B.Sc. BIO-TECHNOLOGY/
B.Sc. BIO-TECH (HONS./BY RESEARCH)
COURSE CURRICULUM
(SESSION 2025-26)

INSTITUTE OF APPLIED SCIENCES&HUMANITIES

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COURSE STRUCTURE

B.Sc.

BIOTECHNOLOGY

[As Per NEP 2020]

First Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BBIC 0001	Cell Biology & Genetics	Core (Major 1)	4	0	0	4	4
2.	BCHE 0011	Principles of Chemical Science	(Minor)	4	0	0	4	4
3.	BPHE 0001	Optics	(Minor)	3	0	0	3	3
4.	BELA 0003	Language Skills-I	AEC	2	0	0	2	2
5.	BCAO 0001	Fundamental of Information Technology	Multidisciplinary	3	0	0	3	3
6.	BCHO 0011	Food, Nutrition & Hygiene	VAC	2	0	0	2	2
PRACTICALS								
5.	BBIC 0801	Cell Biology & Genetics Lab	Core (Major) Lab	0	0	4	2	3
6.	BPHE 0801	Optics Lab	(Minor) Lab	0	0	2	1	2
7.	APFJ 0001	Field Project	Lab	0	0	2	1	1
TOTAL				18	00	08	22	24

Second Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BBIC 0003	Molecular Biology & Genetic Engineering	Core (Major 1)	4	0	0	4	4
2.	BBIC 0004/ BBIC 0005	Plant Physiology, Evolution & Ecology/ Human Physiology & Developmental Biology	Core (Major 2)	4	0	0	4	4
3.	BBIK 0001	Fundamentals of Clinical Biochemistry & Microbiology	SEC	2	0	0	2	2
4.	BELA 0004	Language Skills-II	AEC	2	0	0	2	2
5.	BMAS 0505	Statistics & Numerical Methods	(Minor)	4	0	0	4	4
		First Aid and Health	VAC	1	0	0	1	1
PRACTICALS								
6.	BBIC 0802	Genetic Engineering Lab	Core (Major) Lab	0	0	4	2	3
7.	BBIK 0801	Fundamentals of Clinical Biochemistry & Microbiology Lab	SEC Lab	0	0	2	1	2
TOTAL				19	00	06	22	26

- **Students who opt to exist after completion of first year and have secured 40 credits will be awarded a UG certificate if, in addition, they complete Vocational course (Skill oriented) of 4 credits during summer vacation of first year.**

Third Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BBIC 0006	Biochemistry & Biochemical Tools	Core (Major)	4	0	0	4	4
2.	BPSO 0004	Pharmacognosy-I	(Minor)	3	0	0	3	3
3.	BPSO 0003	Pathophysiology	(Minor)	4	0	0	4	4
4.	BELA 0007	Technical Writing	AEC	2	0	0	2	2
5.	BBAO 0404	E-Business	Multidisciplinary	3	0	0	3	3
6.	BPSO 0002	First Aid & Health	VAC	2	0	0	2	2
7.	BBIK 0802	Fundamentals of Biological Science	SEC	2	0	0	2	2
PRACTICALS								
8.	BBIC 0803	Biochemistry Lab	Core (Major)	0	0	4	2	4
9.	BPSO 0801	Pharmacognosy Lab -I	Minor	0	0	2	1	2
10.	BBIK 0802	Fundamentals of Biological Science Lab	SEC	0	0	2	1	2
TOTAL				20	00	8	24	28

Fourth Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BBIC 0007	Microbiology & Immunology	Core (Major 1)	4	0	0	4	4
2.	BBIC 0008	Tools & Techniques in Biotechnology	Core (Major 2)	4	0	0	4	4
3.	BPSO 0006	Pharmacognosy-II	(Minor)	4	0	0	4	4
4.	BEDO 0001	Physical Education & Yoga	AEC	2	0	0	2	2
5.	BELA 0012	Workplace Communication	VAC	2	0	0	2	2
PRACTICALS								
6.	BBIC 0804	Microbiology & Immunology Lab	Core (Major 1)	0	0	4	2	4
7	BBIC 0805	Tools & Techniques in Biotechnology Lab	Core (Major 2)	0	0	4	2	4
8	BPSO 0802	Pharmacognosy-II Lab	(Minor)	0	0	2	1	2
TOTAL				16	00	10	21	26

Students who opt to exist after completion of second year and have secured 80 credits will be awarded a UG Diploma if, in addition, they complete Vocational course (skill oriented) of 4 credits during summer vacation of first/second year.

Fifth Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.		Animal & Plant Biotechnology	Core (Major 1)	4	0	0	4	4
2.		Biostatistics & Bioinformatics	Core (Major 1)	4	0	0	4	4
3.		Fermentation Technology	Core (Major 2)	2	0	0	4	4
4.		Cancer Biology	Core (Major 2)	3	0	0	3	3
5.		Medical Microbiology	Core (Major 2)	2	0	0	2	2
6.		Cyber ethics and Law	Multidisciplinary	3	0	0	3	3
7.		Communication skills and Personality development	VAC	1	0	0	1	1
PRACTICALS								
8.		Biostatistics & Bioinformatics Lab	Core (Major 1)	0	0	4	2	4
9.		Fermentation Technology Lab	Core (Major 2)	0	0	2	1	2
10.		Medical Microbiology Lab	Core (Major 2)	0	0	2	1	2
TOTAL				16	00	8	20	24

Six Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.		Industrial and Environmental Biotechnology	Core (Major 1)	4	0	0	4	4
2.		Food Biotechnology	Core (Major 1)	4	0	0	4	4
3.		Animal Cell Culture	Core (Major 2)	2	0	0	4	4
4.		Proteomics & Genomics	Core (Major 2)	2	0	0	2	2
5.		Clinical Biochemistry	Core (Major 2)	2	0	0	2	2
6.		Nanotechnology	SEC	3	0	0	3	3
7.		Analytic ability and digital awareness	VAC	1	0	0	1	1
PRACTICALS								
8.		Industrial and Environmental Biotechnology	Core (Major 1)	0	0	4	2	4
9.		Animal Cell Culture Lab	Core (Major 2)	0	0	2	1	2
10.		Proteomics & Genomics Lab	Core (Major 2)	0	0	2	1	2
11.		Clinical Biochemistry Lab	Core (Major 2)	0	0	2	1	2
TOTAL				16	00	8	20	24

B.Sc.
(BIOTECHNOLOGY)
COURSE CURRICULUM

(w.e.f. Session 2025-26)

AS PER NEP- 2022

INSTITUTE OF APPLIED SCIENCES & HUMANITIES

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B.Sc. (Hons.) Biotechnology Course Structure ..... **i**
B.Sc. (Hons.) Biotechnology Syllabus **1**

COURSE STRUCTURE
B.Sc.
BIOTECHNOLOGY

First Semester

S. NO.	CODE	SUBJECT	CORE/ ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BBIC 0001	Cell Biology & Genetics	Major	4	0	0	4	4
2.	BCAO 0001	Fundamentals of Information Technology	Multidisciplinary	4	0	0	4	4
3.	BCHE 0011	Principles of Chemical Science		2	2	0	3	4
4.	BCHO 0011	Food, Nutrition &Hygiene		4	0	0	4	4
5.	BELA 0003	Language Skills-I	Ability Enhancement					
6.	BPHE 0001	Optics						
PRACTICALS								
7.	BBIC 0801	Cell Biology & Genetics Lab		0	0	4	2	4
8.	BPHE 0801	Optics Lab		0	0	3	2	3
TOTAL				14	02	09	21	25

Second Semester

S. NO.	CODE	SUBJECT	CORE/ ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BBIC 0003	Molecular Biology & Genetic Engineering		4	0	0	4	4
2.	BBIC 0004	Plant Physiology, Evolution & Ecology		4	0	0	4	4
3.	BBIC 0005	Human Physiology & Developmental Biology		2	2	0	3	4
4.	BBIK 0001	Fundamental of Biochemistry & Microbiology		4	0	0	4	4
5.	BELA 0004	Language Skills-II	Ability Enhancement					
6.	BMAS 0505	Statistics & Numerical Methods						
PRACTICALS								
7.	BBIC 0802	Genetic Engineering Lab		0	0	3	2	3
8.	BBIK 0801	Fundamental of Biochemistry & Microbiology Lab		0	0	3	2	3
TOTAL				14	02	09	21	25

BSBC: CELL BIOLOGY AND GENETICS

OBJECTIVES: Cell biology is increasingly important in all life sciences. Many of the advancements in modern science are the result of a better understanding of cellular components and their functions. In addition, this course is to understand the Mendelian and non-mendelian modes of inheritance that govern passage of genetic traits across generation, to use this knowledge of inheritance to track alleles through generations and categorize and predict genotypes and phenotypes, to understand different mechanism of sex determination, basic principles of population genetics and classical and modern concept of genes.

Credits: 04 **Semester** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Introduction and history of Biotechnological science with special referenceto contribution of Indian scholars in biological sciences. Prototype structure of animal, plant and bacterial cells, Diversity of cell sizeand shape, Cell theory, C-value paradox, Cell Membrane: Chemical components of biological membranes, organization and Fluid Mosaic Model, and membrane transport. Cytoskeleton and Extra cellular matrix. **Cell cycle, Cancer and Cell Signaling:** • Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progressionin yeast and higher organisms • Cell senescence and programmed cell death • Cancer - chromosomal disorders, oncogenes and tumor suppressor genes • Introduction to cell signalling and cell, cell interaction **Mendelian and nonmendelian genetics:** • Historical developments in the field of genetics, Organisms suitable for genetic experimentation and their genetic significance. • Mendelian genetics: Mendel's experimental design, monohybrid, di- hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy. • Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory.	30
II	**Structure and Function of Cell organelles:** • Lysosomes: Vacuoles and micro bodies: Structure and functions • Ribosomes: Structures and function including role in protein synthesis. • Mitochondria: Structure and function, Genomes, biogenesis. • Chloroplasts: Structure and function, genomes, biogenesis • Nucleus: Structure and function, nuclear envelope	30

	Chromosome structure: Chromosomes: chromatin and chromosomes organization, euchromatin and heterochromatin, nucleosome, metaphase chromosome, genes and chromosomes. DNA as genetic material, Structure of DNA, Structural and numerical changes in human, chromosomes and ploidy in plants. Mutations: Types of mutations, spontaneous and induced mutations, Physical and chemical mutagens. **Linkage, crossing over and population genetics:** Linkage, crossing over and chromosome and genetic mapping, Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting. • Genetic Code: deciphering genetic code; degeneracy, unusual codons in mitochondria Mutations: types, mechanisms • Evolution and population genetics: Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, evolutionary genetics, natural selection. **Cytological techniques**: Microscopy and staining techniques, Microtomy, Karyotyping, Chromosome banding, in situ hybridization and FISH chromosome painting, Fluorescence Activated Cell Sorting.	

TEXT BOOK: Cytology, Genetics & Molecular Biology by Gupta, P.K

REFERENCE BOOKS:

- Cell Biology, Author: S.C. Rastogi
- Cell and Molecular Biology, Author: De Robertis
- Cell and Molecular Biology, Author: Lodish
- Cytology, Genetics and mol. Biology, Author: P.K. Gupta
- Biotechnical cell biology, Author: Veer Bala Rastogi
- Cell biology, Genetics, Mol. Biology, Author: P.S.Verma & V.K. Agrawal
- Mol. Biology of cell, Author: Albert et al
- The Cell, Author: Cooper
- Principles of Genetics, Author: Gardner E.J & Snustad D.P, Pub: john Wiley
- Principles of Genetics, Author: Snustad D.P, Simmons M.J, Pub: john Wiley
- Genetics A molecular approach, Author: Brown T.A, Pub: BIOS Scientific
- Fundamentals of Genetics, Author: Singh B.D, Pub: Kalyani
- Genetics, Author: Rastogi V.B, Pub: Kedar Nath Ram Nath
- Genetics, Author: Verma P.S & Aggarwal V.K, Pub: S.Chand
- Principles of Gene Manipulations, Author: Old & Primose, Pub: Black Well Scientific
- Genes, Author: Lewine B, Pub: Oxford University Press, London

FOCUS: This course focuses on Employability aligned with CO2

COURSE OUTCOMES: After completion of course, the student will be able to:

CO1- Learn different areas of cell biology including the structure and functions of cell, its organelles such as mitochondria, nucleus etc.
CO2- Understand how genetic information is transmitted in organism.
CO3- Understand the role of cytoskeleton and its remodelling including the diseases associate with improper remodelling.
CO4- Earn how the synthesized proteins are transported to different organelles.
CO5- Understand the regulation of cell cycle, programmed cell death and Cancer.
CO6- Learn different cell biology techniques like karyotyping, chromosome banding, FISH, FACS, centrifugation and microscopy

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO2, PSO3
CO2	PO1, PO2, PO4/PSO1, PSO3
CO3	PO6, PO7,PO8, PO9/PSO2
CO4	PO1, PO4, PO5, PO8/PSO1, PSO2
CO5	PO3, PO4, PO56 PO7/PSO2, PSO3
CO6	PO2, PO3, PO6, PO8, PO10/PSO2, PSO3

BCAO 0001: FUNDAMENTAL OF INFORMATION TECHNOLOGY

Objective: The objective of this course is that students will be able to learn basic fundamentals and concepts related to computer architecture.

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	Computer Fundamentals: Block Structure of a Computer, Characteristics of Computers, Generation of Computers and Classification of Computers. Programming Languages: Classification, Machine Code, Assembly Language, Higher Level Language and Fourth Generation Languages. Number System: Bit, Byte, Binary, Decimal, Hexadecimal and Octal Systems, Conversion from One System to the Other; Binary Arithmetic Addition, Subtraction and Multiplication. Information Concepts & Processing System: Evolution of Information Processing, Data, Information, Knowledge & Wisdom. Elements of a Computer Processing System: Hardware - Input-Output Devices, VDU, CPU Storage Devices and Media. Software Concepts: Type of Software, Translator, Compiler, Interpreter, Assembler, Loader. Application Software: Office Automation.	20
II	Operating System: Concepts as Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System. DOS: Command Interpreter, Booting Internal & External Commands, Batch Files, exe, com, System Files, bin, txt, bmp Files. Computer Network and Communication: Network Types, Network Topologies; Data Communication – Mode, Channel, and Media; OSI Reference Model, TCP/IP, Data Communication Equipment/Devices. Internet and its Applications: E-Mail, TELNET, FTP, World Wide Web, Internet and Applications.	20

Text Book:

- P.K. Sinha, (2008), "Computer fundamentals", BPB Publisher, New Delhi, 4 edition.

Reference Books:

- Anita Goel, "Computer fundamentals", Pearson Education.
- Peter Nortron, "Inside PC", TMH, New Delhi.
- Alexis Leon, Methews Leon, (1999), "Fundamentals of Information Technology", Vikas Publishing, New Delhi.

Outcomes: A student who successfully completes the course will have the ability to:
CO1: Understand the basic concepts of computer hardware and software.
CO2: Demonstrate problem solving skills.
CO3: Understand the structure of operating system, its applications and commands.
CO4: To be familiar with network tools, concepts of protocols and network interfaces.
CO5: Understands the concept of Computer's Input/output devices.

Year: I/II	Semester: I/II/III/IV	Credit: 04	L–T–P: 4–0–0
Course Code: BCHE 0011		Course Name: PRINCIPLES OF CHEMICAL SCIENCE	
Course Prerequisite		Chemistry in class 12th	

Specific objectives of this course include understanding of:

- the fundamental laws and theories of chemistry, molecular geometries physical and chemical properties of the molecules.
- the structure of simple inorganic and organic molecules in order to predict important bonding parameters.
- the basics of organic chemistry give the most primary and utmost important knowledge and concepts of organic chemistry including reactive intermediate, catalyst, stereochemistry and major and minor products of any organic reaction
- Fundamentals of reactive intermediates, transition states and
- the chemical properties of different classes of compounds, such as acids, bases, salts, and organic compounds.

Module No.	Contents	Teaching Hours
I	Mole Concept and Concentration Units (Special emphasis on numerical problems): *Mole Concept* - calculations of moles of different systems (atoms, molecules, gaseous, solutions etc), molar mass, formula mass, and equivalent mass. *Concentration units* - Molarity, Formality, Normality, Molality, Mole fraction, Percent by weight, gram/liter, Percent by volume, Parts per thousand, Parts per million, Parts per billion, equivalents and milli equivalents, Moles and milli moles. **Molecular polarity and Weak Chemical Forces:** Resonance and resonance energy, formal charge, Van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction, dipole moment and molecular Structure (Diatomic and polyatomic molecules), Percentage ionic character from dipole moment, polarizing power and polarizability. Fajan's rules and consequences of polarization. Hydrogen bonding. **Periodic properties of Atoms (with reference to s & p-block):** Brief discussion, factors affecting and variation trends of following properties in groups and periods. Effective nuclear charge, shielding or screening effect, Slater rules, Atomic and ionic radii, Electronegativity, Pauling's/ Allred Rochow's scales, Ionization enthalpy, Electron gain enthalpy. **Simple Bonding theories of Molecules** Atomic orbitals, Aufbau principle, multiple bonding (σ and π bond approach) and bond lengths, the valence bond theory (VBT), Concept of hybridization, hybrid orbitals and molecular geometry, Bent's rule, Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H_2O, NH_3, PCl_5, SF_6, SF_4, $XeOF_2$, $XeOF_4$, XeF_4, ClF_3, I_3^-, SO_4^{2-}, CO_3^{-2}, and H_3O^+. Molecular orbital theory (MOT).	22

II	**Recapitulation of basics of Organic Chemistry:** Hybridization, bond lengths and bond angles, bond energy, dipole moment localized and delocalized chemical bonding, van der Waals interactions, *Electronic Displacements:* Inductive, electrometric, resonance mesomeric effects, hyperconjugation, and their applications. **Mechanism of Organic Reactions:** Curved arrow notation, drawing electron movements with allows, half-headed and double-headed arrows, homolytic and heterolytic bond fission, Types of reagents – electrophiles and nucleophiles, Types of organic reactions, Energy considerations. *Reactive intermediates* – Carbocations, carbanions, and free radicals (Structure,stability, method of preparation and reactions). **Acid, Base, Salts Concepts and their merits and demerits:** Arrhenius concept, Brönsted-Lowry concept, Lewis's acid-base concept, Pearson concept, The Lux-Flood Concept, Usanovich Concept, HSAB conceptand its applications in stability of organic compounds.	22

Suggested Readings:

1. Lee, J.D. Concise Inorganic Chemistry, Pearson Education, 2010.
2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structureand Reactivity, Pearson Education 2006.
3. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
4. Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.,* Oxford University Press, 1994.
5. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.
6. Singh J.,Yadav L.D.S., Advanced Organic Chemistry, Pragati Edition.
7. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd.
8. Carey, F. A., Guiliano, R. M.*Organic Chemistry*, Eighth edition, McGraw Hill Education, 2012.
9. Loudon, G. M. *Organic Chemistry*, Fourth edition, Oxford University Press, 2008.
10. Clayden, J., Greeves, N. &Warren, S. *Organic Chemistry,* 2nd edition, Oxford University Press,2012.
11. Graham Solomons, T.W., Fryhle, C. B. *Organic Chemistry,* John Wiley & Sons, Inc.
12. Sykes, P. *A guidebook to Mechanism in Organic Chemistry,* Pearson Education, 2003.

