DAV UNIVERSITY JALANDHAR

SCHEME FOR

Bachelor of Science (Hons.) Biotechnology

(Program ID-3)

1st TO 6th SEMESTER

Examinations 2021–2022 Session Onwards

Applicable For Admissions in 2021 Onwards

Programme Name: B.Sc. (Hons.) Biotechnology

Programme Mission:

The curriculum of B.Sc. (Hons.) Biotechnology is focused on correlation of concepts with the scientific happenings for deep rooted concept building to harness the research potential in the upcoming streams of Biotechnology.

Programme Learning Outcomes:

1. Graduates will gain and apply knowledge of Basic Sciences and Biotechnology concepts to identify, analyze and understand problems and find valid conclusions related to field of Biotechnology while keeping in mind safety factor for environment and society.
2. Graduates will be able to decide and apply appropriate tools and techniques in biotechnological manipulation.
3. Graduates will be able to justify societal, health, safety and legal/ethical issues and understand his/her responsibilities in biotechnological practices and product/technique development.
4. Graduates will be able to understand the need and impact of biotechnological solutions on environment and societal context keeping in view need for sustainable solution.
5. Graduates will be able to demonstrate knowledge of scientific project management and undertake responsibility as an individual and as a team in a multidisciplinary environment.

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Scheme of Courses: B.Sc. (Hons.) Biotechnology

Session: 2021-2022 onwards

Semester I

S. No.	Paper Code	Course Type	Course Title	L	T	P	Credits
1	MBB101	Core	Biomolecules	4	0	0	4
2	MBB102	Core	Biomolecules Laboratory	0	0	3	2
3	BTY231A	Core	Basic Genetics	4	0	0	4
4	BTY232A	Core	Basic Genetics Laboratory	0	0	3	2
5	ENG151B	AECC1*	Basic Communication Skills	3	0	0	3
6	ENG152A	AECC1*	Basic Communication Skills Laboratory	0	0	2	1
7	Generic Elective I						4
8	Generic Elective I Laboratory						2
Total							22
L: Lectures T: Tutorial P: Practical Cr: Credits **Ability Enhancement Compulsory Course*							
List of Generic Electives							
1	BOT131	Generic Elective	Plant Diversity	4	0	0	4
2	BOT132	Generic Elective	Plant Diversity Laboratory	0	0	3	2
3	MBB216	Generic Elective	Membrane Biology and Bioenergetics	4	0	0	4
4	MBB217	Generic Elective	Membrane Biology and Bioenergetics Laboratory	0	0	3	2

Semester II

S. No.	Paper Code	Course Type	Course Title	L	T	P	Credits
1	BTY123	Core	Fundamentals of Cell Biology	4	0	0	4
2	BTY124	Core	Fundamentals of Cell Biology Laboratory	0	0	3	2
3	CHE157	Core	General Chemistry-1	4	0	0	4
4	CHE158	Core	General Chemistry-1 Laboratory	0	0	3	2
5	EVS100	AECC 2*	Environmental Studies	4	0	0	4
6	SGS107	AECC 3*	Human Values and General Studies	4	0	0	4
7	Generic Elective II						4
8	Generic Elective II Laboratory						2
Total							26
L: Lectures T: Tutorial P: Practical Cr: Credits ******Ability Enhancement Compulsory Course*							
List of Generic Electives							
1	MIC333A	Generic Elective	Basics of Immunology	4	0	0	4
2	MIC334A	Generic Elective	Basics of Immunology Laboratory	0	0	3	2
3	MIC113	Generic Elective	Bacteriology	4	0	0	4
4	MIC114	Generic Elective	Bacteriology Laboratory	0	0	3	2

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Semester III

S. No.	Paper Code	Course Type	Course Title	L	T	P	Credits
1	MIC111B	Core	Introductory Microbiology	4	0	0	4
2	MIC112B	Core	Introductory Microbiology Laboratory	0	0	3	2
3	BOT241	Core	Plant Physiology & Metabolism	4	0	0	4
4	BOT242	Core	Plant Physiology & Metabolism Laboratory	0	0	3	2
5	BTY361	Core	Bioanalytical Tools	4	0	0	4
6	BTY362	Core	Bioanalytical Tools Laboratory	0	0	3	2
7	BTY381A	SEC*	Fundamentals of Nanobiotechnology	2	0	0	2
8	CEC101	AECC	Community Engagement Course	1	0	1	2
9	Generic Elective III						4
10	Generic Elective III Laboratory						2
Total							28
L: Lectures T: Tutorial P: Practical Cr: Credits **Skill Enhancement Course*							
List of Generic Electives							
1	ZOO101	Generic Elective	Animal Diversity-I	4	0	0	4
2	ZOO102	Generic Elective	Animal Diversity-I Laboratory	0	0	3	2
3	ZOO321	Generic Elective	Fundamentals of Developmental Biology	4	0	0	4
4	ZOO322	Generic Elective	Fundamentals of Developmental Biology	0	0	3	2

			Laboratory				
5	MIC221	Generic Elective	Microbial Physiology	4	0	0	4
6	MIC222	Generic Elective	Microbial Physiology Laboratory	0	0	3	2
List of Skill Enhancement Courses							
1	BTY382	SEC	Molecular Diagnostics	2	0	0	2
2	BTY381A	SEC	Fundamentals of Nanobiotechnology	2	0	0	2
3	BTY399	SEC	Medical Microbiology	4	0	0	4

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Semester IV

S. No.	Paper Code	Course Type	Course Title	L	T	P	Credits
1	BTY241A	Core	Fundamentals of Molecular Biology	4	0	0	4
2	BTY242A	Core	Fundamentals of Molecular Biology Laboratory	0	0	3	2
3	BTY111A	Core	Fundamentals of Plant Biotechnology	4	0	0	4
4	BTY112A	Core	Fundamentals of Plant Biotechnology Laboratory	0	0	3	2
5	CHE257	Core	General Chemistry –II	4	0	0	4
6	CHE258	Core	General Chemistry –II Laboratory	0	0	3	2
7	BTY382	SEC*	Molecular Diagnostics	2	0	0	2
8	Generic Elective IV						4
9	Generic Elective IV Laboratory						2
Total							26
L: Lectures T: Tutorial P: Practical Cr: Credits **Skill Enhancement Course*							
List of Generic Electives							
1	ZOO103	Generic Elective	Animal Diversity-II	4	0	0	4
2	ZOO104	Generic Elective	Animal Diversity-II Laboratory	0	0	3	2
3	MIC225	Generic Elective	Microbial Genetics	4	0	0	4
4	MIC226	Generic Elective	Microbial Genetics Laboratory	0	0	3	2
5	MBB218	Generic Elective	Proteins and Enzymes	4	0	0	4
6	MBB219	Generic Elective	Proteins and Enzymes Laboratory	0	0	3	2
List of Skill Enhancement Courses							
1	BTY382	SEC	Molecular Diagnostics	2	0	0	2

2	BTY381A	SEC	Fundamentals of Nanobiotechnology	2	0	0	2
3	BTY399	SEC	Medical Microbiology	4	0	0	4

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Semester V

S. No.	Paper Code	Course Type	Course Title	L	T	P	Credits
1	BTY351	Core	Bioprocess Technology	4	0	0	4
2	BTY352	Core	Bioprocess Technology Laboratory	0	0	3	2
3	BTY353A	Core	Introduction to Genetic Engineering	4	0	0	4
4	BTY354A	Core	Introduction to Genetic Engineering Laboratory	0	0	3	2
5	Discipline Specific Elective I						4
6	Discipline Specific Elective I Laboratory						2
7	Discipline Specific Elective II						4
8	Discipline Specific Elective II Laboratory						2
Total							24
L: Lectures T: Tutorial P: Practical Cr: Credits							
List of Discipline Specific Electives (DSE) For Semester V							
1	BTY243	DSE	Biotechnology and Human Welfare	4	0	0	4
2	BTY244	DSE	Biotechnology and Human Welfare Laboratory	0	0	3	2
3	BTY399	DSE	Medical Microbiology	4	0	0	4
4	BTY400	DSE	Medical Microbiology Laboratory	0	0	3	2
5	BTY395	DSE	Biostatistics and Bioinformatics	4	0	0	4
6	BTY396	DSE	Biostatistics and Bioinformatics Laboratory	0	0	3	2
7	BTY397A	DSE	Introduction to Food Biotechnology	4	0	0	4
8	BTY398A	DSE	Introduction to Food Biotechnology Laboratory	0	0	3	2

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Semester VI

S. No.	Paper Code	Course Type	Course Title	L	T	P	Credits
1	BTY391A	Core	Basics of Animal Biotechnology	4	0	0	4
2	BTY392A	Core	Basics of Animal Biotechnology Laboratory	0	0	3	2
3	BTY363	Core	Genomics and Proteomics	4	0	0	4
4	BTY364	Core	Genomics and Proteomics Laboratory	0	0	3	2
5	Discipline Specific Elective III						4
6	Discipline Specific Elective III Laboratory						2
7	Discipline Specific Elective IV						4
8	Discipline Specific Elective IV Laboratory						2
Total							24
L: Lectures T: Tutorial P: Practical Cr: Credits							
List of Discipline Specific Electives (DSE) For Semester VI							
1	BTY393A	DSE	Basic Virology	4	0	0	4
2	BTY394A	DSE	Basic Virology Laboratory	0	0	3	2
3	BTY383A	DSE	Introduction to Enzymology	4	0	0	4
4	BTY384A	DSE	Introduction to Enzymology Laboratory	0	0	3	2
5	BTY385A	DSE	Fundamentals of Environmental Biotechnology	4	0	0	4
6	BTY386A	DSE	Fundamentals of Environmental Biotechnology Laboratory	0	0	3	2
7	BTY387	DSE	Herbals and Nutraceuticals	4	0	0	4
8	BTY388	DSE	Herbals and Nutraceuticals Laboratory	0	0	3	2
9	BTY371A	DSE	Basic Immunology	4	0	0	4
10	BTY372A	DSE	Basic Immunology Laboratory	0	0	3	2

Course Name: Biomolecules

Course Code: MBB101

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The course aims to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis. The students will be able to acquire a specialized knowledge and understanding of selected aspects of biochemistry by means of lectures and a well-planned experimental series.

Course Contents:

Unit I **No. of Hours: 15**

Introduction to Biochemistry: Water as a biological solvent. Weak acids and bases. pH and buffers. Henderson-Hasselbalch equation. Physiological buffers. Fitness of the aqueous environment for living organisms.

Carbohydrates Structure of monosaccharides: Stereoisomerism and optical isomerism of sugars. Reactions of aldehyde and ketone groups. Ring structure and anomeric forms, mutarotation. Reactions of sugars due to hydroxyl groups. Important derivatives of monosaccharides, disaccharides and trisaccharides (structure, function and occurrence of important ones). Structure, occurrence and biological importance of monosaccharides, oligosaccharides and polysaccharides - cellulose, chitin, agar, algenic acids, pectins, proteoglycans, sialic acids, blood group polysaccharides, glycogen and starch. Bacterial cell wall polysaccharides. Glycoproteins.

Unit II **No. of Hours: 15**

Proteins: Introduction to proteins. Classification based on solubility, shape, composition and functions. Amino acids: common structural features, stereoisomerism and RS system of designating optical isomers. Classification and structures of standard amino acids as zwitterion in aqueous solutions. Physical and chemical properties of amino acids. Titration of amino acids. Separation of amino acids. Essential amino acids.

Structure of peptide bond. Solid-phase synthesis of peptides. Peptide sequencing. Chemical and enzymatic cleavage of polypeptide chains and separation of peptides.

Levels of structure in protein architecture, denaturation and renaturation of proteins. Behaviour of proteins in solutions. Salting in and salting out of proteins. Structure and biological functions of fibrous proteins (keratins, collagen and elastin), globular proteins (haemoglobin, myoglobin), lipoproteins, metalloproteins, glycoproteins and nucleoproteins.

Unit III **No. of Hours: 15**

Nucleic Acids

Nature of genetic material. Evidence that DNA is the genetic material. Composition of DNA and RNA. Generalized structural plan and Nomenclature of nucleic acids. DNA double helix. Structure and roles of different types of RNA. Size of DNA in prokaryotes and eukaryotes. Central dogma of molecular biology. Concepts of gene, genome and chromosome.

Porphyrins: Porphyrin nucleus and classification of porphyrins. Important metalloporphyrins occurring in nature. Detection of porphyrins. Bile pigments – chemical nature and physiological significance.

Unit IV **No. of Hours: 15**

Lipids

Definition and classification of lipids. Fatty acids: introduction, classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids, prostaglandins. Triacylglycerols: nomenclature, physical properties, chemical properties and characterization of fats – hydrolysis, saponification value, rancidity of fats, Reichert-Meissel Number and reaction of glycerol. Biological significance of fats. Glycerophospholipids (lecithins, lysolecithins, cephalins, phosphatidylserine, phosphatidylinositol, plasmalogens), sphingomyelins, glycolipids – cerebrosides, gangliosides. Properties and functions of phospholipids, isoprenoids and sterols.

Learning Outcomes:

The course will be able to demonstrate an understanding of fundamental biochemical principles, such as the structure and function of biomolecules, metabolic pathways and their regulation. The students will gain proficiency in basic laboratory techniques and will be able to apply and effectively communicate scientific reasoning and data analysis in both written and oral forms.

Text Books:

1. Fromm, Herbert J., Hargrove, Mark., Essentials of Biochemistry, Springer-Verlag Berlin Heidelberg, Switzerland, 2012. Print.
2. Singh, SP., Textbook of Biochemistry, 6th Edition, CBS Publishers, India, 2015. Print.

Reference Books:

1. Nelson, David L., and Cox, Michael M., Lehninger Principles of Biochemistry, 5th Edition, W.H. Freeman & Company, New York, 2008. Print.
2. Voet, Donald and Voet, Judith G., Biochemistry, 3rd Edition, John Wiley & Sons Inc., Singapore, 2004. Print.
3. Murray, R.K., Granner, D.K. and Rodwell, V.W. Harper's Illustrated Biochemistry, 27th Edition, McGraw Hill Company Inc. Singapore, 2006. Print.

Course Name: Biomolecules Laboratory

Course Code: MBB102

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Preparation of normal, molar and percent solutions.
2. Titration curve of Glycine.
3. Buffer preparation.
4. Qualitative tests for Carbohydrates, Lipids, Amino acids, Proteins, Nucleic acids
5. Preparation of casein from milk and determination of its isoelectric point.
6. Titrimetric analysis of Vitamin C.

Course Name: Basic Genetics

Course Code: BTY231A

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

This course is aimed at understanding the basic concepts of genetics at molecular level to develop analytical and quantitative skills from classical to molecular genetics.

Course Contents:

Unit I **No. of Hours: 10**

The chromosome theory of heredity, sex chromosomes, sex linkage, the parallel behavior of autosomal genes and chromosomes.

Unit II **No. of Hours: 20**

Mendelian laws of inheritance, monohybrid cross and the law of segregation, dihybrid cross and law of independent assortment, chromosome theory of inheritance, multiple allele, lethal allele, blood group, Rh factor, gene interactions, modified dihybrid ratio. Basic eukaryotic chromosome mapping, the discovery of linkage, recombination linkage symbolism, linkage of genes on x chromosomes, linkage maps, three point testcross, interference, calculating recombinant frequencies from selfed dihybrids, examples of linkage maps, the X2 test mitotic segregation in humans.

Unit III **No. of Hours: 20**

The concept of promoter, coding sequence, terminator, induction of gene for expression. Structural organization of chromatids, centromeres, telomeres, chromatin, nucleosome organization; euchromatin and heterochromatin; special chromosomes (e.g., polytene and lamp brush chromosomes), banding patterns in human chromosomes. Structural and numerical aberrations involving chromosomes; hereditary defects - Kleinefelter, Turner, Cri-du-Chat and Down syndromes. Mutations - spontaneous and induced, chemical and physical mutagens.

Unit IV **No. of Hours: 12**

Extra-chromosomal inheritance and molecular genetics: coiling of shell in snails, mitochondrial and chloroplast genetic systems, population genetics: Hardy-Weinberg equilibrium, gene and genotypic frequencies.

Learning Outcomes:

The student will understand the fundamental molecular principles of genetics, the structure and function of biological molecule DNA, RNA and protein. The students will be well versed with genes code for proteins, relationship between phenotype and genotype in human genetic traits, concept of genetic mapping and gene expression regulation.

