



**Maharashtra Education Society's
Abasaheb Garware College
(Autonomous)**

(Affiliated to Savitribai Phule Pune University)

**Three Year B.Sc. Degree Program in Biotechnology
(Faculty of Science and Technology)**

**Syllabi under Autonomy
F.Y.B.Sc. (Biotechnology)**

**Choice Based Credit System Syllabus
To be implemented from Academic Year 2022-2023**

Title of the Course: Bachelor's course in Biotechnology

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, 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 practised 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 skillsets will help a graduate student to avail the opportunities in the applied fields (research, industry or institutions) without any additional training.

Programme Outcomes

1. To introduce different biological systems (Plants, Animals and Microorganisms)
2. To learn basic concepts of allied subjects ((Chemistry, Physics, Instrumentation, Computers, Mathematics) for better understanding biological systems
3. To impart knowledge in basic and applied aspects of life sciences
4. To make students aware of various applications of Biotechnology and develop their practical skill sets
5. To inculcate scientific, social and environmental awareness in students

Eligibility:

H.S.C. (10+2) Science Passed or equivalent.

Students should have Physics, Chemistry and Biology/ Biotechnology as the principal subjects.

Structure of the Course: B.Sc. Biotechnology

Year	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of Lectures /Practical to be conducted		
1	I	Discipline specific core courses: Theory	USBT-111	Fundamentals of Chemistry I	T	2	30		
			USBT-112	Fundamentals of Physics	T	2	30		
			USBT-113	Biochemistry I	T	2	30		
			USBT-114	Biophysics	T	2	30		
			USBT-115	Animal Sciences I	T	2	30		
			USBT-116	Plant Sciences I	T	2	30		
			USBT-117	Microbiology I	T	2	30		
			USBT-118	Biomathematics and Biostatistics-I	T	2	30		
			USBT-119	Practical In Chemistry and Biochemistry-I	P	1.5	15		
			USBT-110	Practical In Plant and Animal Science-I	P	1.5	15		
			USBT-1111	Practical In Microbiology & Biostatistics-I	P	1.5	15		
			USBT-1112	Practical In Physics and Biophysics	P	1.5	15		
	II	Discipline specific core courses: Theory	USBT-121	Fundamentals of Chemistry II	T	2	30		
			USBT-122	Biochemistry II	T	2	30		
			USBT-123	Bioinstrumentation	T	2	30		
			USBT-124	Animal sciences II	T	2	30		
USBT-125			Plant sciences II	T	2	30			
USBT-126			Microbiology II	T	2	30			

			USBT-127	Biomathematics and Biostatistics-II	T	2	30		
			USBT-128	Computer in Biology	T	2	30		
		Discipline specific core courses: Practical	USBTP-129	Practical In Chemistry & Biochemistry II	P	1.5.	15		
			USBTP-1210	Practical In Plant and Animal Science II	P	1.5.	15		
			USBTP-1211	Practical In Microbiology & Bioinstrumentation	P	1.5.	15		
			USBTP-1212	Practical In Computer & Biostatistics	P	1.5.	15		
2	III	Discipline specific core courses: Theory	USBT-231	Cell Biology I	T	2	30		
			USBT-232	Molecular Biology I	T	2	30		
			USBT-233	Genetics	T	2	30		
			USBT-234	Metabolism	T	2	30		
			USBT-235	Environmental Biotechnology	T	2	30		
			USBT-236	Bioanalytical Techniques	T	2	30		
		Ability Enhancement Compulsory Courses	UEVS-231	AECC-I Environment Science Theory Paper 1	T	2	30		
			USLGA-231	AECC-II Language Theory Paper 1	T	2	30		
			Discipline specific core courses: Practical	USBTP-237	Practical in Cell Biology and Genetics	P	2	15	
		USBTP-238		Practical in Bioanalytical Techniques and Metabolism	P	2	15		
		USBTP-239		Practical in Molecular Biology and Environmental Biotechnology	P	2	15		
		IV		Discipline specific core courses: Theory	USBT-241	Cell Biology II	T	2	30
					USBT-242	Molecular Biology II	T	2	30
USBT-243	Immunology				T	2	30		
USBT-244	Animal Development				T	2	30		
USBT-245	Plant Development				T	2	30		
USBT-246	Microbial Biotechnology				T	2	30		

		Ability Enhancement Compulsory Courses	UEVS-241	AECC-I Environment Science Theory Paper 2	T	2	30
			USLGA-241	AECC-II Language Theory Paper 2	T	2	30
		Discipline specific core courses: Practical	USBTP-247	Practical in Molecular Biology and Microbial Biotechnology	P	2	15
			USBTP-248	Practical in Animal and Plant Development	P	2	15
			USBTP-249	Practical in Cell Biology and Immunology	P	2	15
3	V	Discipline specific core courses: Theory	USBT-351	Industrial Microbiology	T	2	30
			USBT-352	R- DNA technology	T	2	30
			USBT-353	Plant Tissue Culture	T	2	30
			USBT-354	Animal Tissue Culture	T	2	30
			USBT-355	Applied Biotechnology I	T	2	30
			USBT-356	Biodiversity and Systematics	T	2	30
		Skill Enhancement Courses	USBTSEC-357	SEC - I: Summer Industrial Internship / Review Writing/ Start-up Design or Case Study Report	T	2	30
			USBTSEC-358	SEC - II: Project Formulation and Presentation	T	2	30
		Discipline specific core courses: Practical	USBTP-359	Practical in Industrial Microbiology	P	2	15
			USBTP-3510	Practical in Plant Tissue Culture and Animal Tissue Culture	P	2	15
			USBTP-3511	Practical in R- DNA Technology and Biodiversity	P	2	15
		VI	Discipline specific core courses: Theory	USBT-361	Enzyme and Enzyme Technology	T	2
	USBT-362			Agriculture Biotechnology	T	2	30
	USBT-363			Applied Biotechnology II	T	2	30
	USBT-364			Food and Pharmaceutical Biotechnology	T	2	30
USBT-365	Bioinformatics			T	2	30	

			USBT-366	Bio safety and Bioethics and IPR	T	2	30	
		Skill Enhancement Courses	USBTSEC-367 and USBTSEC-368	SEC III and SEC IV (Project)		4	60	
		Discipline specific core courses: Practical	USBTP-369	Practical in Enzyme Technology	P	2	15	
			USBTP-3610	Practical in Agriculture Biotechnology and Bioinformatics	P	2	15	
			USBTP-3611	Practical in Food and Pharmaceutical Biotechnology	P	2.	15	
		Total Credits					132	

SEMESTER-I**Course Code and Title: USBT-111 Fundamentals of Chemistry I****Credits-2****Lectures: 30****Course Outcomes:**

1. To learn concepts of thermodynamics, stereochemical aspects of molecules, and orientation in molecules.
2. To get introduced to different functional groups and their reactions.