Suggested online links:
http://heecontent.upsdc.gov.in/Home.aspx
https://nptel.ac.in/courses/104/106/104106096/
http://heecontent.upsdc.gov.in/Home.aspx
https://nptel.ac.in/courses/104/106/104106096/
https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm
https://nptel.ac.in/courses/104/103/104103071/#

Course Outcomes:

After studying these course students will be able to:

CO1. Understand the principles of chemical bonding in both organic and inorganic molecules, including the types of bonds, bond energies, and how they affect molecular properties.
CO2. Classify simple and complex organic compounds based on their functional groups, structures,and reactivity.
CO3. Apply the concepts of product analysis, intermediates, isotope effects, kinetic studies, and stereochemical studies to determine the mechanism of organic reactions.
CO4. Identify and predict the stability of reaction intermediates based on their structure and electronic properties.
CO5. Compare the strength of acids and bases on basis of acid-base concepts
CO6. **Arrange the elements on this basis of their periodic properties like Atomic and ionic radii, Electronegativity, Ionization enthalpy, Electron gain enthalpy.**

Focus: This course has a focus on employability which is aligned to CO's 2-8

LANGUAGE SKILLS- I

Course Objectives: The core objectives of this course are to

- Equip the learners with the essential knowledge of grammar,
- Enable them to write and speak English with correctness,
- Enhance their linguistic competence in comprehending the written and the spoken English and to
- Help students acquire the four basic language skills: **Listening, Speaking, Reading and Writing**.

Credits: 02 **Semester: I** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Introducing the Course Details and Assessment Structure** The four skills of language **Spoken Activity:** **Introducing Self** : Talking about Goals, Achievements, Skills etc. Reading the Text for understanding the content and context to identify certain **Language Aspects** as given below: **Text 1: "An Island of Trees" by Ruskin Bond** • **Sentence**: Functional types • **Parts of a sentence**: Subject/Predicate/Object/Compliment • **Identifying Parts of Speech**: Based on Application in the **prescribed text** • **Subject -Verb Concord**: Agreement of Number and Person **Enhancing Word Power: Homophones, Homonyms and Homographs** (Word list will be given) **Reading Comprehension (Enabler):** Reading of a passage and its comprehension. **Writing Skill:** • **Application** within University for various purposes	**14**
II	Reading the text for understanding the content and context to identify certain **LanguageAspects** as given below: **Text: "Three Blind Men Describe an Elephant"** by E Santhosh Kumar **Determiners**: Articles, Quantifiers, Distributives **Tense:** Present, Past and Future; Various Aspects of Tenses and their usage based onaforesaid text. **Text: "Selfitis - The obsessive need to post selfies- is a genuine mental disorder, saypsychologists"** by Sarah Knapton (The Telegraph, 15 December 2017, UK)	**16**

	Voice: Identification and Transformation **Vocabulary:** Antonyms/Synonyms **Story Review:** Characterization; Language Aspects; Social Impact; Moral; Theme	

Suggested Readings:

- A.J Thomson & A.V. Martinet; *A Practical English Grammar*, Oxford, India.
- Murphy, Raymond, *Intermediate English Grammar.* Cambridge University Press.
- Leech, Geoffrey & Svartvik, Jan: *A Communicative Grammar of English*. London: Longman, 2003.
- Swan, Michael. *Practical English Usage.* OUP, 2016.
- Nesfield, J.C. *English Grammar, Composition and Usage*. Macmillan Publishers India Pvt. Ltd, 2019.
- Hornby, A.S., *Advanced Learners' Dictionary of Current English,* OUP.
- Jones, Daniel. *Cambridge English Pronouncing Dictionary.* London: Cambridge University Press, 2006.

Course Outcomes: After completing the course students will be able to

1. Read & comprehend a text with proper understanding,
2. Apply the textual contexts to understand grammatical items,
3. Write answer to the questions based on the texts,
4. Express their ideas in writing,
5. Enrich their vocabulary in terms of contextual and situational conversation.

Year: I	Semester: I/II	Credit: 02	L–T–P: 2–0–0
Course Code: BCHO 0011		**Course Name: Food, Nutrition and Hygiene**	
Course Prerequisite		No Prerequisite	

Course Objective:

Course outcomes:

- To learn the basic concept of the Food and Nutrition
- To study the nutritive requirement during special conditions like pregnancy and lactation
- To learn meal planning
- To learn 100 days Nutrition Concept
- To study common health issues in the society
- To learn the special requirement of food during common illness

Module No.	Contents	Teaching Hours
I	**Concept of Food and Nutrition** (a) Definition of Food, Nutrients, Nutrition, Health, balanced Diet (b) Types of Nutrition- Optimum Nutrition, under Nutrition, Over Nutrition (c) Meal planning- Concept and factors affecting Meal Planning (d) Food groups and functions of food **Nutrients: Macro and Micro** RDA, Sources, Functions, Deficiency and excess of (a) Carbohydrate, (b) Fats, (c) Protein, (d) MineralsMajor: Calcium, Phosphorus, Sodium, Potassium Trace: Iron, Iodine, Fluorine, Zinc (e) Vitamins: Water soluble vitamins: Vitamin B, CFat soluble vitamins: Vitamin A, D, E, K (f) Water, (g) Dietary Fiber	15
II	**1000 days Nutrition** (a) Concept, Requirement, Factors affecting growth of child (b) Prenatal Nutrition (0 - 280 days): Additional Nutrients' Requirement andrisk factors during pregnancy (c) Breast / Formula Feeding (Birth – 6 months of age) Complementary and Early Diet (6 months – 2 years of age) **Community Health Concept** (a) Causes of common diseases prevalent in the society and Nutrition requirement in the following: Diabetes, Hypertension (High Blood Pressure), Obesity, Constipation, Diarrhea, Typhoid (b) National and International Program and Policies for improving DietaryNutrition (c) Immunity Boosting Food	15

Suggested Readings:

1. Singh, Anita, "Food and Nutrition", Star Publication, Agra, India, 2018.
2. 1000-Days-Nutrition_Brief_Brain-Think_Babies_FINAL.pdf
3. https://pediatrics.aappublications.org/content/141/2/e20173716
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5750909/
5. Sheel Sharma, Nutrition and Diet Therapy, Peepee Publishers Delhi, 2014, First Edition.

Course Outcome:

After studying this course students will be able to:

CO1. Remember: Recall the definitions of food, nutrients, nutrition, health, and balanced diet. Also, remember the types of nutrition, including optimum nutrition, undernutrition, and overnutrition. CO2. Apply: Apply knowledge of nutrients by understanding their sources, functions, and the effects of deficiency and excess for carbohydrates, fats, proteins, and minerals (such as calcium, phosphorus, sodium, potassium, iron, iodine, fluorine, and zinc). Apply knowledge of vitamins, including water-soluble vitamins (B and C) and fat-soluble vitamins (A, D, E, and K). Understand the importance of water and dietary fiber. CO3. Analyze: Analyze the concept of nutrition during the first 1,000 days of life, including the requirements and factors affecting the growth of a child. Evaluate the additional nutrient requirements and risk factors during pregnancy. Analyze the feeding practices during the stages of breast/formula feeding and complementary and early diet. CO4. Evaluate: Evaluate the relationship between common diseases prevalent in society and their nutritional requirements, focusing on diabetes, hypertension, obesity, constipation, diarrhea, and typhoid. Assess the national and international programs and policies aimed at improving dietary nutrition. CO5. Create: Create dietary plans and recommend specific immunity-boosting foods to enhance immune function and overall health.
Focus: This course has a focus on skill development which is aligned to CO's 1-7

BPHE 0001: OPTICS

OBJECTIVES: This course is designed to give knowledge of principles of wave optics to graduate students. Students will able to understand the basic phenomenon of interference, diffraction, polarization and their uses in different optical devices.

Credits: 03 L-T-P: 3-0-1

Module No.	Content	Teaching Hours
I	**Interference:** Basics of Inference, Fresnel biprism, determination of wavelength, Newton's ring, Conditions for sustained interference, Theory of interference, Interference in parallel and wedge shaped films, Colors of thin film, Newton's rings, Applications of Newton's ring. **Diffraction:** Fraunhoffer diffraction due to single, N-slits (grating) qualitative explanation of N-slits diffraction direction of principle maxima, maximum number of order with plane transmission grating, Rayleigh criterion of resolution, Resolving and dispersive power of grating.	18
II	**Polarization:** Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light. Optical activity and Fresnel's theory, Biquartz polarimeter. Laser and Optical Fiber: Basic concept of Laser, properties of laser beam, Einstein's coefficients, Ruby laser, He-Ne Laser. Optical fiber, light propagation mechanism, advantages and disadvantages of optical fiber, applications of optical fiber.	18

Reference Books/ Text Books

1. Physical Optics: B. K. Mathur and T. P. Pandya.
2. A textbook of Optics: N. Subrahmanyam, Brijlal and M. N. Avadhanulu.
3. Geometrical and Physical Optics: Longhurst.
4. Introduction to Modern Optics: G. R. Fowels.
5. Optics: P. K. Srivastav
6. Optics: Ajoy Ghatak

BBIC 0801: CELL BIOLOGY AND GENETICS LAB

OBJECTIVES: To provide the students with a comprehensive overview of current developments in bioanalytical techniques.

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	1. Introduction to safety measures in Laboratories 2. Preparation of solutions and buffers 3. Equipment handling and pipetting 4. Study of structure of any Prokaryotic and Eukaryotic cell. 5. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, oesophagus, stomach, pancreas, intestine, kidney etc. 6. Cell division in onion root tip/ insect (grasshopper) gonads. 7. Vital Staining of Mitochondria with Janus green B. 8. Demonstration of diversity of cell types (Muscle, Neuron) 9. Demonstration of Sex chromatin in buccal smear. 10. Karyotype preparation. 11. Preparation of polytene chromosomes from salivary gland of Chironomous larvae. 12. Genetics problems based on : (i) Mendel's law (ii) Gene mapping and (iii) Transposable elements. 13. Ames test for mutagenesis. 14. Genetic experiment – Drosophila model	30

Focus: This course focuses on Employability, Skill development aligned with CO1 & CO2

Course outcome: After completion of this course, student will able to

CO1- learn, understand and develop skill and hands on training in basics of cell biology and Genetics

CO2- be able to differentiate between plant and animal cells

CO3- be analysed different stages of mitosis and meiosis

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO5, PO7, PO8/PSO1, PSO2
CO2	PO3, PO4, PO5, PO7, PO8/PSO1, PSO2
CO3	PO1, PO3, PO4, PO5, PO7, PO8/PSO1

BPHE 0801: OPTICS LAB

OBJECTIVES: Students will able to understand the practical aspects of interference, diffraction, polarization and their uses in different optical devices.

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	1 Wavelength of monochromatic light with the help of Fresnel's biprism. 2. Wavelength of monochromatic light by Newton's rings. 3. Refraction index of the material of the prism for the given colour (wavelengths) of mercury light with the help of a spectrometer. 4. Wavelength of spectral lines using plane transmission /diffraction grating. 5. Wavelength of LASER light by diffraction grating. 6. Specific rotation using Biquartz Polarimeter. 7. To find the polarization angle of laser light using polarizer and analyzer. 8. Focal length of combination of two lenses separated by distance d and verify the formula $1F=1f1+1f2-df1f2$. 9. Polarization of light by simple reflection. 10. Fiber optic trainer for numerical aperture.	30

BBIC0003: MOLECULAR BIOLOGY & GENETIC ENGINEERING

OBJECTIVES: Course covers basic properties of cells, and gives insight into the controlling centre i.e., Nucleus. Course aims to equip students with knowledge of the regulatory element of the cell i.e., DNA its transcript i.e., RNA and protein biosynthesis as well as their interrelationship and regulation. From fundamental students are introduced to scientific literature on the molecular basis of the life and linking it to modern scientific research.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Gene organization and regulation of gene expression**: Structure of DNA, Types of DNA Gene organization in prokaryotes and eukaryotes, polycistronic genes, split genes promoters, enhancers. Regulation of gene expression: Prokaryotes: lac and trp operons in E. coli. **DNA Replication and DNA polymerases:** Replication of genetic material in prokaryotes and eukaryotes A brief description of initiation at replication origins and its cell cycle regulation. Structure and function of prokaryotic and eukaryotic DNA polymerases. **Transcription and mRNA processing**: RNA structure and types of RNA Mechanism of transcription in prokaryotes and eukaryotes: transcription factors, structure of prokaryotic and eukaryotic RNA polymerases, initiation, elongation and termination. RNA processing: processing of mRNA (Splicing, capping and polyadenylation) **Prokaryotic and eukaryotic translation:** Ribosome structure and assembly, tRNA, aminoacyltRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. Posttranslational modifications of proteins.	14 24
II	**Vectors:** Cloning vectors (plasmids, cosmids, bacterial artificial chromosomes and yeast artificial chromosomes), shuttle vectors, expression vectors. **Enzymes used in DNA manipulating:** Restriction endonuclease, Ligases, Polymerases, Kinases, Alkaline phosphatases, Reverse Transcriptase. **Genomic Library, PCR, Sequencing etc:** Preparation and comparison of Genomic and cDNA library. PCR and its applications, DNA Sequencing, Site directed mutagenesis Protein engineering concepts and examples (any two).	24

	Molecular Biology techniques: DNA isolation (Plasmid/ Genomic DNA isolation) Blotting (Southern, Northern, Western) Electrophoresis of nucleic acids and proteins Gene cloning, Screening and characterization of cloned DNA DNA Fingerprinting RFLP, RAPD	

Text book:

- Cell Biology, Genetics, Molecular Biology by Verma, P.K

Reference books:

- Molecular biology of cell, by Alberts B. D. Lewis J. Raff M. Roberts K. and Watson.
- Gene, Vol. V, VI, VII, VIII and IX, Lewin B., Oxford University Press, Oxford.
- Molecular biology of the Gene by Watson J. Hopkins, Roberts Steitz &Weiner, Benjamin Cummings.
- Text Book of Molecular Biology by K. Sivrama Sastry G. Padmanabhan and C. Subramanyam: MacMillan, India.
- Cell and Molecular biology by G. Karp, John Willey & Sons, U.S.A.
- Principles of Genetics by P.D. Snustad, M.L. Smmons, J.B. & Jenkins, John Willey & Sons, U.S.A.
- Cell and Molecular biology, De Robertis and De Robertis by Saunders Publications

FOCUS: This course focuses on Employability aligned with CO2

COURSE OUTCOMES: After completion of course, the student will be able to:

CO1- Learn and understand the important discoveries that are made in the field of molecular biology.
CO2- Learn key molecular events that occur during the DNA replication, transcription, translation and regulation of gene concept.
CO3- Gain knowledge on the foundation of genetic engineering and their applications in biological research as well as in biotechnology industries.
CO4- Understand gene concept, plasmids, and wide range of techniques, especially modern molecular tools in diagnosis.
CO5- Acquainted with various techniques of genetic engineering and their applications in biological research, diagnostics as well as in biotechnology.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO4, PO7, PO8/PSO1, PSO2, PSO3
CO2	PO1, PO2, PO4/PSO2, PSO3
CO3	PO2, PO3, PO5, PO6/PSO2, PSO3
CO4	PO1, PO4, PO7, PO8/PSO1, PSO2
CO5	PO1, PO2, PO5, PO8/PSO2, PSO3

BBIC0004: PLANT PHYSIOLOGY, EVOLUTION AND ECOLOGY

OBJECTIVES: Cell biology is increasingly important in all life sciences. Many of the advancements in modern science are the result of a better understanding of cellular components and their functions.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Plant water relation, Mineral Nutrition, Transpiration and translocation in phloem** Importance of water, Diffusion, Osmosis, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. Criteria of essentiality of elements; Role of essential elements; Symptoms of mineral deficiency in major crops, Transport of ions across cell membrane, active and passive transport, Composition of phloem sap, girdling experiment; Pressure flow model. **Carbon Oxidation** Krebs cycle, Glycolysis, fate of pyruvate- aerobic and anaerobic respiration and fermentation, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of Krebs cycle, mitochondrial electron transport, oxidative phosphorylation, ATP-Synthetase, Chemiosmotic mechanism, P/O ratio, cyanide-resistant respiration, factors affecting respiration. **Theories of Evolution** Origin of Life, Historical review of evolutionary concept: Lamarckism, Darwinism (Natural, Sexual and Artificial selection), Modern synthetic theory of evolution, Patterns of evolution (Divergence, Convergence, Parallel, Coevolution) **Population Genetics** Microevolution and Macroevolution, allele frequencies, genotype frequencies, Hardy- Weinberg equilibrium and conditions for its maintenance, Forces of evolution: mutation, selection, genetic drift	14 24
II	**Lipid Metabolism & Photosynthesis** Lipid Metabolism: Synthesis and breakdown of triglycerides, -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilization of lipids during seed germination, -oxidation. ; Photosynthesis: Pigments, Action spectra and Enhancement effect, Electron transport system and Photophosphorylation, C3 & C4 photosynthesis, CAM- Reaction and Significance **Nitrogen Metabolism** Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes), Physiology and biochemistry of nitrogen fixation, Ammonia assimilation (GS-GOGAT),	24

	reductive amination and transamination, amino acid synthesis. **Plant Development, Movements, Dormancy & Responses** Developmental roles of Phytohormones (auxins, gibberellins, cytokinins, ABA, ethylene.) autonomic & paratonic movements, Control and Coordination in plants, Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red-light responses on photomorphogenesis, Seed physiology & Dormancy, Vernalization **Direct Evidences of Evolution** Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse **Species Concept and Extinction** Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric), Mass extinction (Causes, Names of five major extinctions)	

