DAYANANDA SAGAR UNIVERSITY

SHAVIGE MALLESHWARA HILLS, KUMARASWAMY LAYOUT
BENGALURU – 560 113, KARNATAKA.

SCHOOL OF BASIC & APPLIED SCIENCES

SCHEME & SYLLABUS
FOR
BACHELOR OF SCIENCE (B.Sc.) – 2020

MICROBIOLOGY, BIOCHEMISTRY & GENETICS (MBG)

(With effect from 2020 – 21)

SCHEME – B.Sc. – 2020-21 ONWARDS

I SEM – MBG

(MICROBIOLOGY, BIOCHEMISTRY & GENETICS)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PRE REQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	113	20MB1101	BASIC MICROBIOLOGY	CR	4	-	-	-	4	*	***
2	113	20BC1101	BASIC BIOCHEMISTRY	CR	4	-	-	-	4	*	***
3	113	20GN1101	BASIC GENETICS	CR	4	-	-	-	4	*	***
4	113	20BS1101	BASIC CHEMISTRY	CR	4	-	-	-	4	*	***
5	113	20MB1171	BASIC TECHNIQUES IN MICROBIOLOGY	CR	-	-	4	-	2	*	***
6	113	20BC1171	BASIC BIOCHEMISTRY - LAB	CR	-	-	4	-	2	*	***
7	113	20GN1171	BASIC GENETICS - LAB	CR	-	-	4	-	2	*	***
8	113	20BS1102	COMMUNICATIVE ENGLISH	CR	2	-	-	-	2	*	***
					18	**-**	**12**	**-**	**24**		

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

SCHEME – B.Sc. – 2020-21 ONWARDS

II SEM – MBG

(MICROBIOLOGY, BIOCHEMISTRY & GENETICS)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PRE REQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	113	20MB1201	MICROBIAL PHYSIOLOGY	CR	4	-	-	-	4	*	***
2	113	20BC1201	BIOANALYTICAL TECHNIQUES	CR	4	-	-	-	4	*	***
3	113	20GN1201	FUNDAMENTALS OF CYTOGENETICS	CR	4	-	-	-	4	*	***
4	113	20BS1201	BIOINFORMATICS AND BIOSTATISTICS	CR	4	-	-	-	4	*	***
5	113	20MB1271	MICROBIAL PHYSIOLOGY - LAB	CR	-	-	4	-	2	*	***
6	113	20BC1271	BIOANALYTICAL SEPERATIONS - LAB	CR	-	-	4	-	2	*	***
7	113	20GN1271	FUNDAMENTALS OF CYTOGENETICS - LAB	CR	-	-	4	-	2	*	***
8	113	20BS1202	COMPUTER APPLICATIONS AND INFORMATION TECHNOLOGY	CR	2	-	-	-	2	*	***
					18	**-**	**12**	**-**	**24**		

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

SCHEME – B.Sc. – 2020-21 ONWARDS

III SEM – MBG

(MICROBIOLOGY, BIOCHEMISTRY & GENETICS)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PRE REQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	113	20MB2301	IMMUNOLOGY AND MEDICAL MICROBIOLOGY	CR	4	-	-	-	4	*	***
2	113	20BC2301	HUMAN PHYSIOLOGY	CR	4	-	-	-	4	*	***
3	113	20GN2301	BASIC HUMAN GENETICS AND GENETIC ENGINEERING.	CR	4	-	-	-	4	*	***
4	113	20BS2301	MOLECULAR BIOLOGY	CR	4	-	-	-	4	*	***
5	113	20MB2371	IMMUNOLOGY AND MEDICAL MICROBIOLOGY - LAB	CR	-	-	4	-	2	*	***
6	113	20BC2371	CLINICAL BIOCHEMISTRY - LAB	CR	-	-	4	-	2	*	***
7	113	20GN2371	BASIC HUMAN GENETICS AND GENETIC ENGINEERING - LAB	CR	-	-	4	-	2	*	***
8	113	20BS2302	ENVIRONMENTAL SCIENCE	CR	2	-	-	-	2	*	***
					18	**-**	**12**	**-**	**24**		

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

SCHEME – B.Sc. – 2020-21 ONWARDS

IV SEM – MBG

(MICROBIOLOGY, BIOCHEMISTRY & GENETICS)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PRE REQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	113	20MB2401	INDUSTRIAL, FOOD AND DAIRY MICROBIOLOGY	CR	4	-	-	-	4	*	***
2	113	20BC2401	ENZYMOLOGY AND PROTEIN CHEMISTRY	CR	4	-	-	-	4	*	***
3	113	20GN2401	APPLIED GENETICS	CR	4	-	-	-	4	*	***
4	113	20BS2401	GENOMICS AND PROTEOMICS	CR	4	-	-	-	4	*	***
5	113	20MB2471	INDUSTRIAL, FOOD AND DAIRY MICROBIOLOGY -LAB	CR	-	-	4	-	2	*	***
6	113	20BC2471	ENZYMOLOGY - LAB	CR	-	-	4	-	2	*	***
7	113	20GN2471	APPLIED GENETICS - LAB	CR	-	-	4	-	2	*	***
8	113	20BS2402	BIOETHICS AND IPR	CR	2	-	-	-	2	*	***
					18	**-**	**12**	**-**	**24**		

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

SCHEME – B.Sc. – 2020-21 ONWARDS

V SEM – MBG

(MICROBIOLOGY, BIOCHEMISTRY & GENETICS)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PRE REQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	113	20MB3501	AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY	CR	4	-	-	-	4	*	***
2	113	20BC3501	METABOLISM	CR	4	-	-	-	4	*	***
3	113	20GN3501	POPULATION AND EVOLUTIONARY GENETICS	CR	4	-	-	-	4	*	***
4	113	20BS3571	ESTIMATION OF BIOMOLECULES-LAB	CR	-	-	4	-	2	*	***
5	113	20BS3574	APPLIED MICROBIOLOGY AND POPULATION GENETICS-LAB	CR	-	-	4	-	2	*	***
6	113	20AU0003	CONSTITUTION OF INDIA AND HUMAN RIGHTS	AU	2	-	-	-	-	*	***
7	113	20AU0020	KANNADA KALI – I	AU	2	-	-	-	-	*	***
8	113	20AU0022	KANNADA MANASU – I	AU	2	-	-	-	-	*	***
					16	**-**	**08**	**-**	**16**		

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

SCHEME – B.Sc. – 2020-21 ONWARDS

VI SEM – MBG

(MICROBIOLOGY, BIOCHEMISTRY & GENETICS)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PRE REQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	113	20BS3601	RESEARCH METHODOLOGY	CR	4	-	-	-	2	*	***
2	113	20BS3602	PROJECT	CR	-	-	12	-	6	*	***
					4	**-**	**12**	**-**	**08**		

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

SEMESTER	**I**					
YEAR	**I**					
COURSE CODE	**20MB1101**					
TITLE OF THE COURSE	**BASIC MICROBIOLOGY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**-**	**-**	**-**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To know the importance of microorganisms for our global society
- To understand the structural and functional characteristics of prokaryotic and eukaryotic cells with their classification
- To study the basic techniques for isolation, culturing and identification of prokaryotic microorganisms and their importance
- To study eukaryotic microorganisms in detail and to know their importance

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Provides a strong acquaint in fundamental aspects of basic microbiology	L1
CO2	Enable to understand the diversity of microbial, structure, function and their environment	L2
CO3	Awareness about economic importance of microorganisms	L3
CO4	Students will be equipped with fundamental knowledge of microbial growth patterns and kinetic studies enabling them to apply the same in various allied fields.	L2

COURSE CONTENT:	
MODULE 1	**12Hrs**
HISTORY AND MICROBIAL SYSTEMATICS Development of microbiology as a discipline, spontaneous generation and biogenesis. Contributions of Antony von Leeuwenhoek, Joseph Lister, Edward Jenner, Louis Pasteur, Robert Koch, Alexander Fleming, Sumbunath Dey, Ananda Chakroborty and Sir Ronald Ross in the field of Microbiology. Scope and disciplines of microbiology. Binomial nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems. Brief account of Bergey's manual of bacteriology. Criteria for the classification of	

bacteria. General account of microbiome.	
MODULE 2	**12Hrs**
MICROBIAL TECHNIQUES Microscopy: Principles of resolution and magnification. Types- optical and electron microcopy – Basic principle, sample preparation, applications and limitations of Simple, Compound, Dark field, Phase contrast, Confocal, Atomic force microscope (Toppling & sliding mode), Fluorescence and Electron Microscope-TEM and SEM). Staining techniques: Principles of staining, bacterial and fungal staining methods. Sterilization and Disinfection- principles - methods of sterilization: physical and chemical methods – mode of action. Culture media and its types (simple, selective and differential media). Isolation and purification techniques of bacteria and fungi (aerobic and anaerobic). Microbial Nutrition and kinetics: Growth curve, Macro- and Micronutrients, Factors influencing the growth of microbes. Measurement of microbial growth.	
MODULE 3	**12Hrs**
PROKARYOTIC MICROBIOLOGY Difference between prokaryotic and eukaryotic microorganisms. Virology: General structure and characteristics of viruses, cultivation of viruses, general replication of viruses – lytic and lysogenic cycle with examples (TMV and Lambda phage), significance of viruses, viroids and prions. Bacteriology: Size, shape and arrangement. Ultrastructure of bacteria and functions in detail - Slime layer & Capsule (Klebsiella), Flagella, Pilus/ Fimbriae (E. coli), Cell wall (Gram positive and negative), Cytoplasmic membrane, Cytoplasmic inclusion bodies, nuclear material, Plasmids and episomes, Ribosomes and Endospore (Bacillus /Clostridium). Reproduction – Binary fission and genetic exchange in bacteria (Conjugation, transformation and transduction). Special microbial forms: Actinomycetes, Spirochetes, Rickettsia, Chlamydiae. Introduction to Archaebacteria and extremophiles.	
MODULE 4	**12Hrs**
EUKARYOTIC MICROBIOLOGY Fungi: General account of Fungi - General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization. Reproduction - asexual and sexual. Economic importance of fungi. Type study of Zygomycetes (Rhizopus), Ascomycetes (Aspergillus), Basidiomycetes (Agaricus) and Deuteromycetes (Fusarium). Algae: General characteristics of algae including occurrence, thallus organization, algae cell ultrastructure. Reproduction and life cycles-vegetative, asexual and sexual reproduction. Economic importance of algae. Type study of Cyanophyta (Spirulina), Chlorophyta (Chlamydomonas and Spirogyra), Rhodophyta (Gracillaria). Protozoa: General characteristics with special reference to Amoeba, Trypanosoma, Plasmodium, Paramecium.	

TEXT BOOKS:

1. Alexopoulos, C.J., Mims, C.W., and Blackwell, M. 2007. Introductory Mycology. ; Fourth edition, Wiley India Private Limited
2. Aneja, K.R. 2014. Laboratory Manual of Microbiology and Biotechnology. Medtec
3. Atlas R.M. Microbiology- Fundamentals and applications, Macmillan Publishing Company, New York.
4. Benson, H. J. 1994. Microbiological Application. WCB McGraw-Hill of India Private Limited.
5. Brock T.D and Madigan M.T. Biology of Microorganisms 6th Edition. Prentice Hall, Eagle wood cliffs N. J.
6. Cappuccino and Sherman Microbiology. A Laboratory Manual. 4thEdtn 1999.
7. Dubey, R.C. Microbiology 1st Edition. Chand and company
8. Edward Alcamo. Microbiology. Cliffs Notes 1996.
9. Jacquelyn, G., Black, Larry, M and Lewis. Microbiology. Principles and Explorations. 6th Edition. Wiley, John and sons. 2015. 9
10. Lengeler, Joseph W/Drews, Gerhart. Biology of the prokaryotes Blackwell Pub. 1999.
11. Nigel Dimmock, Andrew Easton and Keith Leppard. Introduction to Modern Virology: 5th edition, Blackwell Publishing, 2005
12. Pelczar, M.J., Chan, E.C.S and Kreig N.R. Microbiology Tata McGraw-Hill 5th Edition.Pub.1986.
13. Pommerville, J.C. 2007. Alcamo's Fundamentals of Microbiology. Eighth Edition. Jones and Bartlett Publishers, USA.
14. Prescott, L.M. Microbiology 6th edition. Mc Graw Hill. 2005.
15. Salle, A. J. 1984. Fundamental Principles of Bacteriology. Tata McGraw-Hill Publishing Company Limited, New Delhi.
16. Salle, A.J. Principles of Microbiology, 2nd edition., 1997, Mc Graw Hill.1997.
17. Sharma, O. P. 1986. Text Book of Algae. Tata McGraw-Hill Education.
18. Stainer, R.Y., et al., General Microbiology 5th edition MacMillan Press.2005
19. Tortora, Funke and Case. Microbioloy, 9th Edition. Benjamin Cummings. 2009
20. Vashishta, B.R. 2010. Botany for Degree Students – Algae. S. Chand and Co.

SEMESTER	**I**					
YEAR	**I**					
COURSE CODE	**20BC1101**					
TITLE OF THE COURSE	**BASIC BIOCHEMISTRY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**0**	**0**	**0**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
1	NA	NA	NA

COURSE OBJECTIVES:

- To familiarize the students with basic concepts and principles of conformation and energy transfer in biological systems.
- To create general understanding about fundamentals of biomolecules, and their structure and significance.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	The students will know about pH, buffer and will be able to decide the importance of biological reactions.	L2
CO2	The students will have an insight of structure and functions of biomolecules	L3
CO3	Students will have a better insight of basics of biochemistry with a detailed understanding of the clinical significance of biomolecules	L4

COURSE CONTENT:	
MODULE 1	**12Hrs**
Water and Buffers: Modern concepts of acids and bases; Ionization of acids. Dissociation of water and ionic product of water, Hydrogen bonding properties of water, Definition and determination of pH and associated numerical; Common ion effect with examples, Buffer preparation by H-H equation, buffer types. Numerical problems on preparation of buffer solutions, Biological buffers and their reactions.	
MODULE 2	**12Hrs**
Conformation and energy transfer *Stereoisomerism*: Optical isomerism: Chirality, Nomenclature of enantiomers -The RS and the DL system. Optical rotation, racemisation and resolution. Fischer projection formula. Geometrical isomerism: Cis trans-isomerism, examples of chirality in the biological world. *Thermodynamics*: First and second law, free energy, entropy, chemical potential, standard free energy change, exergonic and endergonic reactions with examples. Relationship between free energy change and equilibrium constant. Oxidation and reduction reactions in biology	

MODULE 3	**12Hrs**
Carbohydrates and lipids *Carbohydrates:* Classification– monosaccharides, disaccharides, oligosaccharides with examples; Polysaccharides – structural and storage; mucopolysaccharides – peptidoglycan and teichoic acid. *Lipids*: classification – simple, complex and derived with examples. Properties of lipids: interaction with water; micelle, layer, liposome and membrane formation; Saponification, rancidity and iodine number.	
MODULE 4	**12Hrs**
Amino acids and nucleic acids *Amino acids*: General structure of amino acids, acid base property, isoelectric point, peptide bond, classification of proteins based on solubility – fibrous and globular, classification of protein based on location: intracellular, extracellular and membrane bound proteins, introduction to protein hierarchy. Native state and denatured state of proteins *Nucleic acid*: Structure of nitrogen base – purine and pyrimidine, general structure of nucleosides and nucleotides. Melting of DNA, melting temperature, renaturation of nucleic acids.	

TEXT BOOKS:

1. Principles of Biochemistry – Lehninger, Nelson and Cox. Freeman Publishers, 6th Ed
2. Zubay's Principles of Biochemistry – Rastogi and Aneja. MedTech 5th Edition
3. Biochemistry – Berg, Tymoczko and Stryer. Freeman Publishers, 5th Ed.
4. Biochemistry – Voet and Voet. Wiley & Sons. 4th Ed
5. Biochemistry with medical correlations – Devlin. Wiley & Sons, 7th Ed
6. Stereochemistry of Carbon Compounds, Eliel (1977) Tata-McGrawHill

SEMESTER	**I**					
YEAR	**I**					
COURSE CODE	**20GN1101**					
TITLE OF THE COURSE	**BASIC GENETICS**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**0**	**0**	**0**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To gain insight on the historical perspective of the evolution of genetics.
- To comprehend and identify the different types of mendelian and non-mendelian inheritance.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Students will have clarity to the background of genetics before getting into details in the forthcoming semesters	L3
CO2	They will be capable differentiate between mendelian and non mendelian inheritance sources along with associated intricacies.	L3
CO3	Student will gain the ability to analyse and relate phenotype to genotype and potential factors influencing the interaction.	L3

COURSE CONTENT:	
MODULE 1 HISTORY OF GENETICS AND MENDELIAN PRINCIPLES	**12Hrs**
Pre- formation, History and scope of Genetics, Pre- Mendelian genetic concepts epigenesis, pangenesis, germplasm theory. Mendel- Life and his experiments on pea plants. Principle of Dominance (Dominance and Recessiveness); Laws of Inheritance and their applications. Monohybrid Cross, Dihybrid Cross, Back Cross, Test Cross	
MODULE 2 EXTENSIONS OF MENDELISM AND GENE INTERACTIONS	**12Hrs**
Co-dominance and incomplete dominance - definition, examples. Multiple allelism-definition, Eye color in Drosophila, Blood groups and Rh factor in Human; Allelic series; Lethal alleles; Multi-factorial inheritance- Skin colour in Humans; Penetrance and Expressivity; Plieotropy. Epistasis- dominant, recessive. Supplementary and Complementary gene interactions; Non epistatic inter allelic gene interaction, Position effect.	