Units	Topics	Number of Lectures
1	Atomic Structure Historical background electronic structure of atom, atomic & molecular orbitals, Shapes of atomic orbitals molecular orbital method, selection rules to find electronic configuration of elements.	4
2	Molecules Diatomic molecules, Valence bond theory, VSEPR theory, hybridization involving s, p, d, orbitals (sp, sp ² , sp ³ , dsp ² , sp ² d, sp ³ d, sp ³ d ²), homo and heteronuclear diatomic molecules, molecular orbital theory, bond order, magnetic properties	6
3	Stereochemistry Conformations, configurations, isomerism (structural and stereoisomers), Enantiomers, Chiral centres, Geometric isomers Newman's & Fisher Projection formulae, epimers, anomers, furanose and pyranose form, free radical reactions	4
4	Thermodynamics Types of systems, intensive and extensive properties, equilibrium and non-equilibrium states, reversible and irreversible processes, laws of thermodynamics, internal energy, enthalpy, entropy Endothermic and exothermic reactions, free energy and work, (Gibb's, Helmholtz), Bioenergetics, biological oxidation reactions, ATP and its role in bioenergetics, reactions (in terms of electrons),	8
5	Organic chemistry Alkane, alkene, alkyne, alcohol, amines, alkyl halides, ether: IUPAC nomenclature, Reactions of functional groups.	8

	Chemical reactions: Addition, substitution (electrophilic and nucleophilic, Elimination, displacement, oxidation and reduction (with example)	
--	---	--

Recommended Textbooks and References:

1. General Chemistry, 1st edition (2000), C.N. R. Rao, Macmillan Publishers, India.
2. The Elements of Physical Chemistry, 5th edition (2009), Atkins P, de Paula J., W. H. Freeman Publication, USA.
3. Physical Chemistry for Biological sciences, 1st edition, (2005), Chang R., University Science Books, USA 6.
4. Concise Inorganic Chemistry. 5th edition (2008), Author: J. D. Lee, John Wiley & Sons, USA.
5. Guide book to Mechanism in Organic Chemistry by Peter Sykes, 6th edition, (1996), Prentice Hall, India.

Course Code and Title: USBT-112 Fundamentals of Physics**Credits-2****Lectures: 30****Course Outcomes:**

1. To get introduced to laws of physics which are helpful to give reasons behind different process in life science.
2. To get introduced to concepts such as fluid mechanics, surface tension, waves and optics which form basis of advanced techniques such as spectroscopy, microscopy

Units	Topics	Number of Lectures
1	Measurements: Physical quantities, fundamental and derived units, System of Units, order of magnitude. Length: radius of proton to astronomical distances. Mass: atomic mass unit to mass of Earth. Time: fast elementary particle to age of Earth. Amount of substance. Luminous intensity. Inter-conversion of units.	4
2	Fluid mechanics: Fluids: Definition, Pressure, density. Variation of pressure with depth in a fluid at rest. Measurement of pressure. Various units of pressure and their inter conversion. Streamline and turbulent flow. Equation of continuity. Flow of liquids through capillaries. Viscosity, Newton's law of viscosity, coefficient of viscosity. Ostwald's viscometer. Relevance to life sciences.	5
3	Surface Tension: Surface tension and surface energy. Cohesive and adhesive forces. Capillary action, angle of contact, wettability. Factors affecting surface tension. Applications. Relevance to life sciences.	5
4	Waves and oscillations: Difference. Types of waves (transverse and longitudinal). Reflection of waves. Principle of superposition of waves. Standing and travelling waves. Sound waves as pressure waves. Audible, ultrasonic, and infrasonic waves. Characteristics of sound waves. Beats. Doppler Effect. Applications in life sciences.	8
5	Geometrical Optics: Reflection, Refraction (Snell's Law). Types of lenses, combinational lenses, radius of curvature, focal length, Lens maker equation. Microscopes. Optical power, diopter. Magnification. Mirrors. Aberrations.	8

Recommended Textbooks and References

1. Concepts of Physics. Volume I and Volume II. (2010). H. C. Verma.
2. Fundamentals of Physics, 9th edition (2010). David Halliday, Robert Resnick, et.al
3. Sears and Zeemansky's University Physics, 13th edition (2012)
4. A Textbook of Optics (2001). Dr. N. Subrahmanyam, BrijLal, Dr. M. N. Avadhanulu. By S. Chand publications.

Course Code and Title: USBT-113 Biochemistry I**Credits-2****Lectures: 30****Course Outcomes:**

1. To get introduced to the fundamental bio-molecules which constitutes the living organism.
2. To understand how the remarkable properties of the living organism arise due to interaction between these organic molecules and their cellular organization.
3. To understand the role of water as solvent and its properties and interaction in stabilization of metabolites.

Units	Topics	Number of Lectures
1	Introduction to Biochemistry, Origin of life, distinguishing features of living organism, chemical foundation (biomolecules and function groups) and cellular foundation of life	4
2	Water: Physical and chemical properties of water. hydrogen bonding with water molecules and biological molecules, anomalous properties, osmosis. Ionization of water, ion product of water, pH, titration curves, buffers and biological buffer. Types of Bonds: Covalent and non-covalent in biomolecules i.e hydrogen bond, hydrophobic interaction, electrostatic interaction, Van der Waal's force	8
3	Carbohydrates: Definition, classification based on a. physical properties into sugars and non-sugars, b. Chemical nature and monomeric units into monosaccharides, oligo and poly saccharides, Monosaccharides: Structure & properties of Monosaccharides, ketoses and aldoses D and L configuration, mutarotation, epimers, anomers, chemical and physical properties; glycosidic bond, Oligosaccharides: reducing and non-reducing sugars inversion of sugar Polysaccharides and its classification based on function Storage polysaccharide: e.g., starch, glycogen and inulin Structural polysaccharides: e.g., cellulose, chitin	10

	Functions of Carbohydrates	
4	Lipid: Classification of lipids: Simple & complex lipids, fatty acids. Storage and structural lipids Fatty acids, Structure & chemical and physical properties Simple lipids: Triacylglycerol (fats and oils), purity test and functions Complex lipids: Sphingolipids, Phospholipids and Glycolipids. Steroids. Lipoproteins and functions Function of lipids	8

