Course Type	Subjectcode	Course	Course/Paper Title	Hours /Week	Credit	CIA	ESE	Total
Major Mandatory (4+4+2)	23ScBleU5101	Major Core Paper 9 (Theory + Practical)	Biochemistry (T+P)	2 4	4	40	60	100
	23ScBleU5102	Major Paper 10 (Theory +Practical)	Molecular Biology (T +P)	2 4	4	40	60	100
	23ScBleU5103	Major Paper 11(Theory)	Methods in biology	2	2	20	30	50
Major Electives	23ScBleU5201	Elective I (Theory + Practical)	Animal Sciences (T +P)	2 4	4	40	60	100
	23ScBleU5202	Elective II (Theory + Practical)	Genetic Engineering (T +P)	2 4	4	40	60	100
Minor (4)	23ScBleU5301	Minor Paper IV (Theory +Practical)	Plant Sciences (T+P)	2 4	4	40	60	100
OE(2+2)		--	--	--	--	--	--	--
VSC (2)	23ScBleU5501	Major Specific Practical III	Analysis of Biological Data	4	2	20	30	50
SEC (2)		--	--	--	--	--	--	--
AEC(2),		--	--	--	--	--	--	--

VEC (2)		--	--	--	--	--	--	--
IKS (2)		--	--	--	--	--	--	--
FP/CEP(2)	23ScBleU5002	FP–II	Field Project II	4	2	20	30	50
Total				26	22	220	330	550

Semester 6 (Third Year)

Course Type	Subjectcode	Course	Course/Paper Title	Hours /Week	Credit	CIA	ESE	Total
Major Mandatory (4+4+2)	23ScBleU6101	MajorPaper 12 (Theory +Practical)	Evolutionary Developmental Biology(T+P)	2 4	4	40	60	100
	23ScBleU6102	MajorPaper 13 (Theory +Practical)	Systematics and Evolution(T+P)	2 4	4	40	60	100
	23ScBleU6103	MajorPaper 14 (Theory)	AppliedBiology	2	2	20	30	50
Major Electives	23ScBleU6201	ElectiveII (Theory + Practical)	Microorganismsand Diseases (T +P)	2 4	4	40	60	100
	23ScBleU6202	ElectiveII (Theory+ Practical)	ScientificWriting(T +P)	2 4	4	40	60	100
Minor (4)	23ScBleU6301	Minor PaperIV (Theory) Minor Paper IV(Practical)	Computational Biology(T+P)	2 4	4	40	60	100
OE(2+2)		--	--	--	--	--	--	--
VSC (2)		--	--	--	--	--	--	--
SEC (2)		--	--	--	--	--	--	--
AEC(2),		--	--	--	--	--	--	--

VEC (2)		--	--	--	--	--	--	--
OJT (4)	23CpCopU6004	OJT	Onjob Training	8	4	40	60	100
FP/CEP(2)		--	--	--	--	--	--	--
Total				26	22	220	330	550

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Third Year of B.Sc. Blended (Biosciences)

(2023 Course under NEP 2020)

Course Code: 23ScBleU5101 **Course Name: Biochemistry(T+P)**

Teaching Scheme: TH: 2 Hours/Week **Credit: 4(2T+2P)**

P: 4 Hours/Week

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses: Biology and chemistry

Course Objectives:

- Students will be given the basic information of bimolecular, metabolic pathways,

Course Outcomes:

On completion of the course, student will be able to–

- Apply the basic knowledge of biochemistry in the field of biology

Course Contents

Semester V

Chapter	Title	Lectures
Chapter-1	**Basic bio molecules and their properties**	**5 Lectures + 2 Tutorials**
	• Sugars, • Amino acids, • fatty acids and nucleic acids, • Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc)	
Chapter-2	**Biological thermodynamics**	**5 Lectures+2 Tutorials**
	• Concept of free energy,	