MODULE 3 SEX DETERMINATION AND EXTRA CHROMOSOMAL INHERITANCE	12Hrs
Chromosomal theory of Inheritance - Concepts and evidences. Mechanism of sex determination- XX-XY; XX-XO; ZZ-ZW; Bridges genetic balance theory. Environmental and hormonal control of sex determination Gynandromorphs / Intersexes, Super sexes in Drosophila. Sex differentiation and dosage compensation (Drosophila and Man). Sex linked and sex limited traits in Humans. Hemophilia, Hypertrichosis. Extra Chromosomal inheritance, flower colour in Mirabilis jalapa, kappa particle in Paramecium, sigma factor in Drosophila, Cytoplasmic Male Sterility (CMS) in maize.	
MODULE 4 MODEL ORGANISMS IN GENETICS	**12Hrs**
Bacteria - *E. coli*; Viruses - Tobacco Mosaic Virus; Bacteriophage - Lambda Phage; Fungi- Neurospora species, *N crassa*, *Saccharomyces cerevisiae;* Nematode - *Caenorhabditis elegans*, Plant - Arabdosis thaliana, Fly - *Drosophila melanogaster*, Fish - Zebra fish (*Danio rerio*), Mammal - Mice (*Mus musculus*) and Rat (*Rattus rattus*).	

TEXT BOOK:

1. Verma P. S. Cell Biology, Genetics, Molecular Biology: Evolution and Ecology (2006). S Chand Publishers.
2. Strickberger M. W., Genetics. (1968) Macmilla Publishers.

REFERENCES:

1. Mathew Hamilton, (2009) Population Genetics, Wiley-Blackwell
2. Snustad D. P., Simmons M. J., Principles of Genetics. 5th Edition (2008) John Wiley & Sons.
3. Brooker R. B., Genetics Analysis and Principles. Fourth Edition (2009) McGraw-Hill.
4. Tamarin R. H., Principle of Genetics. Seventh Edition. (2002) Tata-McGraw Hill.
5. Hart D and Jones E.W., Genetics Principles and Analysis. 4th Edition (1998) Jones and Bartlett Publication.
6. Atherly A. G., Girton J. R. and Donald M. C. J. F. The Science of Genetics (1999) Sounders College Publication / Harcourt Brace.
7. Sturtevant A. H., A History of Genetics (1965). Harper and Row New York. Mendel G. The First Geneticist by Orel V. (1996) Oxford University Press, New York.
8. Ross S. A first course in Probability. 4th Edition (1994). McMillan, New York.
9. Stansfield W. D., Theory and problems of Genetics (Schaum s Outline Series). (2002) McGraw Hill.
10. Stubbe H., History of Genetics (1972). Harper and Row New York.
11. Prasad S. Fundamentals of Biostatistics (1993). Emkay publications, New Delhi.
12. Khan and Khanum. Fundamentals of Biostatistics. II Revised Edition. (2004). Ukaaz Publication.

SEMESTER	**I**					
YEAR	**I**					
COURSE CODE	**20BS1101**					
TITLE OF THE COURSE	**BASIC CHEMISTRY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**0**	**-**	**-**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-		-	-

COURSE OBJECTIVES:

- To make the students to understand basic facts and concepts in chemistry while retaining the exciting aspects of chemistry so as to develop interest in the study of chemistry as a discipline.
- To make the students to familiarize with the basic concepts related to modern atomic theory, quantum chemistry, acids and bases, chemical bonds in molecules and basics of organic chemistry and different organic reactions.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Students will learn about handling of data and basics of acids and bases	L1
CO2	Students will learn about advanced principles of atomic structure	L2
CO3	Students will get in depth knowledge about chemical bonding and various theories related to that.	L3
CO4	Students will learn about the basic principles of organic chemistry	L1

COURSE CONTENT:

MODULE 1 **10Hrs**

GENERAL CHEMISTRY

Handling of analytical data: SI and CGS units of measurements and physical constants and their inter conversion; Significant figures and calculations, accuracy, precision and errors in quantitative analysis. Stoichiometry: atomic weights, molecular weights, mole concept, molarity, molality, normality, mole fraction, ppt, ppb and ppm. Numerical problems related to the above concepts.

Acids and Bases: Theories of acids and bases – Arrhenius - Bronsted-Lowry theory - Lewis theory -Solvent system definition. Relative strengths of acids and bases – Dissociation constant of acids and bases - Levelling effect of water. Hard and soft acids and bases (HSAB). Non-aqueous solvents – classification - Liquid ammonia as solvent. Acid-base equilibria in aqueous solution and pH. Acid- base neutralisation curves; indicator, choice of indicators.

MODULE 2	**12Hrs**

ATOMIC STRUCTURE

Review of Bohr's theory and its limitations, dual behavior of matter and radiation, de Broglie's equation-derivation, Heisenberg's uncertainty principle. Hydrogen atomic spectra. Need of a new approach to Atomic structure. Elements of Quantum chemistry- Schrodinger wave equation and meaning of various terms in it. Significance of ψ and $\psi 2$, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Quantum numbers and their Significance. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Rules for filling up of electrons in various orbitals (Aufbau principle, Pauli's exclusion principle, Hund's rule of maximum multiplicity and n+l rule), Electronic configuration of the elements (up to Z=30) and anomalous electronic configurations. Stability of half-filled and completely filled orbitals- concept of pairing and exchange energy.

MODULE 3	**12Hrs**

Introduction: Need for the atoms to form molecules, and types of chemical bonds with examples *IonicBond:* Definition and conditions for formation of an ionic bond between atoms, examples of formation of an ionic compound between alkali metal/alkaline earth metals and chalcogen/halogen group elements. Lattice energy, its effect on stability and solubility of ionic solids, Born – Haber cycle for NaCl, KBr, KI, and MgO and $CaCl_2$). *Covalent Bond:* Definition, octet rule, Lewis dot formulae of a few simple molecules and ions, electron deficient and excess molecules ($BeCl_2$, BF_3, PCl_5, SF6). *Geometry of covalent molecules:* (VSEPR concept and hybridisation concepts) basic concepts and definitions: Examples simple inorganic molecules and ions. such as NH_3, H_2O, H_3O+, SF_4, ClF_3. *Theories of covalent bonds (VBT and MOT): Valence bond theory* (VBT): postulates and its limitations, directional characteristics of covalent bonds, Application of VBT to $BeCl_2$, BF_3, $SiCl_4$,PCl5, SF_6 molecules.

Molecular orbital theory: postulates, linear combination of atomic orbitals (LCAO), bonding, nonbonding and antibonding molecular orbitals, pictorial representation of formation of s and p MOs from the corresponding atomic orbitals, Molecular orbital energy level diagram and molecular orbital configuration involving s and p orbitals their importance for the following molecules, (H_2, N_2, O_2, HF and CO).

Metallic Bond: Definition, properties of metals and band theory.

Weak Intermolecular interactions: van der walls forces, dipole-dipole interactions and their significance. *Hydrogen Bond:* Definition, types, importance

MODULE 4	**12Hrs**

Representation of structural formula of organic compounds: condensed formula and bond line formula of organic compounds, classification of organic compounds based on functional groups with examples *IUPAC nomenclature:* IUPAC nomenclature of organic compounds including Bifunctional compounds and substituted benzenes. (o, p and m). *Delocalisation of electrons:* Inductive effect, electrometric effect, resonance (mesomeric effect, EWG and EDG, +M and –M effects) and hyper conjugation. *Reactive intermediates:* Types of bond cleavage, curly arrow rules in representation of mechanistic steps; electrophiles, nucleophiles, carbocations, carbanions, free radicals and carbenes– generation, structures, stability and examples. *Types of organic reactions:* Types of organic reactions with examples (electrophilic/ nucleophilic substitution/addition/free radical reaction with examples.

Aromaticity: Kekule structure of benzene - molecular orbital picture of benzene – resonance energy and stability of benzene - Huckel's rule (aromatic, non-aromatic, and antiaromaticmolecules) - aromaticity of benzene and benzenoid compounds – aromaticity of three, four, five, six, seven and eight-membered systems - annulenes.

List of Laboratory/Practical Experiments activities to be conducted (if any) :NONE
1.
2.

TEXT BOOKS:

1. A New Concise Inorganic Chemistry", J. D. Lee, 5th Ed, Chapman & Hall, London (1996).
2. Organic Chemistry. R.T. Morrison and R.N. Boyd. 6th Ed. Prentice Hall, India (1992)
3. Physical chemistry, 9th Ed., Peter Atkins and Julio de Paula, Oxford University Press (2009)

REFERENCES:

1. A New Concise Inorganic Chemistry", J. D. Lee, 5th Ed, Chapman & Hall, London (1996).
2. Organic Chemistry. R.T. Morrison and R.N. Boyd. 6th Ed. Prentice Hall, India (1992)

SEMESTER	**I**					
YEAR	**I**					
COURSE CODE	**20MB1171**					
TITLE OF THE COURSE	**BASIC TECHNIQUES IN MICROBIOLOGY-LAB**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	**4**	-	-	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To enable students to understand the microbial structure, microbial growth pattern and techniques to measure cell size.
- To help them understand the isolation of various microorganisms from different sources.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Students are aware of microbial diversity and isolation techniques.	L1
CO2	Students will be equipped with fundamental knowledge of microbial growth patterns and kinetic studies enabling them to apply the same in various allied fields.	L2

List of Laboratory/Practical Experiments activities to be conducted (if any) :
1. Study of basic instruments in Microbiology laboratory (2 Units) a) Autoclave b) Hot air oven c) Incubator d) pH meter e) High speed centrifuge f) Colorimeter / Spectrophotometer g) Anaerobic jar h) Bacterial Filters i) Laminar air flow
2. Preparation of culture media: a) Basal media (Nutrient agar and broth, Czapekdox media and MRBA) b) Selective media (EMB agar and McConkey agar) c) Enriched media (Blood agar).
3. Isolation of bacteria and fungi by serial dilution technique from soil, water and air.
4. Methods of pure culture techniques a) Pour plate technique b) Spread plate technique

c) Streak plate technique
5. Transfer of media and inoculum a) Slant culture technique b) Broth culture technique c) Stab culture technique
6. Microscopic examination of bacterial smear a) Simple staining b) Gram's staining c) Capsule staining d) Endospore staining
7. Isolation and identification of fungi (Lactophenol cotton blue mount)
8. Micrometry: Microscopic measurement of bacterial cell (Bacillus), yeast (Saccharomyces).
9. Microscopic observation of temporary slides a. Algae: Chlamydomonas and Spirulina b. Fungi: Rhizopus, Aspergillus, Penicillium, Yeast and Fusarium c. Protozoa: Amoeba, Paramecium and Plasmodium
10. Study of growth curve of bacteria by turbidometric method

REFERENCES

1. Aneja, K.R. 2014. Laboratory Manual of Microbiology and Biotechnology. Medtec

2. Atlas R.M. Microbiology- Fundamentals and applications, Macmillan Publishing Company, New York.

3. Cappuccino, J.G., and Sherman, N. 1999. Microbiology - A Laboratory Manual. Fourth Edition. The Addison Wesley Longman, Inc England.

4. Pelczar, M. J., Chan E.C.S. and Krieg N.R. 1993. Microbiology. McGraw Hill Book Company, New York.

5. Prescott, L.M., Harley, J.P. and Klein, D.A. 2011. Microbiology. WCB McGraw-Hill, NY.

SEMESTER	**I**					
YEAR	**I**					
COURSE CODE	**20BC1171**					
TITLE OF THE COURSE	**BASIC BIOCHEMISTRY - LAB**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	0	**0**	**4**	**0**	**40**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
1	NA	NA	NA

COURSE OBJECTIVES:

- To familiarize the students with good lab practise how to make buffers.
- To create general understanding about detection of biomolecules.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	The students will be familiarized with handling laboratory equipment like weighing balance, pH meter and potentiometer and learn the importance and preparation of buffers.	L2
CO2	They will have an understanding of biomolecule composition of edible materials	L3

EXPERIMENTS/PRACTICALS:
1. Calculation and preparation of buffers
2. Potentiometric titration of potassium hydrogen phthalate/HCl and sodium carbonate
3. Potentiometric titration of HCl and sodium bicarbonate/ sodium hydroxide
4. Potentiometric titration of amino acid against NaOH and HCl
5. Estimation of proteins milk.
6. Estimation of carbohydrates in vegetables (Potatoes etc)
7. Estimation of lipids in milk/vegetables (avocadoes etc)
8. Estimation of iodine number of edible oils
9. Estimation of ascorbic acid in fruits by titrimetric method.

TEXT BOOKS:

1. Introductory Practical Biochemistry- Sawhney and Singh. Narosa Publishing house. 2012, 7th ed
2. An Introduction to practical Biochemistry—Plummer D. T, Tata Mc Graw Hill

SEMESTER	**I**					
YEAR	**I**					
COURSE CODE	**20GN1171**					
TITLE OF THE COURSE	**BASIC GENETICS PRACTICAL**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	0	**0**	**4**	**0**	**-**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To differentiate between the various stages of meiosis in animal and plant cells.
- To gain insight as to the different genetic interactions and their effect on phenotype.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Students will gain skills to process tissue into slides and distinguish various meiotic stages.	L3
CO2	Students will be capable to analyse and identify gene interactions, predict crosses and understand its role in inheritance.	L4

List of Laboratory/Practical Experiments activities to be conducted (if any):
1. Temporary squash preparation of : Grasshopper Testes, Onion flower bud
2. Observation of meiotic stages in permanent slides
3. Blood Typing
4. Sex differentiation in Drosophila
5. Detection of sex chromatin bodies: Preparation of Barr bodies from bucal smears.
6. Genetic problems on : (a) Probability (b) multiple alleles (c) Gene interactions (d) Sex Linkage
7. Study of: (a) Flower color in *Mirabilis jalapa* (b) Coat color in Mice (c) Comb pattern in fowl.

REFERENCES

1. Brooker, R. J. 1999. Genetics: Analysis and Principles. Benjamin Cummings, Longman, INC.
2. Gardner E. J. M. J. Simmons and D.P. Snustad 1991 Principles of Genetics. John Wiley & Sons. INC.New York.
3. Klug, W. S. and M. R. Cummings 1994 Concepts of Genetics MacMillan Colley Publishing and Company NY.
4. Strickberger M. W. 1996. Genetics. Mac Millan Publishing Co. NewYork
5. Tamarin,. R H. 1999. Principles of Genetics. McGraw-Hill.

SEMESTER	**I**					
YEAR	**I**					
COURSE CODE	**20BS1102**					
TITLE OF THE COURSE	**COMMUNICATIVE ENGLISH**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	**-**	**-**	**-**	**24**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To encourage the students to speak English confidently and enable them to communicate for day-to-day needs
- To build up their confidence in the usage of English and to enhance their written communicative competence also helping them for competitive exams

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Students are confident in oral and written communication	L1
CO2	Have enhanced competence for competitive exams	L2

COURSE CONTENT:	
MODULE 1	**6Hrs**
COMMUNICATION SKILLS Definition, importance of communication, communication process – source, message, encoding, channel, decoding, receiver, feedback, context, levels of communication, Flow of Communication, Verbal and Non-Verbal Communication, Barriers to Communication - physiological, physical, cultural, language, gender, interpersonal, psychological, emotional. Perspective in communication/ Communication styles: introduction, visual perception, language, other factors affecting our perspective – past experiences, prejudices, feelings, environment	
MODULE 2	**6Hrs**
Elements of communication – introduction, face to face communication – tone of voice, body language (non-verbal communication), verbal communication, physical communication; **Basic listening skills:** introduction, self-awareness, active listening, becoming an active listener, listening in difficult situations; **Interview skills:** purpose of an interview, do's and dont's of an interview; **Giving presentations:** dealing with fears, planning your presentation, structuring your presentation, delivering your presentation, techniques of delivery;	

Group discussion: introduction, communication skills in group discussion, do's and don't's of group discussion;

Phonetics: The Organs of Speech, The Description and Classification of Speech Sounds, The Description and Classification of Vowels, The Description and Classification of Consonants, Phonetic symbols and the IPA, Phonemic and Phonetic Transcription Phonology, Phoneme sequences and Consonant Cluster, The Syllable, Word Accent, Accent and Rhythm in Connected Speech, Intonation, Varieties of English Pronunciation.

MODULE 3	**6Hrs**

EFFECTIVE WRITING SKILLS

Effective written communication: introduction, when and when not to use written communication – complexity of the topic, amount of discussion required, shades of meaning, formal communication

Writing effectively: subject lines, put the main point first, and know your audience, organisation of the message, Paragraph Writing, Letter Writing, Report Writing, Book Review, Scientific writing, Making a message – Transitivity/ intransitivity – complementation – talking about closely linked action – using two verbs together (eg: She started laughing),Transforming messages – Making statements, questions, orders and suggestions – denying – rejecting – disagreeing – possibility – ability, permission, obligation etc.