Recommended Textbooks and References

1. Outlines of Biochemistry: 5th Edition, (2009), Eric Conn & Paul Stumpf ; John Wiley and Sons, USA
2. Fundamentals of Biochemistry. 3rd Edition, (2008), Donald Voet & Judith Voet , John Wiley and Sons, Inc. USA
3. Lehninger, Principles of Biochemistry. 8th Edition (2021), David Nelson, Michael Cox, and Aaron Hoskins Macmillan Learnings
4. Biochemistry 4th Edition U. Satyanarayan and U Chakrapani (2016) Elsevier and Books and Allied Publications
5. Biochemistry:7th Edition, (2012), Jeremy Berg, Lubert Stryer, W.H.Freeman and company, NY

Course Code and Title: USBT-114 Biophysics**Credits-2****Lectures: 30****Course Outcomes:**

1. To get introduced to the fundamentals of Biophysics
2. To understand the linkage between physics and biology

Units	Topics	Number of Lectures
1	Structure of Biophysics: Introduction, Scope and definition of Biophysics. Biophysics at macroscopic, microscopic level and at the molecular level Divisions of Biophysics: Physical, Physiochemical, Physiological and Mathematical	4
2	Atomic structure: Historical background, Bohr model. Significance of second and third postulate of Bohr's model. Derivation of radius and energy value. Quantization of energy levels. Vector atom model. Quantum numbers. Selection rules. Pauli's exclusion principle. Emission spectra with respect to Na atoms to understand selection rules.	7
3	Radioactivity: Nucleus, Properties. Nuclear forces. Nuclear models (liquid drop and shell model). Radioactive nucleus. Nuclear radiations and their properties - alpha, beta and gamma. Half-life, physical and biological handling of alpha and beta emitting isotopes. GM counter- Principle, construction and working.	7
4	Cell membrane: Organization of plasma membrane. Diffusion basics. Passive and active transport. Membrane potential, Nernst equation. Passive electrical properties of cell (capacitance, resistance). Active electrical properties. Electrical model (equivalent) of cell membrane. Depolarization, hyperpolarization of membrane (neuronal). Generation of action potential. Biopotentials: types and measurement	8

5	Biophysical properties: Surface tension, adsorption, diffusion, osmosis, dialysis and colloids	4
---	--	---

Recommended Textbooks and References:

1. Biophysics, an introduction. 1st edition. (2002) Cotteril R. John Willey and Sons Ltd., USA
2. Instrumentation measurements and analysis – 2nd edition (2003). Makraand Choudhari, Tata McGraw Hill, India.
3. H. H. Willard, Instrumental Methods of Analysis, CBS Publishers.
4. D.C. Harris, Quantitate Chemical Analysis, W. H. Freeman
5. Vogel's Textbook of Qualitative Chemical Analysis, ELBS
6. W. Kemp, Organic Spectroscopy, ELBS

Course Code and Title: USBT-115 Animal Sciences-I**Credits-2****Lectures: 30****Course Outcomes:**

1. To be able to differentiate between different phyla of animals.
2. To understand the structure of different tissue types and relate to their functions

Units	Topics	Number of Lectures
1	Introduction to Kingdom Animalia • Outline classification of non-chordates with examples • Kingdom Protista General characters and classification up to classes; Locomotory Organelles and locomotion in Protozoa • Phylum Porifera General characters and classification up to classes; Canal System in Sycon • Phylum Cnidaria General characters and classification up to classes; Polymorphism in Hydrozoa • Phylum Platyhelminthes General characters and classification up to classes • Phylum Nematelminths General characters and classification up to classes • Phylum Annelida General characters and classification up to classes • Phylum Arthropoda General characters and classification up to classes; Metamorphosis in Insects (Drosophila) • Phylum Mollusca General characters and classification up to classes • Phylum Echinodermata General Characters and classification up to classes; Water-vascular system in Asteroidea.	6
2	Outline classification of chordates with examples • Protochordates General features and examples • Agnatha - General features of Agnatha and classification of cyclostomes • Pisces- General features and Classification up to classes	6

	<ul style="list-style-type: none"> • Amphibia-General features and Classification up to classes • Reptiles-General features and Classification up to classes • Aves- General features and Classification up to classes • Mammals- General features and Classification up to classes 	
3	<p>Animal Tissues: (Mammalian Histology for e.g. Rat/ Human)</p> <ul style="list-style-type: none"> • Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue • Bone and Cartilage - Structure and types of bones and cartilages 	6
4	<p>Introduction to Invertebrate and vertebrate model system</p> <ul style="list-style-type: none"> • Type of Invertebrate: <ul style="list-style-type: none"> I. Hydra ii. C. elegans iii. Drosophila Type of vertebrates <ul style="list-style-type: none"> iv.Frog/Toad v. Zebra fish vi. Mouse/Rat 	12

Recommended Textbooks and References

1. Modern Text Book of Zoology: Invertebrates. (2012), R.L.Kotpal. Publisher, Rastogi Publications.
2. An Introduction to Invertebrates: Janet Moore, New Hall, Cambridge, second edition copyright Cambridge Univ Press 2001,2006
3. Using research organisms to study health and disease Nov 2018 NIH NIGMS

Course Code and Title: USBT-116 Plant Sciences- I**Credits-2****Lectures: 30****Course Outcomes:**

1. To get introduced to plant classification.
2. To learn morphology, modifications and anatomy of vegetative as well as reproductive parts of angiosperms.

Units	Topics	Number of Lectures
1	Introduction to plant world & classification <ul style="list-style-type: none"> • General & Unique features of plants • Principles, aims and objectives of plant classification, outline of the classification with example • A general account of different groups and their characters with one example each of Algae, Bryophytes, Pteridophytes, Gymnosperms • Angiosperms – Characteristic features of Dicot and Monocot 	10
2	Morphology & modifications of <ul style="list-style-type: none"> • Vegetative plant organ: Stem, Leaf and Root • Reproductive plant organs – Flower & Types of Inflorescences, Types of fruits, Dehiscence and seed dispersal, Types of seeds and Seed germination 	8
3	Internal structure of plant organs <ul style="list-style-type: none"> • Plant Tissues and tissue systems, • Meristematic Tissue and its Type - with example • Permanent Tissue - Simple and Complex - with example 	4
4	Internal organization of plant body <ul style="list-style-type: none"> • Primary structure of shoot, root & leaf. • Secondary growth, growth rings formation: cambium and its activities, periderm- cork cambium, secondary cortex and cork. 	8

Recommended Textbooks and References

1. Dutta A.C. (2000) A Classbook of Botany (Oxford University Press, UK)
2. Ganguli, Das Dutta (2011) – College Botany Vol I, II and III (New Central Book Agency, Kolkata)

Course Code and Title: USBT-117 Microbiology I**Credits-2****Lectures: 30****Course Outcomes:**

1. To learn the history of microbiology
2. To get introduced to ultrastructure of bacteria, different staining procedures, aseptic handling and cultivation techniques to observe these microorganisms.