	• energy rich compounds, • Free energy and oxidation reduction reactions. • Energy cycle	
Chapter-3	**Enzymes**	**6 Lectures+ 2 tutorials**
	• Definition, classification, properties, • Lock and key hypothesis, • factors affecting activity of enzymes, Kinetics, • Coenzymes and role in biological systems. • Isoenzymes and their role. Ligand Binding and Allostery	
Chapter-4	**Metabolic pathways**	**12 Lectures + 3 Tutorials**
	• Carbohydrate metabolism- Glycolysis, fates of pyruvate: cori cycle fermentation, ED pathway, TCA cycle, Anapleurotic reactions, gluconeogenesis, glycogen breakdown and glycogen synthesis, Glyoxylate pathway, pentose phosphate pathway. Regulation of pathways. • Lipid metabolism Action of lipases, Beta oxidation of Fatty acids (Even No.) ketone bodies, synthesis of fatty acids, overview of cholesterol synthesis. And phospholipid synthesis • protein metabolism Metabolic fates of amino acids, transamination, transfer of amino group by glutamate, urea cycle, Amino Acid Biosynthetic Families, Grouped by Metabolic Precursorj	
Chapter-5	**Techniques to purify and characterize biomolecules**	**8 Lectures**

Suggested Reference books:

1. John Kuriyan, Boyana Konforti & David Wemmer; The Molecules of life: Physical and Chemical Principles, (2013), Garland Science

2. Lehninger Principles of Biochemistry David L. Nelson, Michael M. Cox. Publisher: W. H. Freeman, Fourth Edition

3. Jeremy M Berg; John Tymoczko; Lubert Stryer (2012), Biochemistry, 7th/6th edition (or older), Wiley.

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(2023 Course under NEP 2020)

Course Code: 23ScBleU5102 **Course Name: Molecular Biology (T+P)**

Teaching Scheme: TH: 2Hours/Week **Credit: 4(2T+2P)**

P: 4 Hours/Week

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses: Biology, chemistry and biochemistry

Course Objectives:

- Students will be given the basic information of nucleic acids, basic processes like replication, transcription and translational.

Course Outcomes:

On completion of the course, student will be able to–

- Apply the basic knowledge of molecular biology in the field of biology

Course Contents

Semester V

Chapter	Title	Lectures
Chapter-1	**Central Dogma in Biology**	**2Lectures+ 2 Tutorials**
	• **Central Dogma in Biology:** A historical perspective	
Chapter-2	**Maintenance of the genome**	**6Lectures + 2 Tutorials**

	• DNA, Chromosomes and Genome • Replication of DNA • The Mutability and Repair of DNA • Homologous Recombination at the Molecular Level	
Chapter-3	**Gene expression**	**20Lectures+ 3 Tutorials**
	• Transcription and Transcription regulation • Transcription machinery • Concept of operon • Gene regulation in prokaryotes and eukaryotes • RNA Editing • Translation • -Post translational modifications and protein folding	
Chapter-4	**Techniques in Molecular Biology**	**8 Lectures + 2 Tutorials**
	• Molecular Cloning methods • Molecular Tools for Studying Genes and Gene Activity	

Suggested Reference books:

1. Molecular Biology of the Gene by Watson, Baker, Levine, Losick et al. [2007] 6 Ed. Benjamin Cummings

2. Principles of Gene Manipulation by Primrose, Twyman, Old [2002] 6 Ed. Wiley-Blackwell

3. Molecular Biology by Weaver [2011] 5 Ed. McGraw- Hill Science.

4. Molecular Biology and Genomics by Mulhardt [2006] 1 Ed. Elsevier.

Course Code: 23ScBleU5103 **Course Name: Methods in Biology**
Teaching Scheme: TH: 2 Hours/Week **Credit: 2T**
Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisite Courses: Basic knowledge of biology, chemistry, physics.

Course Objectives:

- Students will be given the basic information of techniques used in biology

Course Outcomes:

On completion of the course, student will be able to–

- Apply the basic knowledge of techniques and methods in the field of biology

Course Contents

Semester V

Chapter	Title	Lectures
Chapter-1	**Molecular Biology and recombinant DNA technology Methods**	**6 Lectures + 2 Tutorials**
	• Gene cloning and transformation of cells(Suitable example) • DNA and protein sequencing methods • Polymerase chain reaction and Genomesequencing: genomic and cDNA libraries.	
Chapter-2	**Histochemical and Immunological techniques**	**4 Lectures+1Tutorials**
	• Detection of molecules in living cells: ▪ FISH and GISH *in situ* localization ▪ Immunofluorescence microscopy ▪ Flow cytometry and cell sorting	
Chapter-3	**Biophysical Methods**	**5 Lectures+ 1 tutorials**
	• Molecular structure determination by X-ray and NMR studies • ESR, Circular Dichroism and mass spectrometry	
Chapter-4	**Radiolabelling Techniques**	**4 Lectures + 1 Tutorials**
	• Safety guidelines • Addition of radioisotopes in biological cells and tissues	

