology	No. of Hours 30
Unit I	About Biotechnology	08
	Introduction, Milestones in the History of Biotechnology, Traditional & modern Biotechnology, Branches of Biotechnology, commercial potential of biotechnology, Biotechnology in India, Renounced Biotechnology institutes in India (IIT, IISER, NCL, NCCS, ARI, NIV, CCMB, CDFD etc.)	
Unit II	Biotechnology and Healthcare	07
	Disease diagnosis, detection of genetic diseases, disease treatment (Any two examples), stem cell technology	
Unit III	Agricultural Biotechnology	08
	Introduction, Plant Tissue culture, genetically modified crops,(Any two examples), GMOs in Agriculture, Plant based vaccines	
Unit IV	Food Biotechnology	07
	Biotechnological applications in enhancement of Food Quality, Food Products, Microbial role in food products Yeast, Bacterial and other Microorganisms based process and products. Modern Biotechnological Regulatory Aspects in Food Industries.	

Course Outcomes: The students will be able to...

1. Discuss milestones of biotechnology .
2. Discuss the application of biotechnology in health care, disease diagnosis, tissue culturing method
3. Implement biotechnological applications in enhancement of Food and Different

areas in biotechnology

4. Interpret the use of advance technology in food and agriculture sector.

Reference Books:

1. Singh B.D., (2020) Biotechnology , 4th Edition Kalyani Publishers.
2. Razdan M.K., [2019], Introduction to plant tissue culture ,3rd edition oxford and IBH publisher
3. Arora M. P., [2017], Biotechnology ,HimalayaPublisher.
4. Lanza R., Atala A., [2013], Essentials of stem cell biology, 3rd Edition, Academic press
5. Clark D., Pazdernik N., [2012], Biotechnology ,Elsevier inc Publisher
6. Hermann K., Kumar A., jafargholi-imani [2009],Plant cell and tissue culture – A tool in biotechnology, Springer-verlag-berlin Heidelberg publisher
7. Kalyankumarde ,[2008] ,Plant tissue culture, new central book agency, New Delhi
8. Dubey R. C., [2006], A text book in Biotechnology, S. Chand publications
9. Hartl D, Jones E., [2001], Genetics- Analysis of genes and genomes, Jones and bartlett publishers
10. JemsM. J., [2000], Modern food biotechnology, 6th Edition, Aspen publishers Inc.

B.Sc.I Semester I

BBTT 112: Biomolecules

Course Objectives: The students should be able to...

1. Define basics of chemical science in relevance to biological systems
2. Know concept of evolution
3. Understand fundamental Biomolecules
4. Memorize biomolecules

Credit 02	BBTT 112: Biomolecules	No. of Hours 30
Unit I	Origin of life	08
	Basic concept, A.I. Oparin concept, Urey Miller's experiment, Concept of Biomolecules-in general about Carbohydrate, amino acids, protein, lipid just definition with at least one example. pH, pk value definition, Biological buffer systems- e.g. Phosphate, Bicarbonate, Hemoglobin buffer system.	
Unit II	Nucleic Acids	07
	Structure and functions of Nucleic acids, purines&pyrimidines, Nucleosides & Nucleotides, Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and denaturation of DNA, RNA and its Types (rRNA, tRNA, mRNA).	
Unit III	Carbohydrates	08
	Structure, Function, Classification, Characteristic Reactions, Physical and Chemical Properties, D&L Glyceraldehydes, structure of Monosaccharide, Disaccharides, and Polysaccharides. Chemical/Physical Properties of Carbohydrate, Chemical Reactions for Detection of Monosaccharides, Biological functions of carbohydrates.	
Unit IV	Lipids	07

Classification of Lipids, Properties of Saturated, Unsaturated Fatty Acids, Rancidity, and Hydrogenation of Oils Phospholipids: Lecithin, Cephalin structure and function Cholesterol: Structure and Function, Lipoproteins: Structure and Function, Storage Lipids, Structural Lipids	
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Course Outcomes: The students will be able to...

1. Illustrate basics of chemical science in relevance to biological systems
2. Describe the concept of evolution
3. Discuss the biomolecules
4. Classify the biomolecules

Reference Books:

1. Voet J. G., Voet D., Pratt C.W., (2016) Fundamentals of Biochemistry, 5th Ed. John Wiley and Sons Inc, New York, USA
2. Satyanarayanan U. (2013) Biochemistry Elsevier; 4th edition
3. Com E.E & Stumpf P.K. (2010). Outlines of Biochemistry. 5th Ed. John Wiley Publications
4. Purohit S.S. (2009), Biochemistry - Fundamentals and Applications, Agrobios, Jodhpur
5. Palmer T., Philip B. (2007) Enzymes: Biochemistry, Biotechnology, and clinical Chemistry, 2nd Edition, Woodhead Publishing,
6. Nelson D.L., Cox M.M. Lehninger (2004) Principles of Biochemistry, 5th Edition, WH Freeman and Company, New York, USA
7. Jain J. L. (2004) Fundamentals of Biochemistry, S. Chand Pub
8. Rastogi S. C. (2003) - Biochemistry Tata McGraw-Hill Education, New Delhi
9. Rama Rao A. V. S. S., (2002) A Textbook of Biochemistry. Edition, 9, illustrated. Publisher, Sangam Books Limited, New Delhi.
10. Berg J. M., Tymoczko J. L., Lubert Stryer and Gregory J. Gatto, 2002. Biochemistry, 7th Ed. W.H. Freeman and Company, NY, USA

B. Sc. I Semester I

BBTP 113: Practical based on theory paper BBTT111 and BBTT 112

Course Objectives: The students should be able to...

1. Understand concepts of solutions and buffers
2. Know about various biomolecules
3. Understand biomolecules detection techniques
4. Know different Research organizations in India

Sr. No.	Title of the Experiments (Credit-02)	No. of hours (60)
1.	To detect blood group of given sample	4
2.	Preparations of molar / normal solutions	4
3.	To study the plant / Animal tissue culture lab layout	4
4.	To study the methods of sterilization	4
5.	To study different research organizations in India	4
6.	Preparation of buffers (Phosphate buffer, acetate buffer) and determination of pH with pH meter	4
7.	To determine sugars by Molisch test, Benedict's test & Barfoed's test.	4
8.	To determine sugars Resorcinol (Seliwanoff's test)	4
9.	To determine sugars by Fehling's test	4
10.	To perform Qualitative tests for Non - Reducing Sugars	4
11.	To Detect of unknown Carbohydrate from mixture (Glucose, fructose, maltose, sucrose, xylose and starch)	4
12.	To estimate Glucose by DNSA method	4
13.	To Determine iodine number of oil sample	4
14.	To Determine saponification value of oil	4
15.	To Estimation of vitamin C (Ascorbic acid)	4

Course Outcomes: The students will be able to...