Units	Topics	Number of Lectures
1	Introduction to Microbial World: History of Microbiology, Abiogenesis vs Biogenesis, Discovery of Microorganisms, Germ theory of diseases, Koch's postulates, Pre golden era, Golden Era, post golden Era, Contributions of various scientists in path breaking discoveries, inventions and Product Development. Importance of study of Microbiology and relevance in Biotechnology (Brief discussion of application of Microbiology in various fields)	6
2	Classification of Microorganisms: All 5 major groups of microorganisms, similarities and dissimilarities in relation to evolution. Difference between Prokaryotic and Eukaryotic organisms. Bacterial Classification: Bergey's Manual of Systemic Bacteriology	4
3	Bacterial cell structure: Ultrastructure of Bacteria- Cell wall (Gram Positive and Gram negative), Cell Membrane, Capsule, Flagella, Pili, slime layer, Ribosome, Nucleoid, Mesosomes, Endospore, Cell inclusions (Gas vesicles, carboxysomes, magnetosomes, PHB granules, Glycogen bodies, metachromatic granules)	8
4	Basics of Microscopy: Bright field Microscope, Dark Field Microscope, Magnification, Resolution, Numerical aperture	3
5	Staining techniques: Sample Preparation <ul style="list-style-type: none"> • Wet Mount, hanging drop technique 	9

	<ul style="list-style-type: none">● Theory of staining: Classification of stains, Stain (Basic and Acidic), Fixative, Mordant, Decoloriser, Accentuator● Principles and methods of staining techniques for following (Monochrome, Negative, Differential (Gram, Acid fast), Special staining- Endospore, flagella, cell wall, nucleic acid, capsule)	
--	---	--

Recommended Textbooks and References

1. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology.3rd Edition. Thomson Brooks / Cole.
2. Madigan M.T., Martinko J.M. (2006). Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
3. Prescott L.M., Harley J.P., AND Klein D.A. (2005). Microbiology, 6th Edition. MacGraw Hill Companies Inc.
4. Salle A.J. (1971) Fundamental Principles of Bacteriology.7th Edition. Tata MacGraw Publishing Co.
5. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5th Edition. Macmillan Press Ltd.
6. Tortora G.J., Funke B.R., Case C.L. (2021). Microbiology: An Introduction. 13th Edition. Pearson Education Inc.

Course Code and Title: USBT-118 Biomathematics and Biostatistics**Credits-2****Lectures: 30****Course Outcomes:**

1. To learn the basic concepts of mathematics and statistics.
2. To learn how to apply mathematical and statistical methods for analysis of biological data.

Units	Topics	Number of Lectures
	Biomathematics Credit = 1	15
1	<p>Fundamentals Mathematical Calculations</p> <p>Exponents & Powers: Definition and Simple Powers with Numbers, Algebraic rules for working with Powers. Logarithm: Definition, Laws of logarithm and Change of base theorem (without proofs) Examples based on laws.</p> <p>Permutations & Combinations: Counting Principle, Permutations with Repetitions (like & dislikes), Circular Permutations, Permutations with r-particular things included/excluded.</p> <p>Co-ordinate geometry – Area of triangle and quadrilateral, equation of straight line – in slope form, intercept form and perpendicular form. Conics (ellipse, parabola, hyperbola).</p>	8
2	<p>Matrices: Definition, types of matrices, (zero, Identity, square, unit, scalar, triangular, diagonal, upper triangular, lower triangular, symmetric) Addition of matrices, multiplication of matrices, determinant (singular, non-singular).</p> <p>Linear equations Homogeneous and non-homogeneous linear equation system Eigen values and Eigen vectors, Applications of linear equations in biology</p>	7
	Biostatistics Credit = 1	15
3	<p>Introduction to Statistics</p> <p>Need of Statistics in biology, collection and organisation/classification, summarization and</p>	7

	analysis of biological data · Data, Variables, parameters, populations and samples, types of sampling distribution. · Representation of data using frequency distribution diagram, histogram, ogive curves, bar and pie diagrams.	
4	<p>Descriptive biostatistics Measures of Central Tendency: Mean, Mode, Median. · Measures of Variability: Standard deviation, standard error, Range, Mean deviation, Quartile deviation and coefficient of variation.</p> <p>Correlation and Regression: · Positive and negative correlation, calculation of correlation coefficient, regression, linear regression, and regression equation.</p>	8

Recommended Textbooks and References:

1. Fundamentals of Mathematical Statistics by S.C. Gupta and V. K. Kapoor. Sultan Chand & Co.
2. Introduction to the Practice of Statistics, by David S. Moore, George P. McCabe, and Bruce A. Craig, 9th Edition, W.H. Freeman and Co., New York (2017).
3. P.S.S. Sunderrao and J. Richards-An introduction to Biostatistics, Prentice Hall Pvt. Ltd. India
4. Fundamentals of Biostatistics. By Irfan A Khan. 8. Campbell R.C.- Statistics for Biologists, Cambridge University Press, Cambridge.

Course Code and Title: USBTP-119 Practical in Chemistry and Biochemistry

Credits-1.5

Total Practical= 15 (15x3 hrs.)

Course Outcomes:

1. To acquire basic knowledge of units, pH, concentration through preparation of solution and buffers.
2. To understand chemical reactions based on functional groups of biomolecules which are used in spot tests.
3. To learn spectroscopic techniques

Practicals in Chemistry

Units	Topics	Number of practical
1	Titration · To study Acid base titration based by conductivity measurement. · To determine alkali content in antacid tablet using HCl	1
2	Stereochemistry: To study different conformations of biomolecules using models	1
3	Thermochemistry To determine enthalpy and entropy change of a reaction $2\text{FeCl}_3 + 3\text{Mg} \rightarrow 2\text{Fe} + 3\text{MgCl}_2$	1
4	Qualitative analysis: To perform qualitative test for – Hydrocarbons, alcohols, aldehyde, ketones, aniline, amide	1
5	pH-metry: To determine the pKa value of a given weak acid by pH-metry titration with strong base.	2
6	Hardness of water: To estimate hardness of water by using EDTA	1

Practicals in Biochemistry

Units	Topics	Number of practical
1	Biochemical Calculations Preparation of solutions, buffers	2
2	Spot test for Carbohydrates	1
3	Estimation of Reducing sugar by DNSA method	1
4	Isolation & identification of starch from plant source	1
5	Extraction of oil from plant source	1
6	Saponification number: To find out saponification number of given lipid	1
7	Quantitative Estimations: To estimate concentration of cholesterol in given sample by ZAK's method	1

Course Code and Title: USBTP-1110 Practical in Plant Sciences and Animal Sciences

Credits-1.5

Total Practical= 15 (15x3 hrs.)