	• Measurement and detection of radioisotopes in biological samples by autoradiography	
Chapter-5	**Electrophysiological Methods**	**5 Lectures + 1 Tutorials**
	• CAT,MRI,PET,ECG, Brain activity recording • Patch clamp recording	

Suggested Reference books:

1. Wilson K. and Walker J. Seventh Ed.Principals and Techniques of Biochemistry and Molecular Biology
2. Ghatak 2011Techniques and methods in Biology PHI learning Private Limited.
3. Jost J. 2014 Mathematical Methods in Biology and NeurobiologySpringer-Verlag London
4. Christina E. (Ed.) 2014 Histopathology: Methods and Protocol,Springer Protocols.

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(2023 Course under NEP 2020)

Course Code: 23ScBleU5201 **Course Name: Animal Sciences (T+P)**

Teaching Scheme: TH: 2 Hours/Week **Credit: 2T+ 2P**

PR: 4 Hours/Week

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses: Zoology and Biology.

Course Objectives:

- Students will be given the basic and advance information of animal sciences

Course Outcomes:

On completion of the course, student will be able to–

- Apply the basic knowledge of animal sciences in the field of biology

Course Contents

Chapter	Title	Lectures
Chapter-1	**Animal development**	**15 L**

	• Gametogenesis: oogenesis and spermatogenesis Fertilization • Types and patterns of cleavage, blastulation • Gastrulation in amphioxus, frog and chick up to formation of three germinal layers • Overview of organogenesis in frog, chick • Concept of stem cells, Progenitor cells, cell lineages, determination, commitment and differentiation • Concept of dedifferentiation, redifferentiation, transdifferentiation • Role of gene/s in patterning and development of *Drosophila*.	
Chapter-2	**Cell signaling and signal transduction**	**8 L**
	• Communication between cells,n signaling molecules, major signaling pathways – • G protein coupled receptors, Ras map pathway. • Role of secondary messengers in cell signaling	
Chapter-3	**Techniques in animal sciences**	**7 L**

Suggested Reference books:

1. Development Biology, 9th edition, (2010), Gilbert S.F.(Sinauer Associates, USA)

2. Principles of Development, 4th edition (2010), Wolpert L and Tickle C, Publisher: Oxford University Press, USA.

3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA

4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA

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Third Year of B.Sc.Blended (Biosciences)

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Course Code: 23ScBleU5301 **Course Name: Plant Sciences (T+P)**

Teaching Scheme: TH: 2 Hours/Week **Credit:4C (2T+2P)**

P: 4 Hours/Week

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses: Botany and Biology.

Course Objectives:

- Students will be given the basic and advance information of plant sciences

Course Outcomes:

On completion of the course, student will be able to–

- Apply the basic knowledge of plant sciences in the field of biology and taxonomy.
- It will help student to identify plants,classification and uses of plants.

Course Contents

Chapter	Title	Lectures
Chapter-1	**Plant Taxonomy and morphology**	**10 Lectures+ 3 Tutorials**
	• **Introduction to Plant Taxonomy** • Definition, scope, objectives and importance • Identification, classification, nomenclature - Concept of Systematics • Study of Plant Families Study of following families with reference to systematic position, salient features, floral formula, floral diagram, and any five examples with their economic importance – Malvaeceae, Meliaceae, , Rubiaceae,Solanaceae, Asclepiadaceae, Euphorbiaceae and Liliaceae • .Morphology- Phylotaxy, Inflorescence and fruit types.	
Chapter-2	**Plant metabolism and Biochemistry**	**8 Lectures+ 3Tutorials**

	• Nitrogen Metabolism: Biological nitrogen fixation and nitrogen cycle, ammonia assimilation, • Secondary Metabolites and their roles: Introduction to alkaloids, phenolics, plant terpenes, phytoalexins, sesquiterpenes and sterols • Cell signaling in plants.	
Chapter-3	**Plant development**	**12 Lectures+ 3 Tutorials**
	• Plant Embryology- Introduction, Definition and scope of plant embryology. • Microsporangium and male gametophyte -: Male gametophyte: structure and development of male gametophyte. • Megasporangium and female gametophyte-. a. Megasporangium: structure, types of ovules b. Megasporogenesis: structure and development of female gametophyte. • Fertilization: double fertilization (syngamy and triple fusion) and its significance. • Major phases of plant development - Vegetative development, Pattern formation in plants- vegetative Reproductive development: Shift from vegetative to reproductive phase, Pattern formation in plants- flowering	
Chapter-4	**Techniques in plant sciences**	**6 Lectures**