Text Books:

1. Aggarwal, V.K. and Verma, V.S. Genetics. 9th Edition. S. Chand, India. 2010. ISBN: 9788121931144
2. Strickberger, M.W. Genetics. 3rd Edition. Prentice-Hall, India. 2008. ISBN: 9789332555105
3. Ridley, M. Nature via Nurture: Genes, Experience, & What Makes Us Human. HarperCollins Publishers. 2004. ISBN: 9781841157467

Reference Books:

1. Rajeev K. Varshney, Manish K. Pandey, Annapurna Chitikineni. Plant Genetics and Molecular Biology. 2018. Springer Publishers. ISBN: 978-3-319-91312-4
2. Klug, .S., Cummings, M.R. Essentials of Genetics. 9th edition. Pearson Publishers. 2015. ISBN: 978-0134047799
3. Jones, S. The Language of the Genes. Harper Collins Publishers. 2012. ISBN: 9780006552437
4. Snustad, D.P. and Simmons, M.J. Principles of Genetics. 6th Edition. John Wiley & Sons. 2011. ISBN: 9780470903599
5. Pierce, B.A. Genetics: A Conceptual Approach. 4th Edition. W.H. Freeman & Company, 2010. ISBN: 9781429232524

Course Name: Basic Genetics Laboratory

Course Code: BTY232A

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. To make squash preparations of pre-treated metaphase chromosomes, and PMCs to view diplotene, diakinesis, metaphase I and anaphase I in *Allium cepa*
2. Preparation of karyograms from the given photographs for karyotypic formula
3. To study through photographs normal and deviant cytogenetic mechanisms.
4. Study of Mendel's laws and deviations from Mendelian ratios using seed samples in the ratios of 9:7, 9:4:3, 13:3, 15:1, 12:3:1. Use Chi-Square Test for Testing the ratios
5. Isolation of chloroplasts by sucrose gradient. Photographs of restriction site variation of chloroplast DNA
6. Exercises w.r.t. determination of correct sequence and distance between the linked genes
7. Induction and recovery of mutants in bacteria by UV irradiation
8. Segregation demonstration in preserved material (Maize)
9. Detection of Blood groups (A B O & Rh factors)
10. Inheritance of other human characteristics, ability to test PTC, Thiourea
11. Paternity disputes (blood groups)

Course Name: Basic Communication Skills

Course Code: ENG151B

Credits Components: Theory, Tutorial

Total Credits			
L	T	P	Credits
3	1	0	3

Course Objective:

The course will enhance students' vocabulary and comprehension skills through the prescribed texts. The reading and writing skill of student will be improved. The course content focusses on teaching the English grammar descriptively and to make students aware with the socio-cultural aspects of English.

Course Contents:

Unit I **No. of Hours: 10**

Applied Grammar (in Socio-Cultural Context)

Tenses, Passives, Reported/Reporting Speech

Unit II **No. of Hours: 13**

Reading (Communicative Approach to be Followed)

Nissim Ezekiel : The Patriot (Poem), Sub-topic: Basic Introduction to Indianisms and Difference between Indian English & Standard English, Writing, Paragraph Writing : Topic Sentence, Inductive logic, and Deductive logic, Essays: Narrative, Descriptive, Expository, and Persuasive, Notice: Format, Characteristics, and 5 W's, Email: Structure, Characteristics of Effective Emails, and Advantages

Unit III **No. of Hours: 12**

Applied Grammar (in Socio-Cultural Context)

Parts of Speech: Noun, Pronoun, Adjective, Verb, Adverb, Preposition, Conjunction, and Interjection, Modals: Can, Could, May, Might, Will, Would, Shall, Should, and Must

Unit IV **No. of Hours: 10**

Reading (Communicative Approach to be Followed)

Alleen Pace Nilsen: Sexism in English (Prose), Sub-topic: Relationship between Society & Language and Sexist Language, Writing, Letter Writing: Formal and Informal

Teaching Methodology:

a. **Grammar:** Grammar must be taught descriptively in socio-cultural context. The contextual teaching of grammar helps a learner understand the application of grammar rules in real life situations. The learner who learns grammar in isolation

is unable to use the language fluently, whereas the learner who learns grammar in context uses the language confidently and fluently in real life situations.

b. **Literary Texts:** Communicative approach should be followed to teach the texts. Classroom activities guided by the communicative approach are characterised by trying to produce meaningful and real communication, at all levels. As a result there may be more emphasis on skills than systems, lessons are more learner-centred, and there may be use of authentic materials.

   Teachers can introduce the topic or theme of the text, pre-teach essential vocabulary items and use prediction tasks to arouse the interest and curiosity of students.

c. **Writing:** Some of the strategies that should be adopted are as follows:
   - Regularly assign brief writing exercises in your classes.
   - Provide guidance throughout the writing process, i.e. Pre-Writing, Drafting, Revising, Editing, and Publishing.
   - Give students opportunities to talk about their writing.
   - Encourage students to revise their work.

Learning Outcomes:

Students will have developed a wide vocabulary and be able to summarize ideas. They will be able to read and analyze texts and display competence in written communication. A considerable understanding of English Grammar and sensitivity to cultural differences while communicating will be induced in the students.

Text Books:

1. Eschholz, Paul and Rosa, Alfred (ed.), *Subject and Strategy*. NY: St. Martin's Press, 1978. Print.
2. Ezekiel, Nissim. *Collected Poems 1952-1988*. New Delhi: Oxford University Press, 1999. Print.
3. Hosler, Mary Margaret. *English Made Easy*. Delhi: McGraw, 2013. Print.
4. Koneru, Aruna. *Professional Communication*. Delhi: McGraw, 2008. Print.

Reference Books:

1. Mahanand, Anand. *English for Academic and Professional Skills*. Delhi: McGraw,

2013. Print.

2. Rani, D Sudha, TVS Reddy, D Ravi, and AS Jyotsna. *A Workbook on English Grammar and Composition*. Delhi: McGraw, 2016. Print.
3. Rizvi, M. Ashraf. *Effective Technical Communication*. Delhi: McGraw, 2018. Print.
4. Sharma, R.C. and Krishna Mohan. *Business Correspondence and Report Writing*. Delhi: McGraw, 2013. Print.
5. Tyagi, Kavita and Padma Misra. *Basic Technical Communication*. Delhi: PHI Learning, 2013. Print.

Websites:

1. www.youtube.com (to watch standard videos)
2. http://learnenglish.britishcouncil.org/en
3. https://owl.english.purdue.edu/

Course Name: Basic Communication Skills Laboratory

Course Code: ENG 152A

Total Credits			
L	T	P	Credits
0	0	2	1

Course Objective:

To improve the preparation and presentation competencies necessary for oral communication in a variety of contexts, as both a speaker and a listener, to improve pronunciation, to promote interactive skills through Group Discussions and role plays.

Experiments:

Speaking and Listening

1. IPA for Language Learning - Basic Phonetics
2. Movie-Clippings
3. Role Plays
4. Group Discussions
5. Mock Interviews

Project File:

Each student will prepare a project file on any of the topics given by class teacher. Student should be able to justify the contents of his/her scrap file. The file must be handwritten, not typed. Students must acknowledge all the sources of information in his/her scrap file.

Examination:

The End Term Lab. Examination will be conducted as per the norms of the university. The distribution of marks in the end-term lab. examination is as follows:

Component	**Weightage**
Project File	**30 %**
Marks will be given for originality, creativity and presentation. Student will receive credit for his/her command of the language also.	
Lab. Activity	**30%**
It may include dialogue writing (Dialogue to Prose and Prose to Dialogue), writing about a picture/some object, writing a report, writing on a topic of general interest, listening exercise, English phonetic exercise, etc. It will be decided by examiner on the spot.	
Viva Voce	**40%**

Questions will be based on the project file. Examiner may ask other non-technical questions related to student's life and interests.

Total	**100%**

For the final result, marks will be calculated as per the criterion laid down by the university:

Component	**Weightage**
Marks Obtained in the labexamination	**80%**
Continuous Assessment (Based on Student's Regularity & Class Performance)	**20%**
Total	**100%**

Learning Outcomes:

Students will be able to develop proper listening skills, articulate and enunciate words and sentences clearly and efficiently, show confidence and clarity in public speaking projects

Course Name: Plant Diversity

Course Code: BOT131

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The student will demonstrate knowledge of plant taxa starting with bryophytes and finishing with gymnosperms including their morphology and physiology. The student will demonstrate knowledge of similarities and differences between vascular and non-vascular plants. The student will demonstrate knowledge of plant growth, reproduction, and responses. The student will demonstrate knowledge of the processes of photosynthesis and cellular respiration. The student will demonstrate knowledge of organisms in the Protista, Fungi, Monera, and Archaea Kingdoms as well as Viruses.

Course Contents:

Unit I **No. of Hours: 15**

Viruses: Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

Unit II **No. of Hours: 15**

Algae: General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Fucus, Polysiphonia. Economic importance of algae.

Fungi: Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi-General characteristics, ecology and significance, life cycle of Rhizopus (Zygomycota) Penicillium, Alternaria (Ascomycota), Puccinia, Agaricus (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

Unit III **No. of Hours: 15**

Introduction to Archegoniate: Unifying features of archegoniates, Transition to land habit, Alternation of generations.

Bryophytes: General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of Marchantia and Funaria. Ecology and economic importance of bryophytes with special mention of Sphagnum.

Unit IV **No. of Hours: 15**

Pteridophytes: General characteristics, classification, Early land plants (Cooksonia and Rhynia). Classification (up to family), morphology, anatomy and reproduction of Selaginella, Equisetum and Pteris. Heterospory and seed habit, stellar evolution.Ecological and economical importance of Pteridophytes.

Gymnosperms: General characteristics; Classification (up to family), morphology, anatomy and reproduction of Cycas and Pinus. Ecological and economical importance.

Learning Outcomes:

Gain adequate knowledge on comparative account of various algal divisions Study and impart knowledge about the occurrence, distribution, structure and life history of lower plants such as algae, fungi, lichens, bryophytes, pteridophytes and gymnosperms Learn the phylogeny and evolutionary concepts in lower group of organisms Know about role of fossil in oil exploration and coal excavation, study of paleopalynology.

Text Books:

1. Kumar, H.D. *Introductory Phycology*. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition. 1999.
2. Tortora, G.J., Funke, B.R., Case, C.L. *Microbiology: An Introduction*, Pearson Benjamin Cummings, U.S.A. 10th edition. 2010.
3. Sethi, I.K. and Walia, S.K. *Text book of Fungi & Their Allies*, MacMillan Publishers Pvt. Ltd., Delhi. 2011.
4. Parihar, N.S. *An introduction to Embryophyta*. *Vol. I. Bryophyta*. Central Book Depot, Allahabad. 1991.

Reference Books:

1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. *Introductory Mycology*, John Wiley and Sons Asia), Singapore. 4th edition. 1996.
2. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S. R., *Biology*. Tata McGraw Hill, Delhi, India. 2005.
3. Vashishta, P.C., Sinha, A.K., Kumar, A. *Pteridophyta*, S. Chand. Delhi, India. 2010.
4. Bhatnagar, S.P. and Moitra, A. Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India. 1996

Course Name: Plant Diversity Laboratory

Course Code: BOT132

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining
4. Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas* (electron micrographs), *Oedogonium*, *Vaucheria*, *Fucus** and *Polysiphonia* through temporary preparations and permanent slides. (* Fucus - Specimen and permanent slides)
5. Rhizopus and Penicillium: Asexual stage from temporary mounts and sexual structures through permanent slides.
6. Alternaria: Specimens/photographs and tease mounts.
7. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
8. Agaricus: Specimens of button stage and full grown mushroom; Sectioning of gills of Agaricus.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
10. Mycorrhiza: ectomycorrhiza and endomycorrhiza (Photographs)
11. Marchantia- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
12. Funaria- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
13. Selaginella- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m.microsporophyll and megasporophyll (temporary slides), l.s. strobilus

(permanent slide).

14. Equisetum- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore,w.m. spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).
15. Pteris- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
16. Cycas- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
17. Pinus- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m.dwarf shoot, t.s. needle, t.s. stem, l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. &r.l.s. stem (permanent slide).

Course Name: Membrane Biology and Bioenergetics

Course Code: MBB216

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The aim of course is to deepen student's knowledge on structure, function and pathology of biological membranes with particular emphasis on principles of energy transformation (bioenergetics). The topics of the course are selected to achieve the following objectives:

1. to introduce and to explain the basic concepts in Membrane biology and Bioenergetics
2. to develop more adequate understanding of cellular and biotechnological processes.

Course Contents:

Unit I **No. of Hours: 15**

Introduction to biomembranes

Composition of biomembranes - prokaryotic, eukaryotic, neuronal and subcellular membranes. Study of membrane proteins. Fluid mosaic model with experimental proof. Monolayer, planer bilayer and liposomes as model membrane systems.

Membrane structures

Polymorphic structures of amphiphilic molecules in aqueous solutions - micelles and bilayers. CMC, critical packing parameter. Membrane asymmetry. Macro and micro domains in membranes. Membrane skeleton, lipid rafts, caveolae and tight junctions. RBC membrane architecture.

Unit II **No. of Hours: 15**

Membrane dynamics

Lateral, transverse and rotational motion of lipids and proteins. Techniques used to study membrane dynamics - FRAP, TNBS labeling etc. Transition studies of lipid bilayer, transition temperature. Membrane fluidity, factors affecting membrane fluidity.

Membrane transport

Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport - glucose transporter, anion transporter and porins. Primary active transporters - P type ATPases, V type ATPases, F type ATPases. Secondary active transporters - lactose permease, Na+-glucose symporter. ABC family of transporters - MDR, CFTR. Group translocation. Ion channels - voltage-gated ion channels (Na+/K+ voltage-gated channel),

ligand-gated ion channels (acetyl choline receptor), aquaporins, bacteriorhodopsin. Ionophores - valinomycin, gramicidin.

Vesicular transport and membrane fusion

Types of vesicle transport and their function - clathrin, COP I and COP II coated vesicles. Molecular mechanism of vesicular transport. Membrane fusion. Receptor mediated endocytosis of transferrin. Membrane biogenesis

Unit III **No. of Hours: 15**

Introduction to bioenergetics

Laws of thermodynamics, state functions, equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, other phosphorylated compounds and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers.

Oxidative phosphorylation

Mitochondria. Electron transport chain - its organization and function. Inhibitors of ETC and uncouplers. Peter Mitchell's chemiosmotic hypothesis. Proton motive force. Fo F1ATP synthase, structure and mechanism of ATP synthesis. Metabolite transporters in mitochondria. Regulation of oxidative phosphorylation. ROS production and antioxidant mechanisms. Thermogenesis. Alternative respiratory pathways in plants.

Unit IV **No. of Hours: 15**

General features of photophosphorylation, historical background, Hills reaction, photosynthetic pigments, light harvesting systems of plants and microbes and resonance energy transfer. Bacterial photophosphorylation in purple bacteria, Green sulfur bacteria and Halobacteriumsalinarum. Photophosphorylation in plants -structure of chloroplast, molecular architecture of Photosystem I and Photosystem II, Z-scheme of photosynthetic electron flow, oxygen evolving complex and action of herbicides. Cyclic photophosphorylation and its significance. Photo inhibition. Evolution of oxygenic photosynthesis.

Learning Outcomes:

The students will need to be able to describe the structure, organisation and dynamic nature of biological membranes; explain how ions and solutes are transported across

biological membranes; explain chemiosmotic theory of energy transduction by biological membranes; explain the thermodynamics underpinning these mechanisms; describe how extracellular signals can be transmitted across biological membranes; demonstrate skills of data analysis and applications of equations.

Text Books:

1. Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston), ISBN-13:978-0-495-11464-2.
2. Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W.,John Wiley & Sons, Inc. (New York), ISBN:13: 978-0470-23396-2

Reference Books:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641- 0962-1.
2. Molecular Cell Biology (2013) 7th ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman & Company (New York), ISBN:13:978-1-4641-0981-2.

Course Name: Membrane Biology and Bioenergetics Laboratory

Course Code: MBB217

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Effect of lipid composition on the permeability of a lipid monolayer.
2. Determination of CMC of detergents.
3. RBC ghost cell preparation and to study the effect of detergents on membranes.
4. Separation of photosynthetic pigments by TLC.
5. Isolation of mitochondria from liver and assay of marker enzyme SDH.
6. Study photosynthetic O_2 evolution in hydrilla plant.
7. Isolation of chloroplast from spinach leaves, estimation of chlorophyll and photosynthetic activity.
8. Study of changes in erythrocyte membrane permeability under hypotonic and hypertonic consitions.

Course Name: Fundamentals of Cell Biology

Course Code: BTY123

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

To study in detail about the cell which encompasses the cell structure, structure and functions of organelles, locomotion, life cycle and division. To impart knowledge to students about the basics of stem cells and their applications as well as to introduce them to the world of cellular differentiation and cloning.

Course Contents:

Unit I **No. of Hours: 13**

Cells and organelles: Cell as a basic unit of living system, biochemical composition of cell, the cell theory, ultra-structure of cell.

Cytoskeleton: The nature of the cytoskeleton and endomembrane system, intermediate filaments, microtubules, cilia and centrioles, actin filaments, actin-binding proteins.

Cell membranes: architecture and membrane models; membrane composition, the lipid bilayer/membrane, protein types and carbohydrates; a summary of membrane functions; transport across the membrane: simple diffusion, osmosis, facilitated transports, active transport.

Unit II **No. of Hours: 12**

Eukaryotic cell organelles and functions: Structure and functions of the following cell organelles: endoplasmic reticulum, secretory and transmembrane protein synthesis; Golgi complex, hypothesis of transport across golgi cisternae; lysosome, autophagic pathway; ribosome; mitochondria, ATP synthesis: structure of ATP synthetase, binding change mechanism. Principles & applications of differential centrifugation in the fractionation of cellular organelles and Svedberg unit; endosymbiotic theories

Unit III **No. of Hours: 12**

Nucleus and cell cycle: Genome organization, structure and function of nucleus, nuclear envelope, nuclear pore complex, structure of chromatin, nucleosome and chromosome, protein import from cytoplasm to nucleus; cell cycle and its regulation, cyclins-CdKs, checkpoints, mitosis and meiosis

Unit IV **No. of Hours: 13**

Molecule and Protein Trafficking: The compartmentalization of higher cells, transport of molecules into and out of organelle membranes, the endoplasmic reticulum, transport from the ER to the Golgi Apparatus, transport from the trans Golgi network to lysosomes, molecular mechanisms of vesicular transport, coated proteins, COPI, COPII and clathrin coated vesicular transport; transport from the plasma membrane via endosome: Receptor mediated endocytosis, phagocytosis.