MODULE 4	**6Hrs**

GRAMMAR

Word Classes: Open Word Classes: - Nouns, Verbs, Adjectives, Adverbs, Pronouns; Closed Word Classes: - Pre-determiners, Determiners, Numerals, Enumrators, Prepositions, Conjunctions, Auxiliary Verbs, Interjection;

Morphology: Bound and Free Morphemes; Affixes, Stems and Roots; Morphological Analysis; **Phrases:** Noun Phrase, Verb Phrase, Genetive Phrase, Adjective Phrase, Adverb Phrase, Prepositional Phrase, Phrases and its types, Clauses and its types, Sentences and its types, Common errors, phonetics;

Clauses: Clause Elements, Clause Types, Kinds, Concord;

Sentences: Simple Sentences, Compound Sentences, Complex Sentences;

Sub Ordination: Sub-Clauses, Finite and Non-Finite Sub-Clauses;

Co-ordination: Linked and Unlinked Coordination, Synthesis;

Ambiguity: Types of Ambiguity, Structural and Lexical Ambiguity;

Common Errors: Nouns and Pronouns, Articles, Verbs, Concord, Adjectives, Adverbs, Prepositions, Vocabulary, Expressing time, Referring to present, past and future time - use of adjuncts - frequency and duration, Talking about manner and place, Information about place, manner - position of adjuncts - types of adverbs (time, frequency, duration etc), Reporting what people say/think, Reporting verbs - reporting someone's actual words - reporting in one's own words, The structure of information, Focusing on the thing affected (passive voice) - selecting focus (left structure) taking the focus off the subject (impersonal 'it' etc.) – Introducing something new (with 'there') - focusing on information using adjuncts.

TEXT BOOKS:

1. Crystal, David. 1985, Rediscover Grammar with David Crystal. Longman
2. Bakshi, R. N. A Course in English Grammar. Orient Longman Close, R. A. Reference Grammar for Students of English. Orient Longman

3. Krishnaswamy, N. Modern English – A Book of Grammar, Usage & Composition. Macmillan India Ltd.
4. Aroor, Usha (Ed.) WordMaster Learner's Dictionary of Modern English. Orient Longman 17
5. Hewings, M. 1999, Advanced English Grammar. Cambridge University Press
6. Basic communication skills for technology, Andreja J. Ruther Ford, 2nd Edition, Pearson Education, 2011.
7. Communication Skills, Sanjay Kumar, Pushpalata, 1st Edition, Oxford Press, 2011.
8. Brilliant – Comminication Skills, Gill Hasson, 1st Edition, Pearson Life, 2011.
9. Soft Skill and Professional Communication, Francis Peters SJ, 1st Edition, Mc GrawHill Education, 2011.

SEMESTER	**II**					
YEAR	**I**					
COURSE CODE	**20MB1201**					
TITLE OF THE COURSE	**MICROBIAL PHYSIOLOGY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**-**	**-**	**-**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- The major features of growth and metabolism of microorganisms including determination of growth with environmental influence on the microbial growth and primary and secondary metabolism.
- Energy source for microorganisms and relationship between metabolism and energy source.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	To understand the complexity of microbial structures, and metabolism	L3
CO2	Enable to grasp the mechanisms the microbial transport systems and the modes and mechanisms of energy conservation	L3

COURSE CONTENT:

MODULE 1 **12Hrs**

ENZYMOLOGY

Introduction, properties, nomenclature and classification, specificity, active sites, coenzymes, activators and inhibitors, activity unit-prosthetic groups and Isozymes. Effect of temperature, pH and substrate concentration on reaction rate. Enzyme kinetics: Michaelis-Menten equation for simple enzymes, Regulation of enzymes -Covalent and noncovalent modification; Enzyme inhibition - types of inhibitors – competitive non-competitive and uncompetitive. Ribozymes and abzyme.

MODULE 2 **12Hrs**

MICROBIAL METABOLISM

Primary metabolism: Breakdown of carbohydrates – Glycolytic pathways, HMP shunt/pentose phosphate pathway and ED. TCA and Electron transport chain TCA: Substrate and oxidative phosphorylation. Transamination, oxidative deamination, decarboxylation, Urea cycle. Fermentation: Anaerobic respiration, Fermentative modes in microorganisms – alcoholic, Lactic

acid – hetero and homo and Acetic acid. Secondary metabolism: Overview and importance

of secondary metabolites - antibiotics, aflatoxins, carotenoids	
MODULE 3	**12Hrs**
PHOTOSYNTHESIS AND BIOENERGETICS Bacterial photosynthesis: Photosynthetic micro-organisms photosynthetic pigments, and generation of reducing power by cyclic and non-cyclic photophosphorylation (purple and green bacteria), Carbon dioxide fixation pathways. Chemoautotrophy oxidation of inorganic compounds – Nitrate and sulphate. Bioenergetics: Free energy, ATP, NAD, FAD, FMN and its production, other high energy compounds, Oxidation – Reduction reactions. Electron transport chains in some anaerobic bacteria.	
MODULE 4	**12Hrs**
MICROBIAL CELLMEMBRANE PHYSIOLOGY Metabolite transport: Structure of biological membranes, Function of membrane proteins, solute transport across cell membranes (osmosis), regulation of ion concentrations (Hypotonic, Hypertonic and Isotonic solution), Methods to study diffusion of solutes in bacteria, passive diffusion, facilitated diffusion, different mechanisms of active diffusion - PTS, and role of permeases in transport Stress physiology: Osmotic stress and osmoregulation, Oxidative stress – superoxide dismutase and catalase, pH stress and acid tolerance, Thermal stress and heat shock response, Nutrient stress and starvation stress	

TEXT BOOKS:

1. Aneja, K.R. 2014. Laboratory Manual of Microbiology and Biotechnology. Medtec
2. Atherly, A.G., Girton, J.R. and Mc Donald, J.F. 1999. The Science of Genetics. Diane Pub. Co.
3. Boyer, R.F. 2003. Modern Experimental Biochemistry. Third Edition. Pearson Education.
4. Cappuccino, J.G., and Sherman, N. 1999. Microbiology a Laboratory Manual. Fourth Edition. The Addison Wesley Longman, Inc England.
5. David, W. 2000. Physiology and Biochemistry of Prokaryotes. Second Edition. Oxford University Press.
6. Griffin, D.H. 1993. Fungal Physiology. Second Edition. Wiley Liss- A John Willy Sons, Inc, Publication. USA. p: 1-458.
7. Moat, A.G. and Froster, S.W. 2002. Microbial Physiology. Fourth Edition. John Wiley and Sons, New York.
8. Nelson David L. and Cox Michael M. 2007. Lehninger - Principles of Biochemistry. Fourth edition. MacMillan Press/Worth Publishers, New Delhi
9. Prescott, L. M., Harley, J.P. and Klein, D.A. 2011. Microbiology. WCB McGraw-Hill, New York.
10. Stickberger, M.W. 2012. Genetics, Prentice Hall of India Private Limited, New Delhi.
11. Voet, D. and Voet, J.G. 2010. Biochemistry. John Wiley and Sons, New York.
12. Wilson, K., and Walker, J. 2010. Principles and Techniques of Biochemistry and Molecular Biology. 7th edition. Cambridge University Press.

SEMESTER	**II**					
YEAR	**I**					
COURSE CODE	**20BC1201**					
TITLE OF THE COURSE	**BIOANALYTICAL TECHNIQUES**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**0**	**0**	**0**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
1	NA	NA	NA

COURSE OBJECTIVES:

- To create general understanding about theoretical concepts of techniques used to detect and assay biomolecules.
- To familiarize the students with basic concepts and principles of biophysical and biochemical techniques used in biological sciences.
- To give holistic view for understanding the screening, isolation, separation and characterization of molecules.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Student will be scientifically equipped with understanding of the about the different biomolecules and their important functions.	L3
CO2	Student will be aware of the analytical tools and their instrumentation used in biotechnology/biological sciences.	L3
CO3	Students will have a basic understanding of biomedical equipments	L4
CO4	Students will be empowered for better prospects leading to project design and execution.	L3

COURSE CONTENT:	
MODULE 1	**12Hrs**
Spectroscopy: Wave particle duality, the concepts of electromagnetic spectrum, Concepts of Absorbance and Emission Spectroscopy, Beer-Lambert's law, application and its limitations. Extinction coefficient, Concepts of chromophore/auxochrome and Chromic shifts. Principle, schematics and applications of Colourimeter and UV-Vis Spectroscopy. Assay of biomolecules (Carbohydrates and Proteins). Principle, schematics and application of Luminometry, Tubidometry, Klett Photometry, Flame photometry and IR spectroscopy.	
MODULE 2	**12Hrs**
Chromatography History and principle of Chromatography. Distribution/partition coefficient, Absorption and Adsorption phenomenon, Retention factor (Rf & Rt concepts). Types: Planar and columnar, S-L, L- L, G-S, G-L and G-G. Paper and thin layer chromatography, types and their application	

in separation of biomolecules. Plate theory and Rate of theory; resolution, selectivity and effectiveness of columns, Types of matrices used, separation of biomolecules using gel permeation, ion exchange, affinity and adsorption chromatography with applications. Brief idea about High Performance Liquid Chromatography (HPLC) and Gas Chromatography (GC).	
MODULE 3	**12Hrs**
Electrophoresis: Migration of ions in electric field, Factors affecting electrophoretic mobility. Paper electrophoresis, Cellulose acetate electrophoresis, High voltage electrophoresis and their Applications. Gel electrophoresis - Types of gels, Procedure, for gel making. Detection, Recovery & characterization of macromolecules (molecular weight determination and subunit enumeration). Principle and application of Poly acralamide Gel Electrophoresis (PAGE), Iso-electric focussing (IEF) and 2D-PAGE, Submerged agarose gel electrophoresis (SAGE). Application of electrophoresis in molecular biology (genomics, transcriptomics and proteomics).	
MODULE 4	**12Hrs**
Isotopic tracer technique: Radioactive & stable isotopes, Pattern and rate of radioactive decay. Measurement of radioactivity: Geiger-Muller counter, Solid & Liquid scintillation counters (Basic principle, instrumentation & technique), Autoradiography their advantages and limitations. **Centrifugation:** Basic principles, RCF, Svedberg constant and Sedimentation coefficient. Preparative centrifugation: Differential & density gradient centrifugation, Applications. Analytical centrifugation: Determination of molecular weight of biomolecules. **Immunological techniques:** Immuno-diffusion, immuno-electrophoresis and immuno-fluorescence.	

TEXT BOOKS:

1. Principles and Techniques of Practical Biochemistry – Keith Wilson and John Walker. Cambridge low price edition.
2. Biophysical Chemistry – Upadhyay, Upadhyay and Nath. Himalaya Publications.

REFERENCES:

1. Analytical Techniques in Biochemistry and Molecular biology – Katoch. Springer.
2. Fundamentals of Analytical Chemistry - Skoog, Holler and West. Saunders.
3. Handbook of Analytical Techniques – Gunzler and Williams. Wiley & Sons.
4. Immunology – Kuby. Freeman Publishers.
5. A Textbook of Practical Biochemistry- Joshi and Saraswat. Jain Publishers.

SEMESTER	**II**					
YEAR	**I**					
COURSE CODE	**20GN1201**					
TITLE OF THE COURSE	**FUNDAMENTALS OF CYTOGENETICS**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**0**	**0**	**0**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- Understand the characteristics of chromosome and its related anomalies.
- Elucidation on the versatility of the chromosomes and its different interactions.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Students will learn details on chromosomes, its conformations to bring about genetic variability.	L2
CO2	The students will get insight on chromosome abnormality which leads to cytogenetic aberrations and disease.	L3

COURSE CONTENT:	
MODULE 1 CHROMSOME CHARACTERISTICS	**12Hrs**
Physical basis of inheritance: chromosome theory of inheritance, Eukaryotic Chromosome- Macro- molecular organization. Primary and Secondary constriction, Sat-bodies, telomeres, chromosome types. Heterochromatin and Euchromatin and its significance. Ultra structure of chromosome, Nucleosome model and Nucleosome Structure. Karyotype and Ideogram. Special types of chromosomes: Polytene chromosome- Salivary gland chromosome in Drosophila, Lamp- brush chromosome in amphibian Oocyte, B Chromosome.	
MODULE 2 LINKAGE	**12Hrs**
Introduction and definition of Linkage, Discovery of linkage, Coupling and Repulsion hypothesis, Linkage group- Drosophila, maize and man, Types of linkage-complete linkage and incomplete linkage, Factors affecting linkage - distance between genes, age, temperature, radiation, sex, chemicals, nutrition, etc. Sex Linkage: Meiotic behavior of chromosome and non- disjunction. Bridges theories of non-disjunction. Sex linkage in Drosophila.	
MODULE 3 CROSSING OVER	**12Hrs**
Crossing over- definition and types of crossing over-germinal and somatic crossing over. Cytological basis of crossing over- Sterns experiments in Drosophila. Mechanism of crossing over - chiasma type theory, the breakage first theory, the	

contact first theory, strain or torsion theory. Molecular mechanism of crossing over- Holliday model, single strand breaks.	
MODULE 4 CHROMOSOMAL ABERRATIONS	**12Hrs**
Numerical- Euploidy (Monoploidy, Haploidy and Polyploidy). Polyploidy- Autopolyploidy and Allopolyploidy. Aneuploidy- Monosomes, Nullisomes and Trisomes. Structural- Deletions, Duplication, Translocation, Inversions, Centric fusion and centric fission. Evolutionary significance of chromosomal aberrations. Genetic diseases and disorders.	

TEXT BOOK:

1. Verma P. S. Cell Biology, Genetics, Molecular Biology: Evolution and Ecology (2006). S Chand Publishers.
2. Strickberger M. W., Genetics. (1968) Macmilla Publishers.

REFRENCES:

1. Gupta P. K. 2009. Cytology, Genetics and Molecular Biology. Rastogi Publications.
2. Winter P. C., Hickey G. I. & Fletcher H. L. 2003. Instant notes in Genetics. Viva Books Pvt.Ltd.
3. Weaver R. F., Hendrick P. W. and Brown W.C. 1992. Genetics, 2nd Edition.
4. Sinha U., Sunita and Sunita Sinha.1981 Cytogenetics: Plant Breeding and evolution. Vikas publishing House.
5. Snustad D. P. and Simmons M. J. 2009. Principles of Genetics. John Wiley and Sons, INC.
6. Phundan Singh. 2013. Elements of Genetics, Edition 4, Kalyani Publishers.
7. Edgar Altenburg. 1970. Genetics. Oxford & IBH Publications.
8. Gardener E. J., Simmons M. J. and Snustad D. P. 1998. Principles of Genetics J. Wiley and Sons pubs.
9. Obe. G. and Natarajan A.T. 1990 Chromosomal Abberrations: Basic and Applied aspects Springer Verlag, Berlin.

SEMESTER	**II**					
YEAR	**I**					
COURSE CODE	**20BS1201**					
TITLE OF THE COURSE	**BIOINFORMATICS AND BIOSTATISTICS**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**-**	**-**	**-**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To create general interest in applied domain towards using computers for biological applications.
- To familiarize the students with basic concepts and principles statistics and their applications in biological sciences.
- To give holistic view for understanding the scientific validation and biomodelling.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Student will be aware of various applied and allied scientifically domains to innovative and creative think.	L2
CO2	Student will be aware of the computer tools and applications which can be implemented in biological sciences.	L2
CO3	Students will be empowered for better prospects leading to project design and execution.	L3

COURSE CONTENT:	
MODULE 1	**12Hrs**
Introduction to computers: History of Computers, Components of computers (Hardware, Software and accessories). Concepts on Computer software, operating system (Windows), tools and applications of MS Office (notepad, word processor, spread sheet & presentation). **Introduction to networks:** LAN, MAN & WAN, Network protocols- Internal protocol (TCP/IP), File transfer protocols (FTP), WWW, HTTP, HTML, URL. Network Security- Group polices Fire-walls. Concepts on encryption of data. **Relational Databases Management (RDMS):** Codd Rules and concepts of databases, Data mining and applications, accessing bibliographic databases and Basics on citation and indexing (Pub Med and Google scholar).	
MODULE 2	**12Hrs**
Bioinformatics (Genomics): Nucleic acid sequence databank – NCBI, EMBL and DDBJ. Microbial genomic database	

(MBGD), Cell line database (ATCC), Virus data bank (UICTVdb). Restriction mapping - NEB CUTTER. Gene Sequence alignment - Global and Local, Similarity searching (FastA and BLAST), Pair wise comparison of sequences, Multiple Sequence alignment of sequences, alignment, scoring matrices. Identification of genes in genomes and Phylogenetic analysis with reference to nucleic acids, Identification of ORFs.

MODULE 3	**12Hrs**

Bioinformatics (Proteomics):

Introduction to protein structure – Primary, secondary structure prediction, tertiary structure prediction. Concepts on Protein Data Bank (PDB). Protein Sequence alignment - Global and Local, Similarity searching (FastA and BLAST), Pair wise comparison of sequences, Multiple Sequence alignment of sequences, alignment, scoring matrices. Identification of proteins, domain and motif and Phylogenetic analysis.

Protein sequence databank – NBRF-PIR, SWISSPROT and Swiss ExPASy. Metabolic pathway data bank (KEGG/Pub gene). Protein modeling - principles of homology and comparative modeling phylogenetics. Applications - Molecular docking – Patchdoc /Autodoc.