Suggested Reference books:

1. Taiz L, Zeiger E (2010) – Plant physiology (Sinauer Associates, USA).

2. Sharma HP (2009) – Plant embryology: Classical and experimental (alpha sci)
3. Steeves TA & Sussex IM (2004) – Patterns in plant development. (Cambridge Univ Press, Cambridge, New York)

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(2023 Course under NEP 2020)

Course Code: 23ScBleU5501 **Course Name: Analysis of Biological Data**
Teaching Scheme: TH: 4 Hours/Week **Credit: 2P**
Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisite Courses: Mathematics, Statistics and Biology.

Course Objectives:

- Students will be given the basic and advance information of statistics and analysis of data

Course Outcomes:
On completion of the course, student will be able to–

- Apply the basic knowledge of data, data analysis in the field of biological research.

Course Contents

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Course Code: 23ScBleU5501 **Course Name: Analysis of Biological Data**
Teaching Scheme: TH: 4 Hours/Week **Credit: 2C (2P)**
Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisite Courses: Mathematics, Statistics and Biology.

Course Objectives:

- Students will be given the basic and advance information of statistics and analysis of data

Course Outcomes:

On completion of the course, student will be able to–

- Apply the basic knowledge of data, data analysis in the field of biological research.

Course Contents

Semester I

	Title	15 Practicals
Practical 1	**Statistics and biology**	**2 Practical**
	• Data, what it is, data types. Displaying data, • Principles of graphical summary. Types of study; population and sample; sampling. • Measures of location: proportion, mean, median, mode. Measures of spread: quartiles, IQR, SD, Variance	
Practical 2	**Introduction to probability**	**1 Practical**
	• Conditional probability and independence. Random variables and probability distributions. Common pdfs for biological data + CLT	
Practical 3	**Point estimation**	**1 Practical**
	• Sampling and estimation. • Sampling and standard errors. • Confidence intervals	
Practical 4	**Sampling distribution**	**2 practical**
	• Sampling distributions and interval estimation (z) and (t). • Bootstrap inference. • Inference and Models • NHST. Hypotheses with numerical data: One sample z-test	
Practical 5	**NHST in perspective**	**1 Practical**
	• Goodness of fit.	

	• Contingency analysis. • Comparing means from paired data. • Comparing population means	
Practical 6	**Experimental design**	**2 Practical**
	• Experimental design: space, time; blocking and randomisation; controls, bias, replication, and balance. Precision and Power	
Practical 7	**Analysis of variance**	**1 Practical**
	The linear model. Analysis of variance. Comparing models (likelihood)	
Practical 8	**Correlation**	**2 Practical**
	• Correlation covariance. Linear regression. Inference for regression. Extending the regression model (Multiple regression). Multiple regression (interactions, polynomials). Analysis of covariance. Two-way ANOVA w interactions. Shrinkage estimation methods	
Practical 9	**Logistic regression**	**1 Practical**
	• GLM. Logistic regression	
Practical 10	**Model selection**	**1 Practical**
	• Model selection: AIC; BIC; Stepping; CrossValidation	
Practical 11	**Probability**	**1 Practical**
	• Law of total probability, and Bayes. • Introduction to Bayesian inference	

Suggested Reference books:

1) Dutta, N. K. (2004). Fundamentals of Biostatistics, Kanishka Publishers.
2) Gurumani N. (2005). An Introduction to Biostatistics, MJP Publishers.
3) Daniel, W. W. (2007). Biostatistics- A Foundation for Analysis in the Health Sciences,Wiley.
4) Rao, K. V. (2007). Biostatistics – A Manual of Statistical Methods for use in

Health Nutrition and Anthropology.

5) Pagano, M.& Gauvreau, K. (2007). Principles of Biostatistics.
6) Rohatgi, V.K.& Saleh, A.K.Md. (2001). An Introduction to Probability and Statistics,John Wiley & Sons.
7) Sundaram, K.R.(2010) Medical Statistics-Principles & Methods, BI Publications,New Delhi

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Semester VI

Course Code: 23ScBleU6101 Course Name: Evolutionary Developmental Biology
Teaching Scheme: TH: 2Hours/Week Credit: 2T+2P
P: 4 Hours/Week

Examination Scheme: CIA: 40 Marks End-Sem:60 Marks

Prerequisite Courses:

Basic knowledge of Evolution required that will help to study of its other divisions.