Learning Outcomes:

Students who successfully complete this course will be able to: Describe the function and structure of cells including the metabolic reactions that occur in cells. Outline, at the molecular level, the transmission of signals in excitable cells.

Text Books:

1. Gerald Karp, Janet Iwasa, Wallace Marshall. Karp's Cell and Molecular Biology. John Wiley and Sons 9th edition (2020). ISBN: 9781119598244
2. Gerald Karp, Janet Iwasa, Wallace Marshall. Cell and Molecular Biology. John Wiley and Sons 8th edition (2015). ISBN: 978-1-118-88614-4
3. Powar, C.B. Cell Biology. Himalaya Publishing House. 2007. ISBN: 9789350246696

Reference Books:

1. George Plopper, Diana Bebek Ivankovic. Principles of Cell Biology. 3rd Edition. Jones & Bartlett Learning, 2020. ISBN: 9781284210514
2. Bruce Alberts, Karen Hopkin, Alexander D. Johnson, Martin Raff. Essential Cell Biology. 5th Edition. W W NORTON & Company, 2019. ISBN: 9780393680379.
3. Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A, Martin KC. Molecular Cell Biology. 8th Edition. W.H. Freeman & Company. 2016. ISBN-10: 1-4641-8339-2; ISBN-13: 978-1-4641-8339-3
4. Geoffrey M. Cooper and Robert E. Hausman. The Cell: A Molecular Approach, 7th Edition (2015). ISBN-10: 1605355402 ISBN-13: 978-1605355405
5. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. Molecular Biology of the Cell. 6th Edition. Garland Science. 2014. ISBN-10: 0815345240 ISBN-13: 978-0815345244
6. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G.P. The World of the

Cell. 7th Edition. Benjamin Cummings. 2008. ISBN: 9780805393934

Course Name: Fundamentals of Cell Biology Laboratory

Course Code: BTY124

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Understanding principle, working and handling of light microscope.
2. Understanding principle, working and handling of microtome
3. Understanding microscope adjustments, light sources, microscopic measurements, calibration and types of microscopes available.
4. Preparation of different types of stains
5. Staining and observation of microorganisms – simple, negative and differential staining.
6. The theory of histology: Embedding and sectioning.
7. Cytological preparations, Fixation, dehydration and staining
8. Staining and observation of mammalian and plant cells simple staining techniques.
9. Squash preparation of mitotic or meiotic cells
10. Examination of various stages of mitosis and meiosis
11. Isolation of chloroplast

Course Name: General Chemistry - I

Course Code: CHE157

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

Through this course students should be able to identify the structure of an atom and various principles of filling of electrons in an orbital, outline the periodicity of elements of different periods and groups, discuss the chemical properties of particular molecules by using various bonding theories, distinguish different types of chemical bonds, identify structure, bonding and mechanism of organic reactions, determine stereochemistry of organic compounds and describe the fundamental reactions of aliphatic hydrocarbons.

Course Contents:

Section A: Inorganic Chemistry-1

Unit I **No. of Hours: 15**

Atomic Structure

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers *n, l* and *m.* Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (ms). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Unit II **No. of Hours: 15**

Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic

bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizabilty. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonalbipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches.

Section B: Organic Chemistry-1

Unit III **No. of Hours: 15**

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Huckel's rule.

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L *cis–trans*nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Unit IV **No. of Hours: 15**

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline $KMnO_4$ozonolysis and oxidation with hot alk. $KMnO_4$.

Learning Outcomes:

Student will be able to apply significant figures rules in all calculations providing the correct number of significant figures and units. Course is helpful in conversion between different units using conversion factors and dimensional analysis. Can name elements, provide their symbols and determine the number of protons, neutrons, electrons and nuclei in elements and compounds. Calculate percent composition given a molecular formula and molecular formula given the percent composition. Students will be able to name salts, acids, bases and covalent compounds and provide formulas for these given a molecular formula.

Reference Books:

1. J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.
2. F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
3. Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*, John Wiley.
4. James E. Huheey, *Ellen Keiter and Richard Keiter: Inorganic Chemistry:*

Principles of Structure and Reactivity, Pearson Publication.

5. T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons*.
6. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
7. E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
8. I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
9. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
10. ArunBahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand

Course Name: General Chemistry – I Laboratory

Course Code: CHE158

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ with internal indicator.
5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements).
2. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given):
   (a) Identify and separate the components of a given mixture of 2 amino acids (glycine,aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
   (b) Identify and separate the sugars present in the given mixture by paper chromatography.

Course Name: Environmental Studies

Course Code: EVS100

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

This course aims at understanding the students in aspects of environmental problems, its potential impacts on global ecosystem and its inhabitants, solutions for these problems as well as environmental ethics which they should adopt to attain sustainable development.

Course Contents:

Unit I **No. of Hours: 14**

Introduction to Environmental Studies

- Definition, components and types of Environment.
- Meaning of Environmental Studies and its Multidisciplinary nature;
- Scope and importance; Concept of sustainability and sustainable development.

Natural Resources: Renewable and Non-Renewable Resources

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit II **No. of Hours: 10**

Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :
  (a) Forest ecosystem
  (b) Grassland ecosystem
  (c) Desert ecosystem

(d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and Conservation

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots

- India as a mega---biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity: Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity: In---situ and Ex---situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit III **No. of Hours: 15**

Environmental Pollution: types, causes, effects and controls; Air, water, soil and noise pollution

- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies.

Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit IV **No. of Hours: 6**

Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management: floods, earthquake, cyclones and landslides.

- Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Field work **No. of Hours: 5**

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems-pond, river, Delhi Ridge, etc.

Learning Outcomes:

Students will have an understanding of primary environmental problems (e.g., invasive species, climate change, small populations, water pollution) and the science behind those problems and potential solutions. Students will learn skills required to research and analyze environmental issues scientifically and learn how to use those skills in applied situations such as careers that may involve environmental problems and/or issues.

Text Books:

1. Odum, E.P., Odum, H.T. & Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
2. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
3. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.

Reference Books:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., &Guha, R.1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in

Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.

5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36---37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp. 29---64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Pepper, I.L., Gerba, C.P. &Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
10. Rao, M.N. &Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
11. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. *Environment*. 8th edition. John Wiley & Sons.
12. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. *Tripathi 1992*.
13. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.
14. Thapar, V. 1998. *Land of the Tiger*: *A Natural History of the Indian Subcontinent*.
15. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
16. Wilson, E. O. 2006.*The Creation: An appeal to save life on earth*. New York: Norton.

Course Name: Human Values and General Studies

Course Code: SGS107

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The course tries targets the following objectives; to develop a critical ability to distinguish between essence and form, or between what is of value and what is superficial, in life. What makes it difficult is the fact that the ability is to be developed not for a narrow area or field of study, but for everyday situations in life. To move from discrimination to commitment. The course does not teach values. It encourages students to discover what they consider valuable. Accordingly, they should be able to discriminate between valuable and the superficial in real situations in their life.

Course Contents:

Unit I **No. of Hours: 15**

Human Values

Concept of Human Values-Meaning, Types and Importance of Values. Value Education-Basic guidelines for value education. Value crisis and its redressal. Being Good and Responsible- Self Exploration and Self Evaluation, Acquiring Core Values for Self Development, Living in Harmony with Self, Family and Society, Values enshrined in the Constitution: Liberty, Equality, Fraternity and Fundamental Duties

Unit II **No. of Hours: 13**

Value Based and Ethical

Value – based living-Vedic values of life, Karma Yoga and Jnana Yoga, AshtaMarga and Tri-Ratna. Ethical Living- Personal Ethics, Professional Ethics and Ethics in education

Unit III **No. of Hours: 18**

General Geography

World Geography- The Universe, The Solar System, The Earth, Atmosphere, The World we live in, Countries rich in Minerals, Wonders of the World, Biggest and Smallest.Indian Geography- Location, Area and Dimensions, Physical Presence, Indian States and Union Territories Important sites and Monuments, Largest-Longest and Highest in India. General History- Glimpses of India History, Ancient Indian, Medieval India, Modern India, Various Phases of Indian National Movement, Prominent

Personalities, Glimpses of Punjab history with special reference to period of Sikh Gurus.Glimpses of World History- Important Events of World History, Revolutions and Wars of Independence, Political Philosophies like Nazism, Fascism, Communism, Capitalism, Liberalism etc. Indian Polity: Constitution of India-Important Provisions, Basic Structure, Union Government, Union Legislature and Executive, State Government: State Legislature and Executive, Indian Judiciary, The Election Commission, Panachayati Raj System, RTI etc. General Economy- The process of liberalization, privatization, globalization and Major World Issues, Indian Economy, Indian Financial System, Major Economic Issues, Economic Terminology.

Unit IV **No. of Hours: 11**

General Science

General appreciation and understandings of science including the matters of everyday observation and experience, Inventions and Discoveries

Sports and Recreation

World of Sports and recreation, Who's Who is sports, Major Events, Awards and Honours. Famous personalities, Festivals, Arts and Artists

Current Affairs

National and International Issues and Events in News, Governments Schemes and Policy Decisions

Miscellaneous Information

Who is who

Books and Authors, Persons in News, Awards and Honours, Abbreviations and Sports

Learning Outcomes:

The Human Values course tries to achieve the following objectives. 1. To develop a critical ability to distinguish between essence and form or between what is of value and what is superficial, in life.

CURRENT AFFAIRS

Magazines

Economic and Political Weekly, Yojna, the Week, India Today, Frontline, Spectrum.

Competition Success Review, Competition Master, Civil Services Chronicle, Current Affairs, World Atlas Book

Newspapers

The Hindu, Times of India, The Hindustan Times, The Tribune

References:

1. Tripathi, A. N., Human Values, New Age International Publishers, Third Edition, New Delhi, 2009.
2. Surbiramanian, R. *Professional Ethics*, Oxford University Press, New Delhi, 2013.
3. Human Values and Professional Ethics, Anand, R. Prakashan, S. New Delhi, 2012.
4. Human Values and Professional Ethics, SanjeevBhalla, SatyaPrakashan, New Delhi, 2012.
5. Human Values and Professional Ethics, RituSoryanDhanpatRai& Co. Pvt. Ltd., First Edition, 2010.
6. Jayshree, S., and Raghavan, B.S., *Human Values and Professional Ethics,* S Chand & Co. Ltd., 2007.
7. Singh, Y and Garg, A *Human Values and Professional Ethics*, Aitbs publishers, 2011.
8. Kumar, V., *Human Values and Professional Ethics*, Kalyani Publishers, Ludhiana, 2013.
9. R. R. Gaur, R. Sangal, G.P. Bagaria, *Human Values and Professional Ethics*, Excel Books, New Delhi 2010.
10. Osula, B. and Upadhyay, S., *Values and Ethics*, Asian Books Pvt. Ltd., 2011.
11. Indian Philosophy, S. Radhakrishnan, and George Allen & Unwin Ltd., New York: Humanities Press INC, 1929.
12. Dwivedi, A.N., *Essentials of Hinduism, Jainism and Buddhism*, Books Today, New Delhi – 1979.
13. Dayanand: His life and work, SurajBhan, DAVCMC, New Delhi – 2001.
14. Dwivedi, K.D., Essence *of Vedas*, Katyayan Vedic SahityaPrakashan, Hoshiarpur, 1990.
15. Vedic Concepts, Prof. B. B. Chaubey, Katyayan Vedic SahityaPrakashan, Hoshiarpur, 1990.

16. Advance Objective General Knowledge, R. S. Aggarwal, S. Chand Publisher (2013).
17. Concise General Knowledge Manual 2013, S. Sen, Unique Publishers, 2013**.**
18. Encyclopedia of General Knowledge and General Awareness by R. P. Verma, Penguin Books Ltd (2010).
19. General Knowledge Manual 2013-14, Edgar Thorpe and Showick Thorpe;The Pearson, Delhi.
20. General Knowledge Manual 2013-14, MuktikantaMohanty, Macmillan Publishers India Ltd., Delhi.
21. India 2013, Government of India (Ministry of Information Broadcasting), Publication Division, 2013.
22. Manorama Year Book 2013-14, MammenMethew, Malayalam Manorama Publishers, Kottayam, 2013.
23. Spectrum's Handbook of General Studies – 2013-14, Spectrum Books (P) Ltd., New Delhi

Course Name: Basics of Immunology

Course Code: MIC 333A

Credits Components: Theory

Total Credits

L	T	P	Credits
4	0	0	4

Course Learning Objective:

The course will expose the students to the basic concepts of immune system including important cells and organs on immune system, antigens and antibodies, generation of immune response, and experimental immunological techniques.

Course Content:

UNIT 1 **(11 Hours)**

Concept of Innate and Adaptive immunityy; Contributions of following scientists to the development of field of immunology - Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa. Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs– Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT

UNIT 2 **(19 Hours)**

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants,
Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; Monoclonal and Chimeric antibodies. Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways).
Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement Activation

UNIT 3 **(17 Hours)**

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Tolerance,, Autoimmunity and Hypersensitivity Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi

syndrome, Leukocyte adhesion deficiency, CGD.

UNIT 4 **(13 Hours)**

Techniques in immunology: Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Cancer immunology, Cancer vaccines,New approaches for delivery of immunotherapies into tumors.

Learning outcomes: The students will be able to understand the components and working of immune system in response to variety of antigens or pathogens and mode of action of immunotherapeutic agents.

Suggested Readings:

1. Delves P, Martin S, Burton D, Roitt IM. *Roitt's Essential Immunology*. 13th edition Wiley-Blackwell Scientific Publication, Oxford. 2017. Print

2. Goldsby RA, Kindt TJ, Osborne BA. *Kuby's Immunology*. 8th edition W.H. Freeman and Company, New York. 2019. Print

3. Abbas AK, Lichtman AH, Pillai S. *Cellular and Molecular Immunology*. 9th edition Saunders Publication, Philadelphia. 2017. Print

4. Murphy K, Travers P, Walport M. *Janeway's Immunobiology*. 9th edition Garland Science Publishers, New York. 2017. Print

5. Peakman M, and Vergani D. *Basic and Clinical Immunology*. 2nd edition Churchill Livingstone Publishers, Edinberg. 2009. Print

6. Parham P.*The Immune System.* 4th edition, W. W. Norton & Company,Garland Science.2015.

Websites and Audio Video lectures:

https://www.atsu.edu/faculty/chamberlain/Website/Lects/Content1.htm

https://nptel.ac.in/courses/102103015

Course Name: Basics of Immunology Laboratory

Course Code: MIC 334A

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Identification of human blood groups.
2. Perform Total Leukocyte Count of the given blood sample.
3. Perform Differential Leukocyte Count of the given blood sample.
4. Demonstration of serum preparation from the blood sample
5. Demonstration of plasma separation from blood sample.
6. Perform immunodiffusion by Ouchterlony method.
7. Demonstration of ELISA.
8. Demonstration of WIDAL test.
9. Perform DOT ELISA.
10. Perform immunoelectrophoresis.

Course Name: Bacteriology

Course Code: MIC113

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

This course will allow the student to develop an understanding about bacteria, including their structural organization, reproduction and classification. This course will also expose the students to the commonly used techniques in the field of bacteriology.

Course Contents:

Unit I **No. of Hours: 14**

Cell organization

Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili.

Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaebacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall.

Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes.

Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids

Endospore: Structure, formation, stages of sporulation.

Unit II **No. of Hours: 5**

Bacteriological techniques

Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing non-culturable bacteria.

Unit III **No. of Hours: 6**

Microscopy

Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluoresence Microscope, Confocal microscopy, Scanning and Transmission Electron Microscope

Unit IV **No. of Hours: 8**

Growth and nutrition

Nutritional requirements in bacteria and nutritional categories;

Culture media: components of media, natural and synthetic media, chemically defined media,

complex media, selective, differential, indicator, enriched and enrichment media, Diauxic growth, Synchronous growth

Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation

Chemical methods of microbial control: disinfectants, types and mode of action

Unit V **No. of Hours: 3**

Reproduction in Bacteria

Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate

Unit VI **No. of Hours: 8**

Bacterial Systematics

Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers, rRNA oligonucleotide sequencing, signature sequences, and protein sequences.

Differences between eubacteria and archaebacteria

Unit VII **No. of Hours: 16**

Important archaeal and eubacterial groups

Archaebacteria: General characteristics, phylogenetic overview, genera belonging to Nanoarchaeota (*Nanoarchaeum*), Crenarchaeota (*Sulfolobus*, *Thermoproteus*) and Euryarchaeota [Methanogens (*Methanobacterium*, *Methanocaldococcus*), thermophiles (*Thermococcus*, *Pyrococcus*, *Thermoplasma*), and Halophiles (*Halobacterium, Halococcus*)]

Eubacteria: Morphology, metabolism, ecological significance and economic importance of following groups:

Gram Negative:

Non proteobacteria: General characteristics with suitable examples

Alpha proteobacteria: General characteristics with suitable examples

Beta proteobacteria: General characteristics with suitable examples

Gamma proteobacteria: General characteristics with suitable examples

Delta proteobacteria: General characteristics with suitable examples

Epsilon proteobacteria: General characteristics with suitable examples

Zeta proteobacteria: General characteristics with suitable examples

Gram Positive:

Low G+ C (Firmicutes): General characteristics with suitable examples

High G+C (Actinobacteria): General characteristics with suitable examples

***Cyanobacteria*:** An Introduction

Learning Outcomes:

The student will be able to describe the structure of bacterial cells, the form, arrangement and replication of genetic material within a bacterial cell; the types of mutations that may occur in bacterial DNA, evolution of bacteria; the use of nucleic acid in the molecular taxonomy of bacterial species; Physiology, classification and importance of bacteria.