MODULE 4	**12Hrs**

Biostatistics: Introduction to Biostatistics and its significance, use of replicates, Tabulation and graphical representations of data. Different models of data presentations. Frequency distribution. Measures of Central tendency: Arithmetic mean, mode & median. Measures of variability: Range, mean deviation and percentiles. Standard deviation and co-efficient of variation, Standard error. Sampling methods and their significance. Testing of hypothesis: basic concepts and definitions, types of errors, confidence intervals. Statistical package - Features of statistical software. Introduction to statistical software (SPSS/ Graphpad/ SigmaPlot/ ImageJ) Databases.

TEXT BOOKS:

1. Daniel (1999). Biostatistics (3 edition) Panima Publishing Corporation.
2. Khan (1999). Fundamentals of Biostatistics, Panima Publishing Corporation
3. Bioinformatics. Keith, J. Humana Press, 2008.
4. Bioinformatics. Sequence and genome analysis. D.W.Mount. Cold Spring Harbor Lab. press. 2004.

REFERENCES:

1. Swardlaw, A.C. (1985). Practical Statistics for Experimental Biologists.
2. Bazin, M.J. (1983). Mathematics in microbiology Academic press.
3. Green, R.H. (1979). Sampling design & Statistical methods for environmental Biologists, Wiley Int. N.Y.
4. Campbell, R.C. (1974). Statistics for Biologists, Cambridge Univ. Press, Cambridge.
5. Bliss, C.I.K. (1967). Statistics in Biology, Vol.1 Mc Graw Hill, New York. Wiley and Sons, Inc. NY.
6. Bioinformatics and functional genomics. J. Pevsner. Wiley-Liss, 2003.
7. Dhananjaya (2002) Introduction to Bioinformatics, www.sd-bio.com series.
8. Higgins & Taylor (2000). Bioinformatics, OUP.
9. Baxavanis (1998). Bioinformatics.
10. Fry, J.C. (1993). Biological Data Analysis. A practical Approach. IRL Press, Oxford

SEMESTER	**II**					
YEAR	**I**					
COURSE CODE	**20MB1271**					
TITLE OF THE COURSE	**MICROBIAL PHYSIOLOGY - LAB**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	**4**	-	-	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To make students learn quantitative and qualitative methods for study of biomolecules in microbiology lab

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Student will be equipped with coloured based changes given out by microbial tests	L2

List of Laboratory/Practical Experiments activities to be conducted (if any) :
1. Starch hydrolysis
2. Gelatin hydrolysis
3. Catalase test
4. Sugar/Triple fermentation test
5. Nitrate reduction test
6. H_2S production test
7. IMViC test
8. Oxidase test
9. Isolation of antibiotics resistant mutant by gradient plate technique
10. Demonstration of replica plating method for selection of antibiotic resistant mutants

REFERENCES:

1. Aneja, K.R. 2014. Laboratory Manual of Microbiology and Biotechnology. Medtec
2. Boyer, R.F. 2003. Modern Experimental Biochemistry. Third Edition. Pearson Education.
3. Cappuccino, J.G., and Sherman, N. 1999. Microbiology a Laboratory Manual. Fourth Edition. The Addison Wesley Longman, Inc England.
4. David, W. 2000. Physiology and Biochemistry of Prokaryotes. Second Edition.Oxford University Press.
5. Griffin, D.H. 1993. Fungal Physiology. Second Edition. Wiley Liss- A John Willy Sons, Inc, Publication. USA. p: 1-458.
6. Moat, A.G. and Froster, S.W. 2002. Microbial Physiology. Fourth Edition. John Wiley And Sons, New York.

SEMESTER	**II**					
YEAR	**I**					
COURSE CODE	**20BC1271**					
TITLE OF THE COURSE	**BIOANALYTICAL SEPARATIONS -LAB**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
		0	**4**	**0**	**-**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
1	NA	NA	NA

COURSE OBJECTIVES:

- To make students learn quantitative and qualitative methods for study of biomolecules.
- To provide hands-on training to physico-chemical methods.
- To give insights on isolation, separation and characterization of biomolecules.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Student will be equipped with methodology to study biomolecules using spectroscopic, electrophoretic and chromatographic techniques.	L2
CO2	Students will have a complete understanding on methods to analyse biomolecules.	L3
CO3	Students will be empowered for better prospects leading to project design and execution.	L4

EXPERIMENTS/PRACTICAL:
1. Determination of extinction coefficient using colorimetry.
2. Determination of lambda maximum of biomolecules using UV spectroscopy.
3. Estimation of protein by Lowry method or Estimation of sugar by Miller method.
4. Estimation of pKa of amino acid (glycine).
5. Determination of density & viscosity of given unknown solution.
6. Circular Paper chromatography for amino acid/ sugars and Rf calculations.
7. Separation of amino acid by Thin Layer Chromatography (TLC).
8. Column chromatography of phyto-pigments on adsorbent (silica/alumina).

TEXT BOOKS:

1. Principles and Techniques of Practical Biochemistry – Keith Wilson and John Walker. Cambridge low price edition.
2. Biophysical Chemistry – Upadhyay, Upadhyay and Nath. Himalaya Publications.
3. Analytical Techniques in Biochemistry and Molecular biology – Katoch. Springer.
4. Fundamentals of Analytical Chemistry - Skoog, Holler and West. Saunders.

5. Handbook of Analytical Techniques - Gunzler and Williams. Wiley & Sons.
6. A Textbook of Practical Biochemistry- Joshi and Saraswat. Jain Publishers.

SEMESTER	**II**					
YEAR	**I**					
COURSE CODE	**20GN1271**					
TITLE OF THE COURSE	**FUNDAMENTALS OF CYTOGENETICS - LAB**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	0	**0**	**4**	**0**	**-**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- Identifying chromosome features and their status in animal and plants.
- Analyse linkage and crossing over problems by mapping method.
- Understanding cytogenetics using Drosophila as a model organism

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	The student will gain skill to prepare and visualise chromosomal slides from various sources.	L3
CO2	Students can solve genetic linkage analysis by construct ion of cytogenetic maps on linkage. Gene interactions, predict crosses and understand its role in inheritance.	L4
CO3	Students will become skilled in handling and maintaining Drosophila cultures.	L2

List of Laboratory/Practical Experiments activities to be conducted (if any):
1. Micronuclei from buccal cell (H&E basic staining)
2. Preparation of Metaphase spreads from blood for Karyotyping.
3. Genetic Problems on linkage & crossing over - Drosophila, Maize, Human (Sex Linkage)
4. Study of chromosomal aberration using karyotype information by observation of permanent slides of chromosomal aberrations. Cytogenetics using Drosophila as a model organism.
5. Culturing and Handling of Drosophila - Media preparation, Handling drosophila.
6. Study of different types of Drosophila- Body color mutant- Ebony body and Yellow body,Wing mutant- Curly wing and vestigial wing and Eye color mutant- Bar eye, white eye, sepia eye.
7. Mounting of Sex Comb and Genital plate of Drosophila melanogaster
8. Salivary gland Chromosome - Dissection of Salivary glands and preparation of polytene chromosome.

REFERENCES

1. Drosophila Cytogenetics Protocols, Methods in Molecular Biology, Volume 247, Daryl S Henderson, Humana Press.
2. The AGT Cytogenetics Laboratory Manual, Marilyn S Arsham, Margaret J , March , Helen J Lawce, Fourth Edition, Wiley Blackwell.

SEMESTER	**II**					
YEAR	**I**					
COURSE CODE	**20BS1202**					
TITLE OF THE COURSE	**COMPUTER APPLICATIONS AND INFORMATION TECHNOLOGY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	**-**	**-**	**-**	**24**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To create general interest in applied domain towards using computers for biological applications.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Student will be aware of the computer tools and applications which can be implemented in biological sciences.	L2
CO2	Students will be empowered for better prospects leading to project design and execution.	L2

COURSE CONTENT:	
MODULE 1 History and Generations of Computers	**4Hrs**
Evolution, Generations of computers (I, II, III,IV, V) Classification of computers (mainframes, mini computers, microcomputers, special purpose) Comparison with respect to memory, power, cost and size, Real-Time, Online, Offline ,Overview and functions of a computer systems, Input and output devices, Storage devices: Hard disk, Diskette, Magnetic tape, RAID, ZIP, devices, Digital tape, CD-ROM, DVD (capacity and access time), Main Circuit Board of a PC: Chips, Ports, Expansion.	
MODULE 2 Categories of Computers and Operating Systems	**4Hrs**
The workstation, The Minicomputer, Mainframe Computers, Parallel processing Computer & the Super Computer, Operating System concepts, Windows 98/XP and later versions, Windows server NT/2000, Unix/Linux & servers. Introduction to networking: various terminologies, Associated hardware devices, gadgets (Router, Switch) tools, services, and resources, Network Topologies and Protocols, LAN, WAN and MAN World Wide Web (WWW) Network security: fire walls.	
MODULE 3	**8Hrs**

Data processing & presentation: Introduction, Office Automation Software (Open Source Software). **Computer viruses and Internet Searches:** An overview of Computer viruses, What is a virus? Virus symptoms, How do they get transmitted? What are the dangers? General Precautions, Search engines: Google, Yahoo, Concepts in text-based searching, searching Medline, PubMed, and bibliographic databases.	
MODULE 4 Algorithms, Flowcharts, Programming concepts & Bioinformatics	**8Hrs**
Algorithms: Concepts & definitions, converting algorithms to flowchart; Coding: flowcharts to programs, Comparing algorithms, flowcharts & programs; Introduction & Overview of Biological databases. Introduction to Bio-informatics: Definition, Introduction to data mining, Computational gene finding – multiple alignment and sequence search (BLAST, FASTA, CLUSTALW). Applications of Bioinformatics.	

REFERENCES:

1. Computer Fundamentals, 4th edition (2004) P.K. Sinha, BPB publication, India
2. Computer Networks. 4th edition (2008). Tanenbaum. Pearson Education, India
3. Biostatistics: P.N. Arora, P.K. Malha.
4. Introduction to Database Management Systems, 1st edition, (2004), Atul Kahate, Pearson education, India.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20MB2301**					
TITLE OF THE COURSE	**IMMUNOLOGY AND MEDICAL MICROBIOLOGY**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**-**	**-**	**-**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- Demonstrate an understanding at an advanced level of microbial virulence mechanisms and host response to infection.
- To apply molecular techniques to medical microbiology; biochemical and genetic mechanisms of antimicrobial agent activity, microbial susceptibility and resistance to antimicrobial agents.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	To introduce and describe the classification, structure, classification and physiology of bacteria that infect humans	L3
CO2	To introduce basic and molecular techniques employed in diagnostic bacteriology laboratories. To learn about the use of antibiotics and resistant mechanisms encoded in bacteria to neutralise these chemical agents	L3

COURSE CONTENT:

MODULE 1 : ELEMENTS OF IMMUNE SYSTEM 12Hrs

History and scope of immunology, Definition and types of immunity (innate and adaptive). Structure, Functions and Properties of: Immune Cells (Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell and Dendritic cell) and Immune Organs– Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT and CALT. Immune responses- Primary and Secondary Immune Response, Humoral and cell mediated immunity. Complement system – Components, function and activation pathways, Major Histocompatibility Complex.

MODULE 2 : ANTIGENS AND ANTIBODIES 12Hrs

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity), Types, Haptens, Super antigens, Epitopes (T & B cell epitopes), Structure of T-cell and B-cell receptors. Structures of antigen presenting cell. Cluster of differentiation and Co-stimulatory signals and its role T-dependent and T-independent antigens, Adjuvants. Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic). Hypersensitivity reactions (Definition and types).

Immunoglobulin family and class switch mechanism.

MODULE 3 : IMMUNOLOGICAL DISORDERS AND TECHNIQUES 12Hrs

Clonal selection theory of antibody production; Production and application of Monoclonal antibodies. Autoimmune disorders (Type-1 diabetics and Myasthenia gravis,) Transplantation immunology – Graft, types and rejection of graft. Brief concept of cancer immunology. **Immunological techniques**: Types and Principles of Ag-Ab reactions - Precipitation, Agglutination, Complement fixation and its applications. Immunodiffusion, Immunoelectrophoresis, ELISA, RIA, Immunofluorescence, Flow cytometry and Immunoelectron microscopy.

MODULE 4 : MEDICAL MICROBIOLOGY 12Hrs

Normal flora of skin, oral cavity and other body regions. Relationship between normal pathogens and host. Terminologies- Pathogenicity, Virulence, Invasion, Toxins: Exotoxins, Enterotoxins and Endotoxins.

Epidemiology, etiology, pathogenesis and prophylaxis of the following:

Bacteria–*Salmonella typhi* and *Mycobacterium tuberculosis***. Fungi–***Tricophyton spp.* And *Candida albicans.* **Viruses –**Hepatitis and HIV. **Protozoa** – *Leishmania donovani* and *Entamoeba histolytica.* Antibiotics and their mode of action – Antibacterial, Antifungal, antiviral and antiprotozoal agents. Mechanism of drug resistance. Methods of testing drug sensitivity (Kirby Bauer method, Minimum Inhibitory Concentration). **Immunoprophylaxis**- Vaccines and its types. Immunization schedule and its significance.

TEXT BOOKS:

1. Anathnarayana and Panikar (2013) Text Book of Microbiology, 9th Edition. University press.
2. Richard A, Goldsby, Thomas J, Kindt, Barbara A and Osborne (2000). Kuby Immunology. 4th Edition. W.H. Freeman and Company, New York.
3. Kuby J (2006) Immunology 6th Edition. W.H. Freeman and company, New York.
4. Warren Levinson (2000) Medical Microbiology and Immunology, Examination and Board Review. 8th Edition. McGraw Hill.
5. Tortora, Funke, Case (2009) Microbiology, 9th Edition. Benjamin Cummings.
6. Connie R Mahon (2010) Text book of diagnostic Microbiology. 3rd edition, Pearson.
7. Fritz H Kayser (2005) Medical microbiology. ThiemeVerlag.
8. Mackie and McCarthey (1996) Medical Microbiology vol 1, Microbial infection, vol 2, Practical Medical Microbiology, Churchil Livingstone.
9. Frank and Steven A (2002) Immunology and evolution of Infectious Diseases. Princeton University Press.
10. Wadher and Bhoosreddy (2005) Manual of Diagnostic Microbiology. Himalaya Publisher.
11. Kufe (2003) Cancer Medicine. BC Decker Inc.
12. Leslic Collier, John Oxford (2000) Human virology a text book for students of medicine, dentistry and microbiology. 2nd edition. Oxford university press.
13. Jenson, Wright robinson (1997) Microbiology vol 1, Microbial Infection vol 2, PracticalMedical Microbiology, Churchill living stone.
14. Credric, A Mims (2004) Medical Microbiology, 3rd Edition. Mohshy Inc.
15. Nester Roberts Pearsall Anderson (1997) Microbiology- a human perspective, 2nd Edition, McGraw-Hill.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20BC2301**					
TITLE OF THE COURSE	**HUMAN PHYSIOLOGY**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**0**	**0**	**0**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
1	I/I	**20BC1101**	**BASIC BIOCHEMISTRY**

COURSE OBJECTIVES:

1. To illustrate the general human physiology in terms of nutrition and energy synthesis.
2. To have an insight into the cellular to organ level differentiation and their related biochemical concepts

COURSE OUTCOMES :

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	The student will understand the mechanism of action of the energy generation machinery and the organs associated with it.	L2 & L3
CO2	The cell to organ system to organism architecture will be better understood.	L4

COURSE CONTENT:	
MODULE 1	**12Hrs**
Nutrition: Basic principles of a balanced diet to provide energy and nutrients. Respiratory quotient, BMR, SDA and factors affecting them. Role of carbohydrates, protein, lipid and as fuel molecules. **Hematology:** Blood components and their functions, blood groups: the ABO system. role of hemoglobin in oxygen transport. Various buffer systems of the blood, acid base balance, factors affecting acid-base balance. **Respiration:** Components of respiratory system: nasal cavity, trachea, pharynx, lungs, bronchi, bronchioles and alveoli and their functions.	
MODULE 2	**12Hrs**
Biochemistry **Cardiovascular System:** Basic anatomy of the heart, Physiology of heart, blood vessels and circulation. Basic understanding of Cardiac cycle. Blood pressure and its regulation. Brief outline of cardiovascular disorder (hypertension, arteriosclerosis, myocardial infarction and congestive heart failure. **Skeletal system:** Tissues - introduction. Extracellular matrix and its components, Bone-ultra structure, composition, cells: osteoblasts, osteocytes and osteoclasts. Bone growth, remodeling and regulation by hormones **Muscle:** Types – smooth, striated and cardiac. Contractile and regulatory proteins of	

muscle structure of actin and myosin. The sarcomere, sliding filament model of skeletal muscle contraction. Brief idea of contraction of smooth muscles.	
MODULE 3	**12Hrs**
Digestion: Anatomy of GIT and accessory organs, Regulation of GIT movement, Digestion, absorption and transport of carbohydrates, lipids and proteins. **Excretion:** Structure of nephron in brief, mechanism of urine formation: Glomerular filtration, Tubular re-absorption & Active secretion, Regulation of acid–base balance by the kidney, Acidosis and alkalosis. **Reproduction:** Brief account of histological structure of ovary & testis. Structure & functions of male & female sex hormones. Menstrual Cycle.	
MODULE 4	**12Hrs**
Neurobiology: Structure of Neurons, Physiological properties of Nerve fibers, Detailed account of impulse generation, Membrane potential, development, depolarization and repolarization. Transmission of impulse in myelinated and nonmyelinated nerve fibers. Nernst's and Goldman Equation, Nernst's potential. Synapse and mechanism of synaptic transmission: Cholinergic and adrenergic transmission, Functions of acetyl choline, GABA, dopamine and glutamate as neurotransmitters.	