TEXT BOOK: Cytology, Genetics & Molecular Biology by Gupta, P.K

REFERENCE BOOKS:

- Cell Biology - S.C. Rastogi
- Cell and Molecular Biology - De Robertis
- Cell and Molecular Biology - Lodish
- Cytology, Genetics and mol. Biology - P.K. Gupta
- Biotechnical cell biology - Veer BalaRastogi
- Cell biology, Genetics, Mol. Biology, - P.S.Verma& V.K. Agrawal
- Mol. Biology of cell - Albert et al
- The Cell -Cooper

FOCUS: This course focuses on Employability aligned with CO2

COURSE OUTCOMES: After completion of course, the student will be able to:

CO-1: Understand the role of Physiological and metabolic processes for plant growth and development.
CO-2: Learn the symptoms of Mineral Deficiency in crops and their management.
CO-3: Assimilate Knowledge about Biochemical constitution of plant diversity.
CO-4: Know the role of plants in development of natural products, nutraceuticals, dietary supplements, antioxidants.
CO-5: Understand concept of species and population genetics in order to solve the genetic problem existing in population.
CO-6: Learn the theories of evolution and direct evidences of evolution.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO7, PO8/PSO1, PSO3
CO2	PO1, PO2, PO4/PSO2, PSO3
CO3	PO1, PO3, PO7, PO8, PO10/PSO1, PSO4
CO4	PO1, PO4, PO7, PO8/PSO1, PSO2
CO5	PO1, PO2, PO5, PO8/PSO2, PSO3
CO6	PO1, PO4, PO6, PO8, PO9/PSO2, PSO4

BBIC0005: HUMAN PHYSIOLOGY AND DEVELOPMENTAL BIOLOGY

OBJECTIVES: Cell biology is increasingly important in all life sciences. Many of the advancements in modern science are the result of a better understanding of cellular components and their functions.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Digestion, Respiration and Excretion:** Structural organization and functions of gastrointestinal tract and associated glands Mechanical and chemical and enzymatic digestion of food, Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins, Mechanism of respiration, Pulmonary ventilation, Respiratory volumes and capacities, Transport of oxygen and carbon dioxide in blood Respiratory pigments, Dissociation curves and the factors influencing it, Control of respiration Structure of kidney and its functional unit, Mechanism of Urine formation. **Gamete Fertilization and Early Development:** Gametogenesis, Fertilization Cleavage Pattern Gastrulation, fate maps. Developmental mechanics of cell specification. orphogenesis and cell adhesion, Developmental Genes. Genes and development Molecular basis of development, Differential gene expression. \]	24
II	**Circulatory System, Nervous System and Muscular System:** Components of blood and their functions Homeostasis: Blood clotting system, Blood groups: Rh factor, ABO and MN Cardiac cycle, cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation. Structure of neuron and physiology of nerve impulse transmission Histology of different types of muscle, Ultra structure of skeletal muscle Molecular and chemical basis of muscle contraction Control of muscle contraction by nerve impulses **Early Vertebrate Development:** Early development of vertebrates (fish, birds & mammals) Metamorphosis, regeneration and stem cells Environmental regulation of development **Late Developmental Processes**: The dynamics of organ development development of eye, kidney, limb. Metamorphosis: the hormonal reactivation of development in amphibians, insects Regeneration: salamander	24

	limbs, mammalian liver and Hydras. Aging: the biology of senescence.	

TEXT BOOK:

- Element of Human Anatomy, Physio and Health by Goyal, Ramesh K

REFERENCE BOOKS:

- Animal Physiology by Kunt Schmidt, Neilson, Cambridge University Press Cambridge.
- Physiology of Mammals & other vertebrates by Marshall & Hughes. Cambridge Univrsity Press Cambridge.
- Animal Physiology by Roger Eckert & David Randall, CBS Publishers & Distributors, Delhi.
- Text of Anbimal Physiology by Hurt & Mathur, S.Chand & Co. New Delhi.
- Text of Animal Physiology by N agbushanam, Kodarkar & Sarojini, Oxford & IBI Pub. New Delhi.
- Comparative Animal Physiology (Environment & Metabolic Animal Physiology,) by CLadd Prosser, Wiley-Liss, Publication, New York
- Comparative Animal Physiology (Neural & Integrative Animal Physiology) C. Ladd Prosser, Wiley-Liss, Publication New York.
- Human Physiology, Vol.I & II by Dr.C.C.Chatterjee, Medical applied,Agency, Calcutta.

FOCUS: This course focuses on Employability aligned with CO2

COURSE OUTCOMES: After completion of course, the student will be able to:

CO1: Develop the understanding of the Digestive system physiology of human body.
CO2: Develop the concept for the physiology of human respiratory system.
CO3: Understanding the functioning of human excretory system.
CO4: Develop the concept of gamete fertilization and molecular mechanism human developmental biology.
CO5: Develop the knowledge of human circulatory system and blood groups.
CO6: Understanding the physiology of human nervous and muscular system.
CO7: Develop the understanding of early and late vertebrate development.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO2, PSO3
CO2	PO1, PO3, PO4/PSO1, PSO3
CO3	PO2, PO3, PO5, PO8/PSO2, PSO4
CO4	PO1, PO4, PO7, PO8/PSO1, PSO2
CO5	PO1, PO2, PO5, PO8/PSO2, PSO3
CO6	PO2, PO4, PO5, PO8, PO9/PSO3, PSO4
CO7	PO1, PO3, PO4 PO5, PO8/PSO1, PSO4

BBIK 0001: FUNDAMENTALS OF CLINICAL BIOCHEMISTRY & MICROBIOLOGY

OBJECTIVES: Cell biology is increasingly important in all life sciences. Many of the advancements in modern science are the result of a better understanding of cellular components and their functions.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Clinical Biochemistry:** Elementary knowledge of Carbohydrates, proteins and lipids Elementary knowledge of Enzymes and hormones Elementary knowledge of Clinical enzymology **Introduction to Microbiology:** To understand about Microbiology To understand about Gram-negative and Gram-positive bacteria. **Culture and Staining:** Culture Media: Definition, uses, basic requirements, classification, Agar, Peptone, Transport Media, Sugar Media, Anaerobic Media, Containers of Media, Forms of Media. Staining Methods: Simple, Grams staining, Ziehl-Neelsen staining or AFB staining, Negative Impregnation .	24
II	**General characters and classification of Bacteria:** Characteristics of Bacteria: Morphology - Shape, Capsule, Flagella, Inclusion, Granule, Spore. Growth and Maintenance of Microbes: Bacterial division, Batch Culture, Continuous culture. Bacterial growth- total count, viable count, bacterial nutrition, oxygen requirement, CO2 requirement, temperature, pH, light. **Liver, Kidney function test:** Liver Functions & their Assessment- Based on: Carbohydrate metabolism; Protein metabolism; Lipid metabolism. Measurements of serum enzyme levels Bile pigment metabolism, Jaundice, its types and their biochemical findings. Renal Function Tests- Various Tests, GFR & Clearance	24

TEXT BOOK:

A Text Book of Microbiology by Dubey, R.C

REFERENCE BOOKS:

Microbiology, Authors- Pelczar, Chan and Kreig.
Microbiology- an Introduction- (8th Edn), Authors- Tortora, G.J., Funke, B.R., Case,C.L.
General Microbiology, Authors- Stainer, Ingharam, Wheelis and Painter.
Microbial Physiology, Authors- Moat and Foster.

A Text book of Microbiology, Authors- P. Chakraborty.
Textbook of Microbiology, Authors- Dubey and Maheshwari.
Microbiology, A Practical Approach. Authors- Patel and Phanse

FOCUS: This course focuses on Employability aligned with CO2

COURSE OUTCOMES: After completion of course, the student will be able to:

CO1: Understand the basic biochemistry (Carbohydrates, lipids, proteins and amino acids) structures and functions
CO2: Know various Culture media and their applications
CO3: Study the comparative characteristics of microbiological staining techniques and their applications
CO4: Understand the microbial physiology and their functions
CO5: Study the comparative characteristics of Gram Positive and Gram Negative bacteria

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO2, PSO4
CO2	PO1, PO4, PO7, PO8/PSO1, PSO2
CO3	PO1, PO2, PO5, PO8/PSO2, PSO3
CO4	PO2, PO4, PO5, PO8, PO9/PSO3, PSO4
CO5	PO1, PO3, PO4 PO5, PO8/PSO1, PSO4

BELA 0004: LANGUAGE SKILLS- II

Course Objectives: The objectives of this course are to

- equip the learners with some added knowledge of English Language skills,
- make the learners contextually apply the acquired language skills,
- enable them to write English with correctness, and
- enhance their reading competence.

Credits: 02 **Semester: II** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Introducing the course details and assessment structure** **Describing Situations through Pictures:** Describing Pictures orally & in written form **Reading**: Reading a text to understand the content, identify and use language aspects as given below: **Text**: "The Only American from Our Village" by Arun Joshi • **Punctuation Marks**: capitalization, full stop, comma, question mark, exclamatory mark, colon, semi-colon. • **Word Formation:** Inflection, Derivation, Compounding, Blending & Clipping • **Question Tags**: Formation and usage **Reading Comprehension:** Reading of a passage and its comprehension. **Writing Skills:** • Film Review • Development of story using key expressions **Presentation skills:** Planning and delivery	14
II	**Spoken Activity:** Describing a past event **Reading**: Reading to understand the content, identify and use language aspects as given below: **Text:** "How the Camel Got his Hump" by Rudyard Kipling • **Narration**: Direct into Indirect narration and its conversion. • **Conditional Sentences**: Types and usage **Arranging ideas systematically:** Jumbled Sentences **Comprehension of Graphical Data:** Describing graphs **Vocabulary:** One word substitution **Writing Skills:** • Precis Writing • Letter to the Editor	16

Suggested Readings:

- Murphy, Raymond, *Intermediate English Grammar.* Cambridge University Press.
- Leech, Geoffrey & Svartvik, Jan: *A Communicative Grammar of English*. London: Longman, 2003.

- Swan, Michael. *Practical English Usage.* OUP, 2016.
- Nesfield, J.C. *English Grammar, Composition and Usage*. Macmillan Publishers India Pvt. Ltd, 2019.
- Hornby, A.S., *Advanced Learners' Dictionary of Current English,* OUP.
- Jones, Daniel. *Cambridge English Pronouncing Dictionary.* London: Cambridge University Press, 2006.

Course Outcome: After completing the course students will be able to

- orally describe a situation in present and past,
- read & comprehend a text with proper understanding,
- enhance their writing skills,
- analyze graphical data in writing,
- apply the acquired language skills in context, and
- enrich their vocabulary in terms of contextual and situational background.

BMAS 0505: STATISTICS AND NUMERICAL METHODS

Course Objectives: To make the students understand the concepts of statistics and numerical methods by giving more emphasis to their applications in chemistry.

Credits: 04 **Semester II** **L–T–P: 2–0–0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Statistics I:** Importance of Statistics, Measures of central tendency and Dispersion, Moments, Skewness and Kurtosis by method of moments, Introduction to Probability, Addition and Multiplication theorems of probability. **Statistics II**: Binomial and Poisson distributions, Sampling, Statistical hypotheses, Level of significance, Student's t-test.	20
III	Chi-square test as a test of independence. Correlation and Regression between two variables, Fitting of straight line by method of least squares, **Numerical Methods:** Errors & its types, Bisection and Newton Raphson methods, Finite differences, Missing term technique, Interpolation by Newton's forward and divided difference formulae, Numerical integration by trapezoidal and Simpson's rules.	20

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publication, Delhi,2014.
- S. C. Gupta and V. K. Kapoor, Fundamentals of Statistics, Sultan Chand & Sons, Delhi, 2014.

Reference Books:

- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2014.
- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.

Learning Outcomes:

After studying these topics, the student will be able to

- Fit the straight line to a given data and determine regression lines
- Know probability distributions and the characteristics of frequency distributions
- Solve the problems based on numerical integration
- Learn the concept of sampling and test the hypothesis by Student's t-test

BSBC 0808: GENETIC ENGINEERING LAB

OBJECTIVES: To provide the students with a comprehensive overview of current developments in bioanalytical techniques.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	1. Preparation of solutions for Molecular Biology experiments. 2. Preparation of bacterial growth medium (L.B., 2XYT) 3. Competent cell preparation. 4. Transformation of *E.coli*. cells (color selection of transformants – with or without inserts) X –gal and IPTG. 5. Isolation of Plasmid DNA by alkaline lysis method 6. Isolation of genomic DNA from bacterial cells. 7. Agarose gel electrophoresis of genomic DNA & plasmid DNA 8. Concentration estimation by agarose gel electrophoresis 9. Preparation of restriction enzyme digests of DNA samples 10. Ligation 11. Southern blotting 12. PCR	30

Focus: This course focuses on Employability, Skill development aligned with CO1 & CO2

Course outcome: After completion of this course, student will able to

CO1- prepare different bacterial growth media.
CO2- understand principals and methods of competent cell preparation, restriction digestion, gene ligation, gene cloning, and transformation i. e gene manipulation.
CO3- understand the method of agarose electrophoresis for plasmid and genomic DNA separation
CO4: understand the method of blotting and PCR.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7, PO8/PSO1, PSO2
CO2	PO2, PO4, PO5, PO7, PO8/PSO1, PSO2
CO3	PO2, PO3, PO4, PO5, PO7, PO8/PSO1
CO4	PO3, PO4, PO5, PO7, PO8/PSO1, PSO2

BBIK 0801: FUNDAMENTAL OF CLINICAL BIOCHEMISTRY & MICROBIOLOGY LAB

OBJECTIVES: The objective of the course is to familiarize students with aspects, scopes and applications of microbiology and clinical biochemistry.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	1. To perform gram staining to differentiate between gram +ve and gram –ve bacteria. 2. Preparation of nutrient agar and nutrient agar broth media for cultivation of microorganism. 3. To obtain pure culture of microorganism by pouring, spreading, streak plate of method. 4. Qualitative analysis of carbohydrates by iodine test. 5. Estimation of protein by the biuret method. 6. Qualitative examination for normal organism constituent of protein. 7. Experiment to measure the size of the microscopic objectives under microscope.	30

Focus: This course focuses on Employability, Skill development aligned with CO1 & CO2

Course outcome: After completion of this course, student will able to

CO1- culture, isolate and purify microbes form various sites.
CO2- They can observe the morphology of microbes by using different staining techniques.
CO3- They can perform various serological tests which finally enhance the ability to understand related theory.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7, PO8/PSO1, PSO2
CO2	PO2, PO4, PO5, PO7, PO8/PSO1, PSO2
CO3	PO2, PO3, PO4, PO5, PO7, PO8/PSO1

BBIC 0006: BIOCHEMISTRY AND BIOCHEMICAL TOOLS

OBJECTIVES: To consolidate the student's training in Chemistry, Biology and other disciplines, as well as integrates the two to enhance a better understanding of biochemical principles.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Carbohydrates:** Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides, Homo and Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions. **Amino acids and Protein:** Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure, Different Level of structural organization of proteins. Denaturation and renaturation of proteins. **Nucleic acids:** Structure and functions, Physical & chemical properties of Nucleic acids, nucleosides & nucleotides, purines & pyrimidines, Biologically important nucleotides, Double helical model of DNA structure and forces stabilizing DNA double helical structure, A, B and Z – DNA, denaturation and renaturation of DNA. **Lipids:** Structure and functions of Lipids**,** Classification, nomenclature and properties of fatty acids, essential fatty acids, Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.	22
II	**Enzymes and Enzyme classification:** Nomenclature and classification of Enzymes, Brief introduction to active site, Kinetics of enzyme actions, Cofactors, coenzyme, prosthetic groups, holoenzyme and Aponezyme, Enzyme inhibition-competitive, Non-competitive & Uncompetitive type. **Metabolism:** Metabolism of carbohydrates- Gluconeogenesis, Glycolysis, TCA, and Glyoxylate cycle**,** Metabolism of fatty acids-oxidation of saturated, unsaturated fatty acids**,** Oxidation of amino acids and urea cycle. **Vitamins and Hormone:** Introduction to Vitamins, hormones, Phytohormones and their role**,** Deficiency of vitamins and hormones and related human diseases. **Techniques:** Chromatography (Column chromatography, Ion- exchange chromatography, Gel- permeation (molecular sieve, chromatography, Affinity chromatography, Paper chromatography, Thin-layer chromatography, Gas chromatography and HPLC), Spectroscopy (UV-Vis), NMR, X-ray diffraction, Centrifugation, Mass spectrometry.	24

TEXT BOOK:

- Instant notes Biochemistry by Hames, David

REFERENCE BOOKS:

- Principles of Biochemistry, Author: AlbertL. Lehninger, Pub: CBS
- Biochemistry, Author: LubertStryer, Pub: Freeman International Edition

- Fundamentals of Biochemistry, Author: J.L. Jain, Pub: S. Chand and Company
- Biochemistry, Author: KeshavTrehan, Pub: Wiley Eastern
- Principles of Biochemistry, Author: JefforyZubey

FOCUS: This course focuses on Employability aligned with CO1 & CO2

COURSE OUTCOMES: After completion of course, the student will be able to:
CO1: understand the significance of Biochemistry ***(Understand, Analyze and Apply)***.
CO2: learn the chemistry of carbohydrates, lipids, proteins and amino acids ***(Understand, Analyze and Apply)***.
CO3: understand the basics of enzymes ***(Understand, Analyze and Apply)***.
CO4: understand the metabolism of carbohydrate and proteins ***(Understand, Analyze and Apply)***.
CO5: know the chemical structure of nucleotides including their components, describe primary, secondary structure of DNA and RNA ***(Understand, Analyze and Apply)*.**

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs/ PSOs
CO1	PO1, PO3, PO5, PO6/PSO1, PSO3
CO2	PO2, PO3, PO7, PO10/PSO1, PSO2
CO3	PO1, PO3, PO5, PO6, PO7, PO10/PSO3, PSO4
CO4	PO2, PO3, PO7, PO8/PSO1, PSO4
CO5	PO1, PO3, PO5, PO6, PO9/PSO1, PSO3

BELH 0007: TECHNICAL WRITING

OBJECTIVE: Technical Writing seamlessly blends the art of communication with the nuances of technology. Tailored for a diverse audience, this course serves as a beacon, guiding participants toward the creation of effective technical documents tailored to specialized audiences.