Text Books:

1. PelczarJr MJ, Chan ECS, and Krieg NR. *Microbiology*. 5th edition Tata McGraw Hill. 2004. Print
2. Srivastava S and Srivastava PS. *Understanding Bacteria*. Kluwer Academic Publishers, Dordrecht. 2003. Print
3. Atlas RM. *Principles of Microbiology*. 2nd edition. WM.T.Brown Publishers. 1997. Print

Reference Books:

1. Black JG. *Microbiology: Principles and Explorations*. 7th edition. Prentice Hall. 2008. Print
2. Madigan MT, and Martinko JM. *Brock Biology of Micro-organisms*. 14th edition. Parker J. Prentice Hall International, Inc. 2014. Print
3. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. *General Microbiology*. 5th edition McMillan. 2005. Print
4. Tortora GJ, Funke BR, and Case CL. *Microbiology: An Introduction*. 9th edition

Pearson Education. 2008. Print

5. Willey JM, Sherwood LM, and Woolverton CJ. *Prescott's Microbiology*. 9th edition. McGraw Hill Higher Education. 2013. Print
6. Cappucino J and Sherman N. *Microbiology: A Laboratory Manual*. 9th edition. Pearson Education Limited. 2010. Print

Course Name: Bacteriology Laboratory

Course Code: MIC114

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Preparation of different media: synthetic media BG-11, Complex media-Nutrient agar, McConkey agar, EMB agar.
2. Simple staining
3. Negative staining
4. Gram's staining
5. Acid fast staining-permanent slide only.
6. Capsule staining
7. Endospore staining.
8. Isolation of pure cultures of bacteria by streaking method.
9. Preservation of bacterial cultures by various techniques.
10. Estimation of CFU count by spread plate method/pour plate method.
11. Motility by hanging drop method.

Course Name: Introductory Microbiology

Course Code: MIC111B

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The objective of the course is to acquaint the students with various aspects of basic and applied microbiology, comprehend the various methods for identification of unknown microorganisms, understand microbial growth and metabolism, know the various physical and chemical growth requirements of microbes, bacterial reproduction, genetics and life cycle, pathogens, and applications of microbiology in life and industry.

Course Contents:

Unit I **No. of Hours: 20**

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 eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

Unit II **No. of Hours: 10**

Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.

Unit III **No. of Hours: 15**

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.

Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

Unit IV **No. of Hours: 15**

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents 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.

Learning Outcomes:

Upon successful completion of the course, students are expected to be able to appreciate the diversity of microorganism and microbial communities, explain their taxonomy and classification, understand their metabolic and reproduction pathways as well as demonstrate the day-to-day role of microbes in food industry.

Text Books:

1. Prescott, L.M., Microbiology, 6th Edition. McGraw-Hill Companies. 2002. Print.
2. Pelczar, M.J. Microbiology. 6th Edition. McGraw-Hill Companies. 1993. Print

Reference Books:

1. Glazer, A. and Nikaido, H. Microbial Biotechnology: Fundamentals of Applied Microbiology. 2nd Edition. Cambridge University Press. 2007. Print.
2. Atlas, R.M. Principles of Microbiology. 2nd Edition. William C Brown Pub. 1996. Print.

Course Name: Introductory Microbiology Laboratory

Course Code: MIC112B

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Isolation of bacteria & their biochemical characterization.
2. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
3. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.
4. Determination of bacterial cell size by micrometry.
5. Enumeration of microorganism - total & viable count.

Course Name: Plant Physiology and Metabolism

Course Code: BOT241

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The main goal of the course is to help students acquire a comprehension of plant biology from the subcellular to the organismal level. The course explores various topics in plant cell biology, physiology, and biochemistry including primary and secondary metabolism, photosynthesis, respiration, water relations, mineral nutrition, response to environmental stress, roles of plant hormones, and plant biotechnology.

Course Contents:

Unit I **No. of Hours: 15**

Plant-water relations: Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

Mineral nutrition: Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

Unit II **No. of Hours: 15**

Translocation in phloem: Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading

Photosynthesis: Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.

Unit III **No. of Hours: 15**

Respiration: Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

Enzymes: Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

Nitrogen metabolism: Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit IV **No. of Hours: 15**

Plant growth regulators: Discovery and physiological roles of auxins, gibberellins,

cytokinins, ABA, ethylene.

Plant response to light and temperature: Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

Learning Outcomes:

At the end of the course, including also an intensive lab, the student will be able to understand the relationship between structure and function as it relates to plant macromolecules, cells, and tissues, understand the interaction between the environment and plant growth and development, and gain an appreciation of the metabolic and physiological processes unique to plants (transport, photosynthesis, metabolism, mineral nutrition, hormonal regulation and photomorphogenesis).

Text/ Reference Books:

1. Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

Course Name: Plant Physiology and Metabolism Laboratory

Course Code: BOT242

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

Demonstration experiments (any four)

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

Course Name: Bioanalytical Tools

Course Code: BTY361

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

To give an introduction to various analytical methods for quantitative measurement of biological molecules (proteins, DNA, metabolites) in various conditions.

Course Contents:

Unit I **No. of Hours: 15**

Microscopy: Simple and compound light microscopes, phase contrast microscopes, florescence microscopes, principles and types of electron microscopes.

pH meter: Principle and construction of a pH meter, calibration techniques, acids and bases.

Unit II **No. of Hours: 15**

Spectrophotometry: Principle and law of absorption and fluorescence, fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared)

Centrifugation: Principles of centrifugation and sedimentation, Preparative centrifugation, Differential centrifugation, Density Gradient Centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

Unit III **No. of Hours: 15**

Chromatographic techniques: Principles of chromatography, adsorption chromatography, partition chromatography, paper chromatography and TLC, column chromatography, gel filtration chromatography, ion exchange chromatography, affinity chromatography, high-performance liquid chromatography, gas chromatography.

Unit IV **No. of Hours: 15**

PCR: Principle, types and applications

Electrophoresis: Principle of electrophoresis, Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose gel electrophoresis, pulse field gel electrophoresis, immuno-electrophoresis, isoelectric focusing, Western blotting.

Introduction to biosensors and their applications.

Learning Outcomes:

The students will be able to apprehend the functioning, maintenance and safety aspects of the basic apparatus used in a Biotechnology lab; assimilate the principles and applications of centrifuge, electrophoresis and chromatography in research and related experiments; employ the knowledge for the separation of proteins/peptides by selecting appropriate separation techniques; and characterize certain functionalities of biomolecules by using spectroscopic techniques.

Text Books:

1. Wilson, K. and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology. 7th Edition. Cambridge University Press. 2010. ISBN-13: 978-0521731676

Reference Books:

1. Sheehan, D. 2016. Physical Biochemistry: Principles and Applications. 2 nd Edition. Wiley India (JW). ISBN-13: 978-8126564842
2. Ho, P. S., Johnson, C. and van Holde, K. E. Principles of Physical Biochemistry. 2nd Edition. Pearson. 2005. ISBN: 978-0130464279
3. Venn, R. F. Principles and Practice of Bioanalysis. 2nd Edition. Taylor & Francis. 2008. CRC Press. ISBN-13: 978-0849338571
4. Jeanette M. van Emon. 2019. Immunoassay and Other Bioanalytical Techniques. 1st Edition. CRC Press. ISBN-13: 978-0367389666

Course Name: Bioanalytical Tools Laboratory

Course Code: BTY362

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Polymerase chain reaction
2. Native gel electrophoresis of proteins
3. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
4. Preparation of the sub-cellular fractions of rat liver cells.
5. Preparation of protoplasts from leaves.
6. Separation of amino acids by paper chromatography.
7. To identify lipids in a given sample by TLC.
8. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.
9. Agarose gel electrophoresis of nucleic acids
10. Southern blotting
11. Quantification of nucleic acids by spectrophotometry

Course Name: Fundamentals of Nanobiotechnology

Course Code: BTY381A

Credits Components: Theory

Total Credits			
L	T	P	Credits
2	0	0	2

Course Objective:

To understand the applications of nanotechnology in medicine. To gain an exposure to recent techniques in biopharmaceutical drug discovery.

Course Contents:

Unit I **No. of Hours: 15**

Introduction: Concepts of nanotechnology and nanobiotechnology. Methods for synthesis of nanoparticles, physical, chemical, biological synthesis, characterization methods of nanomaterials, Atomic force microscopy, electron microscopy. FTIR. Important nano-particles / materials, bionano robots/molecular motors nano motors and their uses (in brief).

Unit II **No. of Hours: 15**

Applications of nanotechnology: nano-sensors, nano pharmaceuticals, nano carriers for drug delivery, nanoparticles for diagnostics, therapy, regenerative medicine and surgery, with special emphasis on diagnosis and treatment of cancer.

Unit III **No. of Hours: 15**

Drug Development: steps involved in drug discovery, production and characterization, preclinical studies and validation studies, computer aided drug designing and docking and its applications, principle and examples of ligand and structure based drug designing.

Unit IV **No. of Hours: 15**

Clinical Research: Introduction, good clinical practice guidelines, ethical aspects, methodologies and management, data management. Regulatory affairs and pharmacovigilance, ICH, FDA, INDA, classifications of adverse events.

Learning Outcomes:

On successful completion of this course, students should have the skills and knowledge to explain the fundamental principles of nanotechnology and their application to biomedical engineering; apply engineering and physics concepts to the nano-scale and non-continuum domain; identify and compare state-of-the-art nanofabrication methods and perform a

critical analysis of the research literature; design processing conditions to engineer functional nanomaterials; evaluate current constraints, such as regulatory, ethical, political, social and economical, encountered when solving problems in living systems.

Reference Books:

1. Ciofani, G. Smart Nanoparticles for Biomedicine: Micro and Nano Technologies. Elsevier, 2018. ISBN: 9780128141571.
2. Grumezescu, A.M. Nano- and Microscale Drug Delivery Systems: Design and Fabrication. William Andrew, 2017. ISBN: 9780323527286.
3. Abraham, D.J. and Rotella, D.P. Burger's Medicinal Chemistry, Drug Discovery and Development. 8 Volume Set. 7th Edition. John Wiley & Sons Ltd. 2010. Print. ISBN: 978-0-470-27815-4
4. Beale, J.M. and Lock, J. Wilson &Gisvold's text book of organic medicinal and pharmaceutical Chemistry. 12th Edition. Lippincott Williams & Wilkins. 2010. Print. ISBN: 978-0-7817-7929-6
5. Liljefors, T., Krogsgaard-Larsen, P. and Madsen, U. Textbook of Drug Design and Discovery.3rd Edition. CRC Press. 2002. Print. ISBN: 9780415282888
6. Prasad, S.K. Modern Concepts in Nanotechnology. Discovery Publishing House. 2008. Print. ISBN: 9788183562966
7. Trivedi, P.C. Nanobiotechnology. Pointer Publishers. 2008. Print. ISBN: 978-81-7132-543-6
8. Shah MA and Shah KA. Nanotechnology The science of Small. Wiley India. 2013. ISBN: 9788126538683.

Course Name: Animal Diversity I

Course Code: ZOO101

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

To acquaint students with the general characters and classification of invertebrate phyla and the affinities between different groups. To impart knowledge regarding the morphological, anatomical and physiological make up of a few representative organisms from each phylum.

Course Contents:

Unit I **No. of Hours: 12**

- **Description of animal diversity:** Principles of classification-salient features and classification upto orders in non-chordates. Structural organization in different classes of non-chordates.
- **Protozoa:** locomotion, osmoregulation, nutrition and reproduction in Protozoa.

Unit II **No. of Hours: 18**

- Origin of Metazoa-metamerism and symmetry.
- **Porifera:** skeleton and canal system.
- **Coelenterata**: corals and coral reefs, polymorphism in Hydrozoa.
- **Platyhelminthes:** reproduction, variation in life cycles, parasitic adaptations and evolution of parasitism in Helminthes.
- **Nematoda:**pseudocoelom, parasitic adaptations

Unit III **No. of Hours: 15**

- **Annelida:** coelom, metamerism, excretion.
- **Arthropoda:** vision, respiration and larval forms. Social life in insects.

Unit IV **No. of Hours: 15**

- **Mollusca:** torsion and detorsion, shell and respiration.
- **Echinodermata:** water vascular system and larval forms.

Learning Outcomes:

Students will be able to: Appreciate how evolutionary forces act to create complex biological systems; Gain knowledge of the similarities and differences between vertebrate

& some key invertebrate groups: anatomy, functional morphology, behaviour& diversity.

Text Books:

1. Kotpal, R.L., Modern Text Book of Zoology Invertebrates, 10th ed., Rastogi Publishers, Meerut, 2012.
2. Kotpal, R.L., Minor phyla, 5th ed., Rastogi Publishers, Meerut, 2006.

Reference Books:

1. Dhami, P.S. and Dhami, J.K., Invertebrate Zoology, 5th ed., R. Chand & Co., NewDelhi, 2004.
2. Parker, T.J. and Haswell, W.A., Text book of Zoology, Invertebrates, 7th ed., Vol. I (eds. A.J. Marshall & W.D. Williams), CBS Publishers & Distributors., Delhi, 1992.
3. Hyman L.H. The Invertebrates. Vol. I, II, III, IV and V. McGraw Hill Book Company. Inc., New York. London. Toronto, 1959.

Course Name: Animal Diversity-I Lab

Course Code: ZOO102

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

General survey of invertebrate phyla through charts, models and e-resources:

- Protozoa: *Amoeba, Euglena, Paramecium* and *Vorticella, Balantidium, Nyctotherus, Opalina*, Radiolarians and Foraminiferans.
- Porifera: *Sycon, Grantia, Spongilla, Euplectella, Hyalonema, Chalina, Euspongia*, Temporary mounts of gemmules and spicules of *Sycon*.
- Coelenterata: *Hydra, Obelia, Porpita, Velella, Physalia, Aurelia, Metridium, Alcyonium, Tubipora, Zooanthus, Madrepora, Favia, Fungia, Gorgoni, Pennatula, Sertularia, Plumularia, Pennaria, Bougainvillea*, statocyst of *Aurelia*.
- Platyhelminthes: *Planaria, Fasciola*(W.M. & T.S.), larval stages of *Fasciola*, *Taenia (*scolex, proglottids-mature and gravid),*Ascaris* (male and female).
- Annelida: *Pheretima*, T.S. of typhlosolar region, setae, pharyngeal nephridia, septal nephridium and integumentary nephridium of *Pheretima, Eutyphoeus, Lumbricus, Nereis*, parapodium of *Nereis, Heteronereis, Polynoe, Aphrodite, Amphitrite, Chaetopterus, Anodonta, Mytilus, Pholas, Pecten, Haliotis, Aplysia, Doris, Limax, Pila, Sepia, Octopus, Nautilus, Chiton* and *Anodonta*. *Arenicola, Hirudinaria, Pontobdella*.
- Arthropoda: *Peripatus, Lepisma*, cockroach,trachea and mouth parts of cockroach, grasshopper, praying mantis, earwig, dragonfly, termite (queen and other castes), ant, butterfly, moth, beetle, wasp, honeybee, crab, prawn, *Lepas,Balanus, Apus, Limulus*, scorpion, spider, millipede andcentipede, *Cypris, Cyclops, Daphnia*, Prawn, Gill and statocyst of Prawn.
- Mollusca: *Anodonta, Mytilus, Pholas, Pecten, Haliotis, Aplysia, Doris, Limax, Pila, Glochidium* larva and radula of *Pila,Sepia, Octopus, Nautilus, Chiton* and *Anodonta.*

Demonstration of anatomy of the following animals through charts/models/e-resources

- Earthworm: digestive, reproductive and nervous systems
- Cockroach: digestive, nervous and reproductive systems, mouth parts of cockroach
- Prawn: digestive and nervous systems. Appendages and gills of prawn.
- *Anodonta:* digestive and nervous systems,
- *Pila:* digestive and nervous systems, radula of *Pila*
- *Asterias*: Aristotle's lantern, tube feet.

Course Name: Fundamentals of Developmental Biology

Course Code: ZOO321

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

To give students a brief overview of the developmental processes in animals.

Course Contents:

Unit I **No. of Hours: 15**

Introduction: Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division

Unit II **No. of Hours: 15**

Early Embryonic Development: Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers

Unit III **No. of Hours: 15**

Late Embryonic Development: Fate of Germ Layers; Extra- embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)

Post Embryonic Development: Metamorphosis-Changes, hormonal regulations in amphibians and insects; Regeneration- Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing-Concepts and Theories

Unit IV **No. of Hours: 15**

Implications of Developmental Biology: Teratogenesis,Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis

Learning Outcomes:

Students should be able to demonstrate an understanding of the characteristics of living organisms including their chemical composition, cellular structure, and cellular

metabolism. Students should be able to apply methods of scientific measurement, analyze experimental data and report experimental results in scientific format. Students should be able to demonstrate critical thinking skills. Students should be able to demonstrate facility in using laboratory equipment including the microscope, spectrophotometer and computer assisted graphing. Students should be able to demonstrate an understanding of the Chemical Hazards Communication Standard and how it applies to a laboratory setting.