1. Apply knowledge in working of various instruments related to biotechnology
2. Analyse Various biomolecules & their qualitative analysis
3. Prepare Buffer, Standardized and calibrate pH meter.
4. Discuss various institutes in India

Reference Books:

1. Upadhyay A., Upadhyay K., Nath N., (2020) Biophysical Chemistry Fourth Edition Himalaya Publishing House Pvt. Ltd.;
2. Wilson K. and Walker J., (2018) Principles and Techniques of Biochemistry and Molecular Biology 8th edition Cambridge University Press;

3. Plummer D., (2017) An Introduction to Practical Biochemistry 3rd Edition McGraw Hill Education;
4. Nagamani B., (2016) Bioinstrumentation Margham Publications
5. Veerakumari L., (2011) Bioinstrumentation Mjp Publishers
6. Champe P. C., Harvey R. A., Ferrier D. R. 2004 Biochemistry 3rd edition Lippincott Williams and Wilkins;
7. Sadasivam S, Manickam A (1996) *Biochemical methods*. 2nd edition, New Age International (p) Ltd. Publisher, New Delhi..
8. Fasman G. D.; (1989) Practical Handbook of Biochemistry and Molecular Biology CRC Press
9. Plummer D. 1988. An Introduction to Practical Biochemistry. 3rd ed. Tata McGraw Hill, New Delhi
10. Jayaram. T. 1981. Laboratory manual in biochemistry, Wiley Estern Ltd. New Delhi

B. Sc. I Semester I

BBTT114: Basics in Microbiology

Course Objectives: The students should be able to...

1. Understand General bacteriology and microbial techniques
2. Know the importance of the field of microbiology to other areas of biology and to general human welfare
3. Know the Principles of physical and chemical methods used in the control of microorganisms and applications for the prevention and control of infectious diseases.
4. Understand the Laboratory and techniques for isolation, staining, identification and control of microorganisms.

Credit 02	BBTT114: Basics in Microbiology	No. of Hours 30
Unit I	Introduction of Microbiology	08
	Definition, Discovery of microscope (Anton von Leeuwenhoek and Robert Hooke), Contributions of various Scientists (Aristotle, Francesco Redi, Louis Pasteur, Tyndall), Introduction to types of Microorganisms – Bacteria, Algae, Fungi, Protozoa and Viruses Morphology of Bacteria– i) Size, ii) Shape, iii) Arrangements Cytology of Bacteria, Structure and functions of :i) Cell wall ii) Cell membrane iii) Capsule and slimelayer iv) Flagella v) Pilli vi) Nuclear material vii) Mesosome viii) Ribosome, Cell inclusions (PHB granules, metachromatic granules and glycogen bodies) Viruses-General characteristics and lytic cycle of T4 bacteriophage	
Unit II	Bacterial taxonomy	08

	<p>General principles of bacterial nomenclature: Taxonomic ranks, Common or Vernacular name, Scientific or International name, Criteria for bacterial classification - Morphological, cultural, biochemical & serological characters.</p> <p>Microbial nutrition: Nutritional requirements of microorganisms: Water; Micronutrients; Macronutrients; Carbon, Oxygen, Hydrogen, Nitrogen, Sulphur and Phosphorous and growth factors. auxotroph, prototroph and fastidious organisms, Nutritional types of microorganism based on carbon and energy sources (Autotrophs, Heterotrophs, Phototrophs, Chemotrophs, Photoautotrophs, Chemoautotrophs, Photoheterotrophs, Chemoheterotrophs).</p>	
Unit III	Concept of Sterilization	07
	<p>Definitions: Sterilization, Disinfection, Antiseptic, Germicide, Microbiostasis, Asepsis, Sanitization.</p> <p>Methods of sterilization by Physical agents : (i) Temperature-dryheat, moist heat ii) Radiation-U.V, Gamma radiation iii) Bacteriophage filter-membrane filter) Chemical agents Phenol & Phenolic compounds, Alcohol, Heavy metals (e.g. mercury),</p> <p>Gaseous agents-Ethylene oxide, formaldehyde. Checking of Efficiency of Sterilization—Biological and Chemical Indicators</p>	
Unit IV	Staining Techniques	07
	<p>Definitions: dye and stain (Basic and Acidic), Fixative, Mordant, Decoloriser, Accentuator Classification of stains—Acidic, Basic and Neutral, Principles, Procedure, Mechanism and application of staining procedures—Monochrome staining and Negative staining, Differential staining—Gram staining and Acidfast staining, Special staining techniques—Spore, Capsule, Cell wall staining</p>	

Course Outcomes: The students will be able to...

1. Classify microorganisms according to Microbial nutrition.
2. Explain nutritional requirement of microorganism
3. Interpret Basic components of Nutrient medium and their role
4. Explain Basic terms in sterilization, Principles of sterilization and Various agents of sterilization.

Reference Books:

1. Stanier R. Y., Adelberg E. A. and Ingraham J. L. (1987). General Microbiology, 5th Edition. Macmillan Press Ltd.
2. Ingraham J. L. and Ingraham C. A. 2004, Introduction to Microbiology. 3rd Edition, Australia Pacific Grove, CA : Brooks/Cole Pub. Co
3. Frobisher Martin, (1974), Fundamentals of microbiology. 9th ed. Philadelphia: Saunders
4. Pelczar Michael J, JR. Chan E. C. S, Noel R. Krie, (1993), Microbiology, 5th Edition, McGraw Hill Education.
5. Paniker. C. K. Jayaram, Ananthanarayan. R., Medical microbiology. (2005), 7th edition, Universities Press
6. Prescott L. M, Harley J. P, and Klein. D. A. Microbiology, (2005) 6th Edition. MacGraw Hill
7. Kenneth alexzander bisset, The cytology and life history of bacteria [2021] Hassell Street Press
8. Arora. D. R, Arora Birjibala , Textbook of microbiology [2020] 6th edition, CBS publisher.
9. Sharma P. D., Microbiology [2010], Rastogi publication
10. Swarna. G., A textbook of microbiology [2022], Florence publisher

B. Sc. I Semester I

BBTT 115: Plant Science

Course Objectives: The students should be able to...

1. Understand general classification of plant kingdom.
2. Know morphology and anatomy of plants.
3. Learn basic knowledge of angiosperm and its reproduction.
4. Study the basic knowledge of plant cloning.

Credit 02	BBTT 115: Plant Science	No. of Hours 30
Unit I	Plant Diversity	08
	Outline of General Classification of Plant Kingdom. General characters and economic importance of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperms, Angiosperms	
Unit II	Taxonomy of Angiosperms	07
	Taxonomy:-Definition, Aims, objectives and functions, Binomial nomenclature and its significance, Principles of ICBN, Study of outline of Bentham and Hooker's system of Classification of plants.	
Unit III	Sexual Reproduction in Angiosperms	08
	Structure of Typical Flower- Floral whorls and functions:-Calyx, corolla, Androecium, Gynoecium, Pollination- Definition, Types-Self and Cross, Advantages of Self and Cross Pollination, Development of male and female gametophyte, Fertilization:- Definition, Double fertilization and its significance, Parthenocarpy- Definition and significance. Cloning of plants:-Bulbs, corms, tubers, Bulblets and Rhizomes, Runners, Cuttings, Layering, Grafting and mericloneing.	
Unit IV	Seed and Plant Anatomy	07
	Seed-Definition, Formation, structure of Monocot and Dicot seed, Dormancy of seed, Causes and Breaking of seed dormancy. Seed germination- Concept, Types- Epigeal and Hypogeal, factors affecting seed germination. Plant Anatomy Tissues-Simple and complex (Xylem and Phloem)	

Course Outcomes: The students will be able to...