TEXT BOOKS:

1. Textbook of Medical Physiology – Guyton and Hall. Elsevier.
2. Human Physiology – Chatterjee. Sapna Publishers.
3. Fundamentals of Biochemistry - Deb. Central Publishers.
4. Medical Biochemistry – Chatterjee and Shindey.
5. Biochemistry – Das. Central Publishers.
6. Biochemistry –Jain. Himalaya Publications.
7. Principles of Nutrition – Swaminathan. Himalaya Publications.
8. Laboratory Manual for Practical Biochemistry –Hemavathi, Shivraja and Ganesh. Jaypee Publishers.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20GN2301**					
TITLE OF THE COURSE	**BASIC HUMAN GENETICS AND GENETIC ENGINEERING**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**0**	**0**	**0**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES :

- To provide students with basic principles of human genetic engineering including the techniques, applications and limitations.
- To demonstrate the ability to design recombinant molecules and apply information extracted from a variety of sources including journal articles, technical bulletins, product manuals, and drug information sheet to solve problems.

COURSE OUTCOMES :

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	The students will have knowledge of tools and strategies used in genetic engineering.	L3
CO2	Understanding of applications of recombinant DNA technology and genetics	L4

COURSE CONTENT:	
MODULE 1 HUMAN CHROMOSOMES, INHERITANCE	**14Hrs**
Human Chromosomes: Normal Human Karyotype: Paris Nomenclature, karyotyping (Quantification of DNA of individual chromosomes), Pedigree studies: Symbols used in pedigree studies, Pedigree analysis & construction, Pedigree analysis for the inheritance pattern of genetic diseases.	
MODULE 2 GENETIC DISEASES AND INHERITANCE PATTERN	**5Hrs**
Autosomal Dominant Inheritance (Ex.- Adult polycystic kidney, Achondroplasia and Neurofibromatosis). Autosomal Recessive Inheritance (Ex.- Albinism, Sickle cell anemia, Phenylketonuria). X-linked Recessive Inheritance (Ex.- Duchenne muscular dystrophy-DMD). X-linked Dominant Inheritance (Ex.- Xg blood group). Y-linked inheritance (Holandric gene Ex.- Testes determining factor - TDF). Multi-factorial inheritance (Ex.-Congenital malformations- Cleft lip and palate, Rheumatoid arthritis and Diabetes). Mitochondrial diseases (Ex.- Leber's heriditary optic neuropathy).	
MODULE 3 INTODUCTION TO rDNA TECHNOLOGY	**14Hrs**
History and fundamentals of r-DNA technology, Tools for r-DNA technology. Molecular	

tools for gene cloning: Nucleases -Endo and Exonucleases – Nomenclature, Types and characteristic features. Modification of cut ends. DNA ligases and DNA Recombinases. DNA Modifying Enzymes - Alkaline phosphatase, Polynucleotide kinase, Klenow fragment, terminal nucleotidyl transferase.

MODULE 4 VEHICLES FOR CLONING	**15Hrs**

Properties of an ideal vector. Types: Cloning and expression vectors. Cloning vectors: Prokaryotic vectors: Plasmids- pBR322; pUC18; Bacteriophages -Lambda phage, Cosmids. Eukaryotic vectors: YAC vectors; Shuttle vectors- Yeast and E. coli. For higher plants: Integrative DNA transfer- Agrobacterium vectors-Ti plasmid-Binary and Co integrated vectors; Non integrative DNA transfer-Plant viral vectors (CaMV).

REFERENCES:

1. Nicholl D. S. T. An introduction to Genetic engineering (2nd ED), Cambridge University Press, 2002.
2. Satyanarayana U. Biotechnology, Books and Allied (P) Ltd., Kolkata, 2008.
3. Purohit S. S. Biotechnology Fundamentals and applications, student Edition, Jodhpur, 2003.
4. Sandhya M. Genetic engineering: Principles and practice, MacMillan. India Ltd. 2008.
5. Channarayappa. Molecular Biotechnology- Principles and practices, University press (India) Private Limited, 2006.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20BS2301**					
TITLE OF THE COURSE	**MOLECULAR BIOLOGY**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**-**	**-**	**-**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- Understand the general principles of central dogma, DNA and RNA types structure and their role in cells.
- Explain the mechanisms of DNA replication, RNA synthesis and repair, various levels of gene expression, regulation and protein function.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Know the importance of recent discoveries and the applications and potential of molecular biology with these technologies.	L1
CO2	Student will gain understanding of chemical and molecular processes that occur in and between cell.	L2

COURSE CONTENT:	
MODULE 1 THE MOLECULAR BASIS OF LIFE	**12Hrs**
Central dogma, DNA and RNA as genetic material – experimental proof. Evidences for DNA as the genetic material- Griffith's transformation experiment, Hershey and Chase experiment, evidence for RNA as the genetic material of viruses (TMV, Retroviruses). Nucleic acids: DNA structure and types (A, B and Z model), Denaturation and renaturation kinetics of DNA, Types of RNA – mRNA, tRNA and rRNA, mi RNA and siRNA.	
MODULE 2 DNA REPLICATION AND ITS COMPONENTS	**12Hrs**
Replication of DNA (Conservative, Dispersive and Semi Conservative DNA replication, Meselson and Stahl experiment), theta and rolling circle model of replication. Prokaryotic and Eukaryotic – Enzymes and proteins involved in replication.	
MODULE 3 DNA TRANSCRIPTION AND ITS COMPONENTS	**12Hrs**
RNA polymerases, Mechanism of transcription – initiation, elongation and termination in prokaryotes and eukaryotes. Post-transcriptional modifications of Eukaryotic mRNA (Poly A tailing, 5' capping and splicing mechanisms)	
MODULE 4 TRANSLATION AND REGULATION OF GENE EXPRESSION	**12Hrs**
Genetic code, wobble hypothesis, Mechanism of translation in prokaryotes and eukaryotes,	

Post translational modification of Proteins. Regulation of Gene expression in Prokaryotes – Operon concepts, induction, repression, attenuation, examples of Lac and Trp operons. Regulation of Gene expression in Eukaryotes –galactose metabolism in yeast.

TEXT BOOKS:

1. Cell & Molecular Biology by Gerald Karp, 3rd Edition, John Wiley & Sons (2009)
2. Molecular Biology of the Gene by James Watson et al, Pearson Education (2013)
3. Molecular Biology of the Cell, Bruce Alberts et al, Garland Science Publication (2007)
4. Principles of Biochemistry by Nelson and Cox, WH Freeman Publications (2008)
5. Textbook of Cell and Molecular Biology by Ajoy Paul, Books and Allied Ltd (2011).
6. Molecular Biology and Genetic Engineering by P K Gupta, Deep and Deep Publications (2008).
7. Cell Biology, Genetics, Molecular Biology, evolution and Ecology by PS Verma and VK Agarwal, S. Chand Publications (2006).

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20MB2371**					
TITLE OF THE COURSE	**IMMUNOLOGY AND MEDICAL MICROBIOLOGY - LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	**4**	-	-	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To apply molecular techniques to medical microbiology; biochemical and genetic mechanisms of antimicrobial agent activity, microbial susceptibility and resistance to antimicrobial agents.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	To introduce basic and molecular techniques employed in diagnostic bacteriology laboratories.	L3

List of Laboratory/Practical Experiments activities to be conducted (if any) :
1. Identification of different types of blood cells
2. Precipitation reactions: a. Ouchtlerlony Double Diffusion b. Radial Immune Diffusion
3. Agglutination Reaction: a. Blood grouping and Rh typing
4. Isolation of normal microflora from skin and oral cavity
5. Snyder's test for dental caries detection
6. Antibiotic sensitivity test
7. Dot ELISA
8. Determination of effectiveness of antiseptics by thumb impression method.

REFERENCES:

1. Balakrishnan, Senthilkumar & Karthik, Kaliaperumal & Duraisamy, Senbagam. (2015). Practical Immunology- A Laboratory Manual. 10.13140/RG.2.1.4075.4728.
2. Hay, F.C., Westwood, O.M.R., 2002. Practical Immunology, 4th edition. ed. Wiley-Blackwell, Malden, MA.
3. Lab Manual in Biochemistry, Immunology and Biotechnology by Nigam, Arti - AbeBooks." McGraw-Hill Education (India) (2008)
4. Pharmaceutical Biotechnology by S.P.Vyas & V.K.Dixit. CBS Publishers & Distributors, New Delhi.
5. Maheshwari, D. K. (2002). *Practical Microbiology*. S. Chand Publishing.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20BC2371**					
TITLE OF THE COURSE	**CLINICAL BIOCHEMISTRY -LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	0	**0**	**4**	**0**	**-**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
1	NA	NA	NA

COURSE OBJECTIVES:

1. To provide an advanced understanding and applied knowledge of clinical biochemistry using biological samples (Urine or Blood).

COURSE OUTCOMES :

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Students will be able to perform a range of diagnostic techniques relevant to the field of laboratory medicine.	L3

EXPERIMENTS/PRACTICALS:
1. Qualitative analysis of normal components of urine.
2. Qualitative analysis of abnormal components of urine.
3. Estimation of Glucose estimation by Miller's method /DNS method.
4. Protein/DNA by UV absorption spectroscopy.
5. Estimation of Protein by Folin - Ciocalteu method.
6. Estimation of Iron by Wong's method.
7. Estimation of Phosphate by Fiske – Subbarow's method.
8. Estimation of Creatinine by Jaffe's method.

TEXT BOOKS:

1. Practical Clinical Biochemistry, ed. Harold Varley, 4th edn. CBS Publishers (2088).
2. Practical Clinical Biochemistry: Methods and Interpretation, ed. Ranjna Chawla, Jaypee Brothers Medical Publishers (2096).
3. Practical and Clinical Biochemistry for Medical Students, ed. T.N. Pattabhiraman, Gajanna Publishers (2094).
4. Hawk's Physiological Chemistry, ed. Oser, 14th Edn. (2076), Tata-McGrawHill. Biochemistry, ed. Plummer Tata-McGraw Hill, (2071).

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20GN2371**					
TITLE OF THE COURSE	**BASIC HUMAN GENETICS AND GENETIC ENGINEERING-LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	0	**0**	**4**	**0**	**-**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To prepare students for successful career in industry and research institutes.
- To develop the ability amongst the students to apply modern genetic engineering techniques in industry and research.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Proficient in preparing human chromosomes for karyotyping analysis.	L3
CO2	Describe gene cloning, restriction endonucleases, use modern gene technologies are used to elucidate genetic issues	L4
CO3	Critically analyse, evaluate and compile received results	L3

List of Laboratory/Practical Experiments activities to be conducted (if any):

1. Preparation of Human Metaphase Chromosomes
2. Identification of inactivated X chromosome as Barr body.
3. Resolution and molecular weight estimation of fragmented DNA using agarose gel electrophoresis.
4. Preparation of Pedigree chart of some common phenotypic characters of human.
5. Molecular cloning. Demonstrations:
    - Plasmid DNA isolation
    - Restriction Digestion
    - DNA ligation
    - Preparation of competent cells and Transformation.

REFERENCES

1. Jocelyn, E. K., Elliot, S. G., Stephen, T. K. (2009), Lewin's Gene X. Jones & Barlett.
2. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. (2014). Lewin's Genes XI. Jones and Bartlet India Pvt. Ltd.
3. Freshney, R.I. (2011). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley online library.
4. Primrose, S. B., and R. M. Twyman. Principles of gene manipulation and Genomics. Blackwell Publishing MA. USA. 2006.
5. Recombinant DNA: A Short Course by JD Watson, J. Tooze and DT Kurtz. Scientific American books. USA. 1983.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20BS2302**					
TITLE OF THE COURSE	**ENVIRONMENTAL SCIENCE**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	**-**	**-**	**-**	**26**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- The course will offer extensive knowledge on environment and the impact it has on life.
- The course equally focusses on the importance of ecological balance.
- The programme is designed to evoke awareness amongst students who seek careers in the environment sector.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	With an understanding of environmental management, students will be able to solve deleterious impacts on the ecosystem.	L2
CO2	With a background on environmental science, graduates have bright career opportunities in wild life conservation, and other environment sectors.	L3

COURSE CONTENT:	
MODULE 1 FOUNDATION ON ECOLOGY & ENVIRONMENT	**10Hrs**
Organizational level of ecological systems, Abiotic and biotic environment, limiting factors, adaptation, habitat and niche, concept of biosphere, population parameters, structure, growth regulation, interactions between populations, life history strategies (r and k species), the concept of carrying capacity. Structure and function of ecosystems, productivity, decomposition, energy flow, ecological efficiencies, global pattern of productivity, nutrient cycling (Carbon, Nitrogen and Phosphorus), major biomes of India and the world.	
MODULE 2 ENVIRONMENTAL BIOGEOCHEMISTRY	**6Hrs**
Structure and composition of the atmosphere, radiation budgets, general circulation of the atmosphere, prevailing and adiabatic lapse rates, air masses and fronts, monsoon, vertical profiles of major and trace gases, atmospheric photochemistry, reaction of nitrogen, oxygen, ozone, chlorides etc., properties of dust and aerosols in the atmosphere.	
MODULE 3 ENVIRONMENTAL POLLUTION	**5Hrs**
Types and major sources of air pollutants, effects of air pollutants on physico-chemical and	

biological properties surrounding atmosphere, air borne diseases and their effects on health. Types and major sources of water pollutants, effects of water pollutants on physicochemical and biological properties of water bodies, water borne diseases with special reference to water pollution. Types and major sources of soil pollutants, effects of soil pollutants on physico-chemical and biological properties of soil. Major sources of noise pollution, effects of noise pollution on health, noise level standard in industrial, commercial, residential and silence zones. Radioactive and thermal pollution sources and their effects on surrounding environment.	
MODULE 4 ENVIRONMENTAL MANAGEMENT	**5Hrs**
Introduction and scope of environmental management, basic concepts of sustainable development, industrial ecology and recycling industry. Role of natural products and bio-diversity in international trade, fundamentals of fossil fuels use, energy production and trade, energy balance and energy audit. Eco-marketing. Environmental Impact Assessment (EIA), general guidelines for the preparation of environmental impact statement (EIS).	

REFERENCES

1. Ramesh Vijaya K. (2005). Environmental Microbiology. MGP Publishers, Chennai.
2. Edward Alcamo I. (2001). Fundamentals of Microbiology, Jones and Bartlett Publishers, INC. VI Edition.
3. Kumar H.D. (1995). General Ecology, I Ed. Vikas Publishing House Pvt. Ltd., NewDelhi.
4. Pepper W. (1995). Environmental Microbiology. A.P. Publishers.
5. William C. Frazier and Dennis C. Westhoff. (1995). Food Microbiology, Tata McGraw-Hill Publishing Company limited, New Delhi, IVth Edition.
6. Odum E.P. (1971). Fundamental Ecology, 5th Ed., Saunders.
7. Kormondy E.J. (1962). Concepts of Ecology, Prentice Hall. 8.Singh H.R. (1989). Animal Ecology and Environmental Biology. Nagin Chand & Co. Shoban Lal (1992). Ecology.

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20MB2401**					
TITLE OF THE COURSE	**INDUSTRIAL, FOOD AND DAIRY MICROBIOLOGY**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**-**	**-**	**-**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To exhibit depth of knowledge by demonstrating microbial sciences in the field of applied fields of industrial, food and dairy microbiology.
- To relate microbes in interdisciplinary connections with other sciences, in particular to industrial productions, food sciences and dairy products.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	It will develop depth of understanding on fermentation technology, modern microbial techniques and analysis relating to industrial, food and dairy microbiology.	L3
CO2	It will develop problem solving capabilities in practical working in teams in laboratory-based virtual experiments to gather and evaluate microbial data using a range of current analysis techniques relating to productions, food sciences and dairy products.	L4

COURSE CONTENT:	
MODULE 1 : INTRODUCTION TO INDUSTRIAL MICROBIOLOGY	**12Hrs**
Concepts and scope of microbes in industry. Screening, isolation of industrially important microbes. Strain improvement - Mutation, recombination- gene regulation and genetic manipulation. Preservation: Industrially important microbes. Culture collection centers. Basic components and design of Typical fermenter. Types of fermenter-Laboratory, pilot-scale and production fermenters; constantly stirred tank fermenter, fluidized bed bioreactors and air-lift fermenter. Types of fermentation - Batch, Continuous, chemostat, Turbidostat, submerged and solid-state fermentation. Different parameters affecting fermentation.	
MODULE 2 : INDUSTRIAL BIOPROCESSING	**12Hrs**
Upstream Processing: Nutrients: growth factors, carbon, nitrogen, mineral sources, buffers, inhibitors, precursors, inducers, oxygen requirements, antifoam agents and others. Methods of sterilization; inoculum preparation and inoculum development. Downstream processing: Solid matter, Foam separation, Precipitation, Filtration, Centrifugation, Cell disruption,	

Liquid extraction, Solvent recovery, chromatography, Membrane processes, Drying, Crystallization. Productions and Applications: Alcohol production, organic acids (citric acid), enzymes: amylases- (Fungal and Bacterial). Amino acid - L-Glutamic acid. Vaccines (Hepatitis B), hormones (human insulin), antibiotic (Penicillin). Applications of genetic engineering in industrial bioprocessing. Production economics and IPR.
MODULE 3 : FOOD MICROBIOLOGY **12Hrs**
Principles and methods of food preservation by Physical, Chemical and food Additives, Biopreservation. Microbial spoilage of food: Causes and sources of food spoilage. Food borne Infections and Intoxications. Bacteria – Clostridium. Virus- Hepatitis A, Sea toxicants; Mycotoxins (Aflatoxins, Ochratoxins,). Fermented foods (Fermented Vegetables, Beverages, Bread, and Idli). Single cell Protein, Probiotics, Prebiotics and Synbiotics; Neutraceuticals, Quorn). Food control Agencies: HACCP, Employees Health standards, GMP. Industrial effluents treatment, Criteria of microbiological quality control.
MODULE 4 : DAIRY MICROBIOLOGY **12Hrs**
Nutritional level and microbial flora of milk. Sterilization of milk; predominant types of microorganisms in chilled and refrigerated milk and their importance; heat resistant bacteria and their role in milk spoilage. Principles of quality control tests for milk; bacteriological grading. Microbiology of dairy products: Yogurt, acidophilus milk, fat rich products (Cream and butter) and cheese. Biosensors in Food Industry; Food fortification.