Text/ Reference Books:

1. Balinsky B. I. and Fabian B. C. An Introduction to Embryology, V Edition, International Thompson Computer Press, 1981.
2. Carlson, R. F. Patten's Foundations of Embryology
3. Gilbert, S. F. Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA, 2010.
4. Kalthoff. Analysis of Biological Development, II Edition, McGraw-Hill Publishers, 2008.
5. Lewis Wolpert. Principles of Development. II Edition, Oxford University Press, 2002.

Course Name: Fundamentals of Developmental Biology Laboratory

Course Code: ZOO322

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

The following practicals will be conducted using charts/models/e-resources.

- Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
- Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
- Study of the developmental stages and life cycle of Drosophila from stock culture
- Study of different sections of placenta (photomicropgraph/ slides)
- Project report on Drosophila culture/chick embryo

Note: The above mentioned practicals are in accordance with the guidelines of UGC. Practicals involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to the availability of resources.

Course Name: Microbial Physiology

Course Code: MIC221

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

This course will introduce the students to the diversity of microbial life-styles including heterotrophy, chemolithotrophy, photolithotrophy, fermentation, aerobic and anaerobic respiration. The students will also come to know carbon and nitrogen nutrition in microbes.

Course Contents:

Unit I **No. of Hours: 12**

Microbial Growth and Effect of Environment on Microbial Growth

Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve, Microbial growth in response to environment -Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), barophilic.

Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph.

Unit II **No. of Hours: 10**

Nutrient uptake and Transport

Passive and facilitated diffusion

Primary and secondary active transport, concept of uniport, symport and antiport

Group translocation, Iron uptake

Unit III **No. of Hours: 16**

Chemoheterotrophic Metabolism - Aerobic Respiration

Concept of aerobic respiration, anaerobic respiration and fermentation

Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway, TCA cycle

Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors

Unit IV **No. of Hours: 6**

Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation

Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction)

Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways

Unit V **No. of Hours: 10**

Chemolithotrophic and Phototrophic Metabolism

Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction)

Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria, Autotrophy in photosynthetic bacteria

Unit VI **No. of Hours: 6**

Introduction to biological nitrogen fixation, Ammonia assimilation, Assimilatory nitrate reduction, denitrification.

Learning Outcomes:

After successful completion of this course students are expected to be able to explain the principles of the energy-yielding and -consuming reactions, the various catabolic and anabolic pathways, the transport systems and the mechanisms of energy conservation in microbial metabolism; identify the various physiological groups of bacteria/archaea with their special features, their applications and ways to study them. Can compose redox reactions and calculate Gibbs energy values for energy generating reactions using thermodynamic data as well as redox potentials or can calculate electrochemical gradients of compounds over an energized membrane.

Text Books:

1. Reddy SR and Reddy SM. Microbial Physiology. Scientific Publishers India. 2005. Print
2. Willey JM, Sherwood LM, and Woolverton CJ. Prescott's Microbiology. 9th

edition. McGraw Hill Higher Education. 2013. Print

Reference Books:

1. Madigan MT, and Martinko JM. Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc. 2014. Print
2. Moat AG and Foster JW. Microbial Physiology. 4th edition. John Wiley & Sons. 2002. Print
3. Gottschalk G. Bacterial Metabolism. 2nd edition. Springer Verlag. 1986. Print
4. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. General Microbiology. 5th edition, McMillan Press. 1987. Print

Course Name: Microbial Physiology Laboratory

Course Code: MIC222

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Study and plot the growth curve of *E. coli* by turbidometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data.
3. Effect of temperature on growth of *E. coli*
4. Effect of pH on growth of *E. coli*
5. Effect of carbon and nitrogen sources on growth of *E.coli*
6. Effect of salt on growth of *E. coli*
7. Demonstration of alcoholic fermentation
8. Demonstration of the thermal death time and decimal reduction time of *E. coli.*
9. Determination of thermal death point of the given culture.

Course Name: Fundamentals of Molecular Biology

Course Code: BTY241A

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

Course Contents:

Unit I **No. of Hours: 15**

DNA as genetic material, structure of DNA, types of DNA, replication of DNA in prokaryotes and eukaryotes: Semi conservative nature of DNA replication, bi-directional replication, DNA polymerases, the replication complex: Pre-priming proteins, primosome, replisome, rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

Unit II **No. of Hours: 15**

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, non-homologous end joining. Homologous recombination: models and mechanism.

Unit III **No. of Hours: 15**

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, initiation, elongation and termination of RNA chains. Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5′ capping, polyadenylation, splicing of mRNA, rRNA and tRNA.

Unit IV **No. of Hours: 15**

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), genetic code and its characteristics, prokaryotic and eukaryotic translation: ribosome structure and assembly, charging of tRNA, aminoacyltRNAsynthetases, mechanism of initiation, elongation and termination of polypeptides, fidelity of translation, inhibitors of translation. Posttranslational modifications of proteins.

Learning Outcomes:

Upon successful completion of this course, participants will be able to interpret the outcome of experiments that involve the use of recombinant DNA technology and other common gene analysis techniques.

Text Books:

1. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2017) Molecular Biology of the Gene (VII Edition.), Pearson Pub. ISBN: 978-93-325-8547-8.
2. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. (2014) Molecular Biology of the Cell. 6th Edition. W. W. Norton & Company. ISBN: 978-0815344643

Reference Books:

1. Benjamin Lewin (2017) Genes XII. Jones and Bartlett Publishers. ISBN-13: 978-1284104493
2. Michael R. Green and J. Sambrook (2013) Molecular cloning: A laboratory manual. 4 th Edition. Viva Books Private Limited. ISBN-13: 978-1621821045
3. George M. Malacinski (2015) Freifelders Essentials Of Molecular Biology. Jones & Bartlett Publishers. ISBN-13: 978-9384323059

Course Name: Fundamentals of Molecular Biology Laboratory

Course Code: BTY242A

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Isolation of DNA from animal and plant tissue using classical methods
2. Isolation of RNA from animal and plant tissue using classical methods
3. Isolation of plasmid DNA from E. coli using boiling-prep and alkali lysis method
4. Quantitation of nucleic acids
5. Restriction fragment length polymorphism
6. Agarose gel electrophoresis
7. Polyacrylamide gel electrophoresis
8. Elution of nucleic acids from agarose gel
9. Primer Designing
10. Polymerase Chain Reaction

Course Name: Fundamentals of Plant Biotechnology

Course Code: BTY111A

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The aim is to teach set of in vitro techniques, methods and strategies related to plant biotechnology. Students will learn how to create genetic variability for the improvement of crops, to improve the state of health of planted material and to increase the number of desirable germplasm.

Course Contents:

Unit I **No. of Hours: 15**

Introduction, cyto and organogenic differentiation, Types of culture and their applications: Seed, embryo, callus, organs, cell and protoplast culture. Micropopagation: axillary bud proliferation, meristem and shoot tip culture, bud culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation.

Unit II **No. of Hours: 15**

In vitro haploid production Androgenic methods: Anther culture, Microspore culture.. 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.

Unit III **No. of Hours: 15**

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, methods, applications and disadvantages.

Unit IV **No. of Hours: 15**

Development of transgenic plants, Gene subtraction and gene addition approaches, examples, application of transgenic plants towards agriculture, Plant growth promoting bacteria and relevant effects. Nitrogen fixation, nitrogenase, hydrogenase, nodulation, biocontrol of pathogens.

Entrepreneurship in plant tissue culture, various schemes & funding for setting up of commercial PTC units. Protection of plant varieties and Farmers rights and intellectual

property rights.

Learning Outcomes:

Successful students will be able to explain the basics of the physiological and molecular processes that occur during plant growth and development and during environmental adaptations. Can understand how biotechnology has been used to develop knowledge of complex processes that occur in the plant. Will be able to use basic biotechnological techniques to explore molecular biology of plants. Will understand the processes involved in the planning, conduct and execution of plant biotechnology experiments. Will be able to explain how biotechnology is used for plant improvement and discuss the ethical implications of that use.

Text/ Reference Books:

1. Khan, F.A. Biotechnology Fundamentals. 3rd Edition. CRC Press, 2020. ISBN 9781138612082
2. Nelson, I. Plant Development and Biotechnology. SYRAWOOD Publishing House, 2019. ISBN 9781682867020
3. Chawla, H.S. Introduction to Plant Biotechnology. 3rd Edition. Oxford & IBH Publishing Co. Pvt. Ltd. 2008. Print. ISBN 9781578086368
4. Bhojwani, S.S. and Razdan, M.K. Plant Tissue Culture: Theory and Practice. 5th Edition. Elsevier Science. 2005. Print. ISBN: 9780080539096
5. Gupta, P.K. An Introduction to Biotechnology. Rastogi Publications, India. 1990. Print. ISBN: 978-81-7133-937-2
6. Reinert, J. and Bajaj, Y.P.S. Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture, Springer Verlang, Berlin, 1977. Print. ISBN 978-3-662-02279-5
7. Razdan, M.K. Introduction to Plant Tissue Culture. 2nd Edition. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. 2006. Print. ISBN1578082374, 9781578082377
8. Singh, B.D. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi. 2013. Print. ISBN: 8127220744, 9788127220747

Course Name: Fundamentals of Plant Biotechnology Laboratory

Course Code: BTY112A

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Methods of sterilization
2. Preparation of simple growth nutrient (Knop's medium) full strength, solid and liquid.
3. Preparation of complex nutrient medium (Murashige&Skoog's medium)
4. Callus induction and sub-culturing.
5. To select, prune, sterilize and prepare an explant for culture.
6. Significance of growth hormones in culture medium.
7. Embryo excision and culturing on media
8. To demonstrate various steps of Micropropagation.
9. Isolation of plant genomic DNA from the leaf sample
10. Suspension cultures and their maintenance.

Course Name: General Chemistry – II

Course Code: CHE257

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

To familiarize the students with basic concepts of physical and organic chemistry and their applications in predicting the structure and behavior of molecules.

Course Contents:

CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY-I

Section A: Physical Chemistry-1

Unit I **No. of Hours: 10**

Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Unit II **No. of Hours: 10**

Chemical Equilibrium:

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between *Kp*, *Kc* and *Kx* for reactions involving ideal gases.

Unit III **No. of Hours: 10**

Ionic Equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases,

pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Section B: Organic Chemistry-2

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Unit IV **No. of Hours: 8**

Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene).

Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Unit V **No. of Hours: 10**

Alkyl and Aryl Halides

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution reactions.

Preparation: from alkenes *and* alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile &isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer

&Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH2/NH3 or NaNH2.

Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Unit VI **No. of Hours: 12**

Alcohols: *Preparation:* Preparation of primary, secondary and tertiary alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation *Diols:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) *Preparation:* Cumenehydroperoxide method, from diazonium salts.

Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde)

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemmensen reduction and Wolff Kishner reduction. Meerwein-PondorffVerley reduction.

Learning Outcomes:

On successful completion of the course students will be able to develop understanding of fundamentals of physical and organic chemistry. Students should be able to provide nomenclature and predict properties of organic compounds; classify, explain and apply fundamental reactions; apply concepts of thermodynamics and reaction equilibrium in predicting the structure and properties of molecules.

Text/ Reference Books:

1. T. W. Graham Solomons: Organic Chemistry, John Wiley and Sons.
2. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
3. I.L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
4. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
5. ArunBahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.
6. G. M. Barrow: Physical Chemistry Tata McGraw-Hill. 2007.
7. G. W. Castellan: Physical Chemistry 4th Edn. Narosa. 2004.
8. J. C. Kotz, P. M. Treichel& J. R. Townsend: General Chemistry CengageLening India Pvt. Ltd., New Delhi. 2009.

9. B. H. Mahan: University Chemistry 3rd Ed. Narosa. 1998.
10. R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York. 1985.

Course Name: General Chemistry – II Laboratory

Course Code: CHE258

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

Section A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO3, NH4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic equilibria

pH measurements

a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

b) Preparation of buffer solutions:

   (i) Sodium acetate-acetic acid

   (ii) Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallization, determination of melting point and calculation of quantitative yields to be done.

a) Bromination of Phenol/Aniline

b) Benzoylation of amines/phenols

c) Oxime and 2, 4 dinitrophenylhydrazone of aldehyde/ketone

Reference Books

1. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
2. F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman. 1960.
3. B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

Course Name: Molecular Diagnostics

Course Code: BTY382

Credits Components: Theory

Total Credits			
L	T	P	Credits
2	0	0	2

Course Objective:

The aim is to understand the molecular basis of various diagnostic techniques and to gain an exposure to recent techniques in genome and proteome analysis.

Course Contents:

Unit I **No. of Hours: 8**

Immunoassays: Direct, indirect, competitive, dot and sandwich ELISA. Enzymes and types of antisera available in immunoassays, purification and standardization of antigen and specific antibodies. Radioimmunoassay (RIA), western blotting, immuno-tissue printing and immune-capture PCR

Unit II **No. of Hours: 7**

Nucleic acid based methods: Southern and Northern hybridization methods, methods of radiolabeled and non-radiolabeled probe preparation. Polymerase chain reaction, real-time and quantitative PCR, reverse transcription PCR, DNA fingerprinting

Unit III **No. of Hours: 8**

DNA Sequencing: Maxam-Gilbert method Manual and Automated Sanger sequencing, Pyrosequencing and Next Generation Sequencing (NGS).

UNIT-IV **No. of Hours: 8**

Protein identification methods: 2D gel electrophoresis, MALDI-TOF, GLC, HPLC, Electron microscopy, flow cytometry and cell sorting.

Learning Outcomes:

Student will study about the cellular structure and function, especially DNA and RNA, to molecular diagnostic procedures. Gain a thorough working knowledge of nucleic acid extraction, resolution and detection. Gain a solid foundation in the most commonly utilized molecular diagnostic testing protocols. Apply the knowledge of molecular testing to the most commonly performed applications in the clinical laboratory such as: nucleic acid extraction, resolution and detection, analysis and characterization of nucleic acids and proteins, nucleic acid amplification and DNA sequencing.

Text Books:

1. Wilson, K. and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology. 7th Edition. Cambridge University Press. 2010. ISBN-13: 978-0521731676
2. Brown, T.A. Gene cloning and DNA analysis: An Introduction. 7th Edition. Wiley-Blackwell. 2016. ISBN-13: 978-1119072560

Reference Books:

1. George P. Patrinos, Wilhelm Ansorge, Phillip B. Danielson. 2016. Molecular Diagnostics. Publisher: Academic Press; 3 rd edition. ISBN-13: 978-0128029718
2. Jenni Punt, Sharon Stranford, Patricia Jones, Judith A Owen. 2018. Kuby Immunology. WH Freeman Publisher, 8th ed. ISBN-13: 978-1319114701
3. George P. Patrinos, Wilhelm J. Ansorge, Phillip B. Danielson. 2017. Molecular Diagnostics. 3 rd Edition. Academic Press Elsevier. ISBN: 978-0-12-802971-8

Course Name: Animal Diversity-II

Course Code: ZOO103

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

To acquaint students with the general characters and classification of chordates and the affinities between different groups.

Course Contents:

Unit I **No. of Hours: 20**

- Origin and general characters of chordates with detailed classification of each animal group with special emphasis on salient features and interrelationships
- Hemichordata: Hemichordates as link between non-chordates and chordates
- Urochordata: development, affinities, retrogressive metamorphosis.
- Cephalochordata: development, affinities.

Unit II **No. of Hours: 10**

- Cyclostomata: migration.
- Pisces: scales, fins, migration, parental care.

Unit III **No. of Hours: 12**

- Amphibia: Respiration, Parental care.
- Reptilia: Terrestrial adaptations, parental care.

Unit IV **No. of Hours: 18**

- Aves: Respiration, Flight, Endothermy.
- Mammals: Integument, Dentition, Respiration, Reproduction

Learning Outcomes:

The course provides the biologist with some of the skills necessary for environmental survey (animal identification) identification of agricultural pests and biological control
An understanding of physiology and trophic level interactions for different groups of organisms (necessary for toxicological studies, eg. filter feeders & predators are important (bio concentrators of pollutants) an understanding of evolutionary relatedness (useful for identifying likely classes of organisms for pharmacologically-active substances in biotechnology, etc.) Recognition of organisms important in human health and commerce

(eg. parasites and modes of transmission, toxin producers, food sources, aqua culture prospects, etc).

Text Books:

1. Dhami, P.S., Dhami, J.K., *Chordate Zoology*, 5th ed., R. Chand & Co., New Delhi,2006.
2. Kotpal, R.L., *Text Book of Zoology- Vertebrates*, Rastogi Publications, Meerut, 2012.

Reference Books:

1. Parker, T.J., and Haswell, W.A., *A Text Book of Zoology Vertebrates*, 7th ed. Vol. II(eds. A.J. Marshall &Williams, W.D.), Mac Millan, London, 1972.
2. Dodson, E.O., *A Text Book of Zoology*, CBS Publishers & Distributors, Delhi, 1976.

