Rayat Shikshan Sanstha's

SADGURU GADAGE MAHARAJ COLLEGE, KARAD.

(An Autonomous)

Accredited By NAAC with 'A^{+} (3.63 CGPA)' Grade

ISO- 9001-2015 Certified

Affiliated to Shivaji University, Kolhapur

Bachelor of Science (B. Sc.)

DEPARTMENT OF BIOTECHNOLOGY (ENTIRE)

Under the Faculty of Science and Technology
Choice Based Credit System (CBCS)

Regulations in accordance with **National Education Policy-2020**
to be implemented from Academic Year 2023-24

Syllabus For

B. Sc. Part – I (Biotechnology-Entire)

SEMESTER I & II

(Syllabus to be implemented from June 2023)

Rayat Shikshan Sanstha's
SADGURU GADAGE MAHARAJ COLLEGE, KARAD.
(An Autonomous College)
Regulations and Guidelines as per NEP 2020

Choice Based Credit System (CBCS) Syllabus for Bachelor of Science Part- I (Biotechnology- Entire)

1. Title: B.Sc. I Biotechnology (Entire)

2. Year of Implementation: 2023-24

3. Preamble:

Biotechnology is a field that combines basics of life science (biology) and technology. It has been one of the most fast-growing fields in last few decades. Biotechnology can be classified in four categories – green biotechnology (agricultural biotechnology), white biotechnology (industrial biotechnology), red biotechnology (medical biotechnology) and blue biotechnology (marine biotechnology). With development of advanced techniques such gene editing and gene manipulations biotechnology can also be divided as conventional biotechnology and advanced biotechnology/modern biotechnology. Conventional Biotechnology involves usage of natural resources such as plants, animals, microorganisms at optimum conditions to obtain higher yields of commercially important products of biological origin. In Modern Biotechnology genetic engineering approach is used to obtain high yielding recombinants to obtain commercially important products of biological origin. Stem cell research, Tissue engineering, Site specific drug delivery techniques are examples of Modern Biotechnology. The realm of Biotechnology involves understanding and application of basic sciences such as Physics, Chemistry and Mathematics as well as applied sciences such as Microbiology, Food technology, Bioinformatics, Recombinant DNA technology. State of the art technologies such as Artificial Intelligence and Machine learning are now being explored for their application in Biotechnology. Biotechnology is one such course that provides an educational environment where STEM- Science Technology Engineering and Mathematics are not only taught but practiced together. India has recently implemented its NEP2020- New educational policy. One of the major objectives of NEP is to bridge gaps in education and industry by empowering the students by providing them with training in skill-based courses. To provide such training there is a need to develop courses/syllabi with subjects which provide knowledge about the current and most relevant technologies. Along with the training of basics of core subject the students need to be

exposed to subjects such as entrepreneurship and intellectual property rights to inculcate interest in product development. The proposed credit-based curriculum ensures the requirement of academia and industry. Theory supplemented with extensive practical skill sets will help a graduate student to avail the opportunities in the applied fields (research, industry or institutions) without any additional training. Benefit of society and sustainable development. The policy mainly focuses on flexibility in education, multidisciplinary approach, creativity, developing critical thinking and critical thinking. Keeping these mottos in mind, the new syllabi has been designed which will also help students to develop skill sets required when Biotechnology is chosen as a career.

4. Programme Outcomes:

- To introduce different biological systems (Plants, Animals and Microorganisms)
- To learn basic concepts of allied subjects (Biotechniques, Biostatistics, Instrumentation, Computers for better understanding biological systems.)
- To impart knowledge in basic and applied aspects of life sciences.
- To make students aware of various applications of Biotechnology and develop their practical skills.
- To inculcate scientific, social and environmental awareness in students.

5. General Objectives:

- Enrichment of basic knowledge in areas of Biotechnology
- Reconstruction and redesigning of the courses to suite local needs.
- To develop aptitude of students in the field of research.
- More emphasis on applied aspects of biotechnology.

Structure of the Course: B.Sc. I (Entire Biotechnology)

Level	Year	Sem.	Course Type	Course Code	Course Title	Credits	No. of Lectures / Practicals
4.5	I	Sem. I	Major	N-MJT-BT-101	Biotechniques and Instrumentation	2T	30
			Major	N-MJT-BT-102	Biomolecules	2T	30
			Major	N-MJP-BT-103	Laboratory Exercises in Biotechniques and Instrumentation & Biomolecules	2P	15
			Minor	N-MNT-BT-110	Microbiology: Introduction to Microbiology	2T	30
			Minor	N-MNT-BT-111	Microbiology: Microbial diversity	2T	30
			Minor	N-MNP-BT-112	Laboratory Exercises in Introduction to Micro. and Microbial diversity	2P	15
			OE /GE	N-OET-BT-120	Plant Science	2T	30
			OE /GE	N-OET-BT-121	Computer Basics	2T	30
			OE /GE	N-OEP-BT-122	Laboratory Exercises in Plant Science & Computer Basics	2P	15
			AEC	N-AEC-BT-130	English - I	2T	30
			IKS	N-IKS-BT-140	Biotechnology in human welfare	2T	30

		Sem-II	Major	N-MJT-BT-201	Basics in Cell biology	2T	30
			Major	N-MJT-BT-202	Proteins & Enzymes	2T	30
			Major	N-MJP-BT-203	Laboratory Exercises in Basics in Cell biology & Proteins & Enzymes	2P	15
			Minor	N-MNT-BT-210	Microbiology: Microbial Physiology	2T	30
			Minor	N-MNT-BT-211	Microbiology: Medical Microbiology	2T	30
			Minor	N-MNP-BT-212	Laboratory Exercises in Microbial Physiology & Medical microbiology	2P	15
			OE /GE	N-OET-BT-220	Animal Science	2T	30
			OE /GE	N-OET-BT-221	Basics in Biostatistics	2T	30
			OE /GE	N-OEP-BT-222	Laboratory Exercises in Animal Science and Basics in Biostatistics	2P	15
			AEC	N-AEC-BT-230	English-II	2T	30
			SEC	N-SCT-BT-250	Basics in Bioinformatics	2T	30

B.Sc. Biotechnology Semester I

Course Code and title: N-MJT-BT-101 Biotechniques and Instrumentation

Credits: 02 **Total Lectures: 30**

Course Objective:

- To study working and instrumentation of instruments.
- To learn applicability of instruments in biology
- To understand concepts of bioinstrumentation
- To study use and applications of biophysics
- To study different stains and staining techniques in biology.

Topic No.		Lectures
	Credit – I	
1.	**Basic Laboratory Instruments:** Principle, working and application of PH meter, Conductometer, Colorimeter, Refractometer, Autoclave, Laminar Air Flow, Incubator, Water bath, Centrifuge - types of Centrifugation (Desktop, High speed and Ultracentrifuge, Differential and Density gradient)	7
2.	**Chromatography:** Introduction, Theory, Principle and applications of paper chromatography and Thin layer chromatography. **Electrophoresis-** Introduction, Principle, theory and applications of paper electrophoresis, Agarose gel Electrophoresis, PAGE.	8
	Credit -II	
3.	**Microscopy** General principles of microscopy- Image formation, magnification, numerical aperture (Uses of oil immersion objective), resolving power of microscope and working distance. Ray diagram, special features, applications and comparative study of compound microscope and Electron Microscope (Scanning and Transmission Electron Microscope).	7
4.	**UV-Visible Spectroscopy** Introduction of spectroscopy, properties of electromagnetic radiation, Electromagnetic spectrum, Electronic Transitions and designation of UV-bands. General applications, spectrum, isolated double bonds, conjugated dienes, carbonyl compounds, aromatics. Analytical uses. Lambert-Beer's law Principle, Instrumentation with respect to colorimeter and single beam spectrophotometer. Principle, Instrumentation, Applications of UV and Visible spectroscopy.	8

Course outcome:-

- Student should be able to understand basic concepts of Instruments and its Application
- To be able to apply this knowledge in the laboratory
- Student should able to handle instruments during project.
- Student should understand principle behind the instruments.