1. Analyze the terminology used in Morphology and Anatomy
2. Explain the plant kingdom and need of classification
3. Apply basic and advanced knowledge of plant cloning
4. Describe basic knowledge of angiosperm and its reproduction.

Reference books

1. Dube H. C. (2009) [A Text Book of Fungi Bacteria and Viruses](#), Jodhpur: Agrobios
2. Naik V.N. (1984) Taxonomy of angiosperms. New Delhi: Tata McGraw-Hill
3. Chopra G.L., ., (1984) Angiosperms: Systematic and lifecycle. Jalandhar: Pradeep Pub
4. Chopra G.L. and Verma V (1983), Text Book of Fungi Pradeep Publications, Jalandhar
5. Devlin R. M., (1983) Fundamentals of plant physiology New York: MacMillan
6. Chopra G.L., (1978) A Textbook of Algae Jalandhar: Pradeep Pub.,
7. Chang Shu-ting, Hayes W. A. (1978) The Biology and Cultivation of Edible Mushrooms Academic Press, - Technology & Engineering - 819 pages
8. Bold H.C., (1977) The Plant kingdom, New Delhi: Prentice-Hall India
9. Dutta A.C., (1959) A Classbook of botany, New Delhi: Oxford University Press
10. [Eames A. J.](#) and [Laurence H. MacDaniels](#) (1947) An introduction of plant anatomy, New York: McGraw-Hill.

B. Sc. I Semester: I

BBTP 116: Practical based on theory paper BBTT114 and BBTT 115

Course Objectives: The students should be able to...

1. Understand concepts of microbiology.
2. Know about various bacterial media preparation techniques.
3. Study algae and bryophytes.
4. Learn various techniques plant anatomy.

Sr. No.	Title of the Experiments (Credit-02)	No. of hours (60)
1.	Introduction to laboratory-rules and procedures, laboratory equipment and apparatus.	4
2.	Preparation of bacteriological culture media-1) Nutrient agar media2) Nutrient agar broth	4
3.	Preparation of bacteriological culture media- 1)Peptone water 2) Mac-conkeys agar media	4
4.	Preparation of culture media for fungi (Sabouraud's agar, PDA)	4
5.	Isolation of bacteria by pour plate technique.	4
6.	Isolation of bacteria by spread plate technique.	4
7.	Isolation of bacteria by streak plate technique.	4
8.	Microscopic examination of bacteria by, Monochrome staining, Gram staining, negative staining, cell walls staining	4
9.	Observation of motility by hanging drop technique	4
10.	Mounting and identification of Aspergillus, Mucor	4
11.	Aseptic transfer techniques–types– slant to slant, broth to broth, broth to Agar	4
12.	Study of algae (<i>Nostoc</i> , <i>Sargassum</i>) and bryophyte (<i>Riccia</i> / <i>Anthoceros</i>)	4
13.	Study of Pteridophyte (<i>Selaginella</i>) and gymnosperms (<i>Pinus</i>)	4
14.	Study of Angiosperms (Sunflower, Maize)	4
15.	Plant root, stem, leaf anatomy–Dicot and monocot	4

Course Outcomes: The students will be able to...

1. Understand handling of equipments and instruments.
2. Differentiate between plant cells & microbial cells
3. Apply Staining techniques, Gram staining, motility.
4. Analyse Structure and morphological aspects of algae, bryophytes.

Reference Books:

1. Aneja K.R. Laboratory Manual of Microbiology and Biotechnology(2018),Medtech publisher.
2. Leboffe.J.Michael ,Pierce.E.Burton Microbiology Laboratory Theory & Application(2012)
Brief LooseLeaf
3. Johnson Ted, Case, Christine,Laboratory Experiments in Microbiology (What's New in Microbiology),(2018)Spiral-bound illustrated.
4. [Zothansanga](#),Senthilkumar.B. Practical Microbiology (2013)A Laboratory Manual Publisher: Panima Publishing Corporation, New Delhi, India.
5. Mathur R.C, *Systematic Botany Angiosperms*. (1963) Agra Book Store
6. Kaufman, [Peter B.](#),*Practical Botany* (1983)New York
7. Sarvanan.R.,Dhachinamoorthi.D,CH..Prasadarao.M.M A hand book of microbiology (2019) ,lambert academic publisher
8. Goldman emanuel,Green H lorrence,Practical handbook of microbiology(2015)
9. edition 3rd, CRC publication.
10. Colbert.J.Bruce,Gonzalezluis.S. Microbiology-practical application and infection prevention,(2015),2NDedition, Cengage Learning

B. Sc. I Semester: I
BBTT117: Basics in Computer

Course Objectives: Student should be able to...

1. Aware of basics of computer
2. Know Basic Formulas in excel
3. Know different file formats
4. Understand basic networking concept

Credit 02	BBTT117: Basics in Computer	No. of Hours 30
Unit I	Introduction of Computer	08
	Knowing computer: What is Computer, Basic Applications of Computer; Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Computer Memory, Concepts of Hardware and Software; Concept of Computing, Data and Information; Connecting keyboard, mouse, monitor and printer to CPU and checking power supply.	
Unit II	MS Word	07
	MS Word: Overview of MS Word, Creating and saving documents, - Typing and editing text, Selecting and formatting text, Cutting, copying, and pasting, Undo and redo, Creating headings and subheadings, Using sections and breaks, Creating tables of contents, Creating and formatting tables, - Font styles and sizes, Alignment and spacing, Numbering and bullets, Margins and indentation Inserting images and graphics, Resizing and formatting images, - Printing documents, Saving documents in different formats (PDF, RTF, etc.), Sharing documents via email or online storage.	
Unit III	MS Excel	08
	MS Excel : Introduction to MS Excel, Overview of MS Excel, Creating and saving workbooks, - Entering and editing data, Selecting and formatting cells, Basic calculations (sum, average, count), Undo and redo, - Creating formulas (arithmetic, comparison, logical) Using functions (SUM, AVERAGE, COUNT, IF), - Organizing and formatting data. Using filters and sorting, Creating and managing pivot tables, Using conditional formatting	
Unit IV	Introduction to Internet	07

<p>Introduction to Internet, WWW and Web Browsers: Basic of Computer networks; LAN, WAN; Concept of Internet; Applications of Internet; connecting to internet; What is ISP; Knowing the Internet; Basics of internet connectivity related troubleshooting, World Wide Web; Web Browsing softwares, Search Engines; Understanding URL; Domain name; IP Address; Using e-governance website</p>	
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Course Outcomes: Student will be able to...