Course Objectives:

- To give the students an understanding of the concept of development on the genetic content of a species
- The understanding of the role of evolution on the different aspects of how species have evolved to present times
- The role of conserved genes and epigenetics in development during evolution
- Theories put forward to explain the mechanism of development

Course Outcomes:

- An understanding of how development, epigenetics and phylogeny are useful in understanding evolution.

Course Contents

Chapter	Title	Lectures
Chapter 1	**Ontogeny and phylogeny**	**2 Lectures+1Tutorial**
	• Ontogeny of some animal and plant groups, as well as their organ systems, in a phylogenetic perspective • Steven J. Gould – Ontogeny and Phylogeny	
Chapter 2	**Concepts of Evolutionary developmental biology**	**3 Lectures + 1 Tutorial**
	• Concepts of Evolutionary developmental biology • Introduction to developmental biology from a historical and evolutionary perspective	
Chapter 3	**Ontogeny, Recapitulation and Epigenesis**	**3 Lectures+1 Tutorial**
	• Haeckel, von Baer, • the biogenetic law,	
Chapter 4	**Evolutionary morphology**	**3 Lectures + 1 Tutorial**
	• Fritz Muller (using embryology to discover relationships) • Implications of similarity in early developmental stages (eg Barnacle larvae are arthropod-like, not molluscan; Tunicates are Chordates) • D'Arcy Thomson – On Growth and Form (minor changes in shape lead to major changes in morphology)	
Chapter 5	**The Modern Synthesis (early 20thC)**	**4 Lectures + 1 Tutorial**
	• Ronald Fischer: Integration of Darwin's Theory of Natural Selection with Mendel's laws of genetics • Gene-protein-structure; Gene mutation-change in biochemical pathway	

	• Gavin deBeer: Changes in timing of developmental events - Heterochrony, neoteny	
Chapter 6	**Second Synthesis and deep homology**	**4Lectures + 1 Tutorial**
	• Steven J. Gould – Ontogeny and Phylogeny • Homeotic genes in *Drosophila* and the emergence of developmental genetics • Homeobox genes as a eukaryotic feature • The concept of Deep Homology • Highly conserved genes control dissimilar organs in different organisms; eg pax-6 in eyes of insects, cephalopods and vertebrates.	
Chapter 7	**Homeobox genes and the Gene Toolkit**	**6 Lectures + 1 Tutorial**
	• Regulation of transcription factors • HOX genes in animals – axis development and segmentation • MADS-box genes in plants and the ABC model of flower development • Hen's Teeth	
Chapter 8	**Embryo regulatory networks and epigenetics**	**6Lectures + 1 Tutorial**
	• Pleiotropy • Origins of novelty are not mutations in genes, but variation in the toolkit • Case-studies (eg.*Distal-less* affecting snake's legs, fruit fly antennae, butterfly wing spots, vertebrate mandibles) • Epigenetics	
Chapter 9	**Origins of novel features**	**5Lectures + 1 Tutorial**
	• Variations in the toolkit • Consolidation of epigenitic changes • Developmental bias and constraint	

References:

1. Brian K. Hall Evo Edu Outreach (2012) 5:184–193 DOI 10.1007/s12052-012-0418-x Evolutionary Developmental Biology (Evo-Devo): Past, Present, and Future

2. Arthur W. A theory of the evolution of development. Chichester: Wiley; 1988.

3 Gehring WJ. Master control genes in development and evolution: the homeobox story. New Haven: Yale University Press; 1998

4 Gilbert SF, Apel D. Ecological developmental biology: integrating epigenetics, medicine, and evolution. Sunderland: Sinauer Associates; 2008

5 Biémont C. From genotype to phenotype. What do epigenetics and epigenomics tell us? Heredity. 2010;105:1–3.

6 Bowler PJ. Life's splendid drama. Evolutionary biology and the reconstruction of life's ancestry 1860–1940. Chicago: The University of Chicago Press; 1996.

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Course Code: 23ScBleU6102 Course Name: Systematics and Evolution (T+P)

Teaching Scheme: TH: 2Hours/Week **Credit: 2T+2P**
P: 4 Hours/Week

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses:

Course Objectives:

- To Study the systematics, classification and evolution.

Course Outcomes:

On completion of the course, student will be able to–

- Obtain the latest developments in the field of Genetics and Immunology and applications of the same in diagnostics.