- Student should understand different staining methods in biological world.

References:-

i) Biophysical Chemistry by Nath and Upadhya.
ii) Practical biochemistry principles and techniques by Wilson and Walker.
iii) Instrumental methods of chemical analysis by Chatwal and Anand.
iv) Lab Manual in Biochemistry by J. Jayaraman.
v) Chromatography: Concepts and Contrasts- 1988 James Miller, John Wiley and Sons, Inc.
vi) Analytical Biochemistry by Holme.
vii) Spectroscopy by B.P. Straughan and S. Walker
viii) Introduction to HPLC by R.J. Hamilton and P.A. Sewell
ix) General microbiology-Stanier

B.Sc. Biotechnology Semester I

Course Code and title: N-MJT-BT-102 Biomolecules

Credits: 02 **Total Lectures: 30**

Course Objectives:

- To make students aware of fundamentals of Biochemistry.
- To make the student aware of basics of chemical science in relevance to biological systems.

Topic No.		Lectures
	Credit – I	
1.	**Origin of life:** Basic concept, Theory of spontaneous generation, A.I. Oparin concept, Urey Miller's experiment. Concept of Biomolecules- In general about Carbohydrate, protein, lipid just definition with at least one example. PH, PK value definition, H-H Equation, Biological buffer systems e.g. Phosphate, Bicarbonate, Hemoglobin buffer system, Protein buffer system.	7
2.	**Nucleic acids:** Nucleosides, nucleotides, polynucleotide, DNA and its different forms with properties. (A, B, C, D and Z). RNA and its types- m-RNA, t-RNA, r-RNA, hnRNA, snRNA, sno RNA, Forces Stabilizing nucleic acid structure.	8
	Credit -II	
3.	**Carbohydrates:** Biological importance of carbohydrates, Classification. Monosaccharide- Glyceraldehydes, simple aldoses & ketoses, conformation of D-glucose, reactions of monosaccharide (Oxidation, reduction, osazone), glycosidic bond. Oligosaccharides- disaccharides (Sucrose, maltose, lactose) Polysaccharides- homo polysaccharides (Starch, glycogen, Cellulose.)	7
4.	**Lipids :** Fatty acids Physical properties- state, color, odour, melting point, solubility, specific gravity, geometric isomerism, insulation, emulsification, surface tension. Chemical properties- sap value, acid value, iodine no., rancidity; Classification of Lipids- A) Simple lipid- Triacylglycerol & waxes. B)Compound lipid- 1) Phospholipid e.g- Phosphotidyl choline, ethanolamine Glyserolipid, 2) Sphingolipids- Sphingomycelin, cerebrosides, gangliosides; C) Derived lipid- Cholestrol lipoprotein- LDL, VLDL, HDL, Chylomicrons. Liposome.	8

Course Outcomes: Student should understand**:**

- Basic concepts and experiments about origin of life,
- Concept of buffer and its importance in biological system,
- Fundamentals of biochemistry i.e. Nucleic acid, carbohydrates and lipids.

References:-

1) Biochemistry – Nelson & Cox
2) Biochemistry - Stryer
3) Enzymes - Trevor Palmer
4) Biochemistry - Voiet & Voiet
5) Biochemistry - J. L. Jain
6) Basic Biophysics- M. Daniel
7) Biochemistry - Powar and Chatwal
8) Protein Purification- Harris and Angel
9) Principles of Biochemistry - T. N. Pattabriraman.
10) Biochemistry 3rd Edition – Hames & Hopper.
11) General Biochemistry – J. H. Well.
12) Biochemistry – J. H. Ottaway & D. K. Apps
13) Biochemistry – Trchan 14) Text Book of Biochemistry- R. A. Joshi.
15) Biochemistry – U. Satyanarayanan
16) Biochemistry a Functional Approach – Robert W McGilvery & Goldstein
17) Text Book of Biochemistry – A.V. S. S. Rama Rao
18) Clinical Biochemistry –Praful B. Godkar.

B.Sc. Biotechnology Semester I

Course Code and title: N-MJP-BT-103 (Practical) Laboratory Exercises in Biotechniques and Instrumentation & Biomolecules

Credits: 02 **Total Practicals: 15**

Sr. No.	Name of the Experiment	Number of practical
1.	Use, care and study of compound microscopy.	01
2.	Demonstration (Principle, working, construction) of Colorimeter and Determination of λ max of a dye solution.	01
3.	Demonstration (Principle, working, construction) of PH meter and Conductivity meter.	01
4.	Demonstration (Principle, working, construction) of Autoclave and Centrifuge.	01
5.	Demonstration (Principle, working, construction) of Hot air oven and microbial Incubator.	01
6.	Demonstration (Principle, working, construction) of Laminar Air Flow and Refractometer.	01
7.	Spectrophotometric determination of nucleic acid purity and concentration.	01
8.	Study of UV absorption spectra of macromolecules. (protein and nucleic acid)	01
9.	Separation and identification of plant pigments using Ascending paper Chromatography.	01
10.	Separation and identification of amino acids using TLC.	01
11.	Separation of amino acid by Paper Electrophoresis.	01
12.	General test for carbohydrates and detection of unknown Carbohydrate from mixture. (Glucose, fructose, maltose, sucrose, xylose and starch)	01
13.	Estimation of reducing sugar from apple juice by Benedict's method.	01
14.	Isolation and characterization of starch from potatoes.	01
15.	Estimation of Glucose by 3, 5 Dinitro salicylic acid method.	01
16.	Estimation of Cholesterol by iron reagent.	01
17.	Estimation of DNA by diphenylamine method	01
18.	Estimation of RNA by orcinol method	01

B.Sc. Biotechnology Semester I

Course Code and title: N-MNT-BT-110 Microbiology: Introduction to Microbiology

Credits: 02 **Total Lectures: 30**

Course Objectives:

- To learn the history of microbiology
- To define the science of microbiology and describe some of the general principles used in the nomenclature of microorganisms
- To learn about different stains and staining procedures.
- To understand the ultra structure of microbial cells.