1. Demonstrate basics of computer
2. Create a word document
3. Make use of formulas
4. Access Internet

Reference Books :

1. David A. Patterson and John L. Hennessy , 2013 "Computer Organization and Design" 5th edition
2. Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne , 2012 "Operating System Concepts" 9th edition
3. Harvard University, MIT, 2012 edX - Offers online courses and practicals on computer science and related topics.
4. Zach Sims, Ryan Bubinski, 2011 Codecademy - Provides interactive coding exercises and practicals.
5. Andrew S. Tanenbaum and David J. 2010 "Computer Networks" Wetherall 5th edition,
6. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein 2009 "Introduction to Algorithms" 3rd edition
7. Jeremy Grossmann, 2008 GNS3 - A network simulator for practicing network configurations.
8. Jan Egil Refsnes, 1999 W3Schools - Offers tutorials, examples, and reference materials for web development.
9. Diane Greene, Mendel Rosenblum, 1998 VMware - A virtualization software for creating virtual machines
10. Microsoft Corporation, 1997 Microsoft Visual Studio - An integrated development environment (IDE) for programming

B. Sc. I Semester: I

BBTT118:Basics in Bioinformatics

Course Objectives: The students should be able to...

1. Understand the basics of Bioinformatics .
2. Study the computational tools to analyze the biological data.
3. Implement sequence techniques and gene annotation
4. Understand application of bioinformatics

Credit 02	BBTT : Basics in Bioinformatics	No. of Hours 30
Unit I	Introduction of Bioinformatics	08
	Definition, Introduction, History, application Study of NCBI , All Database - Nucleotide,Protein,SNP Popular resource -Pub Med ,PubMed Central ,Pubchem Study of -NLM,NIH,EMBL,PDB,DDBJ,EBI	
Unit II	Bioinformatics tools	07
	NCBI -study protein and nucleotide PubMed- full text article Entrez- Retrieve the sequences of protein and nucleotide Clustal Omega - phylogenetic tree analysis	
Unit III	Introduction of sequence alignment	08
	Gene,nucleotide,aminoacid,protein Sequence alignment -1.Global alignment 2.Local Alignment Pairwise sequence alignment :Dot Matrix ,BLAST,FASTA Multiple Sequence alignment .	
Unit IV	Application of Bioinformatics	07
	Human Genome Project and its goals, Applications of Bioinformatics in various fields ,Environment, biotechnology, molecular biology, neurobiology, agriculture, drug designing, biomedical genome medicines, medical microbiology	

Course Outcomes: The students will be able to...

1. Apply the various bioinformatics tools and techniques for the analysis of the biological data .
2. Understand the sequence techniques for evolutionary study
3. Discuss the application of bioinformatics
4. To apply bioinformatics tools for dan and protein study .

Reference Books:

1. A. M. Campbell , L. J. Heyer (2007) Discovering genomics, proteomics, and bioinformatics, 2nd edition, CSHL Press : Pearson/Benjamin Cummings, San Francisco
2. A. Malcolm Campbell , Laurie J (2006) Discovering genomics, Proteomics and Bioinformatics
3. Essential Bioinformatics(2006). Jin Xiong Cambridge University Press 1st edition
4. J. Xiong (2006) Essential Bioinformatics Cambridge University Press; 1st edition
5. Y. V. Peter(2006) Trends in Bioinformatics Research, Published by Nova Science Publishers, Incorporated, Mishawaka, IN, U.S.A.
6. D.R. M. Graham (2005) Broad-based Proteomics strategies: a practical guide to proteomics and functional screening et al J. Physiol
7. D. W. Mount (2004), Bioinformatics-Sequence and Genome Analysis Cold Spring Harbor Laboratory Press; 2nd edition
8. W. Miller (2004). Comparative Genomics et al Annu. Rev. Genomics Hum. Genet
9. P Baldi, G W Hatfield (2002) DNA microarrays and gene expression Cambridge University Press.
10. Thomas Langauer (2001) (editor) Bioinformatics - From Genomes to Drugs Wiley-VCH; 1st edition

B. Sc. I Semester: I

BBTP 119: Practical based on theory paper BBTT117 and BBTT 118

Course Objectives: Student should be able to...

1. Aware of basics of computer
2. Know Basic Formulas in excel
3. Study the computational tools to analyze the biological data.
4. Implement sequence techniques and gene annotation.

Sr. No.	Title of the Experiments (Credit-02)	No. of hours (60)
1	Study opening and closing Documents (Opening documents Save and Save as ,Page setup ,Print preview , Printing of documents)	4
2	Perform text creation and manipulation (Document creation, Editing text ,Text selection , Cut, Copy and Paste ,Spell check	4
3	Demonstrate Formatting the Text (Font and size selection , Alignment of text , Paragraph indenting ,Bullets and Numbering ,Changing case)	4
4	To study table manipulation (Draw table ,changing cell width and height ,Alignment of text in cell ,Delete / Insertion of row and column ,Border and shading)	4
5	Demonstrate Word Processing Basics (Opening word processing package ,Menu bar ,Using the help ,Using the icons below menu bar)	4
6	To study the Elements of Electronic Spread Sheet (Opening of spread sheet ,Addressing of cells, Printing of spread Sheet ,Saving Workbooks)	4
7	To perform Manipulation of Cells (Entering Text, Numbers and Dates ,Creating Text, Number and Date Series ,Editing Worksheet Data ,Inserting and Deleting Rows, Column ,Changing Cell Height and Width)	4
8	To study Opening of Email account	4
9	Introduction to PubMed central database	4
10	Retrieval of amino acid sequence from NCBI database	4
11	Retrieval of Nucleic acid sequence from NCBI database	4
12	Similarity search for nucleotide using the BLASTn	4
13	Similarity search for protein using the BLASTn	4
14	Perform multiple sequence alignment	4
15	Perform Phylogenetic tree construction.	4

Course Outcomes: The students will be able to...

1. Know different file formats

2. Understand basic networking concept
3. Discuss the application of bioinformatics
4. To apply bioinformatics tools for DNA and protein study .

Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein 2009 "Introduction to Algorithms" 3rd edition
2. Jeremy Grossmann, 2008 GNS3 - A network simulator for practicing network configurations.
3. Jan Egil Refsnes, 1999 W3Schools - Offers tutorials, examples, and reference materials for web development.
4. Diane Greene, Mendel Rosenblum, 1998 VMware - A virtualization software for creating virtual machines
5. Microsoft Corporation, 1997 Microsoft Visual Studio - An integrated development environment (IDE) for programming
6. A. Malcolm Campbell, Laurie J (2006) Discovering genomics, Proteomics and Bioinformatics
7. Essential Bioinformatics (2006). Jin Xiong Cambridge University Press 1st edition
8. J. Xiong (2006) Essential Bioinformatics Cambridge University Press; 1st edition
9. Y. V. Peter (2006) Trends in Bioinformatics Research, Published by Nova Science Publishers, Incorporated, Mishawaka, IN, U.S.A.
10. D.R. M. Graham (2005) Broad-based Proteomics strategies: a practical guide to proteomics and functional screening et al J. Physiol

B.Sc.I Semester II

BBTT121: Environmental Biotechnology

Course Objectives: Students should be able to...