Credits: 02 **Semester III** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Principles and Style of Technical Writing** **Simplicity** • Avoiding Ambiguity • Avoiding phrasal verbs and Idiomatic expressions • Using Simple Verb Forms • Avoiding Redundancies • Avoiding Nominalizations **Clarity** • Avoiding Loosely Connected Words and Phrases • Avoiding Confusing Terms • Avoiding Words that Can Have Opposite Meanings • Avoiding Abbreviations, Contractions, and Acronyms **Jargons, clichés and Literary Language** • Avoiding Figurative Language in General • Avoiding Technical Terms in Non-technical Contexts • Avoiding Sarcasm and Irony • Avoiding Humor and Wordplay **Consistency** • Cohesion • Coherence • Grammatical consistency **Sentence Structure** • Preferring Simple Sentences to Compound and Complex Sentences • Preferring the Active Voice (Situations and Conditions where passives can be useful) **Writing Letters and Emails** • Formality and Persuasiveness • Using the 'You Attitude' • Focusing on the benefits for the reader • Using a positive tone	14

II	• Writing modular content • Thinking like a user • Maintaining a consistent style • Writing content **ss and Academic Proposals II** • Types • Style and Format • Writing the draft • Revising the content **ing** • Style and Format • Determining the purpose • Collecting the data • Analyzing the data • Organizing the information • Writing the draft • Revising the content	14

Suggested Readings:

- Burnett, Rebecca E. Technical Communication. 6th ed. Boston: Thomson/Wadsworth, 2006.
- Glenn, Cheryl et al. The Writer's Harbrace Handbook. 3rd ed. Boston: Thomson, 2006.
- M. A. Rizvi, Effective Technical Communication, New Delhi: Tata McGraw Hill, 2005. 14
- R. Meenakshi and S. Sharma, Technical Communication: Principles and Practice, New Delhi: Oxford University Press, 2015.
- Weiss, Edmond H. The Elements of International English Style, New Delhi, Routledge, 2005. https://www2.latech.edu/~bmagee/303/eng303.html

Course Outcomes:

After completing this course, the students will be able to:

• Demonstrate rhetorical knowledge to create effective technical writing documents for end users.

• Apply and adapt flexible writing process strategies to produce clear, high-quality deliverables in a multitude of technical writing genres.

• Use professional technical writing conventions of clean and clear design, style, and layout of written materials.

• Gather and apply researched information that is appropriate to your field, as demonstrated by reading and analyzing documents, and citing sources correctly.

• Write clearly, correctly, and concisely.

BPSO-0002: FIRST AID AND HEALTH

Credits: 02 **Semester III** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Basic First Aid:** Aims of first aid & First aid and the law. Dealing with an emergency, Resuscitation (basic CPR). Recovery position, Initial top to toe assessment. Hand washing and Hygiene Types and Content of a First aid Kit **First AID Technique:** Dressings and Bandages. Fast evacuation techniques (single rescuer). Transport techniques. **First aid related with respiratory system:** Basics of Respiration. No breathing or difficult breathing, Drowning, Choking, Strangulation and hanging, Swelling within the throat, Suffocation by smoke or gases and Asthma. **First aid related with Heart, Blood and Circulation:** Basics of The heart and the blood circulation. Chest discomfort, bleeding. **First aid related with Wounds and Injuries**: Type of wounds, Small cuts and abrasions Head, Chest, Abdominal injuries Amputation, Crush injuries, Shock **First aid related with Bones, Joints Muscle related injuries:** Basics of The skeleton, Joints and Muscles. Fractures (injuries to bones). **First aid related with Nervous system and Unconsciousness:** 15 Hours Basics of the nervous system. Unconsciousness, Stroke, Fits – convulsions – seizures, Epilepsy. **First aid related with Gastrointestinal Tract:** Basics of The gastrointestinal system. Diarrhea, Food poisoning. **First aid related with Skin, Burns:** Basics of The skin. Burn wounds, Dry burns and scalds (burns from fire, heat and steam). Electrical and Chemical burns, Sun burns, heat exhaustion and heatstroke. Frost bites (cold burns), Prevention of burns, Fever and Hypothermia. **First aid related with Poisoning:** Poisoning by swallowing, Gases, Injection, Skin **First aid related with Bites and Stings:** Animal bites, Snake bites, Insect stings and bites **First aid related with Sense organs:** Basic of Sense organ. Foreign objects in the eye, ear, nose or skin. Swallowed foreign objects. **Specific emergency satiation and disaster management:** Emergencies at educational institutes and work Road and traffic accidents. Emergencies in rural areas. Disasters and multiple casualty accidents. Triage. **Emergency Child birth**	15
II	**Basic Sex Education** ew, ground rules, and a pre-test of Urinary system and Reproductive system. uberty — physical and emotional changes puberty — physical and emotional changes	15

	emale similarities and differences intercourse, pregnancy, and childbirth ttitudes, and myths about LGBTQ+ issues and identities ontrol and abortion thout love — harassment, sexual abuse, and rape tion of sexually transmitted diseases. **Mental Health and Psychological First Aid** Health and Psychological First Aid, s Mental Health First Aid? Health Problems in the India ental Health First Aid Action Plan tanding Depression and Anxiety Disorders First Aid for Suicidal Behavior & Depressive symptoms s Non-Suicidal Self-Injury? isis First Aid for Depression and Anxiety First Aid for Panic Attacks, Traumatic events tanding Disorders in Which Psychosis may Occur First Aid for Acute Psychosis tanding Substance Use Disorder First Aid for Overdose, Withdrawal Mental Health First Aid	

Suggested Readings:

Indian First Aid Mannual-https://www.indianredcross.org/publications/FA-manual.pdf

Red Cross First Aid/CPR/AED Instructor Manual https://mhfa.com.au/courses/public/types/youthedition4 Finkelhor, D. (2009).

The prevention of childhood sexual abuse. Durham, NH:

Crimes Against Children Research Center. www.unh.edu/ccrc/pdf/CV192. pdf Kantor L. & Levitz N. (2017). Parents' views on sex education in schools:

How much do Democrats and Republicans agree? PLoS ONE, 12 (7): e0180250. Orenstein, P. (2016). Girls and sex: Navigating the complicated new landscape. New York, NY: Harper.

Schwiegershausen, E. (2015, May 28). The Cut. www.thecut.com/2015/05/most-women-are-catcalled-before-they-turn 17.html Wiggins, G. & McTighe, J. (2008).

Understanding by design. Alexandra, VA: ASCD.

https://marshallmemo.com/marshall-publications.php#8

Suggested Continuous Evaluation Methods:

Assignments, Presentation, Group Discussion, and MCQ

Suggested equivalent online courses:

https://www.redcross.org/take-a-class/first-aid/first-aid-training/first-aid-online
https://www.firstaidforfree.com/

https://www.coursera.org/learn/psychological-first-aid • https://www.coursera.org/learn/mental-health

Course outcomes:

- Learn the skill needed to assess the ill or injured person.
- Learn the skills to provide CPR to infants, children and adults.
- Learn the skills to handle emergency child birth
- Learn the Basic sex education help young people navigate thorny questions responsibly and with confidence.
- Learn the Basic sex education help youth to understand Sex is normal. It's a deep, powerful instinct at the core of our survival as a species. Sexual desire is a healthy drive.
- Help to understand natural changes of adolescence Learn the skill to identify Mental Health status and Psychological First Aid

BBIK 0002: Fundamental of Biological Science

OBJECTIVES: The goal of this course is to introduce students to laboratory experiences complementary to the theoretical knowledge of cell biology, Molecular Biology, Genetics and molecular diagnostic techniques. It will help the students to understand the concept of metabolism and different pathway.

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Cell Biology -** An Overview of Cells, tools and techniques in cell biology, cancer. **Molecular biology and rDNA technology -** Genes and genomic organization, replication of DNA, DNA repair, Proteins Synthesis, Recombinant DNA technology. **Medical genetics-** Clinical genetics, metabolic/biochemical genetics, cytogenetics, molecular genetics.	18
II	**Molecular diagnostics-** Molecular cloning, macromolecule blotting and probing, gel electrophoresis, polymerase chain reaction, spectral karyotyping imaging and DNA microarrays **Metabolism and Integration-** Concept of Metabolism, metabolic Pathways, metabolic Integration	18

Text Book:

Thomas M.Devlin, Text Book of Biochemistry with Clinical Correlations, 6th edition, 2006, Wiley-Liss

An Introduction to Genetic Analysis (2010), 10 th ed., Griffiths, A.J.F, Wessler, S. R, Carroll, S. B. and Doebley, J., W.H. Freeman & Company (New York), ISBN:10: 1-4292-2943-8.

Reference Books:

Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6 th Edition, John Wiley & Sons. Inc.

COURSE OUTCOMES: After completing this course, student will able to

CO1- Learn the fundamentals of microscopy.
CO2- Make the slides of Different plant and animal materials.
CO3- Learn the isolation of protein and their visualization.
CO4- Learn the isolation of DNA and their visualization.
CO5- Learn the use of different molecular diagnostic techniques.
CO6-Learn the Metabolic pathway of animals.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO3, PO4, PO5, PO7, PO8/PSO1, PSO2
CO2	PO1, PO4, PO6, PO7, PO9, PO10/PSO2, PSO3
CO3	PO1, PO2, PO4, PO5, PO7, PO8/PSO1, PSO2
CO4	PO1, PO3, PO6, PO7, PO8, PO9/PSO2, PSO3
CO5	PO1, PO2, PO4, PO5, PO7, PO10/PSO1, PSO2
CO6	PO2, PO4, PO6, PO7, PO9, PO10/PSO2, PSO3

BPSO 0003. PATHOPHYSIOLOGY

SCOPE: Pathophysiology is the study of causes of diseases and reactions of the body to such disease producing causes. This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge required to practice medicine safely, confidently, rationally and effectively.

OBJECTIVES: Upon completion of the subject student shall be able to –

1. Describe the etiology and pathogenesis of the selected disease states;
2. Name the signs and symptoms of the diseases; and
3. Mention the complications of the diseases.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Basic principles of Cell injury and Adaptation: Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury, Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage), Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia), Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis &Alkalosis, Electrolyte imbalance Basic mechanism involved in the process of inflammation and repair: Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, Mediators of inflammation, Basic principles of wound healing in the skin, Pathophysiology of Atherosclerosis. Cardiovascular System: Hypertension, congestive heart failure, ischemic heart disease (angina,myocardial infarction, atherosclerosis and arteriosclerosis) • Respiratory system:Asthma, Chronic obstructive airways diseases. • Renal system:Acute and chronic renal failure .	25
II	**Haematological Diseases:** Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia Endocrine system: Diabetes, thyroid diseases, disorders of sex hormones Nervous system: Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease. Gastrointestinal system: Peptic Ulcer Inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease. • **Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout • **Principles of cancer:** classification, etiology and pathogenesis of cancer • **Diseases of bones and joints:**Rheumatoid Arthritis, Osteoporosis,Gout • **Principles of Cancer:** Classification, etiology and pathogenesis of Cancer	35

	• **Infectious diseases:** Meningitis,Typhoid, Leprosy, Tuberculosis, Urinary tract infections • **Sexually transmitted diseases:** AIDS, Syphilis, Gonorrhea	

Recommended Books (Latest Editions)

1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins &Cotran Pathologic Basis ofDisease; South Asia edition; India; Elsevier; 2014.
2. Harsh Mohan; Text book of Pathology; 6th edition; India; Jaypee Publications; 2010.
3. Laurence B, Bruce C, Bjorn K. ; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12th edition; New York; McGraw-Hill; 2011.
4. Best, Charles Herbert 1899-1978; Taylor, Norman Burke 1885-1972; West, John B (John Burnard); Best and Taylor's Physiological basis of medical practice; 12th ed; united states;
5. William and Wilkins, Baltimore;1991 [1990 printing].
6. Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston;Davidson's Principles and Practiceof Medicine; 21st edition; London; ELBS/Churchill Livingstone; 2010.
7. Guyton A, John .E Hall; Textbook of Medical Physiology; 12th edition; WB Saunders Company; 2010.
8. Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey; Pharmacotherapy: A Pathophysiological Approach; 9th edition; London; McGraw-Hill Medical; 2014.
9. V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6th edition; Philadelphia; WB Saunders Company; 1997.
10. Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3rd edition; London; Churchill Livingstone publication; 2003.

Recommended Journals

1. The Journal of Pathology. ISSN: 1096-9896 (Online)
2. The American Journal of Pathology. ISSN: 0002-9440
3. Pathology. 1465-3931 (Online)
4. International Journal of Physiology, Pathophysiology and Pharmacology. ISSN: 1944-8171 (Online)
5. Indian Journal of Pathology and Microbiology. ISSN-0377-4929.

Course Outcome:

CO-1: Understand the basic principles of cell injury, adaptation and basic mechanism involved in the process of inflammation and repair.
CO-2: Acquire the knowledge of etiology and pathogenesis of disease states pertaining to cardio-vascular, respiratory, renal, nervous, endocrine and gastro-intestinal systems.
CO-3: Understand the etiology and pathogenesis of cancer and the diseases associated with blood, bones and joints.
CO-4: Know the signs, symptoms & complications of selected diseases.
CO-5: Understand the pathophysiology of infectious diseases.

BPSO 0004 PHARMACOGNOSY I

Scope: The subject involves the fundamentals of Pharmacognosy like scope, classification ofcrude drugs, their identification and evaluation, phytochemicals present in them and theirmedicinal properties.

Objectives: Upon completion of the course, the student shall be able

1. to know the techniques in the cultivation and production of crude drugs
2. to know the crude drugs, their uses and chemical nature
3. know the evaluation techniques for the herbal drugs
4. to carry out the microscopic and morphological evaluation of crude drugs

Credits: 03 **Semester III** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Pharmacognosy:** (a) Definition, history, scope and development of Pharmacognosy (b) Sources of Drugs – Plants, Animals, Marine & Tissue culture (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums andmucilages, oleoresins and oleo-gum -resins). **Classification of drugs:** Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero-taxonomical classification of drugs **Quality control of Drugs of Natural Origin:** Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical,chemical and biological methods and properties. **Cultivation, Collection, Processing and storage of drugs of natural origin:** Cultivation and Collection of drugs of natural originFactors influencing cultivation of medicinal plants. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants **Conservation of medicinal plants**	20
II	**Introduction to secondary metabolites:** Definition, classification, properties and test for identification of Alkaloids, Glycosides,Flavonoids, Tannins and Volatile oil. **Pharmacognosy in various systems of medicine:** Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda,Unani, Siddha, Homeopathy and Chinese systems of medicine. Study of biological source, chemical nature and uses of drugs of natural origin containingfollowing drugs **Plant Products:** Fibers - Cotton, Jute, Hemp **Primary metabolites:** General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites:	25

	Carbohydrates: Acacia, Agar, Tragacanth, Honey **Proteins and Enzymes:** Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin). **Lipids (Waxes, fats, fixed oils)**: Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax	

BBAO 0404: e-BUSINESS

Introduction: This subject focuses on key issues related to e-business such as online aspect of it, CRM, SCM and data warehousing as well as security part of it

Objectives: To enable students gain insights into current and emerging technologies and other concepts related to e-business which are redefining the businesses.