Topic No.		Lectures
	Credit – I	
1.	**History of microbiology** -Spontaneous generation vs. biogenesis. -Contributions of : a) Antony von Leeuwenhoek b) Edward Jenner c) Louis Pasteur d) Robert Koch e) Ivanowsky f) Joseph Lister g)Alexander Fleming i) Martinus W. Beijerinck j) Sergei N. Winogradsky. -Beneficial and harmful activities of microorganisms. -Classification of microorganisms –Whittaker's five kingdom and Carl Woese's three kingdom classification systems	7
2.	**General Principles of bacterial nomenclature** -Taxonomic ranks a. Common or Vernacular name b. Scientific or International name -An overview of Scope of Microbiology a) Air b) Water c) Sewage d) Soil e) Dairy f) Food g) Medical h) Industrial i) Biotechnology j) Geomicrobiology	8
	Credit -II	
3.	**Microbiological staining** -Definition and Classification of microbiological stains a) Acidic, Basic and Neutral -Principles, Procedure, Mechanism and application of microbiological staining procedures -a) Simple staining b) Negative staining c) Differential staining i) Gram staining ii) Acid fast staining d) Special staining methods i) Cell wall (Chance's method) ii) Capsule (Maneval's method) iii) Volutin granule (Albert's method	7
4.	**Ultra structure of Microbial cell** -Variant components and invariant components. Cell wall of bacteria and fungi, Gram positive cell wall, Gram negative cell wall, Cell wall of fungi and yeasts. -Morphology,Ultrastructure and chemical composition of bacteria,	8

	Actinomycetes, Spirochetes, Rickettsiae, Mycoplasma, Chlamydiae. Economic importance of algae and fungi. SCP	

Course Outcomes: After completing the credits students should gain knowledge about:

- History of Microbiology,
- Beneficial and harmful microorganisms.
- Characteristics and classification of microorganisms.
- General principles of nomenclature.
- Ultra structure of microbial cell.
- The Principles and procedures of staining microorganisms

References:

1. Microbiology by Pelczar, M. J. Jr., Chan E.C.S., Krieq, N.R. 5th edition,1986 (McGraw Hills Publication).

2. Fundamental Principles of bacteriology by A. J. Salle, Tata McGraw Hill.

3. Fundamentals of Microbiology by Frobisher, Hindsdill, Crabtree, Good Heart, W.B. Saunders Company, 7th edition

4. A textbook of Microbiology by Ananthnarayan – Orient Longman, Bombay

5. General Microbiology by Stanier R. Y. Vth Edition, McMilan, London.

B.Sc. Biotechnology Semester I

Course Code and title: N-MNT-BT-111 Microbiology: Microbial Diversity

Credits: 02 **Total Lectures: 30**

Course Objectives:

- To learn different types and characteristics of microorganisms.
- To study the ultra structure of prokaryotic and Eukaryotic cell.
- To study different control methods of microorganisms.
- To study the nutritional requirements of microorganisms.
- To introduce the culture media and cultivation of microorganisms.

Topic No.		Lectures
	Credit – I	
1.	**Introduction to types of Microorganisms** -General characteristics of different groups a) Acellular microorganisms-Viruses, Viroids, Prions b) Cellular microorganisms- Bacteria, Algae, Fungi and Protozoa; with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance. -Ultra structure of Prokaryotic and eukaryotic cell. Difference between prokaryotic and eukaryotic microorganisms.	8
2.	**Nutritional requirements of microorganisms:** -Nutritional requirement a) Water b) Micronutrients c) Macronutrients d) Carbon e) Energy source f) Oxygen and g) Hydrogen h) Nitrogen i) Sulphur and Phosphorous and growth factors-auxotroph, prototroph and fastidious organisms.	7
	Credit -II	
3.	**Nutritional types of microorganism based on carbon and energy sources.** 1. Nutritional types of microorganisms a. Autotrophs b. Heterotrophs c. Phototrophs d. Chemotrophs e. Photoautotrophs f. Chemoautorphos g. Phtoheterotrophs h. Chemoheterotrophs. 2. Types of Culture media: a) components of media b) natural and synthetic media c) chemically defined media d) complex media e) selective, differential f) enriched and enrichment media. 3. Cultivation of microorganisms: a) Use of culture media for cultivation b) Conditions required for growth of the microorganisms.	7
4.	**Control of Microorganisms** 1. Definitions of a) Sterilization b) Disinfection c) Antiseptic d) Germicide e) Microbiostasis, f) Antisepsis g) Sanitization.	8

	2. Physical agents for control of microorganisms a) Temperature i) Dry heat ii) Moist heat, b) Desiccation c) Osmotic pressure d) Radiations i) U.V. Ray ii) Gamma rays, e) Filtration i) Asbestos and Membrane filter 3. Chemical Agents for control of microorganisms: Mode of action, application and advantages a) Phenol and Phenolic compounds b) Alcohols (Ethyl alcohol) c) Halogen compounds (chlorine and iodine) d) Heavy metals (Cu and Hg) e) Gaseous Agents – Ethylene oxide, Beta-propiolactone and	

Course Outcomes: After completing the credits students should gain knowledge about:

- Basic concepts of microbial nutrition, growth and control
- Basic techniques of pure culture isolation and preservation of microbes.
- General characteristics of microorganisms.
- Control methods of microbes.
- Basic terms in microbial diversity.

References:

1. General Microbiology Vol. I and II by Powar and Daginawala, Himalaya Publications.

2. General Microbiology by Robert F. Boyd (1984), Times, Mirror/Mosby College.

3. Microbiology by Prescott, Herley and Klein, IInd edition.

4. Bacteriological Techniques by F. K. Baker

5. Introduction to Microbial Techniques by Gunasekaran.

6. Elementary Microbiology Vol. I by Dr. H.A.Modi , Akta Prakashan, Nadiad, Gujrat.

B.Sc. Biotechnology Semester I

Course Code and title: N-MNP-BT-112 (Practical) Laboratory Exercises in Introduction to Microbiology & Microbial diversity

Credits: 02 **Total Practicals: 15**

Sr. No.	Name of the Experiment	Number of practical
1.	**Biosafety precautions** a. Aseptic techniques: i)Table disinfection ii) hand wash, iii) use of aprons b. Proper disposal of used material c. Cleaning and sterilization of glasswares	01
2.	**Microbiology Good Laboratory Practices** a. Preparations of- stains (0.5% basic fuchsin, 0.5% crystal violet), b. Reagents (phosphate buffer of pH 7, 1 N and 1M solutions of HCL and NaOH), c. physiological saline.	01
3.	**Preparation of liquid and solid culture media and their sterilization.** a. Preparation of - agar plates, buts and slants.	01
4.	**Preparation of Simple media (Bacteriological)** a. Peptone water. b Nutrient broth. c. Nutrient agar.	01
5.	**Preparation of Specific media (Bacteriological)** a. Glucose yeast extract agar b. MacConkey's agar.	01
6.	**Preparation of Fungal culture media** a. Sabouraud's agar b. PDA	01
7.	**Isolation of bacteria by** a. Streak plate technique b. Pour plate technique c. Spread plate technique.	02
8.	**Microscopic observation of bacteria and its parts:** a. Monochrome staining b. Negative staining c. Gram's staining d. Motility by Hanging-drop method. e. Cell wall staining (Chance's method) f. Capsule staining (Manuval's method) g. Volutine granule staining (Albert' s method) h. Endospore staining	05

References:

1. Stains and Staining procedures by Desai and Desai.

2. Introduction to Practical Biochemistry by D. Plummer, J Wiley and Sons.

3. Bacteriological techniques by F. J. Baker.

4. Introduction to Microbial techniques by Gunasekaran.

5. Biochemical methods by Sadasivam and D. Manickam.

6. Laboratory methods in Biochemistry by J. Jayaraman.

7. Experimental Microbiology by Patel & Patel

B.Sc. Biotechnology Semester I

Course Code and title: N-OET-BT-120 Plant Science

Credits: 02 **Total Lectures: 30**

Course Objectives:

- To understand diversity of plant kingdom.
- To understand morphology and anatomy of plants.
- To study basic knowledge of Developmental and reproduction plant biology.