1. Understand concept of Environmental Biotechnology
2. Study of Environmental Impact Assessment.
3. Imbibe strategies for Environmental Survey for different approaches.
4. Know various effluent treatment system.

Credit 02	BBTT121: Environmental Biotechnology	No. of hours 30
Unit I	Environmental Toxicology	11
	Definition, classification and concept Pesticide Toxicity –Classification (Organic and Inorganic) Mode of action of toxicants (Metals, organophosphates, carbamates and mutagens) Bioconcentration, Bioaccumulation, Biomagnification, Potentiation and Synergism Control of Toxic effects- Biotransformation and excretion, Toxicants removal techniques with examples	
Unit II	Bioremediation Techniques	12
	Introduction of bioremediation, Definition, Principle, Insitu and Exsitu Bioremediation, Bioremediation of waste waters Activated Sludge Process, Solid Waste Treatment, Slurry Phase Treatment Agricultural Bioremediation- Microbial Composting, Biogas, Land Farming and Pest Control Bioremediation of Industrial wastes, Xenobiotics	
Unit III	Biogeochemical cycle	11
	Carbon cycle (Types of Carbon cycle -Marine carbon cycle, terrestrial carbon cycle), Nitrogen cycle, Sulphur cycle, Phosphorus cycle- Significance and importance of cycles Bio augmentation and Bio filtration Environmental Impact Assessment (EIA)	
Unit IV	Waste water treatment	11
	Introduction, sources of water pollution, Stages of waste water treatment- Preliminary, Primary, Secondary – Aerobic and anaerobic treatment, Tertiary treatment. Waste water treatment for industry water recycling process (dairy, distillery, sugar industry) Waste water treatment for industry water recycling process in dairy distillery, sugar industry (raw process, differences in processing between all bio remedial techniques)	

Course Outcomes: The students will be able to...

1. Understand about recycling, and remediation methods of different pollutants.
2. Apply the technique of remediation method for pollution control.
3. Analyze various techniques for Environmental Impact Assessment
4. Evaluate about effluent treatment system.

Reference Books:

1. Environmental Biotechnology. , Chattergy A. K., Prentice Hall India Learning Private Limited; 3rd edition, 2011.
2. Environmental Chemistry , Sharma B. K., Krishna Prakashan Media (P) Ltd. 2nd Edition 2014.
3. Environmental problems and solution.,Asthana D. K. and Asthana M.S., S. Chand Publishing, 2001.
4. Fundamentals of ecology ;Odum E.P, Cengage Learning India, 5th Edition 2005
5. Environmental Biology, Verma P. S. and Agerwal V. K., S. Chand publishing 2nd Edition. 2015.
6. Biochemistry- Satyanarayan U., Elsevier publication 4th Edition, 2013.

B.Sc.I Semester II
BBTT 122 Proteins & Enzymes

Course Objectives: Students should be able to...

1. Learn basic concepts of proteins, enzymes and vitamins.
2. Understand basics of chemical science in relevance to biological systems.
3. Study 3D structures of enzymes relevance to catalytic properties.
4. Learn techniques of protein purification .

Credit 02	BBTT122: Proteins & Enzymes	No. of hrs. 30
Unit I	Proteins and Amino Acids	08
	Classification of amino acids based on Properties, Proteins: Classification based on Structure and Functions, Denaturation of protein Structure of Peptides, Titration Curve of Amino Acids, Concept of Isoelectric pH, Zwitter ion. Types of Protein: Globular, Fibrous, Elastic Proteins	
Unit II	Enzymes	07
	Introduction, IUB classification, active site, energy of activation, transition state hypothesis, lock and key hypothesis, induced fit hypothesis, enzyme inhibition types competitive, non-competitive, un-competitive. M-M equation	
Unit III	Vitamins	08
	Classification and deficiency diseases of Vitamins, RDA, source, structure of Vitamin and Coenzymes of - Ascorbic acid, thiamine, riboflavin, folic acid, pyridoxine, niacin, pantothenic acid, biotin, lipoic acid, folic acid and cyanocobalamin	
Unit IV	Protein purification	07
	Method of cell disruption - Blenders, grinding with abrasives, French press, enzymatic method, sonication; Salt participation- Salting in, salting out, organic solvent precipitation, dialysis, ultrafiltration	

Course Outcomes: The students will be able to...

1. Acquire knowledge of basic of role of vitamins as coenzymes
2. Apply basics idea of purification of proteins/enzymes
3. Understand the techniques of protein purification .
4. Classify amino acid based on structure and function .

Reference Books:

1. Voet J. G., Voet D., Pratt C.W., (2016) Fundamentals of Biochemistry, 5th Ed. John Wiley and Sons Inc, New York, USA
2. Satyanarayanan U. (2013) Biochemistry Elsevier; 4th edition
3. Com E.E & Stumpf P.K. (2010). Outlines of Biochemistry. 5th Ed. John Wiley Publications

4. Purohit S.S. (2009), Biochemistry - Fundamentals and Applications, Agrobios, Jodhpur
5. Palmer T., Philip B. (2007) Enzymes: Biochemistry, Biotechnology, and clinical Chemistry, 2nd Edition, Woodhead Publishing,
6. Nelson D.L., Cox M.M. Lehninger (2004) Principles of Biochemistry, 5th Edition, WH Freeman and Company, New York, USA
7. Jain J. L. (2004) Fundamentals of Biochemistry, S. Chand Pub
8. Rastogi S. C. (2003) - Biochemistry Tata McGraw-Hill Education, New Delhi
9. Rama Rao A. V. S. S., (2002) A Textbook of Biochemistry. Edition, 9, illustrated. Publisher, Sangam Books Limited, New Delhi.
10. Berg J. M., Tymoczko J. L., Lubert Stryer and Gregory J. Gatto, 2002. Biochemistry, 7th Ed. W.H. Freeman and Company, NY, USA

B.Sc.I Semester II

BBTP 123: Practical based on theory paper BBTT121 and BBTT 122

Course Objectives: Students should be able to...

1. Understand to check the techniques of water quality.
2. Understand the bacteriological study in water resources
3. Understand about screening technique.
4. Know the protein purification techniques.

Sr. No.	Title of the Experiments (Credit-02)	No. of Hours 60
1.	To determine total and permanent hardness of water sample.	4
2.	To estimate COD of water sample.	4
3.	To estimate the BOD of water sample.	4
4.	Quality Control- To determine percentage purity of soda ash sample	4
5.	Determination of TDS of water	4
6.	Routine bacteriological analysis of water and soft drinks Presumptive, Confirmatory, Completed, MPN.	4
7.	IMVIC Test	4
8.	Visit to biodiversity site and ETP site.	4
9.	Spectrophotometric determination of nucleic acid purity and concentration	4
10.	To Separate and identification of plant pigments by using Ascending paper chromatography	4
11.	To Separate and identification of amino acids using TLC	4
12.	To estimate Protein by Lowry's method	4
13.	To estimate of amino acid by Ninhydrin method	4
14.	To estimate protein by biuret method	4
15.	Purification of Protein by precipitation & dialysis method.	4

Course Outcomes: The students will be able to...