TEXT BOOKS:

1. Casida L.E.J.R (2015) Industrial Microbiology, New Age International, New Delhi.
2. Stanbury PF, Whitakar A and Hall SJ (1999) Principles of Fermentation Technology, 2 nd Edition Aditya Books (P) Ltd, New Delhi.
3. Waites Michael J., Morgan Neil., RockeyJohn S and GrayHigton, Industrial Microbiology- An Introduction, Blackwell Science. Delhi
4. McNeil B and Harvey LM. Fermentation. A Practical Approach, IRL press, New York.
5. Robert H (2006) Microbiology and Technology of Fermented Foods. Blackwell Publishers.
6. Matthew Rimmer (2008) Intellectual Property and Biotechnology: Biological Inventions Edward Elgar. Betty C. Hobbs, Food Microbiology, Arnold-Heinemann Publishing Private Limited, New Delhi.
7. Frazier and Wasthoff, Food Microbiology, Tata McGraw-Hill Publishing Company Limited.
8. Hammer B.W and Babal, Dairy Bacteriology, Prentice Hall Incorporated, London.
9. James M.J. Modern Food Microbiology, CBS Publishers and Distributers, Delhi. 1996
10. Mary E.T and Richard E. I. Microbial Food Safety Animal Agriculture: Current Topics, Iowa state University Press. 2003
11. Bibek R. Fundamentals of Food Microbiology. Bibek Ray. 2 nd Edition. CRC press. 2001.
12. Adams M.R. and Moss M.O. Food Microbiology. Royal Publishing Corporation. 2000.
13. John G. Essentials of Food Microbiology. Arnold International Students Edition.
14. Frazer W.C. Food Microbiology. McGraw Hill, New York. 1979.
15. Foster E.M. et al., Dairy Microbiology. Prentice Hall Inc., Englewood. 1975.

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20BC2401**					
TITLE OF THE COURSE	**ENZYMOLOGY AND PROTEIN CHEMISTRY**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**0**	**0**	**0**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
1	I/I	**19BS1207**	**BASIC BIOCHEMISTRY**

COURSE OBJECTIVES:

1. To have a comprehensive understanding about the enzymes present in different systems, and their structure and functions.
2. To enhance the knowledge of kinetics, active sites and mechanism of action of different classes of enzymes from different biological systems.

COURSE OUTCOMES :

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Will be able to understand the biological significance of enzymes, their critical roles in different systems and their efficiency in biological reactions.	L2 & L3
CO1	Will be able to apply skills/knowledge to calculate different kinetic parameter of enzymes and also the will be equipped with information about the enzyme technologies and enzymatic assays and their medicinal/industrial applications.	L4

COURSE CONTENT:	
MODULE 1	**11Hrs**
Introduction, classification & nomenclature of enzymes; Active site, Lock & key model, induced fit model and strain/TS theory-taking lysozyme and chymotrypsin as examples; Enzyme specificity- bond, group, absolute and stereo-chemical specificity; Enzyme catalysis: Proximity & Orientation effect; Regulatory enzymes: - Allosteric (ATCase) and covalently modulated (Glycogen phosphorylase) enzymes, MODULEs-Katal & IU; Effect of physical and chemical parameters on enzyme activity with examples.	
MODULE 2	**11Hrs**
Enzyme Kinetics: Importance of measuring initial velocities, Derivation of Michaelis-Menten equation, Single & double reciprocal plots, Inhibition (Competitive, Noncompetitive & Uncompetitive) on Lineweaver-Burke plots; Importance of Kcat / Km. Bisubstrate reactions – brief introduction. **Enzyme Assay and Purification:** Enzyme assay, Specific activity; Enzyme isolation and purification, criteria for enzyme purity; Isoenzymes; Coenzymes and their significance. Clinical and Industrial applications of enzymes.	

MODULE 3	**11Hrs**
Classification based on composition, shape and function; Peptide bond; Ramachandran Plot; Structural organization: primary, secondary, tertiary and quaternary structures; Structure of Haemoglobin, Immunoglobulin, Collagen, myosin and Keratin; Denaturation of proteins and melting temperature; Hofmeister series; Protein assays and quantification methods; Peptide synthesis.	
MODULE 4	**11Hrs**
Protein purification & Proteomics: Vectors and hosts, downstream processing; Protein Expression; Isolation and purification of proteins (non-enzymatic), Characterization through gel permeation, ion exchange and affinity chromatography; Sequence determination by Sanger and Edman degradation methods; Protein fragmentation and Peptide purification; Derivatization of peptides and mass spectroscopy of peptides; mass determination; Applications of proteomics.	

TEXT BOOKS:

1. Principles of Biochemistry – Lehninger, Nelson and Cox. Freeman Publishers, 6th Ed
2. Principles of Biochemistry – Zubay, Parson and Vance. Brown Publishers, 1st Ed.
3. Biochemistry – Berg, Tymoczko and Stryer. Freeman Publishers, 5th Ed.
4. Biochemistry – Voet and Voet. Wiley & Sons. 4th Ed
5. Biochemistry with medical correlations – Devlin. Wiley & Sons, 7th Ed
6. Protein Protocols Handbook – Walker. Humana Press.
7. Protein Purification Applications – Roe. Oxford University Press.
8. Introductory Practical Biochemistry- Sawhney and Singh. Narosa Publishing house.

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20GN2401**					
TITLE OF THE COURSE	**APPLIED GENETICS**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**0**	**0**	**0**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES :

1. To go through basic and specialized knowledge and understanding the aspects of genetics is essential to applying concepts in Genetics.
2. To take the students through the basics of applied genetics and disease gene mapping.
3. To teach various techniques that students can apply in their future career in biological research as well as in industry.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Applied Genetics deals with the application of Genetics in Molecular Biology, Developmental Biology, Medicine, Pharmaceutical Industries, Medical Sciences, Agriculture and Horticulture based industries etc.	L3
CO2	Students will have a deeper understanding of several facets of applied genetics.	L3
CO3	Students will be equipped to pursue a fitting career in academia or industry.	L4

COURSE CONTENT:	
MODULE 1 GENETIC RESOURCES AND BIODIVERSITY	**8Hrs**
Germplasm, classification, Germplasm activities, and organizations associated with germplasm (NBPGR, IBPGR). Genetic Erosion, biodiversity, centres of Diversity, Vavilovian Centres of Diversity, Law of Parallelism, Gene sanctuaries, Gene bank and Cryopreservation.	
MODULE 2 INTRODUCTION TO TISSUE CULTURE	**7Hrs**
Types of cell culture media for plants and animals; Preparation and sterilization of cell culture media *ANIMAL CELL CULTURES TECHNIQUES:* History of animal cell culture; Different tissue culture techniques; Types of primary culture; Chicken embryo, fibroblast culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture; estimation of cell number;, Characterization and maintenance of cell lines, Cryopreservation; Application of animal cell culture for in vitro testing of drugs.	

PLANT CELL CULTURES TECHNIQUES: Embryo, Anther and Ovary cultures, Shoot and Root Meristem cultures, Callus culture from undifferentiated cells, Protoplast culture. Economic benefits of Tissue Culture: Resistance to pests and Pathogens, Improvement in Nutritive value etc.	
MODULE 3 HETEROSIS IN ANIMALS AND PLANTS	**15Hrs**
Introduction to Heterosis and characteristics. Introduction to animal breeds, inbreeding, grading, cross breeding. Fish breeding: Selection, Induced Polyploidy, Gynogenesis and Androgenesis, Inbreeding. Production of breeds: crossing of inbred lines for commercial production. Breeding strategies for improvement of livestock for milk, meat, wool production. Breeding strategies for improvement of Poultry. Introduction to plants breeding: Estimation of heterosis - Heterobeltosis, Economic heterosis, Standard heterosis. Hybridization techniques- intergeneric and interspecific hybridization. Identification of hybrid plants. Inbreeding depression. Hybrid vigor exploitation in Rice, Tomato.	
MODULE 4 GENETICS IN MEDICAL & INDUSTRIAL BIOTECHNOLOGY	**10Hrs**
Production of recombinant Insulin, Interferon and Human Growth hormone (HGH). Vaccines-Hepatitis B vaccine. Preparation of DNA probes, Monoclonal antibodies and Diagnostic kits (Typhoid, Syphilis). DNA Fingerprinting: Methodology of DNA fingerprinting. Molecular markers-RFLP & RAPD, Micro satellite, SNPs, STR. Applications with examples in forensic science, medico legal aspects, wild life crying	
MODULE 5 BIOINFORMATICS	**10Hrs**
Introduction to Bioinformatics Databases, Nucleic acid Sequence databases (NCBI, EBI), Protein Sequence Databases (UNIPROT, SWISS-PROT), Structure Databases (PDB). Applications of bioinformatics.	

REFERENCES:

1. Alcamo I.E. DNA Technology. The Awesome Skill 2nd edition. Harcourt / Academic press. 2000.
2. Gupta P.K. Elements of Biotechnology. Rastogi. 2002-2003.
3. Singh B. D. Biotechnology. Kalyani Publication. 2002.
4. Glide B.R. and Pasternak, J. J. Molecular Biotechnology, 2nd edition. AS press, Washington. 1998.
5. Nicholl D. S. T. An Introduction to Genetic Engineering Second Edition. Cambridge University Press. 2002.
6. Razdan M. K. An Introduction to plant tissue culture. Oxford & IBH, New Delhi. 1993.
7. Lasley. J.E. Genetics of Livestock Improvement. Prentice India.
8. Animal cell culture Techniques by Ian Freshney, Wiley-Liss.
9. Animal Cell Culture – Practical Approach BY Ed. John R.W. Masters, 3rd Edition, Oxford University Press.
10. Animal Cell Culture Techniques BY Ed. Martin Clynes,. Springer

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20BS2401**					
TITLE OF THE COURSE	**GENOMICS AND PROTEOMICS**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**-**	**-**	**-**	**48**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To go through basic and specialized knowledge and understanding the aspects of genomics and proteomics is essential to understanding Genetics and its architecture.
- To take the students through foundations in genomics and disease gene mapping.
- To teach various approaches to investigating genomics and proteomics that students can apply in their future career in biological research as well as in industry.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Student will be able to understand how genomes are organised and contemplate on the mapping of monogenic and polygenic traits.	L2
CO2	Students should be endowed with strong theoretical knowledge of genomics.	L3
CO3	In conjunction with the practical in bioinformatics, the students should be able to take up biological research as well as find placement in the relevant biotech industry.	L3

COURSE CONTENT:	
MODULE 1 PROKARYOTIC AND EUKARYOTIC GENOME ORGANIZATION	**8Hrs**
Prokaryotes: Bacteria and Bacteriophages. Eukaryotic nuclear genomes: Arabidopsis, rice, yeast, Drosophila, C. elegans and mouse genome. Eukaryotic organelle genomes - Chloroplast and Mitochondria.	
MODULE 2 GENOME MAPPING TECHNIQUES	**8Hrs**
Genetic mapping: Cross breeding and pedigree analysis, DNA markers – RFLPs, SSLPs, SNPs. Physical mapping: Restriction mapping, Fluorescent in situ hybridization.	
MODULE 3 HUMAN GENOME PROJECT	**8Hrs**
History, organization and goals of human genome project. DNA segment nomenclature, Human genome diversity, Organization of human genome, Mitochondrial genome, Gross base composition of nuclear genome, Gene density, CpG islands, RNA-encoding genes,	

Functionally identical genes, Diversity in size and organization of genes.	
MODULE 4 COMPARATIVE GENOMICS	**5Hrs**
Whole genome analysis, Genome sequence, micro assay, molecular phylogeny, C-value, number of genes and complexity of genomes, Conservation and diversity of genomes, Comparative genomics as an aid to gene mapping and study of human disease genes. Comparative genomics of mitochondria and chloroplast genomes.	
MODULE 5 PROTEIN PROFILING	5Hrs
Prediction of primary, secondary and tertiary structure of proteins- SCOP, DALIDD, CATH classification. Determining protein structure, Homology modelling. Introduction to proteome and proteomics, protein separation and analysis using 2D Gel Electrophoresis, Liquid chromatography, Mass spectrometry, Interacting proteins by phage display and Yeast two hybrid system.	

REFERENCES

1. T.A. Brown, Genomes, Bios, 2002.
2. Coleman and Tsongalis, Molecular Diagnosis, Humana, 1997.
3. Dale and Schartz, From Genes to Genomes, Wiley, 2003.
4. Dunham, I., Genome Mapping and sequencing. Horizon Scientific. 2003.
5. Hawley and Mori, The Human Genome, Academic, 1999.
6. Lewis, Human Genetics, WCB, 1999.
7. Liebler, Introduction to Proteomics, Humana, 2002.

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20MB2471**					
TITLE OF THE COURSE	**INDUSTRIAL, FOOD AND DAIRY MICROBIOLOGY - LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	**4**	-	-	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To apply techniques to industrial microbiology; biochemical and fermentation mechanisms.
- To impart basic understanding of principles, and key concepts relevant to industrial microbiology.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	To introduce basic fermentation techniques employed in Microbial industries.	L3
CO2	Course will enable the student to apply the knowledge in various aspects of fermentation or industrial microbiology	L4

List of Laboratory/Practical Experiments activities to be conducted (if any) :
1. Isolation of microorganisms from fruits.
2. Isolation of microorganisms from vegetables.
3. Production and determination of amylase activity.
4. Preparation of wine.
5. Study of different types of fermenters (Models/ Charts).
6. Cell immobilization techniques (yeast cells).
7. Determination of quality of raw milk by methylene blue reduction test.
8. Estimation of lactic acid from different diary product.
9. Production of alcohol from different sources and estimation by specific gravity method.

REFERENCES:

1. Casida L.E.J.R (2015) Industrial Microbiology, New Age International, New Delhi.
2. Prescott S.C and Dunn C.C (2005) Industrial Microbiology, 4th Edition CBS Publishers and Distributors, New Delhi.
3. Stanbury PF, Whitakar A and Hall SJ (1999) Principles of Fermentation Technology, 2nd Edition Aditya Books (P) Ltd, New Delhi.
4. Waites Michael J., Morgan Neil., RockeyJohn S and GrayHigton, Industrial Microbiology- An Introduction, Blackwell Science. Delhi

5. WulfCrueger (2016) A Textbook of Industrial Microbiology First CBS Publishers and Distributors Edition.
6. Robert Mellor (2009) Entrepreneurship for Everyone: A student Textbook. SAGE Publication.

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20BC2471**					
TITLE OF THE COURSE	**ENZYMOLOGY -LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	0	**0**	**4**	**0**	**40**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
1	-	-	-

COURSE OBJECTIVES:

1. To train the students to design the enzymatic assays and learn the calculation of kinetic parameters of the enzymes.
2. To learn isolation, handling and quantification of enzymes from biological samples and to train them to carry out enzymatic assays and interpret the results.

COURSE OUTCOMES :

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Students will be able to interpret the kinetic parameters of the enzymes and assay results.	L3
CO2	Students will be able to design and carry out the enzymatic assays and will gain the practical knowledge about the mechanism of action of different enzymes.	L4

EXPERIMENTS/PRACTICALS:
1 .Introduction to enzymology Lab and product curve determination
2. Isolation of enzymes (amylase/ phosphatase) from biological source and activity determination through time curve.
3. Determination of kinetic constants through LB plot
4. Effect of pH on enzyme activity
5. Effect of temperature on enzyme activity
6. Determination of Arrhenius constant
7. Effect of enzyme dilution on enzyme activity
8. Effect of activators and inhibitors on enzyme activity
9. Immobilization of enzyme using calcium alginate.

TEXT BOOKS:

1. Practical enzymology – Hans Bisswanger, Wiley-VCH, 2019, 3 rd Ed
2. Introductory Practical Biochemistry- Sawhney and Singh. Narosa Publishing house 2001, 1st Ed
3. Principles and Techniques of Practical Biochemistry – Wilson, Wilson and Walker, Cambridge University Press 2000, revised Ed
4. Introduction to practical Biochemistry, Plummer, Tata McGraw-Hill Education 2001, 2nd Ed
5. Basics of Enzyme Immobilization – Alka Dwevedi, Springer International Publishing, 2016, 1 st Ed.