Topic No.		Lectures
	Credit – I	
1.	**Plant Diversity** Outline of General Classification of Plant Kingdom. General characters and economic importance of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperms, Angiosperms. **Taxonomy of Angiosperms** 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.	8
2.	**Plant Development:** Major phases of plant development Vegetative development: Meristem- Organization of shoot apical meristem, Organization of root apical meristem, shoot development, root development, leaf development. Reproductive development: Shift from vegetative to reproductive phase-juvenility, floral signals and floral meristem identity- ABC model. **Plant Anatomy** Primary structure of monocotyledon and dicotyledon root, stem and leaf.	7
	Credit -II	
3.	**Sexual Reproduction in Angiosperms:-** Gametogenesis and Fertilization in plants: Gametogenesis in Plants, Development of male and female Gametophyte. Process of fertilization in Angiosperm, post fertilization changes. Embryogenesis: Structure and development of embryo in Monocotyledons Structure and development of embryo in dicotyledons. Endosperm: Development of endosperm, Types of endosperm-Nuclear, Helobial and Cellular.	7
4.	**Apomixis:** Introduction, Causes of apomixes and Types: Gametophytic and Sporophytic, Significance of apomixes. **Polyembryony:** Introduction, Types of polyembryony- True polyembryony (Cleavage and Adventive), False polyembryony. Causes of Polyembryony, Significance of Polyembryony. **Parthenocarpy**- Definition and significance. **Self incompatibility:** Definition, types and its genetic Control **Seed**: Definition, Formation, structure of Monocot and Dicot seed Seed germination: Seed germination types, Factors affecting Seed germination. Seed Dormancy: Definition, Causes of dormancy, methods of breaking of Seed dormancy, significance.	8

Course outcomes:-

Students should be able to understand:

- The terminology used in Anatomy.
- Diversity in plant kingdom and need of classification.
- The Basic knowledge of Angiosperms .
- The basic and advanced knowledge of developmental plant biology.

References:

1. Devlin R.M. Fundamentals of plant physiology (MacMillan)
2. Malik C.P. Plant physiology, Kalyani publishers
3. Dube H.C. Text of fungi, bacteria and viruses.
4. Bold H.C. The Plant kingdom, Prentice - Hall India
5. Chopra G.L. i. Class book of algae, ii. Class book of fungi
6. Dutta A.C. A Class book of botany, Oxford University Press
7. Kumar H.D. Biodiversity and sustainable development (Oxford & IBH)
8. Mukherji H. Plant groups (New central book depot)
9. Parihar N.S. An Introduction to embryophyta (Central book depot)
10. Vasishtha P.C. Botany for degree students-Gymnosperms
11. Naik V.N. Taxonomy of angiosperms
12. Lawrence G.H. Taxonomy of flowering plants
13. Chopra G.L. Angiosperms (Systematic and life cycle)
14. Shivarajan V.V. Introduction to principles of taxonomy.
15. Pandey B.P. Text book of angiosperms
16. Eames A.J. and An introduction of plant anatomy, Mac Daniels L.H.
17. Esau K. Anatomy of seed plants
18. Esau K. Plant anatomy
19. Fahn A. Plant anatomy
20. Mathur R.C. Systematic botany

B.Sc. Biotechnology Semester I

Course Code and title: N-OET-BT-121 Computer Basics

Credits: 02 **Total Lectures: 30**

Course Objectives:

- To study the computer basics and operating system
- To understand the Office operations like Microsoft Word, Microsoft Excel and power point presentation
- To study the Database management and their importance

Topic No.		Lectures
	Credit – I	
1.	**Computer basics & Operating System:** **Computer basics:** Definition, Block Dig. (I/O/Secondary storage), Applications, Generations, Types of computer, functions of a computer Input and output device, storage devise, Numbering system (binary to decimal & decimal to binary), Personal Computers- PC and its main components, hardware configuration, Computer Memory – Concept, Internal and External Memory, Factors influencing on PC performance. Computer networks – LAN, WAN, MAN, Internet and Intranet Computer viruses: An overview of Computer viruses, What is a virus? Virus symptoms, How do they get transmitted? What are the dangers? General Precautions	7
2.	**Operating System:** Definition, functions, process management, multiprogramming, multitasking, multiprocessing, time sharing, memory management, uniprogramming, memory model, multiprogramming, memory model, virtual memory, security, some popular O.S., Ms-DOS, Microsoft Windows, Unix.	8
	Credit -II	
3.	**Data processing & presentation**: Word Processing : Introduction to MS Office components, Introduction and working with MS Word , Word basic commands, Formatting- text and documents, sorting and tables, introduction to mail-merge. Spread Sheets: Working with EXCEL- formatting, functions, chart features, Working with graphics in Excel, Excel functions, table operations.	7
4.	Presentation with Power-Point: Power-point basics, creating presentation, working with graphics, show time, sound effects and animation effects. Internet, E-mail, Discussion groups, Search tools, Web utilities, concept of E commerce, Application of E commerce. Database Management System:Need of database, data models- Hierarchical, Network, Relational, Object Oriented, SQL Commands DBMS-DDL, DML, DCL.	8

Course Outcomes:

- Student should be able to understand basics of computer & Operating System.
- Student should get Knowledge of Data processing and presentation.
- Student should be able to understand database management.

References :-

1) Computer Fundamentals by P. K. Sinha
2) C Application programs and Projects by Pramod Vasambekar
3) Use of Computer from Vision Publication
4) Let Us C by Kanetkar
5) Ansi C by Balgurusami

B.Sc. Biotechnology Semester I

Course Code and title: N-OEP-BT-122 Laboratory Exercises in Plant Science & Computer Basics

Credits: 02 **Total Lectures: 30**

Sr. No.	Name of the Experiment	Number of practical
1.	Study of Algae (*Nostoc*, *Sargassum*)	01
2.	Study of Bryophyte (Riccia / Anthoceros) and Pteridophyte (Selaginella)	01
3.	Study of Gymnosperms (Pinus) and Angiosperms (Sunflower,Maize)	01
4.	Study of apical meristem (Stem and root)	01
5.	Study of primary structure of Dicot root and stem	01
6.	Study of primary structure of monocot root and stem.	01
7.	Study of pollen germination.	01
8.	Detection of pollen fertility by staining technique.	01
9.	Study of dicotyledon and monocotyledon embryo (by permanent slide or photograph).	
10.	Dissection of embryo / endosperm from developing seeds.	01
11.	Study of breaking of Seed dormancy.	01
12.	Determination of seed viability.	
13.	Study tour-field visit to study Plant diversity.	01
13.	Searching for a web site / application / text documents viewing and downloading. .	01
14.	Create an E-mail account, Retrieving messages from inbox, replying, attaching files, filtering and forwarding.	01
15.	Preparing Resume using MS word formatting commands.	01
16.	Preparing a newsletter: To prepare a newsletter with borders, two columns text, header and footer and inserting a graphic image and page layout.	01
17.	Printing envelopes and mail merge. To print envelopes with from addresses and to addresses, To use mail merge facility for sending	01

	a circular letter to many persons, To use mail merge facility for printing mailing labels.	
18.	Create employee Payment sheet using Excel.	01
19.	Prepare a graph using biological data related to biological experiment in MS-Excel.	01
21.	Creating a new Presentation based on a template – using Auto content wizard, design template and Plain blank presentation.	01
22.	Creating a Presentation with Slide Transition – Automatic and Manual with different effects.	01
23.	Creating a Presentation applying Custom Animation effects – Applying multiple effects to the same object and changing to a different effect and removing effects.	01