Credits: 04 **Semester V** **L–T–P:4–0–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Basics of E-Business:** Introduction, Concept, Nature and Scope of E – Business, Evolution of E-Business, E-commerce business practices v/s traditional business practices, Principles of E-Business, E-Business Infrastructure, E- Business Models, Advantages and Disadvantages, Reasons for going online business, E-Business and its Solutions, e – business and e-commerce comparison. **Online Business with technology:** Business Operation, Concepts of b2b, b2c, c2c, b2g, g2c etc., Management issues relating to E-commerce.	23
II	**Internet Security:** E- Contract, Digital signatures and Legal Affairs, Securities in E- Payment system. Cyber securities: Introduction, Types and Cyber threats, cyber safety tips. **CRM, SCM & Data Warehousing:** Introduction to CRM, Role of CRM, Importance of CRM, E-business to improve supply chain, SCM & e-business, e-logistics, Data Warehousing for e-business, Introduction to Data Warehousing, Data Mining, Major requirements in E-Business; Emerging trends and technologies in E-Business. E-Business Plan Development.	22

Reference Books/ Text Books / Cases:

- Diwan, P. & Sharma, S. E-commerce-A Manager's Guide to e- Business. New Delhi: Excel Books.
- Joseph, P. T. E-Commerce-A Managerial Perspective. New Delhi: Prentice Hall of India.
- Kalakota, R. & Whinston A. B. Frontiers of Electronic Commerce. New Delhi: Pearson Education.
- Laudon K. C. &Traver, C. G. E-Commerce: Business, Technology, Society. New Delhi: Pearson Education

Case Study:

- Case Study on Walmart.com—eCommerce-Guide.com at http://www.ecommerce guide.com/news/trends/article. php/1501651

Intended Outcomes:

- After completion of the course, student will be able to:
- Understand the basic concepts and functions of e-business
- Analyze the security features of online business
- Summarize how online business is reshaping the business scenario.
- Evaluate about CRM, SCM and data warehousing

BBIC 0803: BIOCHEMISTRY LAB

Credits: 02 **Semester III** **L–T–P: 0–0–4**

Programme/Class: Diploma	**Year:** Second (2)	**Semester:** Third (III)
Subject: Biotechnology		
Couse Code: BBIC 0803	**Course Title:** Biochemistry Lab	
Course Outcomes		
Students will get practical exposure to commonly used biochemical techniques and, also they become familiar to use instruments like calorimeter, pH meter etc. Introduce the primary steps in biomolecules (focus on proteins) purification which includes various methods in isolation and quantitation of proteins. 2. Learn how to separate proteins from a heterogenous mixture. 3. Learn to apply important chromatographic techniques to purify biomolecules 4. Familiarize the working principles of electrophoresis and UV/Vis and fluorescence spectroscopic techniques and application of the knowledge to get basic structural information of proteins		
Credits: 2	**Core Compulsory**	
Maximum Marks: 100 (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P: 0-0-4		

Topic	**No. of Lectures**
1. Preparation of normal and molar solutions 2. Preparation of buffers. 3. To study activity of any enzyme under optimum conditions. 4. To study the effect of pH, temperature on the activity of salivary amylase enzyme. 5. Estimation of blood glucose by glucose oxidase method. 6. Spectrophotometer/colorimeter(Beer-Lambert's law) Estimation of Protein by UV-vis Spectrometer i. (i)Lowry et al. method for estimation of protein (ii)Biuret method for estimation of protein 7. Estimation of reducing and total sugar by DNS and H_2SO_4-phenol methods. 8. Spectroscopic estimation of DNA (UV) 9. Electrophoresis (a)Electrophoresis of red blood cell proteins (b) Electrophoresis of DNA 10. Separation of Amino acids by paper chromatography. 11. Qualitative tests for Carbohydrates, lipids and proteins 12. Estimation of DNA by Diphenylamine and RNA by Orcinol methods. 13. Effect of pH and temperature on enzyme activity. 14. Determination of pK_a value of a weak acid by titrating with strong base.	60

BBIK 0802: Fundamental of Biological Science Lab

OBJECTIVES: The aim of this course is to enable learners to develop the practical techniques. Learners will investigate the quantities necessary in chemical reactions, different types of solution. Learn basic instruments used in laboratory, laboratory safety and use of good laboratory practices.

Credits:03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Safety in science laboratory-** General Safety, safe Handling of chemicals and glass wares, working in Biosafety areas. **Elementary knowledge of chemistry-** Elementary knowledge of inorganic chemistry, elementary knowledge of organic chemistry, elementary knowledge physical chemistry.	18
II	**Laboratory instruments** Principle and working of basic laboratory instruments Autoclave, Hot air oven, Incubator, pH meter, water bath, centrifuge, Refrigerator, colorimeter, Balance, Flame photometer, Microscope, Electrophoresis etc. **Reagents and Solutions** Molar solutions, normal solutions Buffer solutions, percent solutions, saturated solutions, standard solutions. Dilution of the concentrated solution to desired concentration	18

Text Book:

1.A guide to laboratory safety and microscale organic laboratory techniques, Kale M. A. CBS Publication.

2. Wilson and Walkers principles and techniques of biochemistry and molecular biology. Hofmann A, Cambridge University press.

Reference Books:

1.Understanding Chemistry, C.N.R. Rao, Universities Press

Course Outcomes: After completing this course, student will able to

CO1- Understand and basic concepts of science laboratory and safe handling of chemicals.
CO2- Understand the Good laboratory practices.
CO3- Understand the Inorganic, organic and physical chemistry.
CO4- Learn the Principle and working of basic laboratory instruments.
CO5- Learn the preparation of different solution and Buffer.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7, PO8, PO10/PSO1, PSO2
CO2	PO2, PO3, PO6, PO7, PO8, PO9/PSO2, PSO3
CO3	PO1, PO2, PO4, PO5, PO7, PO8/PSO1, PSO2
CO4	PO2, PO4, PO6, PO7, PO9, PO10/PSO2, PSO3
CO5	PO2, PO4, PO5, PO7, PO8, PO10/PSO1

BPSO 0801 PHARMACOGNOSY I (Practical)

Credits: 02 **Semester III** **L–T–P: 0–0–2**

1. Analysis of crude drugs by chemical tests: **(**i) Tragaccanth (ii) Acacia (iii)Agar (iv)Gelatin (v) starch (vi) Honey (vii) Castor oil
2. Determination of stomatal number and index
3. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer.
4. Determination of number of starch grains by Lycopodium spore method.
5. Determination of Ash value
6. Determination of Extractive values of crude drugs.
7. Determination of moisture content of crude drugs.
8. Determination of swelling index and foaming

Recommended Books: (Latest Editions)

1. W.C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co.,London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea andFebiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers &Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition,Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, NewDelhi.
7. Essentials of Pharmacognosy, Dr. S. H. Ansari, IInd edition, Birla publications, NewDelhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs by M.A. Iyengar

BBIC 0007: MICROBIOLOGY AND IMMUNOLOGY

OBJECTIVES: The objective of the course is to familiarize students with aspects, scopes and applications of microbiology. The students will be introduced to the basic concepts of immunology as it relates to human and animal health. The course is designed for students with knowledge of immunology and defense mechanism against invading agents and non-self-agents.

Credits: 04 **Semester IV** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Diversity and classification of microbes:** Fundamentals, History and Evolution of Microbiology. Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria. Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms - Viruses, Bacteria, Algae, Fungi, and Protozoa. **Microbial growth:** Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. Microbial Metabolism: Metabolic pathways, amphicatabolic and biosynthetic pathways. Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria. **Pathogen contamination and infectious diseases:** Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal. Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods. Bacterial diseases of human- Tuberculosis, Tetanus, Typhoid, Cholera, Viral diseases of human-Hepatitis B andC, AIDS. **Sterilization, cultivation and staining:** Principals and applications of different methods of sterilization, Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, Methods of isolation, Purification and preservation. Principals of staining and types of staining.	14 24
II	**Introduction to immune system:** Introduction to Immunology, Components of mammalian immune system (cell and organs), Innate and Adaptive immunity**,** Humoral and cell mediated immune response, Clonal selection theory, An overview of primary and secondary immune responses. **Antigen and Antibody structure and diversity:** Antigen, epitopes and Adjuvents, Structure and isotypes of Immunoglobulins allotypes and idiotypes, B- and T-cell receptors B and T cell maturation, Antibody diversity generation, somatic gene rearrangements during B-lymphocyte differentiation, allelic exclusion, affinity maturation, class switching , somatic hypermutation	24

	MHC, antigen processing and presentation: Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Antigen processing and presentation. Autoimmune diseases, Immunodeficiency-AIDS and SCID. **Immunological Techniques and Vaccines:** Introduction to immunodiagnostics – Precipitation, Agglutination, RIA, ELISA and Immunofluorescence. Passive & active immunization. Types of vaccines-DNA vaccines, recombinant vaccines, inactivated vaccine, Common indigenous vaccines.	

Text book:

- A Text Book of Microbiology by Dubey, R.C

Reference books:

- Microbiology, Authors- Pelczar, Chan and Kreig.
- Microbiology- an Introduction- (8th Edn), Authors- Tortora, G.J., Funke, B.R., Case, C.L.
- General Microbiology, Authors- Stainer, Ingharam, Wheelis and Painter.
- Microbial Physiology, Authors- Moat and Foster.
- A Text book of Microbiology, Authors- P. Chakraborty.
- Textbook of Microbiology, Authors- Dubey and Maheshwari.
- Microbiology, A Practical Approach. Authors- Patel and Phanse
- General Microbiology, Authors- Powar and Daginawala.
- Microbiology, Author- S.S. Purohit.
- Microbiology, Authors- Presscott, Herley and Klein.
- Bacteriology, Authors- Topley and Wilson.
- Immunology and immunotechnology by Ashim k. Chakravarty (Oxford university Press)
- Immunology by C. Fatima
- Immunology by Kuby (Free man publication)
- Essentials of immunology by Roitt (Blackwell scientific publication)
- Immunology by Benacera
- Infection & Immunity by John Playfair & Gregory Bancroft (Oxford university Press)

FOCUS: This course focuses on Employability aligned with CO2

COURSE OUTCOMES: After completion of course, the student will be able to:

CO-1: Know about the pioneers in microbiology and their contributions.
CO-2: Understand the physical and chemical method of sterilization.
CO-3: Analyze the media composition and grow the desired microbe.
CO-4: Understand different staining methods.
CO-5: understand and differentiate the different types of microbes.
CO-6: understand the principles of immunology.
CO-7: learn about structural features of components of immune system as well as their function and development of immune system and mechanisms by which our body elicits immune response.
CO-8: predict about nature of immune response that develops against bacterial, viral or parasitic infection, and prove it by designing new experiments.
CO-9: understand the biology of different vaccines against infectious agents

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO7, PO8/PSO1, PSO3
CO2	PO1, PO2, PO4/PSO2, PSO3
CO3	PO1, PO3, PO7, PO8, PO10/PSO1, PSO4
CO4	PO1, PO4, PO7, PO8/PSO1, PSO2
CO5	PO1, PO2, PO5, PO8/PSO2, PSO3
CO6	PO1, PO4, PO6, PO8, PO9/PSO2, PSO4
CO7	PO1, PO4, PO7, PO8/PSO1, PSO2
CO8	PO1, PO2, PO5, PO8/PSO2, PSO3
CO9	PO1, PO3, PO7, PO8, PO10/PSO1

BBIC 0008: TOOLS AND TECHNIQUES IN BIOTECHNOLOGY

OBJECTIVES: To develop skilled manpower in the field of Bioanalytical Sciences. The primary objective of this course are to develop the skills to understand the theory and practice of bio-analytical techniques

Credits: 04 **Semester IV** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Basics of Biophysics** Chemical bonding – Ionic bond, covalent bond, hydrogen bond and Vander-Waals force. **Chromatography** Introduction & Principle of Chromatography, Paper, thin-layer, column, HPLC, GLC and molecular sieving., Ion exchange chromatography Affinity Chromatography, **Centrifugation** Principle of centrifugation, Basic rules of sedimentation, sedimentation coefficient. Various types of centrifuges, low speed centrifuge, high speed centrifuge and ultracentrifuge, types of rotors. Application of centrifugation, differential centrifugation, density gradient centrifugation- zonal and isopycnic. **Electrophoresis:** Basic Principle of electrophoresis, Gel electrophoresis, PAGE, SDS-PAGE, Native gels, denaturing gels, Agarose gel electrophoresis.	24
II	**Microscopy** Principle of light microscopy, Phase contrast microscopy, Fluorescence microscopy, Electron microscopy, Permanent and temporary slide preparation, histology and staining. **Radioactivity** Types, their importance in biological studies, Measure of radioactivity GM counters and Scintillation counting **Fundamental principles and basics of instrument design of:** UV-Visible spectrophotometry and Beer-Lambert law, Fluorescence techniques, Infra-Red and Raman spectrometry, Circular Dichroism and Optical Rotatory dispersion, Nuclear Magnetic Resonance spectrometry, Atomic absorption and emission spectrometry. X Ray diffraction, Mass spectrometry.	24

TEXT BOOK:

- Boyer, R.F., Biochemistry Laboratory: Modern Theory and Techniques, 6th ed., Boston, Mass: Prentice Hall, 2012.

REFERENCE BOOKS:

- Plummer D. T., An Introduction to Practical Biochemistry 3rd ed., Tata McGraw Hill Education Pvt. Ltd. 2006.

- Wilson K. and Walker J., Principles and Techniques of Biochemistry and Molecular Biology, 7th ed., Cambridge University Press, 2010.
- Rastogi & Pathak, Genetic Engineering, Oxford University Press,2009

FOCUS: This course focuses on Employability aligned with CO2

COURSE OUTCOMES: After completion of course, the student will be able to:

CO1: The objective of the course is to introduce various techniques to the students, which are used in biological research.

CO2: Students will acquire knowledge about the principles and applications of spectrophotometric and chromatography techniques used in a biochemistry lab.

CO3: Students will learn about the principle and application of electrophoresis, centrifugation techniques, microscopic and molecular biological techniques.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO2, PSO3
CO2	PO1, PO3, PO4/PSO1, PSO3
CO3	PO2, PO3, PO5, PO8/PSO2, PSO4

BPSO 0006: PHARMACOGNOSY-II

OBJECTIVES: The main purpose of subject is to impart the students the knowledge of how the secondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. Also this subject involves the study of producing the plants and phytochemicals through plant tissue culture, drug interactions and basic principles of traditional system of medicine.

Credits: 2 **Semester - IV** **L–T–P: 2–0–0**

Module No.	Content	Lab Hours
I	**Metabolic pathways in higher plants and their determination** a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway. b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies. **Basics of Phytochemistry** Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.	30
II	General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites: **Alkaloids:** Vinca, Rauwolfia, Opium, **Phenylpropanoids and Flavonoids:** Tea, Ruta **Steroids, Cardiac Glycosides & Triterpenoids**: Liquorice, Digitalis **Volatile oils:** Clove, Cinnamon, Fennel, Coriander. **Resins:** Benzoin, Guggul, Ginger. **Glycosides:** Senna, Aloes. Isolation, Identification and Analysis of Phytoconstituents a) **Terpenoids:** Menthol, Citral, Artemisin b) **Glycosides:** Glycyrhetinic acid & Rutin c) **Alkaloids:** Atropine, Quinine, Caffeine	

TEXT BOOK:

• W.C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.

REFERENCE BOOKS:

• Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
• Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
• Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
• Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007.
• Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.

• A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
• R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
• Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
• The formulation and preparation of cosmetic, fragrances and flavours.
• Remington's Pharmaceutical sciences.
• Text Book of Biotechnology by Vyas and Dixit.
• Text Book of Biotechnology by R.C. Dubey.

Focus: This course focuses on Employability, Skill development aligned with CO1 & CO2

Course outcome: After completion of this course, student will able to

CO1- to know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents
CO2- to understand the preparation and development of herbal formulation.
CO3- to understand the herbal drug interactions.
CO4- to carryout isolation and identification of phytoconstituents

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO5, PO7, PO8/PSO1
CO2	PO2, PO3, PO5, PO7, PO8/PSO1
CO3	PO1, PO3, PO7, PO8/PSO1, PSO2
CO4	PO3, PO4, PO5, PO7, PO8/PSO1

Year:	Semester:	Credit:	L–T–P: 2–0–0
Course Code: BCHO 0012		Course Title: Human Values and Environment studies	
Course Prerequisite		No Prerequisite	

Course Objective:
The mission of the course on Human Values and Environmental Studies is to create morally articulate solutions to be truthful and just and to become responsible towards humanity. The course seeks to establish a continuous interest in the learners to improve their thought process with intent to develop a new generation of responsible citizens capable of addressing complex challenges faced by the society due to disruptions in human interactions effecting human values.

Module No.	Contents	Teaching Hours (Approx.)
I	**Human Values**- Introduction- Values, Characteristics, Types, Developing Value system in Indian Organization Understanding Value Education Ethics, Morality & Values (Personal, Professional & Social Ethics) Fundamental Values: Humility, Integrity and Honesty Values in Business Management, value-based Organisation, Trans –cultural Human values in Management. Swami Vivekananda's philosophy of Character Building, Gandhi's concept of Seven Sins, APJ Abdul Kalam view on role of parents and Teachers. **Self-Exploration and Self Development** Human Values and Present Practices – Issues: Corruption and Bribe, Privacy Policy in Web and social media, Cyber threats, Online Shopping etc. Remedies **UK Bribery Act, Introduction to sustainable policies and practices in Indian Economy. Principles of Ethics** Case Studies: 1. The Violation of Privacy 2. Giving In or Giving Up, 3. May the Truth Be with You **Secular and Spiritual Values in Management- Introduction**- Secular and Spiritual values, features, Levels of value Implementation. Features of spiritual Values, The Pursuit of Purushartha: Dharma, Artha, Kama & Moksha Documentaries: 1. The Modern Times 2: Right Here Right Now 3: Story of Stuff **Corporate Social Responsibility**- Nature, Levels, Phases and Models of CSR, Corporate Governance. CSR and Modern Business Tycoons Ratan Tata, Azim Premji and Bill Gates. **Ecosystem:** Concept, structure & functions of ecosystem: producer, consumer, decomposer, foodweb, food chain, energy flow, Ecological pyramids Conservation of **Biodiversity-** In-situ & Ex- situ conservation of biodiversity Role of individual in Pollution control Human Population & Environment Sustainable Development India and UN Sustainable Development Goals Concept of circular economy and entrepreneurship.	15
	Holistic Approach in Decision making- Decision making, the decision-making process, The Bhagavad Gita: Techniques in Management, Dharma and Holistic Management. Ethical Decision Making: Rationality, Critical Thinking, Problem Solving & Decision Making **Discussion through Dilemmas** – Freedom, Individual Rights & Social Welfare Approach Dilemmas in Marketing and Pharma Organizations, moving from Public to Private – monopoly context, Dilemma of privatization, Dilemma on liberalization, Dilemma on	

II	social media and cyber security, Dilemma on Organic food, Dilemma on standardization, Dilemma on Quality standards. **Case Studies:1. Cyber Harassment 2. The case of Surrogacy 3. The Case of Euthanasia** **Environmental Laws** - International Advancements in Environmental Conservation Role of National Green Tribunal Air Quality Index Importance of Indian Traditional knowledge on environment Bio assessment of Environmental Quality Environmental Management System Environmental Impact Assessment and Environmental Audit	15

Suggested Readings:
1. A foundation course in Human Values and Professional Ethics by RR. Gaur, R. Sangal et.al
2. JUSTICE: What's the Right Thing to Do? Michael J. Sandel.
3. Human Values by A. N. Tripathi New Age International
4. Environmental Management by N.K. Uberoi
5. https://www.un.org/sustainabledevelopment/sustainable-development-goals/
6. https://www.india.gov.in/my-government/schemes
7. https://www.legislation.gov.uk/ukpga/2010/23/contents 8. Daniel Kahneman, Thinking, Fast and Slow; Allen Lane Nov 2011 ISBN: 9780141918921
Suggested Continuous Evaluation Methods:

BEDO 0001: PHYSICAL EDUCATION & YOGA

Objective: Students will learn the introduction of Physical Education, the Concept of fitness and wellness, Weight management and the lifestyle of an individual. The student will also learn about the relationship of Yoga with mental health and value education. In this course, students will also learn about the aspects of the Traditional games of India.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
	Physical Education: Meaning, Aim, Need, Importance and Scope of Physical Education in the Modern Society. Physical Education in India before and after Independence. **Concept of Fitness and Wellness:** Meaning, Importance, and Factors affecting Fitness and Wellness. Components and fitness equipment. **Weight Management:** Meaning, Factor affecting weight management. BMI: (Body mass index) Meaning, charts, range and category. Obesity: Meaning, Causes and its types, Solutions for Overcoming Obesity. **Lifestyle:** Meaning, Definition, Importance, Factor affecting Lifestyle. Healthy Lifestyle through Diet. Relationship between Diet and Fitness. **Yoga and Meditation**: Definition, importance of Yoga.Yoga relation with mental health and sports. Definition of Asana and Pranayama, differences between Asana and physical exercise. Asana-Suraya-Namaskar, Bhujang Asana, Naukasana, Halasana,Vajrasan, Padmasana, Shavasana, Makrasana, Dhanurasana, Tad Asana. Pranayam - Anulom, Vilom, Bhramary. **Traditional Games of India:** Meaning, types and benefits of Traditional Games. **Recreation in Physical Education:** Meaning, Importance, and Benefits of Recreation. Types of Recreational Activities, Aerobics and Zumba (Fit India Movement).	**30** (15 Theory, 15 Practical)

Suggested Readings

- Singh, Ajmer, Physical Education and Olympic Abhiyan, “Kalayani Publishers”, New Delhi, RevisedAddition, 2006
- Patel, Shri krishna, Physical Education, “Agrawal Publishers”, Agra, 2014-15 Panday, Preeti, Sharirik Shiksha Sankalan, “Khel Sanskriti Prakashan, Kanpur
- Kamlesh M.L., “Physical Education, Facts and foundations”, Faridabad P.B. Publications.
- B.K.S. Yengar, & quot; Light and Yog. Yoga Deepika & quot;, George Allen of Unwin Ltd., London,1981. Braj Bilari Nigam, Yoga Power " The Kpath of Personal achievement & quot; Domen and Publishers,New Delhi, 2001.
- Indira Devi, & quot; Yoga for You & quot;, Gibbs, Smith Publishers, Salt Lake City, 2002 Domenand Publishers, New Delhi - 2001.
- Jack Peter, "Yoga Master the Yogic Powers & quot;, Abhishek Publications, Chandigarh, 2004.Janice Jerusalim, & quot; A Guide To Yoga & quot; Parragon Bath, Baiihe-2004.
- **ukjx] fç;dk ijEijkxr Hkkjrh; [ky] " LikVZ ifeyd"ku"] ubZ fnYyh] 2007**

Outcomes:

After completion of this course, the student will be able:

CO1: to understand the concept of holistic health and various dimensions and determinants of Physical health.

CO2: Acquaint them with the Fitness, Wellness and Weight Management programmed & its importance.

CO3: Create interest in the practice of *yoga asanas* and meditation.

CO4: Sensitize students towards Traditional games of India, recreation and fit India movement.

BELA 0012: Workplace Communication

Course Objective:

1. Develop an understanding of the distinction between general and business communication, and explore how effective communication strategies differ in various professional contexts.
2. Identify and address barriers to communication, and acquire practical tools and techniques to overcome challenges in business communication.
3. Learn to apply the "You" perspective and optimistic discourse in business settings to enhance clarity, foster positive interactions, and improve overall communication effectiveness.
4. Master key forms of business correspondence, including the crafting of letters, notices, agendas, minutes, and professional emails, with a focus on clarity, conciseness, and professionalism.
5. Enhance critical reading and speaking skills by analyzing business news, articles, and reports, while also practicing negotiation, persuasion, and effective presentation techniques in various professional settings.

CREDIT –2 SEMESTER III L-T-P-2-0-0

Module	Content	Teaching Hours
I	**The Art of Communication** 1. General Vs Business Communication 2. Barriers to Communication, and ways to overcome 3. Effective Communication: 'You' perspective and 'Optimistic' discourse **Business Correspondence** 1. Letters 2. Notice, Agenda, and Minutes 3. Emails **Reading and Speaking** 1. Decoding Business News and Articles 2. Negotiation and Persuasion Techniques **Vocabulary** 1. Concerning e-mails and Meetings	14
II	**The Art of Writing** 1. CV / Resume and Job Application cum Cover Letters **Reading and Speaking** 1. Reading and Interpreting Reports 2. Group and Individual Presentations 3. Presenting Business Proposals **Vocabulary** 1. Highlights in a CV/Resume 2. Interviews' Terminology	14

Course Outcomes:

After completing this course:

1. Students will be able to differentiate between general and business communication and apply the appropriate communication strategies for diverse business scenarios, ensuring clear and professional interactions.
2. Students will develop the ability to recognize and overcome communication barriers, employing effective strategies to facilitate smooth and efficient communication in both individual and group settings.
3. Students will demonstrate proficiency in crafting various business correspondence (letters, notices, agendas, minutes, and emails), tailoring their writing to suit specific business needs while maintaining clarity and professionalism.
4. Students will enhance their ability to read and analyze business-related texts (news, articles, reports) and apply negotiation, persuasion, and presentation techniques to effectively communicate and influence stakeholders in business contexts.
5. Students will be able to create a compelling CV/resume and job application documents, using precise vocabulary and industry-specific terminology, and practice presenting themselves confidently in interviews and business proposals.

BBIC 0804: MICROBIOLOGY & IMMUNOLOGY LAB

OBJECTIVES: To gain strong foundation and basic knowledge of biochemical methods and their application in biology. To have a greater understanding of the underlying theory of these methods and their practical applications in the laboratories

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	1. Safety measures in microbiology laboratory 2. Study of instruments: Compound microscope, Autoclave, Hot air oven, PH meter, and Laminar airflow 3. Introduction to different sterilization techniques 4. Isolation of bacteria & their biochemical characterization. 5. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop. 6. Preparation of media and sterilization, 7. Methods of isolation of bacteria from different sources. 8. Determination of bacterial cell size by micrometry. 9. Enumeration of microorganism - total & viable count. 10. Differential leucocytes count 11. Total leucocytes count 12. Total RBC count 13. Haemagglutination assay 14. Separation of serum from blood 15. Double immunodiffusion test using specific antibody and antigen. 16. ELISA demonstration	20

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Focus: This course focuses on Employability, Skill development aligned with CO1 & CO2

Course outcome: After completion of this course, student will able to

CO1- understand methods of cleaning and sterilization of plasticwares and glasswares.
CO2- understand and perform pure culture techniques which includes, pour plate and spread plate .
CO3- understand the preparation and use of differential, selective and special media.
CO4: understand and identify the morphology of cells of the immune system.
CO5: understand the basic concepts of blood grouping.
CO6: understand antigen antibody interactions and thus quantitate the presence of antigen and or antibodies in biological samples.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7, PO8/PSO1, PSO2
CO2	PO2, PO4, PO5, PO7, PO8/PSO1, PSO2
CO3	PO2, PO3, PO4, PO5, PO7, PO8/PSO1
CO4	PO3, PO4, PO5, PO7, PO8/PSO1, PSO2
CO5	PO1, PO3, PO5, PO7, PO8/PSO1, PSO2
CO6	PO1, PO4, PO5, PO7, PO8/PSO1, PSO2

BBIC 0805: TOOLS & TECHNIQUES LAB

OBJECTIVES:

Biophysical techniques form the basis for all aspects of modern Biotechnology. The objective of the course is to advance the student's knowledge of spectroscopic, electrophoresis, chromatographic techniques and other current biophysical methods.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	1. Introduction to the laboratory, good lab practices. 2. Introduction to instruments and glassware that are routinely used in the laboratory 3. Paper chromatography of carbohydrates 4. 2D paper chromatography 5. TLC of fatty acids/lipids 6. Separation of proteins by PAGE, SDS- PAGE 7. Agarose gel electrophoresis of nucleic acids 8. To isolate mitochondria by differential centrifugation 9. Visualization of cells by methylene blue	20

FOCUS: This course focuses on Employability and Skill development aligned with CO1, CO2 & CO3

COURSE OUTCOMES: The major outcomes of this course are:
CO1- To understand fundamental concept of instrumentation
CO2- Describe the qualitative analysis of carbohydrates, lipids, protein and nucleic acid
CO3- To understand the quantitative analysis of carbohydrates, lipids, protein, nucleic acid and cholesterol

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1,PO2, PO3
CO2	PO2, PO3
CO3	PO1,PO2, PO3

BPSO 0802- PHRACOGNOSY-II LAB

2 Hours/Week

OBJECTIVES:

To gain strong foundation and basic knowledge of biochemical methods and their application in biology. To have a greater understanding of the underlying theory of these methods and their practical applications in the laboratories

1. Morphology, histology and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Clove, Ephedra, Fennel, Coriander, vinca, vasaka.
2. Extraction of Plant material by different methods.
3. Distillation of volatile oil by Clevenger apparatus.
4. Detection pf phytoconstituents by TLC.
5. Analysis of crude drugs by chemical tests; Asafoetida, Aloe.

Recommended Books: (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
6. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.
7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
9. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours.
11. Remington's Pharmaceutical sciences.
12. Text Book of Biotechnology by Vyas and Dixit.
13. Text Book of Biotechnology by R.C. Dubey.

ANIMAL AND PLANT BIOTECHNOLOGY

OBJECTIVES:

- To understand the principles, practices and application of animal biotechnology in Transgenesis, Tissue Engineering, and biopharmaceuticals.
- To understand the principles, practices and applications of plant biotechnology, transgenic plant generation, plant tissue culture, and genetic transformation.

Credits: 04 **Semester V** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Gene delivery methods for animals:** Viral vectors, Vector less or direct DNA transfer, particle bombardment, electroporation, microinjection & chemical methods, creation of animal models of human diseases. **Transgenesis:** • Introduction to transgenesis. Transgenic Animals Mice, Cow, Pig, Sheep, Goat. • Animal diseases need help of Biotechnology –Foot-and mouth disease, Coccidiosis, **Introduction, Cryo and organogenic differentiation:** • Types of culture: Seed, Embryo, Callus, Organs, Cell and Protoplast culture. • Micropopagation Axillary bud proliferation, Meristem and shoot tip culture, cud culture, Organogenesis, embryogenesis, advantages and disadvantages of micropropagation. • Protoplast isolation and fusion, methods of protoplast isolation, Protoplast development, • Somatic hybridization, identification and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations. Somaclonal variation nomenclature, methods, applications basis and disadvantages **In vitro haploid production Androgenic methods:** • Anther culture, Microspore culture androgenesis • Significance and use of haploids, Ploidy level and chromosome doubling, diplodization, Gynogenic haploids, factors effecting gynogenesis • Chromosome elimination techniques for production of haploids in cereals	20

II	**Animal propagation:** • Artificial insemination, animal Clones. • Conservation Biology – embryo transfer techniques. **Genetic modification in Medicine:** • Gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, • Human genetic engineering, problems & ethics • Introduction to Stem Cell Technology and its applications • **Plant Growth Promoting bacteria:** • Nitrogen fixation, • Nitrogenase, Hydrogenase, Nodulation • Biocontrol of pathogens • Growth promotion by free-living bacteria **Transgenesis:** • Plant transformation technologies • *Agrobacterium tumifaciens* infection, basis of tumor formation, features of Ti & Ri plasmids, mechanisms of DNA transfer, role of virulence genes, use of Ti plasmid as vector, binary vectors • Application of plant transformation for productivity and performance: Herbicides resistance, insect resistance, Bt genes, non-Bt like protease inhibitors, virus resistance, long shelf life of fruits and flowers	20

Course Outcomes

After studying the course, the student will be able to:

- Learn different gene delivery methods to deliver foreign gene in animal cells.
- Understand the principle of animal cloning and propagation by embryo transfer technology.
- Understand the principle, strategy and application of transgenic animals in medical fields.
- Understand the application of animal biotechnology in Tissue Engineering, and biopharmaceuticals.
- Understand applications of stem cells in different fields of animal biotechnology.
- Learn fundamentals of Plant biotechnology and plant tissue culture.
- Learn different gene delivery methods to deliver foreign gene in plants to know about different products of transgenic plants and microbes
- Learn application of somatic hybridization, anther culture, embryo culture etc.
- Understand the application of plant transformation for development of Herbicides resistance, insect and drought resistance plants.

- **Text Books:**

- Gupta PK.(2018) **Animal Biotechnology**. Rastogi Publications
- Chawla HS. (2020) **Introduction to Plant Biotechnology**(3rd edition) OXFORD & IBH Publishing
- Singh BD. (2015). **Biotechnology: Expanding Horizons** (4th edition). Kalyani Publishers

- Dubey RC. (2014) **A Textbook of Biotechnology** (5th edition) S Chand and Company Ltd.

Reference Books:

- Singh B. Gautam SK (2013). **Textbook of animal biotechnology**. The Energy and Resources Institute, TERI
- Razdan, M. K. (2003). **Introduction to Plant Tissue Culture**. Enfield, NH: Science
- Smith R(2012). **Plant Tissue Culture** (3rd Edition) Academic Press.
- Slater, A., Scott, N. W., & Fowler, M. R. (2008). **Plant Biotechnology: an Introduction to Genetic Engineering**. Oxford: Oxford University Press.
- Buchanan, B. B., Gruissem, W., & Jones, R. L. (2015). **Biochemistry & Molecular Biology of Plants.** Chichester, West Sussex: John Wiley & Sons.
- Glick, B. R., & Pasternak, J. J. (2010). **Molecular Biotechnology: Principles and Applications of Recombinant DNA. Washington**, D.C.: ASM Press.
- Brown, T. A. (2006). **Gene Cloning and DNA Analysis: an Introduction.** Oxford: Blackwell Pub.
- Slater, A., Scott, N. W., & Fowler, M. R. (2003). **Plant Biotechnology: The Genetic Manipulation of Plants**. Oxford: Oxford University Press.
- Pörtner, R. (2007). **Animal Cell Biotechnology: Methods and Protocols**. Totowa, NJ: Humana Press

BIOSTATISTICS AND BIOINFORMATICS

COURSE OBJECTIVES:

- Prepare students for a career in Biotechnology by providing them with a sound grounding in multidisciplinary areas of Biotechnology and Bioinformatics.
- Increase students' understanding of Bioinformatics Tools and their application.

Credits: 04 **Semester V** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**History and introduction to Bioinformatics:** • Introduction and applications of bioinformatics • Data generation; Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray). Applications of Bioinformatics **Databases, Data generation, Data storage and retrieval:** • General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL), Protein databases (Primary, Composite, and Secondary). • Specialized Genome databases: (SGD, TIGR, and ACeDB). • Structure databases (CATH, SCOP, and PDBsum) • File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). • Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search. **Types and Collection of data:** • Primary and Secondary data, Classification and Graphical representation of Statistical data. • Measures of central tendency and Dispersion. • Measures of Skewness and Kurtosis. **Probability:** • Definition of probability, Theorems on total and compound probability • Elementary ideas of Binomial, Poisson and Normal distributions.	22
II	**Sequence and Phylogeny analysis:** • Introduction to Sequences, alignments and Dynamic Programming; Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm). • Introduction to BLAST, using it on the web, Interpreting results, Phylogenetic Analysis. • PCR primer designing etc **Searching Databases:** • SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. • Genome Annotation: Pattern and repeat finding, Gene identification tools. **Sampling:** • Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. • Problems on test of significance, t-test, chi-square test • for goodness of fit and analysis of variance (ANOVA)	22

	Correlation and Regression: • Types, Karl-Pearson's correlation, Spearman's Rank correlation, Regression equation and fitting • Main features of regression analysis-simple and multiple regression analysis • Differences between correlation and regression analysis	

Text Book:

Mount, D. W. (2001). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
Daniel, W. W. (1987). Biostatistics, a Foundation for Analysis in the Health Sciences. New York: Wiley

Reference Books:

1.Pevsner, J. (2015). Bioinformatics and Functional Genomics. Hoboken, NJ.: WileyBlackwell.
2. Rastogi VB.(2015). Biostatistics (3rd Edition). MedTec

FOCUS: This course focuses on Employability aligned with CO1, CO3, CO4 & CO6.

COURSE OUTCOMES: After completion of course, the student will be able to:
CO1-learn the need of statistical approach, identify the different axiomatic approach.
CO2- learn to study the variability of observation.
CO3- know effective use of Office package –word, excel, ppt and publisher etc
CO4- understand simple calculation usinf excel
CO5- understand the basic theories and practicals of common computational tools and databases which facilitate investigation of molecular biology and evolution-related concepts.
CO6- critically analyse and interpret results of their studies with the help of bioinfomatical and biostatistical tools

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO5, PO7, PO8/PSO1, PSO3
CO2	PO1, PO3, PO6, PO7, PO9, PO10/PSO2, PSO3
CO3	PO2, PO3, PO4, PO5, PO7, PO8, PO10/PSO1, PSO2
CO4	PO1, PO3, PO6, PO7, PO8, PO9/PSO2, PSO3
CO5	PO1, PO2, PO4, PO5, PO7, PO8, PO10/PSO1, PSO2
CO6	PO2, PO4, PO6, PO7, PO9, PO10/PSO2, PSO3

FERMENTATION TECHNOLOGY

OBJECTIVES: Fermentation technology course helps students to apply the concepts learned in the area of microbiology, biochemistry for obtaining commercially important byproducts. Students are introduced to the concept of fermentation technology, scaling up techniques, wet & dry milling and the concepts, components of a bioreactor enabling students to learn the concept of aerobic, anaerobic and alcoholic fermentation leading to the production of cheese, butter, yoghurt, etc.