Course Outcomes:

1. To study morphological features and mode of reproduction in different organisms.
2. To recognize Drosophila mutants and lifecycle stages.
3. To study of plant groups with one example from each group.
4. To learn basic morphology and anatomy of dicots and monocots.

Practical in Animal Sciences

Units	Topics	Number of practical
1	Study of Paramecium • Morphology • Reproduction-Binary fission & Conjugation	1
2	Culturing of Paramecium	1
3	Study of Hydra: Permanent slides • Morphology • Reproduction • Regeneration in Hydra "	1
4	Study of Drosophila: Characters, sexual dimorphism – eye & wing mutations, Life cycle	2
5	Culturing Drosophila using standard methods	1

Practical in Plant Sciences

Units	Topics	Number of practical
1	Study of Algae, bryophytes, pteridophytes, gymnosperms with one example each	2
2	Study of Angiosperm Families one example of dicot family and one family of monocot	1
3	Study on morphological parameters of Angiosperms, Stem, Root, Leaf	1
4	Study on morphological parameters of Angiosperms, Inflorescence, Flower and Fruit	1
5	Study on anatomy of root, stem & leaf of dicot plant	1
6	Study on anatomy of root, stem & leaf of monocot plant	1

Course Code and Title: USBTP-1111 Practical in Microbiology and Statistics

Credits-1.5

Total Practical= 15 (15x3 hrs.)

Course Outcomes:

1. To learn good microbiology practices
2. To learn different staining and aseptic techniques for observing microorganisms
3. To learn basics of MS-excel and application of spreadsheets for data analysis
4. To study learn different statistical tests

Practicals in Microbiology

Units	Topics	Number of practical
1	Introduction to Microbiology Laboratory and common microbiology laboratory instruments e.g., Incubator, Hot Air Oven, Autoclave, Colorimeter, pH Meter, Distillation Unit, Chemical Balance, Laminar air flow hood, Clinical Centrifuge	2
2	Handling of Microorganisms and Biosafety measures	1
3	Observation of Microorganisms. Use and Care of Compound Microscope <ul style="list-style-type: none"> · Wet Mount- pond water, fungal staining · Monochrome staining · Negative staining · Gram's staining · Spore staining · Motility- Hanging drop technique 	5

Practicals in Biostatistics

Units	Topics	Number of Lectures
1	Introduction to MS Excel and use of spreadsheets for data organization and basic mathematics calculations	2
2	Data representation using various graphical types	3
3	Correlation and regression analysis of data and graphical representation	2

Course Code and Title: USBTP-1112 Physics and Biophysics**Credits-1.5****Total Practical= 15 (15x3 hrs.)****Course Outcomes:**

1. To gain basic knowledge of estimation of least count of various instruments
2. To study basics of optics and spectrometry
3. To apply basic concepts of biophysics like diffusion, osmosis, surface tension in relation to biological systems

Practicals for Physics

Units	Topics	Number of practical
1	Least Count of Vernier Callipers, Micrometer Screw Gauge and travelling microscope	2
2	Surface-tension measurement: Using Jaeger's method	1
3	Viscometer 1 (Viscosity of a solution)	1
4	Viscometer 2 (Unknown percentage of a solution)	1
5	Laws of reflection, refraction and total internal reflection	1
6	Grating elements using a Laser beam	1
7	To Determine the focal length of the given lens: a. Concave b. Convex	1
8	Study of compound microscope	1

Practicals for Biophysics

Units	Topics	Number of practical
1	Study the process of Osmosis	1
2	Determine the surface tension of biological fluid (serum)	1
3	Determination of Diffusion Pressure Deficit using potato tubers	1
4	Dialysis	1
5	Characteristics of G.M counter	1
6	To study the counting statistics of G.M counter	1

SEMESTER-II**Course Code and Title: USBT-121 Fundamentals of Chemistry II****Credits-2****Lectures: 30****Course Outcomes:**

1. To understand the concept of mole and various methods to express the concentration of solution.
2. To learn the basics of ionization and buffer preparation.
3. To get introduced to the chemical kinetics and reaction order

Units	Topics	Number of Lectures
1	Basics of mole concept · Mole concept, Determination of molecular weight by gram molecular volume relationship, problems based on mole concept, Solutions, colligative properties, · Methods of expressing concentrations, strength, Normality, Molarity and Molality, ppm. · Volumetric experiments - acidimetry, alkalimetry, permanganometry, dichrometry, iodometry.	7
2	Ionic equilibria - · pH, buffer, Equilibrium constant, Le Chatelier's principle, Acid and bases, strength of acid & bases, dissociation constant, pK values, solubility product, Acid-base titrations, indicators used in titrations, Titration curves, Solubility product · Ionic product, Condition for precipitation, · Henderson Hasselbach equation & related problems, Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure · Properties of water, water as a reactant, interaction of biomolecules with water	10
3	Chemical kinetics - · Rates of reactions, order, zero, first & second order reactions, & molecularity · Differential and integrated rate equation · Half-life periods, Arrhenius equation, collision theory of reaction rate, temperature dependent reaction rates	6
4	Electrochemistry · Electrochemical cell, half-cell, reaction, reduction potential, electrochemical series, thermodynamic potential function from cell potential	7

	measurement, Liquid junction potential, Huckel theory, overvoltage/overpotential	
--	--	--

Recommended Textbooks and References

1. University General Chemistry, 1st edition (2000), C.N. R. Rao, Macmillan Publishers, India,
2. Principles of Physical Chemistry, 4th edition (1965), S.H. Maron and C.F. Prutton, Collier Macmillan Ltd
3. The elements of Physical Chemistry, 5th edition (2009), Atkins P, de Paula J., W. H. Freeman Publication, USA
4. An Introduction to Electrochemistry, edition reprint, 2011, Samuel Glasstone, Biblio Bazaar, USA

Course Code and Title: USBT-122 Biochemistry II**Credits-2****Lectures: 30****Course Outcomes:**

1. To understand basics of amino acids, proteins and its different functions.
2. To learn about Nucleic acids and their structure and its chemistry.