B.Sc. Biotechnology Semester I

Course Code and title: N-IKS-BT- 140 Biotechnology in Human Welfare

Credits: 02 **Total Lectures: 30**

Course Objectives:

- To make students aware of Biotechnology
- To introduce different areas in Biotechnology
- To introduce students with the role of Biotechnology in Human welfare

Topic No.		Lectures
	Credit – I	
1.	**Introduction to Biotechnology:** Introduction, Milestones in the History of Biotechnology, Traditional and Modern Biotechnology, Areas of Biotechnology (Red, Green, White, Blue), commercial potential of biotechnology, Biotechnology in India, Renounced Biotechnology institutes in India (IIT, IISER, NCL, NCCS, ARI, NIV, CCMB, CDFD etc.) **Agencies in India** : DBT, DDFSL, DFS, FSL, RFSL, MFSL, CFSL, GEQD, NFB, NCRB, CID, CBI, IB, RAW, NIA etc.	8
2.	**Agricultural Biotechnology:** Introduction, Plant Tissue culture, Genetically modified crops, GMOs in Agriculture, Plant Based Vaccines **Biofertilizer -** Definition, types with examples. **Biopesticide –** Definition, types with examples.	7
	Credit -II	
3.	**Health Biotechnology:** Pandemic diseases- definition, examples with causal organism, study of current pandemic COVID-19. Role of Biotechnology in pandemics. Gene Therapy- concept, advantages and disadvantages. Vaccines- concept, types with examples. Disease diagnosis, detection of genetic diseases, disease treatment, stem cell technology.	8
4.	**Food Biotechnology**: Biotechnological applications in enhancement of Food Quality, food safety, Food Products, Microbial role in food products Yeast, Bacterial and other Microorganisms based process and products, Modern Biotechnological Regulatory Aspects in Food Industries Biotechnology and Food - Social Appraisal	7

Course Outcomes:

Students should be able to understand-

- What is biotechnology?
- About the biotechnology institute in India
- Different areas in biotechnology
- Role of Biotechnology in Human welfare

References:

1. Biotechnology – U. Satyanarayana
2. Medical biotechnology – S. N. Jogdand
3. Advances in Biotechnology- S.N.Jogadand
4. A textbook of Biotechnology - R. C. Dubey
5. Pharmaceutical Biotechnology – S. P. Vyas ,V. K. Dixit
6. Biotechnology – B. D. Singh
7. Fundamentals of agriculture biotechnology – S. S. Purohit
8. Agriculture application of Microbiology- Neeelima Rajvaidya.
9. Food Biotechnology- Varun Mehta.

B.Sc. Biotechnology Semester II

Course Code and title: N-MJT-BT-201 Basics in Cell Biology

Credits: 02 **Total Lectures: 30**

- **Course Objectives :-**
- To make the student aware of basic concepts of Cell, Cell organelles.
- To make the student aware of basic concepts cytoskeleton
- To make the student aware of basics of Cell membrane and membrane transport.

Topic No.		Lectures
	Credit – I	
1.	**Cell structure** Discovery of Cell, Cell theory -Definition, discovery, three assumptions of cell theory, exceptions, organismal theory , protoplasm theory Organization of Prokaryotic cell, Organization of Eukaryotic cell (plant and animal cell) Ultra structure & functions of cell organelles Mitochondria, Chloroplast, E.R., Golgi apparatus, Lysosome, Peroxisome, Ribosomes.	7
2.	**Nucleus** Introduction, morphology, occurrence, shape, size, number, position Ultra structure of nucleus- Nuclear membrane, nucleoplasm, nucleopore complex, nucleolus. Chromosome structure- introduction, General features of Prokaryotic chromosome. General features of Eukaryotic chromosome- Chromosome number, size, Chromosomal nomenclature & General structure.	8
	Credit -II	
3.	**Cytoskeletal assembly** Introduction, Cytoskeletal elements. Microtubules- occurrence, structure, chemical composition, Microtubule associated proteins, HMW proteins, DAU proteins, MTOC, assembly and disassembly of microtubules, functions. Microfilaments- occurrence, structure, chemical composition, functions. Intermediate filaments- occurrence, structure, chemical composition, types of IF, functions. Organization of cilia and flagella.	8
4.	**Cell membrane & Membrane transport** Cell membrane– components. Molecular models of cell membrane- Unit membrane model, Protein crystal model, fluid mosaic model, Types of membrane transport Passive transport- simple diffusion, facilitated diffusion, osmosis. Active transport- primary and secondary transport, Sodium pump, Na^+-K^+ ATPase pump, Calcium channel. Bulk transport- endocytosis and exocytosis	7

Course Outcomes:

- After completing the credits students should gain knowledge about:
- Basic concepts of Cell and sub cellular structures
- Basic Concept of Cytoskeletal assembly.
- Basic Concept of Cell membrane and membrane transport.

References-

1) Molecular biology of cell-Albert
2) Molecular biology & cell biology – Loddish etal
3) Cell biology –De Robertis
4) Cell biology-Genetics, molecular biology-P.S. Warma & Agarwal
5) Genes Lewin
6) Cell biology –Geral karp
7) Practical biochemistry – Keith, Wilson and Walker
8) Cell Biology- C.B.Pawar

B.Sc. Biotechnology Semester II

Course Code and title: N-MJT-BT-202 Proteins and Enzymes

Credits: 02 **Total Lectures: 30**

Course Objectives:

- To make the student aware of basic concepts of Amino acids, proteins.
- To make the student aware of basics of chemical science in relevance to biological systems.

Topic No.		Lectures
	Credit – I	
1.	**Amino acids** Structure and classification, proteinogenic and non - proteinogenic amino acids, Essential and non essential amino acids. physical, chemical and optical properties of amino acids Uses of amino acids Detection of amino acid– Ninhydrin, o-phthalaldehyde reaction	7
2.	**Proteins:** Definition, Formation and characteristics of peptide bond, structural level of proteins, primary structure (oxytocin), secondary structure (alpha helix and beta plates e.g. keratin) tertiary structure (myoglobin), quaternary structure (hemoglobin) Forces involved in stabilization of protein structure (covalent – disulphide, non-covalent- hydrogen bonds, wander wall, ionic, hydrophobic) Types of proteins on the basis of structure– fibrous, Globular and Membrane proteins.	8
	Credit -II	
3.	**Ramchandran plot**: Discovery, phi and psi angles, applications, (Importance of glycine and proline) **Protein purification:** Method of cell disruption (Blenders, grinding with abrasives, presses, enzymatic method, sonication); Salt participation- Salting in, salting out, organic solvent precipitation, dialysis, ultra filtration.	7
4.	**Enzymes:** 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, Line weaver-Burk plot, Eadie - Hofstee plot. Factor Affecting Enzyme Activity	8

Course Outcomes:

Student should be able to

- Understand fundamentals of biochemistry.
- Understand basics of chemical science in relevance to biological systems.