Credits: 02 **Semester V** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Introduction** Fermentation processes, Microbial culture selection for fermentation processes. Media formulation and optimization; inoculum development, Raw material availability and pretreatment. **Sterilization and Metabolic pathway analysis** Sterilization of fermentor, media and air. Sterilization kinetics Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes. Induction, nutritional repression, carbon catabolite repression, crab tree effect, feedback inhibition and feedback repression. **Design of fermenters** Design and operation of Fermenters, Basic concepts for selection of a reactor, stirred tank reactor, Packed bed reactor, Fluidized bed reactor, Trickle bed reactor, Bubble column reactor.	18
II	**Processes involved in fermentation-I** Scale-up process and Scale down process: Purposes of scale-up; Stages of fermentation –laboratory scale, pilot-plant scale and production scale; Criteria of scale-up for critical parameters-aeration, agitation, broth rheology and sterilization; Scale-down **Processes involved in fermentation-II** Cell disruption; Filtration; Centrifugation; Liquid-liquid extraction; Solvent extraction (distillation); Chromatography; Electrophoresis; Lyophilization.	24

TEXT BOOK:

- Principle of Fermentation Technology by Stanbury, O.F

REFERENCE BOOKS:

- Murray Moo -Young, Comprehensive Biotechnology, Vol. 1 & III.
- Microbes & Fermentation, A. Lel and Kotlers Richard J. Mickey, Oriffin Publication
- Industrial Fermentations- Leland, N. Y. Chemical Publishers.
- Prescott and Dunn's- Industrial Microbiology.
- Biotechnology Series, Rehm, Reed & Weinheim, Verlag-Chemie.

- Biochemical Engg., Aiba, Humphrey & Miller, Academic Press.
- Fermentations & Enzyme technology,Wang & Humphrey, Wiley & Inter Science

FOCUS: This course focuses on Entrepreneurship, Skill development aligned with all COs.

COURSE OUTCOMES: After completing this course, student will able:

CO1-Understand basic concepts of fermentation technology. ***(Understand)***
CO2 - Understand design, working, computational control and applications of Bioreactor/Fermenter. ***(Understand and Analyze)***
CO3 - Understand principles and strategies involved in media formulation and strain development. ***(Analyze)***
CO4 - Understand the concept of feedback mechanisms such as inhibition and repression. ***(Analyze)***
CO5 - Understand the concept of recombinant microbial cells and their significance in fermentation technology. ***(Understand and Analyze)***
CO6 - Understand downstream processing and factors affecting the phenomena. ***(Analyze)***
CO7 -To develop novel ideas in the area of fermentation technologies and their applications agents. ***(Create)***

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs/ PSOs
CO1	PO1, PO3, PO5, PO7, PO8/PSO2
CO2	PO1, PO2, PO3, PO4, PO7, PO8/PSO1, PSO3
CO3	PO1, PO3, PO7, PO8, PO9/PSO1, PSO3
CO4	PO2, PO3, PO5, PO5, PO8, PO10/PSO1, PSO2
CO5	PO1, PO2, PO3, PO5, PO7, PO8, PO10/PSO2, PSO3
CO6	PO2, PO3, PO5, PO7, PO8, PO9/PSO1, PSO3
CO7	PO1, PO2, PO3, PO4, PO7, PO8/PSO1, PSO3

CANCER BIOLOGY

COURSE OBJECTIVES:

- Embark on a dynamic journey into the intricate world of Cancer Biology with our Bachelor of Science in Biotechnology program
- Established to meet the growing demand for skilled professionals in the field, this comprehensive four-year curriculum provides a robust foundation in Cancer Biology.
- Equipping students with the knowledge and skills necessary for impactful careers and contributions to cancer research.

Credits: 03 **Semester V** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	Types of Cancer, Prevalence and causes of cancer, Risk factors of cancer, Hallmarks of cancer,Cancer progression and metastasis. Oncogenes and Tumor suppressor genes, signaling pathways involved in cancer progression, Biomarkers used for diagnosis of cancer, Cancer antigens	18
II	Different therapeutics for cancer treatment, Chemotherapy, Immunotherapy, Nanoparticles in cancer treatment, Role of Artificial Intelligence and Machine learning in diagnosis and treatment of cancer.	18

Text Book:

1.Robin Hesketh, "Introduction to Cancer Biology" University of Cambridge Publishers, 2023

Reference Books:

1. Robert A Weinberg,The Biology of Cancer. WW Norton & Co. Publishers 2023.
2. Picorino L, Molecular Biology of Cancer, Oxford Publishing Group3rd Edition, 2023

FOCUS: This course focuses on Employability aligned with CO1, CO3, CO4 & CO6.

COURSE OUTCOMES: After completion of course, the student will be able to:

CO1- The necessary foundation for training in research.
CO2- Provide theoretical and practical knowledge related to Cancer Biology.
CO3- On completing Bachelor's degree, should be capable of reflecting on central, ethical and scientific problems related to cancer Biology.
CO4- Students will become familiar with fundamental concepts, working principles, and techniques in the field of synthesis and characterization of therapies for cancer.
CO5- Provide understanding of the strengths, limitations and potential uses of anticancer agents.
CO6- Students can identify and compare the different methods and perform a critical analysis of the biomarkers and techniques for cancer diagnosis.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO4, PO5, PO7, PO8/PSO1, PSO3
CO2	PO1, PO3, PO6, PO7, PO9, PO10/PSO2, PSO3
CO3	PO2, PO3, PO4, PO5, PO7, PO8, PO10/PSO1, PSO2
CO4	PO1, PO3, PO6, PO7, PO8, PO9/PSO2, PSO3
CO5	PO1, PO2, PO4, PO5, PO7, PO8, PO10/PSO1, PSO2
CO6	PO2, PO4, PO6, PO7, PO9, PO10/PSO2, PSO3

MEDICAL MICROBIOLOGY

OBJECTIVES:

The objective of the course is to familiarize students with aspects, scopes and applications of medical microbiology.

Credits: 02 **Semester V** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	Normal Microflora of human body: skin, mouth and gastro-intestinal tract. Bacterial diseases Diseases caused by certain bacterial pathogens: Staphylococcus aureus, Streptococcus pneumoniae, E. coli Viral diseases caused by certain viruses: Influenza virus, Herpes virus Parasitic disease caused by protozoa Giardia sp., Plasmodium sp., and Entamoeba sp.	18
II	Pathogenic fungal disease I: Dermatophytes- Trichophyton, Microsporum, Filamentous fungi causing subcutaneous infection by Aspergillus Pathogenic fungal disease II: Systemic mycoses caused by Blastomyces and Yeast like fungi: Candida. Antibiotics and Chemotherapeutics Historical development of chemotherapeutic and antibiotic substances, Major antimicrobial agents, Mode of action of chemotherapeutic and antibiotic substances.	18

Course Outcomes

Upon completion the students will learn:

- The historical development of medical microbiology
- The importance of microorganisms in life.
- The microorganisms associated with various infectious diseases.
- The treatment strategies followed for the infectious diseases.
- Antibiotics and chemotherapeutics.
- Mode of action of antibiotic substances.

Text Books:

- Microbiology, Authors- Pelczar, Chan and Kreig.
- Microbiology- an Introduction- (8th Edn), Authors- Tortora, G.J., Funke, B.R., Case, C.L.
- General Microbiology, Authors- Stainer, Ingharam, Wheelis and Painter

Reference Books:

1. Annadurai, A. A textbook of Immunology and Immunotechnology. S. Chnd
2. Anantha Narayanan R and Panicker C K. Textbook of Microbiology. Orient Longman.
3. Baveja, CP. Text book of Microbiology. Arya publications.
4. Ken S.Rosenthal, Patrick R.Murray, and Michael A.Pfaller. Medical Microbiology 7th Edition, Elsevier
5. Karen C.Carroll, Geo.Brooks, Stephen Morse, and Janet Butel.Jawetz, Melinck, &Adelberg's Medical Microbiology, Lang

BIOINFORMATICS AND BIOSTATICTICS LAB

OBJECTIVES:

The main objective of this course is to well verse the students with practical knowledge of medical Microbiology that they have taught in the theory and provide hands on training on practical techniques of medical microbiology related practical.

Credits: 02 **Semester V** **L–T–P: 0–0–4**

Module No.	Content	Teaching Hours
I	• An introduction to Computers, MS-Word, MS Excel, MS Power Point. 2 • Sequence information resource: Using NCBI, EMBL, Genbank, Entrez, Swissprot/ TrEMBL, UniProt. • Similarity searches using tools like BLAST and interpretation of results. • Multiple sequence alignment using ClustalW and interpretation of results. • Use of gene prediction methods (GRAIL, Genscan, Glimmer). • Use of various primer designing and restriction site prediction tools. • Use of different protein structure prediction databases (PDB, SCOP, CATH etc.). • Exercise to data entry, edit, copy, move etc. using MS EXCEL spreadsheet. • Computations analysis of biological data by Mean, Median, Mode, S.D., • Correlation, regression Analysis, Chi square test, Student test, ANOVA. • Designing of bar diagram, pi chart, histogram, scatter plots, in EXCEL for presentation of data. • Measure of skewness and kurtosis	36

Course Outcomes

Upon completion of the practical course in medical microbiology and immunology the students will learn about –

1. apply basic bioinformatics tools for the studies and research in other areas of their biotechnology and microbiology programs, such as finding
2. gene/protein homologs, designing primers, identifying mutations, etc.
3. understand and solve the problems in the area of animal and plant Biotechnology

FERMENTATION TECHNOLOGY LAB

OBJECTIVES: Learn the components of fermenter designing and use of fermentation technology in development of different fermented food products and applications in food science. Main aim of these experiments to make safe, high quality fermented food and beverages products that are profitable to all segments of society.

Credits: 01 **Semester V** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	• Mantling and dismantling of Bioreactor for study of its components. • To study the Growth kinetics in batch fermentation process. • Isolation of *Aspergillus niger* fungi and its characterization. • Anaerobic fermentation for wine production • Fermentation for the production of Citric acid • Fermentation for the production of antibiotics • Shake flask fermentation (Study of effect of agitation) • Solid state fermentation for production of enzymes.	20

FOCUS: This course focuses on Entrepreneurship, Skill development aligned with all CO1.

COURSE OUTCOMES: After completing this course, student will able:

CO1- To expertise in fermentation technology, handling of Bioreactor and production of fermented food and beverages so that students can get the job in food and beverages industries.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7, PO9/PSO1, PSO3

MEDICAL MICROBIOLOGY LAB

OBJECTIVES:

The main objective of this course is to well verse the students with practical knowledge of medical Microbiology that they have taught in the theory and provide hands on training on practical techniques of medical microbiology related practical.

Credits: 01 **Semester V** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	• Preparation of blood agar, chocolate agar, and other media required for medically important microorganisms. • Isolation and characterization of skin normal microflora • Isolation of bacteria from teeth crevices • Demonstration of α and β haemolysis on blood agar medium. • Demonstration of pathogenic fungi in mycoses lesion • Antibiotic sensitivity test and MIC determination	12

Course Outcomes

Upon completion of the practical course in medical microbiology and immunology the students will learn about -

• The preparation of culture media, microorganisms associated with human body, characterization of microorganisms associated with disease.

• Learning of the application of antibodies for diagnostic purposes, antibiotic sensitivity test and resistance transfer.

Six Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.		Industrial and Environmental Biotechnology	Core (Major 1)	4	0	0	4	4
		Food Biotechnology	Core (Major 1)	4	0	0	4	4
2.		Animal Cell Culture	Core (Major 2)	2	0	0	4	4
3.		Proteomics & Genomics	Core (Major 2)	2	0	0	2	2
		Clinical Biochemistry	Core (Major 2)	2	0	0	2	2
		Nanotechnology	SEC	3	0	0	3	3
		Analytic ability and digital awareness	VAC	1	0	0	1	1
PRACTICALS								
6.		Industrial and Environmental Biotechnology L:ab	Core (Major 1)	0	0	4	2	4
		Animal Cell Culture Lab	Core (Major 2)	0	0	2	1	2
		Proteomics & Genomics Lab	Core (Major 2)	0	0	2	1	2
		Clinical Biochemistry Lab	Core (Major 2)	0	0	2	1	2
TOTAL				16	00	8	20	24

INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY

OBJECTIVES: The objective of the course is to help students attain a basic proficiency, role and application of biotechnology in the area industrial processes and environmental management.

Credits: 04 **Semester VI** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction of Industrial microbiology and Bioprocess technology:** History-Introduction, scope and relation with other sciences. Screening for new metabolites: primary and secondary products, Strain development through selection, mutations and recombination, and other recent methods **Bioprocess technology:** Introduction to bioprocess technology, Design and working of a typical bioreactor, Range of bioprocess technology and its chronological development, Basic principle components of fermentation technology, Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture. **Production of alcohols, antibiotic and enzymes:** Production of alcohols (Ethanol) and organic acids (citric and acetic). Production of biologically active compounds: antibiotics (penicillin) and enzymes (amylase, protease). Production of microbial food and single cell proteins, Bioreactor for immobilized cells/enzyme system, Biosensors and their applications	18
II	**Environment and pollution:** Physico-chemical and biological characteristics of environment. Water, soil and air as a component of environment. Pollutants: Nature, origin, source, monitoring and their impacts. Air, Water and Noise pollution. Conventional fuels and their environmental impact **Bioremediation:** Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinates hydrocarbons and petroleum products. **Sewage treatment and biofertilizers:** Treatment of municipal waste and Industrial effluents. Bio-fertilizers: Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil, Algal and fungal biofertilizers (VAM) **Bioleaching and genetically modified organisms:** Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals.	24

TEXT BOOK:

- Biotechnology by Dubey, R.C

REFERENCE BOOKS:

- Frazier, W.S. and Weshoff, D.C., Food Microbiology by McGraw Hill Book Co., New York.
- Mann & Trusswell, Essentials of human nutrition by oxford university press.
- Jay, J.M., Modern Food Microbiology, CBS Publications, New Delhi.
- Lindsay, Applied Science Biotechnology. Challenges for the flavour and Food Industry, Willis Elsevier.
- Roger, A., Gordon, B. and John, T., Food Biotechnology.

FOCUS: This course focuses on Employability, Skill development aligned with CO3, CO5 & CO6

COURSE OUTCOMES: The main outcomes of this course are:

CO1: Understand the problems in isolation, strain improvement and growth of microorganisms in industrial processes. (Understand)
CO2: Understand the problems in isolation, strain improvement and growth of microorganisms in industrial processes.
CO3: Isolate and improve the industrially important microorganisms. (Understand and Apply)
CO4: Understand design and types of fermenters and operation of fermenters. (Understand and Analyze)
CO5: Learn fundamentals of Environmental Biotechnology. (Understand and Analyze)
CO6: Understand the importance of clean (pollution free) environment. (Understand and Analyze)
CO7: Understand biotechnological solutions to address environmental issues including pollution, mineral resource winning, renewable energy and water recycling. ***(Understand)***

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO6, PO7, PO8/PSO1, PSO2
CO2	PO1, PO3, PO4, PO6, PO7, PO8/PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PO5, PO7, PO8/PSO3
CO4	PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10/PSO1, PSO3
CO5	PO1, PO3, PO4, PO6, PO7, PO8, PO9, PO10/PSO1, PSO2
CO6	PO2, PO3, PO5, PO6, PO8, PO9, PO10/PSO1, PSO2, PSO3
CO7	PO1,PO3, PO4, PO5, PO6, PO7, PO8,PO10/PSO1, PSO2

FOOD BIOTECHNOLOGY

OBJECTIVES: The aim of this course is to learn the students about the-

- Role of food additives in food processing and preservation.
- Role of bacteria, yeast and mould in food processing and role of fermentation of food.
- Food borne diseases caused and food poisoning.

Credits: 04 **Semester - VI** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Food Biotechnology** Historical Background of Food technology,Traditional fermented foods (meat, fish, bread,sauerkraut, soy bean, coffee, cocoa, tea) Importance, global trends, codex guidelines, nutritional labelling in India, FSSAI guidelines ,Improvements through Biotechnology (e.g. Golden Rice, Potato, Flavr Savr Tomato etc.). **Enzymes in Food Industry** Common fermented foods - Cheese, Butter, Yoghurt,fermented/condensed milk and kefir.Alcoholic beverages (Beer, Wine, Whisky),Sauerkraut, Pickles, Soy products, Tea, coffee etc. **Food preservation:** **Growth of microorganisms in food:** Intrinsic and extrinsic factors. Food Spoilage (microbial and non-microbial) Control mechanisms of food spoilage: Physical and Chemical. Microbial spoilage of food and factors affecting them: Spoilage of various kinds of foods: fish. meat, poultry, sea foods, bread and dairy products).	18
II	Value addition products: Value addition products like High Fructose Syrup, Invert Sugars etc. SCPs (e.g. Spirulina, Yeast etc.) as food supplements, Edible fungus: Mushrooms. Potential of Probiotics. Flavour enhancers: Nucleosides, nucleotides and related compounds. Organic acids (Citric acid, Acetic acid) and their uses in foods/food products. Vitamins – B12 Microbial Cells as Food- Single Cell Protein, Mushroom Cultivation. **Vitamins and Minerals:** Importance of Vitamins and their supplementation in foods and feedstock. Food preservation and storage. Food Processing Important minerals and their function in body and deficiency conditions Requirements, allowances, enrichment, restorations, fortifications, losses of minerals, optimization and retention of minerals. **Food and water borne diseases:** Gastroenteritis, Diarrhoea, Shigellosis, Salmonellosis, Typhoid, Cholera, Polio, Hepatitis, Dental Infections, etc.Food borne intoxications: Staphylococcal, Bacillus, Clostridium etc.Detection of food-borne pathogens.	24

Text Books:

- Food Microbiology: Frazier, W. C. And Westhoff, D.C., Tata McGraw Hill Pvt. Co. Ltd.