Course Contents

Chapter	Title	Lectures
Chapter 1	**Principles of classification of organisms at species rank**	**5 Lectures + 1 Tutorial**
	• purpose of classification, • monophyly/paraphyly/polyphyly,	

	• species concepts, • practical approaches to species delimitation (molecular/morphological/behavioural), • rules of nomenclature	
Chapter 2	**Method for phylogenetic inference from morphological and molecular data**	**6Lectures + 2 Tutorial**
	• Homology/analogy, synapomorphy, • Parsimony v. likelihood and Bayesian methods • types of molecular markers, including sequencing/genotyping methods/technology (Sanger, high throughput etc.), • properties of nuclear and organellar genomes, • some processes of molecular evolution (transitions/transversions, gene duplications, indels, polyploidy)	
Chapter 3	**Analysis of phylogenetic data, including the use of computer programs for assembling and analyzing morphological and molecular datasets**	**6 Lectures + 1 Tutorial**
	• Gene trees vs species trees: paralogy/orthology, incomplete lineage sorting • "capture" of organellar genomes through introgression, • concatenation vs concordance approaches to phylogenetic analysis	
Chapter 4	**Importance of biological collections to the discipline of systematics and familiarity with common curatorial practices and use of specimen data**	**7 Lectures + 2 Tutorial**
	• collecting methods, • vouchering, • specimens as objects for classifying, • distribution mapping, • databasing of specimens and name information, • ancient DNA techniques	
Chapter 5	**Inference of evolutionary and biogeographic patterns within and between species**	**6 Lectures + 2 Tutorial**
	• Use of phylogenies to infer rates of speciation and extinction • Historical biogeography: cf. ecological biogeography, vicariance/dispersal, molecular dating, patterns of diversity, endemism, phylogenetic diversity (focus on broad scale/higher-level patterns)	

	• Phytogeography(focus on within-species patterns; could tie back to species delimitation, introgression etc.)	
Chapter 6	**Biogeographic patterns in the Indian biota**	**6 Lectures + 1 Tutorial**
	• Biogeographic patterns in the Indian biota	

References:

1. M. Anji Reddy Textbook of Remote sensing and GIS (Third edition, 2006) by BS Publication,Hyderabad
2. George Joseph Fundamentals of remote sensing (Second edition, 2005) by Universities press (India) Private Ltd., Hyderabad.
3. 3. John R. Jensen Remote sensing of the environment (2000), Dorling Kindersley India Pvt. Ltd.
4. G.J. Rau and C.D. Weeten, "Environmental Impact Analysis Handbook, McGraw Hill, 1980.
5. E.P. Odum. 1996. Fundamentals of Ecology. Natraj Publishing, Dehradun.
6. Daubenmire.R.F. 1974. Plants and Environment- A Text Book of Plant Ecology (3rd edition). John Wiley & Sons. New York.
7. Kumar.H.D. 1996. Modern Concepts of Ecology (3rd edition). Vikas Publishing House Pvt., Ltd. Delhi.
8. Kumar.H.D. 1997. General Ecology. Vikas Publishing Pvt. Ltd., Delhi. 12.KermondyF.J. 1996. Concepts of Ecology.Prentice Hall of India Pvt. Ltd.,New Delhi.
9. Smith.L.R. 1996. Ecology and Field Biology (5th edition). Harper Collns College Publishers, USA.
10. Weaver. J.E. and Clements. S.E. 1966. Plant Ecology. Tata McGraw Publishing Co. Ltd. Bombay.

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(2023 Course under NEP 2020)

Course Code: 23ScBleU6103 **Course Name: Applied Biology**
Teaching Scheme: TH: 2 Hours/Week **Credit: 2T**
Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisite Courses: Basic knowledge of all branches of biology.

Course Objectives:

- Students will be given the basic information of applications of biology

Course Outcomes:

On completion of the course, student will be able to–

- Apply the basic knowledge of concepts, techniques, methods in the field of biology

Course Contents

Semester I

Chapter	Title	Lectures
Chapter-1	**Biodiversity uses and Bioresources**	**6Lectures + 1 Tutorials**
	• Bioresources and bioresource conservation • Bioresources for food and nutrition • Ethnic knowledge in bioresource conservation • Gene bank and Bioprospecting traditional medicines	
Chapter-2	**Marker Assisted breeding in Plants and Animals**	**5 Lectures+2Tutorials**
	▪ Marker Assisted Selection ▪ Types of Markers ▪ QTL mapping, DNA markers in animal and plant breeding	
Chapter-3	**Genomics applications in health**	**5 Lectures+ 1 tutorials**
	• Identification and diagnosis of genetic disorders • Parental diagnosis and testing • Pharmacogenetics and gene therapy • Personalized medicines	
Chapter-4	**Transgenic animals and plants**	**5Lectures + 1 Tutorials**
	• Transgenic animals in biomedical science • Transgenic animal in livestock maintenance • Transgenic plants in Nutrition improvement • Transgenic plants in high yield • Transgenic plants in disease resistance	