Course Name: Animal Diversity-II Laboratory

Course Code: ZOO104

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

General survey of chordates through charts/models and e-resources:

- Hemichordata: *Balanoglossus*
- Protochordata - *Herdmania*, pharynx and spicules of *Herdmania, Molgula, Ciona, Ascidia, Botryllus, Pyrosoma, Salpa, Doliolum, Oikopleura*and*Branchiostoma*, T.S. *Branchiostoma*through different regions
- Cyclostomata – *Myxine, Petromyzon*and*Ammocoetes*larva. Chondrichthyes - *Zygaena, Pristi.,Narcine, Trygon*and*Rhinobatos*.
- Actinopterygii – *Polypterus, Acipenser, Lepidosiren, Mystus, Catla, Labeorohita, Cirrhinusmrigala, Cyprinuscarpio, Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Ostracion, Tetradon, Echeneis, Lophius, Solea*and*Anguilla*, cycloid and ctenoid scales of fishes.
- Dipneusti (Dipnoi) – Any of the lungfishes.
- Amphibia – *Necturus, Proteus, Amphiuma, Salamandra, Ambystoma, Triton, Hyla, RhacophorusIchthyophis*and*Axolotl* larva.
- Reptilia- Tortoise, Turtle, *Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon, Typhlops, Python,Ptyas, Bungarus, Naja, Hydrus, Vipera, Crocodilus, Gavialis*and Alligator.
- Aves: *Anas, Ardea, Milvus, Pavo, Tyto, Alcedo, Eudynamis, Casuarius;* and *Struthio.*
- Mammalia – *Echidna, Ornithorhynchus, Macropus, Erinaceus, Sorex, Loris, Macaca, Manis, Hystrix, Funambulus, Felis, Capra, Canis, Herpestes, Pteropus*and*Leo*.

Demonstration of anatomy of the following animals through charts/models/e-resources

- *Herdmania*: General Anatomy, pharynx and spicules
- *Labeo*: Digestive and reproductive systems, skeleton

- *Rana:* Digestive, arterial, venous and reproductive systems. Skeleton
- *Varanus:* Digestive, arterial, venous and reproductive systems. Skeleton
- Hen: Digestive, arterial, venous and reproductive systems. Skeleton
- Rat: Digestive, arterial, venous, urinogenital systems, skeleton

Course Name: Microbial Genetics

Course Code: MIC225

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

This course will introduce the students to various aspects of microbial genetics including genome organization in bacteria and phages, plasmids, genetic recombination and transposition in bacteria.

Course Contents:

Unit I **No. of Hours: 18**

Genome Organization and Mutations

Genome organization: *E. coli*, *Saccharomyces*, *Tetrahymena*

Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens;Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of mutations

Reversion and suppression: True revertants; Intra- and inter-genic suppression; Ames test; Mutator genes, Genome organization of *Aspergillusnidulans*

Unit II **No. of Hours: 10**

Plasmids

Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast- 2 μ plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids

Unit III **No. of Hours: 12**

Mechanisms of Genetic Exchange

Transformation - Discovery, mechanism of natural competence

Conjugation - Discovery, mechanism, Hfr and F’ strains, Interrupted mating technique and time of entry mapping

Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers, Recombination and genome mapping in viruses

Unit IV **No. of Hours: 8**

Phage Genetics

Features of T4 genetics, Genetic basis of lytic versus lysogenic switch of phage lambda

Unit V **No. of Hours: 12**

Transposable elements

Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon

Eukaryotic transposable elements - Yeast (Ty retrotransposon), Drosophila (P elements), Maize (Ac/Ds)

Uses of transposons and transposition.

Learning Outcomes:

On completion of the course, the student should be able to:

- explain the processes behind mutations and other genetic changes
- identify and distinguish genetic regulatory mechanisms at different levels
- solve theoretical and practical problems in genetic analysis particularly concerning genetic mapping and strain construction
- identify genes and mutations in non-annotated sequence data from databases by means of relevant bioinformatics programs
- plan basic experiments in microbial genetics concerned with clarifying phenotypes and their relationship with the genotype
- use common methods in microbial genetics
- describe and summarize experimental work in a correct way in a laboratory notebook.

Text Books:

1. Watson JD, Baker TA, Bell SP et al. *Molecular Biology of the Gene,* 6th Ed., Benjamin Cummings. 2008. Print
2. Gardner EJ, Simmons MJ, Snustad DP. *Principles of Genetics*. 8th Ed. Wiley-India. 2008. Print

Reference Books:

1. Klug WS, Cummings MR, Spencer, C, Palladino, M. *Concepts of Genetics*, 10th Ed., Benjamin Cummings. 2011. Print
2. Krebs J, Goldstein E, Kilpatrick S. *Lewin's Essential Genes*, 3rd Ed., Jones and

Bartlett Learning. 2013. Print

3. Pierce BA. *Genetics: A Conceptual Approach*, 4th Ed., Macmillan Higher Education Learning. 2011. Print

Course Name: Microbial Genetics Laboratory

Course Code: MIC226

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Preparation of Master and Replica Plates
2. Study the effect of chemical (HNO_2) and physical (UV) mutagens on bacterial cells
3. Study survival curve of bacteria after exposure to ultraviolet (UV) light
4. Isolation of Plasmid DNA from *E.coli*
5. Study different conformations of plasmid DNA through Agaraose gel electrophoresis.
6. Demonstration of Bacterial Conjugation
7. Demonstration of bacterial transformation and transduction
8. Demonstration of AMES test

Course Name: Proteins and Enzymes

Course Code: MBB218

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

To familiarize the students with the properties and techniques to isolate and study proteins, with emphasis on enzyme action, regulation and application in the field of medicine and industry.

Course Contents:

Unit I **No. of Hours: 15**

Introduction to proteins

Polypeptides and proteins. Subunit structures, conjugated proteins, diversity of function.

Isolation and analysis of proteins

Techniques to isolate and analyze proteins- salt fractionation, ion-exchange chromatography, gel permeation, HPLC, SDS-PAGE, IEF. Protein primary structure - sequencing by Edman degradation, use of enzymes and chemical reagents to obtain overlap peptides. Synthesis of peptides using Merrifeld method.

Unit II **No. of Hours: 15**

Introduction to protein three-dimensional structures

Secondary structure: alpha-helices and beta-sheets, Ramachandran maps. Nature of non-covalent bonds and covalent bonds in protein folding. Tertiary and quaternary structures.

Myoglobin and haemoglobin - structure and function

Oxygen binding curves, cooperativity models for haemoglobin.

Unit III **No. of Hours: 15**

Introduction to enzyme catalysis

Features of enzyme catalysis, superior catalytic power. General mechanisms of catalysis. Nomenclature.

Enzyme kinetics

Principles of reaction rates, order of reactions and equilibrium constants. Derivation of Michaelis-Menten equation. Significance of Km and Vmax. Catalytic efficiency parameters. Competitive and mixed inhibitions. Kinetics and diagnostic plots. Types of irreversible inhibitors.

Unit IV **No. of Hours: 15**

Mechanisms of enzyme action and regulation

Mechanism of action of chymotrypsin. Inhibitors of enzymes - antibiotics. Regulation of enzyme activity and its importance - aspartate transcarbamoylase**.**

Enzymes in medicine and industry

Enzymes used in clinical biochemistry as reagents, diagnostics and therapy. Role of immobilized enzymes in industry.

Learning Outcomes:

On completion of this course the students will be able to describe/recognize amino acid and protein structures, describe their physical and chemical properties, and predict how their ionic charges change with pH; Will describe the chemical nature of enzymes and their function in biochemical reactions. Explain how enzyme activity is (a) regulated, and (b) affected by temperature, pH, and concentration. Apply the knowledge in application of enzymes in industry.

Text/ Reference Books:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M.,W.H. Freeman and Company (New York), ISBN:13; 978-1-4641-0962-1 / ISBN:10-14641- 0962-1.
2. Fundamentals of Enzymology (1999) 3rd ed., Price, N.C and Stevens, L., OxfordUniversity Press Inc., (New York), ISBN:13: 978-0-19-806439-8.

Course Name: Proteins and Enzymes Laboratory

Course Code: MBB219

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Protein estimation by UV absorbance and Biuret method.
2. Protein microassay by Lowry/Bradford method.
3. Ammonium sulphate fractionation of crude homogenate from germinatedmung bean.
4. Setting up assay for acid phosphatase and activity measurements of theammonium sulphate fractions (progress curve and effect of pH).
5. Determination of Km and Vmax of enzyme enriched fraction.
6. Inhibition of acid phosphatase activity by inorganic phosphate.

Course Name: Bioprocess Technology

Course Code: BTY351

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The aim is to study how living matter, in the form of organisms or various biomolecules, under specific optimal conditions can be implied to make a desired product.

Course Contents:

Unit I **No. of Hours: 15**

Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fed batch and Continuous culture.

Unit II **No. of Hours: 15**

Design of bioprocess vessels- Significance of impeller, baffles, Sparger; Types of culture/production vessels- Continuous stirred-tank reactor, Airlift; cyclone column; Fluidized bed reactor, Packed tower and their application in production processes. Principles of upstream processing – Media preparation, inocula development and sterilization.

Unit III **No. of Hours: 15**

Introduction to oxygen requirement in bioprocess; volumetric mass transfer coefficient; oxygen transfer from gas bubble to cell, factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.

Unit IV **No. of Hours: 15**

Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and single cell proteins.

Learning Outcomes:

Student will be able to apply knowledge of biological science and engineering to bio-catalyzed reaction systems. Will understand mechanism and kinetics of enzyme/microbial catalyzed reactions, select suitable bioreactor for desired application and can select suitable separation system for downstream processing.

Text/ Reference Books:

1. Stanbury P, Whitaker A and Hall S, Principles of Fermentation Technology, Elsevier, 3rd Edition, 2016**.** ISBN: 9780444634085.
2. Jackson, A.T, Process Engineering in Biotechnology 2nd ed., Prentice Hall, Engelwood Cliffs. 2009, *ISBN*-10: 0070032122.
3. Pauline M. Doran, Bioprocess Engineering Principles, Elsevier, South Asia Edition, 2005. ISBN: 9780122208515.
4. Shuler, M and Kargi, F, Bioprocess Engineering Basic Concepts 2nd Edition, Prentice-Hall India.2006. ISBN: 9780130819086.
5. Doran, P. M. Bioprocess Engineering Principles, Elsevier Science & Technology Books. 2002. ISBN: 9788131200018.
6. Clarke K. G. Bioprocess Engineering: An introductory engineering and life science approach. Woodhead Publishing Limited. 2013. *ISBN*-13 : 978-1782421672.
7. Show P. L., Ooi C. W., Ling T. C. Bioprocess Engineering Downstream Processing. CRC Press, 2021 ISBN 9780367779658.
8. Claire K and Weichang Z Bioprocessing Technology for production of biopharmaceuticals and bioproducts. Wiley Press, 2018, ISBN:9781119378341

Course Name: Bioprocess Technology Laboratory

Course Code: BTY352

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Methods of sterilization.
2. Media preparation and inoculum development.
3. Calculation of bacterial growth curve.
4. Calculation thermal death point (TDP) of a microbial sample.
5. Production and analysis of ethanol.
6. Production and analysis of amylase.
7. Production and analysis of lactic acid.
8. Isolation of industrially important microorganism from natural resource.
9. Demonstration of fermenters.

Course Name: Introduction to Genetic Engineering

Course Code: BTY353A

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

Recombinant DNA technology refers to the process of manipulating the characteristics and functions of the original genes of an organism. The objective of this process is to introduce new physiological and physical features or characteristics. The students will learn how the genes can be cut and pasted from one organism to another and what its implications are.

Course Contents:

Unit I **No. of Hours: 15**

Molecular tools and applications - restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene recombination and gene transfer: transformation, episomes, plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), microinjection, electroporation, principle and applications of polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR

Unit II **No. of Hours: 15**

Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of genomic and cDNA library, screening of recombinants, reverse transcription, genome mapping, DNA fingerprinting, applications of genetic engineering; genetic engineering in animals: production and applications of transgenic mice, role of ES cells in gene targeting in mice, therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each)

Unit III **No. of Hours: 15**

Random and site-directed mutagenesis: PCR based methods of site directed mutagenesis, random mutagenesis, gene shuffling, production of chimeric proteins, translation product identification: HRT, HART, protein engineering concepts and examples (any two), protein-protein interaction: yeast two hybrid system, phage display library.

Unit IV **No. of Hours: 15**

Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and *A. rhizogenes*, Ti

plasmids, strategies for gene transfer to plant cells, direct DNA transfer to plants, gene targeting in plants, use of plant viruses as episomal expression vectors, genome/ gene editing: role of CRISPR/Cas9.

Learning Outcomes:

At the end of the course, the students should be able to:

1. isolate and purify nucleic acids for routine laboratory procedures,
2. explain the underlying mechanisms of gene cloning,
3. discuss the practical aspects of applying recombinant DNA technology,
4. explain the significance of model organisms in recombinant DNA technology,
5. describe recombinant gene expression systems.

Reference Books:

1. Kammermeyer, J. Genetic Engineering Fundamentals: An Introduction to Principles and Applications. Taylor & Francis Group, 2019. ISBN: 9780367451134
2. Brown, T.A. Gene Cloning and DNA Analysis: An Introduction. John Wiley & Sons, 2016. ISBN: 9781119072577
3. Caudy, A.A., Watson, J.D., Myers, R.M. and Witkowski, J.A. Recombinant DNA: Genes and Genomes. 3rd Edition. W.H. Freeman & Company. 2006. ISBN: 978-0716728665
4. Primrose, S.B. and Twyman, R.M. Principles of Gene Manipulation & Genomics.7th Edition. Oxford University Press. 2006. ISBN: 978-1405135443
5. Brown, T.A. Gene cloning and DNA analysis: An introduction.6th Edition. Wiley-Blackwell. 2010. ISBN: 978-1405181730
6. Sambrook, J., Fritsch, E.F. and Maniatis, T. Molecular cloning: A Laboratory Manual. Vol. I-III.2nd Edition. Cold Spring Harbor Laboratory, 1989. ISBN: 978-0-87969-309-1
7. Lodge, J., Lund, P. and Minchin, S. Gene Cloning: Principles and Applications. 1st Edition. Taylor & Francis. 2006. ISBN: 978-0748765348

Course Name: Introduction to Genetic Engineering Laboratory

Course Code: BTY354A

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Isolation of chromosomal DNA from plant cells
2. Isolation of chromosomal DNA from E. coli
3. Qualitative and quantitative analysis of DNA using spectrophotometer
4. Plasmid DNA isolation
5. Restriction digestion of DNA
6. DNA extraction from agarose gel
7. Making competent cells
8. Transformation of competent cells.
9. Demonstration of PCR

Course Name: Biotechnology And Human Welfare

Course Code: BTY 243

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

To study application of biotechnology in various areas e.g. industry, agriculture, environment, forensic and health.

Course Contents:

Unit I **No. of Hours: 15**

Industrial Biotechnology: Introduction, protein and metabolic engineering; enzyme and polysaccharide synthesis; Bioreactors and microbial activity and secretion; alcohol fermentation and production of antibiotics.

Environmental Biotechnology: Introduction, Bioremediation, Biodegradation of pollutants e.g. halogens, organic pollutants, hydrocarbons and agricultural wastes; development of biodegradable polymers such as PHB; Biosensors for environmental monitoring.

Unit II **No. of Hours: 15**

Agriculture Biotechnology: Introduction to genetic engineering for plants, Strategies for introducing biotic and abiotic stress resistance/tolerance genes to plants, interaction between plants and microbes, nitrogen fixation

Animal Biotechnology: DNA transfer techniques into mammalian cells, Transgenic animals and applications of Animal Biotechnology for biodiversity conservation and qualitative improvement of livestock.

Unit III **No. of Hours: 15**

Medical Biotechnology I

DNA fingerprinting and forensic analysis: solving crimes with molecular methods

Molecular Diagnostics: PCR to detect infectious diseases

Molecular Therapeutics: Antibodies, nucleic acids and proteins

Unit IV **No. of Hours: 15**

Medical Biotechnology II

Vaccines: live, attenuated, killed, subunit, Recombinant and DNA vaccines

Gene Therapy: Types of gene therapy, Ethical issues

Human genome project.

Learning Outcomes:

After the completion of the course, it is expected that students have understood the basic concepts of protein engineering and forensic science and their applications. It is also expected that in field of environment, they have learnt about role of biotechnology in waste management and are able to describe various concepts and principles of Bioremediation using microbes and plants.

Text/ Reference Books:

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd. ISBN: 978-8190675703
2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international Publishers. ISBN: 978-8122420852
3. B B et al Kaliwal(2017) Role of Animal Science in National Development Vol-2 Biotechnology for Human Welfare ISBN: 978-8170195597
4. BD Singh (2015) Biotechnology: Expanding Horizons. Kalyani publishers. ISBN: 978-9327222982

Course Name: Biotechnology And Human Welfare Laboratory

Course Code: BTY244

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. To perform ethanolic fermentation using Baker's yeast
2. Study of a plant part infected with a microbe
3. To perform quantitative estimation of residual chlorine in water samples
4. Isolation and analysis of DNA from minimal available biological samples
5. Case studies on Bioethics

Course Name: Medical Microbiology

Course Code: BTY399

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The aim is to study the prevention, diagnosis and treatment of infectious diseases. In addition, various clinical applications of microbes for the improvement of health.

Course Contents:

Unit I **No. of Hours: 15**

Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels. Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: *S. aureus, S. pyogenes, B. anthracis, C. perferinges, C. tetani, C. botulinum, C. diphtheriae M. tuberculosis, M. leprae*.