Units	Topics	Number of Lectures
1	Amino acids: Classification of standard amino acids Based on solubility, functional groups, nutritional and metabolic fate. Uncommon and non-standard amino acids Properties of amino acids physical and Chemical.: Configuration, Ionisation of amino acid side chains, zwitterion, reactions of amino acids, titration of amino acids, Isoelectric pH.	6
2	Protein: Polymer of standard amino acids, diverse functions Peptide bond and Structure of protein Primary structure, Secondary structure, secondary repeats, Tertiary and Quaternary structure (e.g., Haemoglobin, keratin). Protein denaturation and renaturation Classification of proteins a. simple and conjugated; b. Nutritional value c, Function: hormone, defence, enzyme, receptor, structural, storage, transport Enzymes as biocatalyst, Active site, specificity. Classification"	10
3	Vitamins: • Classification, Structure and Biochemical functions of fat soluble and water-soluble Vitamins. • Coenzymes: Thiamine, Riboflavin, Niacin, PIP, Coenzyme A, lipoic acid, Folic acid and B12.	8
4	Nucleic acids: DNA and RNA polymer of nucleotides Nitrogenous base: Purine, Pyrimidines Nucleosides, Nucleotides, Polynucleotide Covalent structure of DNA, Watson Crick model, Chargaff's rule and Different forms of DNA, DNA as heredity molecule Forces stabilizing nucleic acid structure Denaturation, DNA melting & renaturation	6

	of Nucleic Acids. RNA types and structure and function	
--	--	--

Recommended Textbooks and References

1. Outlines of Biochemistry: 5th Edition, (2009), Erice Conn & Paul Stumpf ; John Wiley and Sons, USA
2. Fundamentals of Biochemistry. 3rd Edition, (2008), Donald Voet & Judith Voet , John Wiley and Sons, Inc. USA
3. Lehninger, Principles of Biochemistry. 8th Edition (2021), David Nelson & Michael Cox, W.H. Freeman and company, NY5.
5. Biochemistry 2nd Edition U. Satyanarayan
6. Biochemistry:7th Edition, (2012), Jeremy Berg, Lubert Stryer, W.H.Freeman and company,NY

Course Code and Title: USBT-123 Bioinstrumentation**Credits-2****Lectures: 30****Course Outcomes:**

1. To learn basic principle and working of Bioinstruments like spectroscope, microscope, pH meter etc.
2. To learn application of different types of thermometers

Units	Topics	Number of Lectures
1	Bio instrumentation: Introduction, Concepts- Analytical techniques	2
2	Spectroscopy: · Definition. Electromagnetic wave. Electromagnetic spectrum. Applications of each region of electromagnetic spectrum for spectroscopy. · Lambert-Beer's Law, types of sources, Instrumentation of single beam and double beam instrument. Introduction to molecular energy levels. Excitation. Absorption. Emission. Rotational spectra. Energy levels of rigid diatomic molecules. · Electron spectroscopy. UV-visible spectroscopy. Principle, construction and working of colorimeter, Spectrophotometer. Application to biomolecules (proteins, DNA, Hb, chlorophyll).	8
3	Bioinstruments: Concepts- Analytical techniques, Principal construction, working and applications for analysis of biomolecules of following instruments. · pH meter , isoelectric pH. · Centrifuge (RCF, sedimentation concept), different types of centrifuges. different rotors, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, · Mass spectroscopy (Bainbridge mass spectrometer). · Atomic absorption spectrometer (AAS).	10
4	Microscopes: Concepts - Resolving power. Construction and working principles of the following microscopes- Stereo zoom (Dissecting), Compound, Light microscopy, Inverted, Phase contrast, Fluorescence microscopy.	6
5	Thermoregulation:	4

	Thermometric properties and types of thermometers (clinical, thermocouple, bimetallic, platinum resistance, thermistor - thermometers). Body temperature and its regulation.	
--	--	--

Recommended Textbooks and References

1. Biophysics, an introduction. 1st edition. (2002) Cotteril R. John Willey and Sons Ltd., USA
2. Biophysics. 1st edition (2002), Pattabhi V and Gautham N. Kluwer Academic Publisher, USA.
3. Instrumentation measurements and analysis – 2nd edition (2003). Nakraand Choudhari, Tata McGraw Hill, India.
4. Principles and Techniques of Biochemistry and Molecular Biology (2010) 7th Edition K. Wilson and J. Walker Cambridge University Press ,NY

Course Code and Title: USBT-124 Animal Sciences- II**Credits-2****Lectures: 30****Course Outcomes:**

1. To learn and understand basics of physiological processes such as respiration, digestion etc.,
2. To understand the basic concepts of parasitology, host-parasite relationship, life cycles of parasites.
3. To understand methods of Vermiculture, Aquaculture, Sericulture and Apiculture

Units	Topics	Number of Lectures
1	Animal Physiology I • Digestion: Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins • Respiratory: Physiology, External and internal Respiration, Transport of oxygen and carbon dioxide in blood, Factors affecting transport of gases.	6
2	Animal Physiology II • Functioning of Excitable Tissue (Nerve and Muscle) Structure of neuron, Propagation of nerve impulse (myelinated and non-myelinated nerve fibre); Structure of skeletal muscle, Mechanism of muscle contraction (Sliding filament theory), Neuromuscular junction • Endocrine and Reproductive Physiology Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes), Brief account of spermatogenesis and oogenesis	6
3	Parasitology • Introduction to Host-parasite Relationship Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism • Parasitic Protozoa Life history and pathogenicity of Plasmodium vivax • Parasitic Helminthes Life history and pathogenicity of Fasciola hepatica • Parasitic Helminthes Life history and pathogenicity of Taenia sp.	10
4	Economic Zoology • Vermiculture • Aquaculture	8

	<ul style="list-style-type: none">• Sericulture• Apiculture	
--	--	--

Recommended Textbooks and References

1. Economic Zoology, Shukla & Upadhyaya, 4th Edition., Rastogi Publications, 2009.
2. Modern Parasitology: A Textbook of Parasitology, 2nd edition, (1993) F. E. G. Cox, Wiley & Sons, USA
3. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hecourt Asia PTE Ltd. /W.B. Saunders Company.
4. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & son

Course Code and Title: USBT-125 Plant Sciences- II**Credits-2****Lectures: 30****Course Outcomes:**

1. To learn physiology and nutrition of angiosperms
2. To get introduced to plant relations, indicator plants and plant diseases as well as special reference is given to the economic importance of plants.