Chapter-5	Biosensors	3 Lectures + 1 Tutorials

Suggested Reference books:

1. Purohit and S.S. 2010 third edition Biotechnology: Fundamentals And Applications, Student edition.
2. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
3. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edition. Agrobios, India.
4. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
5. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
6. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
7. Robbins S.L. (1974) Pathological basis of Disease. W B Saunders Company
8. Macleod J.: Davidson's Principles & Practice of Medicine: A textbook for students and doctors' 14th Edition. Churchill Livingstone.
9. Guyton A.C. and Hall J.E. (2006) Textbook of Medical Physiology 11th edn. Saunders
10. Hage D S and Carr J D, (2010) Analytical Chemistry & Quantitative Analysis, Prentice Hall

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Third Year of B.Sc. (Blended)

(2023 Course under NEP 2020)

Course Code: 23ScBleU6201

Course Name: Microorganisms and Disease

Teaching Scheme: TH: 2 Hours/Week **Credit: 2 T**

Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisite Courses:

Course Objectives:

- To Study the microorganisms belonging to various groups.
- To understand the pathogenesis of disease caused by these organisms.
- To study the immunity mechanisms developed by higher animals and plants to counteract these pathogens.

Course Outcomes:

On completion of the course, student will be able to–

- Understand the mechanism using which the microorganisms cause disease.

Course Contents

Chapter	Title	Lectures
Chapter 1	**Prokaryote diversity and biology**	**5 Lectures + 1 Tutorial**
	● Bacteria and Archaea; Bacterial growth, reproduction, and genetics; Transformation ● Pathogenic examples (selected examples as case studies)	
Chapter 2	**Protist diversity and biology**	**6 Lectures + 1 Tutorial**
	● Major groups of protists (emphasis on major pathogenic lineages) ● Protist cell biology (eukaryotic); Evolution of protistan parasitism (from autotrophy); Obligate v. Facultative parasites ● Pathogenic examples (selected examples as case studies): Animal Blood and tissue - *Plasmodium*, *Toxoplasma*, *Babesia* (Apicomplexans); *Trypanosoma*, *Leishmania* (Kinetoplastids); *Naegleria* (Amoebae); Dinoflagellates (in fish, crustacea, bivalves). Animal gut and digestive - *Entamoeba* (Amoebae); *Balantidium* (Ciliate); *Giardia* (Diplomonad); *Trichomonas* (Parabasalids); *Cryptosporidium*, *Cystoisospora* (Apicomplexa). Plants - *Phytomonas* (Kinetoplastid disease of coconuts and oil palms); *Phytopthora* (Oomycete – potato blight). Red alga on red alga (substitution of nuclei).	
Chapter 3	**Fungal diversity and biology**	**5 Lectures + 2 Tutorial**
	● Fungal diversityand life cycles, major lineages ● Pathogenic examples (selected examples ascase studies): Microsporidians; Chytrids - *Batrachochytrumdendrobatidis* (chytridiomucosis in	

	amphibians), *Synchytriumendobioticum* (potato disease). Fungal Pathogens of animals - *Pneumocystis jiroveci*, other respiratory tract fungi; *Candida albicans*; Tinea. Fungal pathogens of plants	
Chapter 4	**Helminth diversity and biology**	**4 Lectures + 1 Tutorial**
	● Nematodes; Trematodes (flukes); Cestodes (tapeworms)	
Chapter 5	**Animal responses (immunology)**	**10 Lectures + 3 Tutorial**
	● Immune system and its evolution; Immunisation in mammals	
Chapter 6	**Plant responses**	**6 Lectures + 1 Tutorial**
	● Inducible defense; Microbe-associated molecular pattern (MAMP)-triggered immunity; R-genes (resistance to intracellular effectors) ● Hypersensitive response; Phytoalexins ● Plant Systemic Immunity: Systemic Acquired Resistance (SAR): Induced Systemic Resistance (ISR)	

References:

1. Kuby immunology, Judy Owen , Jenni Punt , Sharon Stranford., 7th edition (2012), Freeman and Co., NY
2. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India
3. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA.
4. Paniker's Textbook of Medical Parasitology,8th Edition, The health Sciences Publisher.