1. Apply principles and basics of bacteriological analysis of water
2. Perform different test for water quality.
3. Illustrate screening technique
4. Learn various separation techniques.

Reference Books:

1. Practical Biochemistry (Principle and protocols) – 2nd edition – HrudayanathThatoi, SupriyaDash, Dreamtech Press - 2021
2. Jordening H J and Winter J, Environmental Biotechnology: Concepts and Application" (2016) Margham Publication
3. Evans G M and Furlong J C, Environmental Biotechnology: Theory and Application– (2011) Mjp Publishers; 1st edition

4. Wilson K. and Walker L.(2010) ,Principles and Techniques of Biochemistry and Molecular Biology .
5. G. D. Fasman (1989) Practical Handbook of Biochemistry and Molecular Biology Hardcover–Important
6. Bhattacharya B C and Banerjee R, Environmental Biotechnology, Volume 436) 2nd Edition Academic Press.
7. Springer M. G.; (2005) "Measurement Uncertainties in Science and Technology" 5th edition
8. Wiley J. & Sons Inc; 1st edition (2000)Analytical Instrumentation - Performance Characteristics & Quality: Performance Characteristics and Quality: 1 (Analytical Techniques in the Sciences (AnTs))
9. nvironmental Science - A practical Manual –G. Swarajya Lakshmi, BS Publications; St ed.-2011
10. Philip B.(2019) Protein Purification 2nd Edition .

B.Sc.I Semester II

BBTT 124: Microbiology II

Course Objectives: Students should be able to...

- 1.Learn basic concepts of culture media with their different types and study the isolation methods of pure culture.
- 2.To study the different phases of bacterial growth.
- 3.To introduce the concept and use of indicate or bacteria in water quality monitoring.
- 4.The role of microorganisms in a range of diseases, including the nature of disease causing organisms as well as their route of transmission and how we can control them.

Credit 02	BBTT 124: Microbiology II	No. of Hours 30
Unit I	Culture media and pure culture techniques:	7
	Common components of media and their functions (peptone, yeast extract, Nacl, agar and sugar techniques of enrichment). culture media – a)Living media - (Lab.animals, plants, bacteria, embryonated eggs) b) Nonliving media – i) Natural, ii) Synthetic, iii) Semisynthetic, iv)Differential, v) Enriched, vi) Enrichment, vii) Selective. Methods for isolation of pure culture - Introduction to concept of pure culture and methods for pure culture - i) Streak plate ii) Pour plate iii) Spread plate	
Unit II	Microbial growth	8
	Growth Kinetics and growth curve; definitions of Growth, Generation time, Growth rate, specific growth rate, Growth curve and phases of growth curve (Continuous culture, Synchronous growth, Diauxic growth). Effect of environmental factors on growth-temperature, pH, osmotic pressure.	
Unit III	Water Microbiology: Sources of microorganisms in water, fecal pollution of water, Routine bacteriological analysis of water (SPC, Tests for coliforms-Qualitative: detection and differentiation of coliforms, Quantative: MPN technique.) Soil Microbiology: Types of microorganisms in soil and their role in soil fertility, Microbial interactions in soil (Symbiosis, commensalism, amensalism, parasitism and predation.)	7
Unit IV	Medical Microbiology	8
	Definitions - Host, parasite, Saprophytes, Commensals, Infection, Etiological agent, Disease, Pathogen, Opportunistic pathogen, True pathogen, Virulence, Pathogenicity, Fomites, Incubation period, Carriers, Morbidity rate, Mortality rate, Epidemiology, Etiology, Prophylaxis, Antigen, Antibody, Hapten, Vaccine, Immunity.	

Types of infections: Chronic, Acute, Primary, Secondary, Reinfection, Iatrogenic, Congenital, Local, Generalized, Covert, Simple, Mixed, Endogenous, Exogenous, Latent, Pyogenic, Nosocomial. General principles of prevention and control of microbial diseases.

Course Outcomes: The students will be able to...

1. Basic concepts of microbial nutrition, growth and control
2. Basic techniques of pure culture isolation and preservation of microbes.
3. Bacteriological analysis of water and types of microorganisms in soil and their application.
4. Basic terms in medical microbiology.

Reference books:

1. John L. Ingraham, Catherine A.(2003) Ingraham Introduction to Microbiology: A Case-History
Study Approach 3rd Edition
2. John M. Madigan, Michael T.:(2006) Martinko Brock Biology Of Microorganisms 11th edition Perfect Paperback
3. Prescott, Lansing M.; Harley, John P; Klein, Donald A (2004). Microbiology 6th edition published
by McGraw-Hill Science/Engineering/Math Hardcover Unknown Binding.
4. Patel A H (2011),Industrial Microbiology Paperback
5. C K JayaramPaniker (2005); R Ananthanarayan, Text book of microbiology, 7th ed,
Himayatnagar,
6. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg (1993).Microbiology, 5th Edition, Tata
McGraw Hill Press
7. A.J. Salle (1984) Fundamental Principles of Bacteriology Paperback
8. R.Y. Stanier (1987) General Microbiology Paperback – Import.
9. Gerard J. TortoraBerdell R. Microbiology(2014): An Introduction Hardcover – Import.
10. Peter F Stanbury, Allan Whitaker (2016) Principles of Fermentation Technology Paperback

B. Sc. I Semester II
BBTT125 Animal science

Course Objectives: Students should be able to...

1. Interpret the general concept of classification system of Animal kingdom.
2. Classify the Application of animal science to study the Host and parasite relationship.
3. Compare Human anatomy and physiology with reference to Tissues and Histology of different mammalian organs.
4. Reconize the Application of animal science with reference to vermiculture, sericulture, apiculture and pisciculture.