- Learn basic concepts of amino acids, proteins.
- Understand the basic methods to determine structure of protein and protein purification.
- Should be able to relate it to day today life.

References:-

1) Biochemistry – Nelson & Cox
2) Biochemistry - Stryer
3) Enzymes - Trevor Palmer

B.Sc. Biotechnology Semester II

Course Code and title: N-OEP-BT-122 Laboratory Exercises in Cell Biology & Proteins and Enzymes.

Credits: 02 **Total Lectures: 30**

Sr. No.	Name of the Experiment	Number of practical
1.	Measurement of size of cell structure/cell organelle/spore by micrometry	02
2.	Isolation of nucleus.	01
3.	Isolation of chloroplast.	01
4.	Isolation of giant chromosomes using Drosophila / Chironomous larvae.	01
5.	Use of dialysis to separate smaller molecules than larger molecules.	01
6.	Study the cell count and viability	01
7.	Preparation of permanent slide	01
8.	Quantitative estimation of α- amylase using starch as substrate	01
9.	General test for Amino acids and detection of unknown Amino acid from mixture. (Arginine, methionine, cystine, tyrosine, histidine, proline, tryptophan)	01
10.	Isolation and characterization of casein from milk.	01
11.	Estimation of reducing sugar from apple juice by Benedict's method	01
12.	Qualitative assay of α- amylase using starch as substrate.	01
13.	Estimation of amino acid by Ninhydrin method.	01
14.	Study the factors affecting on enzyme activity (pH/Temp)	01

B.Sc. Biotechnology Semester II

Course Code and title: N-MNT-BT- 210 Microbiology: Microbial Physiology

Credits: 02 **Total Lectures: 30**

Course Objectives:

- To know the basic concepts of bacterial cell organization.
- To understand the structure and functions of cytoplasmic components.
- To understand the different techniques of isolation of microbes from natural habitats.
- To learn morphological, cultural and biochemical characteristics of microbes.
- To learn about primary and secondary screening procedures.

Topic No.		Lectures
	Credit – I	
1.	**Bacterial Cell organization** 1. Cell size, shape and arrangement 2. Cytology of Bacteria : a) Cell-wall : Composition and detailed structure of Grampositive and Gram-negative bacterial cell walls b) Cell Membrane: Structure, function and chemical composition of bacterial cell membranes. c) Structure and functions of Capsule and slime layer. d) Structure and functions of Flagella e) Structure and functions of Pili.	7
2.	**Structure and functions of Cytoplasmic components** -Cytoplasmic Components: a) Ribosomes b) mesosomes c) inclusion bodiesd d) nucleoid e) chromosome f) plasmids g) Endospore: Structure, stages of sporulation. h) Reserve food materials – Nitrogenous and non nitrogenous	8
	Credit -II	
3.	**Isolation of Microorganisms from natural habitats.** 1. Pure culture techniques a) Streak plate b) Spread plate c) Pour Plate and micromanipulator 2. Isolation and cultivation of anaerobic organisms by using media components and by exclusion of air/O2 3. Preservation of microbial cultures – a) Sub-culturing b) overlaying cultures with mineral oils 8 c) storage at low temperature d) lyophilization.	7
4.	**Systematic study of pure cultures:** 1. Morphological characteristics. 2. Cultural characteristics – a) Colony characteristics on solid media, b) growth in liquid media c) growth on agar slants. 3. Biochemical Characteristics - a) Sugar fermentation b) Production of metabolites - H2S gas c) Production of enzymes - Amylase, Caseinase and Catalase.	8

Course outcomes:

Students should be able to

- Understand the principles of bacterial cell organization.
- Learn about methods of isolation of microbes from natural habitats.
- Learn morphological, cultural and biochemical characteristics of microbes.
- Understand the structure and functions of cytoplasmic components.

References:

1. Microbial Physiology and Metabolism, Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company Caldwell, D.R. (1995)., W.C. Brown Publications, Iowa, USA.

2. Principles of Biochemistry, Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993)., 2 nd• Edition, CBS Publishers and Distributors, New Delhi.

3. Biochemistry: A short course, 2nd ed Tymoczko JL, Berg JM and Stryer L (2012).,• W.H.Freeman.

4. Biochemistry 3rd edition Voet,D. and Voet J.G (2004), John Wiley and Sons• White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, New York.

B.Sc. Biotechnology Semester II

Course Code and title: N-MNT-BT- 211 Microbiology: Medical Microbiology

Credits: 02 **Total Lectures: 30**

Course Objectives:

- To know the basic concepts of medical microbiology.
- To understand concepts of normal flora and immunity.
- To understand bacterial, fungal, protozoal, viral diseases.
- To learn about different causal organisms of diseases.
- To study different types of immunity.

Topic No.		Lectures
	Credit – I	
1.	**Normal flora and immunity of human.** -Host pathogen interactions: infection, invasion, pathogen, pathogenicity, virulence and opportunistic infection. General account on nosocomial infection. -General principles of diagnostic microbiology- collection, transport and processing of clinical samples. -General methods of laboratory diagnosis - cultural, biochemical, serological and molecular methods	7
2.	**General account on microbial diseases** -Causal organism, pathogenesis, epidemiology, diagnosis, prevention and control. -Bacterial diseases - Tuberculosis and Typhoid -Fungal diseases – Candidiasis, Aspergillosis, Yeast -Protozoal diseases – Malaria, Filaria & Diseases spread by House Fly. -Viral Diseases - Hepatitis- A & C and AIDS.	8
	Credit -II	
3.	**Description and pathology of diseases** -Deseases caused by Aspergillus, Penicillium. -Diseases caused by hemoflagellates, Leishmania donavani, L.tropica, Trypanosoma gambiense. -Principles of chemotherapy, Antibacterial drugs – Penicillin, -Antifungaldrugs – Nystatin, Antiviralagents – Robovirin, Drug resistance in bacteria. -Interferon – Nomenclature, types & classification, Induction of interferon, types of Inducers.	7

4.	**Types of immunity** - Innate and acquired; active and passive; humoral and cell-mediated immunity. -Primary and secondary organs of immune system - Thymus, Bursa fabricus, bone marrow, spleen and lymph nodes. Cells of immune system. -Identiification and function of B and T lymphocytes, null cells, monocytes, macrophages, neutrophils, basophils and eosinophils.	8

Learning outcomes

Students should be able to

- Know the basic concepts of medical microbiology.
- Understand concepts of normal flora and immunity.
- Understand bacterial, fungal, protozoal, viral diseases.
- Learn about different causal organisms of diseases.
- Know different types of immunity.

References:

1. Textbook of Microbiology. 8th edition, Ananthanarayan R. and Paniker C.K.J. (2009), University Press Publication.

2. Medical Microbiology. 26th edition, Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013). Jawetz, Melnick and Adelberg's.. McGraw Hill Publication.

3. Roitt's Essential Immunology.11th edition, Delves P, Martin S, Burton D, Roitt IM. (2006). Wiley-Blackwell Scientific Publication, Oxford.