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20GN2471**					
TITLE OF THE COURSE	**APPLIED GENETICS -LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	0	**0**	**4**	**0**	**-**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES :

1. Experiments will give emphasis on current methods and applications of genetic manipulation in plants and crops.
2. Through the use of transgenics, one can produce plants with desired traits and even increased yields.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	After being introduced to the topics students will cover 'methods available for plant transformation through Agrobacterium mediated.	L3
CO2	Students will also study about the role of precise genome modification in crops, role of vectors and markers in gene expressions.	L3
CO3	The students are expected to read, research and discuss papers related to the topic	L4

List of Laboratory/Practical Experiments activities to be conducted (if any) :

1. Tissue culture techniques:
   - Sterilization
   - Explants preparation
   - Media Composition and preparation
   - Culturing of all kinds of explants for callus induction, multiple shoot proliferation.
2. Synthetic seed preparation
3. Study of different techniques in plant hybridization
4. Study of pollen fertility
5. Study of diagnostic kits - WIDAL & VDRL
6. Study of hybrid plants - Rice, Cotton, Chilly, and Tomato.
7. Study of hybrid animals - Poultry, dairy, fishery.
8. Homology sequence analysis using Blast and Fasta.

REFERENCES

1. Pasternak, An Introduction to Molecular Human Genetics, Fritzgerald, 2000.
2. Primrose and Twyman, Principles of Genome Analysis & Genomics, Blackwell, 2003.
3. Razdan M. K. An Introduction to plant tissue culture. Oxford & IBH, New Delhi. 1993.
4. Ravishanker G.A. and Venkataraman L.V. Biotechnology Application of Plant Tissue and cell culture. BH Publications. 1997.

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20BS2402**					
TITLE OF THE COURSE	**BIOETHICS AND IPR**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	**-**	**-**	**-**	**26**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To introduce the students to the concepts of biosafety regulatory frameworks concerning genetically modified organisms at national and International levels
- To give elementary essential concepts of Bioethics, IPR and patent laws.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Student should develop basic understanding of the concepts of Biosafety, regulations concerning GMOs IPR and patent laws.	L2
CO2	This course should generate interest for avenues for pursuing higher studies and careers in these areas.	L2
CO3	General knowledge should create awareness necessary for higher studies in biotechnological fields.	L2

COURSE CONTENT:	
MODULE 1 : BIOSAFETY-REGULATORY FRAMEWORK FOR GMO's IN INDIA	**8Hrs**
Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety Committee (IBC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic Plants (1998), Seed Policy (2002), Prevention Food Adulteration Act (1955), The Food Safety and Standards Bill (2005), Regulation for Import of GM Products Under Foreign Trade Policy (2006-2007), National Environment Policy (2006). Rules for the manufacture, use/import/export and storage of hazardous microorganisms/ genetically engineered organisms or cells (Ministry of Environment and Forests Notification,1989).	
MODULE 2 BIOSAFETY-REGULATORY FRAMEWORK FOR GMO's AT INTERNATIONAL LEVEL	**6Hrs**
Convention of Biological Diversity (1992) – Cartagena Protocol on Biosafety – Objectives and salient features of Cartagena Protocol – Advanced Information Agreement (AIA) procedure – procedures for GMOs intended for direct use-risk assessment-risk	

management-handling, transport, packaging and identification of GMOs- Biosafety Clearing House-unintentional transboundary movement of GMOs-Benefits of becoming a party to the Cartagena Protocol- status of implementation in India.	
MODULE 3 BIOETHICS	**4Hrs**
What is bioethics- The legal and socioeconomic impacts of biotechnology - Public education of the process of biotechnology involved in generating new forms of life for informed decision-making – ethical concerns of biotechnology research and innovation.	
MODULE 4 INTELLECTUAL PROPERTY RIGHTS	**3Hrs**
Intellectual property rights-TRIPS, GATT-International conventions patents and methods of application of patents-Legal Implications-Biodiversity and farmer rights.	
MODULE 5 PATENTS AND PATENT LAWS	5Hrs
Objectives of the patent system - Basic principles and general requirements of patent law-biotechnological inventions and patent law-Legal Development-Patentable subjects and protection in biotechnology-The patenting living organisms.	

REFERENCES

1. Beier, F.K., Crespi, R.S. and Straus, T. Biotechnology and Patent protection-Oxford and IBH Publishing Co. New Delhi.
2. Ganguli Prabuddha Gearing up for Patents…..The Indian Scenario" , Universities Press (1998)
3. Ganguli Prabuddha "Intellectual Property Rights--Unleashing the Knowledge Economy", Tata McGrawHill (2001)
4. Ganguli Prabuddha and Jabade Siddharth, "Nanotechnology Intellectual Property Rights. Research, Design, and Commercialisation", CRC Press , Taylor and Francis Group, USA (2012)
5. Beyond Intellectual Property: Toward Traditional Resource Rights for Indigenous Peoples and Local CommMODULEies [Paperback],Darrell A. Posey and Graham Dutfield , IDRC Books; annotated edition (June 1996).
6. F. H. Erbisch and K. M. Maredia. Intellectual property rights in agricultural Biotechnology, University Press.
7. Sivamiah Shantharam, Jane F. Montegomery. Biotechnology, Biosafety and Biodiversity, Oxford & IBH Publ. New Delhi.
8. Tutelyal, VA. Genetically modified Food Sources, Safety Assessment and Control, Academic Press an Imprint of Elsevier, New Delhi.
9. Jecker Nany S, JohsenAlbert, Perlman, Robert A. Bioethics: An Introduction to the History Methods and Practice, John & Bartlett, New Delhi.
10. Sharma, HC Dhillon, MK, Sahrawat, KN. Environmental Safety of Biotech and Conventional IPM Technology, Stadium Press LLC. USA.
11. Jecker Nany S, Jones & Barlet Bioethics: An Introduction to the History Methods and Practice, New Delhi
12. Sathish MK Bioethics and Biosafety, IK International.

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20MB3501**					
TITLE OF THE COURSE	**AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**-**	**-**	**-**	**44**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To observe the importance of various life cycles carried out in the nature, for plants growing, animal husbandry and processing of plant and animal products.
- Explains the geochemical and the environmental significant processes carried out by the microbial communities that include the activities of controlled by various environmental factors and limiting microbial activities.

COURSE OUTCOMES:

Fundamental concepts and techniques in soil microbiology, soil microbial diversity, basic and applied concepts environmental problems and available solutions towards them.

TOTAL:44 HRS

PART A: AGRICULTURAL MICROBIOLOGY	
MODULE I: BIOFERTILIZERS AND BIOLOGICAL CONTROL	**11 hrs**
Types of Biofertilizers, Mass cultivation of biofertilizers- *Rhizobium*, *Azotobacter,* VAM and Azolla. **Bio-fertilizers**: Mode of application of biofertilizers. Advantages and limitations. **Bio-inoculants-** Mechanisms of biological control, Mass production and field applications of *Bacillus thuringiensis, Trichoderma spp*. and Nuclear Polyhedrosis Virus. Advantages and limitations. Marketing - Carrier and Legal clearances.	
MODULE II: PLANT PATHOLOGY	**11 hrs**

Host pathogen interaction, disease triangle, disease cycle, classification of plant pathogens and plant diseases.

Defence mechanisms – Concepts of constitutive defense mechanisms in plants, inducible structural defences (histological-cork layer, abscission layer, tyloses, gums), inducible biochemical defences (hypersensitive response (HR), SAR and ISR, phytoalexins, pathogenesis related (PR) proteins, Plantibodies.

Plant disease control- Principles and practices in disease control – Regulatory (quarantine, crop certification), Cultural (host eradication, crop rotation, sanitation), Chemical (Protectants and Systemic fungicides), Biological (Suppressive soil and microbial antagonism).

Study of different plant diseases- Bacteria –Blight of rice, Fungi – Rust of Wheat, Virus – Tobacco Mosaic Virus, Mycoplasma – Sandal Spike, Nematode- Root knot disease.

PART B- ENVIRONMENTAL MICROBIOLOGY

MODULE III: AEROBIOLOGY AND SOIL MICROBIOLOGY	**11 hrs**

Aerobiology: Significance of microorganisms in air, air borne pathogens and aeroallergens. Techniques in aerobiology: Gravity slide, Plate exposure, Rotorod sampler, Anderson Samplers, Impingers and Filteration. Control of Air borne microorganisms – Dust control, Filtration, Fumigation and UV light exposure.

Soil Microbiology: Soil profile, Soil microorganisms - Bacteria, fungi, actinomycetes, algae, protozoa and viruses. Biogeochemical cycles - Carbon cycle, Nitrogen cycle and Sulphur cycle. Microbial interactions in soil - Neutralism, Positive interactions (mutualism, commensalism, synergism, syntropism, protocoperation), Negative interactions (amensalism, antagonism and parasitism). General account of bioleaching, biodegradation and bioremediation.

MODULE IV: AQUATIC AND WASTE WATER MICROBIOLOGY	**11 hrs**

Aquatic Microbiology: Zonation of water system (Fresh and Marine), Factors affecting aquatic flora (Oxygen, Temperature, pH, light, hydrostatic pressure, turbidity and nutrients). Water Pollution: Sources and Eutrophication. Water quality analysis: Collection of water samples, Standard plate count, MPN and membrane filter technique. **Municipal treatment of water**: Sedimentation, Filtration and Disinfection.

Waste water Microbiology: Characteristics of sewage (physical, chemical and biological), Concept of BOD and COD. **Sewage Treatment**: Domestic treatment plants (septic tanks), Municipal sewage treatment Primary (coagulation and sedimentation), Secondary (Trickling filter, activated sludge, oxidation pond) and Tertiary treatment (ion exchange, reverse osmosis and dialysis). Brief account on solid waste treatment (Landfills and Composting); Biogas production.

REFERENCES

1. Alexander M., Introduction to Soil Microbiology, Wiley Eastern Limited, New Delhi.

2. Alexopoulas C.J and Mims C.W., Introductory Mycology, New Age International, New Delhi.
3. Aneja K.R., Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Cultivation, New Age International, New Delhi.
4. Agrios, G. Plant Pathology, Fifth Edition, Elsevier Academic Press, 2005.
5. Mehrotra R.S., Plant Pathology, Tata McGraw Hill Publications Limited, New Delhi.
6. Subbarao N.S, Soil Microorganisms and Plant Growth, Oxford and IBH Publishing Company, New Delhi.7. Bhatia A.L, Textbook of Environmental Biology. I.K. International Publishing Housing Ltd. New Delhi. 2009.
7. Atlas R.M. Handbook of media for environmental microbiology. CRC press.
8. Francis H Chapelle. Ground Water Microbiology and Geochemistry. 2nd Edition. ASM press.
9. Baker K.H and Herson D.S. Bioremediation. McGraw Hill Inc., New York. 1994.
10. Jabir Singh. Solid Waste Management. I. K. International Publishing House Ltd. New Delhi. 2010.
11. Patrik, K. Jjemba. Environment Microbiology: principles and applications. Science
12. InduShekhar Thakur, Environmental Microbiology: Basic Concepts and Applications. JNU, New Delhi.
13. Jogdand, Environmental Biotechnology, Himalaya Publishing House, 3rd Revised Edition: 2006.
14. Robert L Tate, Soil Microbiology,2nd Edition, John Wiley and Sons.
15. Christopher S Cox, Christopher M Wathes, Bioaerosols Handbook. Lewis Publishers.
16. Grant W.D and Long P.E. Environmental Microbiology. Kluwer Academic Publishers, 1981.
17. Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, ASM Press, 2007.
18. Singh A and Ward O.P. Applied Bioremediation, Springer, 2004.
19. Singh A, Kuhad R.C. Ward O.P, Advances in Applied Bioremediation. Springer, 2009.

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20BC3501**					
TITLE OF THE COURSE	**METABOLISM**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**-**	**-**	**-**	**44**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:
• To enhance the comprehensive understanding of biochemical processes/metabolic pathways in the living systems, particularly about the human system.
• Educate the students about the concepts of nutrition, pathophysiology and inborn errors associated with the metabolism.

COURSE OUTCOMES:		
CO No.	**OUTCOMES**	**BLOOM'S TAXONOMY LEVEL**
CO1	Student will know how the biomolecules play a role in energy production/storage which is an absolute necessity to sustain life.	L3
CO2	Students will have a greater understanding of how the homeostasis of a body is maintained and a slight change in the system could tip the balance which could lead to disease.	L4
CO3	Students will have an idea as to how hormones control the physiology of an organism via signaling mechanisms.	L4
CO4	The students will be able to comprehend the importance of proper diet and nutrition and diseases/disorders associated with improper diet.	L4

COURSE CONTENT:	
MODULE 1 CARBOHYDRATE METABOLISM	**11 Hrs**
Introduction to anabolic, catabolic, amphibolic pathways and intermediary metabolism. Glycolytic pathway; energetics and regulation, aerobic and anaerobic fates of pyruvate, entry of sugars other than glucose into metabolism, Gluconeogenesis, Cori cycle, TCA cycle. Degradation, synthesis and regulation of glycogen. Disorders of Carbohydrate Metabolism- Diabetes mellitus, glycogen storage disorders and lactose intolerance.	
MODULE 2 LIPID METABOLISM	**11 Hrs**
Oxidation of fatty acid – α, β and ω types, β-oxidation of even number saturated fatty acids. Energetics of β-oxidation. Schematic representation of biosynthesis of even number saturated fatty acids and cholesterol biosynthesis. Metabolism of ketone bodies with physiological significance. Fatty acid biosynthesis, chain elongation and desaturation. Biosynthesis of triacylglycerol, phospholipids and sphingolipids, sphingolipid storage disorders. Regulation of cholesterol metabolism; Biochemistry of obesity, atherosclerosis and hypercholesterolemia; synthesis of prostaglandins and related compounds.	
MODULE 3 METABOLISM OF AMINO ACIDS AND PEPTIDES	**11 Hrs**

Biosynthesis of physiologically active amines; serotonin, histamine, dopamine, norepinephrine and epinephrine. General mechanisms of amino acid metabolism and regulations: Role of cofactors; PLP and THF in amino acid metabolism. Deamination, transamination, decarboxylation de-sulphuration process. Urea Cycle and its regulation; Synthesis and degradation of Basic and Aromatic amino acids and their Regulation. In born errors of amino acid degradation; Phenyl Ketonuria, alkaptonuria, maple syrup urine. Introduction to bioactive peptides; Structure, localization and mechanism of action of- leptin, ghrelin, neuropeptides, enkephalin, angiotensin, defensin, vasopressin and oxytocin and associated disorders.

MODULE 4 METABOLISM OF NUCLEIC ACIDS	**11 Hrs**

Synthesis of purine and pyrimidine nucleotides – the de novo and the salvage pathway and their regulation. Degradation of purine and pyrimidines and disorders associated with degradation: Lesch-Nyhan syndrome, Gout, SCID, adenosine deaminase deficiency.

TEXT BOOKS/REFERANCES:

1. Biochemistry; Voet, D. and Voet, J.G. [Eds.] 3rdEd. John Wiley and Sons(2099).
2. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds), 6th Edn. Macmillan Publications (2012).
3. Biochemistry VI Edition; Jeremy M Berg, John L Toymoczko and LubertStryer, W H Freeman and Co. (2006).
4. Textbook of Biochemistry with Clinical Correations – Thomas M. Devlin, John Wiley & Sons; 7th edition (22 January 2010)
5. Biochemistry of Foods, Eskin, Elsevier (2012).
6. Biochemistry and Molecular Biology; 5thEd. D. Papachristodoulou, A. Snape, W.H. Elliott, and D. C. Elliott, Oxford University Press (2014).
7. Harpers Illustrated Biochemistry; 30th Ed. V.W. Rodwell , D. Bender , K.M. Botham , P. J. Kennelly, P. A. Weil (2015)

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20GN3501**					
TITLE OF THE COURSE	**POPULATION AND EVOLUTIONARY GENETICS**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**-**	**-**	**-**	**44**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To make student understand the forces that have an impact on levels of genetic variations in natural and/or experimental populations for both qualitative and quantitative traits.
- To make the students familiar with different types of DNA markers and the range of tools for their detection to enable advanced studies on molecular population genetics.

COURSE OUTCOMES:

CO No.	OUTCOMES	BLOOM'S TAXONOMY LEVEL
CO1	This course will give students exposure towards understanding population health and disease susceptibility.	L3
CO2	This course will be helpful to the students to conceptualize the existence of genetic variation and speciation.	L4

COURSE CONTENT:

MODULE 1 INTRODUCTION TO POPULATION GENETICS	**11 Hrs**

Mendelian Population and scope of population genetics. Gene and genotype frequencies, mating patterns, Hardy-Weinberg principle, heterozygotes, extension of H-W principle to multiple alleles, sex-linked alleles. Non-random mating, inbreeding and assortative mating, inbreeding coefficient. Factors that change allelic frequencies.

MODULE 2 GENETIC VARIATION AND INHERITANCE OF COMPLEX TRAITS	**11 Hrs**

Testing gene mutations for alleles: complementation test, intragenic complementation Genotypes & phenotypes: Effect of the environment on phenotype development, Penetrance and expressivity, Visible, sterile and lethal mutations, Gene interactions and modifying genes, Pleiotropy.