Units	Topics	Number of Lectures
1	Introduction to plant world & classification • General & Unique features of plants • Principles, aims and objectives of plant classification, outline of the classification with example • A general account of different groups and their characters with one example each of Algae, Bryophytes, Pteridophytes, Gymnosperms • Angiosperms – Characteristic features of Dicot and Monocot	10
2	Morphology & modifications of • Vegetative plant organ: Stem, Leaf and Root • Reproductive plant organs – Flower & Types of Inflorescences, Types of fruits, Dehiscence and seed dispersal, Types of seeds and Seed germination	8
3	Internal structure of plant organs • Plant Tissues and tissue systems, • Meristematic Tissue and its Type - with example • Permanent Tissue - Simple and Complex - with example	4
4	Internal organization of plant body • Primary structure of shoot, root & leaf. • Secondary growth, growth rings formation: cambium and its activities, periderm- cork cambium, secondary cortex and cork.	8

Recommended Textbooks and References

1. Taiz L, Zeiger E 2006 Plant Physiology 4th edition Sinauer Associates Inc.
2. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, New York, USA.
3. Economic Botany: Hill, A.W ; McGraw Hill Book Co., New York.
4. Economic Botany: Pandey, B.P. ;S.Chand and Co., New Delhi.
5. Economic Botany: Sen, S. ; New Central Book Agency, Calcutta.

Course Code and Title: USBT-126 Microbiology II**Credits-2****Lectures: 30****Course Outcomes:**

1. To learn bacterial nutrition and different cultivation techniques
2. To learn basics of sterilization and disinfection

Units	Topics	Number of Lectures
1	<p>Cultivation, growth and isolation of microorganisms: Basic Nutritional (Macro and micro), and environmental requirements (Hydrogen ion concentration, Temperature and Oxygen and other), Nutritional classification of bacteria</p> <ul style="list-style-type: none"> · Design of media (Bacterial and Fungal): Types of media and Composition: Liquid, semi-solid and solid media, Selective media, Enrichment media, Enriched media, differential media, selective and differential media, Minimal media and there uses. · Reproduction in microorganisms: Binary Fission and other asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate. · Cultivation –Concept of Pure culture, co-culture and Mixed culture, Colony characteristics. · Isolation of microorganisms and pure culture techniques: Streak, Spread, Serial Dilution, Pour plate, Enrichment, Single cell isolation Colony · Preservation and Maintenance methods 	15
2	<p>Control of microbial growth: Definition: Sterilization and Disinfection.</p> <ul style="list-style-type: none"> · Physical Agents – Heat (Dry and Moist heat), pasteurization, Radiation, Filtration · Principle and working of Autoclave and Hot air oven. · Sterilization Efficiency · Chemical Agents and their Mode of Action - Aldehydes, Halogens, Quaternary Ammonium 	12

	<p>Compounds, Phenol and Phenolic Compounds, Heavy Metals, Alcohol, Dyes, and Detergents</p> <ul style="list-style-type: none"> · Disinfectant-Characteristics of an Ideal disinfectant, Examples of Disinfectants and Evaluation of Disinfectant · Antibiotics and other chemotherapeutic agents- Examples and mode of action (one example each), Concept of MIC and MBC 	
3	<p>Microbial Interactions (Any 2 examples each)</p> <p>Microbe-Plant,</p> <ul style="list-style-type: none"> · Microbe-Animal · Microbe-Microbe interaction · Handling of microorganisms and Biosafety measures. 	3

Recommended Textbooks and References

1. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology.3rd Edition. Thomson Brooks / Cole.
2. Madigan M.T., Martinko J.M. (2006). Brock’s Biology of Microorganisms. 11th Edition. Pearson Education Inc.
3. Prescott L.M., Harley J.P., AND Klein D.A. (2005). Microbiology, 6th Edition. MacGraw Hill Companies Inc.
4. Salle A.J. (1971) Fundamental Principles of Bacteriology.7th Edition. Tata MacGraw Publishing Co.
5. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5th Edition. Macmillan Press Ltd.
6. Tortora G.J., Funke B.R., Case C.L. (2021). Microbiology: An Introduction. 13th Edition. Pearson Education Inc.

Course Code and Title: USBT-127 Biomathematics and Biostatistics II**Credits-2****Lectures: 30****Course Outcomes:**

1. Introduction to Concepts of calculus and vectors and its application in field of biotechnology
2. Concepts of probability and Hypothesis testing

Units	Topics	Number of Lectures
	Mathematics	15
1	<p>Linear equations Homogeneous and non-homogeneous linear equation system Eigen values and Eigen vectors, Applications of linear equations in biology</p> <p>Differentials equations Types (ordinary and partial), order and degree of differential equation. Homogeneous and non-homogeneous differential equation. Applications: growth and decay, law of cooling."</p>	8
2	<p>Differential Calculus Derivative and its physical significance, derivative of a function, implicit function, basic rules for differentiation, maxima and minima – their applications in biology (wave equation, heat equation, laplace equation).</p> <p>Integral Calculus Integration of functions, basic rules for integration, definite and indefinite integrals, geometric meaning of integration, applications in finding area under curves. Applications of integration in biology.</p>	7
	Biostatistics	15
3	<p>Probability and probability distribution Probability theory experiments · Discrete random variable, binomial distribution and the poisson distribution, Normal distribution and application in biosciences</p>	7
4	Hypothesis testing and correlation	8

	Purpose of hypothesis testing, data, assumptions and hypothesis, significance level, types of errors · Test statistics: Testing mean, testing variance, distribution of test statistics (t and z). · Student's t – test, chi square test, ANOVA (One and Two way)	
--	---	--

Recommended Textbooks and References:

1. Fundamentals of Mathematical Statistics by S.C. Gupta and V. K. Kapoor. Sultan Chand & Co.
2. Introduction to the Practice of Statistics, by David S. Moore, George P. McCabe, and Bruce A. Craig, 9th Edition, W.H. Freeman and Co., New York (2017).
3. P.S.S. Sunderrao and J. Richards-An introduction to Biostatistics, Prentice Hall Pvt. Ltd. India
4. Fundamentals of Biostatistics. By Irfan A Khan. 8. Campbell R.C.- Statistics for Biologists, Cambridge University Press, Cambridge.

Course Code and Title: USBT-128 Computer in Biology**Credits-2****Lectures: 30****Course Outcomes:**

1. To learn the history of computers with knowledge of past and current operating systems
2. To learn contemporary languages like python
3. To learn applications of computer in Biology

Units	Topics	Number of Lectures
1	History: Generations of computers (I, II, III, IV, V) · Modern computers The workstation, The Minicomputer, Mainframe Computers, Parallel processing Computer & The Super Computer.	2
	Introduction to computers: · Overview and functions of a computer system · Input and output devices · Storage devices: Hard disk, Diskette, Magnetic tape, RAID, ZIP devices, Digital tape, CD-ROM, DVD (capacity and access time)	3
	Introduction to operating system: · Operating system concept, services of operating system, features of latest version of Windows and unix/Linux, Macintosh	4
2	Data processing & presentation: · Introduction: MS office (Word, Excel & Power Point)	4
	Computer viruses: · An overview of Computer viruses · What is a virus? Virus symptoms, How do they get transmitted? · General Precautions	3
3	Databases Introduction & need of databases, Types of databases Text Databases, Introduction to Biological database, Types of Biological Database Internet searches: Concepts in text-based searching, Searching Medline. Pub Med, bibliographic database	4

4	<p>Bioinformatics: Introduction to bioinformatics, History, Goals, Relation to other fields.</p>	2
5	<p>Introduction to Python</p> <ul style="list-style-type: none"> • What is Python programming? • Application of Python • Python identifiers and reserved words • Lines and indentation, multi-line statements and Comments • Input/output with print and input functions, • Standard data types - basic, none, Boolean (true & False), numbers • Python basic operators (Arithmetic, comparison, assignment, bitwise logical) • Python sample program 	8

Recommended Textbooks and References

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

Course Code and Title: USBTP-129 Practical in Chemistry and Biochemistry

Credits-1.5

Total Practical= 15 (15x3 hrs.)