4. Kuby's Immunology. 6th edition, Goldsby RA, Kindt TJ, Osborne BA. (2007). W.H. Freeman and Company, New York.

5. Medical Microbiology. 26th edition, Jawetz, Melnick and Adelberg's. McGraw Hill. Microbiology. 4th edition. Elsevier Publication.

6. Prescott Harley and Klein's. Microbiology. 9th edition. Willey JM, Sherwood LM, and Woolverton CJ. (2013), McGraw Hill Higher Education

B.Sc. Biotechnology Semester II

Course Code and title: N-MNP-BT-212 Laboratory Exercises in Microbial Physiology & Medical microbiology

Credits: 02 **Total Lectures: 30**

Sr. No.	Name of the Experiment	Number of practical
1.	Microscopic observation of bacteria (Gram +ve bacilli and cocci, Gram - ve bacilli), Cyanobacteria, Algae and Fungi	01
2.	Isolation of pure cultures of bacteria by four quadrant streaking method a. Escherichia coli b. Bacillus species c. Staphylococcus aureus	01
3.	Identification of bacteria - using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, urease production and catalase tests a. E. coli b.Pseudomonas c.Staphylococcus d.Bacillus,	04
4.	Preservation of bacterial cultures by various techniques.	01
5.	Identify presence of microbes in hand nails, Teeth and skin (swabbing) by cultivation methods.	01
6.	Antibacterial sensitivity by Kirby-Bauer method	01
7.	Study symptoms of the diseases with the help of photographs: Anthrax, Polio, Herpes, chicken pox, HPV warts, Dermatomycoses (ring worms)	01
8.	Study of various stages of malarial parasite in RBCs using permanent mounts.	01
9.	Virtual demonstration of detection and recovery of fungi from clinical specimens.	01
10.	Virtual demonstration of detection and recovery of viruses from clinical specimens.	01
11.	Demonstration of fermenter	

References:

1. Textbook of Microbiology, 8th edition, Ananthanarayan R and Paniker CKJ (2009), Universities Press Private Ltd.

2. Medical Microbiology. 26th edition, Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's. McGraw Hill Publication.

3. Practical Medical Microbiology. 14th edition, Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and Mccartney, Elsevier.

4. Practicals and Viva in Medical Microbiology. 2nd edition, Randhawa, VS, Mehta G and Sharma KB (2009), Elsevier India Pvt Ltd.

5. Diagnostic Microbiology. 13th edition, Tille P (2013) Bailey's and Scott's, Mosby.

B.Sc. Biotechnology Semester II

Course Code and title: N-OET-BT- 220 Animal Science

Credits: 02 **Total Lectures: 30**

Course Objectives:

- To study the general concept of classification system of Animal kingdom.
- Application of animal science to study the Host and parasite relationship
- To study Animal tissue system.
- To study the Animal embryology and developmental Zoology

Topic No.		Lectures
	Credit – I	
1.	**Taxonomy** 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 Chordates:-Study of class Pisces, Amphibia, Reptilia & Mammalia – General characters with representative examples – Labeo, Frog, Cobra, Alligator, Fowl and Rat.	8
2.	**Parasitology:** Protozoan parasite- Plasmodium (Morphology, parasitic adaptations, Life cycle), Nematode parasite- Ascaris (Morphology, parasitic adaptations, Life cycle), Platyhelminthes parasite- Liver fluke (Morphology, parasitic adaptations Life cycle)	7
	Credit -II	
3.	**Histology of mammalian organs** i. Skin ii. Stomach iii. Intestine iv. Kidney v. Testis vi. Ovary vii. Uterus viii. Liver	8
4.	**Applied zoology** Vermiculture: - suitable species/types of earthworms, 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.	7

- **Course Outcomes:**
- Animal Science is a multidisciplinary course in learning Classification, parasitology animal physiology, anatomy , etc. along with fundamental principles of animal life.
- Students should be able to understand basic knowledge of classification of animal kingdom.
- Students should be able to understand basic concepts of host and parasite relationship which may useful to develop an interest in diagnosis and modern research in parasitology.
- Professional education in Animal Science prepares the students for career opportunities in the field of diagnostic parasitology .
- Students should be able to understand basic knowledge of appliedl zoology.

References-

1. Kotpal – Invertebrates
2. Kotpal – Chordates
3. Development Biology, 9th edition, (2010), Gilbert S.F. (Sinauer Associates, USA).
4. Foundations of Embryology – Patten
5. Cell and Developmental Biotechnology – Raj Narian D esikar

B.Sc. Biotechnology Semester II

Course Code and title: N-OET-BT- 221 Basics in Biostatistics

Credits: 02 **Total Lectures: 30**

Course Objectives:

- To understand data analysis of given samples.
- To understand concept of correlation and regression
- To make inference about a sample based on information we get from a population
- To understand concept of statistic and its use in biological field

Topic No.		Lectures
	Credit – I	
1.	**Introduction to statistics and collection of data**. Meaning of statistics, Scope of statistics in Biological and medical sciences Primary and Secondary data. Classification of data, Inclusive and Exclusive methods, Discrete and Continuous frequency Distribution. Cumulative frequencies Graphical representation: Histogram and give Curves.	8
2.	**Measures of central tendency and measures of dispersion** Concept of measures of central tendency Definitions of A.M., Median, Mode, Quartiles, Weighted mean, Examples on ungrouped and grouped data. Properties of A.M. (statement only) Methods of obtaining mean& quartiles graphically;- in place of mean mode is expected. Concept of measures of dispersion. Absolute and Relative measures of dispersion. Definitions of Range, Q.D, S.D and variance, coefficient of variation. Examples on grouped and ungrouped data.	7
	Credit -II	
3.	**Probability and Sampling** Definition of representative sample and Sample space, Outcomes, events, exhaustive events, Mutually exclusive events, Equally likely events, certain events impossible events. Definition of probability, Limits of probability. Probability of complementary event, Additive law of probability. Simple illustrative examples. Definition of conditional probability, Multiplicative law of probability, Independent events, Simple illustrative examples. Idea of population and sample. Simple Random Sampling and Stratified Random sampling. Advantages and disadvantages of both the methods.	8

4.	**Correlation and Regression** 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. Examples on ungrouped data. Concept of regression, Lines of regression, Regression coefficients and properties without proof. Examples on ungrouped data. Testing of hypothesis, Simple and composite hypothesis, Null and alternative hypothesis, types of errors, Critical region, Acceptance region, level of significance. Tests of significance: Chi square tests, t tests and F test	7

- **Course Outcomes:**
- Students should understand the basic fundamentals of the statistics.
- Students should be able to do the data analysis statistically
- Representation of the data in tabular format and graphical representation of the data.
- They should be able to draw the statistical inference based on the statistical tools and techniques.
- Students should understand the basic Probability and sampling

B.Sc. Biotechnology Semester II

Course Code and title: N-OEP-BT-222 Laboratory Exercises in Animal Science & Basics in Biostatistics