Credit 02	BBTT124 : Animal science	No. of Hours 30
Unit I	Taxonomy	08
	<p>General classification of animal kingdom.(General characteristics and one representative example) Non-chordates –Study of phylum Porifera, Ceolenterata, Platyhelmenthes, Nemathelmenthes, Arthropoda, Mollusca & Echinodermata – General characters with representative examples- Sycon, Hydra, Liver fluke/Taenia, Earthwarm / Nereis, Cockroach, Pearl oyster / Pila, Starfish</p> <p>Chordates:-Study of class Pisces, Amphibia, Reptilia& Mammalia – General characterswith representative examples – Lebeo, Frog, Cobra, Alligator, Fowl and Rat.</p>	
Unit II	Host and Parasite Relationship	07
	<p>Protozoan parasite- Plasmodium (Morphology, parasitic adaptations, Life cycle), Nematode parasite- Ascaris (Morphology, parasitic adaptations, Life cycle), Plathelminthes parasite- Liver fluke (Morphology, parasitic adaptations</p>	
Unit III	Tissues	08
	<p>Definition and types of tissues (Epithelial, Muscular, Nervous, Connective tissue). Blood Plasma, Serum, Corpuscles, Bone, Cartilage. Histological Architecture of Skin, Stomach/Intestine, Uterus</p>	
Unit IV	Applied zoology	07
	<p>Vermiculture :- species/types of earthworms , stages of vermiculture, various models/methods, economic importance, Apiculture: Types/ species of Honey bees, castes of Honey bees, Economic Importance ., Sericulture : Types of Silkworms, Life cycle, economic importance., Pisciculture: History ,Inland ,Marine and culture fisheries, Economic importance.</p>	

Course Outcomes: The students will be able to...

1. Discuss applied biological sciences.
2. Illustrate of classification of animal kingdom.
3. Memorize and Relate host and parasite relationship which may useful to develop an interest in diagnosis and modern reasarch in parasitology.
4. Summarize Human physiology and anatomy.

Reference Books:

1. KotpalR .L., (2019) Modern Textbook of Zoology : Vertibrates India, Rastogi Publications
2. Chatterjee K D ,Parasitology (2019) (Protozoology and Helminthology) ,CBS publications,India,; 13th edition
3. DerricksonB.H. ,Torotora, (2017) Principles of Anatomy and Physiology,wiley,15Th edition ,
4. Shukla G.S. and Upadhyay V.B., (2014) Appliedand Economic Zoology, Rastogi Publications; First Edition ,
5. Bardarch J.E, J.H.Ryther ,W.O.Mclarney, (2013) Aquaculture:The farming and Husbandary of fresh water and Marine organisms,Wiley India PvtLtd,
6. Kotpal R.L., (2012) Modern Text Book of Zoology: Invertebrates ,Rastogi Publications,
7. Gyton A. C. , Hall J.E. , (1995) Textbook of medical Physiology (Gyton Physiology) Saunders; 9th edition ,
8. Cox F.E.G,Wiley-Blackwell & Sons (1993) Modern Parasitology : A Textbook of Parasitology , USA, ,2nd edition ,
9. Jhingran V .G , (1991) Fish and Fishreis of india, HindusthanPub.Corporation, Delhi, India,
10. Jordan E.L, and. Verma P.S (1978) (i) Chordate Zoology S. Chand & Company Ltd. Ram Nagar. New Delhi.

B. Sc. I Semester: II**BBTP 126: Practical based on theory paper BBTT124 and BBTT 125****Course Objectives: Students should be able to...**

1. Interpret dissection and microscopy needed for research work in animal sciences.
2. Recognize the basics of Parasitology.
3. Illustrate practical knowledge related to Blood.
4. Memorize applied zoology like –Sericulture, Apiculture, Vermiculture.

Sr. No.	Title of the experiments (Credits: 2)	No. of Hours 60
1.	Mounting and identification of Aspergillus, algae	4
2.	Enumeration of bacteria by total viable count from soil by spread plate technique and pour plate technique	4
3.	Isolation of pure cultures of bacteria by four quadrant streaking method and study of colony characteristics, Gram staining & motility of <i>E.coli</i>	4
4	Isolation of pure cultures of bacteria by four quadrant streaking method and study of colony characteristics <i>Staphylococcus aureus</i>	4
5	Perform biochemical test for given specimen- H ₂ S production Test	4
6	Perform biochemical test for given specimen- Catalase test.	4
7	Classification and Identification of Non-chordates & Chordates. (One animal each). Non- chordates- Sycon, Hydra, Liver fluke/ Earthworm / Nereis, Cockroach, Pearl oyster/ Pila, Starfish. Chordates- Lebeo, Frog, Cobra, Alligator, Fowl and Rat	4
8	Earthworm Dissection -Digestive system,	4
9	Study of Plasmodium, Ascaris, Liver Fluke, Taenia- Solium	4
10	Blood slide Preparation and Identification of Blood cells	4
11	Blood cell count: Differential count of W. B. Cs. & R. B. Cs	4
12	Preparation of Haemin Crystals.	4
13	Determination of Hemoglobin	4
14	Demonstration of : Beekeeping – Study of instruments	4
15	Study tour –Visit to Biodiversity spot, Sericulture, Apiculture, Vermicomposting	4

Course Outcomes: The students will be able to...

1. Describe and Develop the skill in dissection and microscopy which is highly needed for any type of research work in animal sciences.
2. Relate and meet Basics of Parasitology.
3. Classify and compare practical knowledge related to Blood.
4. Acquire discover in applied zoology like –Sericulture, Apiculture, Vermiculture.

Reference Books:

1. Jasrai L. , (2020) Data Analysis Using SPSS Paperback
2. Scott H. (2015) Hypothesis Testing: A Visual Introduction To Statistical Significance Kindle Edition.
3. S .S. Lal, (2015) Practical zoology Vertebrate, RastogiPublications,India,
4. Thigale T. K. and Dixit P. G., A (2003) text book Of paper II for B.Sc. I.
5. Rohatgi V. K. and Sauh A. K. Md E. (2002) An Introduction to probability and statistics.
6. JhonHimmelman (2001) Children's Press An Earthworm's Life (NatureUpclose)

7. Prabhashekhar, Martin Hardingham (1995) Sericulture and silk production intermediate technology publication's.
8. Cochran, W.G. (1997) Sampling Techniques, Wiley Estern Ltd., New Delhi,
9. Meyer P. L(1970) Introduction, probability and statistical Application. Addisonwesly. .
10. Waiker and Lev: (1958). Elementary Statistical methods.

B. Sc. I Semester: II
BBTT127 : Biostatistics

Course Objectives: Students should be able to...

1. Understand data analysis of given samples.
2. Recognize concept of correlation and regression
3. Make inference about a sample based on information we get from a population
4. Study concept of statistic and its use in biological field

Credit 02	BBTT125: Biostatistics	No.of hrs.
Unit I	Introduction to statistics and collection of data	08
	Meaning of statistics, Scope of statistics in Biological and medical sciences, Classification of data: Primary and Secondary data, Discrete and Continuous frequency Distribution, Cumulative frequencies, Graphical representation: - Histogram and Ogive Curves	
Unit II	Descriptive Statistics	07
	Measure of central tendency Mean (Definition & simple problems) Mode, Median, Quartiles (Definition, Graphical calculation), Measures of dispersion: Variance (Definition, simple problems) Standard deviation, Coefficient of variance, Skewness (Definition, types of skewness , real life example), Kurtosis (Definition, types of Kurtosis, real life example)	
Unit III	Correlation and Regression	08
	Concept of correlation between two variables and types of correlation, Method of obtaining correlation (i) by scattar diagram method ii) By Karl Pearson Correlation coefficient Properties of correlation coefficient, Concept of regression, Lines of regression coefficients and properties without proof, Examples on ungrouped data.	
Unit IV	Probability and Sampling	07
	Definition of sample space, Outcomes, events, exhaustive events, mutually exclusive events, certain events, impossible events. Independent events, Definition of probability, Limits of probability, Probability of complementary event, Additive law of Probability. Simple illustrative examples, Idea of population and sample, Simple Random Sampling and Stratified Random sampling, Advantages and disadvantages of both the method, Testing of hypothesis, Null and alternative hypothesis, types of errors, Critical region, Acceptance region, level of	

Course Outcomes: The students will be able to...