Unit II **No. of Hours: 15**

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: *E. coli, N. gonorrhoea, N. meningitidis, P. aeruginosa, S. typhi, S. dysenteriae, Y. pestis, B. abortus, H. influenzae, V. cholerae, M. pneumoniae, T. pallidum M. pneumoniae,* Rickettsiaceae, Chlamydiae.

Unit III **No. of Hours: 15**

Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses.

Unit IV **No. of Hours: 15**

Fungal and Protozoan infections. Dermatophytoses (Trichophyton, Microsporun and Epidermophyton) Subcutaneous infection (Sporothrix, Cryptococcus), systemic infection (Histoplasma, Coccidoides) and opportunistic fungal infections (Candidiasis, Aspergillosis), Gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis,

Malaria)

Learning Outcomes:

The successful completion of this course will help the student to understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue. Students will also be able to recall the relationship of infection to symptoms, relapse and the accompanying pathology and explain the methods of microorganisms control, e.g. chemotherapy & vaccines, solve problems in the context of this understanding, and demonstrate practical skills in fundamental microbiological techniques.

Text Books:

Ananthanarayan R. and Kapil A. (2013) Ananthanarayan & Panicker's Text book of Microbiology, 9th Ed. Paperback, Orient BlackSwan

Reference Books:

1. Brooks, G.F., Carroll, K.C., Butel, J.S. and Morse, S.A. Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication. 2007. ISBN: 9780071815789
2. Goering, R, Dockrell, H, Zuckerman, M and Wakelin, D. Mims' Medical Microbiology. 5th edition. Elsevier. 2007. ISBN: 9780808924401
3. Willey, J.M., Sherwood, L.M., and Woolverton, C.J. Prescott, Harley and Klein's Microbiology. 8th edition. McGraw Hill Higher Education. 2008. ISBN: 9780071313674
4. Murray, P., Rosenthal, K., Pfaller, M. Medical Microbiology 8th Edition. Elsevier Paperback. 2015. ISBN: 9780323299565
5. Baron, S. Medical Microbiology. 4th edition Univ of Texas Medical Branch. 1996. ISBN: 978-0963117212

Course Name: Medical Microbiology Laboratory

Course Code: BTY400

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Identification of pathogenic bacteria (any two) based on cultural, morphological and biochemical characteristics.
2. Growth curve of a bacterium.
3. To perform antibacterial testing by Kirby-Bauer method.
4. To prepare temporary mounts of Candida by appropriate staining.
5. To prepare temporary mounts of Aspergillus by appropriate staining.
6. Staining methods: Gram's staining permanent slides showing Acid fast staining
7. Capsule staining
8. Spore staining.

Course Name: Biostatistics And Bioinformatics

Course Code: BTY395

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The course focuses on design, analysis, and interpretation of data for research studies. It also gives insight into the uses of computation to better understand biology which involves analysis of biological data, particularly DNA, RNA, and protein sequences.

Course Contents:

Unit I **No. of Hours: 15**

Types of data, collection of data; primary & secondary data, classification and graphical representation of statistical data. Measures of central tendency and dispersion. Measures of Skewness and Kurtosis. Probability classical & axiomatic definition of probability, theorems on total and compound probability), Elementary ideas of Binomial, Poisson and Normal distributions.

Unit II **No. of Hours: 15**

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), correlation and regression. Emphasis on examples from biological sciences.

Unit III **No. of Hours: 15**

History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web. Searching Databases: SRS, Entrez, sequence similarity searches-BLAST, FASTA, Data submission. Genome annotation: Pattern and repeat finding, gene identification tools. Alignments: Pairwise and multiple sequence alignment, using it on the web, interpreting results, phylogenetic analysis

Unit IV **No. of Hours: 15**

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of data generating techniques and bioinformatics problem posed by them-restriction digestion, chromatograms, blots, PCR, microarrays, mass Spectrometry.

Learning Outcomes:

Upon successful completion of the course, the student has advanced knowledge of topics, algorithms, tools and methods in the field of Bioinformatics; has knowledge of statistical methods for analysis of biological data; can analyze and use bioinformatic methods associated with advanced sequence alignment, database searches, genome analysis and protein structural studies; can use statistical operations in biology.

Text Books:

1. Balakrishnan N. (2003) Statistical Methods and Practice – Recent Advances, Narosa Publishing House Private Limited.
2. Preston Gralla (2000) How the Internet Work, Tech. Media.

Reference Books:

1. Rao, G.N. Biostatistics & Research Methodology. PharmaMed Press, 2018. ISBN: 9789387593527.
2. Williams, B. Biostatistics: Concepts and Applications for Biologists. CRC Press, 2017. ISBN: 9781351367905
3. Lesk, A. Introduction to Bioinformatics. 5th Edition. Oxford University Press, 2019. ISBN: 9780198794141
4. Banerjee, P.K. Introduction to Biostatistics. 4th Edition. S. Chand & Co. Ltd. 4th Edition. 2013. ISBN: 9788121923293
5. Pevzner, P. and Shamir, R. Bioinformatics for Biologists. 1st Edition. Cambridge University Press. 2011. ISBN: 978-1107648876
6. Gupta S.P. Statistical Methods, 28th Edn. Sultan Chand and Sons. 2009.
7. Sokal, R.R. and Rohlf, F.J. Introduction to Biostatistics. 2nd Edition. Dover Publications. 2009. ISBN: 978-0486469614
8. Lesk, A.M. Introduction to Bioinformatics. 3rd Edition. Oxford University Press. 2008. ISBN: 978-0199208043
9. Bourne, P.E. and Weissig, H. Structural Bioinformatics. 2nd Edition. John Wiley & Sons Ltd. 2009. ISBN: 0 471201995

Course Name: Biostatistics And Bioinformatics Laboratory

Course Code: BTY396

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Based on graphical Representation
2. Based on measures of Central Tendency & Dispersion
3. Based on Distributions Binomial Poisson Normal
4. Based on t, f, z and Chi-square
5. Introduction to SPSS and MATLAB
6. Sequence information resource
7. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene,
8. Protein information resource (PIR)
9. Understanding and using: PDB, Swissprot, TREMBL
10. Using various BLAST and interpretation of results.
11. Retrieval of information from nucleotide databases.
12. Sequence alignment using BLAST.
13. Multiple sequence alignment using Clustal W.

Course Name: Introduction to Food Biotechnology

Course Code: BTY397A

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The course aims at discussing the microbiological and technological principles of industrial application of microorganisms and enzymes in food production and processing systems to provide useful products and services.

Course Contents:

Unit I **No. of Hours: 15**

History of microbiology of food - microbial growth pattern, physical and chemical factors influencing structure of micro-organisms - types of micro-organism normally associated with food - mold, yeast and bacteria. Micro-organisms in natural food products and their control - contaminants of foods -stuffs, vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing - biochemical changes caused by micro-organisms - deterioration of various types of food products - food poisoning and microbial toxins. Food borne diseases.

Unit II **No. of Hours: 15**

Scope and importance of food processing - principles and methods of food preservation - freezing, heating, dehydration, canning, additives, fermentation, irradiation, extrusion cooking, hydrostatic pressure cooking, dielectric heating, microwave processing.

Unit III **No. of Hours: 15**

Introduction to packaging - packaging principles and operation - package functions and design - methods to extend shelf life. Food fermentation, alcoholic beverages, fermented milk products, fermented sauces.

Unit IV **No. of Hours: 15**

Objectives, importance and functions of quality control - methods of quality -assessment of food materials - fruits, vegetables, cereals, dairy products, meat, poultry, egg and processed food products - sampling and specification of raw materials and finished products - statistical quality controls - food regulations, grades and standards - food adulteration, food safety and evaluation.

Learning Outcomes:

Students should be able to appreciate the positive role and benefits of microorganisms and enzymes in food production, processing, and preservation; understand basic biological and chemical processes of living cells, enzymes, and microbial nutrition in relation to fermentation processes; understand principles of inoculum /starter culture development for industrial fermentations and fermentor /reactor design, control and operation; and understand both upstream and downstream unit operations and technologies used for substrate preparation and recovery and purification of fermentation products.

Reference/ Text Books:

1. Pelezar, H.J., Rober, D. Microbiology. 5th Edition. McGraw Hill:New York., 2012
2. Fundamentals of Food Biotechnology, Byong H. Lee, Wiley Online Library, 2014, ISBN:9781118384954
3. Advances in Food Biotechnology, Ravishankar Rai V, Wiley Online Library, 2015, ISBN:9781118864555
4. Food Traceability, McEntire J, Kennedy A, Springer, 2019, ISBN 978-3-030-109028
5. Lee B.H. Fundamentals of Food Biotechnology. Wiley, 2014, ISBN:9781118384947 .
6. Gutierrez-Lopez, G. F. and Barbosa-Canovas G. V. Food science and food biotechnology. CRC Press, 2013, ISBN 1-56676-892-6.
7. Bielecki, S., Polak, J., Tramper, J. Food Biotechnology. Elsevier Science, 2000, ISBN: 9780444505194.

Course Name: Introduction to Food Biotechnology Laboratory

Course Code: BTY398A

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. MBRT of milk samples and their standard plate count.
2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3. Isolation of any food borne bacteria from food products.
4. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
5. Isolation of spoilage microorganisms from bread.
6. Preparation of Yogurt/Dahi.
7. Staining methods of bacteria
8. Measurement of bacterial size

Course Name: Basics of Animal Biotechnology

Course Code: BTY391A

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The aim of the course is to provide equal importance to areas like *in vitro* fertilization, animal cell and tissue culture, hormone vaccine and important enzyme production through animal biotechnology.

Course Contents:

Unit I **No. of Hours: 15**

Introduction: Historical background, objectives, advantages and limitations of animal biotechnology; Set-up of an animal biotechnology lab and the aseptic technique – physical and chemical procedures, types of chemical agents and their applications/limitations.

Unit II **No. of Hours: 15**

Culture Techniques: Media and its properties, Complete media, serum and serum-free media; primary culture – procedure and its applications, tissue disaggregation methods, subculture and cell lines; adherent and monolayer cultures.

Unit III **No. of Hours: 15**

Gene transfer methods in Animals: Calcium Phosphate Precipitation, DEAE Dextran Mediated Transfection, Electroporation, Microinjection, embryonic stem cell gene transfer, Gene gun and Retrovirus Gene transfer.

Animal propagation: Artificial insemination, IVF, animal clones. Conservation biology – Embryo transfer techniques. Introduction to stem cell technology and its applications, Techniques for scale up of animal cell culture and cryopreservation.

Unit IV **No. of Hours: 15**

Introduction to transgenics: Transgenic animals – mice, cow, pig, sheep, goat, bird, insect. Animal diseases in need of help from biotechnology – foot and mouth disease, Trypanosomiasis.

Genetic modification in Medicine: gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

Learning Outcomes:

By the end of the course, students would be able to: Comprehend the fundamental

concepts of animal cell culture, and its importance. Discuss the significance of transgenesis with reference to animal models. Explain the principles and applications of animal cloning and gene therapy along with ethical concern.

Text Books:

1. Freshney, R. I. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. 7th Edition. Wiley-Blackwell, 2010. ISBN: 978-1-118-87365-6
2. Verma, A and Singh, A. Animal Biotechnology, Elsevier 2nd Edition, Academic Press, 2020, **ISBN:** 9780128117101
3. **Singh**, B., **Mal**, G., **Gautam,** S.K., **Mukesh**, M. Advances in Animal Biotechnology, Springer, 2019, ISBN 978-3-030-21309-1
4. **Ramadass, P.** Animal biotechnology: recent concepts and developments. MJP Publishers, 2019, ISBN-13 : 978-1074443917.
5. Kumaresan V. Animal Biotechnology. Saras Publication, 2019, ISBN: 9789386519481
6. John R.W. M. Animal Cell Culture: A Practical Approach, OUP Oxford, 2000, ISBN **978-0199637966**

Reference Books:

1. Masters, J.R.W. Animal Cell Culture: A Practical Approach. 3rd Edition. Oxford University Press. 2000. ISBN: 9780199637966
2. Twine, R. Animals as Biotechnology: Ethics, Sustainability and Critical Animal Studies. 1st Edition. Routledge Publishers. 2010. ISBN: 978-1138867000
3. Verma, A. and Singh, A. Animal Biotechnology: Models in Discovery and Translation. 1st Edition. Academic Press. 2013. ISBN: 9789351073420

Course Name: Basics of Animal Biotechnology Laboratory

Course Code: BTY392A

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Sterilization techniques: Theory and Practices: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium
5. Isolation of lymphocytes for culturing
6. Isolation of rat macrophages from peritoneum for culturing
7. Primary Lymphoid culture
8. DNA isolation from animal tissue
9. Quantification of isolated DNA
10. Resolving DNA on Agarose Gel.

Course Name: Genomics And Proteomics

Course Code: BTY363

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The course helps in developing a detailed understanding of eukaryotic genome complexity and organization. The students will be familiarized with the techniques in Genomics and Proteomics.

Course Contents:

Unit I **No. of Hours: 15**

The origin of genes and genomes: eubacteria, eukaryotes, archaebacteria. Introduction of first genome: hypercycle concept, backward evolution of metabolic pathways, origin of organelle genome, genic and non-genic DNA, hypothesis for introduction of non-genic DNA, Acquisition of new genes. The origins of introns. Basic principles of protein structure.

Unit II **No. of Hours: 15**

Restriction mapping, DNA & RNA finger printing: technique and applications, DNA sequencing-chemical and enzymatic methods: sanger seqencing, maxam-gillbert sequencing, whole genome shotgun sequencing, hierarchical shotgun sequencing, pyrosequencing, next generation sequencing, the human genome: detailed methodology adopted by IHGSC and Celrea genomics.

Unit III **No. of Hours: 15**

Phylogeny, SAGE, ESTs, AFLP & RFLP analysis. 2D– gel electrophoresis and mass spectroscopy for proteome analysis. Protein – protein interactions: Yeast- two hybrid method, affinity chromatography, co-immunoprecipitation, far western blot analysis, pull down assay, GFP tags, proteome- wide interaction maps: significance of interactomics, protein microaarays: analytical, reverse phase, functional microarray.

Unit IV **No. of Hours: 15**

Modelling of three-dimensional structure of a protein from amino acid sequence. Homology modeling: template recognition, alignment correction, backbone generation, loop and side chain modeling, model optimization and validation. Modeling mutants. Designing proteins. Analysis of nucleic acid / protein sequence and structure data,

genome and proteome data using web-based tools.

Learning Outcomes:

On the completion of the course the student will be able to infer the basic concepts of genomics, transcriptomics and proteomics; list and discuss the use of genomics and proteomics in human health; suggest and outline solution to theoretical and experimental problems in Genomics and Proteomics field

Reference Books:

1. Saraswathy, N., Ramalingam, P. Concepts and Techniques in Genomics and Proteomics. Elsevier Science, 2016. ISBN: 9780081017302.
2. Malkoff, C. Exploring Genomics, Proteomics and Bioinformatics. Syrawood Publishing House, 2016. ISBN: 9781682862537.
3. Thangadurai, D., Sangeetha, J. Genomics and Proteomics: Principles, Technologies, and Applications. CRC Press, 2015. ISBN: 9781498723114.
4. Twyman, R. Principles of Proteomics. 2nd Edition. Garland Science. 2013. ISBN: 9780815344728Mount, D. Bioinformatics: Sequence and Genome Analysis. 2nd Edition. Cold Spring Harbor Laboratory Press. 2013. ISBN: 978-0879697129
5. Gibson, G. and Muse, S.V. A Primer of Genome Science. 3rd Edition. Sinauer Associates, Inc. 2009. ISBN: 978-0878932368
6. Brown, T.A. Genomes III. 3rd Edition. Garland Science. 2006. ISBN: 978-0815341383
7. Caudy, A.A., Watson, J.D., Myers, R.M. and Witkowski, J.A. Recombinant DNA: Genes and Genomes. 3rd Edition. W.H. Freeman & Company. 2006. ISBN: 978-0716728665
8. Xiong, J. Essential Bioinformatics. 1st Edition. Cambridge University Press. 2006. ISBN: 9780521600828

Course Name: Genomics And Proteomics Laboratory

Course Code: BTY364

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Electrophoretic separation of plasmid DNA.
2. Restriction, digestion & ligation of DNA.
3. Native PAGE
4. SDS PAGE
5. Gene finding tools and genome annotation- Gen Scan, Net Gene, Hmm gene.
6. Use of SNP databases at NCBI and other sites
7. Detection of Open Reading Frames using ORF Finder
8. Proteomics 2D PAGE database
9. Comparison of two given genomes- Mummer.
10. Homology modelling of 3-D structure from amino acid sequence: SWISS-MODELLER
11. Graphics tools: SWISS- PDB Viewer.

Course Name: Basic Virology

Course Code: BTY393A

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

To give an introduction to the basics in virology and provide general information on morphology, architecture, transmission of plant and animal viruses and viruses infecting microbes and insects.

Course Contents:

Unit I **No. of Hours: 15**

Introduction & history of virology, origin & evolution of viruses, Virus taxonomy. Defective particles, satellite nucleic acids and satellite viruses, multiparticles, viroids, virusoids, prions, mycoviruses, bacteriophages, cynophages, virophages, baculoviruses.