MODULE 3 GENETIC POLYMORPHISMS AMONG POPULATIONS	**11 Hrs**

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Genetic polymorphism, transient and stable and factors responsible for stable polymorphism. DNA markers and populations differences. Application of population genetics. Role of population genetics in genetic counselling. Genetic origin and evolution of human races. Genetic Demography, age and gender specific death and birth rates, intrinsic rate of natural increase. Index of opportunity for natural selection.

MODULE 4 EVOLUTIONARY GENETICS	**11 Hrs**

Darwinism, Neo Darwinism and Synthetic Theory. Evolution of Sexual Reproduction. Sex Ratio and Sex Determination. Chromosomal evolution, genome evolution, selfish DNA. Competition Among Levels of Organization. Speciation and Phylogeny. Coalescent Theory. Drift versus selection in population. Kin and group Selection. Cancer as an evolutionary process.

REFERANCES:

1. Hamilton M.B. (2009). Population Genetics. Wiley-Blackwell, UK.
2. Hedrick P.W.(2011). Genetics of Populations. Jones and Bartlett Publishers, Massachusetts.
3. Jobling, M., Hollox, E., Hurles, M., Kivisild, T. and Tyler-Smith, C. (2013). Human Evolutionary Genetics. Garland Science.
4. Nielsen, R. and Slatkin, M. (2013). An Introduction to Population Genetics: Theory and Applications. Sinauer Associates, Inc.
5. Relethford, J.H. (2012). Human Population Genetics. John Wiley & Sons.
6. Snusted, D.P., Simmons, M. J. (2010). Principles of Genetics. John Wiley & Sons, New York.
7. Knight, J.C. (2009). Human Genetic Diversity –Functional consequences for Health and Disease. Oxford University Press, USA.

YEAR	**III**					
COURSE CODE	**20BS3571**					
TITLE OF THE COURSE	**ESTIMATION OF BIOMOLECULES- LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	**4**	-	-	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To make students learn Qualitative analysis of biomolecules
- To make students learn Quantitative methods of study of biomolecules

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Students will be able to learn the procedures and safety precautions while handling the biomolecules	L2 and L3
CO2	Students will be able to learn quantitate biomolecules and estimate using standard graphs	L3

List of Laboratory/Practical Experiments activities to be conducted (if any):
1. Qualitative analysis of Monosaccharides and disaccharides (Glucose, Fructose, Lactose, Sucrose)
2. Estimation of Glucose estimation by Miller's method
3. Qualitative Analysis of amino acids (Trypotophan, Tyrosine, Cystiene, Proline, Arginine, Histidine)
4. Estimation of Protein by Folin - Ciocalteu method/Estimation of aminoacids by Ninhydrin method
5. Lipids (Solubility, acrolein test)
6. Determination of Iodine Number of a fat sample
7. Estimation of DNA by DPA method
8. Estimation of RNA by Orcinol method

REFERENCES:

1. Introductory Practical Biochemistry- Sawhney and Singh. Narosa Publishing house 2012, 7th edition
2. An Introduction to Practical Biochemistry: Plummer D.T, Tata Mc Graw Hill.
3. Biochemistry – Harper, Lange Publications, 2nd edition
4. Biochemistry- Voet and Voet. Wiley and Sons. 4th edition

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20BS3574**					
TITLE OF THE COURSE	**APPLIED MICROBIOLOGY AND POPULATION GENETICS-LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	**-**	**4**	**-**	**-**	**2**

Perquisite Courses (if any)

#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To understand the fundamental concepts and techniques in soil microbiology, soil microbial diversity, basic and applied concepts environmental problems.
- To make the students to learn about various inorganic experiments.
- To make the students to learn about estimation of different elements present in various compounds.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	To enable us to know how microorganisms may be utilized in agricultural microbiology.	L2
CO2	Students will get to know about the estimation of different elements like iron, calcium, nickel etc.	
CO3	The students will learn the synthesis of coordination compounds.	

List of Laboratory/Practical Experiments activities to be conducted (if any):
1. Isolation and enumeration of bacteria, fungi and Actinomycetes from rhizosphere soil.
2. Examination of Bacteroides from legume root nodules.
3. Demonstration of fungal contaminants in ground nut by standard blotter method.
4. Isolation and enumeration of air borne microbes by Petri plate exposure method.
5. Estimation of Biological Oxygen Demand (BOD).
6. Genetic problems on polygenic variance, Heritability.
7. Disease-risk prediction in population using Hardy-Weinberg equations
8. Study of phylogenetic trees
9. Study on finger and Palmer dermatoglyphic patterns
10. Pedigree analysis and construction

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20AU0003**					
TITLE OF THE COURSE	**CONSTITUTION OF INDIA AND HUMAN RIGHTS**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	**0**	**0**	**0**	**22**	**0**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- Define a constitution
- Describe the salient features of the Indian Constitution
- Explain different ways of acquiring Indian Citizenship
- List the Fundamental Rights and Fundamental Duties of Indian citizens
- Describe the Directive Principles of State Policy and their significance

COURSE OUTCOMES:

ppreciate the fundamental law of the land

e aware of what kind of government the country will have.

anding what lays down the rules to govern the country

ut the rights and also the duties of its citizens

COURSE CONTENT:	
MODULE 1	**4Hrs**
Framing of the Indian Constitution: Role of the Constituent Assembly. Philosophy of the Constitution: Objectives, resolution, preamble, fundamental Rights and Duties. Human rights and Environmental protection.	
MODULE 2	**4Hrs**
Special Rights created in the Constitution of Dalits, Backward Classes, Women and Children, and religious and linguistic minorities. Directive Principles of State policy: The need to balance fundamental rights with directive principles.	
MODULE 3	**5Hrs**

Union Executive: President, Prime Minister and Council of Ministers; powers and functions, coalition Government, problems in their working. Union Legislature: Lok Sabha and Rajya Sabha, powers and functions. Recent trends in their functioning.	
MODULE 4	**4Hrs**
State Government: Governor, Chief Minister and Council of ministers, Legislature. Centre – State relations: Political, financial, administrative: Recent Trends.	
MODULE 5	**5Hrs**
Judiciary: Supreme Court, Judicial Review, Writs, Public interest litigations. Enforcing rights through writs. Emergency provisions (Article 356)	

TEXT BOOK:

1 D.D. Basu – Introduction to the Indian Constitution.
2 A.S. Narang – Indian Constitution, Government and Politics.
3 Nani Palkhivala – We, the People, UBS Publishers, New Delhi, 1999.
4 A.G. Noorani – Indian Government and Politics
5 J.C. Johari – Indian Government and Politics Vol. I & II, Vishal, New Delhi
6 Gran Ville Austin – The Indian Constitution – Corner stone of a Nation, Oxford, New Delhi, 2000.
7 M.U. Pylee, Constitutional Government in India.
8 K.K. Ghai, Indian Constitution.

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20AU0020**					
TITLE OF THE COURSE	**KANNADA KALI – I**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	**0**	**0**	**0**	**-**	**0**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To enable students read and write in Kannada
- To make students to communicate in Kannada helping them to interact with local people for their daily needs

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Students should be able to read, write and communicate in Kannada	L3

COURSE CONTENT:

1. ALPHABETS – AKSHARAMAALE - ಅಕ್ಷರಮಾಲೆ
2. SIGNS OF VOWELS AND CONJUNCT CONSONANTS –
   KAAGMODULEHA MATTHU OTTHAKSHARAGALU
   ಕಾಗುಣಿತ ಮತ್ತು ಒತ್ತಕ್ಷರಗಳು
3. DAILY USING WORDS PART – 1
   DINANITHYADA PADAGALU BHAAGA – 1
   ದಿನನಿತ್ಯದ ಪದಗಳು ಭಾಗ – 1
4. WEEKDAY AND MONTH NAMES –
   VAARADA MATTHU THINGALA HESARUGALU
   ವಾರದ ಮತ್ತು ತಿಂಗಳ ಹೆಸರುಗಳು
5. TASTE – RUCHI – ರುಚಿ
6. COLOURS – BANNAGALU – ಬಣ್ಣಗಳು
7. NUMBERS – SANKYEGALU - ಸಂಖ್ಯೆಗಳು
8. DAILY USING WORDS PART – 2
   DINANITHYADA PADAGALU BHAAGA – 2
   ದಿನನಿತ್ಯದ ಪದಗಳು ಭಾಗ – 2
9. QUESTION PATTERNS – PRASHNEYA VIDHAANAGALU
   ಪ್ರಶ್ನೆಯ ವಿಧಾನಗಳು
10. MEASUREMENTS – ALATHEGALU - ಅಳತೆಗಳು
11. EDUCATION WORDS – SHAIKSHANIKA PADAGALU
    ಶೈಕ್ಷಣಿಕ ಪದಗಳು
12. LIQUID ITEMS – NEERINAAMSHADA PADAGALU
    ನೀರಿನಾಂಶದ ಪದಗಳು
13. FRUITS – HANNUGALU – ಹಣ್ಣುಗಳು
14. VEGETABLES – THARAKAARIGALU – ತರಕಾರಿಗಳು

15. FOOD ITEMS – AAHAARA PADAARTHAGALU
ಆಹಾರ ಪದಾರ್ಥಗಳು

16. DAILY USING WORDS PART -3 –
DINANITHYADA PADAGALU BHAAGA -3
ದಿನನಿತ್ಯದ ಪದಗಳು ಭಾಗ –3

17. METALS – LOHAGALU – ಲೋಹಗಳು

18. RELATIVES – SAMBANDHIKARU – ಸಂಬಂಧಿಕರು

19. SEASONS AND CLOTHES –
KAALAGALU MATTHU BATTEGALU
ಕಾಲಗಳು ಮತ್ತು ಬಟ್ಟೆಗಳು

20. HOUSE AND FURNITURE –
MANE MATTHU PEETOPAKARANAGALU
ಮನೆ ಮತ್ತು ಪೀಠೋಪಕರಣಗಳು

21. OPPOSITE WORDS – VIRUDDHA PADAGALU
ವಿರುದ್ಧ ಪದಗಳು

22. VERBS - KRIYAA PADAGALU – ಕ್ರಿಯಾ ಪದಗಳು

23. ANIMALS – PRAANIGALU – ಪ್ರಾಣಿಗಳು

24. INSECTS – KRIMIKEETAGALU – ಕ್ರಿಮಿಕೀಟಗಳು

25. BIRDS – PAKSHIGALU – ಪಕ್ಷಿಗಳು

26. FEELINGS – BHAAVANEGALU – ಭಾವನೆಗಳು

27. TENSES – KAALASOOCHAKAGALU – ಕಾಲಸೂಚಕಗಳು

28. COMMUNICATION WORDS – SAMBHAASHANEYA PADAGALU-
ಸಂಭಾಷಣೆಯ ಪದಗಳು

List of Laboratory/Practical Experiments activities to be conducted (if any) :
1.
2.

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20AU0022**					
TITLE OF THE COURSE	**KANNADA MANASU-I**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	**0**	**0**	**0**	**-**	**0**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
-	-	-	-

COURSE OBJECTIVES:

- To equip the native Kannada speaking students with advanced skills in Kannada
- communication and understanding.
- To enrich the students with creative writing.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Students will have better speaking and writing communication skills in Kannada	L3

COURSE CONTENT:

ಕನ್ನಡ ಪಠ್ಯಕ್ರಮ

1. ಕನ್ನಡ ಭಾಷಾ ವಿಜ್ಞಾನದ ಸ್ವರೂಪಗಳು
2. ಭಾಷಾ ಕಲಿಕೆಯ ವಿವಿಧ ನೆಲೆಗಳು
3. ವ್ಯವಹಾರಿಕ ಭಾಷೆಯಲ್ಲಿ ಕನ್ನಡ
4. ಕಂಪ್ಯೂಟರ್ ಕಲಿಕೆಯಲ್ಲಿ (ಗಣಕಯಂತ್ರ) ಕನ್ನಡ ಬಳಕೆ
5. ಪತ್ರ ಲೇಖನ
   1. ವೈಯಕ್ತಿಕ ಪತ್ರಗಳು 2. ವ್ಯವಹಾರಿಕ ಪತ್ರಗಳು
6. ಪ್ರಬಂಧ ರಚನೆ
   1. ಸಾಮಾಜಿಕ ಕ್ಷೇತ್ರ 2. ಶೈಕ್ಷಣಿಕ ಕ್ಷೇತ್ರ
7. ಗಾದೆಗಳ ಬಳಕೆ
   1. ಜನಪದದ ಶೈಲಿ 2. ಅನುಭವದ ಶೈಲಿ
8. ವಾಕ್ಯ ಸಂಯೋಜನೆ
   1. ಸರಳ ವಾಕ್ಯ 2. ಮಿಶ್ರವಾಕ್ಯ 3. ಸಂಯೋಜಿತ ವಾಕ್ಯ _
9. ವ್ಯಾಕರಣ ಭಾಗ
   1. ಅನುಕರಣವಾಚೀ ಪದಗಳು 2. ವಿರುದ್ಧ ಪದಗಳು, ನುಡಿಗಟ್ಟುಗಳು
   3. ವಿದ್ಯರ್ಥಕ ಪದಗಳು 4. ಅರ್ಥ, ಸಮಾನಾರ್ಥ, ನಾನಾರ್ಥ ಪದಗಳ
   5. ನಿಷೇದಾರ್ಥಕ ಪದಗಳು 6. ಸಂಖ್ಯಾವಾಚಕ, ನಾಮವಾಚಕಗಳು
   7. ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು 8. ಕ್ರಿಯಾಪದಗಳು, ಧಾತುರೂಪ
   9. ಪದ ವಿಂಗಡಣೆ 10. ದ್ವಿರುಕ್ತಿ, ಜೋಡುನುಡಿ, ಇತ್ಯಾದಿ

10. ಸೃಜನಾತ್ಮಕ ಬರವಣಿಗೆ
    1. ವಿಷಯದ ಆಯ್ಕೆ 2. ಅನಿಸಿಕೆಯ ಭಾಗ
    3. ವಿಶ್ಲೇಷಣೆ 4. ಉಪಸಂಹಾರ
11. ವಿಷಯದ ಚರ್ಚೆ, ಪ್ರಬಂಧ ಮಂಡನೆ
12. ಸಮೂಹ ಚರ್ಚೆ, ಪಠ್ಯ – ಪದ್ಯ – ನಾಟಕ ಭಾಗ
13. ವಿಷಯ ಸಂಗ್ರಹಣೆ, ವರದಿ, ಲೇಖನ ಕಲೆ
14. ಸಂಪರ್ಕ ಮಾಧ್ಯಮಗಳು – ಅದರ ಬಳಕೆ
15. ಸ್ವತಂತ್ರ ಕಥೆ, ವರ್ಣನೆ, ಪ್ರವಾಸಕಥನ ಮತ್ತು ಅನುಭವಗಳ ನಿರೂಪಣೆ

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SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20BS3601**					
TITLE OF THE COURSE	**RESEARCH METHODOLOGY**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2		**-**	**-**	**22**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
1	-	-	-

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
1	-	-	-

COURSE OBJECTIVES :

1. Students understand research terminology one that can be used to carry out different approaches to research

2. To be aware of the ethical principles of research, challenge and approval processes

COURSE OUTCOMES :

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Demonstrate knowledge of research processes (reading, evaluating and developing)	L2
CO2	Compare and contrast qualitative and quantitative research	L4

COURSE CONTENT:	
MODULE I	**11Hrs**
Meaning, Objectives and Characteristics of research. Research Methods Vs Methodology. Types of research. Descriptive Vs. Analytical, Applied Vs. Fundamental, Quantitative Vs. Qualitative, Conceptual Vs. Empirical. Research process. Criteria of good research. Developing a research plan. Defining the research problem. Techniques involved in defining the problem Survey of literature. Primary and secondary sources. Reviews, treatise, monographs patents. Identifying gap areas from literature review. Development of working hypothesis.	
MODULE II:	**11Hrs**

Research design and methods - Basic Principle. Features of good design. Prediction and explanation, Induction, Deduction, Development of Models. Developing a research plan. Exploration, Description, Diagnosis, and Experimentation. Determining experimental and sample designs. Sampling design - Steps and types in sampling design. Measurement and scaling techniques. Methods of data collection. Testing of hypotheses. Procedure for hypotheses testing flow diagram for hypotheses testing. Data analysis with Statistical Packages. Correlation and Regression. Important parametric test. Chi-square test. Analysis of variance and Covariance.

List of Laboratory/Practical Experiments activities to be conducted (if any) :
1**.NO**
2. **NO**

TEXT BOOKS :

REFERENCES

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Anderson, T. W., An Introduction to Multivariate Statistical Analysis, Wiley Eastern Pvt., Ltd., New Delhi
4. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.
5. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
6. Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
7. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
8. Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20BS3602**					
TITLE OF THE COURSE	**PROJECT**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	**-**	**-**	**12**	**-**	**6**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
1	-	-	-

COURSE OBJECTIVES:

1. Construct a project from Plan, schedule, monitor and control students' own work and to exhibit ideas in discussions and presentations

2. Apply tools and techniques to the applied courses taught and to communicate their findings through a written report and poster presentation

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	To provide a postgraduate level knowledge in Microbiology, including understanding, analysis, management, and handling of real-life information technology problems in workplace.	L4
CO2	To provide graduate education that will prepare students to become thoughtful, productive members of the competing profession and community.	L4
CO3	To provide a high-quality post graduate education and training in microbiology which prepares students for productive careers and lifelong learning.	L5