1. Memorize the basic fundamentals of the statistics.
2. Explain the data analysis statistically.
3. Represent the data in tabular format and graphical representation of the data.
4. Illustrate the basic Probability and sampling.

Reference Books:

1. Gupta S.C. & Kapoor V. K., (2014) Fundamental of mathematical statistics Sultan chand & sons
2. Prayag V. R. and Dixit P. G., (2020) A text book of paper- I for B.Sc. I, Nirali Publication, Pune,
3. Walker H.M. and Lev J, (2010) Elementary Statistical methods , Holt, Rinehart & Winston of Canada Ltd; 3rd Revised edition,
4. Rohatgi V. K. and Ehsanes A. K. Md, ., (2008) An Introduction to probability and statistics , Wiley India Pvt. Ltd
5. Meyer P. L., (1970) Introduction, probability, and statistical Application. Addison Wesley. Generic Publications,
6. Cochran W.G., (1977) Sampling Techniques, Wiley Eastern Ltd., New Delhi.
7. Des Raj, Pramod Chandak, (2013). Sampling theory (Createspace Independent Pub.,
8. Hampton R. E , John E. Havel, (2018) Introductory Biological Statistics, 3rd Edition,
9. Jan Lepš , Petr Šmilauer, (2000) Biostatistics : An Introductory Guide for Field Biologists 1st Edition ,
10. Catherine Legrand , (2021). Advanced Survival Models (Chapman & Hall/CRC Biostatistics Series) 1st Edition

B. Sc. I Semester: II
BBTT128 : Cell Biology I

Course Objectives: Students should be able to...

1. Understand the importance of the cell as a structural and functional unit of life.
2. Know and compare between the prokaryotic and eukaryotic system and extrapolate life to the aspect of development.
3. Understanding the dynamism of bio membranes indicates the dynamism of life. Its working mechanism and precision are responsible for our performance in life.
4. Know the cellular mechanisms and its functioning depend on endo-membranes and structures.

Credit 02	BBTT128: Cell Biology I	No of hours (30)
Unit I	Introduction To Cell	8
	Cell Theory, Types of Cell: Structure and function of Prokaryotic cell (bacteria), Structure and function of Eukaryotic cell (Plant and animal cell), Cellular Diversity: Cell structure & related functions	
Unit II	Cell Membrane	6
	Chemical components of biological membranes, Structure and functions of Plasma membrane, Fluid Mosaic Model, membrane as a dynamic entity ,Functions of cell membrane.	
Unit III	Cell Organelle	8
	Structure, components and function of: Nucleus: Structure of Nucleus, Nuclear envelope, Nuclear pore complex, Nucleoplasm, Nucleolus and function, Ultrastructure and function of Mitochondria , Chloroplast, Peroxisomes	
Unit IV	Endomembrane system:	8
	Structure, location and Functions of Endoplasmic reticulum, Lysosomes , Golgi Bodies, vacuoles Cytoskeleton: Microtubules, Microfilaments, Intermediate filaments	

Course Outcomes: The students will be able to...

1. Interpret and explain key experiments in the history of cell biology.
2. Describe the structure and function of membranes, especially the phospholipid bilayer.
3. Identify membrane-bound organelles found in eukaryotic and Prokaryotic cell cells.
4. Describe and explain the structure and function of membranes.

Reference books:

1. Cooper, G.M. and Hausman, R.E. (2013),. The Cell: A Molecular Approach. 6th edition ASM Press& Sunderland, Washington, D.C.; Sinauer Associates, MA.

2. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., KReiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA
3. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
4. Lodish, H., D. Baltimore, A. Berk, L. Zipursky, M. Matsudaira and J. Darnell. (2010).
5. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
6. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
7. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
8. JhonHimmelman (2001) Children's Press An Earthworm's Life (Nature Upclose)
9. Prabhashekhar, Martin Hardingham (1995) Sericulture and silk production intermediate technology publication's.
10. Cochran, W.G. (1997) Sampling Techniques, Wiley Estern Ltd., New Delhi,

B. Sc. I Semester: II

BBTP 129: Practical based on theory paper BBTT127 and BBTT 128

Course Objectives: Students should be able to...

1. Understand the different techniques of isolation of organelles.
2. Understand the different technique of fungal study
3. Illustrate practical knowledge related to Blood.
4. Memorize applied zoology like –Sericulture, Apiculture, Vermiculture.

Sr. No.	Title of the Experiments (Credit 02)	No. of Hours 60
1.	Frequency distribution – Graphical, Histogram, ogive curve [less & greater than]	4
2.	Measures of central tendency (Grouped and Ungrouped) A. M., Median, Mode.	4
3.	Measures of Dispersion	4
4	Correlation in between given data. (Karl Pearson's, spearman's/Scattered diagram R software	4
5	Equation of Regression lines	4
6	Test based on TF and Chi square test	4
7	Application of probability	4
8	Cell Counting and viability from given sample	4
9	Isolation of fungus from soil	4
10	Purification and characterisation of fungal body	4
11	Staining and visualization of mitochondria by janus green stain	4
12	Visualization of plant cell	4
13	Visualization of animal cell	4
14	Study of fruiting body of fungi/conoidal structure	4
15	Study of fungal spore germination	4

Course Outcomes: Students will be able to ...

1. Learn the technique of micrometry for measurement of size of cell
2. Acquire the knowledge of isolation techniques for various organelles.
3. Classify and compare practical knowledge related to Blood.
4. Acquire discover in applied zoology like –Sericulture, Apiculture, Vermiculture.

Reference Books:

1. Cell Biology Laboratory Manual, William H. Heidcamp
2. Cell biology practical manual, SRM university

3. Cell biology Laboratory Manual: Jerry D. Berlin, Kendall Hunt Pub Co., 1987
4. Thigale T. K. and Dixit P. G., A (2003) text book Of paper II for B.Sc. I.
5. Rohatgi V. K. and Sauh A. K. Md E. (2002) An Introduction to probability and statistics.
6. John Himmelman (2001) Children's Press An Earthworm's Life (Nature Up Close)
7. Prabhashekhar, Martin Hardingham (1995) Sericulture and silk production intermediate technology publications.
8. Cochran, W.G. (1997) Sampling Techniques, Wiley Eastern Ltd., New Delhi,
9. Meyer P. L(1970) Introduction, probability and statistical Application. Addison Wesley. .
10. Waiker and Lev: (1958). Elementary Statistical methods.,

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Board of studies in Biotechnology