Credits: 02 **Total Lectures: 30**

Sr. No.	Name of the Experiment	Number of practical
1.	Classification and Identification of Non-chordates & Chordates. (One animal each) Non- chordates- Sycon, Hydra, Liver fluke/ Earthworm / Nereis, Cockroach, Pearl oyster/Pila, Starfish.	01
2.	Chordates- Lebeo, Frog, Cobra, Alligator, Fowl and Rat.	01
3.	Earthworm Dissection (Digestive system, Nervous system)	01
4.	Blood slide Preparation and Identification of Blood cells.	01
5.	Blood cell count i) Differential count of W. B. Cs. ii)Total count of W. B. Cs and R. B. Cs.	01
6.	Preparation of Haemin Crystals.	01
7.	Determination of Hemoglobin.	01
8.	Demonstration of – i) Bee Keeping- Study of bee-keeping Instruments. ii) Sericulture - Study of different Stages of life cycle.	01
9.	Study tour: Visit to Biodiversity spot, Sericulture, Apiculture, Vermicomposting	01
10.	Frequency distribution – Graphical, Histogram, give curve [less & greater than].	01
11.	Measures of central tendency - I (Grouped data)	01
12.	Measures of central tendency - II (Ungrouped data)	01
13.	Measures of Dispersion – I (Grouped data)	01
14.	Measures of Dispersion – I (Ungrouped data)	01
15.	Correlation	01
16.	Regression	01
17.	Testing of Hypothesis: Small Sample Tests (Chi-square Test)	01
18.	Testing of Hypothesis: Small Sample Tests (t- Test)	01
19.	Testing of Hypothesis: Small Sample Tests (F- Test)	01

B.Sc. Biotechnology Semester II

Course Code and title: N-SCT-BT- 250 Basics in Bioinformatics

Credits: 02 **Total Lectures: 30**

Course Objectives:

- To study the general concept of bioinformatics.
- To understand applications of bioinformatics in various field.
- To study the biological databases.
- To study the goal and scope of bioinformatics.

Topic No.		Lectures
	Credit – I (Theory)	
1.	**Introduction to Bioinformatics :** Definition, History, Goal and scope of Bioinformatics, internet and its role in bioinformatics. Algorithms Characteristics, Types of Algorithms, Application of Bioinformatics in various fields- Neurology, drug designing, biotechnology, molecular biology, medical microbiology, biomedical research.	8
2.	**Biological Databases :** Introduction. Importance, Types of Biological databases, Introduction to NCBI, Sequence and structure databases, Nucleic acid database (GenBank, EMBL and DDBJ), Protein database (PIR, MIPS, UniProt, TrEMBL, NRL- 3D, PRINTS, Pfam), specialized database, Genome database, Literature database (Pubmed and PMC). Database searching methods (Entrez).	7
	Credit –II (Practical)	
1.	Introduction and overview of NCBI.	1
2.	Querying the PUBMED Central database by using the ENTREZ search engine.	1
3.	Getting the amino acid sequences by exploring and querying the protein Sequence database.	1
4.	Getting the gene sequences by exploring and querying the protein Sequence database.	1
5.	Introduction to Genome Information resources:- Gene Bank, DDBJ etc.	1
6.	Introduction to Protein Information resources:- PIR, MIPS etc.	1

- **Course Outcomes:**
- Students should understand the basic concepts of bioinformatics.
- Student should able to extract biological data from database.
- They should be able to use different basic tools and techniques in bioinformatics.
- Students should understand the applications of bioinformatics.

References:

- An Introduction to Biochemistry- C. Stain Tsai, John Wiley and Sons.
- Bioinformatics- Methods and applications, Genomics, Proteomics and Drug discovery -0 Rastogi S. C. and Mendiratta and Rastogi P.
- Principles of Bioinformatics – P. Shanghumavel
- An Introduction to Bioinformatics – T. K. Atwood, Parry- Smith D. J.
- A Text Book of Bioinformatics – Sharma, Munjal, Shankar

Rayat Shikshan Sanstha's
SADGURU GADAGE MAHARAJ COLLEGE, KARAD.
(An Autonomous College)

EVALUATION PATTERN

B. Sc. BIOTECHNOLOGY (ENTIRE) 2023-2024

B. Sc. I SEMESTER– I (Duration – 6 Months)

Theory							**Practical**							
Course Type	**Course Code (Theory)**	**Course Title**	**Credits**	**SEE**	**CCE**	**Total Marks Theory Exam**	**Course Type**	**Course Code (Theory)**	**Course Title**	**Credits**	**Exam**	**Journal**	**Case study/ Tour report**	**Total Marks Practical Exam**
Major	N-MJT-BT-101	Biotechniques and Instrumentation	2	40	10	50	Major	N-MJP-BT-103	Laboratory Exercises in Bio techniques and Instrumentation & Biomolecules	2	40	05	05	50
Major	N-MJT-BT-102	Biomolecules	2	40	10	50	Minor	N-MNP-BT-112	Laboratory Exercises in Introduction to Micro. and Microbial diversity	2	40	05	05	50
Minor	N-MNT-BT-110	Microbiology: Introduction to Microbiology	2	40	10	50	OE /GE	N-OEP-BT-122	Laboratory Exercises in Plant Science & Computer Basics	2	40	05	05	50
Minor	N-MNT-BT-111	Microbiology: Microbial diversity	2	40	10	50								
OE /GE	N-OET-BT-120	Plant Science	2	40	10	50								
OE /GE	N-OET-BT-121	Computer Basics	2	40	10	50								
AEC	N-AEC-BT- 130	English for Communication- I	2	40	10	50								
IKS	N-IKS-BT- 140	Biotechnology in human welfare	2	40	10	50								
		Total	**16**			**400**				**06**				**150**
Total Marks for semester I (Theory + Practical) = 550														
Total Credits for Semester I = 22														

B. Sc. I SEMESTER– II (Duration – 6 Months)

Theory							Practical							
Course Type	**Course Code (Theory)**	**Course Title**	**Credits**	**SEE**	**CCE**	**Total Marks Theory Exam**	**Course Type**	**Course Code (Theory)**	**Course Title**	**Credits**	**Exam**	**Journal**	**Case study/ Tour report**	**Total Marks Practical Exam**
Major	N-MJT-BT-201	Basics in Cell biology	2	40	10	50	Major	N-MJP-BT-203	Laboratory Exercises in Basics in Cell biology & Proteins & Enzymes	2	40	05	05	50
Major	N-MJT-BT-202	Proteins & Enzymes	2	40	10	50	Minor	N-MNP-BT-212	Laboratory Exercises in Microbial Physiology & Medical microbiology	2	40	05	05	50
Minor	N-MNT-BT-210	Microbiology: Microbial Physiology	2	40	10	50	OE /GE	N-OEP-BT-222	Laboratory Exercises in Animal Science and Basics in Biostatistics	2	40	05	05	50
Minor	N-MNT-BT-211	Microbiology: Medical Microbiology	2	40	10	50								
OE /GE	N-OET-BT-220	Animal Science	2	40	10	50								
OE /GE	N-OET-BT-221	Basics in Biostatistics	2	40	10	50								
AEC	N-AEC-BT- 230	English for Communication -II	2	40	10	50								
SEC	N-SCT-BT- 250	Basics in Bioinformatics	2	40	10	50								
		Total	**16**			**400**				**06**				**150**

Total Marks for semester I (Theory + Practical) = 550

Total Credits for Semester II = 22

Total Marks For B. Sc. I (Semester I + II) = (550+550) = 1100

Total Credits for Semester I + II = (22 + 22) = 44