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Modern College of Arts, Science and Commerce,
Shivajinagar, Pune - 5
Third Year of B.Sc. (Blended)
(2023 Course under NEP 2020)

Course Code: 23ScBleU6202

Course Name: Scientific Writing
Teaching Scheme: TH: 2 Hours/Week **Credit: 2 T+2P**
P: 4 hours/Week

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses: Basics of English, English Grammar, Research Methodology.
Course Objectives:

- To Study methods and types of research communication.

Course Outcomes:

On completion of the course, student will be able to–

- Obtain the basics of scientific writing and scientific communication.
- Use the methods for project proposal writing, project thesis writing and publications.

Course Contents

Chapter	Title	Lectures
Chapter 1	Analysis and presentation data	**4L+1 tutorial**
	• Using graphs, presenting data in tables, Hints for solving numerical problems	
Chapter 2	The Internet and World Wide Web	**8L+1 tutorial**
	• internet resources for biosciences, using spreadsheets, word processors, databases and other packages, finding and citing information	
Chapter 3	Communicating information	**8 L+1 tutorial**
	• General aspects of scientific writing, writing essays, reporting practical and project work, writing literature surveys and reviews, organizing a poster display, giving an oral presentation examinations and preparation of scientific papers	
Chapter 4	Research Report	**7L+1 tutorial**
	• Format of the research report, style of writing the report, references and bibliography	
Chapter 5	Structure and Components of Research Report	**2L + 1 Tutorial**
	• Types of Report: research papers, thesis. Research Project Reports, Pictures and Graphs, citation styles,	
Chapter 6	Seminars and presentation skills	**1L + 1**

		Tutorial

Suggested References

Research Methodology. Methods and Techniques: C. R. Kothari,

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Third Year of B.Sc. (Blended)
(2023 Course under NEP 2020)

Course Code: 23ScBleU6301
Course Name: Computational Biology (T+P)
Teaching Scheme: TH: 4Hours/Week **Credit: 2T+2P**
Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses: Basics of molecular biology, gene sequencing techniques and computer science.

Course Objectives:

- To Study history, methods and softwares of computational biology.

Course Outcomes:

On completion of the course, student will be able to–

- Obtain the basics of computational biology,biological databases and tools in computational biology.
- Understand the applications of computational biology.

Course Contents

Chapter	Title	Lectures
Chapter 1	**Introduction to Bioinformatics and computational biology**	**5 Lectures + 2 Tutorial**

	• Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics	
Chapter 2	**Databases in Bioinformatics**	**5 Lectures + 2 Tutorial**
	• Introduction, Biological Databases, • Classification format of Biological Databases, Biological Database Retrieval System.	
Chapter 3	**Biological and Sequence Databases**	**6 Lectures + 2 Tutorials**
	• National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST) • Nucleotide Database, Protein Database, Gene Expression Database. EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools. DNA Data Bank of Japan Introduction, Resources at DDBJ, Data Submission at DDBJ. • Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR. Swiss-Prot: Introduction and Salient Features.	
Chapter 4	**Sequence Alignments**	**8 Lectures + 2Tutorial**
	• Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), • Blocks of Amino Acid Substitution Matrix (BLOSUM).	
Chapter 5	**Molecular Phylogeny**	**6 Lectures + 1 Tutorial**
	• Analyses Methods of Phylogeny, • Software for Phylogenetic Analyses, • Consistency of Molecular Phylogenetic Prediction.	
Chapter 6	**Applications of Bioinformatics**	**6 Lectures**

	• Drug Design, Microbial genome applications, Crop improvement, RNA-sequencing and transcriptomics, • Infectious disease modelling, • Analysis of complex ecological networks, Bayesian inference in systems biology	

References:

1. Robbe W. 2004 Computational Biology: Unix/Linux, Data Processing and Programming Springer-Verlag New York.

2. Fall C., MarlandE.,Wagner J., Tyson J. 2002 Computational cell biology Springer Verlag New York.

3. 3. Voit E. 2000 Computational Analysis of Biochemical Systems: A Practical Guide for Biochemists and Molecular Biologists Cambridge University Press.

4. CloteP.,Backofen R. 2000 Computational Molecular Biology: An Introducation John Wiley and Sons.