Course Outcomes:

1. To study various methods of separation and estimation techniques.
2. To determine pI of amino acid and isoelectric point of proteins.
3. To learn methods for estimation of Proteins.

Practicals in Chemistry

Units	Title of Experiments	Number of practical
1	Viscometer: To determine viscosity of a given liquid by Ostwald's viscometer	1
2	Chemical Kinetics: To study kinetics of ester hydrolysis	1
3	Titration: To determine content of acetic acid in vinegar using NaOH	1
4	Titration: To determine normality/molarity using acid base volumetric titration	2
5	Separation techniques: · To study Separation Techniques like Recrystallization, distillation, sublimation, · To separate plant pigments by TLC	2

Practicals in Biochemistry

Units	Title of Experiments	Number of Practicals
1	Spot test for amino acids	1
2	Isoelectric pH of amino acid	1
3	Estimation of Protein by Biuret Method	1
4	Estimation of Protein by Lowry Method	1
5	Absorption spectra for DNA, RNA and Proteins and to find absorption maxima	1
6	Isoionic precipitation of Milk	1
7	Enzyme activity: To find out enzyme activity (amylase)	1

Course Code and Title: USBTP-1210 Practical in Plant Science and Animal Science

Credits-1.5

Total Practical= 15 (15x3 hrs.)

Course Outcomes:

1. To study plant water relations
2. To study primary metabolic processes like Photosynthesis, respiration, mineral nutrition, hormonal regulation and biotic diseases of plants.
3. To describe the morphology and anatomy of mouth parts, pollen basket sting apparatus legs and wings of honey bees
4. To identify and study Fasciola and Plasmodium with signet ring stage,

Practicals in Plant Science

Units	Title of Experiment	Number of Practicals
	Plant	
1	Study the process of Osmosis and Turgor pressure and determination of Diffusion Pressure Deficit	1
2	Determination of rate of respiration	1
3	Estimation of chlorophyll content in photosynthesizing and non-photosynthesizing leaves	1
4	Study of mineral deficiency and their symptoms in plants	1
5	Effect of plant growth regulators on germination of seed	1
6	Study of Plant diseases: one example each of Viral, Fungal and Bacterial disease	1
7	Studies on economically important plants: Students should prepare herbarium specimens with their uses	1

Practicals in Animal Science

Units	Title of Experiments	Number of Practicals
1	Study and Dissection of Honey Bee, Mounting of Mouth parts, pollen basket, Antenna Cleaner, Sting Apparatus, legs and wings	4
2	Study of Plasmodium sps.	1
3	Study of Fasciola sp.	1
4	Enumeration of red blood cells using haemocytometer	1
5	Study of spermatogenesis and oogenesis (permanent slides)	1

Course Code and Title: USBTP-1211 Practical in Microbiology II and Bioinstrumentation

Credits-1.5

Total Practical= 15 (15x3 hrs.)

Course Outcomes:

1. To learn media preparation and different cultivation techniques and control of microbial growth.
2. To learn basic construction, working, principle and applications of different instruments used in the biotechnology laboratory.

Practicals in Microbiology

Sr.No	Title of Experiment	Number of Practicals
1	Preparation of Media and Glassware Bacterial growth media- Nutrient broth, Nutrient agar plates, butts and slants, MacConkey's agar plates. · Fungal growth media- potato dextrose agar plates	2
2	Aseptic transfer techniques	1
3	Demonstration of microbes in air, on table surface, finger tips on nutrient media.	1
4	Cultivation of microorganisms: Isolation and purification of bacteria by a. streak plate b. Enumeration of bacteria by using following techniques: Spread plate · Serial dilution and Pour plate · Neubauer's chamber (yeast cells)	4

Practicals in Bioinstrumentation

Units	Title of Experiments	Number of Practicals
1	Working and components of various types of Centrifuges	1
2	Microscopy – Components and working of Bright field compound microscope	1
3	Functioning and Standardization of pH meter and Preparation of buffers and measurement of pH	2
4	Beer and Lambert's Law – Components and working of Colorimeter, Spectrophotometer	1

5	Absorption spectra of DNA, RNA and protein	1
6	To find out isoelectric point of amino acids	1

Course Code and Title: USBTP-1212 Practical in Computers and Biostatistics

Credits-1.5

Total Practical= 15 (15x3 hrs.)

Course Outcomes:

1. To understand basics of computer science and to learn its applications in the field of biology
2. To learn and analyse biological data using different tests like ANOVA, t Test etc.

Practicals in Computer

Units	Topics	Number of practical
1	Word Processing (Microsoft Word): Creating, Saving & Operating a document, Editing, Inserting, Deleting, Formatting, Moving & Copying Text, Find & Replace, Spell Checker & Grammar Check, Document Enhancement (Borders, Shading, Header, Footer), Printing Document (Page Layout, Margins),	2
2	Introduction to the use of Wizards & Templates, Working with Graphics (Word Art), Working with Tables & Charts, Inserting Pictures	1
3	Spreadsheet Applications (Microsoft Excel): Worksheet Basics: Entering information in a Worksheet, Saving & Opening a Worksheet, Editing, Copying & Moving Data, Inserting, Deleting & Moving Columns & Rows, Clearing.	3
4	Database Applications (Microsoft Access): Fields, Records, Files, Organization of Files. Access Modes: Updating Records, Querying, Reports, Forms & sub forms.	1
5	Introduction to Python and basic programme in Phyton	3

Practical in Biostatistics

Units	Topics	Number of Lectures
1	Use of spreadsheets for data organization for mathematics calculations	2
2	Hypothesis testing using 'Data analysis tools': t-test	1

3	Hypothesis testing using 'Data analysis tools': Chi square test	1
4	Analysis of variance	1