Unit II **No. of Hours: 15**

Morphology, architecture and methods for its study, host range, transmission, movement, symptomatology, serology, methods for assay, detection and diagnosis, virus propagation, purification and characterization.

Unit III **No. of Hours: 15**

Biochemistry of viruses & viral pathogenesis, organization & expression of viral genomes. Replication of RNA and DNA Viruses: Attachment, entry, genome replication, transcription, translation, assembly and exit.

Unit IV **No. of Hours: 15**

Management and control of viruses: Virus vaccines, conventional control of plant viruses, quarantine, conventional resistance to plant viruses, transgenic approach of virus control, antiviral drugs. Introduction to beneficial uses and applications of viruses.

Learning Outcomes:

After completing the course, the student should be able to: describe elements of the viral life cycle, explain viral replication strategies and compare replication mechanisms used by viruses relevant for human disease, explain host antiviral immune mechanisms, describe viral strategies to evade host immune and cellular factors (by use of examples of viruses relevant for human disease), discuss principles of virus pathogenesis, describe methods

used for laboratory diagnosis of viral infections,explain vaccine strategies and mechanisms of antiviral drugs, and coherently report outcomes of virological research in oral and written output.

Text/ Reference Books:

1. Cann, A.J. Principles of Molecular Virology. 6th Edition. Academic Press. 2015. ISBN-13: 978-0128019467
2. Carter, J. and Saunders, V. Virology: Principles and Applications. 2nd Edition. John Wiley & Sons Ltd. 2013. ISBN: 978-1119991427
3. S.J. Flint, L.W. Enquist, V.R. Racaniello, A.M. Skalka. 2009. Principles of Virology. 3 rd edition. American Society for Microbiology. ISBN-13: 978-1555814434
4. Hull, R. 2009. Comparative Plant Virology. 2nd Edition. Academic Press. ISBN-13: 978-0123741547
5. Knipe, D.M. and Howley, P.M. 2013. Fields Virology. Two Volumes. 6th Edition. Lippincott Williams and Wilkins. ISBN-13: 978-1451105636

Course Name: Basic Virology Laboratory

Course Code: BTY394A

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Virus diagnosis using ELISA
2. Nucleic acid isolation from virus infected plant samples
3. Virus diagnosis using PCR
4. Virus diagnosis using slot-blot hybridization
5. Study of symptoms of virus diseases through visit to local diseases fields and/or photographs
6. Collection and processing of viral samples
7. Effect of virus infection on chloroplast number and cell size
8. Transmission of plant viruses
9. Collection and identification of local insect vectors
10. Determination of disease progress curve

Course Name: Introduction to Enzymology

Course Code: BTY383A

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The aim of this course is to enable students understand enzymes, their kinetics, structure, and function, as well as their relation to each other, and familiarizes them with recent advancements related to enzymes.

Course Contents:

Unit I **No. of Hours: 15**

Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation, methods of enzyme analysis.

Enzyme classification (rationale, overview and specific examples) zymogens and their activation (proteases and prothrombin).

Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation, Different plots for the determination of Km and Vmax and their physiological significance, factors affecting initial rate, E, S, temperature & pH. Collision and transition state theories, significance of activation energy and free energy.

Unit II **No. of Hours: 15**

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of Ki, suicide inhibitor.

Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples-: chymotrypsin, Lysozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase. Enzyme regulation: Product inhibition, feedback control, covalent modification.

Unit III **No. of Hours: 15**

Allosteric enzymes with special reference to aspartate transcarbomylase and phosphofructokinase. Allosteric Enzyme Models: concerted and sequential models. Enzyme interaction, protein ligand binding, measurements analysis of binding isotherm,

cooperativity, Hill and scatchard plots, kinetics of allosteric enzymes. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase. Multi enzyme complexes. Ribozymes. Multifunctional enzyme-e. g Fatty acid synthase.

Unit IV **No. of Hours: 15**

Enzyme Technology: Methods for large scale production of enzymes, Industrial important enzymes, Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. Application of immobilized and soluble enzyme in health and industry. Application of fundamental studies of biochemistry.

Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering– selected examples, delivery system for protein pharmaceuticals, and structure function relationship in enzymes, structural motifs and enzyme evolution.

Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes. Protein folding in vitro and in vivo.

Learning Outcomes:

Students will be able to define enzyme structure, and define differences between enzymes and normal catalytic substances; recognize the catalytic substances; recognize and explain cofactor and coenzymes chemical structure; recognize biologic coenzymes; recognize and explain activity of catalytic center; define factors that affect enzyme activity.

Reference Books:

1. Punekar, N.S. ENZYMES: Catalysis, Kinetics and Mechanisms. Springer, 2018. ISBN: 9789811307850.
2. Okotore, R.O. Essentials of Enzymology. Xlibris Corporation, 2015. ISBN: 9781503527225.
3. Price, N.C. and Stevens, L. Fundamentals of Enzymology, Oxford University Press, 2003.
4. Jayaraman, J. Laboratory manual in Biochemistry. New Age International. 2006. ISBN: 978-8122430493.
5. Thatoi H. Microbial Fermentation and Enzyme Technology**,** 2020, TAYLOR & FRANCIS, ISBN: 9780367183844.
6. Palmer, T., Bonner, P. L. Biochemistry, Biotechnology, Clinical Chemistry,

Woodhead Publishing, 2007, ISBN: 9781904275275.

7. Singh, R. S., Singhania, R. R., Pandey, A, Larroche, C. Advances in enzyme technology: A volume in biomass, biofuels and bochemicals, Elsevier, 2019

Course Name: Introduction to Enzymology Laboratory

Course Code: BTY384A

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Purification of an enzyme from any natural resource
2. Quantitative estimation of proteins by Bradford/Lowry's method.
3. Perform assay for the purified enzyme.
4. Calculation of kinetic parameters such as Km, Vmax, Kcat

Course Name: Fundamentals of Environmental Biotechnology

Course Code: BTY385A

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The aim is to study the natural environment and to gain knowledge related to the use of microorganisms and their products in the prevention of environmental pollution through bio-treatment, bioremediation and biomonitoring of environment.

Course Contents:

Unit I **No. of Hours: 18**

Renewable and non-renewable resources. Conventional fuels and their environmental impact – firewood, plant, animal, water, coal and gas. Modern fuels and their environmental impact – Methanogenic bacteria, biogas, microbial hydrogen production, conversion of sugar to alcohol gasohol

Unit II **No. of Hours: 20**

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.

Unit III **No. of Hours: 12**

Solid waste management and waste water treatment strategies – 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)

Unit IV **No. of Hours: 10**

Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals.

Learning Outcomes:

The students will be able to recognise the ecological problems and their critical evaluation, impact of human on pollution, climate changes as well as environmental protection.

Text Books:

1. Mohapatra, P.K. Environmental Biotechnology. 1st Ed. Edition I.K. International Publishing House. 2007. ISBN: 978-8188237548

2. Santra, S.C. Environmental Science. 3rd revised Ed. New Central Book Agency (P) Ltd. 2011. ISBN 9788173814044

Reference Books:

1. Burton, F.L., H. David Stensel metcalf George Tchobanoglous. Waste Water Engineering: Treatment And Reuse, Metcalf and Eddy, 4th edition Tata McGraw Hill. ISBN: 9780070495395

2. Jordening, H.J. (Ed.) and Winter, J. (Ed.). Environmental Biotechnology – Concepts and Applications. Wiley-Blackwell.2004 ISBN: 978-3-527-30585-8
3. Wainwright, M. Introduction to Environmental Biotechnology. 1st Edition. Springer US. ISBN:9781461373940

Course Name: Fundamentals of Environmental Biotechnology Laboratory

Course Code: BTY386A

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Sampling techniques.
2. Calculation of Total Dissolved Solids (TDS) of water sample.
3. Calculation of BOD of water sample.
4. Calculation of COD of water sample.
5. To check the faecal contamination.
6. Bacterial Examination of Water by MPN Method.
7. Optimum coagulant dose estimation through turbidity measurement.
8. Methods of measurement chlorine content of water.
9. Isolation of nitrogen fixing bacteria.
10. Isolation of phosphate solubilizing bacteria.
11. Isolation of pesticide degrading organisms from soil.

Course Name: Herbals And Neutraceuticals

Course Code: BTY387

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The course focuses on study of various plants and their products intended for medicinal purposes and for supplementing a diet. It involves study the cultivation, extraction and analysis of the plant products and their applications.

Course Contents:

Unit I **No. of Hours: 10**

Crude Drugs – scope & importance, classification (taxonomical, morphological chemical, pharmacological); cultivation, collection & processing of crude drugs.

Unit II **No. of Hours: 15**

Cultivation and utilization of medicinal & aromatic plants in India. Genetics as applied to medicinal herbs. Modern biotechnological tools and its influence in medical and aromatic plant cultivation. Plant tissue culture as a mean of conservation of rare and endangered medicinal plants.

Unit III **No. of Hours: 15**

Plant tissue culture as source of medicines, secondary metabolite production in plants; plant tissue culture for enhancing secondary metabolite production (*Withania somnifera*, *Rauwolfia serpentina*, *Swertia chirayit*, *Andrographis paniculata*, *Aconitum* sp.); anticancer, anti-inflammatory, antidiabetic, analgesic drugs, biogenesis of phyto-pharmaceuticals.

Unit IV **No. of Hours: 20**

Analysis of phytochemicals: Preliminary screening, and characterization of drugs.

Types of phytochemicals: Carbohydrates & derived products; glycosides - extraction methods; alkaloids - extraction methods; flavonoids- extraction methods, resins-extraction methods; lectins.

Application of phytochemicals in industry and healthcare; biocides, biofungicides, biopesticides. Nutraceuticals.

Learning Outcomes:

Successful completion of the course should enable the students to identify the basic nutraceuticals and demonstrate their medical importance to health and society. The students should be able to recognize and explain the beneficial phytochemicals in food and illustrate their health benefits.

Text/ Reference Books:

1. Dewick, P.M. Medicinal Natural Products: A Biosynthetic approach 3rd Ed.Wiley. ISBN: 978-0-470-74168-9
2. Hornok, L. (ed.) Cultivation & Processing of Medicinal Plants, Chichister, U. K:J. Wiley & Sons 1992. ISBN: 978-0471923831
3. Kokate, C.K., Purohit, A. P. & Gokhale, S. B. Pharmacognosy 14th Ed. Gokhale Nirali Prakashan, 2008. ISBN-13: 978-8185790091
4. Trease & Evans, Pharmacognosy – William Charles Evans, 16th ed. Harcourt Brace & Company. ISBN: 9780702029349

Course Name: Herbals And Neutraceuticals Laboratory

Course Code: BTY388

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Isolation of secondary metabolites from various plant organs
2. Identification of secondary metabolites by classic separation methods
3. Quantitation of secondary metabolites by spectral methods
4. Sterilization of explants for micro propagation of medicinal plants
5. Mass propagation of medicinal plants through plant tissue culture
6. Standardisation of plant Tissue Culture for Secondary metabolite production.
7. Demonstration of Capillary electrophoresis
8. Demonstration of Secondary metabolites analytical technique – HPLC

Course Name: Basic Immunology

Course Code: BTY371A

Credits Components: Theory

Total Credits			
L	T	P	Credits
4	0	0	4

Course Objective:

The aim is to study immune system and its various lines of defense, components of immune system, autoimmunity, hypersensitivity and immunodeficiency, antigen-antibody structure, function and interaction, and various antibody related techniques.

Course Contents:

Unit I **No. of Hours: 15**

Concept of innate and adaptive immunity; contributions of following scientists to the development of field of immunology - Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa. Structure, functions and properties of: immune cells – stem cell, T cell, B cell, NK cell, macrophage, neutrophil, eosinophil, basophil, mast cell, dendritic cell; and immune organs – bone marrow, thymus, lymph node, spleen, GALT, MALT, CALT

Unit II **No. of Hours: 15**

Characteristics of an antigen (foreignness, molecular size and heterogeneity); haptens; epitopes (T& B cell epitopes); T-dependent and T-independent antigens; adjuvants.

Structure, types, functions and properties of antibodies; antigenic determinants on antibodies (isotypic, allotypic, idiotypic); VDJ rearrangements; monoclonal and chimeric antibodies. organization of MHC locus (Mice & Human); structure and functions of MHC I & II molecules; antigen processing and presentation (cytosolic and endocytic pathways).

Components of the complement system; activation pathways (classical, alternative and lectin pathways); biological consequences of complement activation

Unit III **No. of Hours: 20**

Primary and secondary immune response; generation of humoral immune response (plasma and memory cells); generation of cell mediated immune response (self MHC restriction, T cell activation, Co- stimulatory signals); killing mechanisms by CTL and NK cells, introduction to tolerance

Types of autoimmunity and hypersensitivity with examples; immunodeficiencies - animal

models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Types of tumors, tumor Antigens, causes and therapy for cancers.

Unit IV **No. of Hours: 10**

Principles of precipitation, agglutination, immunodiffusion, immunoelectrophoresis, ELISA, ELISPOT, Western blotting, immunofluoresence, flow cytometry, immunoelectron microscopy.

Learning Outcomes:

On satisfactory completion of the course, students be able to identify the cellular and molecular basis of immune responsiveness, describe the roles of the immune system in both maintaining health and contributing to disease, describe immunological response and how it is triggered and regulated, and demonstrate a capacity for problem-solving about immune responsiveness.

Text Books:

1. Abbas, A.K., Lichtman, A.H., Pillai, S. Cellular and Molecular Immunology. 8th edition Saunders Publication, Philadelphia. 2007.ISBN: 9780323222754
2. Goldsby, R.A., Kindt, T.J., Osborne, B.A. Kuby's Immunology. 6th edition W.H. Freeman and Company, New York. 2007. ISBN-13: 9781429202114

Reference Books:

1. Delves, P., Martin, S., Burton, D., Roitt, I.M. Roitt's Essential Immunology.13th edition Wiley-Blackwell Scientific Publication, Oxford. 2006. ISBN: 9781118415771
2. Richard, C. and Geiffrey, S. Immunology. 7th edition. Wiley Blackwell Publication. 2009. ISBN : 978-1-118-39691-9
3. Peakman, M., and Vergani, D. Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg. 2009. ISBN: 9780443100826
4. Murphy, K., Travers, P., Walport, M. Janeway's Immunobiology. 7th edition Garland Science Publishers, New York. 2008. ISBN 9780815341239

Course Name: Basic Immunology Laboratory

Course Code: BTY372A

Total Credits			
L	T	P	Credits
0	0	3	2

Experiments:

1. Identification of human blood groups.
2. Perform Total Leukocyte Count of the given blood sample.
3. Perform Differential Leukocyte Count of the given blood sample.
4. Separate serum from the blood sample (demonstration).
5. Perform immunodiffusion by Ouchterlony method.
6. Perform immunodiffusion by Mancini method.
7. Perform DOT ELISA.
8. Perform immunoelectrophoresis.

Assessment:

For Theory Courses:

Mid Semester Examination (MSE)	25 Marks
Written Quiz (Objective Type MCQs)	10 Marks
Assignment/ Project Work/Seminar (evidence based)	10 Marks
End Semester Examination (ESE)	50 Marks
Attendance	5 Marks

For Practical Courses:

End Semester Practical Exam	80 Marks
Continuous Assessment	20 Marks

DAV UNIVERSITY, JALANDHAR

Question Paper pattern for Mid Semester Examination (MSE)

DAV University, Jalandhar.	**MSE**
(Term-…….)	**Month, Year**
Name: …….....	**Regd. No.: ……**
Course Code: BTYXXX	**Time: 1 Hour 30 Minutes**
Course Name: ……	**Maximum Marks: 25**

Section – A **(Maximum Marks: 1 x 5 = 5)**

All Questions are compulsory.

Very Short Answer Type: Each question should be answered within 5-8 lines.

Q.1 Write short notes on:

i.

ii.

iii.

iv.

v.

Section – B **(Maximum Marks: 4 x 3 = 12)**

Short Answer Type: Attempt any **3 Questions out of 5 Questions** and each question should be answered in maximum 2 pages

Q.2

Q.3

Q.4

Q.5

Q.6

Section – C **(Maximum Marks: 8 x 1 = 8)**

Long Answer Type: Attempt **1 Questions out of 2 Questions** and each question should be answered in maximum 4 pages.

Q. 7

Q. 8.

DAV UNIVERSITY, JALANDHAR

Question Paper pattern for End Semester Examination (ESE)

DAV University, Jalandhar. **ESE**

(Term-…….) **Month, Year**

Name: ……..... Regd. No.: ……

Course Code: BTYXXX Time: 3 Hours

Course Name: ……. Maximum Marks: 50

Section – A **(Maximum Marks: 1 x 10 = 10)**

All Questions are compulsory.

Very Short Answer Type: Each question should be answered within 5-8 lines.

Q.1 Write short notes on:

i.

ii.

iii.

iv.

v.

vi.

vii.

viii.

ix.

x.

Section – B **(Maximum Marks: 4 x 6 = 24)**

Short Answer Type: Attempt any **6 Questions out of 8 Questions** and each question should be answered in maximum 2 pages

Q.2

Q.3

Q.4

Q.5

Q.6

Q. 7

Q. 8.

Q. 9.

Section – C **(Maximum Marks: 8 x 2 = 16)**

Long Answer Type: Attempt **2 Questions out of 4 Questions** and each question should be answered in maximum 4 pages.

Q.10

Q.11

Q.12

Q.13