Reference Books:

- Food Microbiology: James, J, CBS Publisher & Distributor, New Delhi. Comprehensive Dairy Microbiology: Yadav, J S., Grover, S. & Batish, V. K., S. Chand & Co., New Delhi
- Food Microbiology: ,Adams, M. R. And Moss, M. 0., New Age International (P) Ltd. Publishers, New Delhi.
- Soil Microorganisms & plant Growth: Subbarao, N. S., Oxford & IBH Publishing Co. Pvt. Ltd., New

COURSE OUTCOMES: After completion of this course student will be able to

CO1: Recognize and describe the characteristics of food biotechnology and traditional fermented foods. **(Remembering, Understand, Analyze)**
CO2: Understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods. **(Remembering, Understand)**
CO3: Know the spoilage mechanisms in foods and thus identify methods to control deterioration and spoilage. **(Remembering, Understand)**
CO4: Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation. **(Remembering, Understand, Analyze)**
CO5: Learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries. ***(*Understand, *Apply)***
CO6: Understand the beneficial role of microorganisms in fermented foods and in food processing and the microbiology of different types of fermented food products – dairy, pickles, Legume and cereal based food products. **(Remembering, Understand)**
CO7: Understand of the basis of food safety regulations and discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food. **(Remembering, Understand, Analyze)**
CO8: Acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems. **(Remembering, Understand, Analyze)**

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO4
CO2	PO1,PO2 PO3, PO4, PO5, PO6/ PSO2, PSO3, PSO4
CO3	PO3, PO4, PO6, PO7, PO8 /PSO1, PSO4
CO4	PO1, PO2, PO5, PO7, PO8 /PSO3, PSO4
CO5	PO2, PO4, PO5, PO7, PO8 /PSO2, PSO4
CO6	PO3, PO4, PO5, PO7, PO8 /PSO1, PSO4
CO7	PO1, PO3, PO5, PO6, PO8 /PSO1, PSO2
CO8	PO2, PO3, PO5, PO7, PO8 /PSO2, PSO4

ANIMAL CELL CULTURE

OBJECTIVES:

To understand the principles of animal cell culture, its maintenance and application in virology, medical field, tissue engineering and drug testing.

Credits: 02 **Semester VI** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Scope of animal tissue culture:** In virology, medical field, and tissue engineering **Natural media and artificially defined media:** composition, ingredients and their functions **Primary cell culture:** Enzymes used in disaggregation of tissues, Methods of disaggregation, enzymatic disaggregation & mechanical disaggregation, application in drug testing **Cell lines:** Sub culture and maintenance of cell lines	10
II	**Cryopreservation of cell lines**: Principle, method and applications of cryopreservation of cell lines **Large scale production of animal cells:** Principle and application of bioreactors for the production of large amount of animal cells. Batch, fed batch and continuous bioreactors, Air-lift fermenters, Fluidized & Fixed bed bioreactors, Hollow fiber and membrane perfusion systems, microcarriers, microencapsulation. **Monoclonal antibodies production by hybridoma technology:** Principle and procedure for monoclonal antibodies production, Diagnostic and therapeutic applications of monoclonal antibodies	10

Course Outcomes

After studying the course, the student will be able to:

CO1- Develop basic aseptic skills for mammalian cell culture and their applications.
CO2- Understand media constituents and media formulation strategies for animal cell culture
CO3- Can able to understand the process and applications of primary culture
CO4-. Develop proficiency in mammalian cell culture and the maintenance of cell lines
CO5-. Can apply the knowledge of cryopreservation and recovery techniques in stem cell banking industries
CO6-. Develop the concept for growing the animal cells in large scale with bioreactors and its utilization in vaccine production and production of other recombinant proteins
CO7-. Explain the concept of monoclonal antibody technology and its application in different fields

Text Books:

- Animal Tissue Culture by A. Wilson Aruni & P. Ramadass

Reference Books:

- Culture of Animal Cells by R.I Freshney
- Animal Cell Culture: Practical Approach by John R W Masters
- Principles of Animal Cell Culture by Basant Kumar Sinha& Rinesh Kumar, International Book Distributing Co.

PROTEOMICS AND GENOMICS

OBJECTIVES:

To understand the advances in the field of Genomics & Proteomics and their implication in life sciences research.

Credits: 02 **Semester VI** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Genomics:** Prokaryotic and Eukaryotic genome organization and packaging, Features of Plasmids, Mitochondria Genome and Chloroplast genome. **Genome Sequencing:** Types of sequencing Techniques (Generations), Human Genome sequencing, Shot Gun sequencing, Chromosome walking, Sequence tagged Site. **Functional Genomics:** Genome Annotation, DNA Microarray Technology, Metagenomics, Serial analysis of gene expression, RNA interference (RNAi), Quantitative trait loci (QTL).	12
II	**Introduction to Proteomics:** Chemical classification of amino acids, Protein structures (Primary, Secondary, Tertiary and Quaternary), Ramachandran Plot, Post Translation Modifications. **Proteome Characterization:** Separation of proteins using 2D Gel, Mass spectrometry, Types of Ionization, Types of Mass analyzers, MALDI-TOF, MS/MS, MS hybrid. **Functional Proteomics:** Protein Microarray Technology, Chromatin Immuneprecipitation Sequencing (ChIP), Yeast-Two Hybrid system.	12

Course Outcomes

After studying the course, the student will be able to:

CO1-Inferring the basic concepts of genomicsand proteomics.
CO2-Understanding the use of genomics and proteomics tools and techniques.
CO3-Suggesting and outlining solution to theoretical and experimental problems in Genomics and Proteomics fields.
CO4-Be able to classify the complexity of genome/ proteome structural and functional organization.
CO5-Formulate and assess experimental design for solving theoretical and experimental problems in Genomics and Proteomics fields.

Text Books:

- Dubey, R. C. (2014). Advanced biotechnology. S. Chand Publishing.
- Sing, B. D. (2007). Biotechnology Expanding Horizon.
- Griffiths, A. J. (2005). An introduction to genetic analysis. Macmillan.

Reference Books:

- Lesk, A. M. (2017). *Introduction to genomics*. Oxford University Press.
- Brown, T. A. (2023). Genomes 5.
- Campbell, A. M., & Heyer, L. J. (2003). *Discovering genomics, proteomics, and bioinformatics* (No. QH447 C35 2007). San Francisco, CA: Benjamin Cummings.
- Krane, D. E. (2002). Fundamental concepts of bioinformatics. Pearson Education India.
- Primrose, S. B., & Twyman, R. (2006). Principles of gene manipulation and genomics. John Wiley & Sons.
- Glick, B. R., Pasternak, J. J., & Patten, C. L. Molecular Biotechnology: Principals and Applications of Recombinant DNA. 4th.

CLINICAL BIOCHEMISTRY

OBJECTIVES:

To understand the basic fundamental concept of clinical biochemistry and application in disease diagnosis.

Credits: 02 **Semester VI** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Basic concepts of Clinical Biochemistry**: A Brief review of units and abbreviations used in expressing concentrations and standard solutions, specimen collection and processing (Blood, urine, feces), anticoagulant and preservatives for blood and urine samples, transport of specimens **Hematology:Blood-**Composition and functions of various components, Anemia: classifications, erythrocyte indices, Blood coagulation system, clotting time, bleeding time Prothrombin time, RBC count, WBC count, Platelet count, Differential count, Determination of Hb, PCV and ESR, Hemoglobinopathies, Thalassemia	10
II	**Disorders of Carbohydrate metabolism**: Regulation of blood sugar, Glycosuria-types of Glycosuria, Oral glucose tolerance test in normal and diabetic condition, Diabetes mellitus and Diabetic insipidus - hypoglycemia, hyperglycemia. Ketonuria, ketosis **Disorders of Lipid metabolism**: Cholesterol-Factors affecting blood cholesterol level, Dyslipoproteinemia, atherosclerosis risk factor and fatty liver, Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin **Liver function test:** Types, differential diagnosis, Liver function test - Icteric index, Vandenberg test, plasma protein changes. Renal function test: Clearance test–Urea, Creatinine Para- aminohippuric acid (PAH) test, Concentration and dilution test. Enzymology: Clinical significance of SGOT, SGPT, ALP, ACP, CPK and LDH	10

Course Outcomes

After studying the course, the student will be able to:

CO1-Develop an understanding of the inter relationships within and between anatomical and physiological systems of the human body.

CO2-Develop the understanding of basic concepts of clinical biochemistry

CO3-To understand disorder related with biomolecules metabolism.

CO4- Anticoagulant preservatives for blood and urine.

CO5- Metabolism of bilirubin, jaundice - types, differential diagnosis and Liver function.

Text Books:

- Text book of Biochemistry with clinical correlation, Thomas M. Devlin, 3rd edition, A. John Wiley-Liss Inc. Publication. 10. Practical Clinical B

Reference Books:

- Medical Biochemistry by MN Chatterjee, Rana Shinde, 8th edition, 2013, Jaypee publications.
- Textbook of Medical Laboratory Technology by Praful B. Godkar and Darshan P. Godkarth
- Practical Clinical Biochemistry, Harold Varley, 4th edition, CBS Publication and Distributors, New Delhi.

NANOTECHNOLOGY

COURSE OBJECTIVES:

- The mission of the Nanomaterials Program is to provide a multidisciplinary education in nanoscale science and technology. The primary goals are:
- Prepare students for a career in nanotechnology by providing them with a sound grounding in multidisciplinary areas of nanoscale science and engineering.
- Increase students' understanding of materials and their properties.

Credits: 03 **Semester VI** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	Types of nanomaterials, Synthesis and characterization of nanomaterials Electron microscopy (TEM, SEM, Cryo-SEM), Nanoscale visualization techniques 2: Scanning probe microscopy (AFM, STM), Diffraction techniques (XRD, synchrotron), Inorganic and organic nanomaterials. Polymer nanotechnology	18
II	Nanotechnology by self-assembly: Principles, thermodynamics, interactions, properties, Supramolecular selfassembly, Protein nanotechnology, DNA nanotechnology. Nanofluidics: nanopores and nanocapillaries. Applications in research. Nanomedicine and Nanotoxicology.	18

Text Book:

1. B.S. Murty, P. Shankar, Baldev Raj, B. B. Rath, James Murday, "Textbook of Nanoscience and Nanotechnology" Springer Publishers, 2013

Reference Books:

1. M. F. Ashby, P.J. Ferreira, D.L. Schodek,Nanomaterials Nanotechnologies and Design, Butterworth-Heinemann.
2. Dieter Vollath, Nanomaterials: An Introduction to Synthesis, Properties and Applications, Wiley- VCH.

FOCUS: This course focuses on Employability aligned with CO1, CO3, CO4 & CO6.

COURSE OUTCOMES: After completion of course, the student will be able to:

CO1- The necessary foundation for training in research.
CO2- Provide theoretical and practical knowledge related to modern nanotechnology.
CO3- On completing Bachelor's degree, should be capable of reflecting on central, ethical and scientific problems related to nanotechnology.
CO4- Students will become familiar with fundamental concepts, working principles, and techniques in the field of synthesis and characterization of nanomaterials.
CO5- Provide understanding of the strengths, limitations and potential uses of nanomaterials.
CO6- Students can identify and compare state-of-the-art nanofabrication methods and perform a critical analysis of the current available research tools.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO5, PO7, PO8/PSO1, PSO3
CO2	PO1, PO3, PO6, PO7, PO9, PO10/PSO2, PSO3
CO3	PO2, PO3, PO4, PO5, PO7, PO8, PO10/PSO1, PSO2
CO4	PO1, PO3, PO6, PO7, PO8, PO9/PSO2, PSO3
CO5	PO1, PO2, PO4, PO5, PO7, PO8, PO10/PSO1, PSO2
CO6	PO2, PO4, PO6, PO7, PO9, PO10/PSO2, PSO3

INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY LAB

OBJECTIVES: Students learn the practical applications of food science. It explores science application in food products development. Main aim of these experiments to make safe, high quality food products that is profitable to all segments of agriculture.

Credits: 02 **Semester VI** **L–T–P: 0–0–4**

S. No.	Name of Experiments
1.	Calculation of bacterial growth curve.
2.	Calculation thermal death point (TDP) of a microbial sample.
3.	Production and analysis of ethanol.
4.	Production and analysis of amylase
5.	Production and analysis of lactic acid.
6.	Isolation of industrially important microorganism from natural resource.
7.	Calculation of Total Solids (TS), Total Dissolved Solids (TDS) of water sample.
8.	Estimate the concentration of dissolved concentration of water sample.
9.	Calculation of BOD of water sample.
10.	Calculation of COD of water sample.
11.	Bacterial Examination of Water by MPN Method.

FOCUS: This course focuses on Employability, Skill development aligned with CO1

COURSE OUTCOMES: After completing the practical course, student will able to:

CO1: Understand various methods of screening of industrially important microorganisms from different sources.

CO2: Understand the working of small-scale fermenter and also determine the aeration efficiency of the fermenter

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO6, PO7, PO8/PSO1, PSO3

ANIMAL CELL CULTURE LAB

OBJECTIVES:

To develop skills of the students in the area of animal cell culture techniques and its application in drug testing and other purposes.

Credits: 01 **Semester VI** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	• Demonstration and working of laminar air flow, autoclave, Hot air oven, BOD incubator, CO2 incubator, water bath, Centrifuges and microscopes. • Washing and sterilization of glassware for *in vitro* animal cell culture • Washing and sterilization of filter assemblies • Preparation and sterilization of culture media and reagents. • Isolation of lymphocytes from blood by density gradient centrifugation. • Counting of viable cells by trypan blue dye with the help of hemocytometer. • Demonstration of primary cell culture. (spleen/ PBMC) • Feeding of cells growing in monolayer. • Subculture of monolayer/ suspension cultures • Splenocyte proliferation assay by MTT dye method • Cryopreservation of cultured cells.	20

Course Outcomes

After studying the course, the student will be able:

CO1- To learn the sterilization and preparation of reagents required for cell culture.

CO2- To learn aseptic handling of tissues as well as various animal tissue culture methods.

Reference Books:

- Culture of Animal Cells by R.I Freshney
- Animal Cell Culture: Practical Approach by John R W Masters

PROTEOMICS AND GENOMICS LAB

OBJECTIVES:

To understand the experiments in the field of Genomics & Proteomics and their application in life sciences research.

Credits: 01 **Semester VI** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	Analysis of nucleotide sequence similarity and phylogenetic tree construction using BLASTn and BLAST Tree View. Analysis of protein sequence similarity and phylogenetic tree construction using BLASTp and BLAST Tree View. Restriction mapping and generation of restriction map of pBR322 using NEB Cutter (v3.0). Primer design using Primer-BLAST. Prediction of protein secondary structure using SOPMA.	12
II	Multiple sequence alignment and phylogenetic tree construction using MEGA X. Exploration of the UCSC Genome Browser and its genomic features. Application of UCSC Genome Browser tools including BLAST and In Silico PCR. Protein structure validation through Ramachandran plot analysis. Literature search and retrieval of scientific information using PubMed for genomics and proteomics research.	12

Course Outcomes

After studying the course, the student will be able to:

CO1-Inferring the basic concepts of BLASTn and BLASTp.
CO2-Understanding the use of genomics and proteomics tools and techniques.
CO3-Suggesting and outlining solution to experimental problems in Genomics and Proteomics fields.
CO4-Be able to perform Restriction mapping and construct restriction map.
CO5-Formulate and assess experimental design for experimental problems in Genomics and Proteomics fields.

Text Books:

- Rakeeb Ahmad Mir, Sheikh Mansoor Shafi, Sajad Majeed Zargar. (2023). Principles of Genomics and Proteomics: A Technical Guide. Elsevier (https://www.amazon.in/Principles-Genomics-Proteomics-Technical-Guide/dp/0323990452)
- Richard Simpson.(2003). Proteins and Proteomics: A Laboratory Manual. Cold Spring Harbor Laboratory Press,U.S.; Lab Manual edition
- Dubey, R. C. (2014). Advanced biotechnology. S. Chand Publishing.
- Sing, B. D. (2007). Biotechnology Expanding Horizon.

Reference Books:

- Ye, S. Q. (Ed.). (2007). Bioinformatics: a practical approach. CRC Press.
- Krawetz, S. A., & Womble, D. D. (Eds.). (2003). Introduction to bioinformatics: a theoretical and practical approach. Springer Science & Business Media.
- Campbell, A. M., & Heyer, L. J. (2003). *Discovering genomics, proteomics, and bioinformatics* (No. QH447 C35 2007). San Francisco, CA: Benjamin Cummings.
- Krane, D. E. (2002). Fundamental concepts of bioinformatics. Pearson Education India.
- Primrose, S. B., & Twyman, R. (2006). Principles of gene manipulation and genomics. John Wiley & Sons.
- Glick, B. R., Pasternak, J. J., & Patten, C. L. Molecular Biotechnology: Principals and Applications of Recombinant DNA.

CLINICAL BIOCHEMISTRY LAB

OBJECTIVES:

The main objective of this course is to well verse the students with practical knowledge of Clinical Biochemistry that they have taught in the theory and provide hands on training on practical techniques of Clinical biochemistry lab.

Credits: 01 **Semester VI** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	• Qualitative and quantitative analysis of urine: proteins, Bence-Jones proteins, Cl- , Ca+2 • Qualitative analysis of abnormal constituents in urine - glucose, albumin, bile pigments,bile salts and ketone bodies. • Experiments on blood (a) Estimation of haemoglobin by cyanmethemoglobin method (b) Determination of A/G ratio in serum • Isolation and estimation of serum cholesterol • Serum enzyme assays: alkaline phosphatase, SGOT, SGPT • Estimation of haemoglobin using Sahli's haemoglobinometer • Recording of blood pressure using a sphygmomanometer • Recording of blood glucose level by using glucometer • Ninhydrin test for Ñ-amino acids. • Test for sugar and acetone in urine.	40

Course Outcomes

Upon completion of this course students will able to-

- Learn qualitative and quantitative analysis of constituents of biological fluids such as urine, blood and their estimation using standard methods.
- Students will able to perform basic hematological laboratory testing